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TEREX

TA30
Articulated Dumptruck Maintenance Manual



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TECHNICAL PUBLICATIONS DEPARTMENT
TEREX EQUIPMENT LIMITED
MOTHERWELL, SCOTLAND ML1 5RY
REF. NO. SM 799

SM 1936 Rev 3 10-02

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The information contained within this Alert must not be made available to third parties not authorised to receive it.

Service Information Alert

DATE: **April 1994** **B168**

MODEL: **General**

SUBJECT: **VITON 'O' RINGS AND SEALS (FLUORO-ELASTOMERS) - SAFETY HAZARDS**

PURPOSE:

To advise potentially hazardous condition.

DETAIL:

It has been brought to our attention that 'Viton' material used in manufacture of oil seals and 'O' rings, produces a highly corrosive acid (Hydrofluoric) when subjected to temperatures above 315° C.

The resulting contamination can have extreme consequences on human tissue since it is almost impossible to remove after contact.

We therefore recommend the following procedure when it is necessary to inspect any equipment that has been subjected to a high temperature i.e. fire.

a. Visually inspect for any gaskets or seals which have suffered from heat; they will appear black and sticky.

b. If this is affirmed - **Do Not Touch**

c. Make enquiries to ascertain the material composition. Any Fluoro-elastomer (Viton, Fluorel or Tecmoflon) should be considered dangerous but natural rubber and nitrile are non-hazardous.

d. If Fluoro-elastomer seals have been used, then the affected area MUST be decontaminated before undertaking further work.

e. Disposable Heavy Duty Gloves (Neoprene) MUST be worn and the affected area decontaminated by washing thoroughly with Limewater (Calcium Hydroxide solution).

f. Any cloths, residue and gloves used MUST be safely discarded after use.

Note: Burning of the discarded items is NOT RECOMMENDED, except in an approved incineration process where the gaseous products are treated by alkaline scrubbing.

TEREX SERVICE DEPARTMENT

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IMPORTANT SAFETY NOTICE

Proper service and repair is important to the safe, reliable operation of all motor vehicles. The service procedures recommended and described in this publication, are effective methods for performing service operations. Some of these service operations require the use of tools specially designed for the purpose. The special tools should be used when, and as recommended.

It is important to note that this publication contains various WARNINGS and NOTES which should be carefully read in order to minimize the risk of personal injury to personnel, or the possibility that improper service methods will be followed which may damage the vehicle or render it unsafe. It is also important to understand these WARNINGS and NOTES are not exhaustive. It is not possible to know, evaluate and advise the service trade of ALL conceivable ways in which service might be carried out, or, of the possible hazardous consequences of each way. Consequently, no such broad evaluation has been undertaken. Accordingly, anyone who uses a service procedure, or tool, which is not recommended, must first satisfy themselves thoroughly that neither their safety, nor vehicle safety, will be jeopardized by the service method he/she selects.

Two types of heading are used in this manual to attract your attention.

1. ⚠ **WARNING** - This symbol is used when an operating procedure, practice, etc., which, if not correctly followed could result in personal injury or loss of life. Look for this symbol to point out important safety precautions. It means - **ATTENTION! BECOME ALERT! YOUR SAFETY IS INVOLVED!**

2. **Note -** This is used when an operating procedure, practice, etc., which, if not strictly observed, could result in damage to or destruction of equipment.

⚠ **WARNING**
Never use parts which are altered, modified, or weakened in operation. This can seriously jeopardize the integrity of the machine and could result in property damage or serious personal injury.

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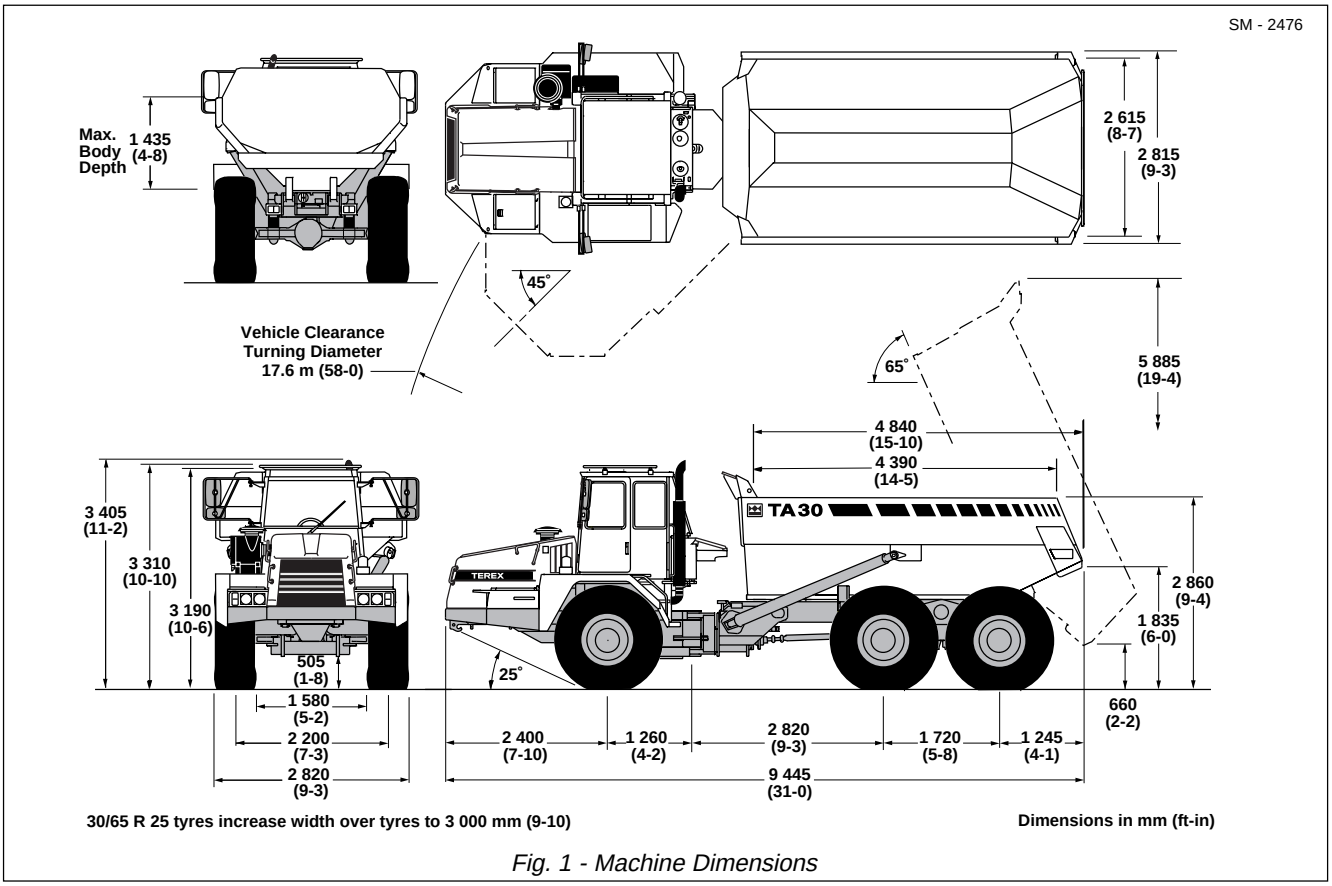


Fig. 1 - Machine Dimensions

ENGINE

Make/Model ..... Cummins MTA11-C300
Type ..... Four cycle, low emission, direct injection diesel, water-cooled, turbocharged and aftercooled.
Gross power at 2 100 rev/min ..... 224 kW (300 hp, 304 PS)
Net power at 2 100 rev/min ..... 214 kW (287 hp, 291 PS)

Note: Gross power rated to SAE J1995 Jun 90. Engine emission meets USA EPA/CARB MOH 40 CFR 89 and EU NRMM (non-road mobile machinery) directive.

Maximum Torque ... 1 376 Nm (1 015 lbf ft) at 1 300 rev/min
Number of cylinders/configuration ..... 6, in line
Bore x Stroke ..... 125 x 147 mm (4.92 x 5.79 in)
Total Displacement ..... 10.8 litres (660 in³)
Air cleaner ..... Dry type, double element
Starting ..... Electric
Maximum Speed (No load) ..... 2 450 rev/min
Maximum Speed (Full load) ..... 2 100 rev/min
Idle Speed ..... 675/750 rev/min
Safe Operating Angle ..... 43°/94% Grade

TRANSMISSION

Make/Model ..... ZF 6WG 260 II Automatic with manual override. The transmission assembly consists of a torque converter close-coupled to a countershaft-type gearbox with integral output transfer gearing. Automatic shifting throughout the range, with kickdown feature. Lockup action in all forward gears. A torque proportioning output differential transmits drive permanently to front and rear axles. This differential may be locked by the driver for use in difficult traction conditions. Standard integral hydraulic retarder which is automatically operated should the engine overspeed. Blocked filter indicator and filter bypass system provide valve block with additional protection from unfiltered oil.

Pressures:
Main ..... 16 + 2 bar (232 + 30 lbf/in²)
Lockup (Wk) ..... 14 ± 1 bar (190 ± 15 lbf/in²)
Converter 'IN' ..... 7.6 bar (110 lbf/in²) at 2 300 rev/min
Converter 'OUT' ..... 4.8 bar (70 lbf/in²) at 2 300 rev/min
Converter Relief Valve ..... 8.5 bar (123 lbf/in²)
Retarder ..... 5.5 bar (80 lbf/in²)
Temperatures:
Normal ..... 80° - 110° C (176° - 230° F)
Maximum ..... 120° C (248° F)

Stall Speed ..... 1 655 ± 50 rev/min

Ratios:
Torque Converter 1.84:1
Transmission ..... Refer to table

Forward						
Gear	1	2	3	4	5	6
Ratio	5.35	3.45	2.21	1.42	0.97	0.62
km/h	5.0	8.0	12.5	19.5	29.0	45.0
mile/h	3.0	5.0	8.0	12.0	18.0	28.0
Reverse						
Gear	1	2	3			
Ratio	5.35	2.21	0.97			
km/h	5.0	12.5	29.0			
mile/h	3.0	8.0	18.0			

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General Information - Technical Data

Section 000-0000

AXLES

Three axles in permanent all-wheel drive with differential coupling between each axle to prevent driveline wind-up. Heavy duty axles with fully-floating axle shafts and outboard planetary reduction gearing.

Automatic limited slip differentials in each axle. Centre axle incorporates a through-drive differential to transmit drive to the rear axle. Locking of this differential is actuated simultaneously with the transmission output differential lock.

Ratios:
- Differential 3.44:1
- Planetary 6.35:1
- Total Reduction 21.85:1

SUSPENSION

Front: Axle is carried on the leading arms of a sub-frame pivoting on the main frame. Suspension is by flexible air bellows with four heavy duty hydraulic dampers.

Axle Vertical Travel ..... 127 mm (5 in)

Rear: Each axle is coupled to the frame by three rubber-bushed links with lateral restraint by transverse link. Pivoting inter-axle balance beams equalise load on each axle. Suspension movement is cushioned by rubber/metal laminated compression units between each axle and underside of balance beam ends.

Axle Vertical Travel ..... ± 130 mm (5.12 in)
Axle Oscillation ..... ± 12°

BRAKES

Air assisted hydraulic dry disc on each wheel with two heavy-duty callipers per disc at the front and a single heavy-duty calliper per disc at the rear. Independent circuits for front and rear brake systems. Overstroke actuates warning light. Brake system meets ISO 3450, SAE J1473.

Air System Pressure ..... 7.6 bar (110 lbf/in²)
Total Air Reservoir Capacity ..... 55 litres (3 356 in³)
Hydraulic Brake Fluid Capacity ..... 2.64 litres (0.68 US gal)

Parking: Spring-applied, air-released disc on rear driveline.

Emergency: Emergency brake control actuates the service brakes. Automatic application of service brakes should pressure fall in the brake air system.

Retardation: Hydraulic retarder integral with transmission.

WHEELS AND TYRES

Wheels: ..... 5-piece earthmover rims with 12 stud fixing
Size:
- Standard ..... 25 x 19.50 in for 23.5 R25** tyres
- Optional ..... 25 x 22.00 in for 30/65 R25** tyres

Tyres:
- Standard 23.5 R25**
- Optional 30/65 R25**

Inflation Pressures (Bridgestone):

	Front	Rear
23.5 R25**	4.0 bar (58 lbf/in²)	4.8 bar (69 lbf/in²)
30/65 R25**	4.3 bar (62 lbf/in²)	4.3 bar (62 lbf/in²)

Note: Tyre pressures should be regarded as nominal only. It is recommended that for tyres both listed and unlisted, the user should consult the tyre manufacturer and evaluate all job conditions in order to make the proper selection.

HYDRAULIC SYSTEM

Steering and Body Hoist
The steering and body hoist systems are supplied with oil from a common tank by the main hydraulic pump. Gear pump driven from power takeoff on transmission. System components are protected by full flow filtration on the return line.

Pump:
Type ..... Gear
Capacity at 2 300 rev/min ..... 4.49 litre/s (71 US gal/min)

Steering System

Hydrostatic power steering by two single-stage, double-acting, cushioned steering cylinders. Emergency steering pressure is provided by a ground driven pump mounted on the rear of the transmission. An audible alarm and warning light indicates should the emergency system activate. Conforms to ISO 5010, SAE J53.

System Pressure ..... 241 bar (3 500 lbf/in²)
Steering Angle to either side ..... 45°
Lock to Lock Turns, steering wheel 4
Vehicle Clearance Circle (SAE) ..... 17.6 m (58 ft)

Body Hoist System

Two single-stage, double-acting hoist rams, cushioned at both ends of stroke. Electro servo assisted hoist control.

System Pressure ..... 221 bar (3 200 lbf/in²)
Control Valve ..... Pilot Operated, Open Centre
Body Raise Time (loaded) ..... 12 sec
Body Lower Time (power down) ..... 7.5 sec

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ELECTRICAL SYSTEM

Type ..... 24 volt, Negative Ground
Battery ..... Two, 12 Volt, 143 Ah each
Accessories ..... 24 Volt
Alternator ..... 70 Amp

BODY

Of all welded construction, fabricated from high hardness (min. 360 BHN) 1 000 MPa (145 000 lbf/in²) yield strength steel. 25° tail chute angle provides good load retention without tailgate.

Plate Thicknesses:
- Floor and Tailchute ..... 15 mm (0.59 in)
- Sides ..... 12 mm (0.47 in)
- Front ..... 8 mm (0.31 in)

Volume:
- Struck (SAE) ..... 13.0 m³ (17.0 yd³)
- Heaped 2:1 (SAE) ..... 16.0 m³ (21.0 yd³)

SERVICE CAPACITIES

Fuel tank ..... 330 litres (87 US gal)
Hydraulic System
(steering & body) ..... 200 litres (52.8 US gal)
Engine Crankcase ..... 40 litres (10.5 US gal)
Cooling System ..... 59 litres (15.6 US gal)
Transmission & filters (dry fill) ..... 52 litres (13.8 US gal)
Transmission & filters (wet fill) ..... 26 litres (6.9 US gal)
Differentials - Front & Rear (each) ..... 11 litres (2.9 US gal)
Differential - Centre ..... 14 litres (3.7 US gal)
Planetaries (each) ..... 3.5 litres (0.9 US gal)
Service Brakes ..... 3 litres (0.79 US gal)
Air Conditioning Compressor ..... 0.125 litres (0.033 US gal)

TYPICAL NOISE LEVELS

Operator Ear (ISO 6394) ..... 79 dbA

*Exterior Sound Rating (SAE J88 JUN 86) ..... TBA dbA
*- The above result is for the mode giving the highest exterior sound level when measured and operated as per the prescribed procedures of the standard. Results shown are for the vehicle in base configuration.

Note: Noise Level Exposure to the operator and bystander personnel may be higher depending upon proximity to buildings, rock piles, machinery, etc.. The actual job site Noise Level Exposure must be measured and applicable regulations complied with in respect to Employee Hearing Protection.

Vehicle Weights

Standard Vehicle	kg	lb
Net Distribution		
Front Axle	10 585	23 335
Centre Axle	5 000	11 025
Rear Axle	4 970	10 955
Vehicle, Net	**20 555**	**45 315**
Payload	**27 000**	**59 525**
Gross Distribution		
Front Axle	14 450	31 860
Bogie Axle, leading	16 545	36 470
Bogie Axle, rear	16 560	36 510
Vehicle, Gross	**47 555**	**104 840**
Bare Chassis	16 025	35 330
Body	4 000	8 820
Body Hoists (Pair)	530	1 170

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Welding

WARNINGS
Before any welding is done on a machine equipped with any electronic systems, disconnect the following (if applicable) in this order: Battery earth cable, battery supply cable, alternator earth cables, alternator supply cables and electrical connections at the engine ECM, transmission ECU, body control lever, hydraulics ECU and cab bulkhead to avoid damage to electrical components. Turn off battery master switch to isolate the batteries before disconnecting any components.
After welding connect all of the above in the reverse order.

Before any welding is done ensure all paint has been removed from the area to be welded. Failure to do so may result in hazardous fumes being given off from the paint.

Note: Always fasten the welding machines ground cable to the piece/frame being welded if possible.

Electric arc welding is recommended for all welded frame repairs. Since the nature and extent of damage to the frame cannot be predetermined, no definite repair procedure can be established. As a general rule however, if parts are twisted, bent or pulled apart, or a frame is bent or out of alignment, no welding should be done until the parts are straightened or realigned.

Successfully welded repairs will depend to a great extent upon the use of the proper equipment, materials and the ability of the welder. The Customer Support Department can be consulted regarding the feasibility of welding repairs.

WARNING
Welding and flame cutting cadmium plated metals produce odourless fumes which are toxic. Recommended industrial hygiene practice for protection of the welding operator from the cadmium fumes and metallic oxides requires enclosure ventilation specifically designed for the welding process. A respiratory protective device such as the M.S.A. 'Gasfoe' respirator with G.M.A. cartridge will provide protection against cadmium, fumes and metallic oxides. The 'Gasfoe' respirator has been approved by the U.S. Bureau of Mines: Approval number 23B-10, and is designed to protect against gases, vapours, and/or metal fumes.

Note: The current from the welding rod always follows the path of least resistance. If, for example, the ground clamp is attached to the rear frame when welding is performed on the front frame, the current must pass a frame connection to return to the welding machine. Since the pivot coupling offers the least resistance but not a sound electrical connection, small electric arcs may be set up across the moving parts which may cause welding blotches on their wearing surfaces and increase the wear rate of these components.

General Welding Procedure

The following general procedure should be used for the repair of defects outwith the vicinity of alloy steel castings.

1. Completely ARC-AIR gouge or grind out the crack until sound metal is reached. If ARC-AIR method is employed, pre-heat area to 100° C (212° F), measure 3 - 4" either side of repair prior to gouging. On completion of gouging grind to remove thin carbon layer.

2. Apply dye-penetrant check to ensure crack has been completely removed.

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3. Pre-heat area to 100° C (212° F), measured 3 - 4" either side of repair. Avoid local overheating.

4. Weld completely using E-7016 electrodes. Care must be taken to ensure electrodes are protected from moisture pick-ups at all times.

5. Allow repair weld to cool slowly.

6. Grind and blend repair to original contour. Paint heat damaged areas.

The following general procedure should be used for the repair of defects in alloy steel castings and in the welds joining steel castings.

1. Completely ARC-AIR gouge or grind out the crack until sound metal is reached. If ARC-AIR method is employed, pre-heat area to 200° C (392° F), measure 3 - 4" either side of repair prior to gouging. On completion of gouging grind to remove thin carbon layer.

2. Apply dye-penetrant check to ensure crack has been completely removed.

3. Pre-heat area to 200° C (392° F), measured 3 - 4" either side of repair. Avoid local overheating.

4. Weld completely using E-7016 electrodes. Care must be taken to ensure electrodes are protected from moisture pick-ups at all times.

5. On completion of welding, post-heat repair area to 400° C (752° F), measure 3 - 4" either side of repair.

6. If welding has to be interrupted for any reason, e.g. overnight, post-heat immediately as in Step 5.

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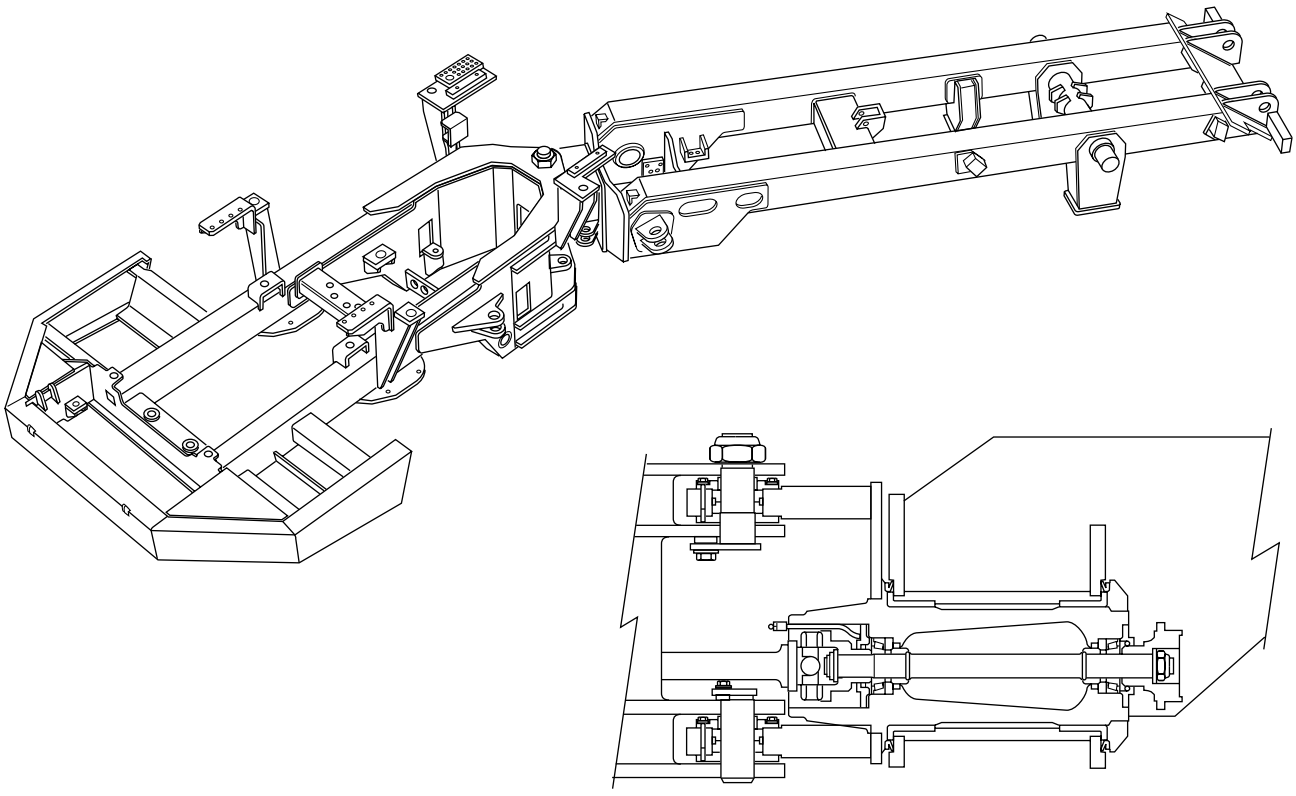


Fig. 1 - General Arrangement of Frame Assemblies

DESCRIPTION

The chassis consists of two separate frame assemblies which provide the articulation of the unit. The front and rear frames are constructed of all welded high-grade steel fabrications with rectangular box section beams forming main, side and cross members. The frames are coupled to provide 45° articulation to each side as well as oscillation.

The front frame is fabricated to form a rigid structure which carries the cab, power train and suspension system.

The rear frame is fabricated to form a rigid structure which carries the body, body hydraulics, suspension and rear drive axles.

Oscillation between the front and rear frames is provided by a large diameter cylindrical coupling carried on nylon bushes located in the rear frame. Longitudinal shocks are absorbed by the thrust faces of the nylon bushes. A large thrust nut, which is threaded to the end of the coupling and locked to the frame, secures the coupling in position. Wear on the thrust faces of the bushes is compensated by tightening this thrust nut.

INSPECTION AND MAINTENANCE

Inspection

Inspect the frames and attached parts at intervals not exceeding 250 hours for cracked or broken welds and bending of the frame. Any defects found should be repaired before they progress into major failures.

Straightening

Hydraulic straightening or aligning equipment should be used to straighten bent or twisted frames whenever possible. However, if heat must be applied, never heat the metal beyond a dull, cherry red colour, as too much heat will weaken the metal. When it is necessary to heat the metal, apply heat uniformly over the area to be straightened and protect the heated surface from sudden cooling. Frame parts that cannot be straightened should be renewed.

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Welding

⚠ WARNINGS

Before any welding is done on a machine, disconnect connections at body hydraulics joystick, all battery connections at both positive and negative terminals and ground cable to alternator to avoid damage to electrical components. Turn battery master switch to the 'Off' position before disconnecting any components. Remove battery ground cable first, and reconnect last, to avoid damaging electrical components.

⚠

Before any welding is done ensure all paint has been removed from the area to be welded. Failure to do so may result in hazardous fumes being given off from the paint.

Note: Prior to welding, switch off/disconnect the following in the order given. Failure to do so may seriously damage the machines electrical components.

a - Turn keyswitch off
b - Turn battery master switch off
c - Battery earth cables
d - Battery supply cables
e - Alternator earth cables
f - Alternator supply cables
g - Body hydraulics joystick
h - Transmission (Est-37) connector

After welding, connect all of the above in the reverse order.

Note: Always fasten the welding machines ground cable to the piece/frame being welded if possible.

Electric arc welding is recommended for all welded frame repairs. Since the nature and extent of damage to the frame cannot be predetermined, no definite repair procedure can be established. As a general rule however, if parts are twisted, bent or pulled apart, or a frame is bent or out of alignment, no welding should be done until the parts are straightened or realigned.

Successfully welded repairs will depend to a great extent upon the use of the proper equipment, materials and the ability of the welder. The Service Department can be consulted regarding the feasibility of welding repairs.

⚠ WARNING

Welding and flame cutting cadmium plated metals produce odourless fumes which are toxic. Recommended industrial hygiene practice for protection of the welding operator from the cadmium fumes and metallic oxides requires enclosure ventilation specifically designed for the welding process. A respiratory protective device such as the M.S.A. 'Gasfoe' respirator with G.M.A. cartridge will provide protection against cadmium, fumes and metallic oxides. The 'Gasfoe' respirator has been approved by the U.S. Bureau of Mines: Approval number 23B-10, and is designed to protect against gases, vapours, and/or metal fumes.

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Reinforcement

Frame reinforcement can be made with channel or angle or flat structural stock. Whenever possible, the reinforcement should extend well beyond the bent, broken or cracked area. The reinforcement stock thickness should not exceed that of the frame stock and the material should be of the same tensile strength.

Painting

A check of the condition of the paint should be made approximately twice a year and chassis repainted if necessary.

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⚠ WARNING
Welding, burning, heating or dressing surfaces previously painted using polyurethane paint produces fumes which are toxic. Surfaces must be prepared using paint stripper prior to area being reworked. Recommended Industrial Hygiene and Safety Rules should be followed for protection of the welding operator from the fumes.

To keep rust and corrosion to a minimum, periodic painting of abrasions and other exposed metal areas on the frames is highly recommended.

If painting of a frame is required, thoroughly clean the areas to be painted. Apply a primer coat of polyurethane red oxide and then a finish coat of polyurethane enamel.

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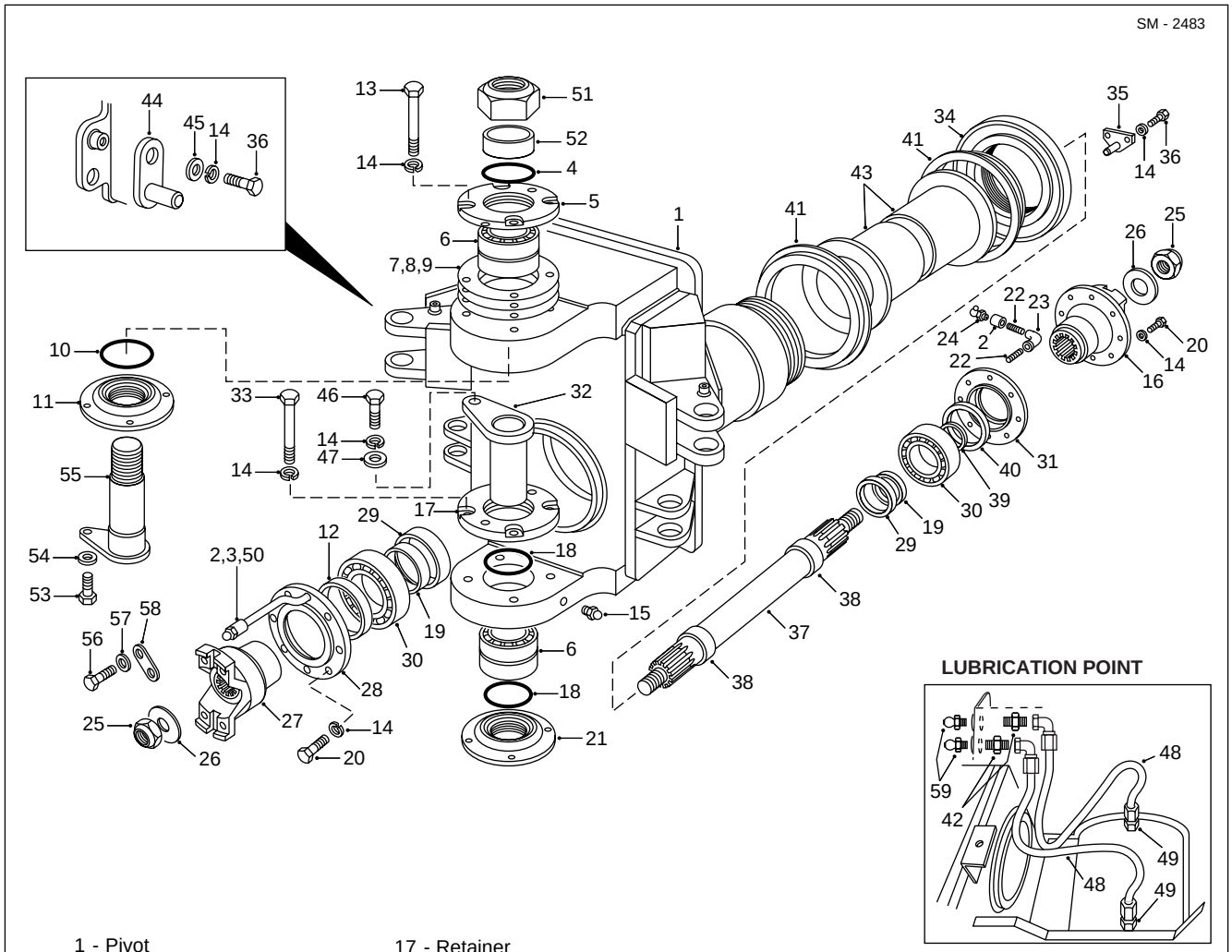
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1 - Pivot
2 - Coupling
3 - Pipe
4 - 'O' Ring
5 - Retainer
6 - Bearing
*7 - Shim
*8 - Shim
*9 - Shim
10 - 'O' Ring
11 - Retainer
12 - Seal
13 - Bolt
14 - Lockwasher
15 - Lube Fitting
16 - Brake Yoke
17 - Retainer
18 - 'O' Ring
19 - Spacer
20 - Bolt
21 - Retainer
22 - Nipple
23 - Elbow
24 - Lube Fitting
25 - Locknut
26 - Washer
27 - Front Yoke
28 - Housing
29 - Seal
30 - Bearing
31 - Housing
32 - Pin
33 - Bolt
34 - Thrust Nut
35 - Lockplate
36 - Bolt
37 - Shaft
38 - Bush
39 - Washer
40 - Seal
41 - 'V' Ring
42 - Adaptor
43 - Bush
44 - Pin
45 - Washer
46 - Bolt
47 - Washer
48 - Lube Line
49 - Connector
50 - Lube Fitting
51 - Nut
52 - Spacer
53 - Bolt
54 - Hardened Washer
55 - Pin
56 - Bolt
57 - Lockwasher
58 - Bracket
59 - Lube Fitting

* Lower bearing shims not shown

Fig. 1 - Articulation and Oscillation Pivot

DESCRIPTION AND OPERATION

The articulation and oscillation pivot allows the front and rear frames to rotate horizontally (articulation) and tilt laterally (oscillation) with respect to each other. It is also the main load bearing coupling between the two frames. The pivot assembly houses the driveshaft connecting the drive between the front and rear frames.

Articulation bearings, oscillation bushes, pivot driveshaft bearings and associated parts can be removed, inspected and replaced or renewed by following the procedures outlined in this section.

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PIVOT DRIVESHAFT BEARINGS

Removal

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: It is not necessary to separate the frames in order to remove the pivot driveshaft assembly.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Open drain cocks on air tanks to drain air pressure from the tanks. Close air tank drain cocks when air has exhausted from the air tanks.

Note: Take extra care when handling drivelines as any deformity on a rotating mass creates vibration and excessive wear during any operation.

4. Match mark yokes and mating surfaces of transmission - pivot driveline (Fig. 2) to aid in 'Installation'. Remove bolts, lockwashers and caps and remove driveline from the machine.

Note: Take care to avoid damaging pipe (3) when performing Step 5.

5. Remove locknut (25) and washers (26) from front yoke (27). Remove yoke (27) from shaft (37).

6. Remove bolts (1, Fig. 3), lockwashers (2, Fig. 3), nuts (3, Fig. 3) and protective guard (4, Fig. 3), if fitted, from beneath rear of pivot housing.

> ⚠ **WARNING**
> **Tensioned spring on adjuster.**

7. Slacken adjuster (14, Fig. 3) until brake pads (13, Fig. 3) are sufficiently clear of parking brake disc (5, Fig. 3) to permit removal of calliper (7, Fig. 3).

8. Note positions of front and rear wedge plates (8 & 9, Fig. 3) to aid in 'Installation'. Remove bolts (6, Fig. 3), washers (11, Fig. 3), nuts (12, Fig. 3), front and rear wedge plates (8 & 9, Fig. 3) and left hand torque plate (10, Fig. 3).

9. Move and secure calliper (7, Fig. 3) clear of parking brake disc (5, Fig. 3).

Note: Take extra care when handling drivelines since any deformity on a rotating mass creates vibration and excessive wear during any operation.

10. Match mark brake yoke (16) and mating surface of pivot - centre axle driveline (Fig. 2) to aid in 'Installation'. Remove bolts, lockwashers and caps and remove driveline from the machine.

11. Remove bolts (57) and lockwashers (14) from rear housing (31).

Note: Take extra care when handling driveshafts as any deformity on a rotating mass creates vibration and excessive wear during any operation.

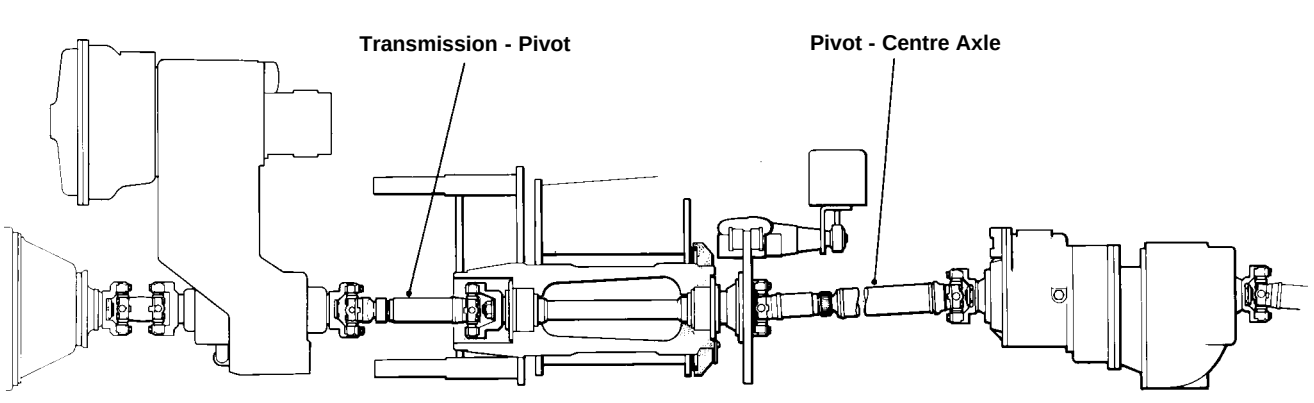


Fig. 2 - Drivelines

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SM - 003

1 - Bolt
2 - Lockwasher
3 - Nut
4 - Guard
5 - Disc
6 - Bolt
7 - Calliper
8 - Front Wedge Plate
9 - Rear Wedge Plate
10 - LH Torque Plate
11 - Washer
12 - Locknut
13 - Brake Pad
14 - Adjuster
15 - Bolts
16 - Washers

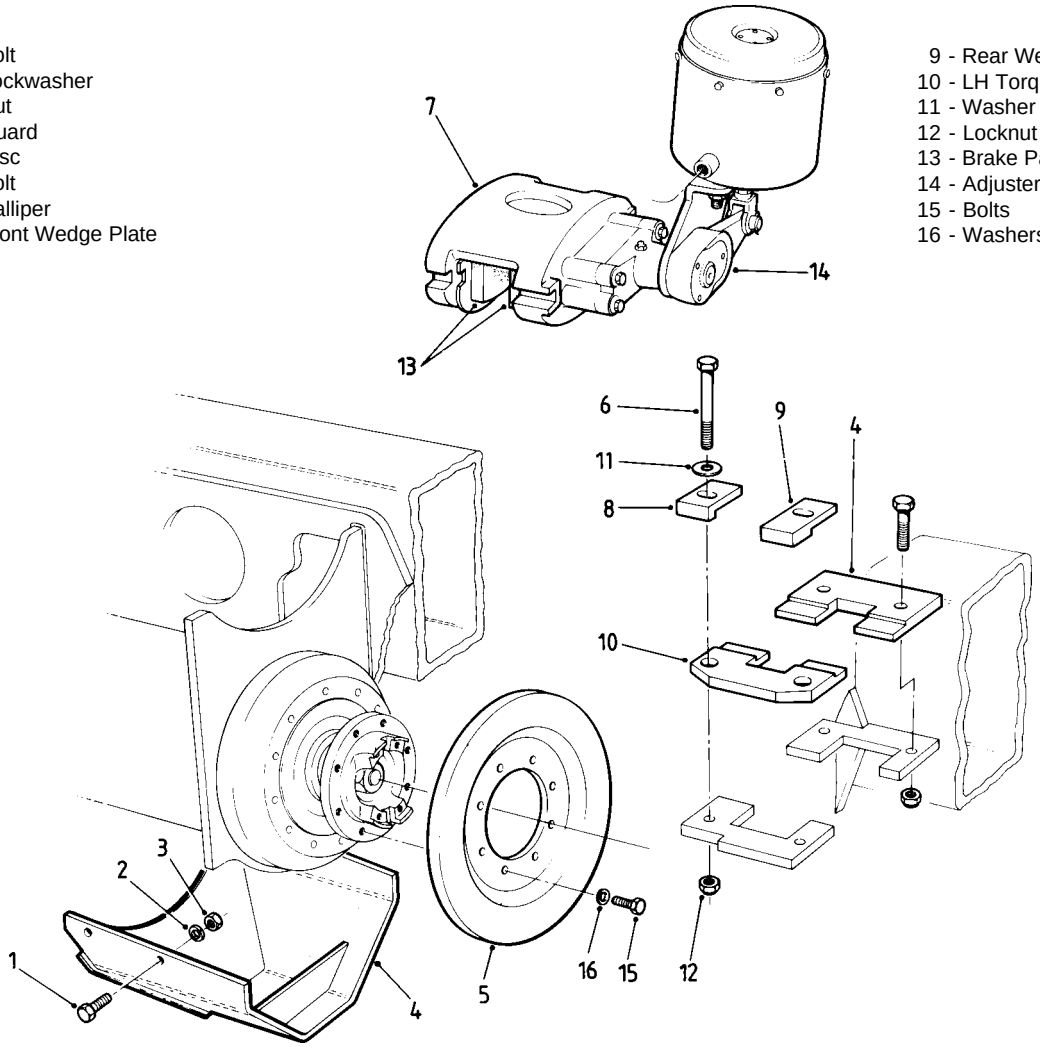


Fig. 3 - Parking Brake Assembly

12. Withdraw pivot driveshaft assembly from pivot by pulling rearwards on brake yoke/disc assembly and place in suitable location for further work.

13. Remove front locknut (25) then position front yoke (27) fully on to front of shaft (37) and suitably restrain to resist rotation. Remove rear locknut (25), washers (26) and rear yoke brake/disc assembly (16). Tag front and rear ends of shaft (37) and install locknuts (25) on the shaft to protect the threads.

14. Tag and remove housing (31). Note position of seal (40) to aid in 'Installation'. Remove and discard seal (40).

15. Remove washer (39), rear bearing (30) and spacer (19) from rear of shaft (37).

16. Remove bolt (56), lockwasher (57) and bracket (58) securing pipe (3) to pivot (1) assembly.

Note: Take care to avoid damaging pipe (3) when performing Steps 17 through 18.

17. Remove bolts (20) and lockwashers (14) from front housing (28).

18. Tag and remove front housing (28). Note position of seal (12) in front housing (28) to aid in 'Installation'. Remove and discard seal (12).

⚠ WARNING
When necessary to drive out components, use a soft drift to avoid injury and damage from flying chips.

19. Using a suitable puller/drift, remove bearing (30).

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20. Remove spacer (19). Note position of seals (29) in pivot (1) housing to aid in 'Installation'. Remove and discard seals (29).

Inspection

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

1. Clean parts with a suitable solvent and let dry. DO NOT spin bearings with compressed air. Place bearings on clean surface, cover with lint free cloth and allow to dry.

2. Check pivot driveshaft bearings (30) for wear or damage, replace if required.

3. Inspect bushes (38) for wear. Replace if badly scored.

Installation

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: Tighten all fasteners without special torques specified, to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: If bushes (38) are to be renewed, then proceed with Steps 1 thru 5, if the bushes (38) are satisfactory, proceed from Step 6.

⚠ WARNINGS
To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.

⚠ When necessary to drive out components, use a soft drift to avoid injury and damage from flying chips.

1. Apply suitable heat to bushes (38) to break bond of retaining compound. Remove locknuts (25) from their protective position on shaft (37), then remove bushes (38) with a suitable drift.

2. Allow shaft (37) to cool. Thoroughly clean shaft (37) and new bushes (38) with a suitable solvent. Wash mating faces of shaft (37) and new bushes (38) with chlorethane and allow to dry.

3. Apply LOCTITE primer to mating faces of shaft (37) and new bushes (38) and allow to dry. Refer to Fig. 4.

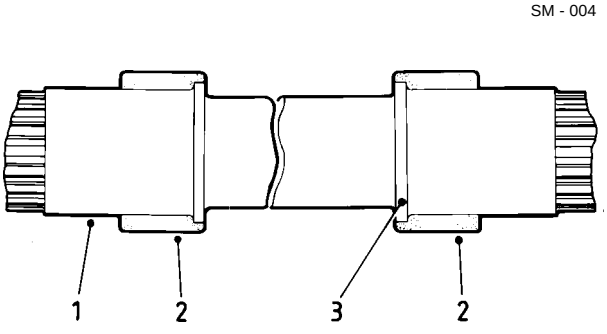


Fig. 4 - Shaft and Bushes

4. Apply LOCTITE Fugeteile 35 to shaft (37) mating faces and install new bushes (38), with the recesses in bushes (38) against shoulder on driveshaft (37). Make sure that bushes (38) are fully home against the shoulders. Refer to Fig. 4.

5. Allow 15 minutes for retaining compound to cure to handling strength.

6. Degrease front bearing (30) housing in pivot (1) with a suitable solvent and allow to dry.

Note: Do not use retaining compound on the housing for the rear pivot shaft bearing.

Note: Front bearing (30) of shaft (37) is secured with retaining compound as well as normal hardware. Cleaning the bearing housing ensures a good bond. THE REAR BEARING IS SECURED BY NORMAL HARDWARE ONLY.

7. Apply coat of grease to new seals (29) and install seals in pivot housing. Make sure seal lips are facing outwards as shown on Fig. 5.

8. Make sure that pivot shaft bearing (30) is pre-packed with grease then position spacer (19), bearing (30) and washer (39) on rear of shaft (37).

9. Apply bead of grease to fill inner rim of new seal (40) and position new seal in rear housing (31). Refer to Fig. 6. Fill lube fitting (24) assembly on rear housing with grease and make sure that nipple (22) does not protrude into grease slot in rear face of housing (31).

Note: Take extra care when handling driveshafts as any deformity on a rotating mass creates vibration and excessive wear during any operation.

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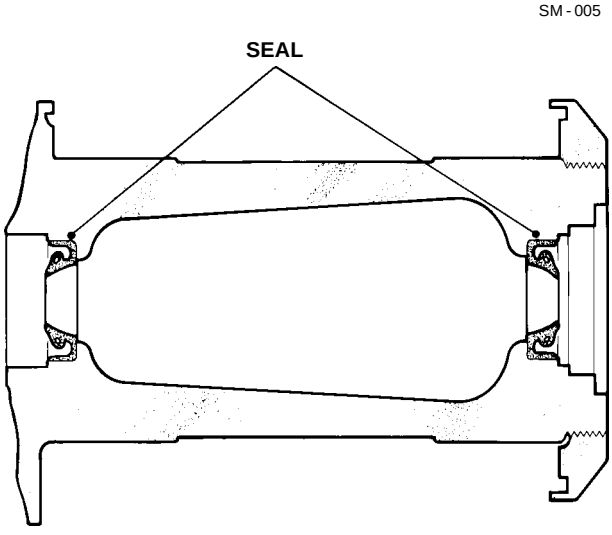


Fig. 5 - Pivot Housing Inner Seals

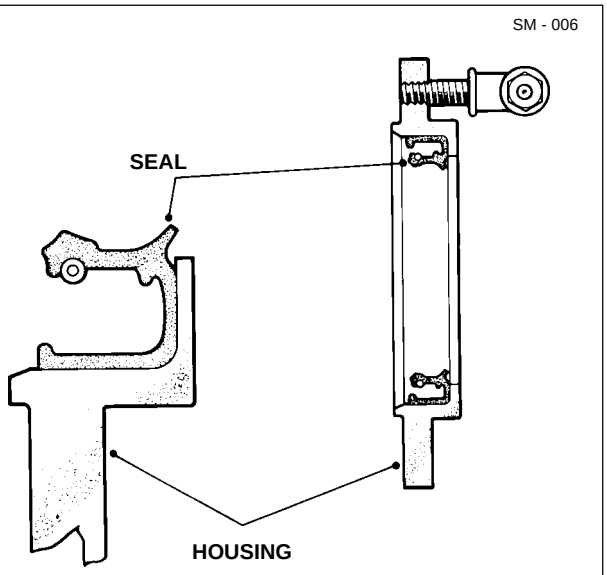


Fig. 6 - Typical Outer Seal Installation

10. Assemble rear housing (31) and brake yoke/disc assembly (16) onto rear of shaft (37). Secure with locknut (25) and both washers (26) but only fingertight at this stage.

11. Insert shaft (37) assembly fully into pivot (1) from the rear. Take care not to dislodge internal seals (29).

12. Partially withdraw shaft (37) assembly to enable housing of rear pivot driveline bearing (30) to be filled with grease from 1/3 to 1/2 of capacity.

13. Reposition shaft (37) assembly fully in pivot (1).

14. Align housing (31) with lube fitting (24) uppermost and secure with lockwashers (14) and bolts (20). Torque tighten bolts (20) to 106 Nm (78 lbf ft).

15. Apply a bead of grease to fill inner rim of new seal (12) and position seal in front housing (28). Refer to Fig. 6. Fill pipe (3), through lube fitting (50), with grease. Make sure that pipe (3) does not protrude into grease slot in rear face of housing (28).

16. Install spacer (19) onto front of shaft (37).

17. Pre-pack bearing (30) with grease taking care not to place any grease on outer curved surface. Clean this surface with a suitable solvent where necessary and allow to dry.

Note: Make sure that Steps 18 through 22 are performed within the hardening time of the retaining compound in use.

18. Make sure mating surfaces of housing (28) are still clean then apply coating of retaining compound to mating surfaces of bearing (30) and housing (28). Install bearing (30) on to front of shaft (37).

19. Pack housing (28) of with grease from 1/3 to 1/2 of capacity.

20. Install front housing (28), front yoke (27), both washers (26) and locknut (25).

Note: Take care to avoid damaging the pipe (3) when performing Steps 21 through 22.

21. Lock brake yoke/disc (16) assembly with a suitable tool and install locknut (25) on front yoke (27). Torque tighten locknut (25) to 678 Nm (500 lbf ft).

22. Lock front yoke (27) and torque tighten locknut (25) on brake yoke assembly to 678 Nm (500 lbf ft).

23. Align front housing (28) with pipe (3) uppermost and secure in place with bolts (20) and lockwashers (14). Torque tighten bolts (20) to 106 Nm (78 lbf ft).

24. Install bracket (58), and secure with lockwasher (57) and bolt (56).

25. Check that no end float exists by pulling and pushing on the brake yoke/disc assembly.

Note: Take extra care when handling drivelines as chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation. (Steps 26 & 28).

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26. Connect pivot - centre axle driveline (Fig. 2) to brake yoke/disc assembly as noted on 'Removal'. Install caps and secure with lockwashers and bolts.

27. Position parking brake calliper (7, Fig. 3) in position and install left hand torque plate (10, Fig. 3), front and rear wedge plates (8 & 9, Fig. 3) and secure in place with bolts (6, Fig. 3), washers (11, Fig. 3) and locknuts (12, Fig. 3).

28. Install transmission - pivot driveline (Fig. 2) with caps, lockwashers and bolts as noted on 'Removal'.

29. Position guard (4, Fig. 3), if fitted, and secure to frame using bolts (1, Fig. 3), lockwashers (2, Fig. 3) and nuts (3, Fig. 3).

30. Place the battery master switch in the on position, start the engine and allow air pressure in the tanks to build up to correct operating pressure.

31. Adjust parking brake as shown in Section 170-0010, PARKING BRAKE AND MOUNTING.

32. Remove all blocking from the road wheels.

ARTICULATION BEARINGS

Removal

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: The lengths of the electrical, hydraulic and air connections between the two frames are designed to permit articulation. As a result, the frames can be separated sufficiently to permit removal of the articulation bearings without disconnecting these connections.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Open drain cocks on air tanks to drain air pressure from the tanks. Close air tank drain cocks when air has exhausted from the air tanks.

4. Position levelling jack under centre front portion of the front frame. Raise jack and block frame to remain level after removal of the articulation pins. Check that front wheels are still effectively blocked.

Note: Make sure that front frame is correctly supported and prevented from tilting on the axle, or damage to coupling etc. could result.

5. Disconnect steering cylinders by removing bolts (36), lockwashers (14), washers (45) and pins (44) from attachment points on pivot (1) housing. Move steering cylinders clear of pivot (1) housing and secure.

Note: Take extra care when handling drivelines as chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation.

6. Match mark yokes and mating surfaces of transmission - pivot driveline (Fig. 2) to aid in 'Installation'. Remove bolts, lockwashers and caps and remove driveline from the machine.

7. Remove bolt (53) and hardened washer (54) securing pin (55) to pivot (1) housing. Remove nut (51) and withdraw pin (55), tapping pin downwards to ease removal. Take care not to damage the threads on pin (55).

Note: It may be necessary to adjust the frame levelling jack to relieve binding between pin (55) and pin bores during removal.

8. Remove bolt (46), lockwasher (14) and washer (47) securing pin (32) to pivot (1) housing.

9. Remove pin (32), tapping pin upwards to ease removal. Take care not to damage the threads on pin (32).

Note: It may be necessary to adjust the frame levelling jack to relieve binding between pin (32) and pin bores during removal.

10. Attach suitable lifting equipment to the rear frame and take up slack.

Note: Only separate the frames sufficiently to permit removal of the articulation bearings or damage to electrical, hydraulic and air connections could result.

11. Remove blocking from the rear frame and wheels

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and use lifting equipment to pull the rear frame away from the front frame. After moving, block the rear frame and wheels securely.

12. Mark all bearing retainers (5, 11, 17 & 21) to aid in 'Installation'.

Note: Retainers (5, 11, 17 & 21) are not interchangeable.

13. Remove bolts (13), lockwashers (14), retainers (5, 11, 17 & 21) and upper and lower shims (7, 8 & 9).

14. Remove and discard 'O' rings (4, 10 & 18). Remove spacer (52) noting orientation to aid in 'Installation'.

15. Remove and tag all bearings (6) to aid in 'Installation', where appropriate.

Note: Never interchange cups or cones between bearings.

Inspection

Numbers in parentheses refer to Fig. 1.

1. Clean parts with a suitable solvent and let dry. DO NOT spin bearings with compressed air. Place bearings on clean surface, cover with lint free cloth and allow to dry.

2. Check articulation bearings (6) and pins (32 & 55) for wear or damage. Renew if required.

Installation

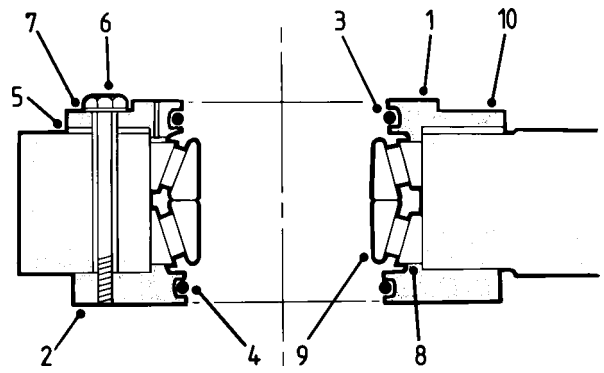
Numbers in parentheses refer to Fig. 1, unless otherwise specified.

⚠ WARNING
To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.

Note: Two bearings are installed on EACH articulation point. Each bearing comprises a cup and a cone and are installed into the articulation point with the cones 'back to back'. Refer to Fig. 7.

Note: Never interchange cups or cones between bearings.

1. Insert both bearing cups and cones into housing so that bearing cones are back to back and position retainer (11), for top articulation bearing, and retainer (21), for bottom articulation bearing on underside of bearing housing. Make sure that bearings are pre-packed with grease including end faces and faces on bearing cups.



1 - Upper Retainer
2 - Lower Retainer
3 - Upper 'O' Ring
4 - Lower 'O' Ring
5 - Shims
6 - Bolts
7 - Washers
8 - Cups
9 - Cones
10 - Lugs

Fig. 7 - Section Through Articulation Bearing

2. Install top retainer (5), for top articulation bearing, and retainer (21), for bottom articulation bearing.

3. Lubricate bolts (13 for top and 33 for bottom) and install along with washers (14). Torque tighten bolts (13 & 33) to 27 Nm (20 lbf ft).

4. Use feeler gauges to measure end float and record value. Refer to Fig. 8.

Note: End float is equal to the sum of the clearances between both retainers and the lug.

5. Select shims to total value of -0.07 to +0.02 mm (-0.003 to +0.001 in) of that recorded at Step 4.

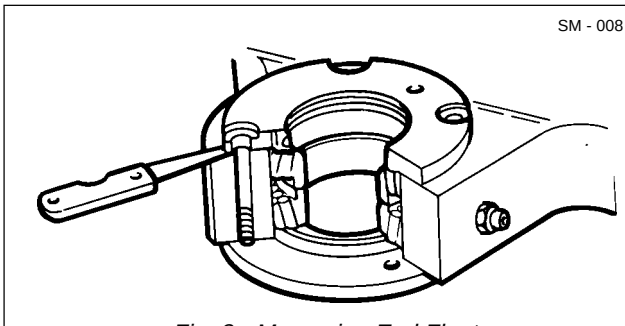


Fig. 8 - Measuring End Float

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6. Remove bolts (13 & 33), lubricate and coat with anti-seize compound then install shims (7, 8 & 9) beneath appropriate upper retainer (5 for upper articulation bearing, 17 for lower articulation bearing).

7. Re-install bolts (13 & 33) and washers (14) and torque tighten to 106 Nm (78 lbf ft).

8. Install spacer (52) in upper bearing as noted on removal. Install upper 'O' ring (4) and lower 'O' ring (10) for top bearing (6).

Note: The lower bearing is NOT fitted with a spacer.

9. Install 'O' rings (18) for lower bearing (6).

10. Attach suitable lifting equipment to the rear frame and take up slack.

11. Remove blocking from rear frame and wheels. Move rear frame with lifting equipment to align the articulation pin bores. Block the rear frame and wheels to remain level and stationary.

12. Clean articulation pins (32 & 55) with suitable solvent, allow to dry then coat them with anti-seize compound including threads on upper pin (55).

13. Insert articulation pin (32).

Note: It may be necessary to adjust the levelling jack beneath front frame to permit entry of articulation pin (32). Pin (32) may be tapped in to place taking care that it is not misaligned and does not cause damage to the pin, bearings or pivot housing lugs.

14. Secure pin (32) with washer (47), lockwasher (14) and bolt (36).

15. Insert upper articulation pin (55).

16. Install nut (51) on pin (55). Torque tighten nut (51) to 1 424 Nm (1 050 lbf ft).

Note: Take extra care when handling drivelines as chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation.

17. Install transmission - centre driveline (Fig. 2) with caps, lockwashers and bolts as noted on 'Removal'.

18. Position steering cylinders in place on pivot (1) and install pins (44). Secure pins (44) with bolts (36), washers (45) and lockwashers (14).

19. Place the battery master switch in the on position, start the engine and allow air pressure in the tanks to build up to correct operating pressure.

20. Lower and remove jack and all blocking equipment.

OSCILLATION BUSHES

Removal

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

> **⚠ WARNING**
> **To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Open drain cocks on air tanks to drain air pressure from the tanks. Close air tank drain cocks when air has exhausted from the air tanks.

4. Remove hydraulic oil tank remote drain plug and drain hydraulic oil into a suitable container. Re-install drain plug in hydraulic tank remote drain fitting.

5. Tag all air and hydraulic lines between front and rear frames to aid in 'Installation. Disconnect all air and hydraulic lines. Cap line fittings and plug lines to prevent ingress of dirt.

6. Disconnect electrical wiring and any other attachments that would be damaged on separation of front and rear frames.

7. Position levelling jack under centre front portion of the front frame. Raise the jack and block the front frame, front and rear, so it will remain level after separation. Check that both front wheels are still securely blocked.

Note: Make sure that the front frame is correctly supported and prevented from tilting on the axle or damage to coupling etc. could result.

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Note: Take extra care when handling drivelines as chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation.

8. Remove bolts (1, Fig. 3), lockwashers (2, Fig. 3), nuts (3, Fig. 3) and protective guard (4, Fig. 3), if fitted, from beneath rear of pivot housing.

⚠ WARNING
Tensioned spring on adjuster.

9. Slacken adjuster (14, Fig. 3) until brake pads (13, Fig. 3) are sufficiently clear of parking brake disc (5, Fig. 3) to permit removal of calliper (7, Fig. 3).

10. Note positions of front and rear wedge plates (8 & 9, Fig. 3) to aid in 'Installation'. Remove bolts (6, Fig. 3), washers (11, Fig. 3), nuts (12, Fig. 3), front and rear wedge plates (8 & 9, Fig. 3) and left hand torque plate (10, Fig. 3).

11. Move and secure calliper (7, Fig. 3) clear of parking brake disc (5, Fig. 3).

Note: Take extra care when handling drivelines since any deformity on a rotating mass creates vibration and excessive wear during any operation.

12. Match mark brake yoke (16) and mating surface of pivot - centre axle driveline (Fig. 2) to aid in 'Installation'. Remove bolts, lockwashers and caps and remove driveline from the machine.

13. Mark disc (5, Fig. 3) assembly to aid in 'Installation' then remove bolts (15, Fig. 3) washers (16, Fig. 3) and disc (5, Fig. 3).

14. Remove bolts (36), lockwashers (14) and lockplate (35).

15. Using special tool, which can be fabricated as shown in Fig. 11, remove thrust nut (34) from pivot (1). Note position of rear 'V' ring (41) to aid in 'Installation'. Remove and discard 'V' ring (41).

16. Attach suitable lifting equipment to the front of the rear frame and take up slack.

17. Remove all blocking from rear frame and wheels and using suitable lifting equipment draw the rear frame from pivot (1) assembly. When clear, block the rear frame and wheels.

Note: Use care when separating rear frame and pivot assembly to avoid damage to end threads.

18. Replace thrust nut (34) on pivot (1) to protect threads.

19. Note position of front 'V' ring (41) to aid in 'Installation'. Remove and discard 'V' ring (41).

20. Inspect oscillation bushes (43) as described in 'Inspection'. If bushes are to be renewed, proceed with Step 20.

21. Remove oscillation bush/es (43) with hammer and chisel.

Note: The suggested method is to make an axial cut along the bush then to lever the bush in order to collapse it upon itself.

Inspection

Numbers in parentheses refer to Fig. 1.

1. Clean oscillation bushes (43) with a suitable solvent and allow to dry.

2. Inspect oscillation bushes (43) for wear, scoring, erosion and 'out of round'. Pay particular attention to the thrust faces of the bushes which should also be inspected for cracking/splitting. Renew if required.

Installation

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: Tighten all fasteners without special torques specified, to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.

1. Wipe bush housing clean using suitable solvent and allow to dry.

2. Apply LOCQUIC primer to housing and allow to dry for 10 minutes. Apply LOCTITE RC-35 to housing.

3. Align new bushes to housing with grease holes aligned vertically and identification 'PAINT DOT' at Top Dead

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Centre. Refer to Fig. 9. Drift bushes into housing using hammer with soft packing for protection.

4. Using special tool, which can be fabricated as shown in Fig. 11, remove thrust nut (34) from pivot (1). Clean grease from pivot exterior using a suitable solvent where necessary and allow to dry.

Note: Use care on inserting the pivot housing assembly or damage to the thread could occur.

5. Install new pre-greased front 'V' ring (41). Refer to Fig. 10. Apply liberal coat of grease to external surface of pivot (1) and mating faces of bushes (43).

6. Attach suitable lifting equipment to the front of the rear frame and take up slack.

7. Remove all blocking from rear frame and wheels and use lifting equipment to line-up and draw the rear frame onto pivot (1) assembly.

8. Install new pre-greased rear 'V' ring (41). Refer to Fig. 10. Using special tool, as shown in Fig. 11, install and tighten thrust nut (34) until there is no end float/ clearance at thrust face of either bush (43). Slacken thrust nut (34) until pin of lockplate (35) can be inserted in first available hole in thrust nut (34).

9. Secure lockplate (35) with bolts (36) and lockwashers (14). Torque tighten bolts (36) to 75 Nm (55 lbf ft).

10. Grease oscillation bushes (43) through lube fittings (59) until excess lubrication is seen.

11. Check that no end float exists at oscillation bushes by pushing and pulling on brake yoke assembly.

12. Position brake disc (5, Fig. 3) onto brake yoke (16) as noted at 'Removal'. Secure in place with bolts (15, Fig. 3) and washers (16, Fig. 3).

Note: Take extra care when handling drivelines as

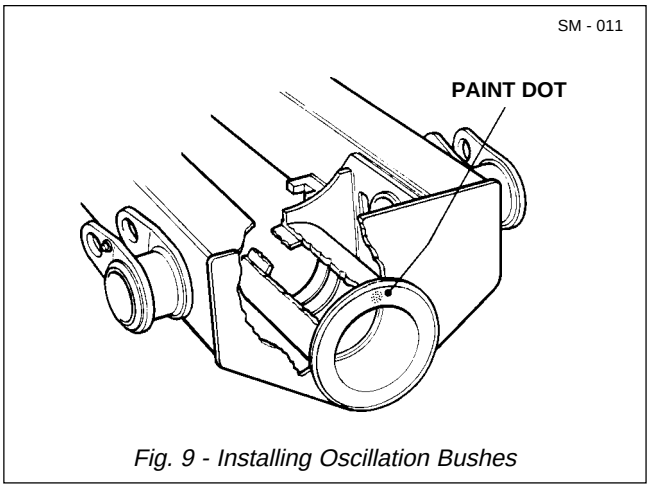


Fig. 9 - Installing Oscillation Bushes

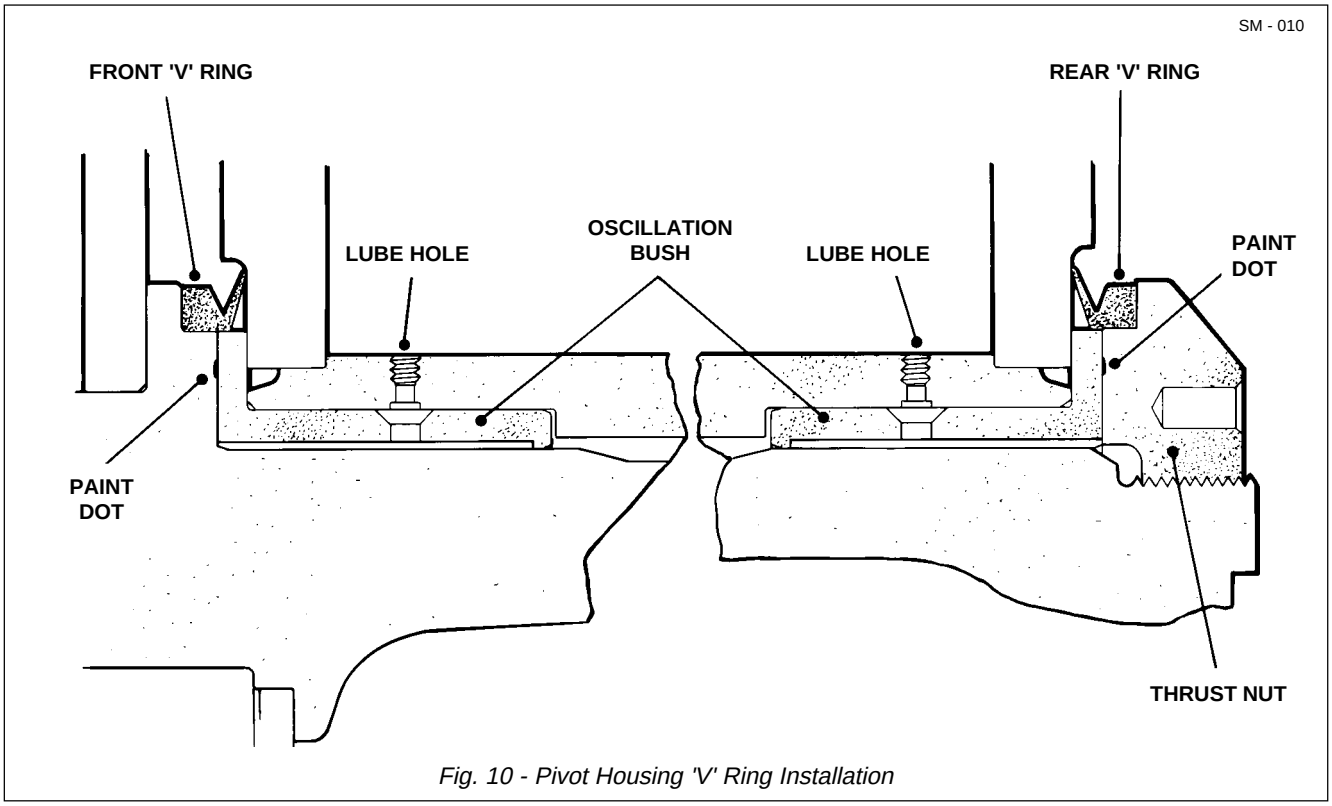


Fig. 10 - Pivot Housing 'V' Ring Installation

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chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation.

13. Connect pivot - centre axle driveline (Fig. 2) at brake yoke using bolts, lockwashers and caps as noted at 'Removal'.

14. Position parking brake calliper (7, Fig. 3) in position and install left hand torque plate (10, Fig. 3), front and rear wedge plates (8 & 9, Fig. 3) and secure in place with bolts (6, Fig. 3), washers (11, Fig. 3) and locknuts (12, Fig. 3).

15. Position guard (4, Fig. 3), if fitted, and secure to frame using bolts (1, Fig. 3), lockwashers (2, Fig. 3) and nuts (3, Fig. 3).

16. Remove all protective plugs and connect all air and hydraulic lines and other attachments disconnected in preparation for separation of front and rear frames.

17. Fill hydraulic oil tank with hydraulic oil, as specified in Section 300-0020, LUBRICATION SYSTEM.

18. Place the battery master switch in the on position, start the engine and allow air pressure in the tanks to build up to correct operating pressure. Check air and hydraulic lines for leaks. Tighten line fittings as required.

19. Adjust parking brake as shown in Section 170-0010, PARKING BRAKE AND MOUNTING.

20. Remove all blocking from the road wheels.

THRUST NUT ADJUSTMENT

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Open drain cocks on air tanks to drain air pressure from the tanks. Close air tank drain cocks when air has exhausted from the air tanks.

4. Position levelling jack under centre front portion of the front frame and raise the jack to ensure both frames are parallel.

5. Remove bolts and lockwashers securing lockplate at the thrust nut and remove the lockplate.

6. Using special tool, which can be manufactured as shown in Fig. 11, tighten thrust nut until there is no end float/clearance at thrust face of either bush. Slacken thrust nut until pin of the lockplate can be inserted in the first available hole in the thrust nut.

7. Secure lockplate with bolts and lockwashers. Torque tighten bolts to 75 Nm (55 lbf ft).

8. Lower jack and remove all blocking from the front wheels.

MAINTENANCE

The end float/clearance at the thrust face of the oscillation bushes should be checked every 250 hours. Any clearance found must be removed by adjustment of the thrust nut, as described under 'Thrust Nut Adjustment'.

Note: A practical method of establishing the effective adjustment of the thrust nut is to use movement of the machines body in the raised position. Move the body from fully raised to almost fully raised while watching the effect of this action on the frame and pivot arrangement. Any slackness between the thrust nut and thrust faces will be clearly visible movement of the frame.

Very little other maintenance of the articulation and oscillation pivot is required other than to stress the importance of correct lubrication of the assembly.

Lubricate the oscillation bushes, articulation bearings/ pins and the pivot driveshaft bearings in accordance with Section 300-0020, LUBRICATION SYSTEM but note the following precautions:-

Note: The oscillation bushes are lubricated every 10 to 15 hours.

Note: DO NOT exceed the lubrication schedule for the pivot driveshaft bearings i.e. 4 shots of a hand grease gun every 250 hours.

SPECIAL TOOL

The special tool required for removal and installation of the thrust nut, can be manufactured, as shown in Fig. 11.

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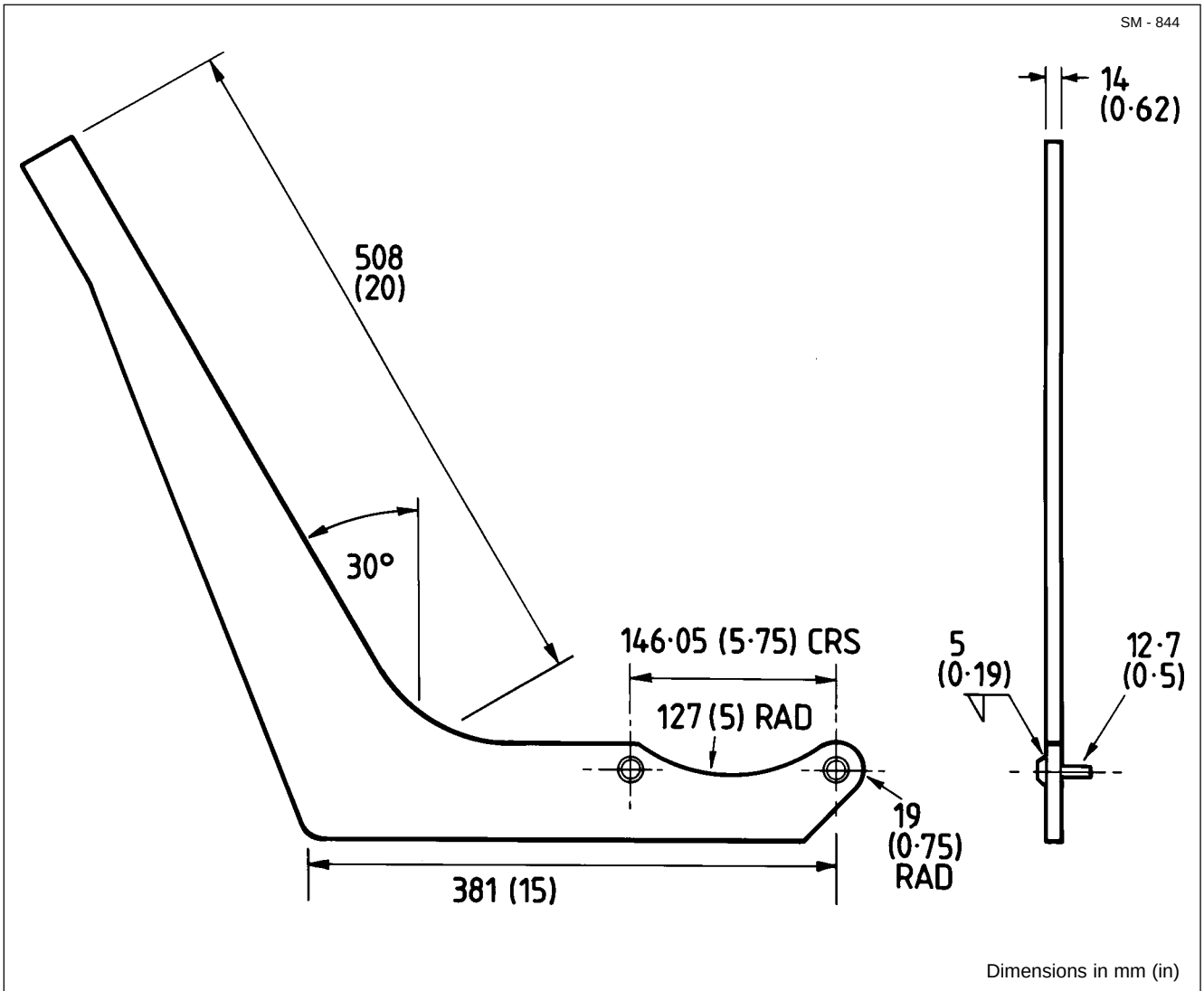


Fig. 11 - Fabrication Details of Thrust Nut Removal and Installation Tool

SPECIAL TORQUE SPECIFICATIONS

			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	13	Bolt	106	78
1	20	Bolt	106	78
1	25	Nut	678	500
1	33	Bolt	106	78
1	36	Bolt	75	55
1	51	Nut	1 425	1 050

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ARTICULATION AND OSCILLATION PIVOT DIAGNOSIS

Noise and vibration caused by the pivot driveshaft assembly appear only at certain speeds and generally come and go as these speeds are approached and passed. When the driveshaft assembly noise becomes excessive, it takes the form of a vibration which can be felt throughout the frame.

Noise from the articulation and oscillation points must be investigated.

An 'Articulation and Oscillation Pivot Diagnosis' table is shown below.

ARTICULATION AND OSCILLATION PIVOT DIAGNOSIS

CONDITION	REASON	REMEDY
Noise (Pivot Driveshaft)	Insufficient lubricant	Check seals.
		Install proper grade of lubricant.
	Out of balance driveshaft assembly	Check alignment.
Vibration (Pivot Driveshaft)	Backlash due to worn bearings, housings, yokes and trunnions	Renew worn parts.
	Yoke not in line	Renew driveshaft assembly or assemble correctly.
	Driveshaft out of balance	Renew driveshaft assembly.
Noise (Articulation/Oscillation Points)	Excessive run out or distorted yokes	Dismantle and correct, or renew, damaged part.
	Loose nut on yoke	Check splines, if worn. Renew shaft. Torque tighten nut to value in 'Special Torque Specifications' in this section.
	Insufficient lubricant	Lubricate. Investigate/revise lubrication schedules. Refer to Section 300-0020, LUBRICATION SYSTEM. Check seals for lubricant loss/contamination. Renew as necessary.
	Worn bearings/bushes	Inspect/renew as necessary.

* * * *

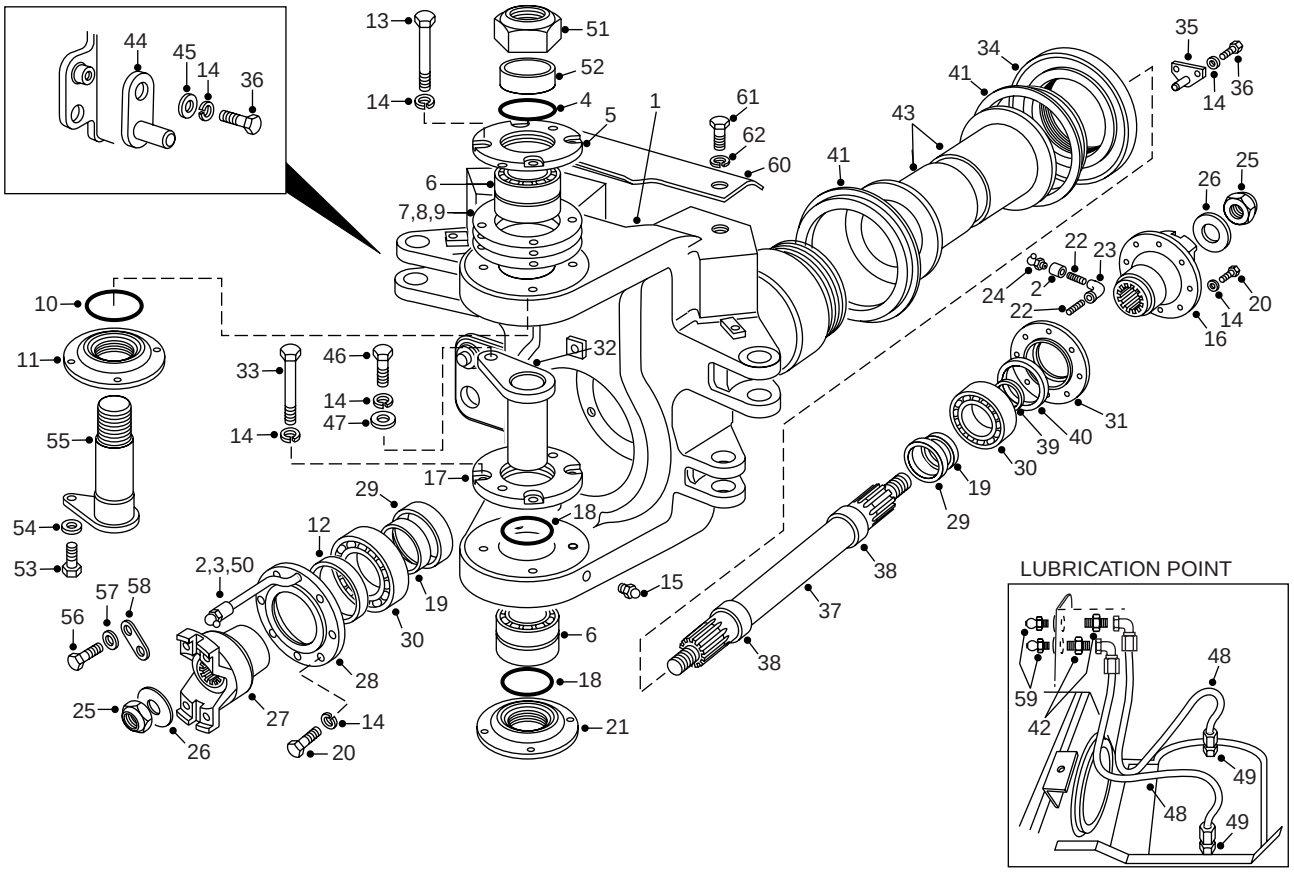
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1 - Pivot
2 - Coupling
3 - Pipe
4 - 'O' Ring
5 - Retainer
6 - Bearing
*7 - Shim
*8 - Shim
*9 - Shim
10 - 'O' Ring
11 - Retainer
12 - Seal
13 - Bolt
14 - Lockwasher
15 - Lube Fitting
16 - Brake Yoke
17 - Retainer
18 - 'O' Ring
19 - Spacer
20 - Bolt
21 - Retainer
22 - Nipple
23 - Elbow
24 - Lube Fitting
25 - Locknut
26 - Washer
27 - Front Yoke
28 - Housing
29 - Seal
30 - Bearing
31 - Housing
32 - Pin
33 - Bolt
34 - Thrust Nut
35 - Lockplate
36 - Bolt
37 - Shaft
38 - Bush
39 - Washer
40 - Seal
41 - 'V' Ring
42 - Adaptor
43 - Bush
44 - Pin
45 - Washer
46 - Bolt
47 - Washer
48 - Lube Line
49 - Connector
50 - Lube Fitting
51 - Nut
52 - Spacer
53 - Bolt
54 - Hardened Washer
55 - Pin
56 - Bolt
57 - Lockwasher
58 - Bracket
59 - Lube Fitting
60 - Guard
61 - Bolt
62 - Lockwasher

* Lower bearing shims not shown

Fig. 1 - Articulation and Oscillation Pivot

DESCRIPTION AND OPERATION

The articulation and oscillation pivot allows the front and rear frames to rotate horizontally (articulation) and tilt laterally (oscillation) with respect to each other. It is also the main load bearing coupling between the two frames. The pivot assembly houses the driveshaft connecting the drive between the front and rear frames.

Articulation bearings, oscillation bushes, pivot driveshaft bearings and associated parts can be removed, inspected and replaced or renewed by following the procedures outlined in this section.

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PIVOT DRIVESHAFT BEARINGS

Removal

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: It is not necessary to separate the frames in order to remove the pivot driveshaft assembly.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Open drain cocks on air tanks to drain air pressure from the tanks. Close air tank drain cocks when air has exhausted from the air tanks.

Note: Take extra care when handling drivelines as any deformity on a rotating mass creates vibration and excessive wear during any operation.

4. Match mark yokes and mating surfaces of transmission - pivot driveline (Fig. 2) to aid in 'Installation'. Remove bolts, lockwashers and caps and remove driveline from the machine.

Note: Take care to avoid damaging pipe (3) when performing Step 5.

5. Remove locknut (25) and washers (26) from front yoke (27). Remove yoke (27) from shaft (37).

6. Remove bolts (1, Fig. 3), lockwashers (2, Fig. 3), nuts (3, Fig. 3) and protective guard (4, Fig. 3), if fitted, from beneath rear of pivot housing.

> ⚠ **WARNING**
> **Tensioned spring on adjuster.**

7. Slacken adjuster (14, Fig. 3) until brake pads (13, Fig. 3) are sufficiently clear of parking brake disc (5, Fig. 3) to permit removal of calliper (7, Fig. 3).

8. Note positions of front and rear wedge plates (8 & 9, Fig. 3) to aid in 'Installation'. Remove bolts (6, Fig. 3), washers (11, Fig. 3), nuts (12, Fig. 3), front and rear wedge plates (8 & 9, Fig. 3) and left hand torque plate (10, Fig. 3).

9. Move and secure calliper (7, Fig. 3) clear of parking brake disc (5, Fig. 3).

Note: Take extra care when handling drivelines since any deformity on a rotating mass creates vibration and excessive wear during any operation.

10. Match mark brake yoke (16) and mating surface of pivot - centre axle driveline (Fig. 2) to aid in 'Installation'. Remove bolts, lockwashers and caps and remove driveline from the machine.

11. Remove bolts (57) and lockwashers (14) from rear housing (31).

Note: Take extra care when handling driveshafts as any deformity on a rotating mass creates vibration and excessive wear during any operation.

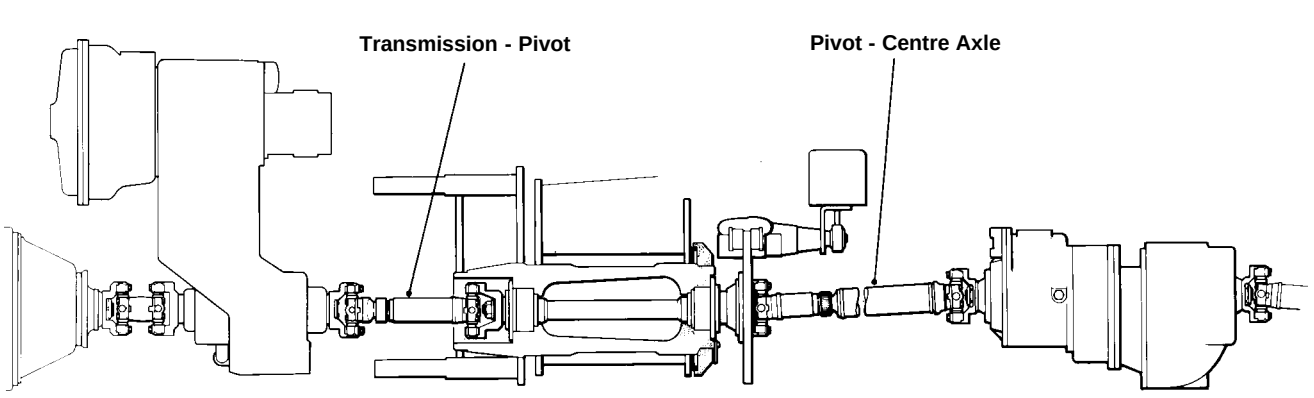


Fig. 2 - Drivelines

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SM - 003

1 - Bolt
2 - Lockwasher
3 - Nut
4 - Guard
5 - Disc
6 - Bolt
7 - Calliper
8 - Front Wedge Plate
9 - Rear Wedge Plate
10 - LH Torque Plate
11 - Washer
12 - Locknut
13 - Brake Pad
14 - Adjuster
15 - Bolts
16 - Washers

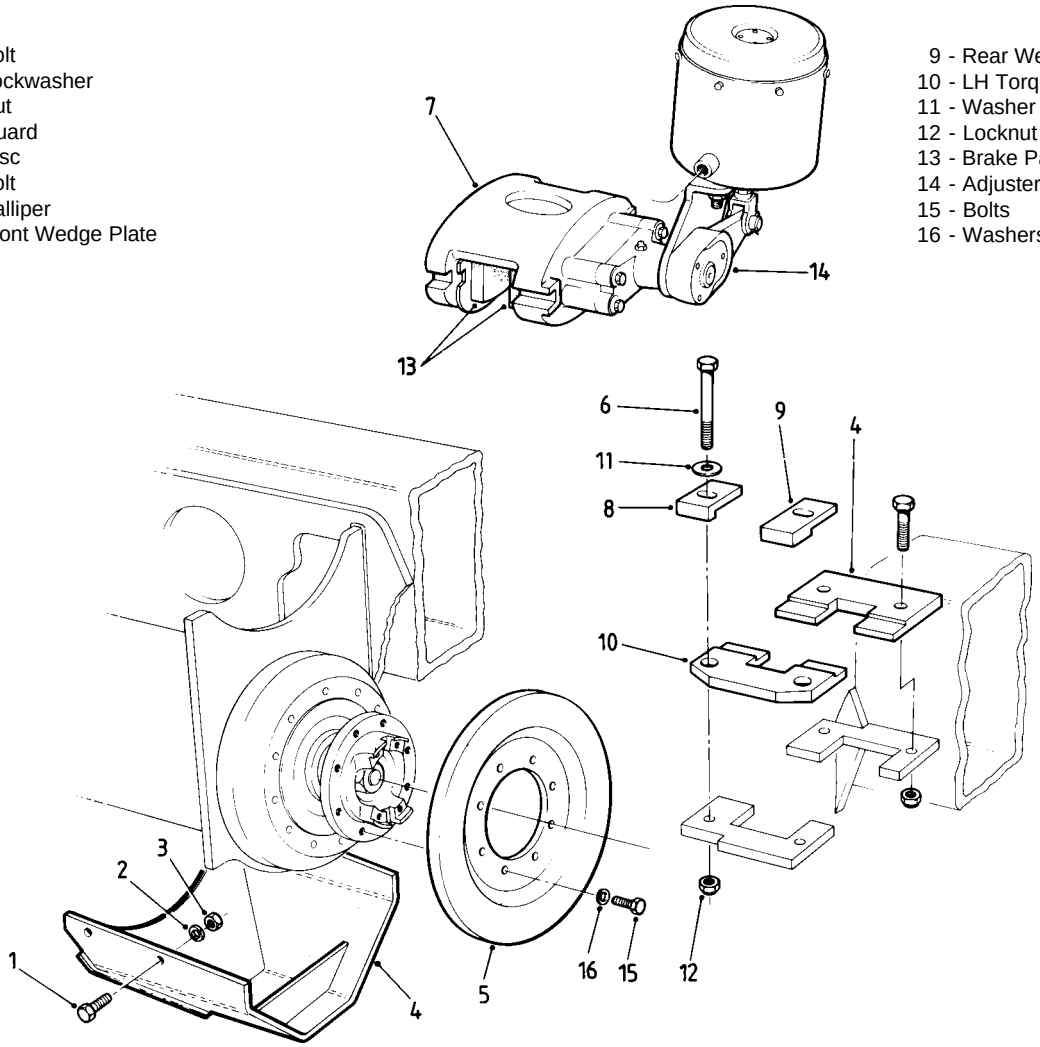


Fig. 3 - Parking Brake Assembly

12. Withdraw pivot driveshaft assembly from pivot by pulling rearwards on brake yoke/disc assembly and place in suitable location for further work.

13. Remove front locknut (25) then position front yoke (27) fully on to front of shaft (37) and suitably restrain to resist rotation. Remove rear locknut (25), washers (26) and rear yoke brake/disc assembly (16). Tag front and rear ends of shaft (37) and install locknuts (25) on the shaft to protect the threads.

14. Tag and remove housing (31). Note position of seal (40) to aid in 'Installation'. Remove and discard seal (40).

15. Remove washer (39), rear bearing (30) and spacer (19) from rear of shaft (37).

16. Remove bolt (56), lockwasher (57) and bracket (58) securing pipe (3) to pivot (1) assembly.

Note: Take care to avoid damaging pipe (3) when performing Steps 17 through 18.

17. Remove bolts (20) and lockwashers (14) from front housing (28).

18. Tag and remove front housing (28). Note position of seal (12) in front housing (28) to aid in 'Installation'. Remove and discard seal (12).

⚠ WARNING
When necessary to drive out components, use a soft drift to avoid injury and damage from flying chips.

19. Using a suitable puller/drift, remove bearing (30).

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20. Remove spacer (19). Note position of seals (29) in pivot (1) housing to aid in 'Installation'. Remove and discard seals (29).

Inspection

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

1. Clean parts with a suitable solvent and let dry. DO NOT spin bearings with compressed air. Place bearings on clean surface, cover with lint free cloth and allow to dry.

2. Check pivot driveshaft bearings (30) for wear or damage, replace if required.

3. Inspect bushes (38) for wear. Replace if badly scored.

Installation

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: Tighten all fasteners without special torques specified, to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: If bushes (38) are to be renewed, then proceed with Steps 1 thru 5, if the bushes (38) are satisfactory, proceed from Step 6.

⚠ WARNINGS
To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.

⚠ When necessary to drive out components, use a soft drift to avoid injury and damage from flying chips.

1. Apply suitable heat to bushes (38) to break bond of retaining compound. Remove locknuts (25) from their protective position on shaft (37), then remove bushes (38) with a suitable drift.

2. Allow shaft (37) to cool. Thoroughly clean shaft (37) and new bushes (38) with a suitable solvent. Wash mating faces of shaft (37) and new bushes (38) with chlorethane and allow to dry.

3. Apply LOCTITE primer to mating faces of shaft (37) and new bushes (38) and allow to dry. Refer to Fig. 4.

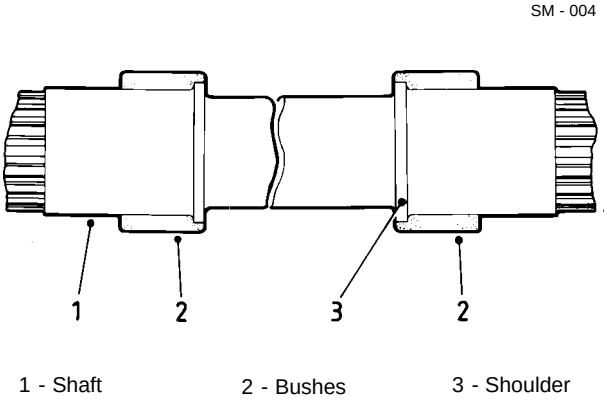


Fig. 4 - Shaft and Bushes

4. Apply LOCTITE 638 to shaft (37) mating faces and install new bushes (38), with the recesses in bushes (38) against shoulder on driveshaft (37). Make sure that bushes (38) are fully home against the shoulders. Refer to Fig. 4.

5. Allow 15 minutes for retaining compound to cure to handling strength.

6. Degrease front bearing (30) housing in pivot (1) with a suitable solvent and allow to dry.

Note: Do not use retaining compound on the housing for the rear pivot shaft bearing.

Note: Front bearing (30) of shaft (37) is secured with retaining compound as well as normal hardware. Cleaning the bearing housing ensures a good bond. THE REAR BEARING IS SECURED BY NORMAL HARDWARE ONLY.

7. Apply coat of grease to new seals (29) and install seals in pivot housing. Make sure seal lips are facing outwards as shown on Fig. 5.

8. Make sure that pivot shaft bearing (30) is pre-packed with grease then position spacer (19), bearing (30) and washer (39) on rear of shaft (37).

9. Apply bead of grease to fill inner rim of new seal (40) and position new seal in rear housing (31). Refer to Fig. 6. Fill lube fitting (24) assembly on rear housing with grease and make sure that nipple (22) does not protrude into grease slot in rear face of housing (31).

Note: Take extra care when handling driveshafts as any deformity on a rotating mass creates vibration and excessive wear during any operation.

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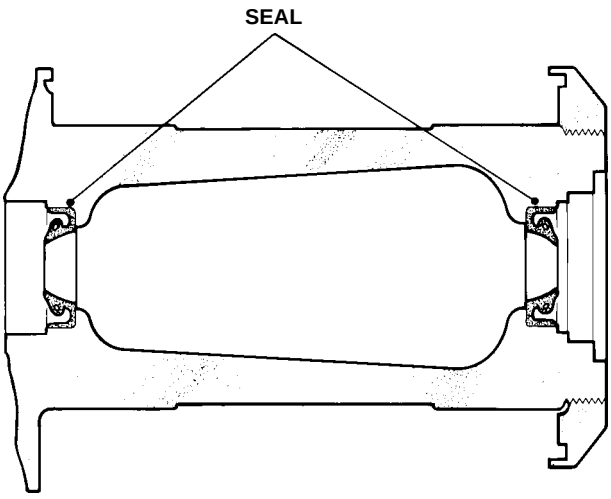


Fig. 5 - Pivot Housing Inner Seals

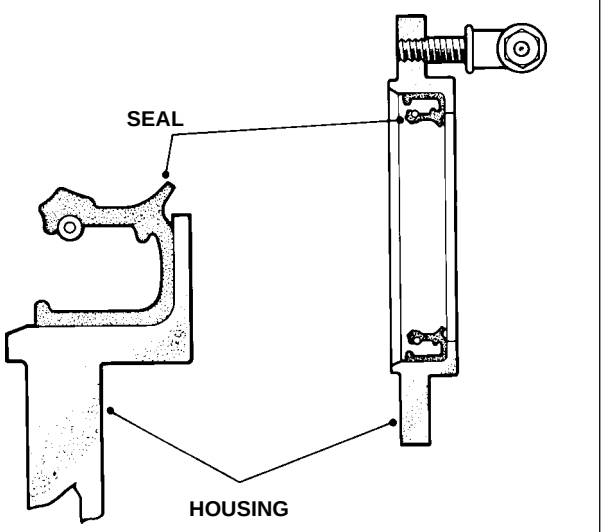


Fig. 6 - Typical Outer Seal Installation

10. Assemble rear housing (31) and brake yoke/disc assembly (16) onto rear of shaft (37). Secure with locknut (25) and both washers (26) but only fingertight at this stage.

11. Insert shaft (37) assembly fully into pivot (1) from the rear. Take care not to dislodge internal seals (29).

12. Partially withdraw shaft (37) assembly to enable housing of rear pivot driveline bearing (30) to be filled with grease from 1/3 to 1/2 of capacity.

13. Reposition shaft (37) assembly fully in pivot (1).

14. Align housing (31) with lube fitting (24) uppermost and secure with lockwashers (14) and bolts (20). Torque tighten bolts (20) to 106 Nm (78 lbf ft).

15. Apply a bead of grease to fill inner rim of new seal (12) and position seal in front housing (28). Refer to Fig. 6. Fill pipe (3), through lube fitting (50), with grease. Make sure that pipe (3) does not protrude into grease slot in rear face of housing (28).

16. Install spacer (19) onto front of shaft (37).

17. Pre-pack bearing (30) with grease taking care not to place any grease on outer curved surface. Clean this surface with a suitable solvent where necessary and allow to dry.

Note: Make sure that Steps 18 through 22 are performed within the hardening time of the retaining compound in use.

18. Make sure mating surfaces of housing (28) are still clean then apply coating of retaining compound to mating surfaces of bearing (30) and housing (28). Install bearing (30) on to front of shaft (37).

19. Pack housing (28) of with grease from 1/3 to 1/2 of capacity.

20. Install front housing (28), front yoke (27), both washers (26) and locknut (25).

Note: Take care to avoid damaging the pipe (3) when performing Steps 21 through 22.

21. Lock brake yoke/disc (16) assembly with a suitable tool and install locknut (25) on front yoke (27). Torque tighten locknut (25) to 678 Nm (500 lbf ft).

22. Lock front yoke (27) and torque tighten locknut (25) on brake yoke assembly to 678 Nm (500 lbf ft).

23. Align front housing (28) with pipe (3) uppermost and secure in place with bolts (20) and lockwashers (14). Torque tighten bolts (20) to 106 Nm (78 lbf ft).

24. Install bracket (58), and secure with lockwasher (57) and bolt (56).

25. Check that no end float exists by pulling and pushing on the brake yoke/disc assembly.

Note: Take extra care when handling drivelines as chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation. (Steps 26 & 28).

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26. Connect pivot - centre axle driveline (Fig. 2) to brake yoke/disc assembly as noted on 'Removal'. Install caps and secure with lockwashers and bolts.

27. Position parking brake calliper (7, Fig. 3) in position and install left hand torque plate (10, Fig. 3), front and rear wedge plates (8 & 9, Fig. 3) and secure in place with bolts (6, Fig. 3), washers (11, Fig. 3) and locknuts (12, Fig. 3).

28. Install transmission - pivot driveline (Fig. 2) with caps, lockwashers and bolts as noted on 'Removal'.

29. Position guard (4, Fig. 3), if fitted, and secure to frame using bolts (1, Fig. 3), lockwashers (2, Fig. 3) and nuts (3, Fig. 3).

30. Place the battery master switch in the on position, start the engine and allow air pressure in the tanks to build up to correct operating pressure.

31. Adjust parking brake as shown in Section 170-0010, PARKING BRAKE AND MOUNTING.

32. Remove all blocking from the road wheels.

ARTICULATION BEARINGS

Removal

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: The lengths of the electrical, hydraulic and air connections between the two frames are designed to permit articulation. As a result, the frames can be separated sufficiently to permit removal of the articulation bearings without disconnecting these connections.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Open drain cocks on air tanks to drain air pressure from the tanks. Close air tank drain cocks when air has exhausted from the air tanks.

4. Position levelling jack under centre front portion of the front frame. Raise jack and block frame to remain level after removal of the articulation pins. Check that front wheels are still effectively blocked.

Note: Make sure that front frame is correctly supported and prevented from tilting on the axle, or damage to coupling etc. could result.

5. Disconnect steering cylinders by removing bolts (36), lockwashers (14), washers (45) and pins (44) from attachment points on pivot (1) housing. Move steering cylinders clear of pivot (1) housing and secure.

Note: Take extra care when handling drivelines as chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation.

6. Match mark yokes and mating surfaces of transmission - pivot driveline (Fig. 2) to aid in 'Installation'. Remove bolts, lockwashers and caps and remove driveline from the machine.

7. Remove bolt (53) and hardened washer (54) securing pin (55) to pivot (1) housing. Remove nut (51) and withdraw pin (55), tapping pin downwards to ease removal. Take care not to damage the threads on pin (55).

Note: It may be necessary to adjust the frame levelling jack to relieve binding between pin (55) and pin bores during removal.

8. Remove bolt (46), lockwasher (14) and washer (47) securing pin (32) to pivot (1) housing.

9. Remove pin (32), tapping pin upwards to ease removal. Take care not to damage the threads on pin (32).

Note: It may be necessary to adjust the frame levelling jack to relieve binding between pin (32) and pin bores during removal.

10. Attach suitable lifting equipment to the rear frame and take up slack.

Note: Only separate the frames sufficiently to permit removal of the articulation bearings or damage to electrical, hydraulic and air connections could result.

11. Remove blocking from the rear frame and wheels

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and use lifting equipment to pull the rear frame away from the front frame. After moving, block the rear frame and wheels securely.

12. Mark all bearing retainers (5, 11, 17 & 21) to aid in 'Installation'.

Note: Retainers (5, 11, 17 & 21) are not interchangeable.

13. Remove bolts (13), lockwashers (14), retainers (5, 11, 17 & 21) and upper and lower shims (7, 8 & 9).

14. Remove and discard 'O' rings (4, 10 & 18). Remove spacer (52) noting orientation to aid in 'Installation'.

15. Remove and tag all bearings (6) to aid in 'Installation', where appropriate.

Note: Never interchange cups or cones between bearings.

Inspection

Numbers in parentheses refer to Fig. 1.

1. Clean parts with a suitable solvent and let dry. DO NOT spin bearings with compressed air. Place bearings on clean surface, cover with lint free cloth and allow to dry.

2. Check articulation bearings (6) and pins (32 & 55) for wear or damage. Renew if required.

Installation

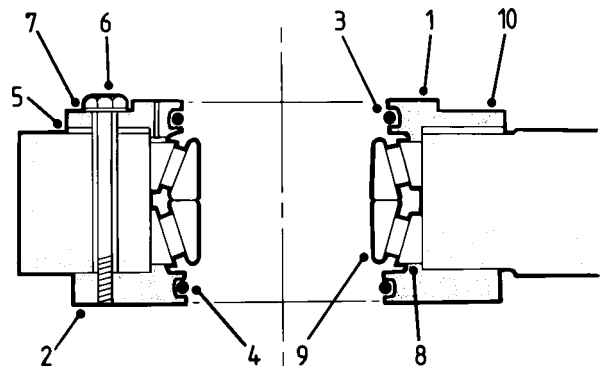
Numbers in parentheses refer to Fig. 1, unless otherwise specified.

⚠ WARNING
To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.

Note: Two bearings are installed on EACH articulation point. Each bearing comprises a cup and a cone and are installed into the articulation point with the cones 'back to back'. Refer to Fig. 7.

Note: Never interchange cups or cones between bearings.

1. Insert both bearing cups and cones into housing so that bearing cones are back to back and position retainer (11), for top articulation bearing, and retainer (21), for bottom articulation bearing on underside of bearing housing. Make sure that bearings are pre-packed with grease including end faces and faces on bearing cups.



1 - Upper Retainer
2 - Lower Retainer
3 - Upper 'O' Ring
4 - Lower 'O' Ring
5 - Shims
6 - Bolts
7 - Washers
8 - Cups
9 - Cones
10 - Lugs

Fig. 7 - Section Through Articulation Bearing

2. Install top retainer (5), for top articulation bearing, and retainer (21), for bottom articulation bearing.

3. Lubricate bolts (13 for top and 33 for bottom) and install along with washers (14). Torque tighten bolts (13 & 33) to 27 Nm (20 lbf ft).

4. Use feeler gauges to measure end float and record value. Refer to Fig. 8.

Note: End float is equal to the sum of the clearances between both retainers and the lug.

5. Select shims to total value of -0.07 to +0.02 mm (-0.003 to +0.001 in) of that recorded at Step 4.

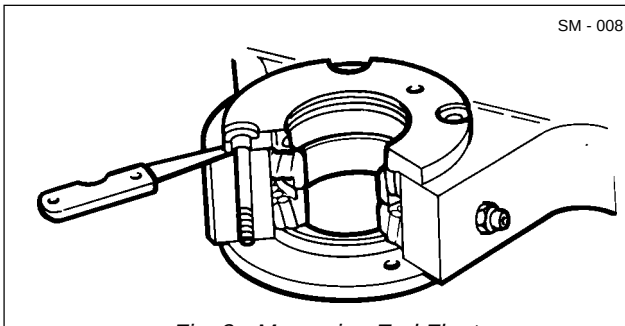


Fig. 8 - Measuring End Float

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6. Remove bolts (13 & 33), lubricate and coat with anti-seize compound then install shims (7, 8 & 9) beneath appropriate upper retainer (5 for upper articulation bearing, 17 for lower articulation bearing).

7. Re-install bolts (13 & 33) and washers (14) and torque tighten to 106 Nm (78 lbf ft).

8. Install spacer (52) in upper bearing as noted on removal. Install upper 'O' ring (4) and lower 'O' ring (10) for top bearing (6).

Note: The lower bearing is NOT fitted with a spacer.

9. Install 'O' rings (18) for lower bearing (6).

10. Attach suitable lifting equipment to the rear frame and take up slack.

11. Remove blocking from rear frame and wheels. Move rear frame with lifting equipment to align the articulation pin bores. Block the rear frame and wheels to remain level and stationary.

12. Clean articulation pins (32 & 55) with suitable solvent, allow to dry then coat them with anti-seize compound including threads on upper pin (55).

13. Insert articulation pin (32).

Note: It may be necessary to adjust the levelling jack beneath front frame to permit entry of articulation pin (32). Pin (32) may be tapped in to place taking care that it is not misaligned and does not cause damage to the pin, bearings or pivot housing lugs.

14. Secure pin (32) with washer (47), lockwasher (14) and bolt (36).

15. Insert upper articulation pin (55).

16. Install nut (51) on pin (55). Torque tighten nut (51) to 1 424 Nm (1 050 lbf ft).

Note: Take extra care when handling drivelines as chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation.

17. Install transmission - centre driveline (Fig. 2) with caps, lockwashers and bolts as noted on 'Removal'.

18. Position steering cylinders in place on pivot (1) and install pins (44). Secure pins (44) with bolts (36), washers (45) and lockwashers (14).

19. Place the battery master switch in the on position, start the engine and allow air pressure in the tanks to build up to correct operating pressure.

20. Lower and remove jack and all blocking equipment.

OSCILLATION BUSHES

Removal

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

> **⚠ WARNING**
> **To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Open drain cocks on air tanks to drain air pressure from the tanks. Close air tank drain cocks when air has exhausted from the air tanks.

4. Remove hydraulic oil tank remote drain plug and drain hydraulic oil into a suitable container. Re-install drain plug in hydraulic tank remote drain fitting.

5. Tag all air and hydraulic lines between front and rear frames to aid in 'Installation. Disconnect all air and hydraulic lines. Cap line fittings and plug lines to prevent ingress of dirt.

6. Disconnect electrical wiring and any other attachments that would be damaged on separation of front and rear frames.

7. Position levelling jack under centre front portion of the front frame. Raise the jack and block the front frame, front and rear, so it will remain level after separation. Check that both front wheels are still securely blocked.

Note: Make sure that the front frame is correctly supported and prevented from tilting on the axle or damage to coupling etc. could result.

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Note: Take extra care when handling drivelines as chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation.

8. Remove bolts (1, Fig. 3), lockwashers (2, Fig. 3), nuts (3, Fig. 3) and protective guard (4, Fig. 3), if fitted, from beneath rear of pivot housing.

⚠ WARNING
Tensioned spring on adjuster.

9. Slacken adjuster (14, Fig. 3) until brake pads (13, Fig. 3) are sufficiently clear of parking brake disc (5, Fig. 3) to permit removal of calliper (7, Fig. 3).

10. Note positions of front and rear wedge plates (8 & 9, Fig. 3) to aid in 'Installation'. Remove bolts (6, Fig. 3), washers (11, Fig. 3), nuts (12, Fig. 3), front and rear wedge plates (8 & 9, Fig. 3) and left hand torque plate (10, Fig. 3).

11. Move and secure calliper (7, Fig. 3) clear of parking brake disc (5, Fig. 3).

Note: Take extra care when handling drivelines since any deformity on a rotating mass creates vibration and excessive wear during any operation.

12. Match mark brake yoke (16) and mating surface of pivot - centre axle driveline (Fig. 2) to aid in 'Installation'. Remove bolts, lockwashers and caps and remove driveline from the machine.

13. Mark disc (5, Fig. 3) assembly to aid in 'Installation' then remove bolts (15, Fig. 3) washers (16, Fig. 3) and disc (5, Fig. 3).

14. Remove bolts (36), lockwashers (14) and lockplate (35).

15. Using special tool, which can be fabricated as shown in Fig. 11, remove thrust nut (34) from pivot (1). Note position of rear 'V' ring (41) to aid in 'Installation'. Remove and discard 'V' ring (41).

16. Attach suitable lifting equipment to the front of the rear frame and take up slack.

17. Remove all blocking from rear frame and wheels and using suitable lifting equipment draw the rear frame from pivot (1) assembly. When clear, block the rear frame and wheels.

Note: Use care when separating rear frame and pivot assembly to avoid damage to end threads.

18. Replace thrust nut (34) on pivot (1) to protect threads.

19. Note position of front 'V' ring (41) to aid in 'Installation'. Remove and discard 'V' ring (41).

20. Inspect oscillation bushes (43) as described in 'Inspection'. If bushes are to be renewed, proceed with Step 21.

21. Remove oscillation bush/es (43) with hammer and chisel.

Note: The suggested method is to make an axial cut along the bush then to lever the bush in order to collapse it upon itself.

Inspection

Numbers in parentheses refer to Fig. 1.

1. Clean oscillation bushes (43) with a suitable solvent and allow to dry.

2. Inspect oscillation bushes (43) for wear, scoring, erosion and 'out of round'. Pay particular attention to the thrust faces of the bushes which should also be inspected for cracking/splitting. Renew if required.

Installation

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: Tighten all fasteners without special torques specified, to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.

1. Wipe bush housing clean using suitable solvent and allow to dry.

2. Apply LOCQUIC primer to housing and allow to dry for 10 minutes. Apply LOCTITE RC-35 to housing.

3. Align new bushes to housing with grease holes aligned vertically and identification 'PAINT DOT' at Top Dead

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Centre. Refer to Fig. 9. Drift bushes into housing using hammer with soft packing for protection.

4. Using special tool, which can be fabricated as shown in Fig. 11, remove thrust nut (34) from pivot (1). Clean grease from pivot exterior using a suitable solvent where necessary and allow to dry.

Note: Use care on inserting the pivot housing assembly or damage to the thread could occur.

5. Install new pre-greased front 'V' ring (41). Refer to Fig. 10. Apply liberal coat of grease to external surface of pivot (1) and mating faces of bushes (43).

6. Attach suitable lifting equipment to the front of the rear frame and take up slack.

7. Remove all blocking from rear frame and wheels and use lifting equipment to line-up and draw the rear frame onto pivot (1) assembly.

8. Install new pre-greased rear 'V' ring (41). Refer to Fig. 10. Using special tool, as shown in Fig. 11, install and tighten thrust nut (34) until there is no end float/ clearance at thrust face of either bush (43). Slacken thrust nut (34) until pin of lockplate (35) can be inserted in first available hole in thrust nut (34).

9. Secure lockplate (35) with bolts (36) and lockwashers (14). Torque tighten bolts (36) to 75 Nm (55 lbf ft).

10. Grease oscillation bushes (43) through lube fittings (59) until excess lubrication is seen.

11. Check that no end float exists at oscillation bushes by pushing and pulling on brake yoke assembly.

12. Position brake disc (5, Fig. 3) onto brake yoke (16) as noted at 'Removal'. Secure in place with bolts (15, Fig. 3) and washers (16, Fig. 3).

Note: Take extra care when handling drivelines as

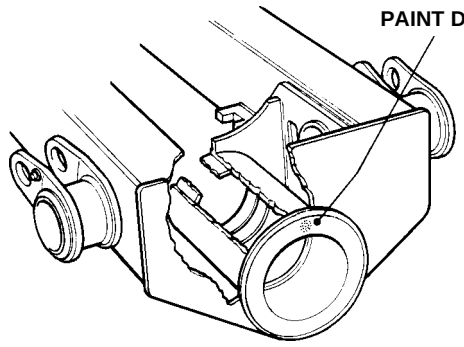


Fig. 9 - Installing Oscillation Bushes

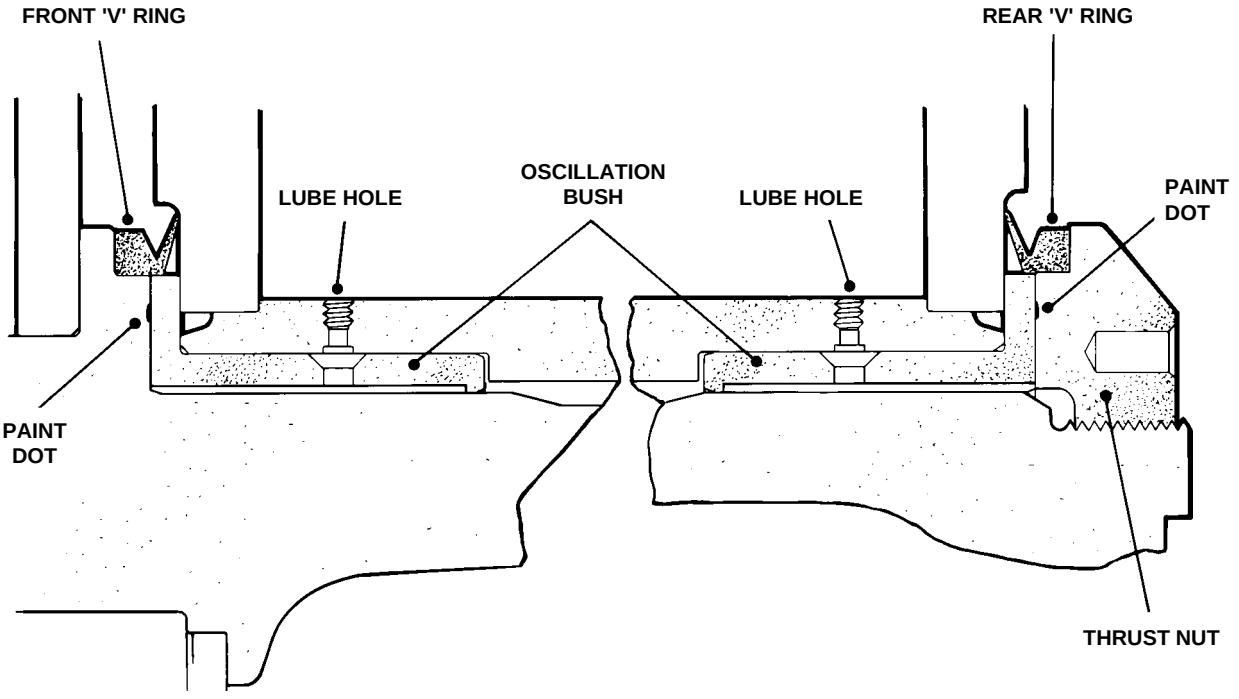


Fig. 10 - Pivot Housing 'V' Ring Installation

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chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation.

13. Connect pivot - centre axle driveline (Fig. 2) at brake yoke using bolts, lockwashers and caps as noted at 'Removal'.

14. Position parking brake calliper (7, Fig. 3) in position and install left hand torque plate (10, Fig. 3), front and rear wedge plates (8 & 9, Fig. 3) and secure in place with bolts (6, Fig. 3), washers (11, Fig. 3) and locknuts (12, Fig. 3).

15. Position guard (4, Fig. 3), if fitted, and secure to frame using bolts (1, Fig. 3), lockwashers (2, Fig. 3) and nuts (3, Fig. 3).

16. Remove all protective plugs and connect all air and hydraulic lines and other attachments disconnected in preparation for separation of front and rear frames.

17. Fill hydraulic oil tank with hydraulic oil, as specified in Section 300-0020, LUBRICATION SYSTEM.

18. Place the battery master switch in the on position, start the engine and allow air pressure in the tanks to build up to correct operating pressure. Check air and hydraulic lines for leaks. Tighten line fittings as required.

19. Adjust parking brake as shown in Section 170-0010, PARKING BRAKE AND MOUNTING.

20. Remove all blocking from the road wheels.

THRUST NUT ADJUSTMENT

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Open drain cocks on air tanks to drain air pressure from the tanks. Close air tank drain cocks when air has exhausted from the air tanks.

4. Position levelling jack under centre front portion of the front frame and raise the jack to ensure both frames are parallel.

5. Remove bolts and lockwashers securing lockplate at the thrust nut and remove the lockplate.

6. Using special tool, which can be manufactured as shown in Fig. 11, tighten thrust nut until there is no end float/clearance at thrust face of either bush. Slacken thrust nut until pin of the lockplate can be inserted in the first available hole in the thrust nut.

7. Secure lockplate with bolts and lockwashers. Torque tighten bolts to 75 Nm (55 lbf ft).

8. Lower jack and remove all blocking from the front wheels.

MAINTENANCE

The end float/clearance at the thrust face of the oscillation bushes should be checked every 250 hours. Any clearance found must be removed by adjustment of the thrust nut, as described under 'Thrust Nut Adjustment'.

Note: A practical method of establishing the effective adjustment of the thrust nut is to use movement of the machines body in the raised position. Move the body from fully raised to almost fully raised while watching the effect of this action on the frame and pivot arrangement. Any slackness between the thrust nut and thrust faces will be clearly visible movement of the frame.

Very little other maintenance of the articulation and oscillation pivot is required other than to stress the importance of correct lubrication of the assembly.

Lubricate the oscillation bushes, articulation bearings/ pins and the pivot driveshaft bearings in accordance with Section 300-0020, LUBRICATION SYSTEM but note the following precautions:-

Note: The oscillation bushes are lubricated every 10 to 15 hours.

Note: DO NOT exceed the lubrication schedule for the pivot driveshaft bearings i.e. 4 shots of a hand grease gun every 250 hours.

SPECIAL TOOL

The special tool required for removal and installation of the thrust nut, can be manufactured, as shown in Fig. 11.

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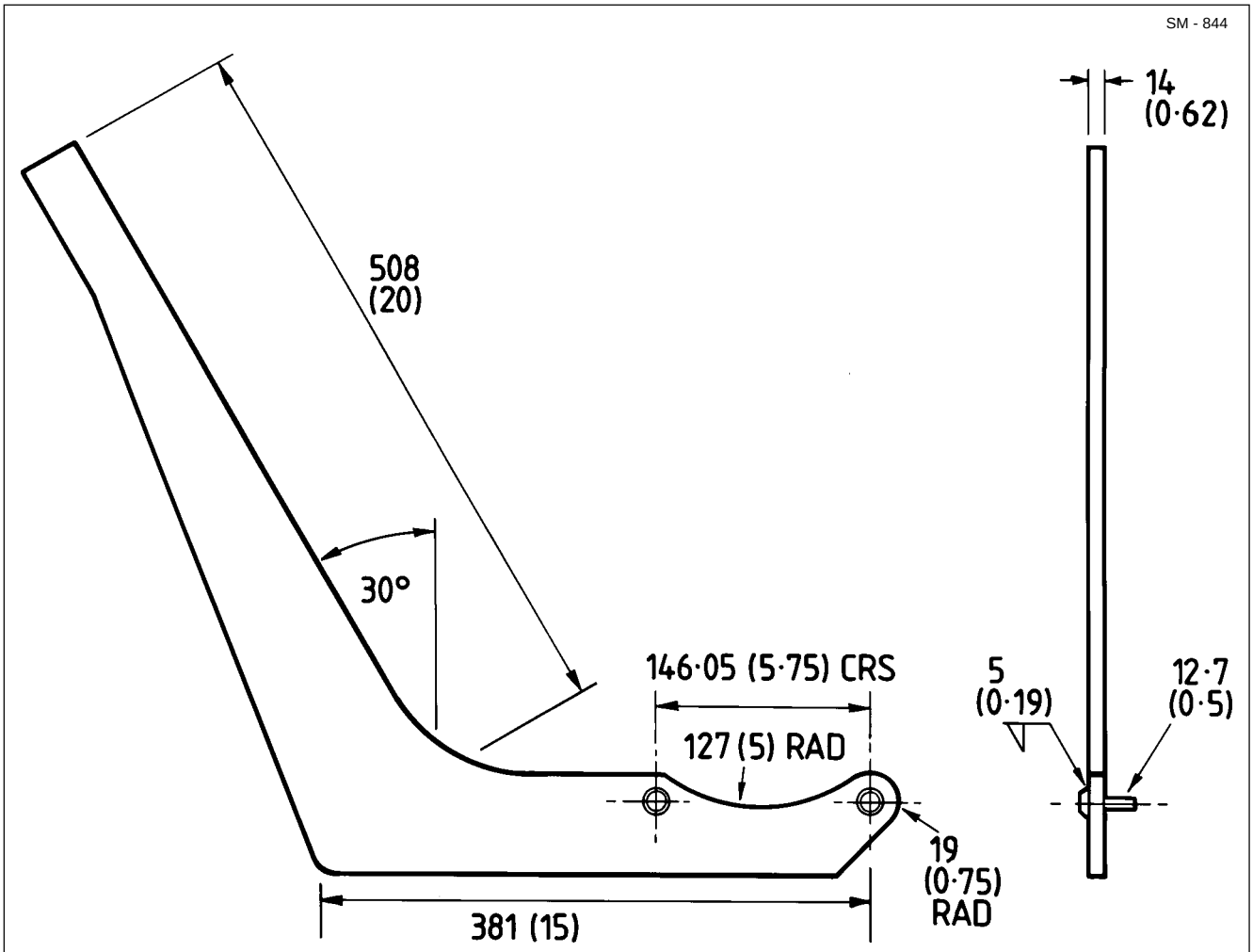


Fig. 11 - Fabrication Details of Thrust Nut Removal and Installation Tool

SPECIAL TORQUE SPECIFICATIONS

			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	13	Bolt	106	78
1	20	Bolt	106	78
1	25	Nut	678	500
1	33	Bolt	106	78
1	36	Bolt	75	55
1	51	Nut	1 425	1 050

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ARTICULATION AND OSCILLATION PIVOT DIAGNOSIS

Noise and vibration caused by the pivot driveshaft assembly appear only at certain speeds and generally come and go as these speeds are approached and passed. When the driveshaft assembly noise becomes excessive, it takes the form of a vibration which can be felt throughout the frame.

Noise from the articulation and oscillation points must be investigated.

An 'Articulation and Oscillation Pivot Diagnosis' table is shown below.

ARTICULATION AND OSCILLATION PIVOT DIAGNOSIS

CONDITION	REASON	REMEDY
Noise (Pivot Driveshaft)	Insufficient lubricant	Check seals.
		Install proper grade of lubricant.
	Out of balance driveshaft assembly	Check alignment.
Vibration (Pivot Driveshaft)	Backlash due to worn bearings, housings, yokes and trunnions	Renew worn parts.
	Yoke not in line	Renew driveshaft assembly or assemble correctly.
	Driveshaft out of balance	Renew driveshaft assembly.
Noise (Articulation/Oscillation Points)	Excessive run out or distorted yokes	Dismantle and correct, or renew, damaged part.
	Loose nut on yoke	Check splines, if worn. Renew shaft. Torque tighten nut to value in 'Special Torque Specifications' in this section.
	Insufficient lubricant	Lubricate. Investigate/revise lubrication schedules. Refer to Section 300-0020, LUBRICATION SYSTEM. Check seals for lubricant loss/contamination. Renew as necessary.
	Worn bearings/bushes	Inspect/renew as necessary.

* * * *

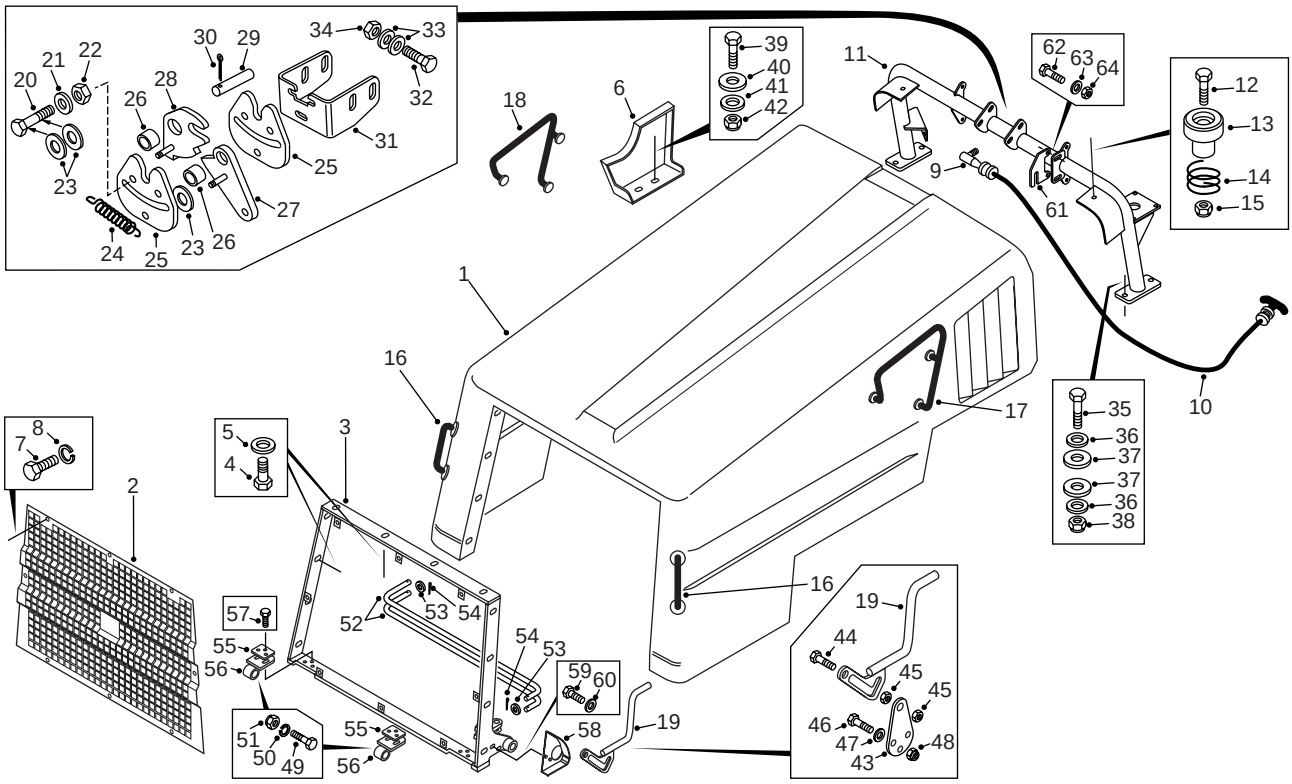
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1 - Hood	17 - Handle - LH	33 - Washer	49 - Bolt
2 - Grille	18 - Handle - RH	34 - Locknut	50 - Lockwasher
3 - Grille Subframe	19 - Hood Prop	35 - Bolt	51 - Locknut
4 - Bolt	20 - Bolt	36 - Hardened Washer	52 - Torsion Bar
5 - Washer	21 - Washer	37 - Washer	53 - Washer
6 - Blanking Cover	22 - Locknut	38 - Locknut	54 - Split Pin
7 - Bolt	23 - Washer	39 - Bolt	55 - Plate
8 - Lockwasher	24 - Spring	40 - Washer	56 - Hinge
9 - Ball Joint	25 - Plate	41 - Hardened Washer	57 - Bolt
10 - Cable Assembly	26 - Spacer	42 - Locknut	58 - Bracket
11 - Goalpost Support Assembly	27 - Cam Plate	43 - Plate	59 - Bolt
12 - Bolt	28 - Cam Plate	44 - Bolt	60 - Washer
13 - Hood Stop	29 - Cotter Pin	45 - Locknut	61 - Plate
14 - Spring	30 - Split Pin	46 - Bolt	62 - Bolt
15 - Locknut	31 - Bracket	47 - Washer	63 - Washer
16 - Handle - Front	32 - Bolt	48 - Locknut	64 - Locknut

Fig 1 - Hood and Mounting

HOOD

Removal

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the machine on a level surface, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Remove bolts (7) and lockwashers (8) securing grille (2) to grille subframe (3). Secure grille (2) clear of hood (1).

4. Pull cable assembly (10), handle inside cab, to release hood catch and lift up hood (1). Secure hood (1) in raised position using suitable lifting equipment.

5. Carefully remove split pins (54) and slide washers (53) from torsion bars (52). Remove torsion bars (52) from mounting brackets.

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Note: Exercise caution as torsion bars (52) may spring when released from mounting brackets.

6. Remove bolts (49), lockwashers (50) and locknuts (51) securing hinges (56) to frame and lift hood (1) assembly from the machine.

7. If required, remove bolts (4) and lockwashers (5) securing grille subframe (3) to hood (1). Secure grille subframe (3) clear of hood (1).

8. If required, remove mounting hardware securing handles (16, 17 & 18) to hood (1). Secure handles (16, 17 & 18) clear of hood (1).

Installation

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
To prevent personal injury and property damage, be sure blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. If removed, secure handles (16, 17 & 18) to hood (1) using mounting hardware as removed at 'Removal'.

2. If removed, secure grille subframe (3) to hood (1) with bolts (4) and lockwashers (5).

3. Using suitable lifting equipment, lift and position hood (1) on the machine and align holes in hinges (56) with mounting holes on frame. Secure hood (1) using bolts (49), lockwashers (50) and locknuts (51).

4. Carefully install torsion bars (52) to mounting brackets and secure in place with washers (53) and split pins (54).

Note: Exercise caution as torsion bars (52) may spring from mounting brackets.

5. Remove lifting equipment and lower hood (1) to match with goalpost support assembly (11).

6. Install grille (2) to hood (1) and secure using bolts (7) and lockwashers (8).

7. Remove wheel blocks.

GOALPOST SUPPORT ASSEMBLY

Removal

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the machine on a level surface, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the off position.

3. Pull cable assembly (10), handle inside cab, to release hood catch and lift up hood (1).

4. Remove mounting hardware securing purge tank to mounting bracket on the right hand side of goalpost support (11) assembly. Secure purge tank clear of goalpost support (11) assembly.

5. Remove mounting hardware securing brake reservoir to mounting bracket on the left hand side of goalpost support (11) assembly. Secure brake reservoir clear of goalpost support (11) assembly.

6. With a suitable container available to catch leakage, remove drain plug from radiator header tank and drain coolant. Apply Loctite 225 to drain plug and reinstall in header tank.

7. Ensure all cooling lines connected to header tank are identified for ease of installation and with suitable containers available to catch leakage, disconnect cooling lines. Fit blanking caps to all open lines.

8. Note routing of all hoses and harnesses attached to goalpost support (11) assembly and disconnect.

9. Disconnect ball joint (9) from cam assembly (27) and secure cable clear of lock mechanism.

10. Check to make certain that all necessary line and cable disconnections have been made, before lifting goalpost support (11) assembly.

11. Attach suitable lifting equipment to goalpost support (11) assembly. Remove bolts (35), hardened washers (36), washers (37) and locknuts (38) securing

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goalpost support (11) assembly to its mounting. Lift goalpost support (11) assembly from the machine.

12. If required, remove locknuts (15), bolts (12), hood stops (13) and springs (14) from goalpost support (11) assembly.

13. If required, remove mounting hardware securing blanking cover (6) to right hand fender. Remove blanking cover (6) from the machine.

Installation

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

WARNING
To prevent personal injury and property damage, be sure blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. If removed, secure blanking cover (6) to right hand fender with mounting hardware as removed at 'Removal'.

2. If removed, secure hood stops (13) and springs (14) to goalpost support (11) assembly with bolts (12) and locknuts (15).

3. Using suitable lifting equipment, lift and position goalpost support (11) assembly on the machine. Secure goalpost support (11) assembly to its mounting with bolts (35), hardened washers (36), washers (37) and locknuts (38).

4. Remove lifting equipment.

5. Connect ball joint (9) to cam assembly (27) and secure cable assembly using clips removed during 'Removal'.

6. Install purge tank to mounting bracket on the right hand side of goalpost support (11) assembly and secure using mounting hardware as removed during 'Removal'.

7. Install brake reservoir to mounting bracket on the left hand side of goalpost support (11) assembly and secure using mounting hardware as removed during 'Removal'.

8. Remove blanking caps from all cooling lines and connect cooling lines to radiator header tank as tagged at 'Removal'.

9. Secure all hoses and harnesses to goalpost support (11) assembly following routing as noted at 'Removal'.

10. Fill radiator header tank with coolant as specified in Section 210-0000, COOLING SYSTEM.

11. Lubricate hood catch mechanism. Use grease as specified in Section 300-0020, LUBRICATION SYSTEM.

12. Lower hood assembly and check for correct alignment between hood (1) and goalpost support (11) assembly and for operation of hood catch mechanism.

13. Remove wheel blocks.

MAINTENANCE

Periodically check bolts (49), lockwashers (50) and locknuts (51) and tighten when necessary.

Periodically check condition of lock mechanism and adjust and lubricate when necessary.

SPECIAL TOOLS

There are no special tools required for procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools and adhesives required. These tools and adhesives are available from your dealer.

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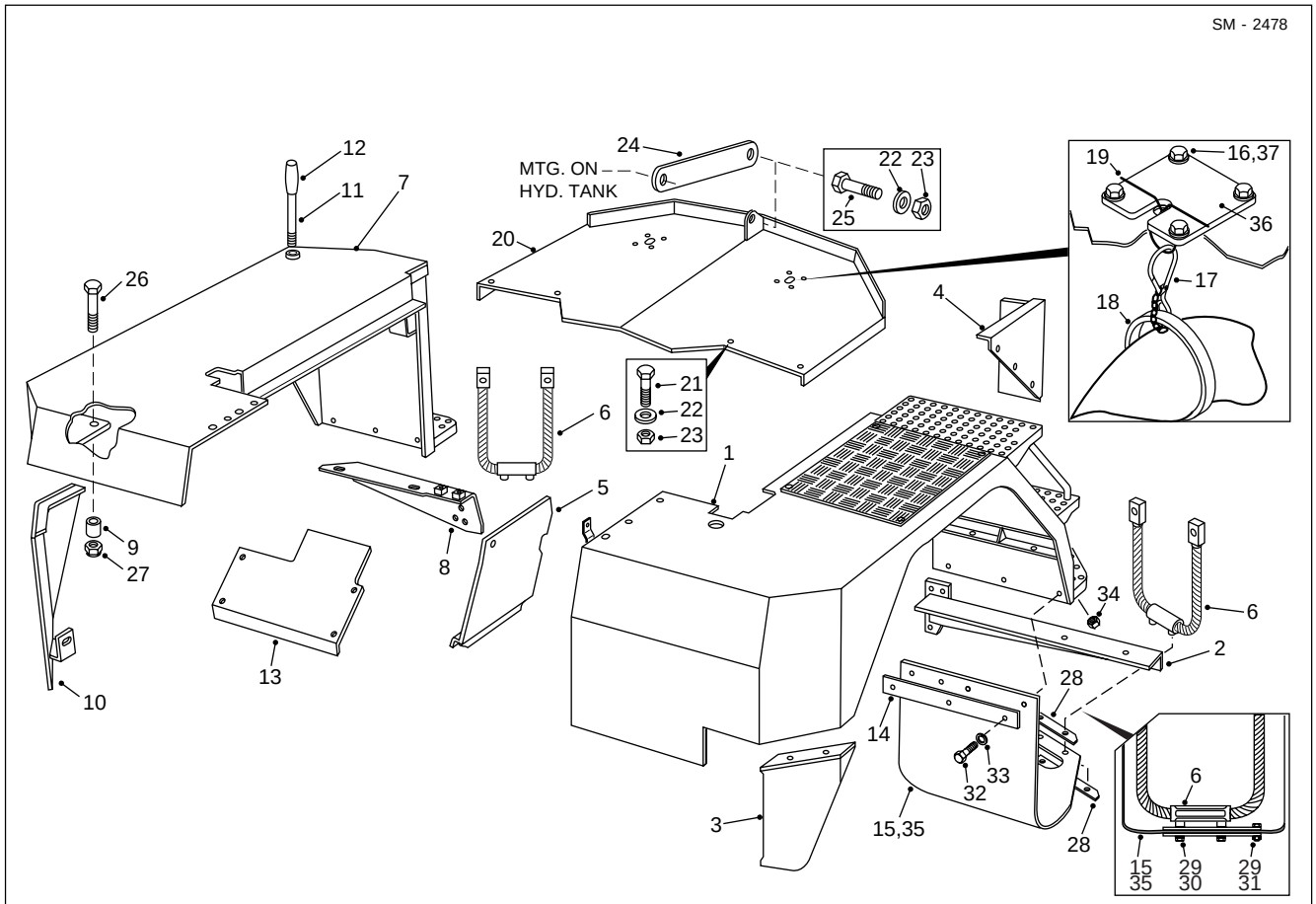
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1 - LH Fender
2 - Support Bracket
3 - Contour Plate
4 - Side Panel
5 - Cover Plate
6 - Step Assembly
7 - RH Fender
8 - Support
9 - Spacer
10 - Counter Plate
11 - Grab Handle
12 - Grip
13 - Cover Plate
14 - Plate
15 - Mudflap - LH
16 - Bolt
17 - Chain Assembly
18 - Strap
19 - Wire Tensioner
20 - Spillguard
21 - Bolt
22 - Washer
23 - Locknut
24 - Support Plate
25 - Bolt
26 - Bolt
27 - Nut
28 - Stiffener
29 - Bolt
30 - Lockwasher
31 - Nut
32 - Bolt
33 - Lockwasher
34 - Nut
35 - Mudflap - RH
36 - Plate
37 - Lockwasher

Fig. 1 - Fenders and Mounting

REMOVAL/INSTALLATION

⚠ WARNING
To prevent personal injury and property damage, be sure blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

The fenders and associated parts are secured by normal hardware. Before loosening any fasteners, secure the items with suitable lifting equipment. Care should be exercised at all times to ensure no damage to equipment or personnel.

MAINTENANCE

Periodically check mounting bolts and nuts and tighten when necessary.

A check of the condition of the paint should be made approximately twice a year. If painting is required, thoroughly clean the areas to be painted. Apply a primer coat of red oxide and then a finish coat of polyurethane enamel.

To keep rust and corrosion to a minimum, periodic painting of abrasions and other exposed metal areas is highly recommended.

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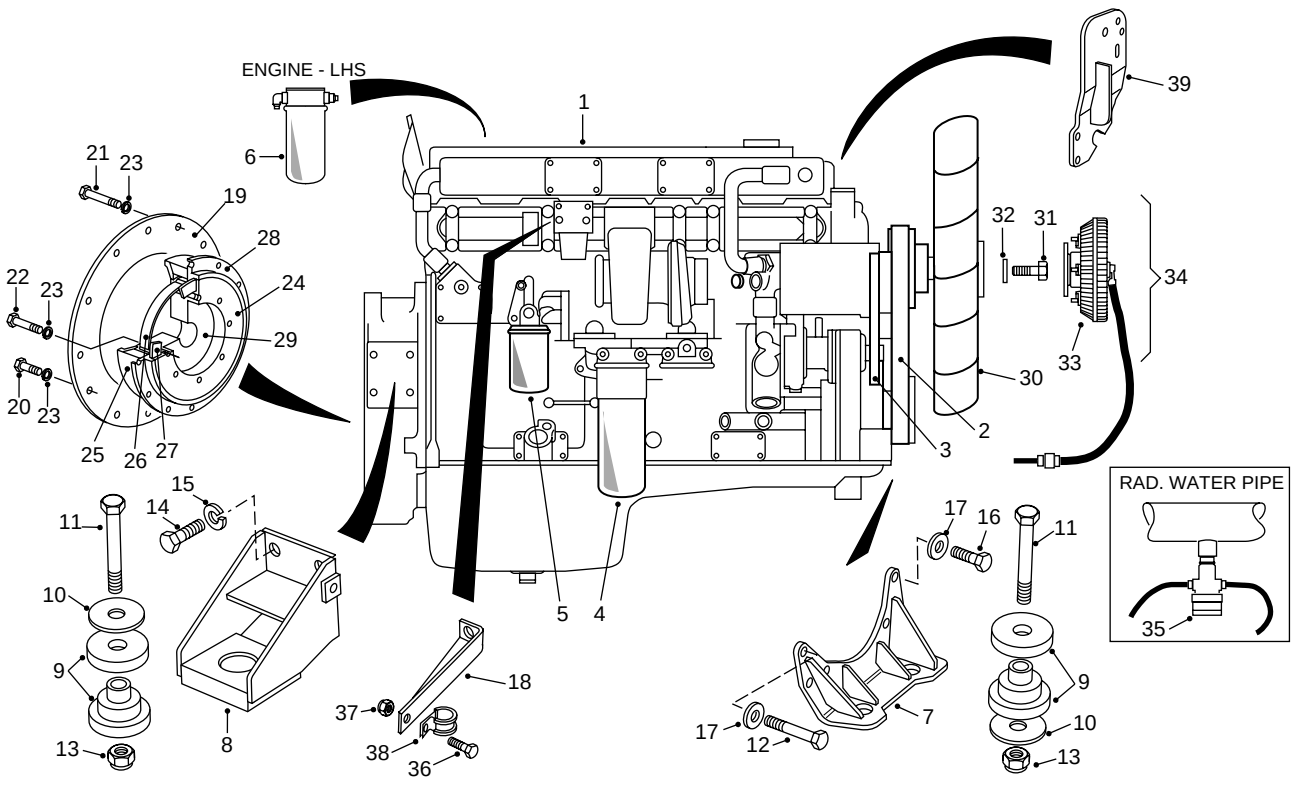
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1 - Engine
2 - Fan Belt
3 - Alternator Belt
4 - Lube Oil Filter
5 - Coolant Filter
6 - Fuel Filter
7 - Front Mounting Bracket
8 - Rear Mounting Bracket
9 - Rubber Mount
10 - Snubbing Washer
11 - Bolt
12 - Bolt
13 - Locknut
14 - Bolt
15 - Lockwasher
16 - Bolt
17 - Lockwasher
18 - Bracket
19 - Cover
20 - Bolt
21 - Bolt
22 - Bolt
23 - Lockwasher
24 - Plate Friction
25 - Flexible Element
26 - Radial Bearing
27 - Axial Bearing
28 - Flange
29 - Hub Flanged
30 - Fan
31 - Bolt
32 - Washer
33 - Drive Clutch Fan
34 - Hose
35 - Valve Sensor
36 - Bolt
37 - Locknut
38 - P-Clip
39 - Radiator Support Bracket

Fig. 1 - Engine and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

For engine make, model and specification, refer to Section 000-0000, GENERAL INFORMATION. For engine servicing and repair data refer to the engine manufacturers service manual.

The engine is supported by front mounting bracket (7) and two rear mounting brackets (8) which are bolted to the engine and attached to the tractor frame through rubber mounts (9). Rubber mounts (9) provide sufficient flexibility to absorb varying engine vibration and torsional loads.

Lube oil filter (4) and coolant filter (5) are mounted on the right hand side of engine (1) and fuel filter (6) is mounted on the left hand side.

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REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ High electrical current. Disconnect battery ground cable at battery before removing engine attachments. High electrical current can cause sparks and personal injury from burns.

Note: Tag all lines, cables and linkages disconnected during removal to aid in installation.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position. Disconnect battery cables from terminal posts (ground cable first).

3. Pull on handle to release hood catch and lift up the hood.

4. Remove engine hood assembly and goalpost support assembly. Refer to Section 110-0030, HOOD AND MOUNTING.

5. Place a suitable container under the engine drain port, remove drain plug and drain oil. After draining, reinstall drain plug and tighten securely.

Note: If anti-spill drain plug is fitted, remove cap from connection, install drain tube connection and drain oil into a suitable container.

⚠ WARNING
Air Conditioners contain harmful gas. Refrigerant will rapidly freeze all objects with which it comes into contact. It can cause serious damage to the eyes and skin. Refer to Section 260-0130, AIR CONDITIONING before disconnecting any air conditioner lines.

6. Evacuate the air conditioning system and disconnect the lines at the compressor. Refer to Section 260-0130, AIR CONDITIONING.

7. With suitable containers in position, open drain cocks and drain coolant from the radiator and engine. Close all drain cocks securely after draining.

8. Identify cooling and heater lines for ease of installation and, with suitable containers in position to catch spillage, disconnect lines from engine (1) and remove the radiator assembly. Refer to Section 210-0040, RADIATOR AND MOUNTING.

9. Disconnect exhaust piping from the engine turbocharger at the silencer.

10. Disconnect compressor air outlet tube and secure clear of engine.

11. Disconnect accelerator cable at engine (1).

12. Identify and disconnect cables at starter motor and alternator.

13. Identify and disconnect electrical cables from the oil pressure sender switch, engine temperature switch, fuel shut off solenoid and proximity switches on engine (1).

14. Identify fuel lines for ease of installation and, with a suitable container in position, disconnect fuel lines from engine (1). Cap open line ends and fittings to prevent entry of dirt.

15. Disconnect clips securing items to the engine that cannot be removed with the engine.

16. Disconnect driveline between transmission and engine (1) and secure clear of the engine. Refer to Section 130-0010, FRONT & REAR DRIVELINES.

⚠ WARNING
Heavy assembly. To prevent personal injury and property damage, be sure lifting device is properly secured and of adequate capacity to do the job safely.

17. Attach suitable lifting equipment to lifting brackets on engine (1) and raise lifting equipment to take up the slack.

18. Remove locknuts (13), snubbing washers (10) and bolts (11) securing front and rear mounting brackets (7 & 8) to the rubber mounts/support brackets and rubber mounts/crossmember.

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19. Check to make certain that all necessary line and cable disconnections have been made, before lifting engine (1).

20. Carefully lift engine (1) up and forwards clear of the frame and remove to a suitable work area. Mount engine (1) securely on a work stand.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Remove bolts (12 & 16) and lockwashers (17) securing front mounting bracket (7) to engine (1). Remove front mounting bracket (7).

2. Remove bolts (14) and lockwashers (15) securing rear mounting brackets (8) to engine (1). Remove rear mounting brackets (8).

3. Remove air cleaner tubes and piping from turbocharger.

4. Remove exhaust piping from turbocharger.

5. If fitted, remove mounting hardware securing drive clutch fan (33) to fan (30). Remove drive clutch fan (33). Remove bolts (31) and washers (32) securing fan (30) on engine (1). Remove fan (30).

6. Remove bolts (20 & 21) and lockwashers (23) securing cover (19) to flywheel housing. Remove cover (19).

7. Remove bolts (22) and lockwashers (23) securing engine coupling (24 thru 29) to flywheel. Remove engine coupling (24 thru 29).

8. Remove mounting hardware securing radiator support bracket (39) to engine (1). Remove radiator support bracket (39).

9. Remove and discard lube oil filter (4), coolant filter (5) and fuel filter (6) from engine (1), as described under 'Maintenance'. Cover engine ports to prevent entry of dirt.

10. Refer to engine manufacturers SERVICE MANUAL if engine service or repair is required.

INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Inspect rubber mounts (9) for damage and replace if required.

2. Check mounting brackets (7 & 8), engine support brackets and crossmember on the frame for cracks and damage. Repair or replace as necessary.

3. Inspect engine coupling (24 thru 29) for damage and repair or replace if required.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Remove covers from engine ports and install new lube oil filter (4), coolant filter (5) and fuel filter (6) on engine (1), as described under 'Maintenance'.

2. Install front mounting bracket (7) on engine (1) and secure with bolts (12 & 16) and lockwashers (17). Tighten bolts (12) to a torque of 60 Nm (44 lbf ft). Tighten bolts (16) to a torque of 45 Nm (33 lbf ft).

3. Install both rear mounting brackets (8) on engine (1) and secure with bolts (14) and lockwashers (15). Tighten bolts (14) to a torque of 190 Nm (140 lbf ft).

4. Install air cleaner tubes and piping and connect to turbocharger.

5. Install exhaust piping and connect to turbocharger.

6. Install radiator support bracket (39) to engine (1) and secure using mounting hardware as removed at Disassembly.

7. Install engine coupling (24 thru 29) on engine flywheel and secure with bolts (22) and lockwashers (23). Tighten bolts (22) to a torque of 31 Nm (23 lbf ft).

8. Install cover (19) on engine flywheel housing and secure with bolts (20 & 21) and lockwashers (23). Tighten bolts (20 & 21) to a torque of 31 Nm (23 lbf ft).

9. Install fan (30) on engine and secure with bolts (31) and washers (32). Tighten bolts (31) to a torque of 31 Nm (23 lbf ft). If applicable, install drive clutch fan (33) to fan (30) using hardware removed during disassembly.

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INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners without special torques specified to standard torques listed in section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
Heavy assembly. To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Lubricate rubber mounts (9) with water or a suitable rubber lubricant. Insert rubber mounts (9) into the frame crossmember from above and support brackets from below. Use a driver of the same diameter as the internal metal sleeve in rubber mount (9) to drive the mounts fully home. Install opposite half of rubber mounts (9) over protruding diameter of rubber mounts previously installed.

2. Attach suitable lifting equipment to engine (1) lifting brackets and carefully position engine (1) in the frame.

3. Install bolts (11) through front mounting bracket (7), rubber mounts (9) and the frame crossmember. Install snubbing washers (10) and locknuts (13) on bolts (11). Tighten locknuts (13) to a torque of 298 Nm (220 lbf ft).

4. Install a snubbing washer (10) onto each rear mounting bolt (11) and install bolts through rear mounting brackets (8), rubber mounts (9) and frame support brackets. Install locknuts (13) on bolts (11) and tighten locknuts (13) to a torque of 298 Nm (220 lbf ft).

5. Connect driveline between transmission and engine and secure with mounting hardware removed during removal. Refer to Section 130-0010, FRONT & REAR DRIVELINES.

6. Remove blanking caps and connect fuel lines to engine (1) ports, as identified at removal.

7. Connect electrical cables to the alternator and starter motor, as identified at removal.

8. Connect cables to the oil pressure sender switch, engine temperature switch, fuel shut off solenoid and proximity switches on engine (1), as identified at removal.

9. Connect accelerator cable to engine (1).

10. Connect compressor air outlet tube to engine (1).

11. Connect air conditioning lines at the compressor as identified at removal. On completion of engine (1) installation, the air conditioning system will require to be charged. Refer to Section 260-0130, AIR CONDITIONING.

12. Connect exhaust piping to the turbocharger at the silencer.

13. Install radiator assembly on the tractor frame and connect cooling and heater lines to radiator assembly and engine (1). Refer to Section 210-0040, RADIATOR AND MOUNTING.

14. Secure any clips to the engine which were removed to facilitate engine removal.

15. Connect air tube to the air cleaner and secure with mounting hardware removed during removal.

16. Connect cables to battery terminal posts (ground cable last).

17. Ensure all lines, harnesses and cables are secured with clips and clamps as removed during removal. Ensure no lines are chaffing on sharp edges or resting against areas where heat will be evident.

18. Ensure all coolant drain cocks on engine (1) and the radiator assembly are securely closed and shut off cock at coolant filter (5) housing is open. Fill the cooling system with coolant specified in Section 300-0020, LUBRICATION SYSTEM. Check the coolant level as described in Section 210-0000, COOLING SYSTEM.

19. Fill engine (1) with lube oil specified in Section 300-0020, LUBRICATION SYSTEM. Check oil level as described under 'Maintenance'.

20. Place the battery master switch in the 'On' position, start the engine and bring the engine oil to operating temperature. Check all lines and fittings for leaks and tighten as required.

21. Using suitable lifting equipment, install hood assembly and goalpost support assembly on the vehicle. Refer to Section 110-0030, HOOD AND MOUNTING.

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22. Ensure parking brake is applied, disconnect steering lock bar and secure in the 'Stowed' position. Remove wheel blocks from all road wheels.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

Note: Carry out the following maintenance procedures in conjunction with additional procedures listed in Section 300-0020, LUBRICATION SYSTEM.

WARNING
Do not use the rocker cover as a step. The material is plastic and will not withstand weight of any consequence.

Every 10 Hours (Daily)

General - Visually check the engine for leaks, loose or damaged parts, worn or damaged belts or any change in engine appearance. Listen for any unusual engine noise which can indicate that a service is required.

Oil Level Check - Position the vehicle on a level work area, apply the parking brake, shut off the engine and wait at least five minutes (to allow oil to drain to the oil pan) before checking the oil level. The oil level should be between the low (L) and high (H) marks on the dipstick. Add oil if low. Refer to Section 300-0020, LUBRICATION SYSTEM for oil specification.

Note: Never operate the engine with oil level below the low (L) or above the high (H) mark on the dipstick.

Fuel Filter/Water Separator (6) - Drain the water and sediment from the separator daily. Position the vehicle on a level work area, apply the parking brake, shut off the engine and, with a suitable container below the drain valve to catch spillage, open the drain valve by hand. Turn the valve anticlockwise approximately 1.5 - 2 turns until draining occurs. Drain the filter sump until clear fuel is visible. Turn the valve clockwise to close the drain valve.

Note: Do not overtighten the drain valve as overtightening can damage the threads.

Cooling Fan (30) - Visually inspect the fan for cracks, loose rivets, and bent or loose blades. Check the fan to make sure that mounting bolts (31) are secure. Tighten bolts as required. Replace any fan that is damaged.

WARNING
Personal injury can result from a fan blade failure. Never pull or pry on the fan as this can damage the blades and lead to fan failure.

Drive Belts - Visually inspect all drive belts daily. Replace belts that are cracked or frayed and adjust belts that have a glazed or shiny surface which indicates belt slippage. Correctly installed and tensioned belts will show even pulley and belt wear.

Every 250 Hours

Fuel Filter (6) - Clean the area around the fuel filter head and replace the fuel filter.

Position the vehicle on a level work area, apply the parking brake and switch off the engine. Using a strap type filter wrench, remove fuel filter (6) and discard the thread adaptor sealing ring. Clean the gasket surface of the filter head.

Install the new thread adaptor sealing ring (supplied with new filter) and apply a film of clean engine oil to lubricate the filter seal. Fill the new filter with clean fuel specified in Section 300-0020, LUBRICATION SYSTEM.

Install new fuel filter (6) on the filter head and tighten by hand until the gasket contacts the filter head surface. Tighten fuel filter (6) per filter manufacturer's instructions.

Note: Mechanical tightening of the filter is not recommended and may result in seal and/or cartridge damage. Tighten filter by hand only.

Engine Oil and Lube Oil Filter (4) - Replace the lubricating oil and oil filters.

WARNING
Avoid direct contact of hot oil with your skin. Hot oil can cause serious personal injury.

Operate the engine until the water temperature reaches 60° C (140° F). Position the vehicle on a level work area, apply the parking brake and switch off the engine. Position a suitable container under the engine oil drain plug and drain the oil immediately to make sure all the oil and suspended contaminants are removed from the engine.

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Clean the area around the lube oil filter head and, using strap type filter wrench, remove lube oil filter (4). Discard lube oil filter (4) if it is not required for a failure analysis. Clean the gasket sealing surface of the filter head.

Note: The 'O' ring can stick on the filter head. Make sure the 'O' ring is removed and discarded.

Note: Fill the filter with clean lubricating oil prior to installation. The lack of lubrication during the delay until the filter is pumped full of oil is harmful to the engine.

Apply a light film of clean lubricating oil to the gasket surface of the new filter and install the filter on the filter head as specified by the filter manufacturer. The tightening instructions are normally printed on the outside of the filter.

Note: Mechanical tightening of the filter is not recommended and may result in seal and/or cartridge damage. Tighten filter by hand only.

Check and clean the engine oil drain plug threads and the seal surface. Install and tighten the drain plug to a torque of 90 Nm (65 lbf ft). Fill the engine with clean lubricating oil specified in Section 300-0020, LUBRICATION SYSTEM. The oil level should be between the low (L) and high (H) marks on the dipstick.

Note: Before starting the engine, follow the steps below to make sure the engine receives correct lubrication. Lack of lubrication will damage the engine.

a. Disconnect the electrical wire from the fuel pump solenoid valve.

b. Switch on the ignition and rotate the crankshaft using the starter motor, until oil pressure appears on the pressure gauge or the warning light goes out.

c. Connect the electrical wire to the fuel pump solenoid valve.

Start the engine and operate at idle speed to inspect for leaks at the filter and oil drain plug. Shut off the engine, wait approximately five minutes to let the oil drain back to the sump and check the oil level again. Add oil as necessary to bring the level to the high (H) mark on the dipstick.

Coolant Filter (5) - Check the DCA4 concentration and replace the coolant filter at every oil and filter change interval. Refer to Section 210-0000, COOLING SYSTEM.

Crankcase Breather - Check and clean the crankcase breather hose. Remove the breather hose and check internally for obstructions or sludge buildup. Clean or replace breather hose as necessary, to prevent excess crankcase pressure buildup.

Drive Belts - Check belt tension and adjust if necessary, as described under 'Drive Belt Adjustment'.

Air Intake System - Inspect the air intake piping for cracked hoses, loose clamps, or punctures which can damage the engine. Tighten or replace parts as necessary to make sure the air intake system does not leak.

DRIVE BELT ADJUSTMENT

Note: Position the vehicle in a level work area, apply the parking brake and switch off the engine. Block all road wheels and place the battery master switch in the 'Off' position.

Measure the belt tension in the centre span of the pulleys using a belt tension gauge. The belt tension should be within the following limits:

Fan Belt Tension
Belt Tension 'New' - 890 N (200 lbf)
Belt Tension 'Used' - 360 to 710 N (80 to 160 lbf)

Alternator Belt Tension
Belt Tension 'New' - 670 N (150 lbf)
Belt Tension 'Used' - 270 to 530 N (60 to 120 lbf)

Note: A belt is considered 'Used' if it has been in service for 10 minutes or longer. If the used belt tension is less than the minimum value, tighten the belt to the maximum value.

An alternative method (deflection method) can be used to check the belt tension by applying 110 N (25 lbf) force on the belt between the pulleys. If the deflection is more than one belt thickness per foot (305 mm) of pulley centre distance, the belt tension must be adjusted.

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Fan Belt Adjustment
Loosen the idler pulley lock nut and adjust the belt to the correct tension. Tighten the idler pulley lock nut to a torque of 165 - 190 Nm (120 - 140 lbf ft).

Note: Do not adjust fan belt tension to full value with the adjusting screw. Belt tension can increase when the lock nut is tightened and cause reduced belt and bearing life.

Alternator Belt Adjustment
Loosen the adjustment link locking capscrew and turn the capscrew to adjust belt tension. Tighten the adjustment link locking capscrew to a torque of 80 Nm (60 lbf ft).

SERVICE TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	12	Bolt	60	44
1	13	Locknut	298	220
1	14	Bolt	190	140
1	16	Bolt	45	33
1	20	Bolt	31	23
1	21	Bolt	31	23
1	22	Bolt	31	23
1	31	Bolt	31	23
-	-	Engine Drain Plug	90	65
-	-	Fan Idler Pulley Lock Nut	165 - 190	120 - 140
-	-	Alternator Adjustment Link Capscrew	80	60

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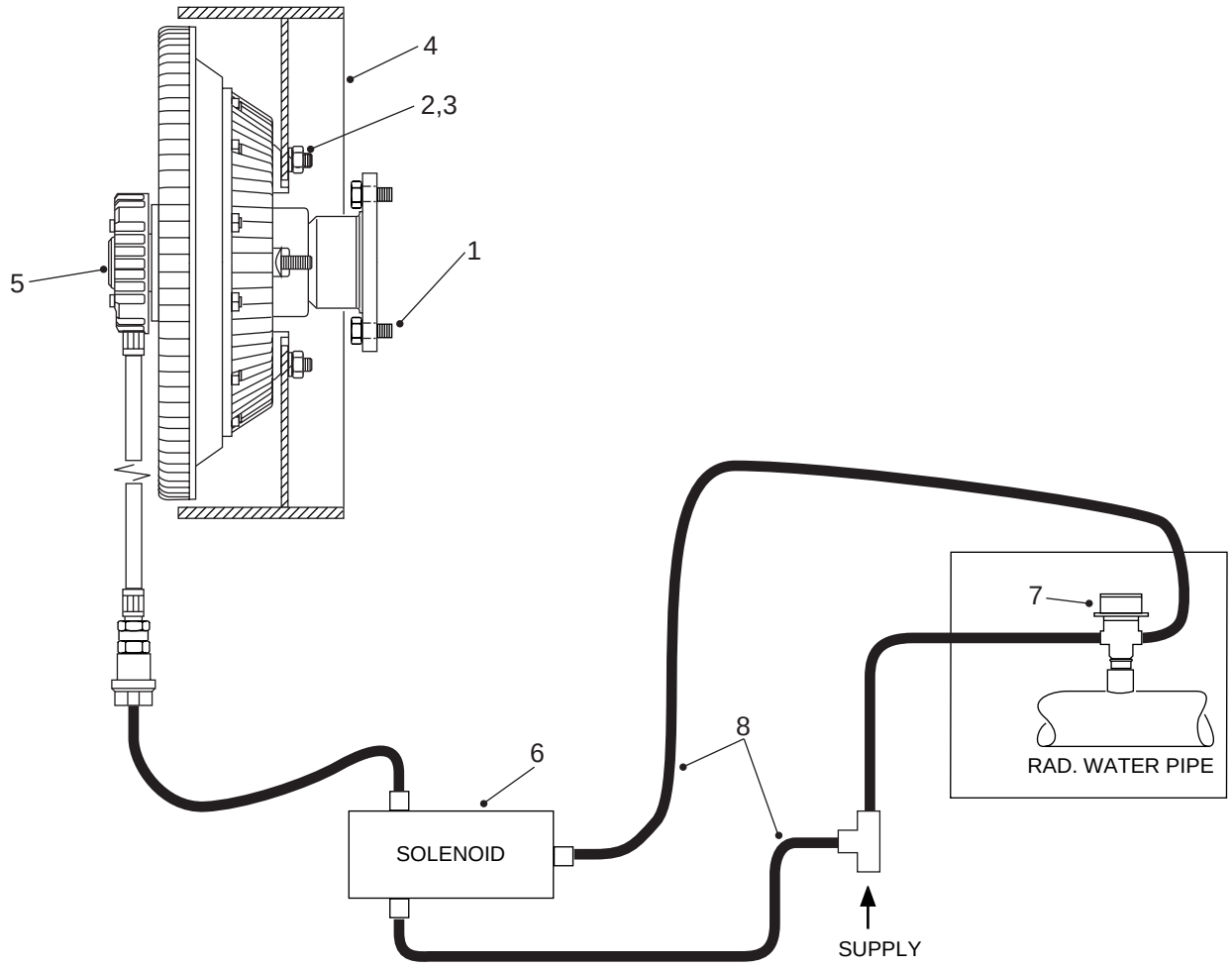
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SM - 1903



1 - Bolt
2 - Lockwasher
3 - Nut
4 - Fan
5 - DST Fan Drive
6 - Solenoid
7 - Sensor Control Valve
8 - Nylon Tube

Fig. 1 - Typical Layout View of Kysor DST Fan and Clutch

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1.

The single sensing direct temperature sensing (DST) fan drive system comprises of two main components. A coolant sensor control valve (7) and a fully modulating viscous fan drive (5) driving the engine cooling fan (4).

Air pressure is fed from the supply into the inlet connection of the sensor control valve (7). When the temperature is below a pre-determined value, the sensor control valve (7) supplies idle pressure to the DST fan drive (5). This idle pressure controls the DST fan drive (5) to give the engine cooling fan (4) idle speed. At a pre-determined coolant temperature, the outlet pressure from the sensor control valve (7) increases giving an increased fan speed. Any further rises in coolant temperature results in increased fan speed. The fan speed increases proportionally with the increase in coolant temperature over a 5° C range, until the fan is fully engaged.

When the coolant temperature drops, so the fan speed reduces proportionally until the idle speed is reached.

The DST fan drive (5) has a failsafe feature, ie. if the air pressure to the fan drops to zero, the fan will be automatically engaged.

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Engine and Mounting - Kysor DST Fan

Section 110-0040

REMOVAL

Numbers in parentheses refer to Fig. 1.

> **WARNING**
> **To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. If required, remove mounting hardware securing hood assembly to the machine and, using suitable lifting equipment, remove hood assembly.

4. Remove mounting hardware securing fan guards to the fan shroud. Remove fan guards from the machine.

5. Disconnect nylon tube (8) from DST fan drive (5) braided tube.

6. Support fan (4) assembly with suitable lifting equipment and remove bolts (1) securing fan (4) assembly to the engine. Remove fan (4) assembly from the machine.

7. Remove nuts (3) and lockwashers (2) securing DST fan drive (5) to fan (4) mounting surface of housing. Remove DST fan drive (5) from housing.

INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners without special torques specified, to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

> **WARNING**
> **To prevent personal injury and property damage, make sure blocking or lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Install DST fan drive (5) on fan (4) mounting surface of housing and secure in place with lockwashers (2) and nuts (3). Torque tighten nuts (3) to 27 Nm (20 lbf ft).

2. Using suitable lifting equipment, position fan (4) assembly on the machine and secure to engine with bolts (1). Torque tighten bolts (1) to 47 Nm (35 lbf ft).

Note: Ensure there is even clearance, all the way round, between fan (4) and the fan shroud.

3. Connect nylon tube (8) to DST fan drive (5) braided tube.

4. Install fan guards to the fan shroud and secure with mounting hardware, as removed at 'Removal'.

5. If removed, position the hood assembly on the machine using a suitable lifting device. Secure hood assembly on the machine with mounting hardware, as removed at 'Removal'.

6. Start the engine and check for correct operation of the fan. Refer to 'Testing' procedures contained in this section.

7. Remove wheel blocks.

TESTING

Static Test

Note: This test will only determine if the fan drive has seized or is very close to seizure.

With the engine stopped, the fan should turn smoothly with resistance (viscous) without scraping, scratching or grating noise.

Note: Rotation without resistance indicates a fault.

Basic Dynamic Test - Cut In/Cut Out

Note: This test is carried out with the machine static and secured at rest.

After the machine has stood for approximately 30 minutes with the engine stopped, start the engine and increase engine speed to 2 100 rev/min.

Initially the fan noise should be loud (cut in), but before a further minute has elapsed, the fan noise should significantly reduce (cut out).

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Basic Dynamic Test - Fan Drive Operation

Note: This test is carried out with the machine static and secured at rest.

1. Place a cardboard, or alternative material, sheet over the radiator front with an approximate 100 mm (4 in) diameter hole in the sheet, in line with the centre of the fan drive.

2. Start the engine and increase engine speed to 2 100 rev/min.

3. Fan noise should initially be loud and reduce significantly before 1 minute has elapsed.

4. Maintain engine speed at 2 100 rev/min. Fan drive should 'cut in' (engage) before coolant temperature gauge indicates excessive coolant temperature.

5. Return engine speed to idle, quickly remove the sheet in front of the radiator and bring engine speed back up to 2 100 rev/min. Fan speed should 'cut out' (disengage) within 1 minute.

Failsafe Check

Note: This test is carried out with the machine static and secured at rest. Hood should be raised and secured.

1. Start the engine and increase engine speed to 2 100 rev/min.

2. Maintain engine speed at 2 100 rev/min and disconnect nylon tubing from the fan drive braided tube. Fan should automatically engage to full flow speed.

MAINTENANCE

Every 10 Hours/Daily

Check the fan for debris or damage. Clean or replace as required.

Note: This Kysor DST fan is a non-serviceable component. However, the following instructions must be strictly adhered to:

1. DO NOT clean around fan drive with steam or high pressure jet.

2. DO NOT tamper with modulation control mechanism for ANY reason.

3. DO NOT add any fluids or lubricants to the drive.

4. DO NOT restrict fan rotation during engine operation for ANY reason.

5. DO NOT operate a machine with a damaged fan assembly. Replace a damaged fan as soon as the fault is noted.

6. DO NOT disassemble ANY fan assembly or associated parts that are still within the warranty coverage period.

7. IMMEDIATELY investigate and correct ANY operator complaint involving drive or cooling system performance.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	PART NAME	TORQUE	
			Nm	lbf ft
1	1	Bolt	47	35
1	3	Nut	27	20

* * * *

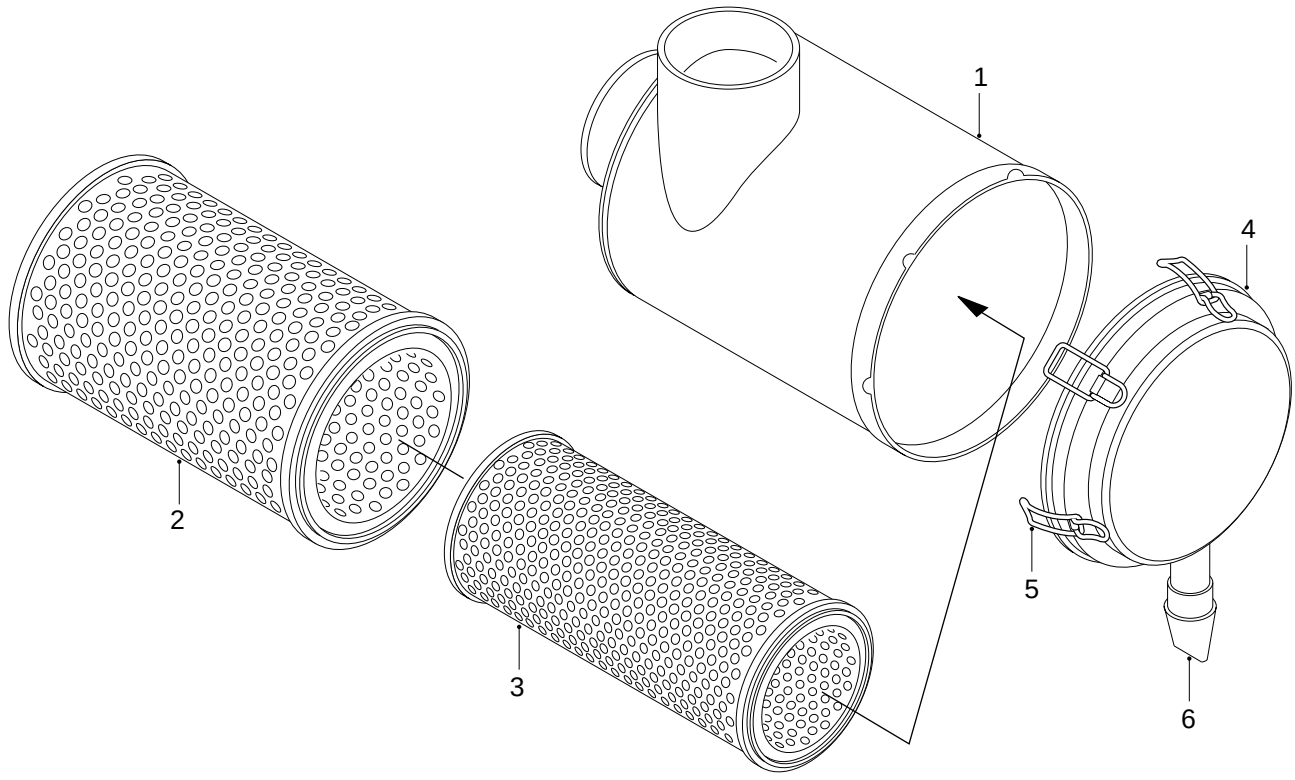
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1 - Air Cleaner Body
2 - Primary Element
3 - Safety Element
4 - Cover Assembly
5 - Latch
6 - Vacuator Valve

Fig. 1 - Exploded View of Typical Air Cleaner

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1.

The dual dry element air cleaner is remote mounted horizontally on the right hand fender of the machine. The air cleaner prolongs engine life by removing grit, dust and water from the air as it enters the engine. Grit and dust, combined with engine oil, forms a highly abrasive compound which can destroy the engine in a comparatively short period of time.

A rubber vacuator valve (6) attached to end cover (1) in a downward position, ejects grit, dust and water while the engine is running. Vacuator valve (6) minimizes the need for daily servicing. Even though vacuator valve (6) is normally under a slight vacuum when the engine is running, pulsing of the vacuum opens and closes the rubber valve, expelling dust and water as they collect. When the engine is stopped, vacuator valve (6) opens and expels any accumulated grit, dust or water.

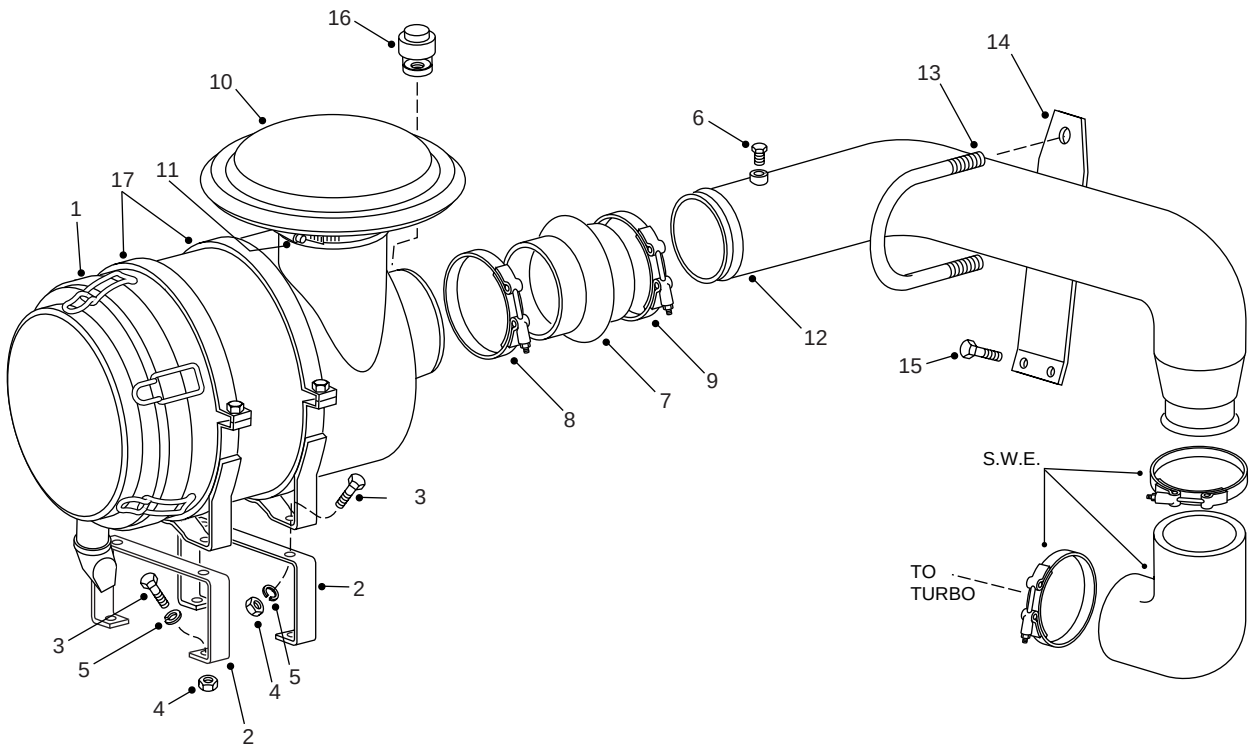
A mechanical air restriction gauge (16, Fig. 2) is mounted on the air cleaner body and shows when the system air flow is being restricted. A red band gradually rises in the gauge window as air restriction increases. The red band is locked when maximum allowable restriction is reached. When the red band locks at the top of the gauge window, primary filter element (2) should be serviced. Air restriction gauge (16, Fig. 2) should be reset by pushing the button on the gauge, holding it for several seconds and then releasing it.

While air restriction gauge (16, Fig. 2) indicates the need for servicing, it does not give as precise a measurement as a water manometer or vacuum gauge. Refer to 'Measuring Air Restriction'.

Secondary (safety) element (3) is installed in air cleaner body (1) inside of primary element (2). This element increases the reliability of the air cleaner's

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1 - Air Cleaner Assembly
2 - Bracket
3 - Bolt
4 - Nut
5 - Lockwasher
6 - Plug
7 - Hose
8 - Band Clamp
9 - Band Clamp
10 - Cap
11 - Clamp
12 - Air Intake Tube
13 - 'U' Bolt
14 - Bracket
15 - Bolt
16 - Air Restriction Gauge
17 - Clamp

Fig. 2 - Exploded View of Typical Air Cleaner Mounting

protection of the engine from airborne dirt. It protects the engine from dirt admitted by a damaged primary element (2), or dirt that might be dropped into air cleaner assembly while changing primary element (2).

AIR CLEANER

Removal

Numbers in parentheses refer to Fig. 2.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

3. Pull on handle to release hood catch and lift up the hood.

4. Slacken clamps (8 & 9) and slide hose (7) clear of the air cleaner assembly.

5. Using suitable lifting equipment, support the air cleaner assembly and remove bolts (3) and nuts (4). Remove air cleaner assembly from brackets (2).

6. Blank off air cleaner outlet and hose (7) end with tape or cardboard to prevent entry of dirt.

7. If required, remove bolts (3), nuts (4) and lockwashers (5) securing brackets (2) to the right hand fender. Remove brackets (2).

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Disassembly

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: Air cleaner body (1) should be thoroughly cleaned twice a year. Do not apply heat in any form to air cleaner body (1).

1. Release latches (5) on cover assembly (4) and remove cover assembly from air cleaner body (1).

2. Remove primary element (2) and safety element (3) from air cleaner body (1).

3. Open clamps (17, Fig. 2) and remove from air cleaner body (1). Open clamp (11, Fig. 2) on cap assembly (10, Fig. 2) and remove cap assembly from air cleaner body (1).

4. Blank off air cleaner body (1) outlets with tape or cardboard. Reach inside body with a compressed air nozzle or brush and remove dust from the body.

5. Remove all loose dust from air cleaner body (1) and remove tape or cardboard from body outlets.

Note: Assembly and installation of the air cleaner assembly is the reverse of disassembly and removal.

Assembly/Installation

Numbers in parentheses refer to Fig. 2, unless otherwise specified.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Assembly and installation of the air cleaner assembly is the reverse of disassembly and removal. Reset air restriction gauge (16).

Following installation, but before starting the engine, the following system checks should be carried out:

a. Check air intake tube (12) for defects and that clamps (8 & 9) (and those supplied with the engine) are securely tightened to ensure that there are no leaks in the system.

b. Check that air cleaner mounting brackets (2) are secure and that air cleaner is mounted securely.

MAINTENANCE

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

> **⚠ WARNING**
> **Always shutdown the engine before servicing air cleaner.**

Check air restriction gauge (16, Fig. 2) daily. The air cleaner elements should be serviced only when the maximum allowable restriction has been reached, as indicated by air cleaner restriction gauge (16, Fig. 2). The elements should not be serviced on the basis of visual observation as this would lead to over service. When restriction readings finally indicate a change, remove primary element (2) carefully and clean/replace as required. Refer to 'Primary Element'.

Never attempt to clean safety element (3). Change safety element (3) after every third primary element (2) service.

Make sure vacuator valve (6) is not damaged or plugged and that the joint with cover assembly (4) is not broken. If vacuator valve (6) is lost or damaged, replace it to maintain pre-cleaner efficiency and normal filter element service life.

Check condition of clamps (8 & 9, Fig. 2), hump hose (7, Fig. 2) and elbow (12, Fig. 2). Tighten/replace as necessary.

Primary Element

Numbers in parentheses refer to Fig. 1.

Although a paper primary element (2) is used, it is possible to clean it so that it can be reused. The number of times one element can be reused depends on the type of dirt on the element and the care exercised in cleaning.

The life of a properly cleaned element will be approximately as long as that of a new element for the first one or two cleanings. After that, the life of the element will gradually decrease with each cleaning; however, it should perform satisfactorily through approximately six cleanings, providing it does not rupture.

Visually determine the condition of primary element (2) and choose either the compressed air or washing method.

1. Release latches (5) on cover assembly (4) and

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remove cover assembly from air cleaner body (1).

2. Remove primary element (2) from air cleaner body (1).

3. Using a damp cloth and a suitable solvent, wipe out all excess dust from air cleaner body (1) and allow to dry.

4. If the major contaminant on primary element (2) is light dust, direct a jet of compressed air, not exceeding 6.9 bar (100 lbf/in^2), against the pleats of the element. The air jet should be directed in the opposite direction of normal operating air flow. Move the air jet up and down the pleats, holding the air nozzle 25 mm (1.0 in) away from the pleats, to prevent rupturing the element with either the nozzle or air jet.

5. In cases where the dust cake on primary element (2) contains oil or carbon, air will not clean effectively. Using manufacturers recommended solution and warm water, not exceeding 48° C (120° F), soak primary element (2) for fifteen minutes. Element should be gently agitated to assist cleaning process.

Note: It is possible to modify an old agitator type washing machine for primary element (2) cleaning. Do not soak or agitate primary element (2) in the solution for more than fifteen minutes. Prolonged exposure softens vertical seams in the element.

6. Rinse washed element thoroughly with a low pressure stream of water, not exceeding 0.7 bar (10 lbf/in^2), opposite from the normal air flow, until rinse water runs clear.

7. Air dry primary element (2) thoroughly before returning it to service. Drying is a slow process which may be hastened by exposing element to slowly circulating heated air. Heated air temperature should not exceed 46° C (115° F). Drying time can be reduced to about three hours with heated air. DO NOT use a light bulb for drying. DO NOT use compressed air on a wet element.

Note: Replace paper elements after six cleanings or two years in service, whichever comes first. Mark each cleaned element to show total cleanings to date.

8. After primary element (2) is thoroughly dried, inspect for damage or ruptures, especially close to the end caps. To detect paper ruptures, place a bright light bulb inside the element and rotate element slowly. Inspection of element on the outside will disclose any holes where concentrated light shines through. Even the smallest hole will pass dust to the engine and may result in costly engine repairs.

9. Install primary element (2) in air cleaner body (1).

10. Install cover assembly (4) on air cleaner body (1) and secure with latches (5).

Secondary Element

Numbers in parentheses refer to Fig. 1.

Since safety element (3) is protected from contamination by primary element (2), it needs no periodic cleaning and should be replaced only after every third primary element (2) service.

1. With primary element (2) removed from air cleaner body (1), remove safety element (3).

2. Remove any dust dislodged into air cleaner body (1) outlet and, using a damp cloth and a suitable solvent, wipe out all excess dust from air cleaner body (1) and allow to dry.

3. Install new safety element (3) followed by primary element (2) in air cleaner body (1)

4. Install cover assembly (4) on air cleaner body (1) and secure with latches (5).

Recommendations

Numbers in parentheses refer to Fig. 2.

1. Under no condition should the vehicle be operated without both filter elements in each air cleaner assembly.

2. It is very important that hump hose (7) and air intake tube (12) from the air cleaner assembly to the engine be airtight or the purpose of the air cleaner will be completely defeated. All clamps (8 & 9) (and those supplied with the engine) should be checked frequently and tightened to prevent leaks.

3. Keep new or cleaned filter elements on hand for replacement to prevent unnecessary downtime of the vehicle.

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MEASURING AIR RESTRICTION

Numbers in parentheses refer to Fig. 2.

As a dry air cleaner element becomes loaded with dust, the vacuum on the engine side of the air cleaner (air cleaner outlet) increases. This vacuum is generally measured as 'restriction in mm (inches) of water'.

The recommended maximum allowable intake restrictions at rated speed and load are as follows:

a. 380 mm-H_2O (15 in-H_2O) with clean filter elements.
b. 635 mm-H_2O (25 in-H_2O) with dirty filter elements.

While the air restriction gauge sends a signal to indicate the need for servicing, it does not give as precise a measurement as a water manometer or vacuum gauge.

Water Manometer
a. Remove air restriction gauge (16) from port in air cleaner assembly.

b. Hold water manometer vertically and fill both legs approximately half full of water. Connect one of the upper ends to port by means of a flexible hose.

c. With the manometer held vertically and the engine drawing maximum air, the difference in height of the water columns in the two legs is measured as the air cleaner restriction.

d. If the restriction exceeds the levels indicated, engine performance will be affected. Primary filter element should be cleaned or replaced.

Vacuum Gauge
a. Remove air restriction gauge (16) from port in air cleaner assembly.

b. Connect the hose from the vacuum gauge to port and, with the engine drawing maximum air, take a note of the reading on the gauge.

c. If the restriction exceeds the levels indicated, engine performance will be affected. Primary filter element should be cleaned or replaced.

SERVICE TOOLS

Refer to Section 300-0070, SERVICE TOOLS for part numbers of service tools referenced in this section and general service tools required. These tools are available from your dealer.

* * * *

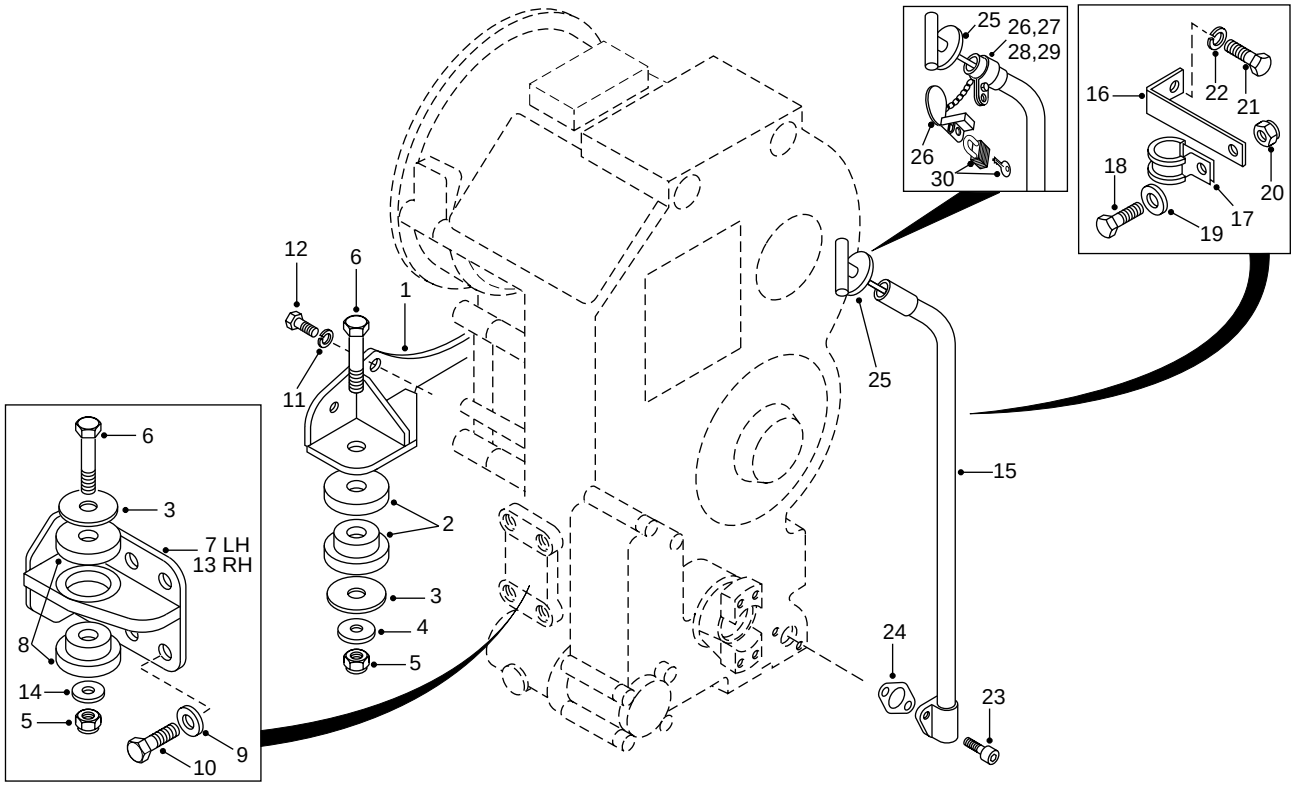
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1 - Front Bracket Assembly
2 - Isolation Mount
3 - Snubbing Washer
4 - Washer
5 - Locknut
6 - Bolt
7 - LH Bracket
8 - Isolation Mount
9 - Lockwasher
10 - Bolt
11 - Lockwasher
12 - Bolt
13 - RH Bracket
14 - Hardened Washer
15 - Dipstick Tube
16 - Bracket
17 - Clamp
18 - Bolt
19 - Washer
20 - Locknut
21 - Bolt
22 - Lockwasher
23 - Screw
24 - Gasket
25 - Dipstick
26 - Latch Assembly
27 - Clamp
28 - Bolt
29 - Locknut
30 - Padlock

Fig. 1 - Exploded View of Transmission and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

For transmission make, model and specification, refer to Section 000-0000, GENERAL INFORMATION. For transmission servicing and repair data refer to transmission manufacturers service manual.

The transmission is supported by front bracket assembly (1), LH bracket (7) and RH bracket (13) which are bolted to the transmission and attached to front frame mounting brackets through isolation mounts (2 & 8). Isolation mounts (2 & 8) provide sufficient flexibility to absorb varying transmission vibration and torsional loads.

The transmission assembly consists of a torque converter close-coupled to a countershaft-type gearbox with integral output transfer gearing. A wear-resistant hydraulic retarder is integral of the transmission.

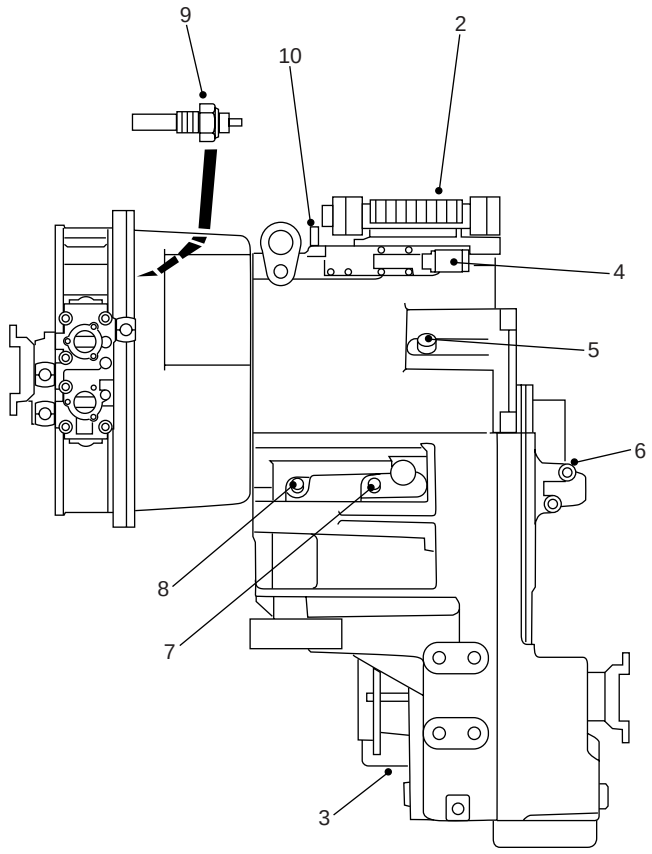
Two engine dependent power takeoffs at the rear of the transmission provide the drive for the steering pump and the hydraulic pump for the body hoist system.

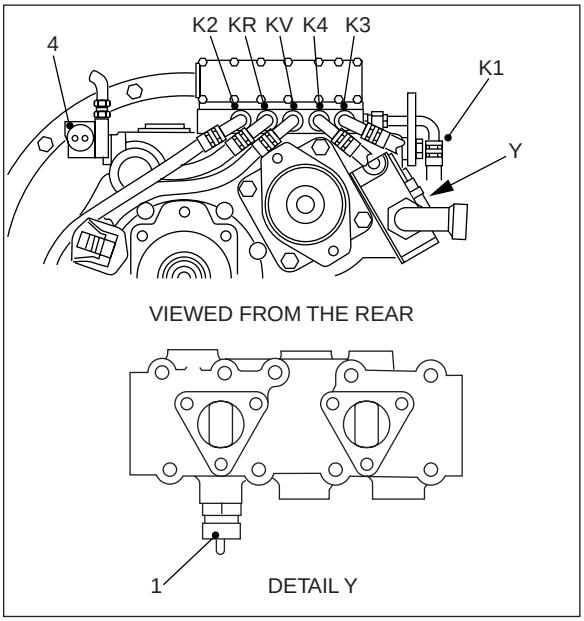
Mounted off front bracket assembly (1) are the retarder solenoid, differential lock solenoid and pressure reducing valve.

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1 - Retarder Oil Temperature Sender
2 - Main Control Valve
3 - Difflock Warning Light Switch
4 - Lockup Solenoid
5 - Engine Speed Sensor
6 - Output Speed Sensor
7 - Central Gear Train Sensor
8 - Turbine Speed Sensor
9 - Oil Temperature Sender (Gauge)
10 - Breather

KV, KR, K1 to K4 - Supply ports to Multi-disc Clutches

Fig. 2 - Location of Transmission Switches, Sensors and Solenoids

SWITCHES AND SENSORS

Numbers in parentheses refer to Fig. 2, unless otherwise specified.

Transmission Oil Temperature

Oil temperature sender (9) sends a signal to indicate transmission oil temperature on the transmission oil temperature gauge. The gauge should read in the green zone during normal operation and may read in the yellow zone during retarder operation. If the needle remains in the red zone for extended periods, the machine should be brought to a stop, transmission shifted to neutral and engine speed increased to 1 200 - 1 500 rev/min. Under this condition, oil temperature should drop to normal values in about 2 - 3 minutes. If oil temperature does not drop, the cause should be investigated.

The transmission oil temperature is monitored by temperature sensors in the main control valve, which sends a signal to illuminate the transmission STOP warning light. The light will illuminate to indicate any of the following conditions:

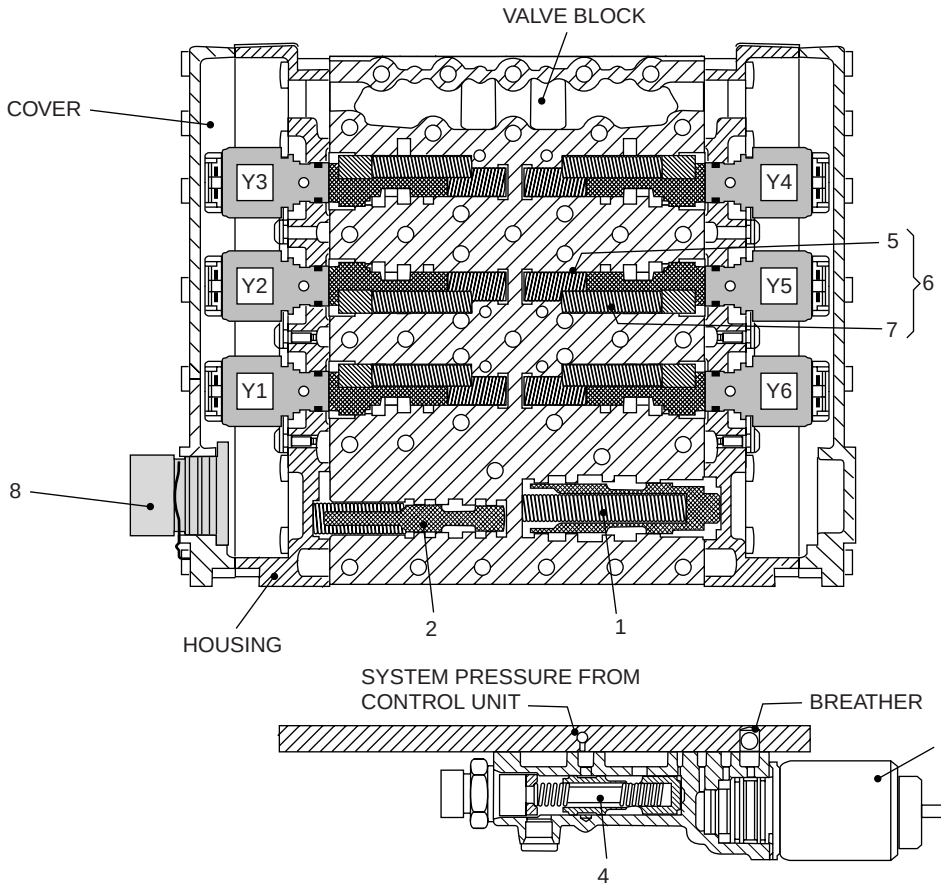
High retarder temperature
High transmission sump temperature
Engine overspeed

If the light illuminates during normal operation, a fault code will also register on the display unit (See EST-37 Trouble Shooting tables). Bring the machine to a stop and investigate the cause.

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1 - Main Pressure Valve 16+2 bar
2 - Pressure Reduction Valve 9 bar
3 - Lockup Solenoid
4 - Lockup Reduction & Shift Valve
5 - Follow-on Slide
6 - Proportional Valve (P1 to P6)
7 - Vibration Damper
8 - Harness Connection

Y1 to Y6 - Pressure Regulators

Fig. 3 - Sectional View of Typical Control Unit with Lockup Clutch (Wk)

Lockup Clutch (Wk)

The transmission lockup clutch is automatically engaged. Engine speed is picked up by turbine speed sensor (8) which sends a signal to energise lockup solenoid (3, Fig. 3) when turbine speed reaches a predetermined level. Energising lockup solenoid (3, Fig. 3) will move lockup valve (4, Fig. 3) across, allowing oil to flow through the valve to engage lockup.

Gear Selection

The transmission can be engaged and disengaged under load by means of hydraulically controlled multi-disc clutches. All gears run in antifriction bearings and are constantly meshed. The gears, bearings and clutches are lubricated with cooled oil.

The transmission is equipped with six multi-disc clutches. These clutches are controlled via the six proportional valves (6, Fig. 3). Each proportional valve (6, Fig. 3) is composed of a pressure regulator (Y1 to Y6, Fig.3), follow-on slide (5, Fig. 3) and vibration damper (7, Fig. 3).

The control pressure of 9 bar for the actuation of the follow-on slides (5, Fig. 3) is created by the pressure reduction valve (2, Fig. 3). The pressure oil (16+2 bar) is directed via the follow-on slide (5, Fig. 3) to the respective clutch.

Due to the direct proportional control with separate pressure modulation for each clutch, the pressures to the clutches, which are taking place in the gear change, are controlled. In this way, a hydraulic

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intersection of the clutches to be engaged and disengaged becomes possible. This creates fast shiftings without traction force interruption.

Speedometer Sensor

Speedometer sensor, within the ECU, sends a signal to the speedometer, via the speedometer frequency divider, to indicate travel speed in kilometres per hour and miles per hour.

Differential Locks

Note: The transmission differential lock requires air pressure to hold it 'Off', whereas, the centre axle differential lock requires pressure to hold it 'On'.

When the engine is started, air pressure is applied to the transmission differential lock to ensure the differential lock is released. On activation of the differential lock switch, the transmission differential lock solenoid is energised and air pressure is exhausted at the transmission differential lock and applied at the centre axle differential lock. In this condition, the differential locks are engaged.

Note: The differential locks can be preselected when the machine is moving however, they will only engage on the move when the vehicle speed is below 5 km/hr.

Note: Before driving in soft or slippery conditions, stop and engage the differential locks. Spinning wheels can result in damage to the transmission and axle differentials.

Note: Disengage differential locks when driving on firm ground.

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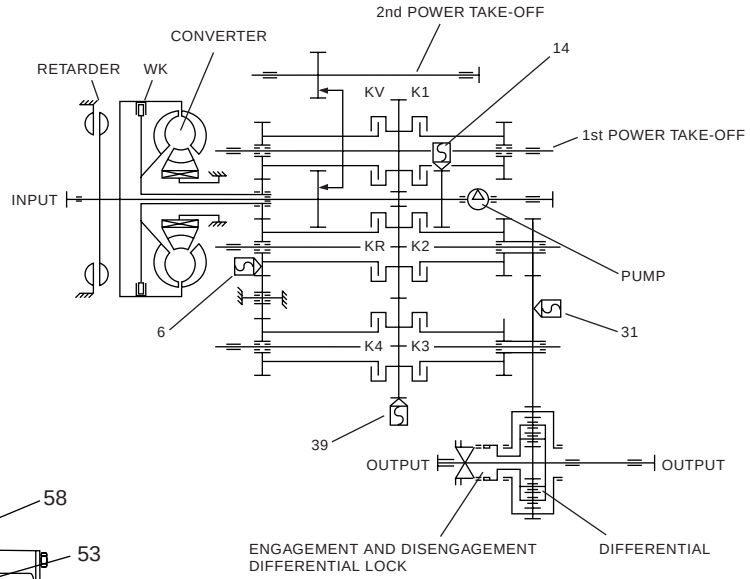
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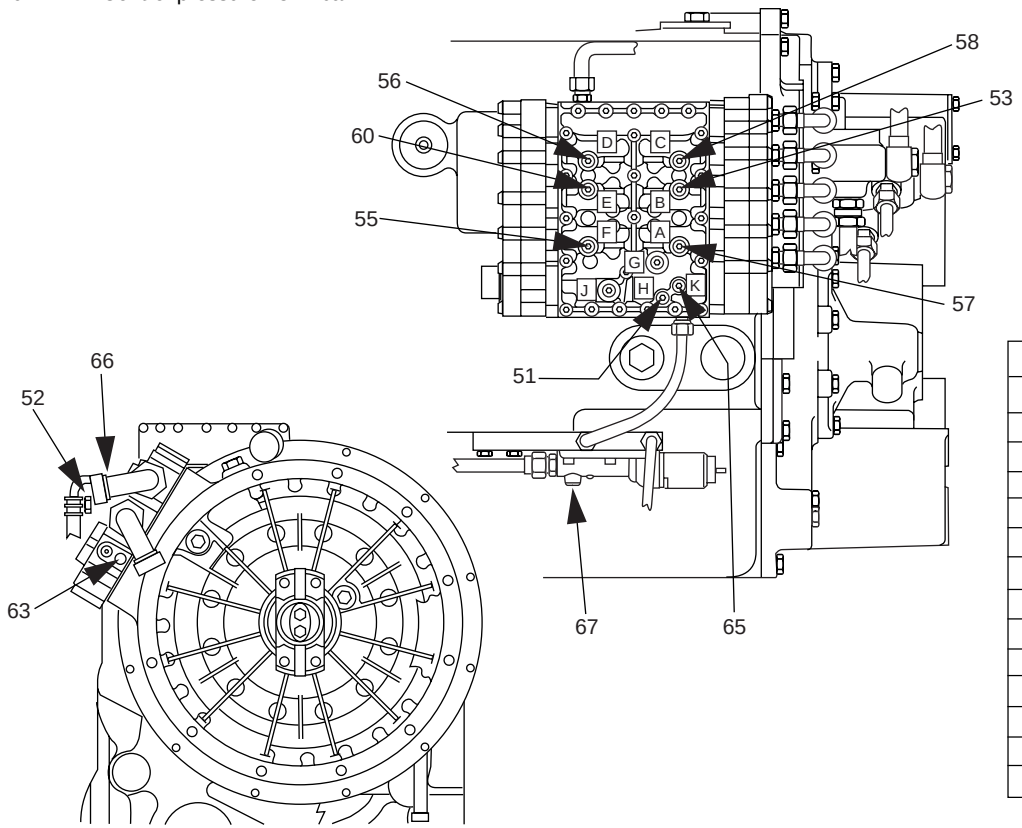
SCHEDULE OF MEASURING POINTS

Measurements to be carried out with oil at normal operating temperature of 80° C and operating at full speed.

MEASURING POINTS FOR PRESSURE OIL AND TEMPERATURE:

51 = Before the Convertor - Opening Pressure 8.5 bar
52 = Behind the Convertor - Opening Pressure 5 bar
53 = Clutch forward 16+2 bar KV
55 = Clutch reverse 16+2 bar KR
56 = Clutch 16+2 bar K1
57 = Clutch 16+2 bar K2
58 = Clutch 16+2 bar K3
60 = Clutch 16+2 bar K4
63 = Temperature 100° C behind the retarder (short time 150° C)
65 = System pressure 16+2
66 = Temperature 100° C behind the converter (short time 120° C)
67 = WK-Control pressure 13±1 bar





INDUCTIVE TRANSMITTERS AND SPEED SENSORS

6 = Inductive Transmitter n Turbine
14 = Inductive Transmitter n Engine
31 = Speed Sensor n Output and Speedometer
39 = Inductive Transmitter n Central Gear Train

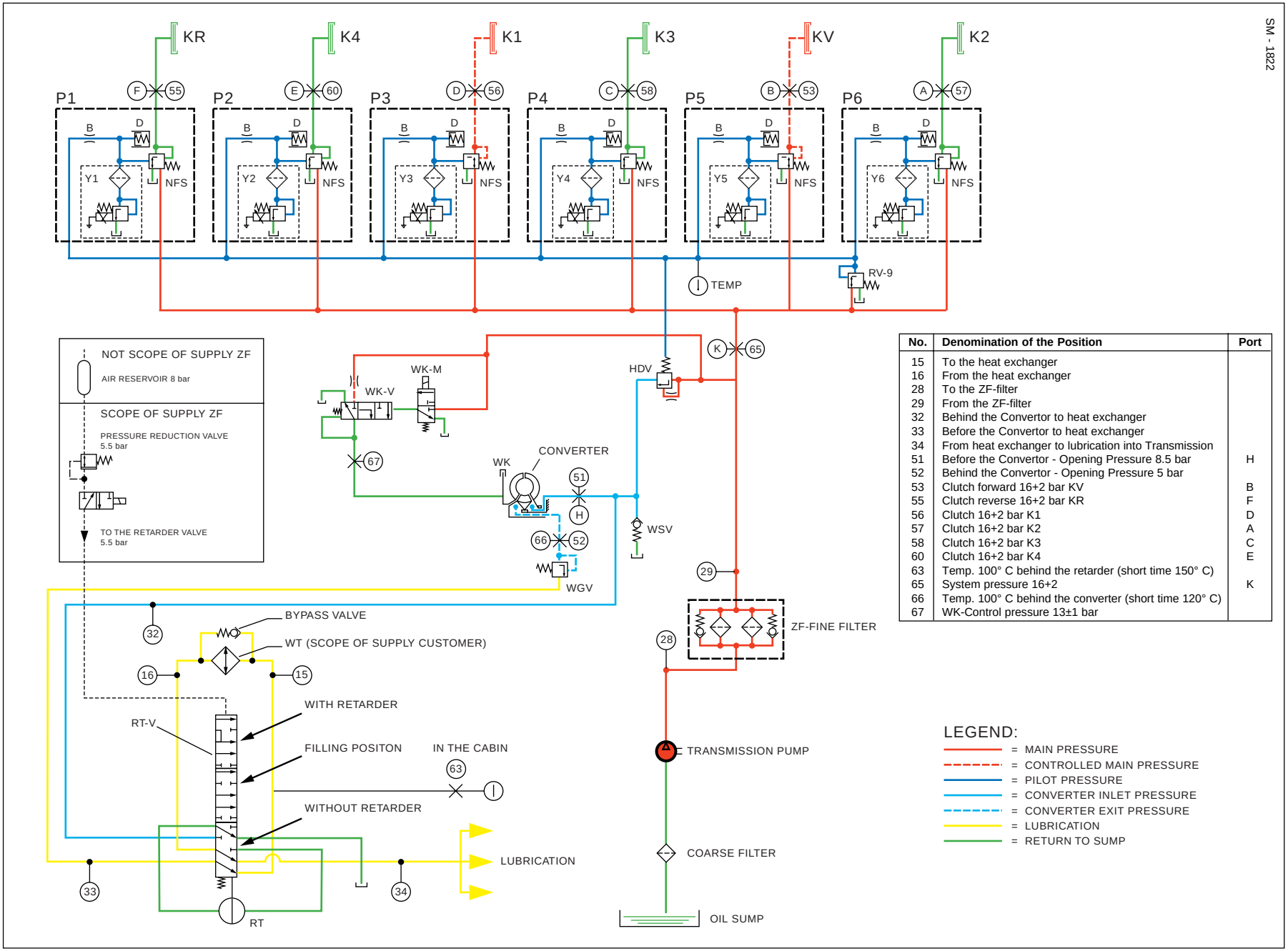
	• PRESS REG. UNDER VOLTAGE					
SPEED	Y1	Y2	Y3	Y4	Y5	Y6
F1			•		•	
F2		•	•			
F3					•	•
F4		•				•
F5				•	•	
F6		•		•		
R1	•		•			
R2	•					•
R3	•			•		
N						
CLUTCH	KR	K4	K1	K3	KV	K2
POS. VALVE	F	E	D	C	B	A
POINTS	55	60	56	58	53	57

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Fig. 4 - Typical Schedule of Measuring Points and Gear Pattern

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No.	Denomination of the Position	Port
15	To the heat exchanger	
16	From the heat exchanger	
28	To the ZF-filter	
29	From the ZF-filter	
32	Behind the Convertor to heat exchanger	
33	Before the Convertor to heat exchanger	
34	From heat exchanger to lubrication into Transmission	
51	Before the Convertor - Opening Pressure 8.5 bar	H
52	Behind the Convertor - Opening Pressure 5 bar	
53	Clutch forward 16+2 bar KV	B
55	Clutch reverse 16+2 bar KR	F
56	Clutch 16+2 bar K1	D
57	Clutch 16+2 bar K2	A
58	Clutch 16+2 bar K3	C
60	Clutch 16+2 bar K4	E
63	Temp. 100° C behind the retarder (short time 150° C)	
65	System pressure 16+2	K
66	Temp. 100° C behind the converter (short time 120° C)	
67	WK-Control pressure 13±1 bar	

Fig. 5 - Oil Circulation Diagram for Typical Transmission with Lockup Clutch and Retarder

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OPERATION

EST-37 Automatic Shift Control

The EST-37 transmission is equipped with an electronic control unit (ECU) which continually monitors the transmission and shift system electrical components and warns the operator when a problem develops. It also takes action to prevent damage to the transmission, and provides the serviceman with diagnostic capabilities so that problems can be corrected quickly and easily.

When a fault occurs, a two digit error code will be displayed on the LCD display on the dash panel. The error code is also recorded in the transmission ECU, and can be accessed by the serviceman by plugging in a data reader to extract information relating to the fault. The error code recorded in the ECU memory will remain until it is erased by a technician.

If a major fault is detected, it is the operators responsibility to shut down the machine as soon as it is safe to do so. The machine should not be restarted until the fault has been diagnosed and corrected.

Refer to 'EST-37 Trouble Shooting' table for a list of fault codes and checks.

The EST-37 transmission control has been designed to provide the driver with maximum operational flexibility by allowing the choice of automatic or manual gear selection to optimize vehicle performance under all operating conditions.

The transmission provides six forward gears, three reverse gears and a neutral position. The gear positions are indicated on the LCD display located on the dash panel. The transmission will only operate in the gear selected by the operator in the manual range, or, when the lever is in the automatic range, shifts will occur automatically between 1st and 6th gear, depending on operating requirements. The reverse gears 1st through 3rd are manual mode only.

⚠ WARNING

Before any welding is done on a machine equipped with an EST-37 shift system, disconnect battery earth cable, battery supply cable alternator earth cables, alternator supply positive cables and electrical connections at the ECU to avoid damage to electrical components. Turn off battery master switch to isolate the batteries before disconnecting any components.

VTS-3 Shift Controller - Operation: The shift controller has 3 positions the lever can rest in, Forward, Neutral and Reverse. Within each of these positions, the gear can be changed by pushing the lever to the right (+) to upshift or to the left (-) to downshift. In the Neutral position, this can be used to preselect the starting gear (the default being 2nd gear).

The shift controller has a 'Function' button on the top of the lever which is used to switch between automatic and manual modes. Press the function button from 'NEUTRAL' and move the lever forward to select automatic mode, when driving normal upshifting and downshifting will occur. If required, a gear can be held in manual mode by pressing the function button once, to resume full automatic mode the function button should be pressed again. Manual gears can also be selected by pushing the lever to the left for lower gears or to the right for higher gears, again by pressing the function button once automatic mode will be resumed.

Note: The transmission will only allow gearshifting when the predetermined values have been reached.

Note: There is no shift inhibitor in the gear shift control, therefore, no resistance would be felt while moving through the gear ranges.

The gear lever housing sends a signal to the electronic control unit, which in turn will only allow the engine to be started when the gear lever is in the 'NEUTRAL' position. The gear shift lever must always be placed in 'NEUTRAL' and the parking brake applied when starting the engine, or whenever the machine is left unattended.

When shifting from 'NEUTRAL' to start from a standstill, or to reverse direction, decelerate the engine to idle speed before selecting the proper gear. When 'REVERSE' is selected, the 'Reverse Alarm' sounds and the 'Reverse Light' illuminates to warn personnel to the rear of the machine that reverse gear has been selected.

During reversing operations it is recommended to reduce engine speed, use only 1st or 2nd gear and never exceed 10 km/h (6.2 mile/h).

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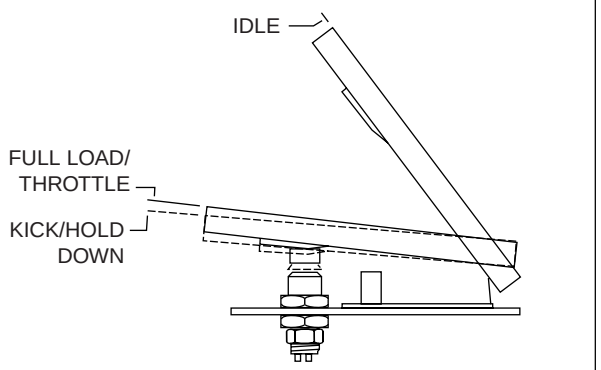
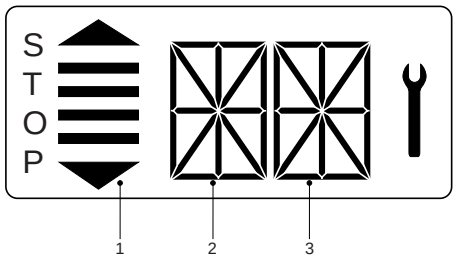


Fig. 6 - Accelerator Load Ranges and Kickdown Position



1 - Bars show gear ranges and full display (as shown) indicates driving in automatic mode.

2 - Display shows actual driving direction.

3 - Display shows actual gear in use.

Fig. 7 - Dashboard Display

The electronic control system distinguishes between the throttle position (or load ranges) depending on the governor position (injection pump). On a light throttle opening, the transmission will give earlier upshifts and later downshifts than when operating at full throttle.

A kickdown facility (See Fig. 6), which can be used when automatic mode is selected, allows for the possibility of selecting a lower gear by pressing down fully on the throttle pedal and holding. This can be used to provide a downshift on demand provided that the vehicle speed is within the range allowable. That is, the vehicle is not travelling at a speed that would result in the engine overspeeding in the lower gear. When driving with kickdown, the transmission will give earlier downshifts and later upshifts. To disengage the transmission kickdown, release the throttle pedal and allow it to return to a light throttle position.

When operating in automatic range with the display indicating that the transmission has downshifted to 2nd gear, there are two options for providing a further downshift as conditions indicate.

1. 1st gear can be manually selected by pushing the shift lever to the left.

2. Kickdown can be selected from 2nd automatic, when the transmission will downshift to 1st gear, depending upon vehicle speed.

When the kickdown is released the transmission will upshift to 2nd automatic, provided that the forward speed has increased sufficiently to allow this to happen, and that the shift lever is in the automatic mode.

A dashboard display is provided which indicates gear selected and driving direction as follows (See Fig. 7):

Manual Mode - When driving with shift selector in manual range, the bars only are shown in position 1, and, driving direction and gear selected are indicated in positions 2 and 3.

Automatic Mode - When driving with shift selector in automatic range, a full display of bars and arrows are shown in position 1, and, driving direction and gear selected are indicated in positions 2 and 3.

Under certain conditions the transmission may start to 'hunt' between gears when in automatic mode. The transmission changes up and down between two gears at short intervals because there is not sufficient power to sustain driving in the higher gear, but is sufficient for upshifting from the lower gear. By using the shift display, it can be established which gears are involved and in these circumstances the lower gear should be selected using the shift control lever. Automatic mode should be reselected at the earliest opportunity.

During machine operation, watch for wide deviations from normal readings on the transmission oil temperature gauge. If the gauge shows the oil temperature rising above the green zone during normal operation, or above the yellow zone during retarder operation, the machine must be stopped and inspected for external oil leakage. If no leaks are found, shift to 'NEUTRAL' and operate the engine at 1 200 - 1 500 rev/min. If the transmission oil temperature does not decrease into the green zone within 2 or 3 minutes, the cause of the overheating should be corrected before the machine is operated further.

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Note: In cold weather, the transmission oil should be warmed up by running the engine at idle speed with the gear selector in neutral, since the system will not operate satisfactorily if the oil is too cold.

When temporarily stopped, such as for yielding the right-of-way to a loaded machine, the transmission can be left in gear and the machine held stationary with the service brakes.

When stopped for a more extended period with the engine left running, shift to 'NEUTRAL' to avoid unnecessary heat buildup, and apply the parking brake.

WARNING

Always select the correct drive direction and gear before releasing the parking brake.

WARNINGS

Never allow the machine to coast with the transmission in 'NEUTRAL'.

When running down a gradient the engine speed should not be allowed to drop below 1 200 rev/min, at which point, lockup would disengage preventing retarder operation.

In the event of a loss of electric power to the gear shift control, the transmission will automatically shift to 'NEUTRAL'. If this occurs, stop the machine using the service brakes and apply the parking brake. Do not operate until the fault has been repaired.

Always select 'NEUTRAL' and apply the parking brake before leaving the operators seat.

The retarder will automatically disengage when the oil temperature reaches 150° C (302° F), unless an engine overspeed condition exists.

Display during operation

Symbol	Meaning	Remarks
1F, 1R 2F, 2R 3F, 3R 4F 5F 6F LF, LR	Actual gear and direction. Left digit shows actual gear, right digit shows actual direction limp home gear	
F or R, no gear	Clutch Cutoff	
F or R flashing	only 6WG: direction F or R selected while turbine speed is too high, CAUTION gear will engage if turbine speed drops	
NN	not neutral, waiting for neutral after power up or a severe fault to F or R position	go engage a gear, first move shift selector to neutral position and again
**	oil temperature too low, no gear available	warm up engine / transmission
*N	oil temperature low, only one gear available	warm up engine / transmission
1 bar (special symbol)	manual mode 1. gear	
2 bars	manual mode 2. gear	
3 bars	manual mode 3. gear	
4 bars	manual mode 4. gear	
4 bars and 2 arrows	automatic mode	
bars flashing	6 WG: converter lockup clutch open	difference of engine and turbine speed above a certain limit and lockup clutch not activated
spanner	at least one fault active	select neutral to get fault code displayed
fault code	see faultcode list	

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Display during operation - Continued		
Symbol	**Meaning**	**Remarks**
WS	warning sump temperature	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WR	warning retarder temperature	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WT	warning torque converter temperature	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WE	warning high engine speed	changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
PN	direction F or R selected while parking brake engaged	transmission in neutral until parking brake is released CAUTION: vehicle starts to move after release of parking brake
F or R flashing	direction F or R selected while turbine speed is to high, CAUTION gear will engage if turbine speed drops	
EE flashing	no communication with display	checked wiring from TCU to display

The AEB-Starter is a tool to start the AEB (automatic filling parameter adjustment) of ergopower transmissions with ease. Connect AEB-Starter to plug X25 located below dash adjacent to TCU.

Display during AEB-Mode		
Symbol	**Meaning**	**Remarks**
PL	AEB - Starter is plugged at the diagnostic plug	
ST	AEB-Starter-button is pressed	
K1..K4,KV,KR	calibrating clutch K1..K4,KV,KR	
_ and Kx	wait for start, initialization of clutch Kx, x: 1, 2, 3, 4, V, R	
≡ and Kx	fast fill time determination of clutch Kx	
= and Kx	compensating pressure determination of clutch Kx	
OK	calibration for all clutches finished	Transmission stays in neutral, you have to restart the TCU (ignition off/on) after removing AEB-Starter
STOP	AEB cancelled (activation stopped)	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
STOP and Kx	AEB stopped, clutch Kx can’t be calibrated	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
Spanner and Kx	Kx couldn’t be calibrated, AEB finished	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
⇧ E	engine speed too low, -> raise engine speed	
⇩ E	engine speed too high, -> lower engine speed	
⇧ T	transmission oil temperature too low, -> heat up transmission	

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Display during AEB-Mode - Continued		
Symbol	**Meaning**	**Remarks**
⇩T	transmission oil temperature too high -> cool down transmission	
FT	transmission temperature not in defined range during calibration	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FB	operating mode not NORMAL or transmission temperature sensor defective or storing of Calibrated values to EEPROM-has failed.	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FO	Outputspeed_not_zero	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FN	Shift lever not in Neutral position	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
FP	Parkbrake_not_applied	Transmission stays in neutral, you have to restart the TCU (ignition off/on)
STOP	AEB - Starter was used incorrect or is defective	Transmission stays in neutral, you have to restart the TCU (ignition off/on)

TABLE OF FAULT CODES

Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
11	LOGICAL ERROR AT GEAR RANGE SIGNAL TCU detected a wrong signal combination for the gear range •*cable from shift lever to TCU is broken* •*cable is defective and is contacted to battery voltage or vehicle ground* •*shift lever is defective*	TCU shifts transmission to neutral OP-Mode: transmission shutdown	•check cables from TCU to shift lever •check signal combinations of shift lever positions for gear range	Failure cannot be detected in systems with DW2/DW3 shift lever
12	LOGICAL ERROR AT DIRECTION SELECT SIGNAL TCU detected a wrong signal combination for the direction •*cable from shift lever to TCU is broken* •*cable is defective and is contacted to battery voltage or vehicle ground* •*shift lever is defective*	TCU shifts transmission to neutral OP-Mode: transmission shutdown	•check cables from TCU to shift lever •check signal combinations of shift lever positions F-N-R	
23	S.C. TO BATTERY VOLTAGE AT LOAD SENSOR INPUT the measured voltage is too high: •*cable is defective and is contacted to battery voltage* •*load sensor has an internal defect* •*connector pin is contacted to battery voltage*	retarder function is affected TCU uses default load OP-Mode: normal	•check cable from TCU to sensor •check connectors •check load sensor sensor •check assembly tolerances of load sensor	Availability of retarder depends on default load
24	S.C. TO GROUND OR O.C. AT LOAD SENSOR INPUT the measured voltage is too low: •*cable is defective and is contacted to vehicle ground* •*cable has no connection to TCU* •*load sensor has an internal defect* •*connector pin is contacted to vehicle ground or is broken*	retarder function is affected TCU uses default load OP-Mode: normal	•check cable from TCU to sensor •check connectors •check load sensor sensor •check assembly tolerances of load sensor	Availability of retarder depends on default load
25	S.C. TO BATTERY VOLTAGE OR O.C. AT TRANSMISSION SUMP TEMPERATURE SENSOR INPUT the measured voltage is too high: •*cable is defective and is contacted to battery voltage* •*cable has no connection to TCU* •*temperature sensor has an internal defect* •*connector pin is contacted to battery voltage or is broken*	no reaction, TCU uses default temp. OP-Mode: normal	•check cable from TCU to sensor •check connectors •check temperature sensor	

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Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
26	S.C. TO GROUND AT TRANSMISSION SUMP TEMPERATURE SENSOR INPUT the measured voltage is too low: *•cable is defective and is contacted to vehicle ground* *•temperature sensor has an internal defect* *•connector pin is contacted to vehicle ground*	no reaction, TCU uses default temp. OP-Mode: normal	•check cable from TCU to sensor •check connectors •check temperature sensor	
27	S.C. TO BATTERY VOLTAGE OR O.C. AT RETARDER TEMPERATURE SENSOR INPUT the measured voltage is too high: *•cable is defective and is contacted to battery voltage* *•cable has no connection to TCU* *•temperature sensor has an internal defect* *•connector pin is contacted to battery voltage or is broken*	no reaction, TCU uses default temp. OP-Mode: normal	•check cable from TCU to sensor •check connectors •check temperature sensor	
28	S.C. TO GROUND AT RETARDER TEMPERATURE SENSOR INPUT the measured voltage is too low: *•cable is defective and is contacted to vehicle ground* *•temperature sensor has an internal defect* *•connector pin is contacted to vehicle ground*	no reaction, TCU uses default temp. OP-Mode: normal	•check cable from TCU to sensor •check connectors •check temperature sensor	
31	S.C. TO BATTERY VOLTAGE OR O.C. AT ENGINE SPEED INPUT TCU measures a voltage higher than 7.00 V at speed input pin *•cable is defective and is contacted to battery voltage* *•cable has no connection to TCU* *•speed sensor has an internal defect* *•connector pin is contacted to battery voltage or has no contact*	OP-Mode: substitute clutch control	•check cable from TCU to sensor •check connectors •check speed sensor	
32	S.C. TO GROUND AT ENGINE SPEED INPUT TCU measures a voltage less than 0.45V at speed input pin *•cable/connector is defective and is contacted to vehicle ground* *•speed sensor has an internal defect*	OP-Mode: substitute clutch control	•check cable from TCU to sensor •check connectors •check speed sensor	
33	LOGICAL ERROR AT ENGINE SPEED INPUT TCU measures a engine speed over a threshold and the next moment the measured speed is zero *•cable / connector is defective and has bad contact* *•speed sensor has an internal defect* *•sensor gap has the wrong size*	OP-Mode: substitute clutch control	•check cable from TCU to sensor •check connectors •check speed sensor •check sensor gap	This fault is reset after power up to TCU
34	S.C. TO BATTERY VOLTAGE OR O.C. AT TURBINE SPEED INPUT TCU measures a voltage higher than 7.00 V at speed input pin *•cable is defective and is contacted to battery voltage* *•cable has no connection to TCU* *•speed sensor has an internal defect* *•connector pin is contacted to battery voltage or has no contact*	OP-Mode: substitute clutch control if a failure is existing at output speed, TCU shifts to neutral OP-Mode: limp home	•check cable from TCU to sensor •check connectors •check speed sensor	
35	S.C. TO GROUND AT TURBINE SPEED INPUT TCU measures a voltage less than 0.45V at speed input pin *•cable / connector is defective and is contacted to vehicle ground* *•speed sensor has an internal defect*	OP-Mode: substitute clutch control if a failure is existing at output speed, TCU shifts to neutral OP-Mode: limp home	•check cable from TCU to sensor •check connectors •check speed sensor	
36	LOGICAL ERROR AT TURBINE SPEED INPUT TCU measures a turbine speed over a threshold and at the next moment the measured speed is zero *•cable / connector is defective and has bad contact* *•speed sensor has an internal defect* *•sensor gap has the wrong size*	OP-Mode: substitute clutch control if a failure is existing at output speed, TCU shifts to neutral OP-Mode: limp home	•check cable from TCU to sensor •check connectors •check speed sensor •check sensor gap	This fault is reset after power up of TCU

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Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
37	S.C. TO BATTERY VOLTAGE OR O.C. AT INTERNAL SPEED INPUT TCU measures a voltage higher than 7.00 V at speed input pin •*cable is defective and is contacted to battery voltage* •*cable has no connection to TCU* •*speed sensor has an internal defect* •*connector pin is contacted to battery voltage or has no contact*	OP-Mode: substitute clutch control	•check cable from TCU to sensor •check connectors •check speed sensor	
38	S.C. TO GROUND AT INTERNAL SPEED INPUT TCU measures a voltage less than 0.45V at speed input pin •*cable / connector is defective and is contacted to vehicle ground* •*speed sensor has an internal defect*	OP-Mode: substitute clutch control	•check cable from TCU to sensor •check connectors •check speed sensor	
39	LOGICAL ERROR AT INTERNAL SPEED INPUT TCU measures a internal speed over a threshold and at the next moment the measured speed is zero •*cable / connector is defective and has bad contact* •*speed sensor has an internal defect* •*sensor gap has the wrong size*	OP-Mode: substitute clutch control	•check cable from TCU to sensor •check connectors •check speed sensor •check sensor gap	This fault is reset after power up of TCU
3A	S.C. TO BATTERY VOLTAGE OR O.C. AT OUTPUT SPEED INPUT TCU measures a voltage higher than 12.5 V at speed input pin •*cable is defective and is contacted to battery voltage* •*cable has no connection to TCU* •*speed sensor has an internal defect* •*connector pin is contacted to battery voltage or has no contact*	special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home	•check cable from TCU to sensor •check connectors •check speed sensor	
3B	S.C. TO GROUND AT OUTPUT SPEED INPUT TCU measures a voltage less than 1.00V at speed input pin •*cable / connector is defective and is contacted to vehicle ground*	special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home	•check cable from TCU to sensor •check connectors •check speed sensor	
3C	LOGICAL ERROR AT OUTPUT SPEED INPUT TCU measures a output speed over a threshold and at the next moment the measured speed is zero •*cable / connector is defective and has bad contact* •*speed sensor has an internal defect* •*sensor gap has the wrong size*	special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home	•check cable from TCU to sensor •check connectors •check speed sensor •check sensor gap	This fault is reset after power up of TCU
3E	OUTPUT SPEED ZERO DOESN'T FIT TO OTHER SPEED SIGNALS if transmission is not neutral and the shifting has finished, TCU measures outputspeed zero and turbine speed or internal speed not equal to zero. •*speed sensor has an internal defect* •*sensor gap has the wrong size*	special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home	•check sensor signal of output speed sensor •check sensor gap of output speed sensor •check cable from TCU to sensor	This fault is reset after power up of TCU
56	ENGINE CONF TIMEOUT Timeout of CAN-message ENGINE CONF from engine controller •*interference on CAN-Bus* •*CAN wire/connector is broken* •*CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	OP-Mode: substitute clutch control	•check engine controller •check wire of CAN-Bus •check cable to engine controller	

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Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
57	EEC1 TIMEOUT Timeout of CAN-message EEC1 from EEC controller •*interference on CAN-Bus* •*CAN wire/connector is broken* •*CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	OP-Mode: substitute clutch control	•check EEC controller •check wire of CAN-Bus •check cable to EEC controller	
58	EEC3 TIMEOUT Timeout of CAN-message EEC3 from EEC controller •*interference on CAN-Bus* •*CAN wire/connector is broken* •*CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	OP-Mode: substitute clutch control	•check EEC controller •check wire of CAN-Bus •check cable to EEC controller	
65	ENGINGE TORQUE SIGNAL CAN signal for engine torque is defective •*engine controller is defective* •*interference on CAN-Bus*	OP-Mode: substitute clutch control	•check engine controller •check wire of CAN-Bus •check cable to engine controller	
66	KICKDOWN SIGNAL CAN signal for kickdown is defective •*engine controller is defective* •*interference on CAN-Bus*	no reaction	•check engine controller •check wire of CAN-Bus •check cable to engine controller	
69	REFERENCE ENGINE TORQUE SIGNAL CAN signal for reference of engine torque is defective •*engine controller is defective* •*interference on CAN-Bus*	OP-Mode: substitute clutch control	•check engine controller •check wire of CAN-Bus •check cable to engine controller	
6A	ACTUAL ENGINE TORQUE SIGNAL CAN signal for actual engine torque is defective •*engine controller is defective* •*interference on CAN-Bus*	OP-Mode: substitute clutch control	•check engine controller •check wire of CAN-Bus •check cable to engine controller	
6B	NOM FRICTION TORQUE SIGNAL CAN signal for nominal friction torque is defective •*engine controller is defective* •*interference on CAN-Bus*	OP-Mode: substitute clutch control	•check engine controller •check wire of CAN-Bus •check cable to engine controller	
6E	EEC2 TIMEOUT Timeout of CAN-message EEC2 from EEC controller •*interference on CAN-Bus* •*CAN wire/connector is broken* •*CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	no reaction TCU uses default signal accelerator pedal in idle position OP-Mode: normal	•check EEC controller •check wire of CAN-Bus •check cable to EEC controller	
6F	ACCELERATOR LOW IDLE SWITCH SIGNAL CAN signal for manual downshift is defective •*EEC controller is defective* •*interference on CAN-Bus*	no reaction TCU uses default signal accelerator pedal in idle position OP-Mode: normal	•check EEC controller •check wire of CAN-Bus •check cable to EEC controller	if this signal is not transmitted via CAN, TCU uses default signal
71	S.C. TO BATTERY VOLTAGE AT CLUTCH K1 the measured resistance value of the valve is out of limit, the voltage at K1 valve is too high. •*cable / connector is defective and has contact to battery voltage* •*cable / connector is defective and has contact to another regulator output of the TCU* •*regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from TCU to gearbox •check regulator resistance [1] •check internal wire harness of the gearbox	[1] see figure 8
72	S.C. TO GROUND AT CLUTCH K1 the measured resistance value of the valve is out of limit, the voltage at K1 valve is too low. •*cable / connector is defective and has contact to vehicle ground* •*regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1] •check internal wire harness of the gearbox	[1] see figure 8

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Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
73	O.C. AT CLUTCH K1 the measured resistance value of the valve is out of limit. *•cable / connector is defective and has no contact to TCU* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
74	S.C. TO BATTERY VOLTAGE AT CLUTCH K2 the measured resistance value of the valve is out of limit, the voltage at K2 valve is too high. *•cable / connector is defective and has contact to battery voltage* *•cable / connector is defective and has contact to another regulator output of the TCU* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
75	S.C. TO GROUND AT CLUTCH K2 the measured resistance value of the valve is out of limit, the voltage at K2 valve is too low. *•cable / connector is defective and has contact to vehicle ground* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
76	O.C. AT CLUTCH K2 the measured resistance value of the valve is out of limit. *•cable / connector is defective and has no contact to TCU* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
77	S.C. TO BATTERY VOLTAGE AT CLUTCH K3 the measured resistance value of the valve is out of limit, the voltage at K3 valve is too high. *•cable / connector is defective and has contact to battery voltage* *•cable / connector is defective and has contact to another regulator output of the TCU* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
78	S.C. TO GROUND AT CLUTCH K3 the measured resistance value of the valve is out of limit, the voltage at K3 valve is too low. *•cable / connector is defective and has contact to vehicle ground* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
79	O.C. AT CLUTCH K3 the measured resistance value of the valve is out of limit. *•cable / connector is defective and has no contact to TCU* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
81	S.C. TO BATTERY VOLTAGE AT CLUTCH K4 the measured resistance value of the valve is out of limit, the voltage at K4 valve is too high. *•cable / connector is defective and has contact to battery voltage* *•cable / connector is defective and has contact to another regulator output of the TCU* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8

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Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
82	S.C. TO GROUND AT CLUTCH K4 the measured resistance value of the valve is out of limit, the voltage at K4 valve is too low. *•cable / connector is defective and has contact to vehicle ground* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
83	O.C. AT CLUTCH K4 the measured resistance value of the valve is out of limit. *•cable / connector is defective and has no contact to TCU* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
84	S.C. TO BATTERY VOLTAGE AT CLUTCH KV the measured resistance value of the valve is out of limit, the voltage at KV valve is too high. *•cable / connector is defective and has contact to battery voltage* *•cable / connector is defective and has contact to another regulator output of the TCU* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
85	S.C. TO GROUND AT CLUTCH KV the measured resistance value of the valve is out of limit, the voltage at KV valve is too low. *•cable / connector is defective and has contact to vehicle ground* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
86	O.C. AT CLUTCH KV the measured resistance value of the valve is out of limit. *•cable / connector is defective and has no contact to TCU* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
87	S.C. TO BATTERY VOLTAGE AT CLUTCH KR the measured resistance value of the valve is out of limit, the voltage at KR valve is too high. *•cable / connector is defective and has contact to battery voltage* *•cable / connector is defective and has contact to another regulator output of the TCU* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
88	S.C. TO GROUND AT CLUTCH KR the measured resistance value of the valve is out of limit, the voltage at KR valve is too low. *•cable / connector is defective and has contact to vehicle ground* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8
89	O.C. AT CLUTCH KR the measured resistance value of the valve is out of limit. *•cable / connector is defective and has no contact to TCU* *•regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check cable from TCU to gearbox •check connectors from gearbox to TCU •check regulator resistance [1)] •check internal wire harness of the gearbox	[1)] see figure 8

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Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
91	S.C. TO GROUND AT RELAY REVERSE WARNING ALARM TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground •*cable is defective and is contacted to vehicle ground* •*backup alarm device has an internal defect* •*connector pin is contacted to vehicle ground*	backup alarm will be on until TCU power down even if fault vanishes (loose connection) OP-Mode: normal	•check cable from TCU to backup alarm device •check connectors from backup alarm device to TCU •check resistance [1] of backup alarm device	[1] see figure 8
92	S.C. TO BATTERY VOLTAGE AT RELAY REVERSE WARNING ALARM TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage •*cable is defective and is contacted to battery voltage* •*backup alarm device has an internal defect* •*connector pin is contacted to battery voltage*	no reaction OP-Mode: normal	•check cable from TCU to backup alarm device •check connectors from backup alarm device to TCU •check resistance [1] of backup alarm device	[1] see figure 8
93	O.C. AT RELAY REVERSE WARNING ALARM TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin •*cable is defective and has no connection to TCU* •*backup alarm device has an internal defect* •*connector has no connection to TCU*	no reaction OP-Mode: normal	•check cable from TCU to backup alarm device •check connectors from backup alarm device to TCU •check resistance [1] of backup alarm device	[1] see figure 8
9A	S.C. TO GROUND AT CONVERTER LOCK UP CLUTCH TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground •*cable is defective and is contacted to vehicle ground* •*converter clutch solenoid has an internal defect* •*connector pin is contacted to vehicle ground*	no reaction OP-Mode: normal	•check cable from TCU to converter clutch solenoid •check connectors from converter clutch solenoid to TCU •check resistance [1] of converter clutch solenoid	[1] see figure 8
9B	O.C. AT CONVERTER LOCK UP CLUTCH TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin •*cable is defective and has no connection to TCU* •*converter clutch solenoid has an internal defect* •*connector has no connection to TCU*	converter clutch always open, retarder not available OP-Mode: normal	•check cable from TCU to converter clutch solenoid •check connectors from converter clutch solenoid to TCU •check resistance [1] of converter clutch solenoid	[1] see figure 8
9C	S.C. TO BATTERY VOLTAGE AT CONVERTER LOCK UP CLUTCH TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage •*cable is defective and is contacted to battery voltage* •*converter clutch solenoid has an internal defect* •*connector pin is contacted to battery voltage*	no reaction OP-Mode: normal	•check cable from TCU to converter clutch solenoid •check connectors from converter clutch solenoid to TCU •check resistance [1] of converter clutch solenoid	[1] see figure 8
9D	S.C. TO GROUND AT RETARDER TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground •*cable is defective and is contacted to vehicle ground* •*retarder solenoid has an internal defect* •*connector pin is contacted to vehicle ground*	no reaction OP-Mode: normal	•check cable from TCU to retarder solenoid •check connectors from retarder solenoid to TCU •check resistance [1] of retarder solenoid	[1] see figure 8
9E	O.C. AT RETARDER TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin •*cable is defective and has no connection to TCU* •*retarder solenoid has an internal defect* •*connector has no connection to TCU*	no reaction OP-Mode: normal	•check cable from TCU to retarder solenoid •check connectors from retarder solenoid to TCU •check resistance [1] of retarder solenoid	[1] see figure 8
9F	S.C. TO BATTERY VOLTAGE AT RETARDER SOLENOID TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage •*cable is defective and is contacted to battery voltage* •*retarder solenoid has an internal defect* •*connector pin is contacted to battery voltage*	no reaction OP-Mode: normal	•check cable from TCU to retarder solenoid •check connectors from retarder solenoid to TCU •check resistance [1] of retarder solenoid	[1] see figure 8

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Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
A1	S.C. TO GROUND AT DIFFLOCK SOLENOID TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground •*cable is defective and is contacted to vehicle ground* •*difflock solenoid has an internal defect* •*connector pin is contacted to vehicle ground*	no reaction OP-Mode: normal	•check cable from TCU to difflock solenoid •check connectors from difflock solenoid to TCU •check resistance [1] of difflock solenoid	[1] see figure 8
A2	S.C. TO BATTERY VOLTAGE AT DIFFLOCK SOLENOID TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage •*cable is defective and is contacted to battery voltage* •*difflock solenoid has an internal defect* •*connector pin is contacted to battery voltage*	no reaction OP-Mode: normal	•check cable from TCU to difflock solenoid •check connectors from difflock solenoid to TCU •check resistance [1] of difflock solenoid	[1] see figure 8
A3	O.C. AT DIFFLOCK SOLENOID TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin •*cable is defective and has no connection to TCU* •*difflock solenoid has an internal defect* •*connector has no connection to TCU*	no reaction OP-Mode: normal	•check cable from TCU to difflock solenoid •check connectors from difflock solenoid to TCU •check resistance [1] of difflock solenoid	[1] see figure 8
A4	S.C. TO GROUND AT WARNING SIGNAL OUTPUT TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground •*cable is defective and is contacted to vehicle ground* •*warning device has an internal defect* •*connector pin is contacted to vehicle ground*	no reaction OP-Mode: normal	•check cable from TCU to warning device •check connectors from warning device to TCU •check resistance [1] of warning device	[1] see figure 8
A5	O.C. AT WARNING SIGNAL OUTPUT TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin •*cable is defective and has no connection to TCU* •*warning device has an internal defect* •*connector has no connection to TCU*	no reaction OP-Mode: normal	•check cable from TCU to warning device •check connectors from warning device to TCU •check resistance [1] of warning device	[1] see figure 8
A6	S.C. TO BATTERY VOLTAGE AT WARNING SIGNAL OUTPUT TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage •*cable is defective and is contacted to battery voltage* •*warning device has an internal defect* •*connector pin is contacted to battery voltage*	no reaction OP-Mode: normal	•check cable from TCU to warning device •check connectors from warning device to TCU •check resistance [1] of warning device	[1] see figure 8
B1	SLIPPAGE AT CLUTCH K1 TCU calculates a differential speed at closed clutch K1. If this calculated value is out of range, TCU interprets this as slipping clutch. •*low pressure at clutch K1* •*low main pressure* •*wrong signal at internal speed sensor* •*wrong signal at output speed sensor* •*wrong size of the sensor gap* •*clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check pressure at clutch K1 •check main press. in system •check sensor gap at internal speed sensor •check sensor gap at output speed sensor •check signal at internal speed sensor •check signal at output speed sensor •replace clutch	
B2	SLIPPAGE AT CLUTCH K2 TCU calculates a differential speed at closed clutch K2. If this calculated value is out of range, TCU interprets this as slipping clutch. •*low pressure at clutch K2* •*low main pressure* •*wrong signal at internal speed sensor* •*wrong signal at output speed sensor* •*wrong size of the sensor gap* •*clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check pressure at clutch K2 •check main press. in system •check sensor gap at internal speed sensor •check sensor gap at output speed sensor •check signal at internal speed sensor •check signal at output speed sensor •replace clutch	

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Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
B3	SLIPPAGE AT CLUTCH K3 TCU calculates a differential speed at closed clutch K3. If this calculated value is out of range, TCU interprets this as slipping clutch. *•low pressure at clutch K3* *•low main pressure* *•wrong signal at internal speed sensor* *•wrong signal at output speed sensor* *•wrong size of the sensor gap* *•clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check pressure at clutch K3 •check main press. in system •check sensor gap at internal speed sensor •check sensor gap at output speed sensor •check signal at internal speed sensor •check signal at output speed sensor •replace clutch	
B4	SLIPPAGE AT CLUTCH K4 TCU calculates a differential speed at closed clutch K4. If this calculated value is out of range, TCU interprets this as slipping clutch. *•low pressure at clutch K4* *•low main pressure* *•wrong signal at internal speed sensor* *•wrong signal at turbine speed sensor* *•wrong size of the sensor gap* *•clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check pressure at clutch K4 •check main press. in system •check sensor gap at internal speed sensor •check sensor gap at turbine speed sensor •check signal at internal speed sensor •check signal at turbine speed sensor •replace clutch	
B5	SLIPPAGE AT CLUTCH KV TCU calculates a differential speed at closed clutch KV. If this calculated value is out of range, TCU interprets this as slipping clutch. *•low pressure at clutch KV* *•low main pressure* *•wrong signal at internal speed sensor* *•wrong signal at turbine speed sensor* *•wrong size of the sensor gap* *•clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check pressure at clutch KV •check main press. in system •check sensor gap at internal speed sensor •check sensor gap at turbine speed sensor •check signal at internal speed sensor •check signal at turbine speed sensor •replace clutch	
B6	SLIPPAGE AT CLUTCH KR TCU calculates a differential speed at closed clutch KR. If this calculated value is out of range, TCU interprets this as slipping clutch. *•low pressure at clutch KR* *•low main pressure* *•wrong signal at internal speed sensor* *•wrong signal at turbine speed sensor* *•wrong size of the sensor gap* *•clutch is defective*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	•check pressure at clutch KR •check main press. in system •check sensor gap at internal speed sensor •check sensor gap at turbine speed sensor •check signal at internal speed sensor •check signal at turbine speed sensor •replace clutch	
B7	OVERTEMP SUMP TCU measured a temperature in the oil sump that is TCU measured a temperature in the oil sump that is over the allowed threshold.	no reaction OP-Mode: normal OP-Mode: normal	•cool down machine •check oil level •check oil level •check temperature sensor	
B8	OVERTEMP RETARDER TCU measured a temperature in the retarder oil that is over the allowed threshold.	TCU disables retarder OP-Mode: normal	•cool down machine •check oil level •check temperature sensor	
B9	OVERSPEED ENGINE	retarder applies OP-Mode: normal	-	not used
BA	DIFFERENTIAL PRESSURE OIL FILTER TCU measured a voltage at differential pressure switch out of the allowed range. *•oil filter is polluted* *•cable/connector is broken or cable/connector is contacted to battery voltage or vehicle ground* *•differential pressure switch is defective*	no reaction OP-Mode: normal	•check oil filter •check wiring from TCU to differential pressure switch •check differential pressure switch (measure resistance)	

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Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
BB	SLIPPAGE AT CONVERTER LOCKUP CLUTCH TCU calculates a differential speed at closed converter lockup clutch. If this calculated value is out of range, TCU interprets this as slipping clutch. *•low pressure at converter lockup clutch* *•low main pressure* *•wrong signal at engine speed sensor* *•wrong signal at turbine speed sensor* *•wrong size of the sensor gap* *•clutch is defective*		•check pressure at converter lockup clutch •check main pressure in the system •check sensor gap at engine speed sensor •check sensor gap at turbine speed sensor •check signal at engine speed sensor •check signal at turbine speed sensor •replace clutch	
BD	S.C. TO GROUND AT ENGINE BRAKE SOLENOID TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground *•cable is defective and is contacted to vehicle ground* *•engine brake solenoid has an internal defect* *•connector pin is contacted to vehicle ground*	no reaction OP-mode: normal	•check cable from TCU to engine brake solenoid •check connectors from engine brake solenoid to TCU •check the resistance [1] of engine brake solenoid	[1] see figure 8
BE	S.C. TO BATTERY VOLTAGE AT ENGINE BRAKE TCU detected a wrong voltage at the output pin, that looks like a s.c. to battery voltage *•cable is defective and is contacted to battery voltage* *•engine brake solenoid has an internal defect* *•connector pin is contacted to battery voltage*	no reaction OP-mode: normal	•check cable from TCU to engine brake solenoid •check connectors from engine brake solenoid to TCU •check the resistance [1] of engine brake solenoid	[1] see figure 8
BF	O.C. AT ENGINE BRAKE TCU detected a wrong voltage at the output pin, that looks like a o.c. for this output pin *•cable is defective and has no connection to TCU* *•engine brake solenoid has an internal defect* *•connector has no connection to TCU*	no reaction OP-mode: normal	•check cable from TCU to engine brake solenoid •check connectors from engine brake solenoid to TCU •check the resistance [1] of engine brake solenoid	[1] see figure 8
D1	S.C. TO BATTERY VOLTAGE AT POWER SUPPLY FOR SENSORS TCU measures more than 6V at the pin AU1 (5V sensor supply)	see fault codes no. 21 to no. 2C	•check cables and connectors to sensors, which are supplied from AU1 •check power supply at pin AU1 (should be approx. 5V)	fault codes no. 21 to no. 2C may be a reaction of this fault
D2	S.C. TO GROUND AT POWER SUPPLY FOR SENSORS TCU measures less than 4V at the pin AU1 (5V sensor supply)	see fault codes no. 21 to no. 2C	•check cables and connectors to sensors, which are supplied from AU1 •check power supply at pin AU1 (should be approx. 5V)	fault codes no. 21 to no. 2C may be a reaction of this fault
D3	LOW POWER AT BATTERY measured voltage at power supply is lower than 18 V	shift to neutral OP-Mode: TCU shutdown	•check power supply battery •check cables from batteries to TCU •check connectors from batteries to TCU	
D4	HIGH POWER AT BATTERY measured voltage at power supply is higher than 32.5 V	shift to neutral OP-Mode: TCU shutdown	•check power supply battery •check cables from batteries to TCU •check connectors from batteries to TCU	

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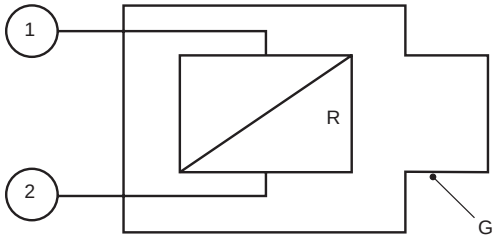
https://truckmanualshub.com/

Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
D5	ERROR AT SWITCH 1 FOR VALVE POWER SUPPLY VPS1 TCU switched on VPS1 and measured VPS1 is off or TCU switched off VPS1 and measured VPS1 is still on *•cable or connectors are defect and are contacted to battery voltage* *•cable or connectors are defect and are contacted to vehicle ground* *•permanent power supply KL30 missing* *•TCU has an internal defect*	shift to neutral OP-Mode: TCU shutdown	•check fuse •check cables from gearbox to TCU •check connectors from gearbox to TCU •replace TCU	
D6	ERROR AT SWITCH 2 FOR VALVE POWER SUPPLY VPS2 TCU switched on VPS2 and measured VPS2 is off or TCU switched off VPS2 and measured VPS2 is still on *•cable or connectors are defect and are contacted to battery voltage* *•cable or connectors are defect and are contacted to vehicle ground* *•permanent power supply KL30 missing* *•TCU has an internal defect*	shift to neutral OP-Mode: TCU shutdown	•check fuse •check cables from gearbox to TCU •check connectors from gearbox to TCU •replace TCU	
E3	S.C. TO BATTERY VOLTAGE AT DISPLAY OUTPUT TCU sends data to the display and measures always a high voltage level on the connector. *•cable or connectors are defect and are contacted to battery voltage* *•display has an internal defect*	no reaction OP-Mode: normal	•check cable from TCU to the display •check connectors at the display •change display	
E4	S.C. TO GROUND AT DISPLAY OUTPUT TCU sends data to the display and measures always a high voltage level on the connector. *•cable or connectors are defect and are contacted to vehicle ground* *•display has an internal defect*	no reaction OP-Mode: normal	•check cable from TCU to the display •check connectors at the display •change display	
F1	GENERAL EEPROM FAULT TCU cannot read non volatile memory *•TCU is defective*	no reaction OP-Mode: normal	•replace TCU	often shown together with fault code F2
F3	APPLICATION ERROR something of this application is wrong	transmission stay neutral OP-Mode: TCU shutdown	•replace TCU	fault occurs only if a test engineer did something wrong in the application of the vehicle
F5	CLUTCH FAILURE AEB was not able to adjust clutch filling parameters *•One of the AEB-Values is out of limit*	transmission stay neutral OP-Mode: TCU shutdown	•check clutch	TCU shows also the affected clutch on the Display
F6	CLUTCH ADJUSTMENT DATA LOST TCU was not able to read correct clutch adjustment parameters *•interference during saving data on non volatile memory* *•TCU is brand new or from another vehicle*	TCU shifts to neutral OP-Mode: limp home	•execute AEB	

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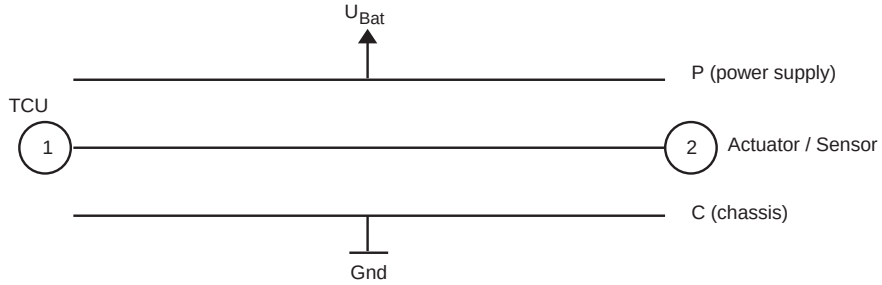
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8.1 Actuator:



open circuit:	$R_{12} \approx R_{1G} \approx R_{2G} \approx \infty$		
short cut to ground:	$R_{12} \approx R$;	$R_{1G} \approx 0$, $R_{2G} \approx R$ or $R_{1G} \approx R$, $R_{2G} \approx 0$	(for s.c. to ground, G is connected to vehicle ground)
short cut to battery:	$R_{12} \approx R$;	$R_{1G} \approx 0$, $R_{2G} \approx R$ or $R_{1G} \approx R$, $R_{2G} \approx 0$	(for s.c. to battery, G is connected to battery voltage)

8.2 Cable:



open circuit:	$R_{12} \approx R_{1P} \approx R_{1C} \approx R_{2P} \approx R_{2C} \approx \infty$		
short cut to ground:	$R_{12} \approx 0$;	$R_{1C} \approx R_{2C} \approx 0$,	$R_{1P} \approx R_{2P} \approx \infty$
short cut to battery:	$R_{12} \approx 0$,	$R_{1C} \approx R_{2C} \approx \infty$,	$R_{1P} \approx R_{2P} \approx 0$

Fig. 8 - Measuring Resistance at Actuator/Sensors and Cable

REMOVAL

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

Note: Tag all lines, cables and linkages disconnected during removal to aid in installation.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position. Disconnect battery cables from terminal posts (ground cable first).

3. Place a suitable container under the transmission drain port, remove drain plug and drain oil. After draining, reinstall drain plug and tighten securely.

Note: If anti-spill drain plug is fitted, remove cap from connection, install drain tube connection and drain oil into a suitable container.

4. Open drain cocks on air tanks and drain all air from the system. Close drain cocks securely after draining.

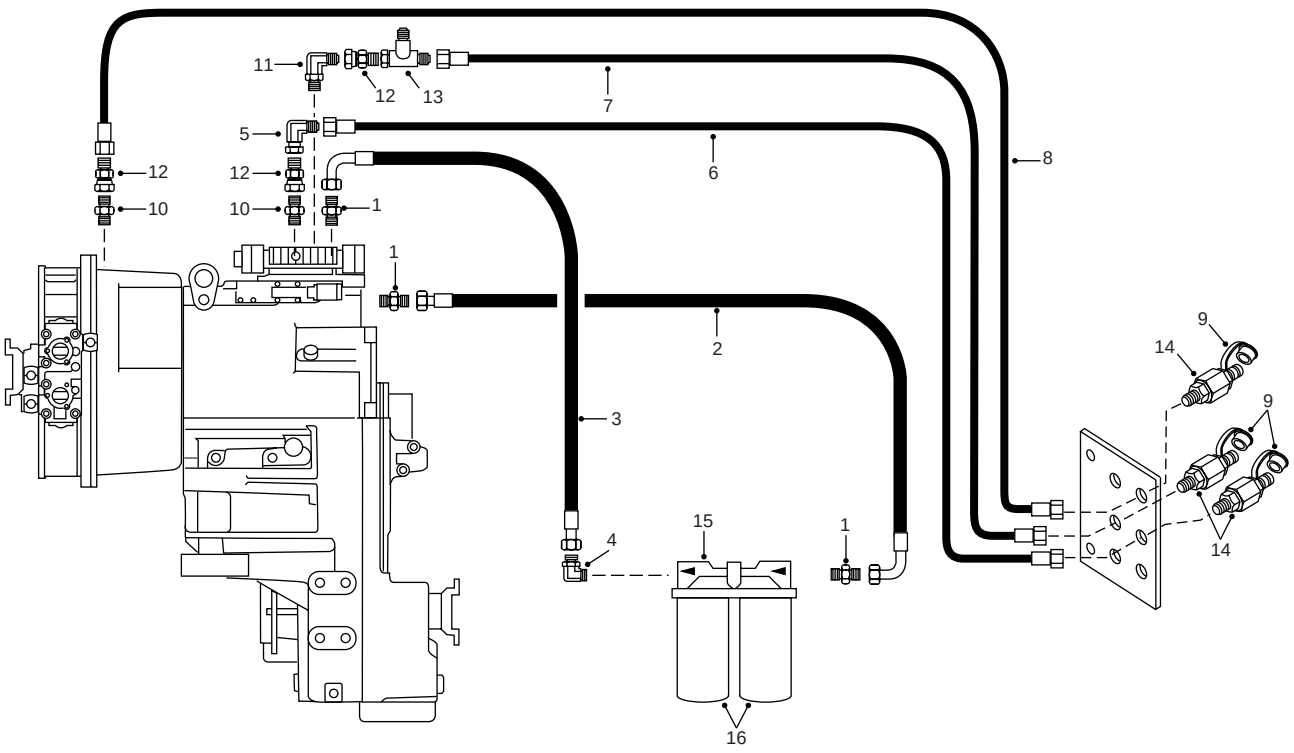
5. Remove drain plug from remote drain cock on the hydraulic tank and drain hydraulic oil into a suitable container. Close drain cock and reinstall drain plug. Refer to Section 230-0040, HYDRAULIC TANK.

6. Disconnect transmission harness at the cab floor and earth strap between rear LH side of the transmission and the frame.

7. Remove cab from the machine. Refer to Section 260-0010, CAB AND MOUNTING.

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1 - Adaptor
2 - Hose Assembly
3 - Hose Assembly
4 - Elbow
5 - Elbow
6 - Tube Assembly
7 - Tube Assembly
8 - Tube Assembly
9 - Dust Cap
10 - Adaptor
11 - Elbow
12 - Adaptor
13 - Tee Piece
14 - Diagnostic Nipple
15 - Oil Filter Head
16 - Filter Cartridge

Fig. 9 - Transmission Oil Lines

8. Disconnect all drivelines connected to the transmission and secure clear of the transmission. Refer to Section 130-0010, FRONT & REAR DRIVELINES.

9. Identify and tag hydraulic lines at the main hydraulic pump to aid in installation. Disconnect hydraulic lines and cap lines and ports to prevent entry of dirt.

10. Remove main hydraulic pump from transmission PTO. Refer to Section 230-0050, MAIN HYDRAULIC PUMP.

11. Identify and tag oil cooler lines at the transmission retarder to aid in installation. Disconnect both lines and cap lines and ports to prevent entry of dirt. Refer to Section 210-0060, TRANSMISSION OIL COOLER.

12. Identify and tag air lines connected to retarder solenoid, differential lock solenoid and pressure reducing valve mounted on front bracket assembly (1).

13. Disconnect air line from transmission retarder port fitting. Cap line end and fitting to prevent entry of dirt.

14. Identify and tag oil filter hose assemblies (2 & 3, Fig. 9) to aid in installation. Disconnect hose assemblies (2 & 3, Fig. 9) and cap open ends and adaptors (1, Fig. 9) and elbow (4, Fig. 9) to prevent entry of dirt.

15. Identify and tag diagnostic hose assemblies (6, 7 & 8, Fig. 9) to aid in installation. Disconnect tube assemblies (6, 7 & 8, Fig. 9) and cap open ends and elbow (5, Fig. 9), adaptor (12, Fig. 9) and tee piece (13, Fig. 9) to prevent entry of dirt.

16. Remove mounting hardware securing body control valve bracket to the RH frame rail and ease bracket towards the wheel to allow clearance for transmission removal.

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17. Remove locknut (20), bolt (18), washer (19) and clamp (17) securing dipstick tube (15) assembly to bracket (16). Remove screws (23), dipstick tube (15) assembly and gasket (24) from the transmission.

18. Disconnect all clips securing lines and cables to the transmission which are not removed with the transmission assembly.

19. Attach suitable lifting equipment to transmission lifting eyes and raise lifting equipment to take up the slack.

20. Remove locknut (5), hardened washer (14), bolt (6) and snubbing washer (3) securing LH bracket (7) to frame mounts.

21. Remove locknut (5), hardened washer (14), bolt (6) and snubbing washer (3) securing RH bracket (13) to frame mounts.

22. Remove locknuts (5), washers (4), snubbing washers (3) and bolts (6) securing front bracket assembly (1) to frame mounts.

23. Check to make certain that all necessary line and cable disconnections have been made before lifting the transmission.

24. Carefully raise the transmission ensuring that no lines, cables or components foul during removal. When the transmission is clear of the frame assembly, move to a suitable work area and mount securely on a work stand.

25. Remove front isolation mounts (2) from frame mounts and replace if required.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

1. Remove mounting hardware securing retarder solenoid, differential lock solenoid and pressure reducing valve to front bracket assembly (1). Remove items from front bracket assembly (1).

2. Remove bolts (12), lockwashers (11) and front bracket assembly (1) from the transmission.

3. Remove bolts (10), lockwashers (9) and LH bracket (7) from the transmission. Remove isolation mount (8) from LH bracket (7) and replace if required.

4. Remove bolts (10), lockwashers (9) and RH bracket (13) from the transmission. Remove isolation mount (8) from RH bracket (13) and replace if required.

5. If required, identify and tag electrical connections to engine speed sensor, output speed sensor, central gear train sensor and turbine speed sensor (5, 6, 7 & 8, Fig. 2) and remove sensors from the transmission.

6. If required, identify and tag electrical connections to oil temperature sender (gauge) (9, Fig. 2) and retarder oil temperature sender (1, Fig. 2) and remove from the top of the transmission.

7. Refer to transmission manufacturers service manual if transmission service or repair is required.

INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Check front bracket assembly (1), LH bracket (7), RH bracket (13) and frame mounting brackets for cracks and damage. Repair or replace as required.

2. Check general condition of transmission assembly for wear and damage. Check for worn or damaged driveline flanges and excessive wear on mounting holes.

3. Check condition of all electrical harnesses and connections and repair/replace as required. Check condition of all hydraulic lines on the transmission and replace if damaged.

ASSEMBLY

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

1. If removed, install oil temperature sender (gauge) (9, Fig. 2) and retarder oil temperature sender (9, Fig. 2) in top of the transmission. Tighten electrical connection securely.

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2. If removed, install engine speed sensor, output speed sensor, central gear train sensor and turbine speed sensor (5, 6, 7 & 8, Fig. 2) in the transmission as shown in Fig. 2. Tighten electrical connections securely.

3. Apply Loctite Activator 'T' and Loctite 638 to bolts (10). Secure LH bracket (7) and RH bracket (13) to the transmission with bolts (10) and lockwashers (9). Tighten bolts (10) to a torque of 410 Nm (302 lbf ft).

4. Secure front bracket assembly (1) to the transmission with bolts (12) and lockwashers (11). Tighten bolts (12) to a torque of 225 Nm (166 lbf ft).

5. Secure retarder solenoid, differential lock solenoid and pressure reducing valve to front bracket assembly (1) with mounting hardware removed during disassembly.

INSTALLATION

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 250-0000, BRAKING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

Note: Isolation mounts (2 & 8) are colour coded to aid in installation. Front isolation mounts (2) are green and white whereas rear isolation mounts (8) are blue and white.

1. Lubricate front isolation mounts (2) with water or a suitable rubber lubricant and install in front frame mounts, with spigots to the underside of the mounts.

2. Lubricate rear isolation mounts (8) with water or a suitable rubber lubricant and install in brackets (7 & 13), with spigots to the underside of the brackets.

3. Attach suitable lifting equipment to transmission lifting eyes and carefully position the transmission assembly in the frame. Take care to avoid snagging any lines, harnesses or components attached to the transmission.

4. Secure rear mounting brackets (7 & 13) to frame mounts with bolts (6), snubbing washers (3), hardened washers (14) and locknuts (5), as shown in Fig. 1. Tighten bolts (6) to a torque of 265 Nm (195 lbf ft).

5. Secure front bracket assembly (1) to frame mounts with bolts (6), snubbing washers (3), washers (4) and locknuts (5), as shown in Fig. 1. Tighten bolts (6) to a torque of 300 Nm (220 lbf ft).

6. Remove lifting equipment from transmission lifting eyes.

7. Install new gasket (24) on dipstick tube (15) assembly and secure assembly to the transmission with screws (23). Secure dipstick tube (15) to bracket (16) with bolt (18), washer (19), clamp (17) and locknut (20).

8. Secure body control valve mounting bracket to the RH frame rail with mounting hardware removed during removal.

9. Remove blanking cap from tube assembly (8, Fig. 9) and adaptor (12, Fig. 9) and connect tube assembly to the adaptor.

10. Remove blanking cap from tube assembly (7, Fig. 9) and tee piece (13, Fig. 9) and connect tube assembly to the tee piece.

11. Remove blanking cap from tube assembly (6, Fig. 9) and elbow (5, Fig. 9) and connect tube assembly to the elbow.

12. Remove blanking caps from hose assemblies (2 & 3, Fig. 9), elbow (4, Fig. 9) and adaptors (1, Fig. 9) and connect hose assemblies to the elbow and adaptors.

13. Remove blanking cap from retarder air line and retarder port fitting and connect air line to the fitting.

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14. Remove blanking caps and connect air lines to retarder solenoid, differential lock solenoid and pressure reducing valve mounted on front bracket assembly (1), as identified at removal.

15. Remove blanking caps from transmission oil cooler lines and retarder ports and connect oil cooler lines. Refer to Section 210-0060, TRANSMISSION OIL COOLER.

16. Install main hydraulic pump on transmission PTO and secure with mounting hardware removed during removal. Refer to Section 230-0050, MAIN HYDRAULIC PUMP.

17. Remove blanking caps and connect hydraulic lines to the main hydraulic pump, as identified at removal.

18. Connect all drivelines to the transmission and secure with mounting hardware removed during removal. Refer to Section 130-0010, FRONT & REAR DRIVELINES.

19. Prior to installing the cab, ensure that all connections to the transmission, other than cab connections, are connected securely and properly clipped.

20. Install the cab assembly on the front frame. Refer to Section 260-0010, CAB AND MOUNTING.

21. Connect transmission harness at the cab floor and earth strap between LH side of the transmission and the frame.

22. Fill hydraulic tank with hydraulic oil specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK for fill level and procedure.

23. Fill transmission with engine oil specified in Section 300-0020, LUBRICATION SYSTEM. Check the oil level as described under 'Oil Level Check'.

24. Connect battery cables to battery terminal posts (ground cable last).

25. Turn the battery master switch to the 'On' position, start the engine and make an operational check of all lines and electrical connections disconnected during removal. Check for leaks and tighten lines and fittings as required.

26. Ensure parking brake is applied, disconnect steering lock bar and secure in the 'Stowed' position. Remove wheel blocks from all road wheels.

27. Check for correct operation of the transmission, shift selector and warning lights.

MAINTENANCE

Periodic Inspections

For easier inspection, the transmission should be kept clean. Make periodic checks for loose mounting bolts and leaking air and oil lines. Check the condition of electrical harnesses and connections regularly.

Transmission breather (10, Fig. 2) should be checked on a regular basis, and as frequently as necessary, depending on operating conditions. A badly corroded or plugged breather restricts proper breathing and causes a buildup of condensation and subsequent oil deterioration.

Oil Level Check

⚠ WARNING
When checking the oil level, be sure that the parking brake is applied and all road wheels are securely blocked.

Check the transmission oil level and add oil if low, every 10 hours/daily. Use only oil specified in Section 300-0020, LUBRICATION SYSTEM.

Because the transmission oil cools, lubricates and transmits hydraulic power it is important that the proper oil level be maintained at all times. If the oil level is too low, the converter and clutches will not receive an adequate supply of oil. If the oil level is too high, the oil will aerate and the transmission will overheat. It is absolutely necessary that the oil put into the transmission is clean.

Cold Oil Level Check
This check is made only to determine if the transmission contains sufficient oil for safe starting. Make sure there is some oil showing on dipstick (25, Fig. 1).

Hot Oil Level Check
1. Position the vehicle on a level work area, apply the parking brake and block all road wheels securely.

2. With the transmission in neutral and the engine running, allow the machine to idle until normal operating temperature of 80° C (176° F) is achieved. Transmission oil pressure gauge on the dash should show a steady reading.

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3. With parking brake applied, foot on service brake, engine idling and transmission operating at normal temperature, select each gear position in turn. Allow the transmission to remain in each gear for 5 - 10 seconds.

4. Return gear selector to neutral and, with the engine idling, check the oil level on dipstick (25, Fig. 1). Oil level should be up to, but not over, the upper mark on the dipstick. Add oil if low.

Oil and Filter Change

After the first 100 hours of operating a new or rebuilt transmission, the transmission oil and filter cartridges (16, Fig. 8) should be changed. Internal filter and finger magnet at the lower front left hand of the sump should be removed and cleaned.

The transmission oil and filter cartridges should be changed every 1 000 hours, or sooner, depending on operating conditions. Clean oil filter head (15, Fig. 9) when changing filter cartridges (16, Fig. 9). Also, the oil must be changed whenever there are traces of dirt or evidence of high temperature indicated by discoloration or strong odour.

The internal filter and finger magnet at the lower front left hand of the sump should be removed and cleaned with mineral spirits at each oil and filter change. Metal particles in the oil (except for the minute particles normally trapped in the oil filters) indicate damage has occurred in the transmission. When these particles are found in the filters, the cause must be established and rectified immediately to prevent damage to the transmission.

At each oil change, examine the used oil for evidence of dirt or water. A normal amount of condensation will emulsify in the oil during transmission operation. However, if there is evidence of water or engine coolant in the oil, the cause must be established and rectified immediately to prevent damage to the transmission.

SERVICE TOOLS

There are no special tools required for the procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of service tools which should be used in conjunction with procedures outlined in the transmission manufacturers service manual, and, general service tools required. These tools are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	6, Front Mounts	Bolt	300	220
1	6, Rear Mounts	Bolt	265	195
1	10	Bolt	410	302
1	12	Bolt	225	166

* * * *

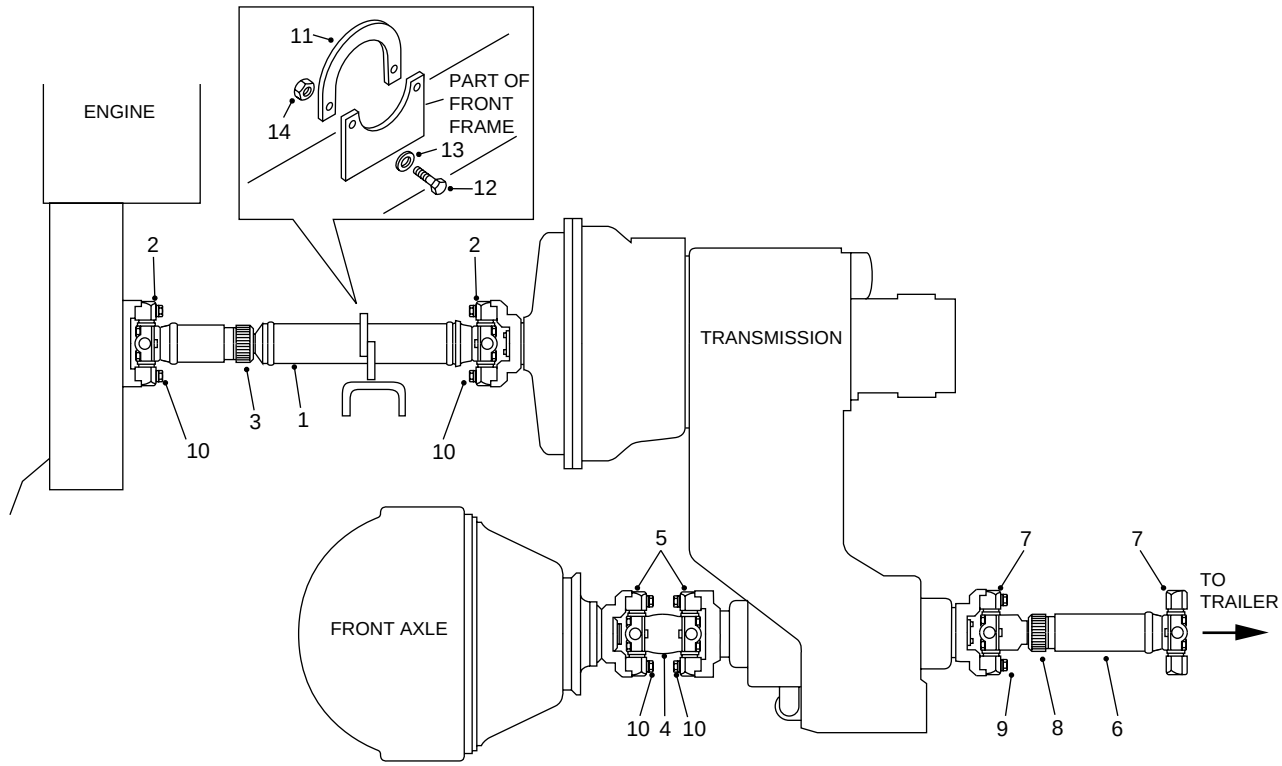
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1 - Driveline Assembly
2 - Cross Assembly
3 - Shaft Seal
4 - Driveline Assembly
5 - Cross Assembly
6 - Driveline Assembly
7 - Cross Assembly
8 - Shaft Seal
9 - Capscrew
10 - Capscrew
11 - Bracket
12 - Bolt
13 - Washer
14 - Locknut

Fig. 1 - Front Drivelines and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

The function of the driveline is to transmit rotating power from one point to another in a smooth and continuous action while allowing a degree of movement or misalignment of the components it connects.

The drivelines must operate through constantly changing relative angles between the components they are mounted to and must also be capable of changing length while transmitting torque.

A typical driveline consists of universal joints which allow some misalignment and permit the driveline to pivot in any direction, and, a light rigid hollow slip yoke and splined shaft assembly forming a slip joint.

The slip joint accommodates length variations generated during operation, preventing tension or compression loads from causing serious damage to the components.

Note: Extra care should be taken when handling the drivelines since chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation.

There are three driveline assemblies installed between various components in the tractor frame as follows:

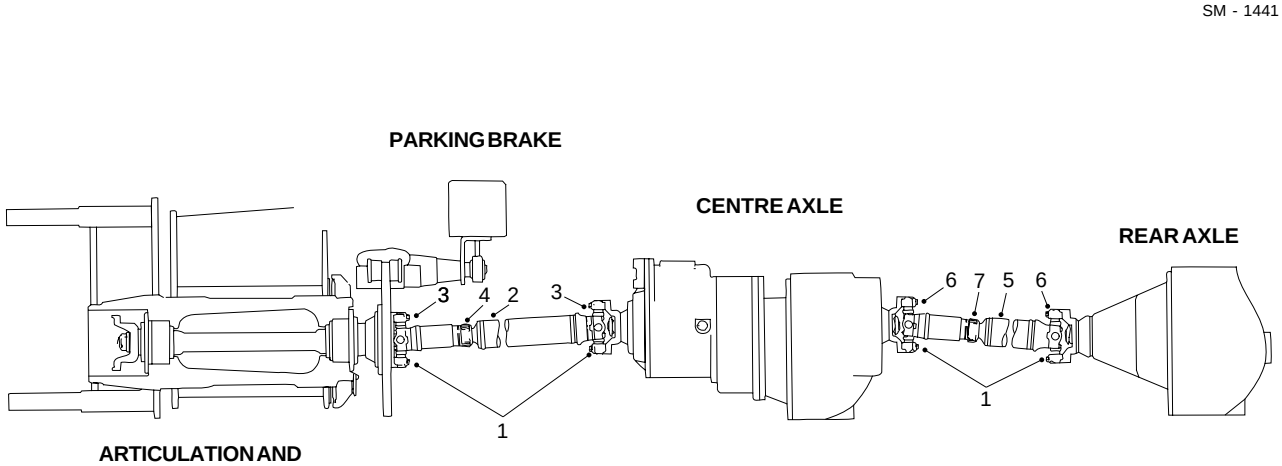
Driveline assembly (1) is connected between the engine drive and transmission input drive.

Driveline assembly (4) is connected between the front axle drive flange and transmission final drive.

Driveline assembly (6) connects the rear final drive of the transmission to the articulation and oscillation pivot.

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1 - Capscrew
2 - Driveline Assembly
3 - Cross Assembly
4 - Shaft Seal
5 - Driveline Assembly
6 - Cross Assembly
7 - Shaft Seal

Fig. 2 - Rear Drivelines and Mounting

There are two driveline assemblies connecting the centre and rear axles to the drive supplied from the transmission, through the pivot drive arrangement, as follows:

Driveline assembly (2, Fig. 2) is connected between the pivot drive arrangement and the centre axle.

Driveline assembly (5, Fig. 2) is connected between the centre axle and the rear axle.

REMOVAL

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: Extra care should be taken when handling drivelines since carelessness can result in premature failure of the components. Chips, dents, burrs, or any other deformity of universal joints will prevent accurate mating. This will cause misalignment which is accompanied by vibration and excessive wear.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ WARNING
To prevent serious injury or death, DO NOT go under the vehicle when the engine is running. Rotating shafts can be dangerous. You can snag clothes, skin, hair, hands, etc..

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

Note: Access to remove driveline assembly (1) can be obtained through the service access plate on the cab floor.

3. Remove floor mat back and remove mounting hardware securing access plate to the cab floor. Remove access plate from the cab.

4. Remove bolts (12), washers (13) and locknuts (14) securing bracket (11) over driveline assembly (1) and onto the engine crossmember. Remove guard bracket.

5. Match mark cross assemblies (2) and their mating surfaces to ensure correct mating alignment when installing driveline assembly (1).

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6. Support driveline (1) with suitable lifting equipment and remove capscrews (10) securing cross assemblies (2) to their mating components. Remove driveline assembly (1). If necessary tap driveline assembly (1) from its mating components with a soft faced hammer.

Note: Access to driveline assemblies (4 & 6) can be obtained from underneath the vehicle.

7. Match mark cross assemblies (5 & 7) and their mating surfaces to ensure correct mating alignment when installing driveline assemblies (4 & 6).

8. Remove capscrews (10) securing cross assemblies (5) to their mating components and remove driveline assembly (4). If necessary tap driveline assembly (4) from its mating components with a soft faced hammer.

9. Remove capscrews (9) securing cross assemblies (7) to their mating components and remove driveline assembly (6). If necessary tap driveline assembly (6) from its mating components with a soft faced hammer.

Note: Access to driveline assemblies (2 & 5, Fig. 2) can be obtained from underneath the vehicle.

10. Match mark cross assemblies (4 & 6, Fig. 2) and their mating surfaces to ensure correct mating alignment when installing driveline assemblies (2 & 5, Fig. 2).

11. Remove capscrews (1, Fig. 2) securing cross assemblies (4, Fig. 2) to their mating components and remove driveline assembly (2, Fig. 2). If necessary tap driveline assembly (2, Fig. 2) from its mating components with a soft faced hammer.

12. Remove capscrews (1, Fig. 2) securing cross assemblies (6, Fig. 2) to their mating components and remove driveline assembly (5, Fig. 2). If necessary tap driveline assembly (5, Fig. 2) from its mating components with a soft faced hammer.

DISASSEMBLY

Cross Assembly

Numbers in parentheses refer to Fig. 1.

1. Place the yoke end of driveline assembly (1) in a soft jawed vice, clamping on the tube of shaft.

Note: Do not distort the tube with excessive grip.

2. Remove capscrews (10) and cross assembly (2) from driveline assembly (1).

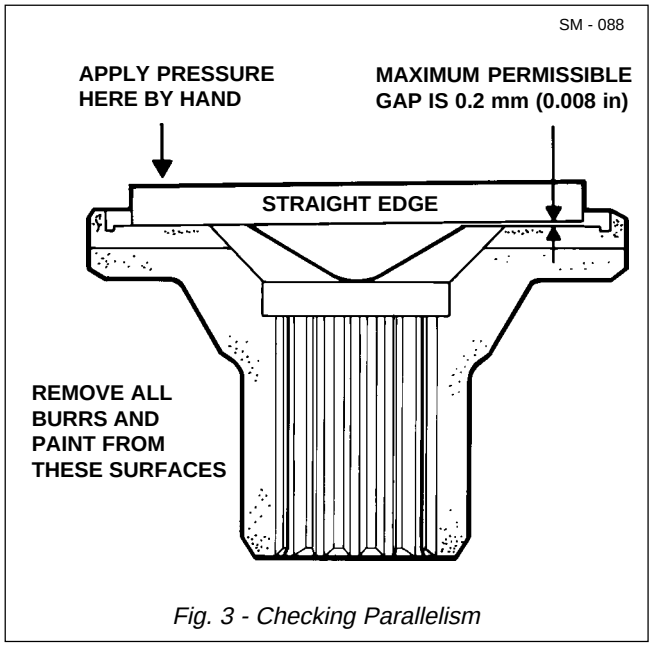


Fig. 3 - Checking Parallelism

3. Place the shaft end of driveline assembly (1) in a soft jawed vice.

4. Remove capscrews (10) and cross assembly (2) from driveline assembly (1).

5. Repeat steps 1 to 4 for drivelines (4 & 6) and (2 & 5, Fig. 2)

INSPECTION

1. Clean all metal parts in a suitable solvent, and dry all parts with compressed air.

2. Inspect splines of shaft and yoke for nicks, burrs and excessive wear. Replace if wear is excessive or splines are nicked. Burrs may be removed with a fine file or medium India stone.

3. Check the surfaces of the components that cross assemblies mate against for parallelism. Refer to Fig. 3.

4. Check condition of mounting capscrews and replace if required.

ASSEMBLY

Cross Assembly

Numbers in parentheses refer to Fig. 1.

1. Place the yoke end of driveline assembly (1) in a soft jawed vice, clamping on the tube of shaft.

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Note: Do not distort the tube with excessive grip.

2. Install cross assembly (2) to yoke end of driveline assembly (1) and secure with capscrews (10).

3. Place the shaft end of driveline assembly (1) in a soft jawed vice.

4. Install cross assembly (2) to shaft end of driveline assembly (1) and secure with capscrews (10).

5. Repeat steps 1 to 4 for drivelines (4 & 6) and (2 & 5, Fig. 2)

INSTALLATION

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Extra care should be taken when handling drivelines since carelessness can result in premature failure of the components. Chips, dents, burrs, or any other deformity of wing bearings will prevent accurate mating. This will cause misalignment which is accompanied by vibration and excessive wear.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ To prevent serious injury or death, DO NOT go under the vehicle when the engine is running. Rotating shafts can be dangerous. You can snag clothes, skin, hair, hands, etc..

1. Position driveline assembly (6) on the vehicle as shown in Fig. 1 and align match marks on cross assemblies (7) with those on its mating surfaces.

2. Apply Loctite 243 to the threads of capscrews (9) and secure cross assemblies (7) to its mating surfaces with capscrews (9). Tighten capscrews (9) to a torque of 153 Nm (113 lbf ft).

3. Position driveline assembly (4) on the vehicle as shown in Fig. 1 and align match marks on cross assemblies (5) with those on its mating surfaces.

4. Apply Loctite 243 to the threads of capscrews (10) and secure cross assemblies (5) to its mating surfaces with capscrews (10). Tighten capscrews (10) to a torque of 153 Nm (113 lbf ft).

5. Position driveline assembly (1) on the vehicle as shown in Fig. 1 and align match marks on cross assemblies (2) with those on its mating surfaces.

6. Apply Loctite 243 to the threads of capscrews (10) and secure cross assemblies (2) to its mating surfaces with capscrews (10). Tighten capscrews (10) to a torque of 153 Nm (113 lbf ft).

7. Secure bracket (11) over driveline assembly (1) and onto engine crossmember with bolts (12), washers (13) and locknuts (14).

8. Secure access plate to cab floor with mounting hardware removed during removal. Place cab floor mat in position and ensure that all pedals are free to operate.

9. Position driveline assembly (2, Fig. 2) on the vehicle as shown and align match marks on cross assemblies (3, Fig. 2) with those on its mating surfaces.

11. Apply Loctite 243 to the threads of capscrews (1, Fig. 2) and secure cross assemblies (3, Fig. 2) to its mating surfaces with capscrews (1, Fig. 2). Tighten capscrews (1, Fig. 2) to a torque of 153 Nm (113 lbf ft).

12. Position driveline assembly (5, Fig. 2) on the vehicle as shown and align match marks on cross assemblies (6, Fig. 2) with those on its mating surfaces.

13. Apply Loctite 243 to the threads of capscrews (1, Fig. 2) and secure cross assemblies (6, Fig. 2) to its mating surfaces with capscrews (1, Fig. 2). Tighten capscrews (1, Fig. 2) to a torque of 153 Nm (113 lbf ft).

14. Place the battery master switch in the 'On' position, ensure the parking brake is applied and start the engine. Remove wheel blocks from all road wheels.

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MAINTENANCE

Every 500 hours, check the universal joints for wear and replace if required.

Periodic Inspection

Use a small pry bar to check the companion flange yokes for looseness. If loose, drop one end of the driveline and twist the yoke to check the backlash between the splines and yokes. Replace any yoke that does not fit snugly.

With the pry bar, check the universal joints for play. If loose, replace the universal joints. Check the splines at the slip joint and replace the yoke if excessively worn.

SERVICE TOOLS

There are no special tools required for the procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools and adhesives required. These tools and adhesives are available from your dealer.

DRIVELINE DIAGNOSIS CHART

CONDITION	REASON	REMEDY
Vibration or noise	Driveline bent or out of balance	Clean driveline in a suitable solvent. Inspect for contact with adjacent parts. If driveline is distorted or sprung, replace. If driveline does not run smoothly, and vibration is felt, remove driveline and dynamically balance the assembly.
	Driveline loose at yoke/flange	Check driveline mounting capscrews for tightness. If loose, replace capscrews and torque tighten to the proper specification.
Excessive wear of universal joints	Poor yoke/flange alignment and/or run-out	Check yoke/flange for alignment, run-out and balance. Repair or replace as required.
	Driveline imbalance	Check to see if balance weights are missing or if driveline is distorted. If driveline is distorted, replace; if weights are missing, check balance of driveline dynamically and rebalance.

SPECIAL TORQUE SPECIFICATIONS

			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	9	Capscrew	153	113
1	10	Capscrew	153	113
2	1	Capscrew	153	113

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DESCRIPTION

The differential assembly is mounted to the axle housing. It comprises of two differentials; one for the normal cross-axle drive function; the other for the thru-drive.

The differential is a spiral bevel ring gear type with an automatically limited slip element (See Fig. 2).

The thru-drive differential is lockable by the operator.

Note: Never engage or disengage the Differential Lock when moving or when the wheels are spinning.

REMOVAL AND INSTALLATION

Numbers in parentheses refer to Fig. 1.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, raise the body and install the body safety prop to secure the body in the partially raised position.

2. Apply the parking brake and switch off the engine.

3. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

4. Drain the gear oil out of the axle housing and both planetaries into a suitable container.

5. Remove the planetary assemblies and axle shafts from the axle housing. Note from which side the long and short axle shafts are removed. Refer to Section 160-0030, AXLE GROUP (HUB).

6. Identify the relationship of the front and rear driveline flanges and differential flanges with punch marks.

7. Disconnect the drivelines from the differential flanges. The drivelines can be removed if it is convenient to do so.

8. Support the weight of the thru-drive differential and countershaft case assembly with suitable lifting equipment. Remove bolts (50 & 74) securing countershaft case (49) to differential housing (73) and carefully remove countershaft case (49) assembly clear of differential housing (73).

9. Support the weight of differential housing (73) assembly with suitable lifting equipment. Remove bolts (75) securing differential housing (73) to the axle housing. Thread in three puller bolts to break the seal between the differential and axle housing and to partially pull the differential assembly out of the axle housing. Carefully remove differential housing (73) assembly clear of axle housing. Remove shim (72).

INSTALLATION

Installation is the reversal of the 'Removal' procedure.

Note: Use sealing compound between the axle housing and differential housing mounting faces.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, AXLE BOLT AND NUT TORQUE SPECIFICATIONS.

Add gear oil of the type specified in Section 300-0020, LUBRICATION SYSTEM, through the differential filler/level hole until the oil is level with the bottom of the filler/level hole. Fill the planetary assemblies up to the 'Oil Level Check Line'.

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Centre Axle - Differential Drive Head

Section 150-0020

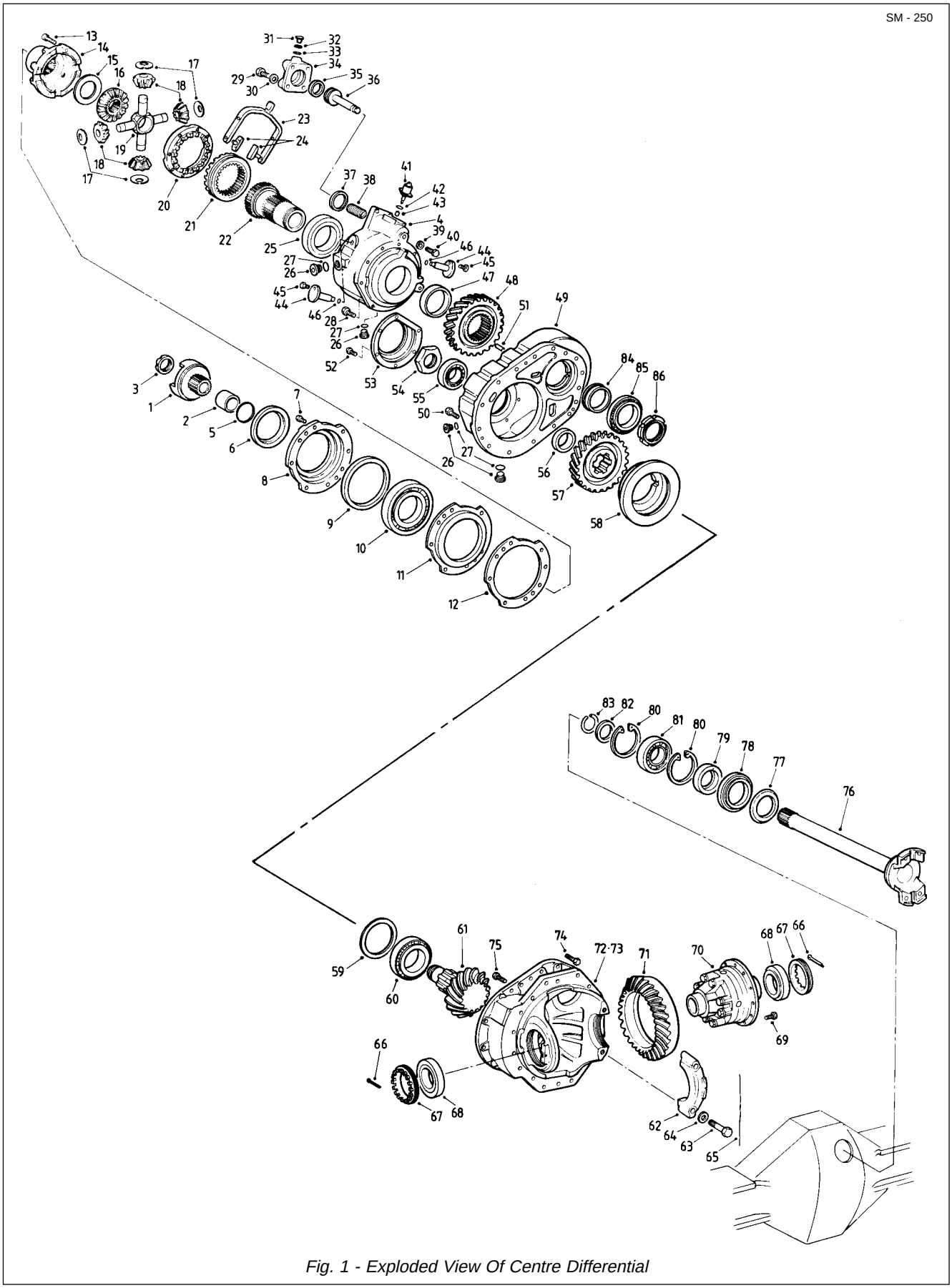


Fig. 1 - Exploded View Of Centre Differential

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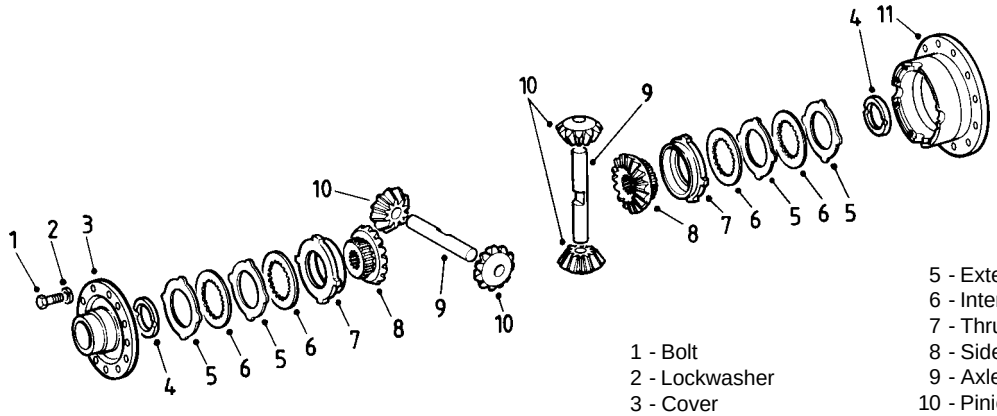
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LEGEND FOR FIG. 1.

1 - Drive Flange
2 - Dust Cover
3 - Castle Nut
4 - Differential Housing
5 - Seal Ring
6 - Shaft Seal
7 - Bolt
8 - Bearing Flange
9 - Shim
10 - Ball Bearing
11 - Shim
12 - Intermediate Flange
13 - Bolt
14 - Differential Case Half
15 - Thrust Washer
16 - Side Gear
17 - Thrust Washer
18 - Pinion Gear
19 - Spider
20 - Differential Case Half
21 - Shift Collar
22 - Differential Side Gear
23 - Shifter Fork Assembly
24 - Thrust Block
25 - Tapered Bearing
26 - Plug
27 - Seal Ring
28 - Bolt
29 - Bolt
30 - Lockwasher
31 - Plug
32 - Filter Element
33 - Limit Disc
34 - Cover
35 - 'U' Section Ring
36 - Piston
37 - Centring Ring
38 - Spring
39 - Nut
40 - Bolt
41 - Contact Switch
42 - Seal Ring
43 - Contact Pin
44 - Shifter Fork Lock Pin
45 - Bolt
46 - Seal Ring
47 - Spacing Ring
48 - Spur Gear
49 - Countershaft Case
50 - Bolt
51 - Roll Pin
52 - Bolt
53 - Cover
54 - Nut
55 - Roller Bearing
56 - Spacing Ring
57 - Gear
58 - Bearing Retaining Bush
59 - Shim
60 - Roller Bearing
61 - Pinion Gear
62 - Bearing Cap
63 - Bolt
64 - Washer
65 - Lockwire
66 - Cotter Pin
67 - Adjusting Nut
68 - Tapered Bearing
69 - Bolt
* 70 - Differential Assembly
71 - Ring Gear
72 - Shim
73 - Differential Housing
74 - Bolt
75 - Bolt
76 - Drive Flange Shaft
77 - Dust Shield
78 - Seal Retainer
79 - Shaft Seal
80 - Snap Ring
81 - Ball Bearing
82 - Shim
83 - Circlip
84 - Spacing Ring
85 - Tapered Bearing
86 - Slotted Nut

* - See Fig. 2

SM - 252



1 - Bolt
2 - Lockwasher
3 - Cover
4 - Thrust Washer
5 - Externally Splined Disc
6 - Internally Splined Disc
7 - Thrust Ring
8 - Side Gear
9 - Axle
10 - Pinion Gear
11 - Housing

Fig. 2 - Exploded View of Limited Slip Cross-axle Differential

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DISASSEMBLY

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

1. If not done so previously, remove bolts (50 & 74) which attach countershaft case (49) to differential housing (73) and lift off the countershaft case assembly.

2. Remove cotter pins (66) and adjusting nuts (67). Index mark bearing caps (62) and differential housing (73). Remove lockwire (65), bolts (63), washers (64) and bearing caps (62). Remove the outer races of tapered bearings (68) from differential assembly (70). Remove differential assembly (70) from the differential housing as shown in Fig. 3.

3. Index mark cover (3, Fig. 2) and housing (11, Fig. 2). Remove bolts (1, Fig. 2) and lockwashers (2, Fig. 2) and lift off cover.

4. Remove thrust washer (4, Fig. 2), two externally splined discs (5, Fig. 2), two internally splined discs (6, Fig. 2), thrust ring (7, Fig. 2) and side gear (8, Fig. 2).

5. Remove four pinion gears (10, Fig. 2) and axle (9, Fig. 2) out of housing (11, Fig. 2).

6. Remove the other side gear (8, Fig. 2), thrust ring (7, Fig. 2), two internally splined discs (6, Fig. 2), two externally splined discs (5, Fig. 2) and thrust washer (4, Fig. 2) from housing (11, Fig. 2).

7. It is not necessary to remove ring gear (71) from housing (11, Fig. 2) unless ring gear (71) and pinion gear (61) are being replaced. The ring gear and pinion gear are only sold as a matched set and cannot be replaced separately. Remove bolts (69) as shown in Fig. 4 and press the ring gear off the housing. If necessary, pull the inner races of tapered bearings (68) from the cover and housing.

8. Screw out contact switch (41) with seal ring (42) and remove contact pin (43) from differential housing (4) bore. Refer to Fig. 5.

9. Remove bolts (29), lockwashers (30) and cover (34) from differential housing (4). Refer to Fig. 6.

10. Remove castle nut (3), drive flange (1), dust cover (2) and seal ring (5) from differential case half (14).

11. Remove bolts (7) and bearing flange (8) from differential housing (4). Shaft seal (6) is removed with bearing flange (8). Remove shims (9 & 11) from intermediate flange (12).

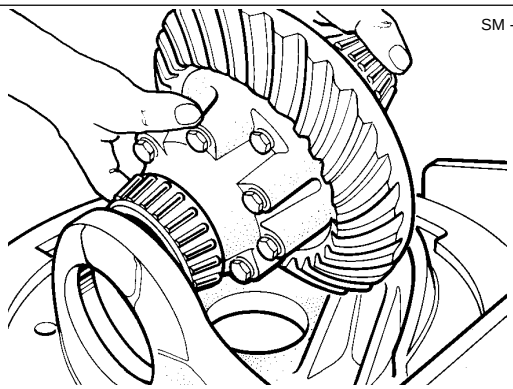


Fig. 3 - Removing Differential Assembly

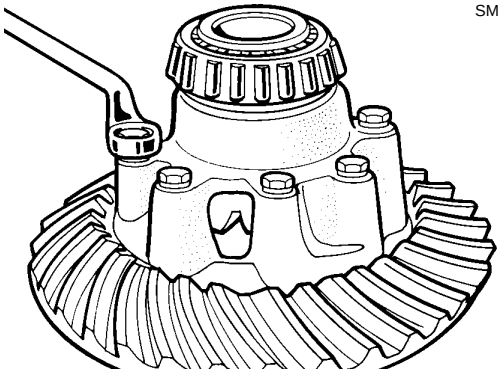


Fig. 4 - Removing Ring Gear Bolts

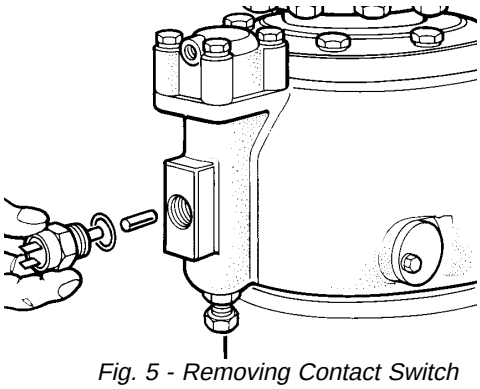


Fig. 5 - Removing Contact Switch

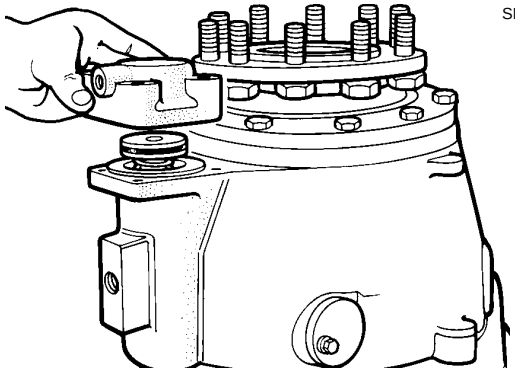


Fig. 6 - Removing Cover

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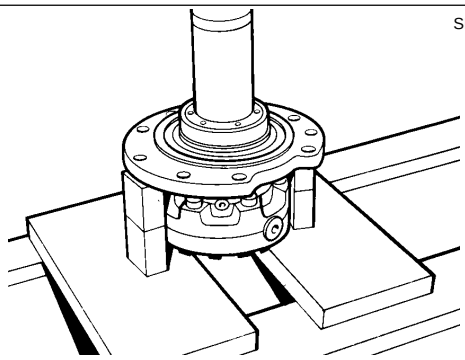


Fig. 7 - Pressing Differential Assembly From Intermediate Flange

12. Press the thru-drive differential case assembly (13 thru 20) out of intermediate flange (12), as shown in Fig. 7.

13. With a bearing puller, pull ball bearing (10) off the bearing journal of differential case half (14).

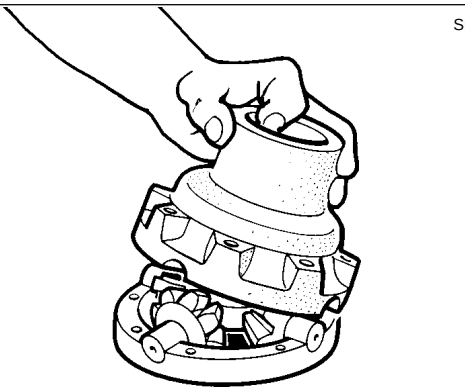


Fig. 8 - Separating Differential

14. Index mark differential case halves (14 & 20). Remove bolts (13) from differential case half (14) and separate the differential case halves. Remove thrust washer (15), side gear (16), thrust washers (17), pinion gears (18) and spider (19). Refer to Fig. 8.

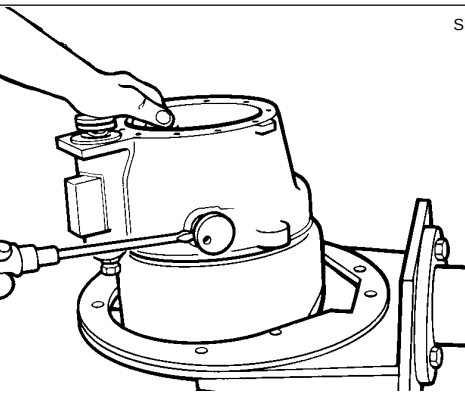


Fig. 9 - Removing Shifter Fork Lock Pins

15. Remove bolts (45) from shifter fork lock pins (44). Push down on piston (36) and remove shifter fork lock pins (44) with seal rings (46) from differential housing (4) as shown in Fig. 9. Remove and discard seal rings (46).

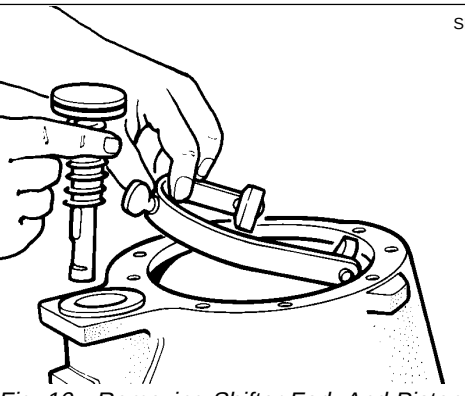


Fig. 10 - Removing Shifter Fork And Piston

16. Remove shifter fork (23) with thrust blocks (24), piston (36) with centring ring (37) and spring (38) from differential housing (4). Also remove shift collar (21). Refer to Fig. 10.

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17. Unlock slotted nut (86) and remove it from the threaded end of differential side gear (22) as shown in Fig. 11. With a soft drift and hammer, drive differential side gear (22) from countershaft case (49). Remove inner race of tapered bearing (85). Inner race of tapered bearing (25) will come out with differential side gear (22). Remove spacing ring (47). If necessary, pull the inner race of tapered bearing (25) from differential side gear (22).

18. Remove inner and outer bolts (28) which fasten differential housing (4) to countershaft case (49). Refer to Fig. 12. Remove the differential housing. If necessary, pull the outer race of tapered bearing (25) from differential housing (4).

19. Remove spur gear (48) from countershaft case (49) as shown in Fig. 13. Pull outer race of tapered bearing (85) from countershaft case (49) and remove spacing ring (84).

20. Remove bolts (52) and cover (53) from countershaft case (49) as shown in Fig. 14.

21. Unlock and remove nut (54) from pinion gear (61) shaft. With the press set shown in Fig. 15, press pinion gear (61) out of countershaft case (49). Remove spacing ring (56) from the shaft end of pinion gear (61).

22. Drive roller bearing (55) out of its bore in countershaft case (49).

23. Press pinion gear (61) out of gear (57) and bearing retaining bush (58) as shown in Fig. 16. Drive roller bearing (60) out of the bearing retaining bush and remove shim (59).

24. Remove circlip (83) and shim (82) from drive flange shaft (76) and withdraw drive flange shaft from axle housing. Remove dust shield (77) from end of drive flange shaft (76).

25. Remove seal retainer (78) and pull shaft seal (79) from axle housing. Remove snap rings (80) and drive ball bearing (81) from the axle housing.

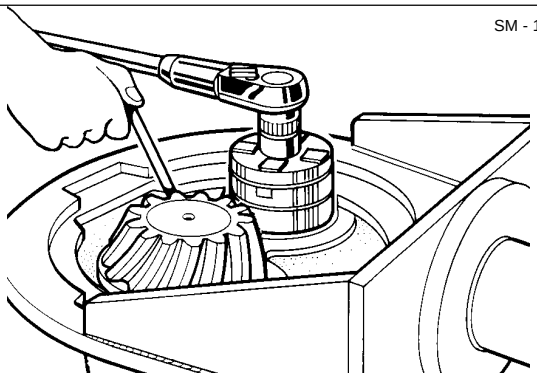


Fig. 11 - Removing Slotted Nut

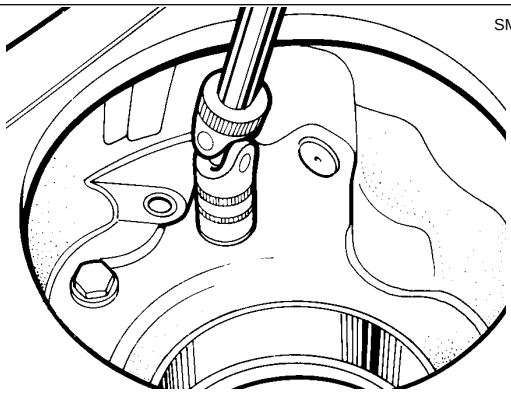


Fig. 12 - Removing Bolts

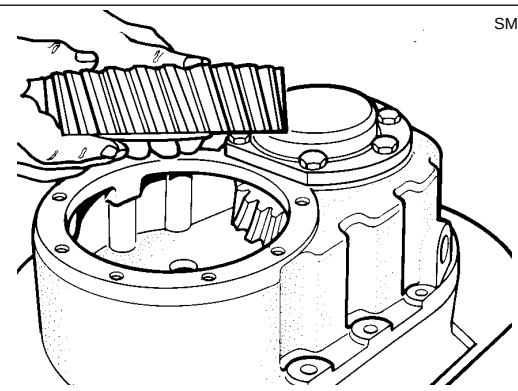


Fig. 13 - Removing Spur Gear

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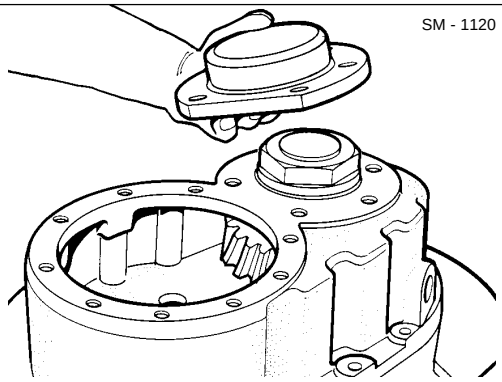


Fig. 14 - Removing Cover

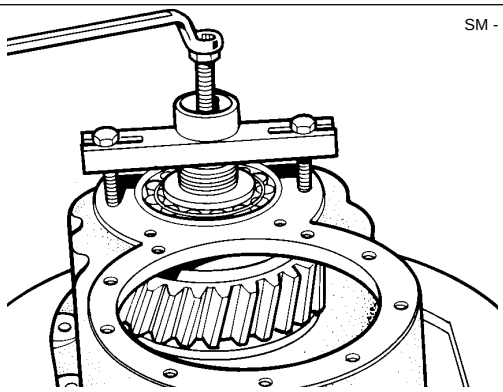


Fig. 15 - Pressing Out Pinion Gear

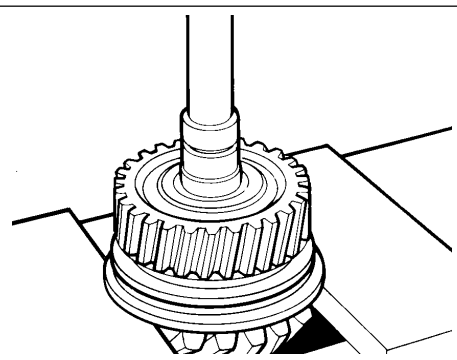


Fig. 16 - Pressing Pinion Gear Out Of Gear And Bearing

INSPECTION

The importance of careful and thorough inspection cannot be overstressed. Thorough inspection and necessary replacement of parts now may eliminate costly and avoidable trouble later.

1. Clean all parts in petroleum base solvent.

2. Immediately after cleaning, dry all parts, except bearings, with compressed air, or with a soft, clean lint free wiping cloth. Compressed air has a corrosive effect on bearings, therefore, they must be wiped dry with a cloth.

3. Coat cleaned, dried parts immediately with light oil to prevent corrosion. If parts are not to be assembled immediately, treat them with a good rust preventive and wrap them with treated paper or other suitable material designed to prevent corrosion.

4. Before installing the differential assembly to the machine, clean the inside and outside of the axle housing to remove any foreign material.

5. Inspect all gears, pinions, and splines for cracked or broken teeth, excessive wear, and pitted or scored surfaces. Repair or replace as necessary.

Note: If either ring gear or pinion gear is defective, both gears must be replaced, because they are serviced only as a matched set. Make sure the ring gear and pinion gear have the same mating numbers.

6. Check for pitted, scored or worn thrust surfaces of differential case halves.

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ASSEMBLY

Numbers in parentheses refer to Fig. 1 unless specified otherwise.

Note: Tighten all fasteners without special torques specified to torques listed in Section 300-0080, AXLE BOLT AND NUT TORQUE SPECIFICATIONS.

Note: During assembly and installation, make sure that mated, punch marked, or otherwise identified parts are returned to their original positions, if still serviceable.

1. Align the index marks on bearing caps (62) and differential housing (73) and fasten with washers (64) and bolts (63). Install the special shims and measuring shaft into the differential bearing bores. Measure the distance from the middle of the differential bearing flange face. Refer to Fig. 17. This will be dimension 'A'. e.g. 164.2 mm (6.40 in).

2. Install bearing retaining bush (58) into countershaft case (49) until it is seated. Measure dimension 'B' from the flange face of countershaft case (49) to the bearing contact face using a straightedge and depth micrometer as shown in Fig. 18. e.g. 25.75 mm (1.00 in).

3. Measure the width of roller bearing (60) as shown in Fig. 19. e.g. 37.05 mm (1.50 in).

Example:

	Dimension 'A'	164.2 mm (6.40 in)
+	Dimension 'B'	25.75 mm (1.00 in)
		= 189.95 mm (7.40 in)
-	Bearing width	37.05 mm (1.45 in)
	Dimension 'X'	= 152.90 mm (5.95 in)

4. Refer to Fig. 20. Read distance dimension etched on the face of pinion gear (61). e.g. 151.80 mm (5.92 in).

Example:

	Dimension 'X'	152.90 mm (5.95 in)
-	Pinion Dimension	151.80 mm (5.92 in)
	Shim Size	= 1.10 mm (0.03 in)

5. Place the determined size shim (59) in bearing retaining bush (58), then press or drive roller bearing (60) into its bore in the retaining bush.

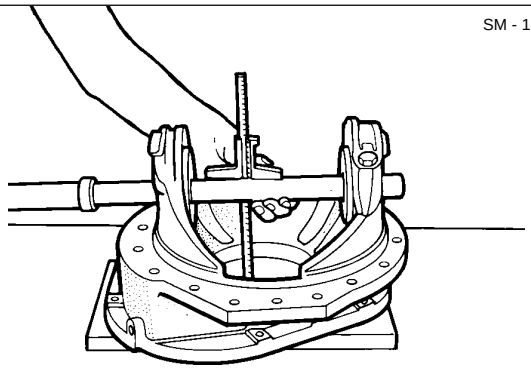


Fig. 17 - Measuring Dimension 'A'

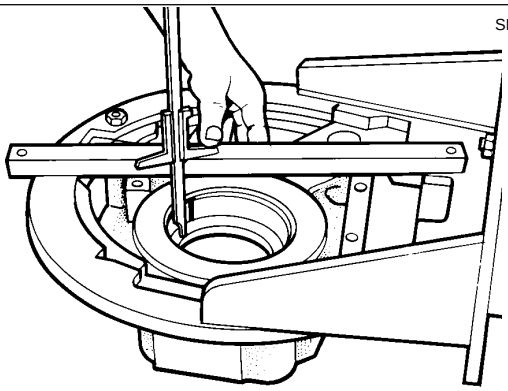


Fig. 18 - Measuring Dimension 'B'

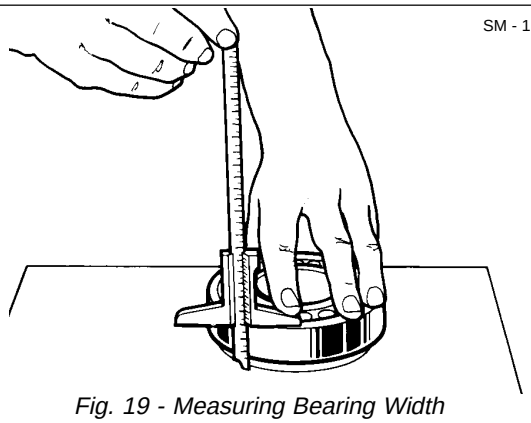


Fig. 19 - Measuring Bearing Width

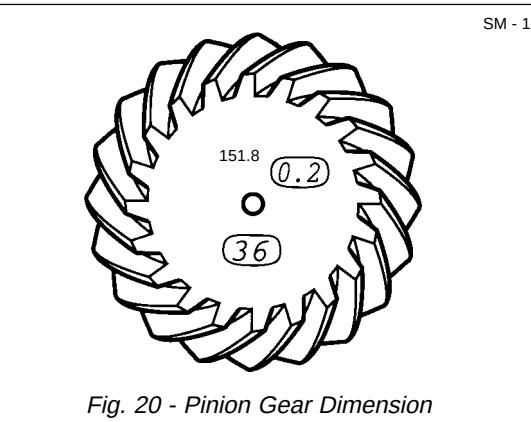


Fig. 20 - Pinion Gear Dimension

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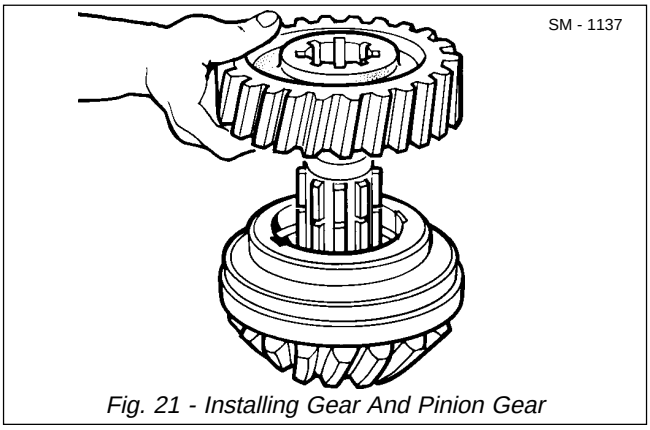


Fig. 21 - Installing Gear And Pinion Gear

6. Place the assembled bearing retaining bush (58) on pinion gear (61) as shown in Fig. 21 and install gear (57) chamfered side down.

7. Press or drive the assembled pinion gear (61) into its bore in countershaft case (49) until it is completely seated.

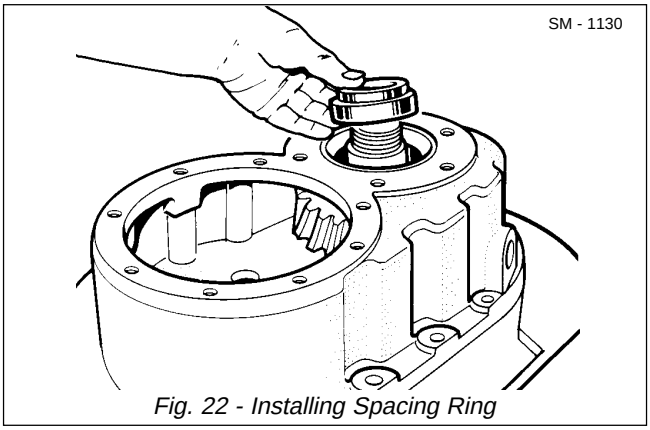


Fig. 22 - Installing Spacing Ring

8. Install spacing ring (56) on the end of pinion gear (61) shaft as shown in Fig. 22. e.g. 23.9 mm (0.93 in). If parts are not being replaced, then use the same spacing ring that was removed. Size of the spacing ring is determined in Step 11.

9. Press roller bearing (55) on pinion gear (61) shaft and into countershaft case (49).

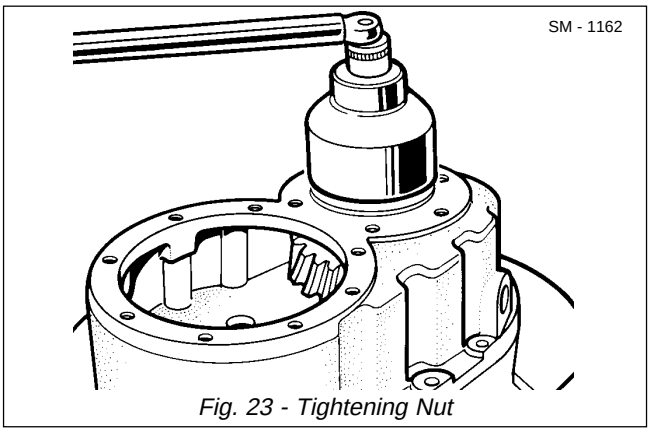


Fig. 23 - Tightening Nut

10. Thread nut (54) on pinion gear (61) shaft. Tighten nut (54) to a torque of 750 Nm (550 lbf ft). Refer to Fig. 23.

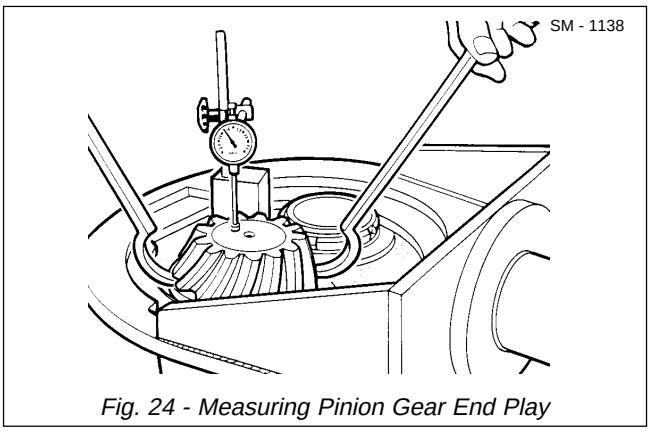


Fig. 24 - Measuring Pinion Gear End Play

11. Install a dial indicator as shown in Fig. 24 and with pry bars move the pinion up and down to determine the end play. Write down the measured end play. If for example there is an end play of 0.2 mm (0.0078 in) the installed spacing ring (56) of 23.9 mm (0.93 in) must be replaced by a narrower spacing ring by 0.22 - 0.24 mm (0.0086 - 0.0094 in). To do this repeat Steps 7 through 10. With the proper thickness spacing ring installed, bearing (55) pre-load will be 3 Nm (18 lbf ft).

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12. Place spur gear (48) in countershaft case (49). It will be necessary to mesh this gear with gear (57) already installed. Refer to Fig. 25.

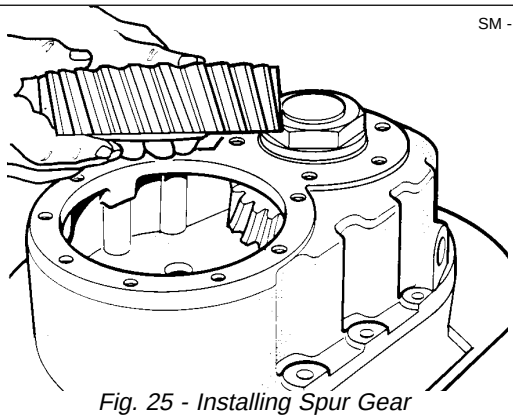


Fig. 25 - Installing Spur Gear

13. Install differential housing (4) on countershaft case (49). Fasten together with bolts (28). Put Loctite 270 on the two outside bolts. Maximum torque of bolts (28) is 160 Nm (120 lbf ft). Refer to Fig. 26.

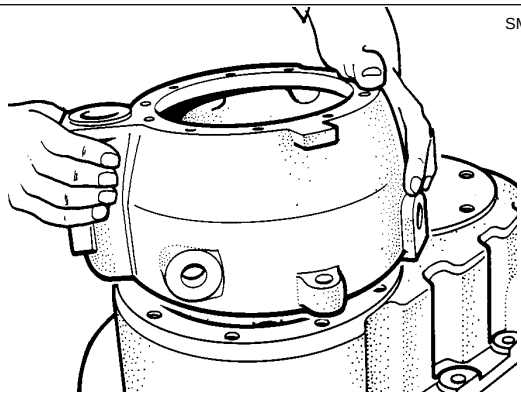


Fig. 26 - Installing Differential Housing

14. Press outer race of tapered bearing (25) into differential housing (4). Press inner race of tapered bearing (25) on differential side gear (22). Slide spacing ring (47) on the differential side gear and insert differential side gear into spur gear (48). Refer to Fig. 27.

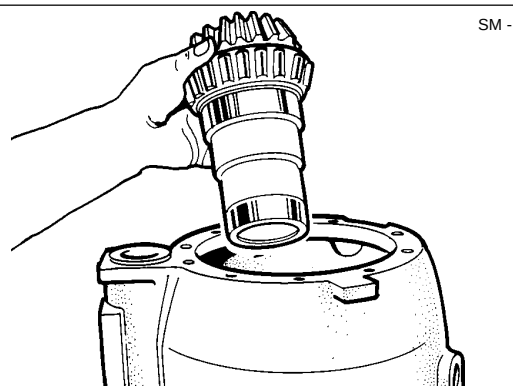


Fig. 27 - Installing Side Gear

15. Place a spacing ring (84) of 22 mm (0.878 in) over the opposite end of differential side gear (22). Press outer race of tapered bearing (85) into its bore in countershaft case (49). Press the inner race of tapered bearing (85) onto differential side gear (22). Refer to Fig. 28.

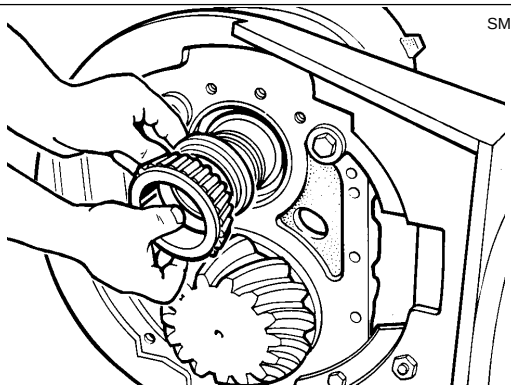


Fig. 28 - Installing Bearing And Spacer

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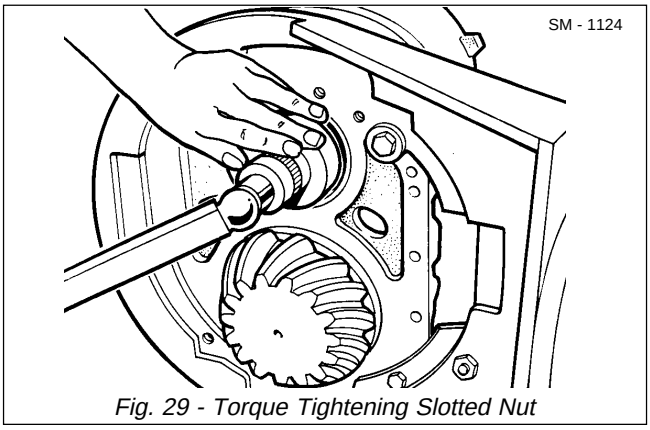


Fig. 29 - Torque Tightening Slotted Nut

16. Thread slotted nut (86) onto the threaded end of differential side gear (22). Tighten slotted nut (86) to a torque of 550 Nm (400 lbf ft). Refer to Fig. 29.

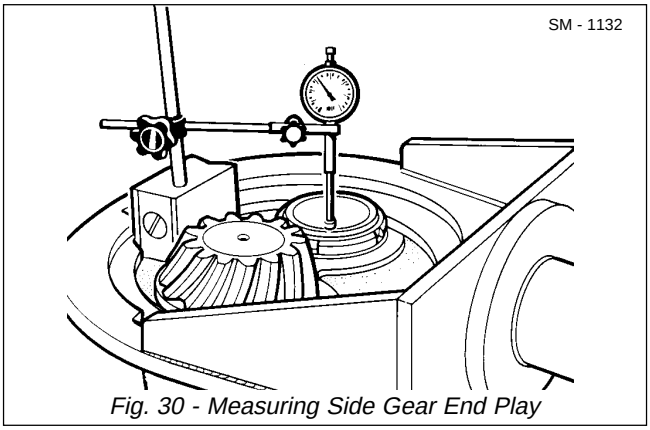


Fig. 30 - Measuring Side Gear End Play

17. Using a dial indicator determine differential side gear (22) end play. For example, if there is a measured end play of 0.1 mm (0.0039 in) then spacing ring (84) thickness must be reduced by 0.1 mm (0.0039 in). To install a narrower spacing ring (84) repeat Steps 15 & 16. Lock slotted nut (86) to differential side gear (22). There must be no bearing (85) end play or pre-load. Refer to Fig. 30.

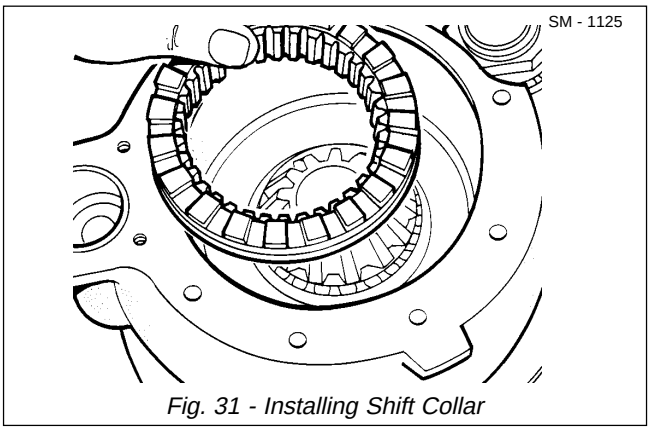


Fig. 31 - Installing Shift Collar

18. Mesh shift collar (21) with differential side gear (22) splines. Refer to Fig. 31.

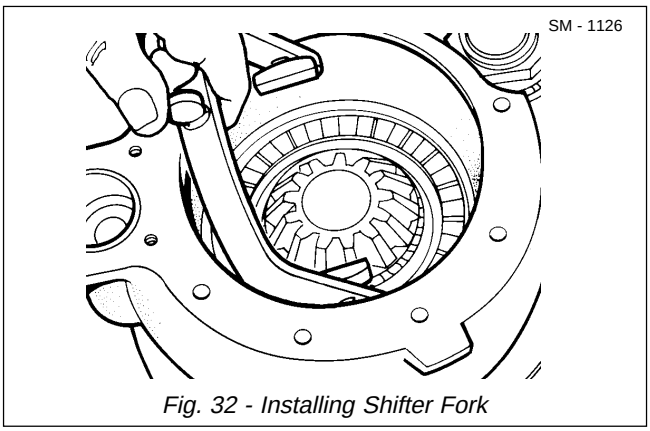


Fig. 32 - Installing Shifter Fork

19. Assemble thrust blocks (24) to shifter fork (23) and install in differential housing (4). Thrust blocks fit into shift collar (21) groove. Refer to Fig. 32.

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20. Place 'U' section ring (35) on piston (36) OD. Slide centring ring (37) and spring (38) on the piston stem. Insert the assembled piston into its bore in differential housing (4). Be sure the piston stem makes contact with shifter fork (23). Refer to Fig. 33.

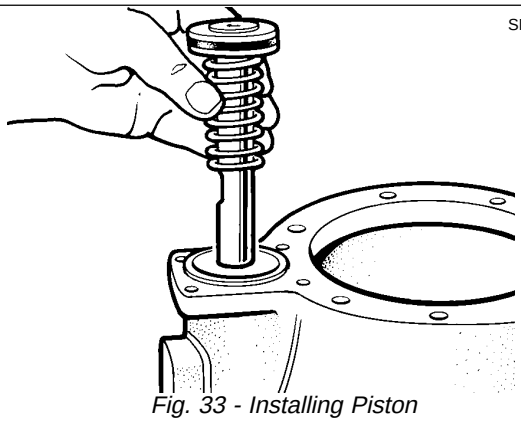


Fig. 33 - Installing Piston

21. Place new seal rings (46) on the ends of shifter fork lock pins (44) and insert them into differential housing (4) bores. To facilitate assembly, push shifter piston (36) down slightly. Bolt in place with bolts (45). Tighten bolts (45) to a torque of 42 Nm (30 lbf ft). Refer to Fig. 34.

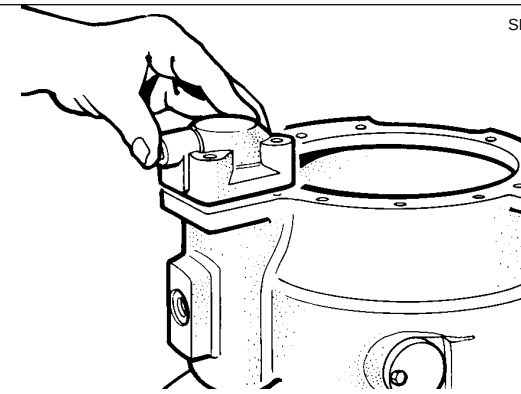


Fig. 34 - Installing Shifter Fork Locks

22. If limit disc (33), filter element (32) and plug (31) were removed from cover (34), reinstall them. Install the cover on differential housing (4) and fasten with bolts (29) and lockwashers (30). Tighten bolts (29) to a torque of 42 Nm (30 lbf ft). Refer to Fig. 35.

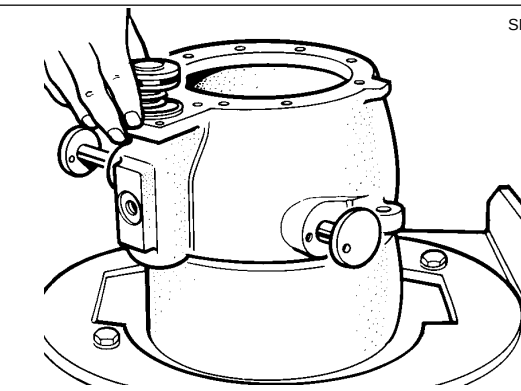


Fig. 35 - Installing Cover

23. Place thrust washer (15) in differential case half (14). Refer to Fig. 36.

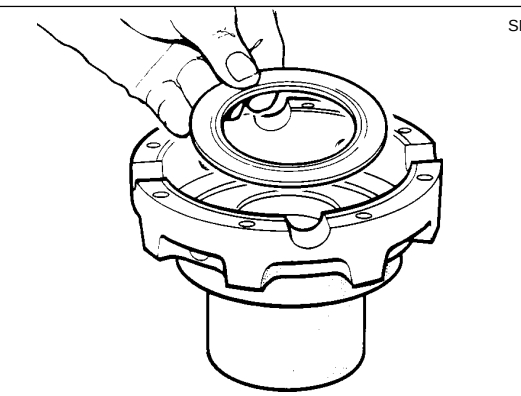


Fig. 36 - Insert Thrust Washer

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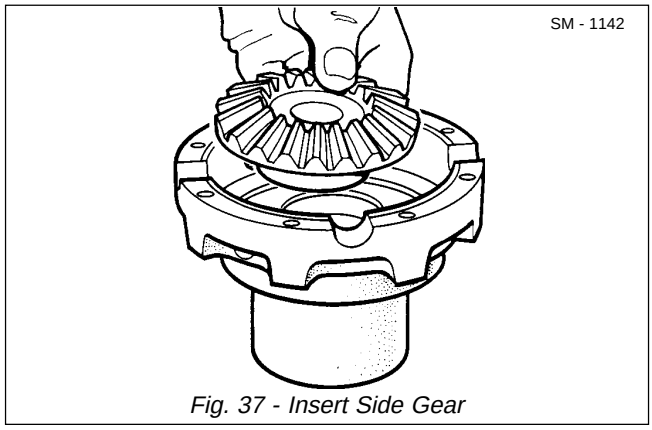


Fig. 37 - Insert Side Gear

24. Place side gear (16) into differential case half (14). Refer to Fig. 37.

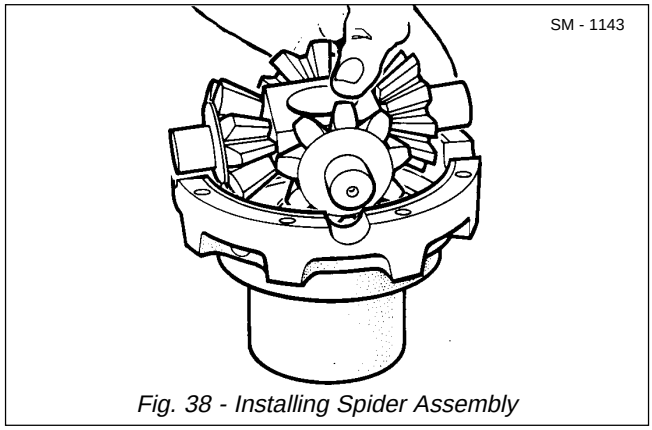


Fig. 38 - Installing Spider Assembly

25. Install pinion gears (18) and thrust washers (17) on spider (19) arms. Be sure the thrust washer notches are properly positioned on the pinion gears. Install the assembled spider in differential case half (14). Refer to Fig. 38.

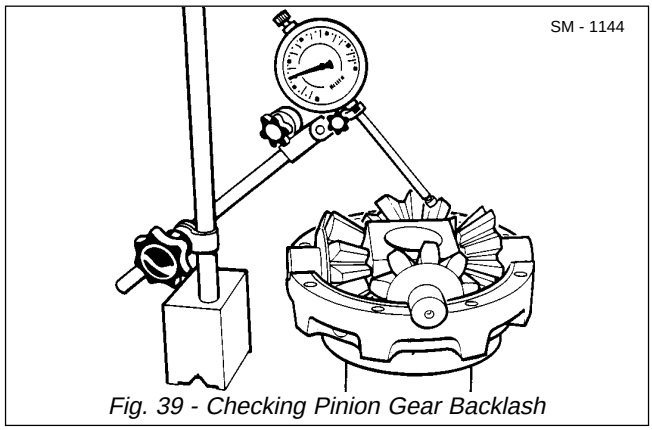


Fig. 39 - Checking Pinion Gear Backlash

26. With a dial indicator gauge, check pinion gear (18) backlash as shown in Fig. 39. Backlash should be between 0.15 - 0.2 mm (0.00585 - 0.0078 in).

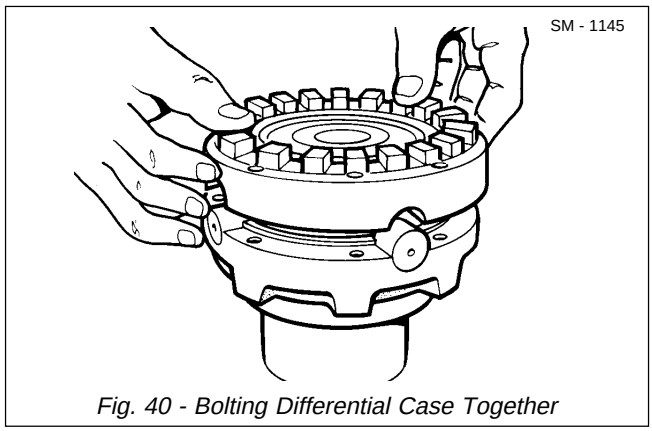


Fig. 40 - Bolting Differential Case Together

27. Align the index marks and place second differential case half (20) on top of the assembled differential case half (14). Bolt the two case halves together with bolts (13). Tighten bolts (13) to a torque of 120 Nm (90 lbf ft). Refer to Fig. 40.

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28. Install differential assembly (13 thru 20) into the bore of differential housing (4) as shown in Fig. 41. Be sure the teeth on differential case half (20) mesh with shift collar (21) teeth.

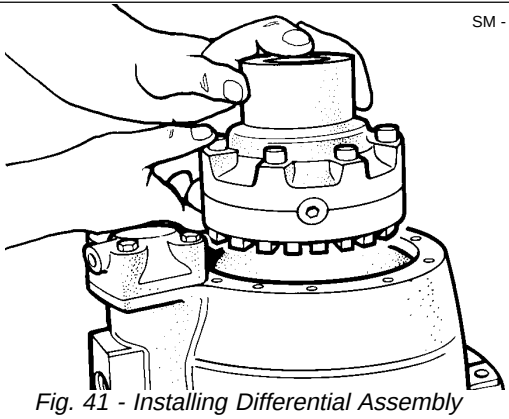


Fig. 41 - Installing Differential Assembly

29. Measure the distance from differential housing (4) face to differential case half (14) face as shown in Fig. 42. Record this as dimension 'A'. e.g. 9.0 mm (0.351 in).

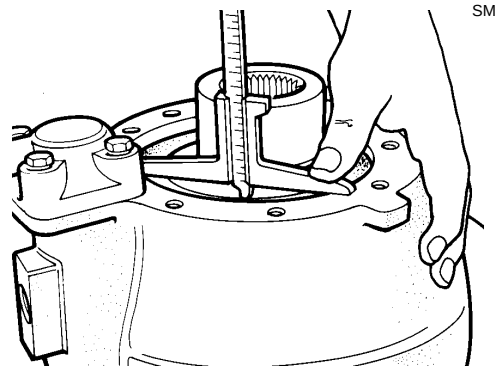


Fig. 42 - Measuring Dimension 'A'

30. With a straightedge and blocks measure dimension 'B' from intermediate flange (12) face to the inner race of ball bearing (10) as shown in Fig. 43. e.g. 10.5 mm (0.410 in).

Example:

Dimension 'B'	10.5 mm (0.410 in)
- Dimension 'A'	9.0 mm (0.351 in)
Difference	= 1.5 mm (0.059 in)

Because of the backlash, the axial displacement of the complete differential assembly is 0.2 mm (0.008 in).

Difference	1.5 mm (0.059 in)
	+ 0.2 mm (0.008 in)
Shim Size	= 1.7 mm (0.067 in)

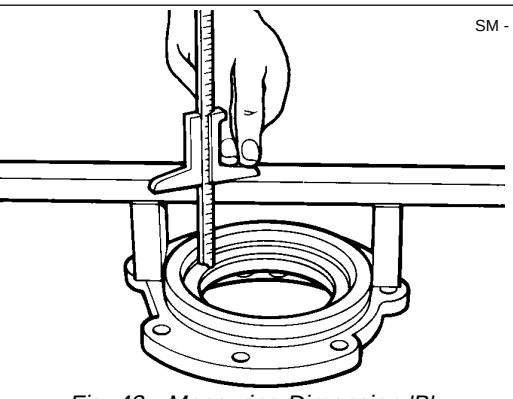


Fig. 43 - Measuring Dimension 'B'

31. Lift the differential assembly (13 thru 20) out of differential housing (4). Place intermediate flange (12) on differential case half (14) and press ball bearing (10) on differential case half (14) as shown in Fig. 44.

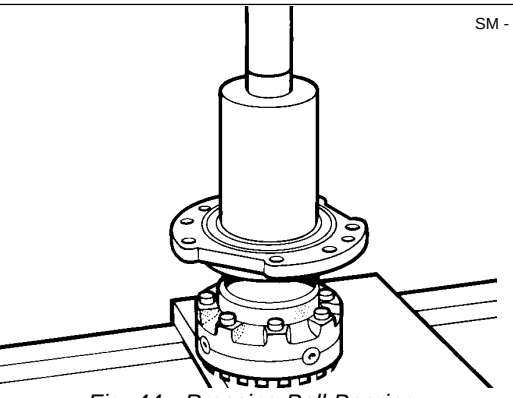


Fig. 44 - Pressing Ball Bearing

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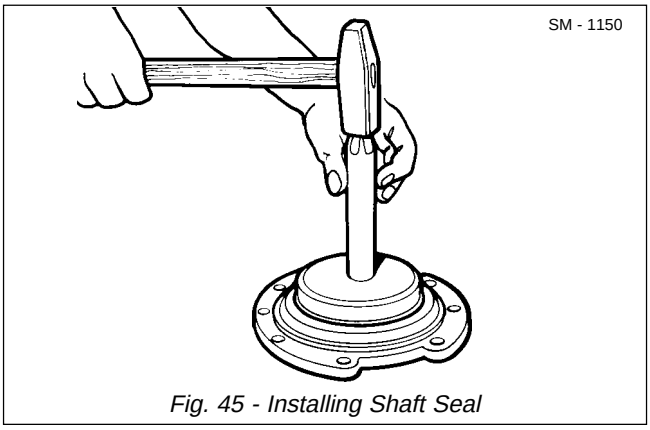


Fig. 45 - Installing Shaft Seal

32. Using a seal driver, install shaft seal (6) in bearing flange (8) with the seal lip facing down. Refer to Fig. 45.

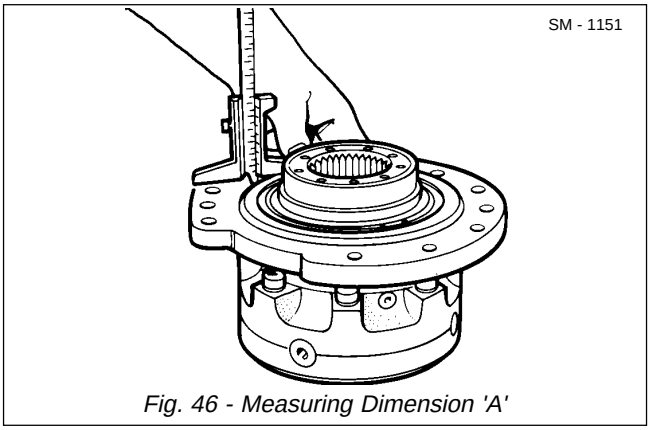


Fig. 46 - Measuring Dimension 'A'

33. Measure the distance ball bearing (10) is above intermediate flange (12) face as shown in Fig. 46. This is dimension 'A'. e.g. 5.0 mm (0.195 in).

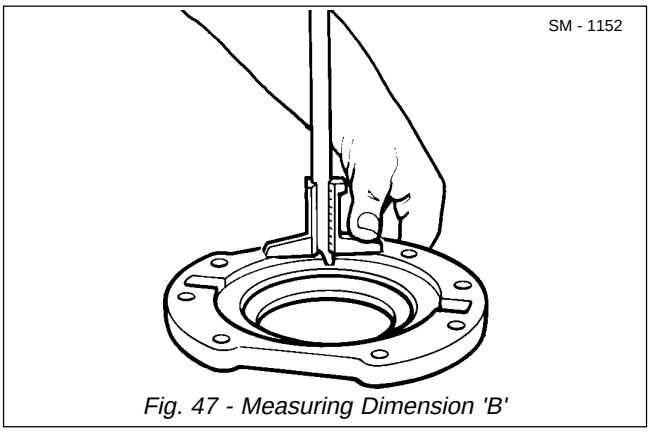


Fig. 47 - Measuring Dimension 'B'

34. Measure the distance from bearing flange (8) face to ball bearing (10) contact face as shown in Fig. 47. This is dimension 'B'. e.g. 6.5 mm (0.240 in).

Dimension 'B'	6.5 mm (0.240 in)
- Dimension 'A'	5.0 mm (0.195 in)
Required Shim	= 1.5 mm (0.045 in)

Place the required shim (9) in bearing flange (8) recess.

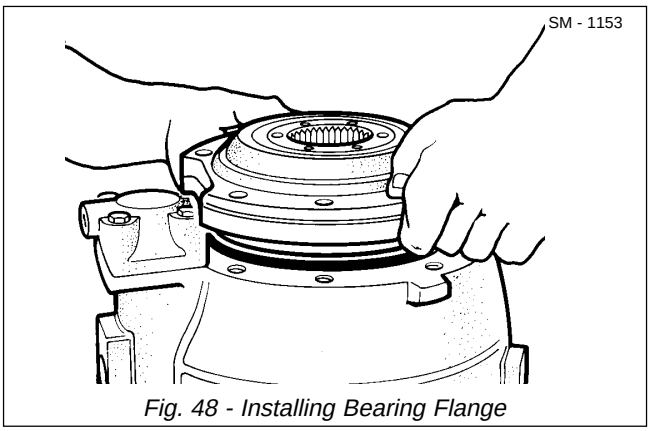


Fig. 48 - Installing Bearing Flange

35. Coat intermediate flange (12) bolt circle with sealing compound, install the size shim (11) determined in Steps 29 and 30 and install bearing flange (8). Bolt the flanges together with bolts (7). Refer to Fig. 48.

36. Install dust cover (2) and seal ring (5) on the splined end of drive flange (1). Align the drive flange splines with the internal splines in differential case half (14) and install the drive flange into the differential case assembly. Thread castle nut (3) onto the threaded end of differential case half (14). Tighten castle nut (3) to a torque of 1 200 Nm (885 lbf ft).

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37. If removed, install differential lock nut (39) and bolt (40). Coat the bolt threads with Loctite 270. Actuate the differential lock with compressed air while threading the bolt with lock nut in differential housing (4) until contact is made. After contact is made, turn adjusting bolt (40) in approximately 1/3 turn and lock in position with lock nut (39). Refer to Fig. 49.

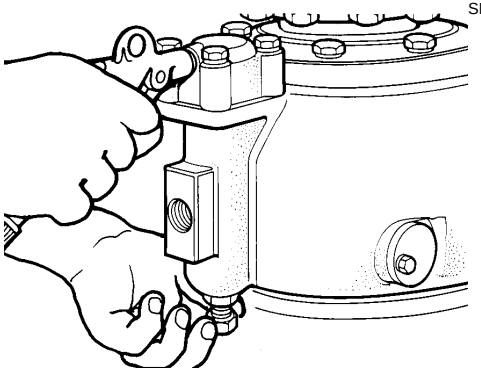


Fig. 49 - Adjusting Differential Lock Bolt

38. Install contact pin (43) in differential housing (4). Place seal ring (42) on contact switch (41) and insert contact switch in differential housing as shown in Fig. 50.

39. If ring gear (71) was removed from housing (11, Fig. 2) then assemble them. Align the index marks and press the ring gear on the housing and bolt them together with bolts (69). Tighten bolts (69) to a torque of 210 Nm (160 lbf ft).

40. Press the inner races of tapered bearings (68) on cover (3, Fig. 2) and housing (11, Fig. 2).

41. Place one thrust washer (4, Fig. 2) with lubrication slot facing up in housing (11, Fig. 2).

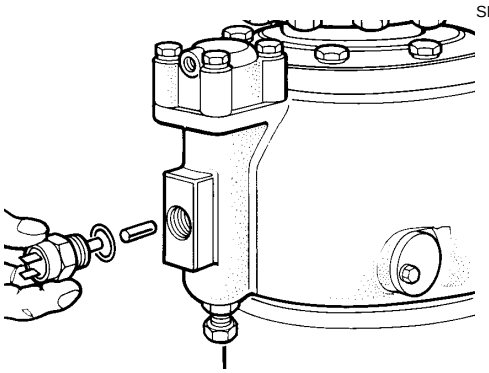


Fig. 50 - Installing Contact Switch

42. Alternately, install an externally splined disc (5, Fig. 2) and then an internally splined disc (6, Fig. 2) until all the discs have been installed.

43. Install thrust ring (7, Fig. 2) on top of internally splined disc (6, Fig. 2). Install the thrust ring with the open face up.

44. Install one side gear (8, Fig. 2) into thrust ring (7, Fig. 2) and make sure the side gear splines into the two internally splined discs (6, Fig. 2).

45. Assemble axles (9, Fig. 2) and pinion gears (10, Fig. 2) together and install on the installed side gear (8, Fig. 2). Refer to Fig. 51

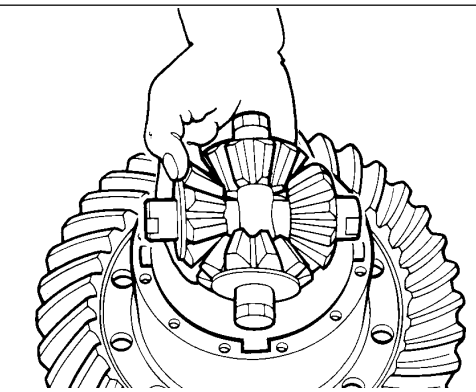


Fig. 51 - Installing Shaft and Pinion Gears

46. Install other side gear (8, Fig. 2) and other thrust ring (7, Fig. 2) flat side up. Refer to Figs. 52 & 53.

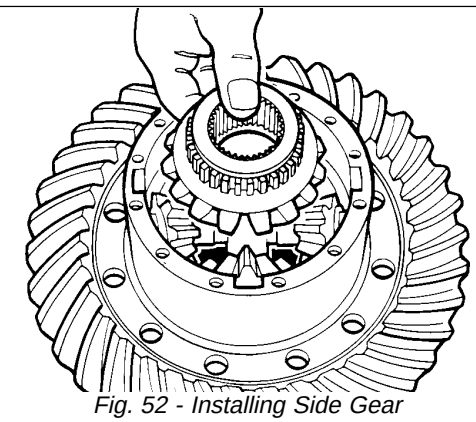


Fig. 52 - Installing Side Gear

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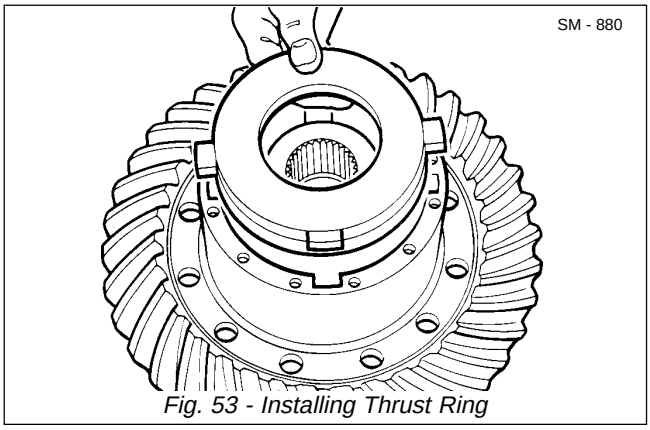


Fig. 53 - Installing Thrust Ring

47. Alternately, install an internally splined disc (6, Fig. 2) and then an externally splined disc (5, Fig. 2) until all the discs have been installed.

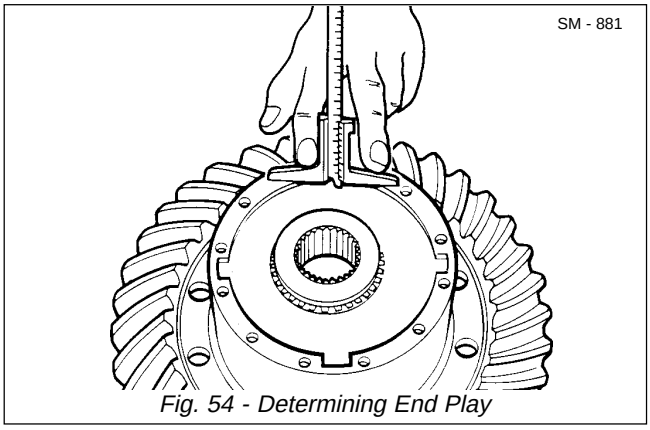


Fig. 54 - Determining End Play

48. Determine the end play between the discs and the housing as shown in Figs. 54 & 55.

Step 1 - Determine the dimension between the housing face and internally splined disc (6, Fig. 2). e.g. The measurement is 6.00 mm (90.236 in).

Step 2 - Determine the dimension between housing (11, Fig. 2) and cover (3, Fig. 2). For example the measurement is 5.80 mm (0.228 in).

	Step 1 Dimension	6.00 mm (0.236 in)
-	Step 2 Dimension	5.80 mm (0.228 in)
	Difference	= 0.20 mm (0.008 in)

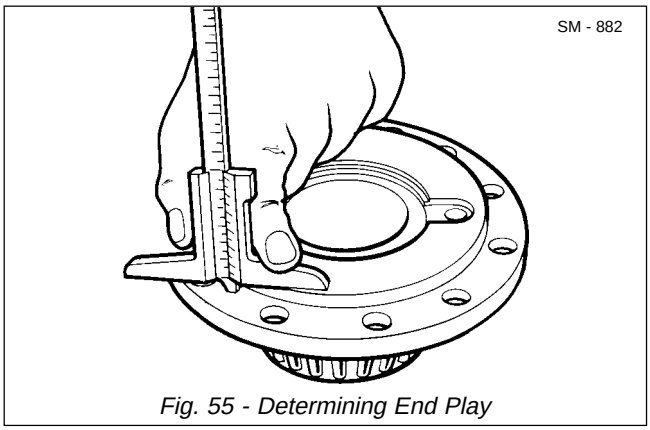


Fig. 55 - Determining End Play

The correct end play between the housing cover and both plate packs should be between 0.20 - 0.80 mm (0.008 - 0.031 in). The end play should be as close to 0.20 mm (0.008 in) as possible. The end play is controlled by installing different thicknesses of internally splined plates. Refer to the parts book for different thicknesses of plates available.

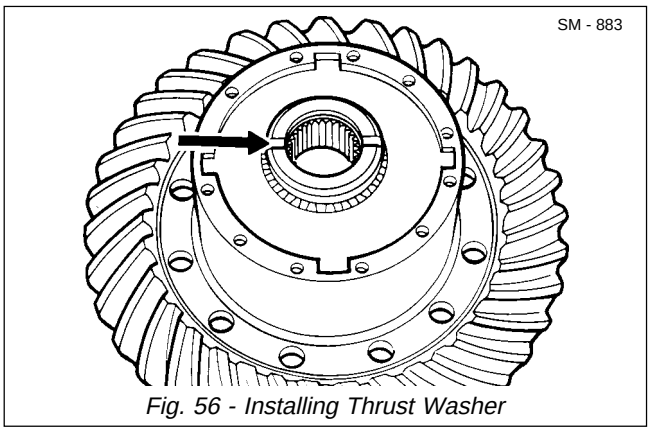


Fig. 56 - Installing Thrust Washer

49. Place thrust washer (4, Fig. 2) on side gear (8, Fig. 2) as shown in Fig. 56.

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50. Place cover (3, Fig. 2) on housing (11, Fig. 2), cover threads of bolts (1, Fig. 2) with Loctite 270 and fasten cover and housing together as shown in Fig. 57. Tighten bolts (1, Fig. 2) to a torque of 110 Nm (82 lbf ft).

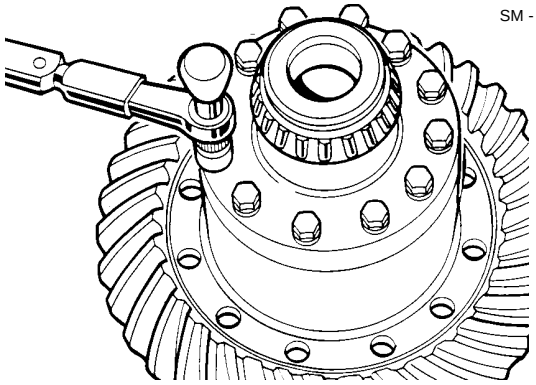


Fig. 57 - Fastening Cover and Housing

51. Temporarily install countershaft case (49) assembly on differential housing (73). Bolt together with bolts (50 & 74). Refer to Fig. 58.

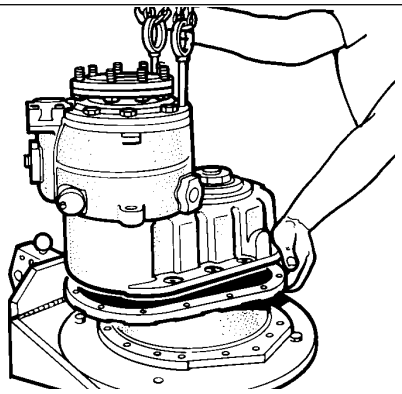


Fig. 58 - Installing Countershaft Case

52. Place the two outer races of tapered bearings (68) on the inner races and install the differential assembly into differential housing (73). Install bearing cap (62), washers (64) and bolts (63). Tighten bolts (63) to a torque of 245 Nm (180 lbf ft). Thread in adjusting nuts (67) and displace the differential to obtain a backlash of 0.25 - 0.35 mm (0.010 - 0.014 in). Refer to Fig. 59.

Bearing adjusting nuts (67) have two basic functions: Pre-loading the bearings, and positioning ring gear (71) to obtain the correct backlash between the ring gear and the pinion gear.

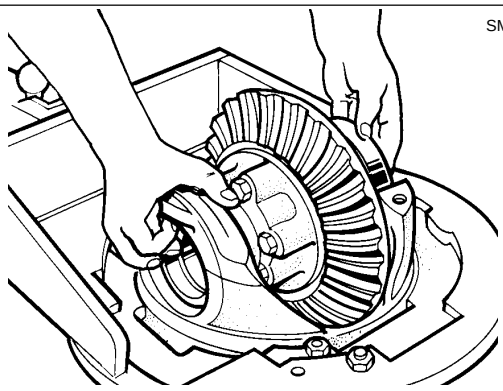


Fig. 59 - Installing Differential And Bearing Caps

53. To check the backlash between ring gear (71) and pinion gear (61), mount a dial indicator gauge at a right angle on the ring gear outer diameter as shown in Fig. 60. Rock the ring gear back and forth being careful not to move the pinion.

Note: Backlash can be adjusted without changing the bearing pre-load by loosening one bearing adjusting nut a certain number of notches and tightening the opposite nut the same number of notches.

54. Tighten adjusting nut (67) opposite ring gear (71) two notches in order to obtain the bearing pre-load of 3 - 4 Nm (115 - 155 lbf ft), then recheck the backlash.

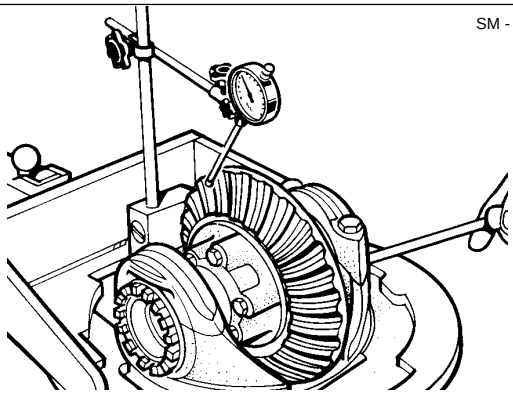


Fig. 60 - Checking Backlash

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55. Ring gear runout is measured by mounting a dial indicator gauge on the backside of the ring gear. Carefully rotate the ring gear and read the dial indicator gauge. Maximum allowable run out is 0.08 mm (0.003 in).

56. To check ring gear (71) tooth pattern, coat about twelve ring gear teeth with prussian blue, oiled red lead or some other easily removed paint or dye. When the pinion is rotated, the paint is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape and location of the contacts.

Gear tooth patterns are covered under 'Gleason Gear Tooth System'.

57. After all adjustments are made and the gear tooth pattern is correct, lock adjusting nuts (67) with cotter pins (66). Lock bearing cap bolts (63) in place with lockwire (65).

58. Coat cover (53) bolt flange with sealing compound and install on countershaft case (49). Fasten the cover to the countershaft case with bolts (52). Tighten bolts (52) to a torque of 49 Nm (35 lbf ft).

59. Press ball bearing (81) into bore in the axle housing and retain with snap rings (80). Install shaft seal (79) in axle housing and retain with seal retainer (78).

60. Insert dust shield (77) over drive flange shaft (76) and insert drive flange shaft through axle housing, shaft seal (79) and ball bearing (81). Install shim (82) over drive flange shaft (76) and retain with circlip (83).

GLEASON GEAR TOOTH SYSTEM

Ideal tooth-contact patterns are shown in Figs. 61 & 62 indicating the pinion distance is correct.

If the patterns obtained are the same as that shown in Figs. 63 & 64 then decrease the pinion distance. Refer to Fig. 65.

If the patterns obtained are the same as that shown in Figs. 66 & 67 then increase the pinion distance. Refer to Fig. 68.

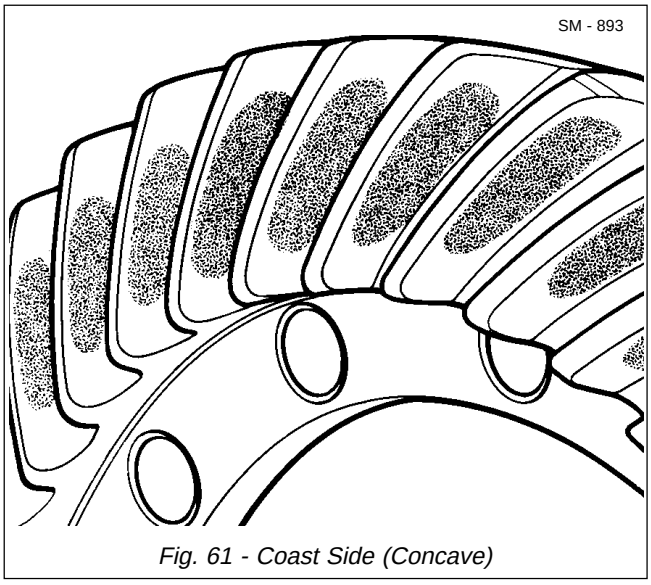


Fig. 61 - Coast Side (Concave)

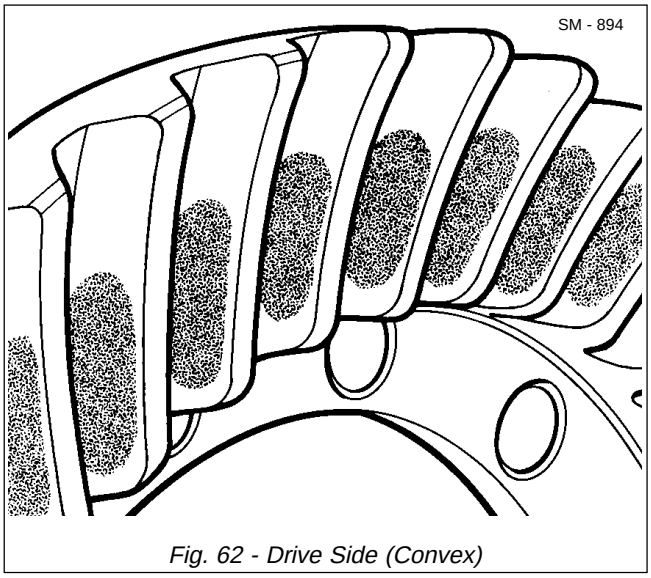


Fig. 62 - Drive Side (Convex)

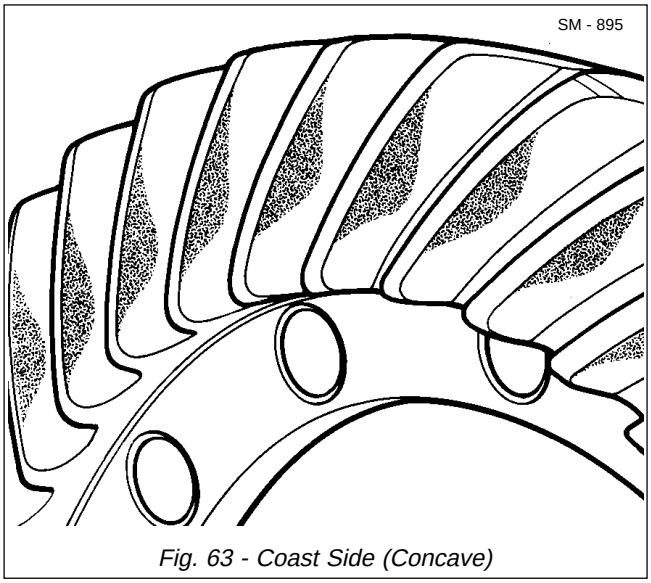


Fig. 63 - Coast Side (Concave)

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SM - 896

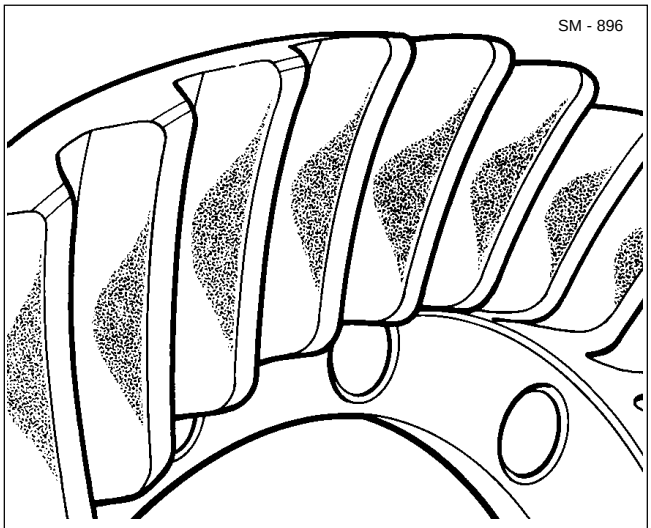


Fig. 64 - Drive Side (Convex)

SM - 899

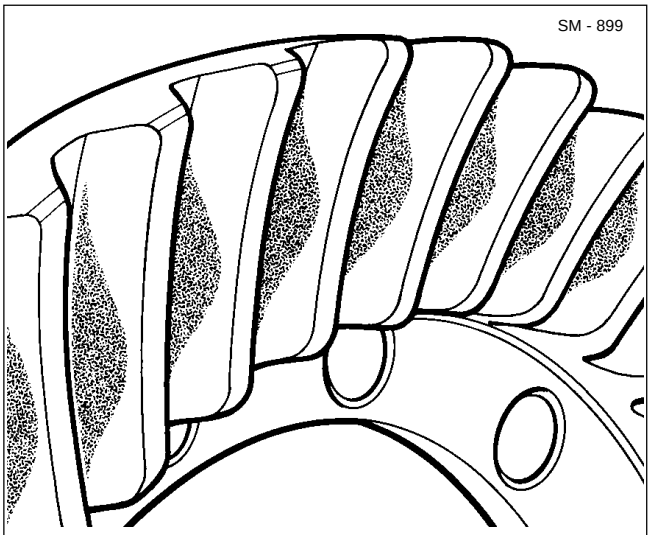


Fig. 67 - Drive Side (Convex)

SM - 897

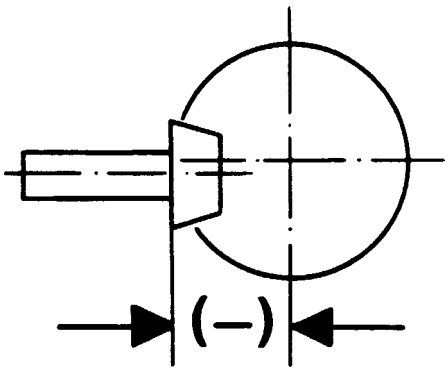


Fig. 65 - Pinion Distance Must Be Decreased

SM - 900

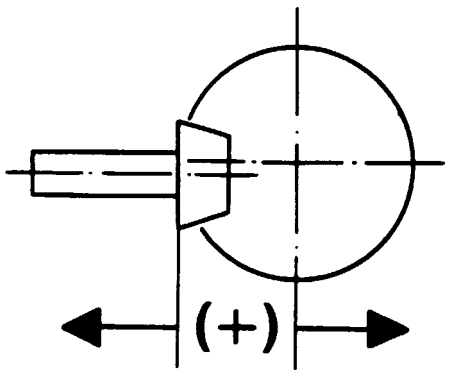


Fig. 68 - Pinion Distance Must Be Increased

SM - 898

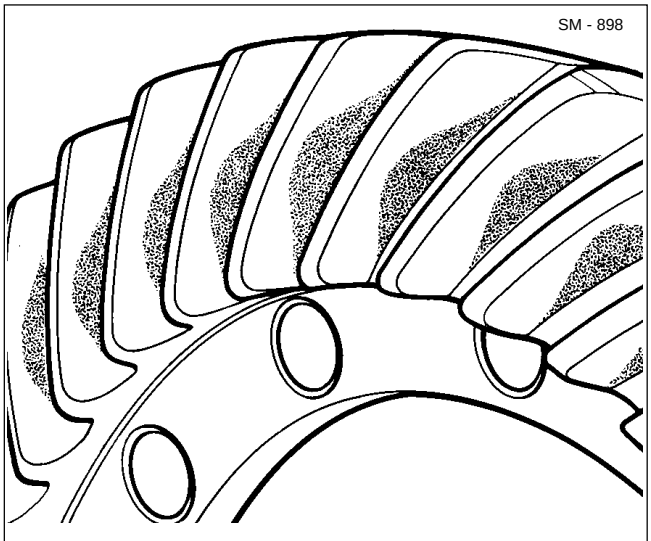


Fig. 66 - Coast Side (Concave)

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MAINTENANCE

Proper lubrication of the differential assembly is essential if the differentials are to deliver the service intended. Section 300-0020, LUBRICATION SYSTEM gives full information on the proper lubrication intervals and the lubricant which should be used.

SPECIAL TOOLS

The special tools referenced in this section are available from your dealer. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools and sealants required.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	PART NAME	TORQUE	
			Nm	lbf ft
1	3	Castle Nut	1 200	885
1	13	Bolt	120	90
1	28	Bolt	160	120
1	29	Bolt	42	30
1	45	Bolt	42	30
1	52	Bolt	49	35
1	54	Nut	750	550
1	63	Bolt	245	180
1	69	Bolt	210	160
1	86	Slotted Nut	550	400
2	1	Bolt	110	82

DIFFERENTIAL DIAGNOSIS

Noises and vibrations originating in the tyres, transmission, planetaries and drivelines are easily transmitted and may be erroneously attributed to the differential. Therefore, all possible sources of noise should be investigated before the differential is taken apart.

Whenever noises such as a grating or rattle are heard coming from the differential, stop the unit immediately. One tooth from a gear can cause damage to all gears and bearings. When the differential is definitely at fault, remove the axle shafts and disconnect the driveline before moving the vehicle.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ WARNING
Removing the axle shafts or drivelines will make the parking brake ineffective.

DIAGNOSIS CHART

CONDITION	REASON	REMEDY
Vibration	Broken gear teeth, worn bearings	Replace gear or bearings
Continual noise	Worn gear or bearings	Replace gear or bearings
Noise on drive	Ring or pinion gear adjustment tight	Adjust
Noise on coast	Bearings damaged	Replace bearings
	Ring and pinion gear adjustment loose	Adjust
	Excessive pinion gear end play	Adjust

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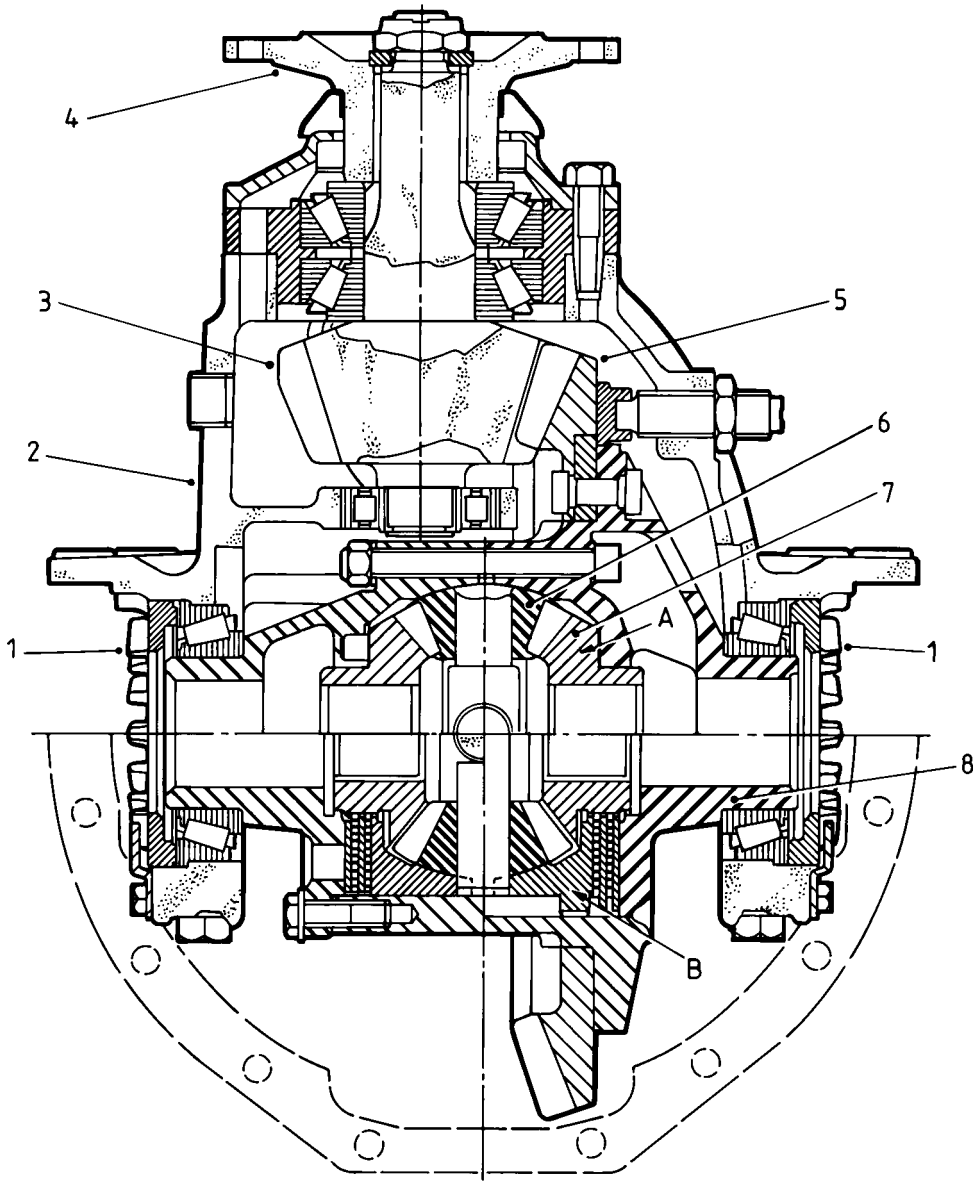
DIAGNOSIS CHART (CONTINUED)		
CONDITION	REASON	REMEDY
Noise on turns	Normal limited slip differential operation	Use an EP oil with limited slip additives. Refer to Section 300-0020, LUBRICATION SYSTEM
	Worn pinion gears or side gears	Replace gears
	Worn or damaged axles (spiders)	Replace axles (spiders)
Loss of lubricant	Oil seals worn	Replace seals
	Loose nuts or bolts	Tighten nuts or bolts to correct torque
	Cracked housing/case	Repair or replace housing/case

* * * *

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SM - 849



1 - Bearing Adjuster
2 - Housing
3 - Pinion Gear (Drive)
4 - Drive Flange
5 - Ring Gear
6 - Spider (Pinion) Gear
7 - Side Gear
8 - Differential Case Assembly

Fig. 1 - Sectional View of Typical Differential

DESCRIPTION

Numbers and letters in parentheses refer to Fig. 1.

Fig. 1 illustrates both a standard pinion gear and spider differential (A) and a limited slip type (B). Basically the differential consists of pinion gear (3) and ring gear (5). The differential is a spiral bevel ring gear type with an automatically operating limited slip element (B).

The differential is mounted to the axle housing. The driveline yoke attaches directly to differential flange (4) which is splined to the shaft of pinion gear (3).

Limited Slip Assembly

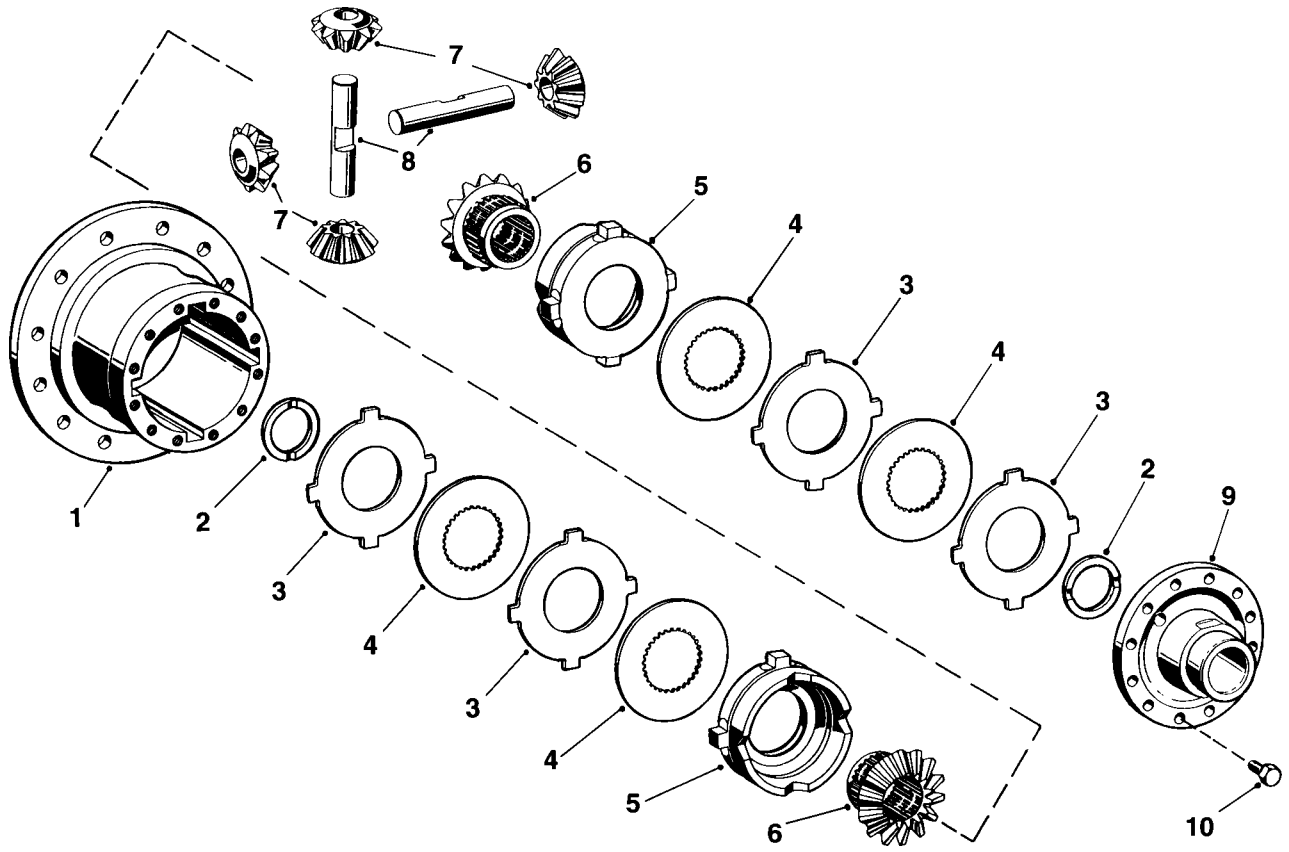
Numbers in parentheses refer to Fig. 2.

The limited slip assembly consists of housing (1), thrust washers (2), externally splined discs (3), internally splined discs (4), thrust ring (5), side gears (6), pinion gears (7), differential axle (8) and cover (9).

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SM - 850



1 - Housing
2 - Thrust Washers
3 - Externally Splined Discs
4 - Internally Splined Discs
5 - Thrust Ring
6 - Side Gears
7 - Pinion Gears
8 - Differential Axle
9 - Cover
10 - Bolts

Fig. 2 - Exploded View of Limited Slip Assembly

OPERATION

Numbers in parentheses refer to Fig. 2, unless otherwise specified.

Pinion gear (3, Fig. 1) is mated with ring gear (5, Fig. 1) which is bolted to differential case assembly (8, Fig. 1).

When both drive wheels are free to turn under equal resistance loads, ring gear (5, Fig. 1) and four small pinion (spider) gears (7, Fig. 1) act as one rigid unit, transmitting torque to both splined side gears (6). Side gears (6), being splined to the axle shafts, then drive each rear wheel with the same amount of torque at identical rates of speed. In this instance, pinion gears (7) do not rotate on their axis, therefore, side gears (6) rotate at the same rev/min as ring gear (5 Fig. 1).

When resistance on one drive wheel exceeds the resistance on the other, or when the vehicle makes a turn creating the same effect, one gear continues to revolve but pinion gears (7) cease to act rigidly with it. Pinion gears (7) now rotate on their own axis, permitting one drive wheel to rotate at a different speed from the other. Since the ratio of the pinion and side gear assembly is approximately 2 to 1, the result is that as one drive wheel slows down, the speed of the other proportionately increases. This prohibits the application of a torsional load to either axle, which is greater than that existing during normal operation.

Thus pinion gears (7) serve a dual purpose:

1. They allow a differential in speed between the two drive wheels, permitting maximum manoeuvrability.

2. They prohibit the application of all torque to one axle shaft.

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REMOVAL

Numbers in parentheses refer to Fig. 3.

> **⚠ WARNING**
> **To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.**

1. Before attempting to remove the road wheels, drive the vehicle onto a level, solid concrete floor, preferably after a short run to warm the oil.

Note: If the rear differential is being removed, raise the body and prop it up with the body prop.

2. Apply the parking brake and switch off the engine.

3. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

4. Drain the gear oil out of the axle housing and both planetaries into a suitable container.

5. Remove the planetary assemblies and axle shafts from the axle housing. If necessary, note from which side the long and short axle shafts are removed. Refer to Section 160-0030, AXLE GROUP (HUB).

6. Identify the relationship of the driveline flange and differential pinion flange with punch marks.

7. Disconnect the driveline from the differential drive flange. The driveline can be removed if it is convenient to do so.

8. Index mark differential housing (14) and the axle housing to ensure that differential housing (14) is installed in the same position.

9. Loosen and remove bolts (13) from the differential and axle housings. Thread in three puller bolts to break the seal between the differential and axle housings and to partially pull the differential assembly out of the axle housing.

10. Using suitable lifting equipment, support the weight of the differential assembly.

Note: When removing the rear differential, weld a loop to the bottom side of the body above the differential and attach the lifting device.

11. Pull out the differential assembly until it clears the axle housing, then carefully lower it to the floor. Slide the differential assembly out from beneath the vehicle.

INSTALLATION

Installation is the reversal of the 'Removal' procedure.

Note: Use sealing compound between the axle housing and differential housing mounting faces.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, AXLE BOLT AND NUT TORQUE SPECIFICATIONS.

Add gear oil of the type specified in Section 300-0020, LUBRICATION SYSTEM, through the differential filler/level hole until the oil is level with the bottom of the filler/level hole. Fill the planetary assemblies up to the 'Oil Level Check Line'.

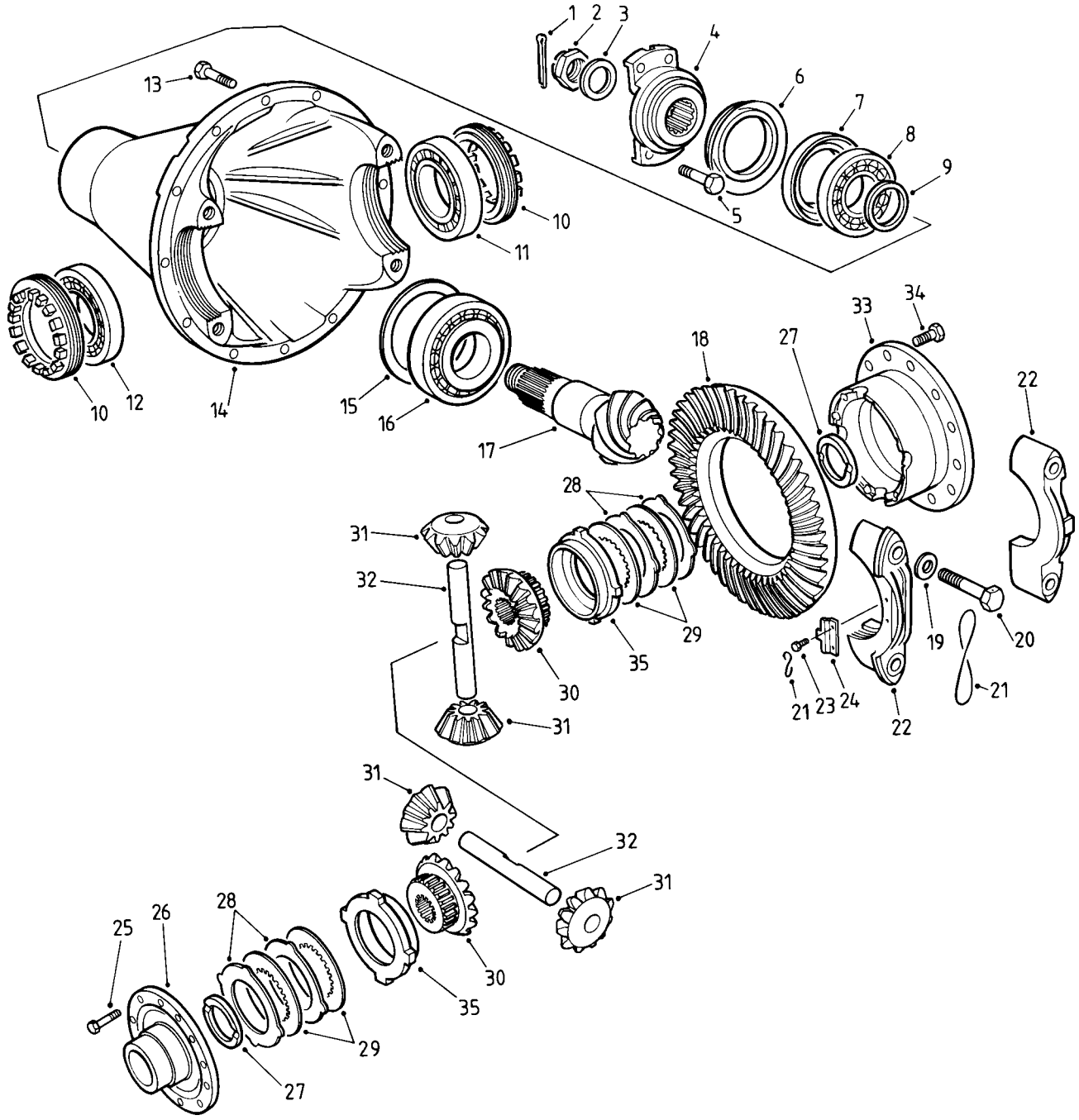
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Rear Axle Group - Differential Drive Head

Section 160-0020

SM - 851



1 - Cotter Pin
2 - Slotted Nut
3 - Washer
4 - Drive Flange
5 - Bolt
6 - Dust Shield
7 - Pinion Shaft Seal
8 - Bearing
9 - Spacing Washer (Shim)
10 - Adjusting Nut
11 - Roller Bearing
12 - Roller Bearing
13 - Bolt
14 - Differential Housing
15 - Spacing Washer (shim)
16 - Roller Bearing
17 - Pinion Gear
18 - Ring Gear
19 - Washer
20 - Bolt
21 - Lockwire
22 - Bearing Cap
23 - Bolt
24 - Lock Plate
25 - Bolt
26 - Cover
27 - Thrust Washer
28 - Externally Splined Plate
29 - Internally Splined Plate
30 - Side Gear
31 - Pinion Gear
32 - Axle
33 - Housing
34 - Bolt
35 - Thrust Ring

Fig. 3 - Exploded View of Front and Rear Differential

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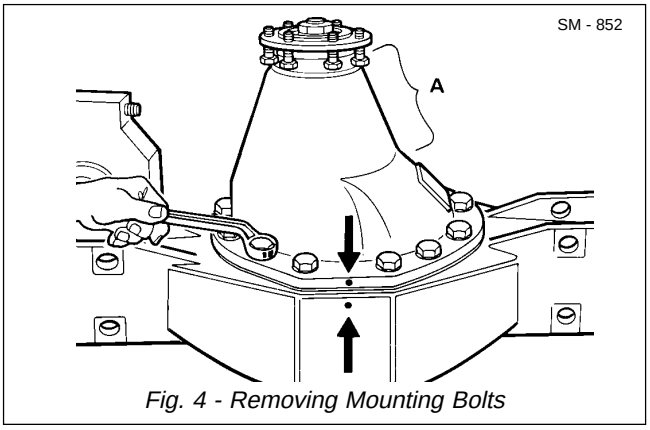


Fig. 4 - Removing Mounting Bolts

DISASSEMBLY

Numbers in parentheses refer to Fig. 3.

Note: The following removal procedure assumes the complete axle assembly was removed from the vehicle.

1. Punch mark the mounting position of differential housing (14) to the axle housing as shown by arrows in Fig. 4. Remove mounting bolts (13).

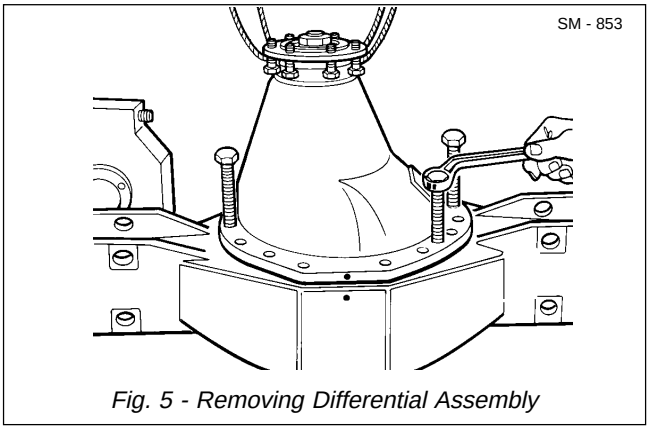


Fig. 5 - Removing Differential Assembly

2. Remove both planetary assemblies and axle shafts by following the procedure in Section 160-0030, AXLE GROUP (HUB). Use three puller bolts to pull the differential assembly away from the axle housing and then lift it out of the axle housing as shown in Fig. 5.

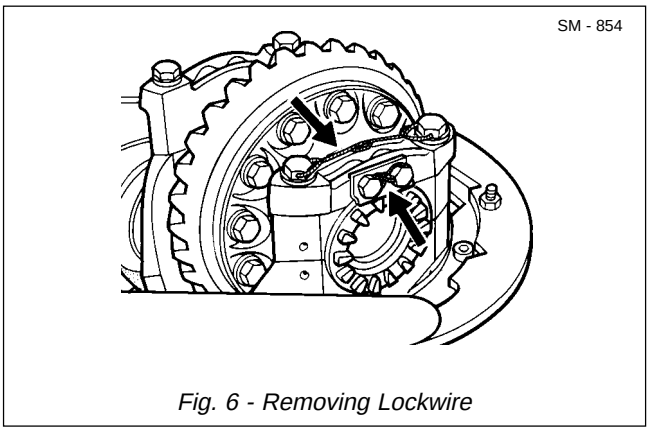


Fig. 6 - Removing Lockwire

3. Remove lockwire (21) from bolts (20 & 23) as shown by the arrows in Fig. 6.

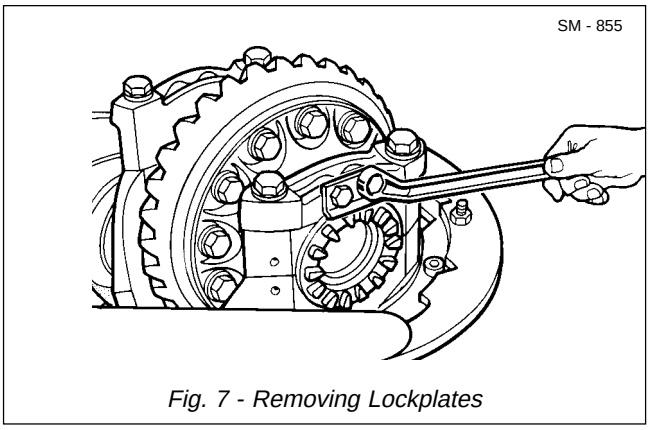


Fig. 7 - Removing Lockplates

4. Remove bolts (23) and lock plate (24) from bearing caps (22) as shown in Fig. 7.

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5. Punch mark bearing caps (22) and differential housing (14) as shown in Fig. 8. Loosen adjusting nuts (10). Remove bolts (20), washers (19) and bearing caps (22).

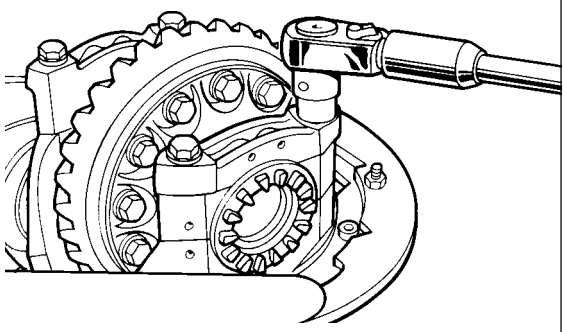


Fig. 8 - Removing Bearing Caps

6. Remove both adjusting nuts (10) as shown in Fig. 9.

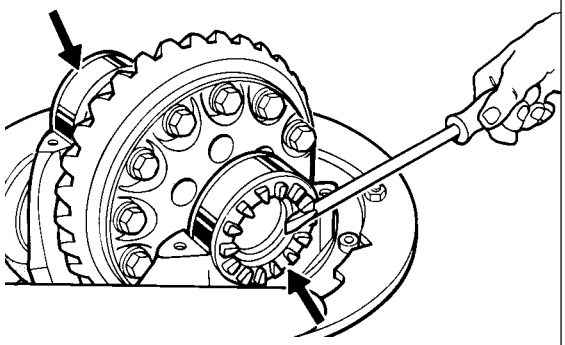


Fig. 9 - Removing Adjusting Nuts

7. Lift the differential assembly out of differential housing (14) with the special tool as shown in Fig. 10.

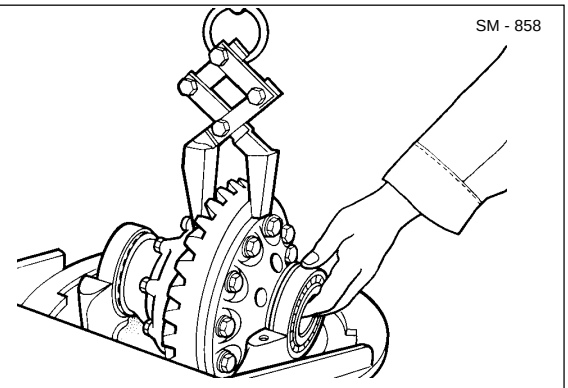


Fig. 10 - Removing Differential

8. Remove outer races of tapered roller bearings (11 & 12). Pull the inner race of the bearings with a puller from cover (26) and housing (33) with the puller shown in Fig. 11.

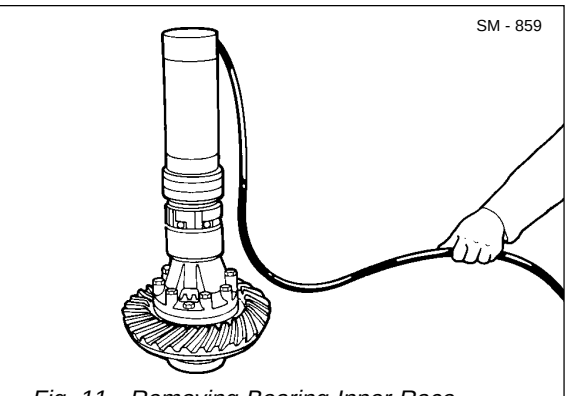


Fig. 11 - Removing Bearing Inner Race

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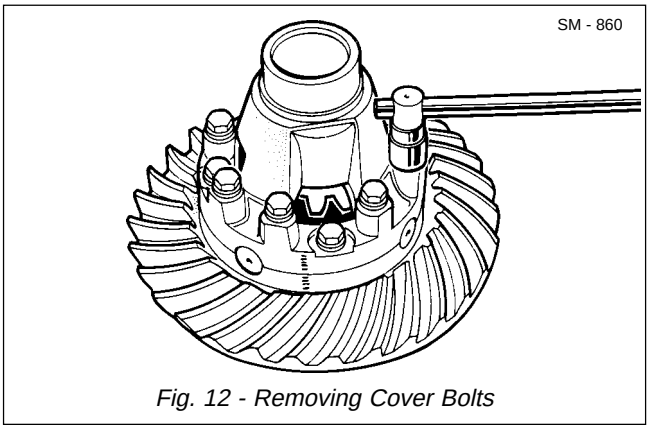


Fig. 12 - Removing Cover Bolts

9. Remove bolts (25) from cover (26) as shown in Fig. 12.

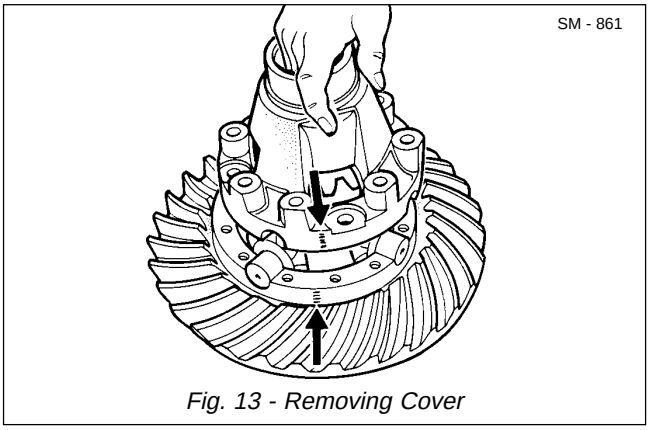


Fig. 13 - Removing Cover

10. Punch mark cover (26) and housing (33) as shown by the arrows in Fig. 13, then lift off the cover.

11. Remove thrust washer (27), two externally splined plates (28), two internally splined plates (29), thrust ring (35) and side gear (30).

12. Remove four pinion gears (31) and axle (32) out of housing (33).

13. Remove other side gear (30), thrust ring (35), two internally splined plates (29), two externally splined plates (28) and thrust washer (27) from housing (33).

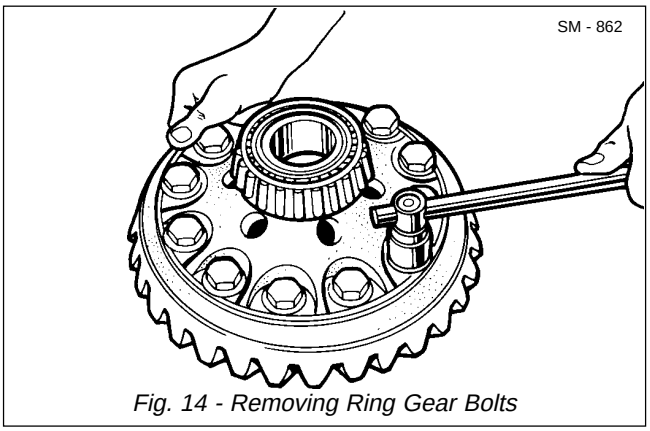


Fig. 14 - Removing Ring Gear Bolts

14. If necessary, pull the inner race of tapered roller bearing (11) off housing (33). If ring gear (18) is being removed from housing (33), punch mark them so they can be assembled in the same position. Remove bolts (34) as shown in Fig. 14 and press ring gear (18) off housing (33).

15. Remove cotter pin (1), slotted nut (2), washer (3) and drive flange (4) from pinion gear (17).

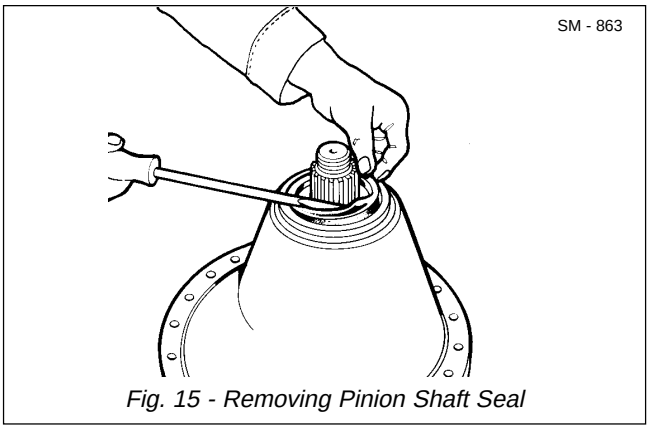


Fig. 15 - Removing Pinion Shaft Seal

16. Remove and discard pinion shaft seal (7) from differential housing (14) as shown in Fig. 15.

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17. Press pinion gear (17) out of differential housing (14) as shown in Fig. 16. Remove spacing washer (15).

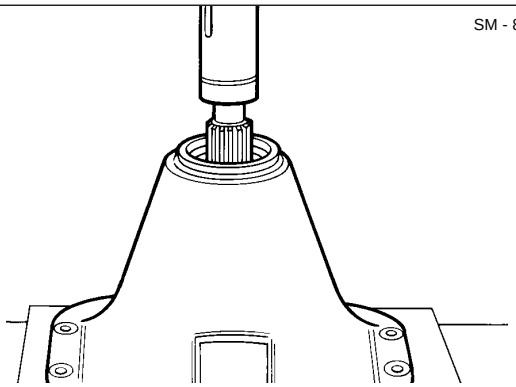


Fig. 16 - Pressing Out Pinion Shaft

18. With the special tool shown in Fig. 17 pull the inner race of the bearing off the pinion drive end.

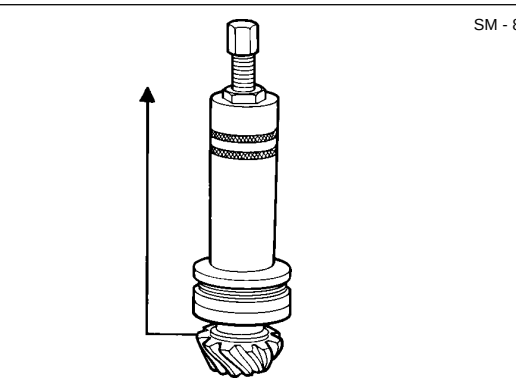


Fig. 17 - Pulling Inner Race of Bearing

INSPECTION

1. Clean all parts with a suitable solvent. Dry all parts, except bearings, with compressed air or with soft, clean lint free cloths. DO NOT spin bearings with compressed air. Place bearings on a clean surface, cover with lint free cloths and allow to dry.

2. Coat cleaned, dried parts immediately with light oil to prevent corrosion. If parts are not to be assembled immediately, treat them with a good quality rust preventive and wrap them with treated paper or suitable material designed to prevent corrosion.

3. Before installing the differential assembly into the axle housing, clean the inside and outside of the axle housing to remove any debris or dirt.

4. Inspect all gears, pinions and splines for cracked or broken teeth, excessive wear, and pitted or scored surfaces. Repair or replace as necessary.

Note: If either ring gear or pinion gear is defective, both gears must be replaced, because they are serviced only as a matched set. Make sure the ring gear and pinion gear have the same mating numbers.

5. Check for pitted, scored or worn thrust surfaces of differential case halves.

6. During assembly and installation, make sure that mated, punch marked or otherwise identified parts are returned to their original positions, if still serviceable.

ASSEMBLY

Numbers in parentheses refer to Fig. 3.

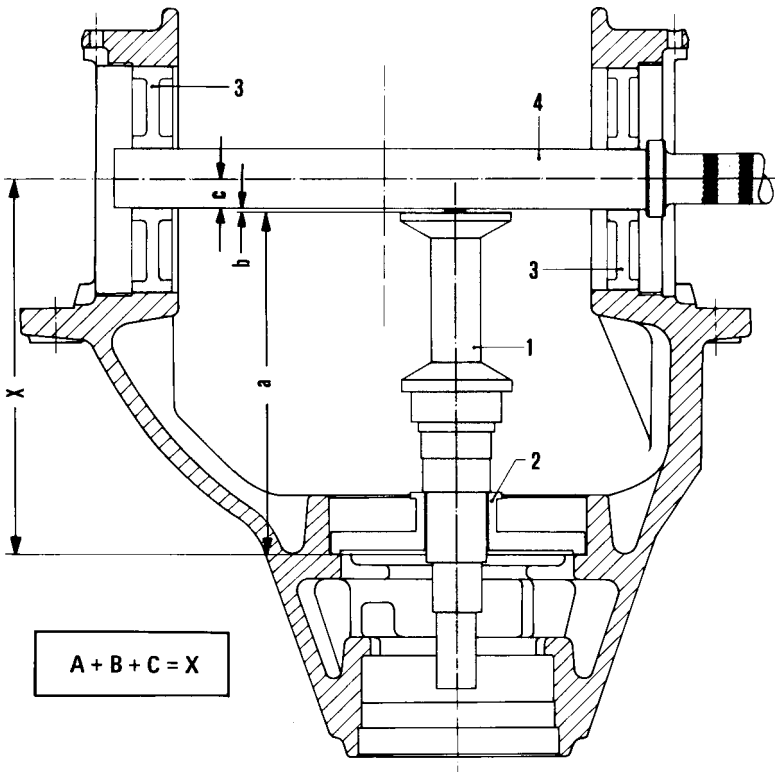
Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, AXLE BOLT AND NUT TORQUE SPECIFICATIONS.

The first step in the assembly procedure is to determine the thickness of the spacing washer or shim (15). Fig. 18 illustrates the special tools needed to determine the shim size.
Dimensions A + B + C = X which is the shim size.

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SM - 866



1	Measuring Piston	15269936
2	Thrust Washer	15269935
3	Adaptor Pieces	15269937
4	Measuring Shaft	15269934

Fig. 18 - Determining Shim Thickness

SM - 867

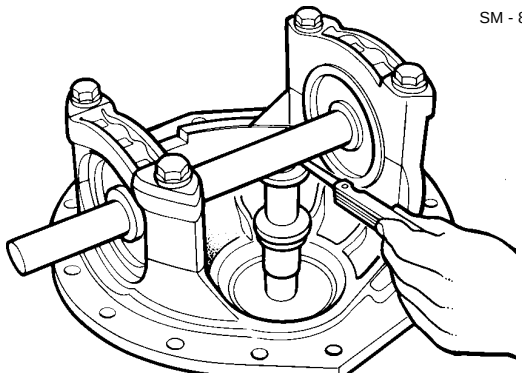


Fig. 19 - Determining Pinion and Shaft Gap

1. Using a feeler gauge, determine the gap between the measuring piston and measuring shaft as shown in Fig. 19. For example:

	Dimension 'A' + 'B'	= 191.8 mm (7.551 in)
+	Dimension 'C'	= 15.0 mm (0.591 in)
	(half the diameter of the measuring shaft).	
	Dimension 'X'	= 206.8 mm (8.142 in)

SM - 868

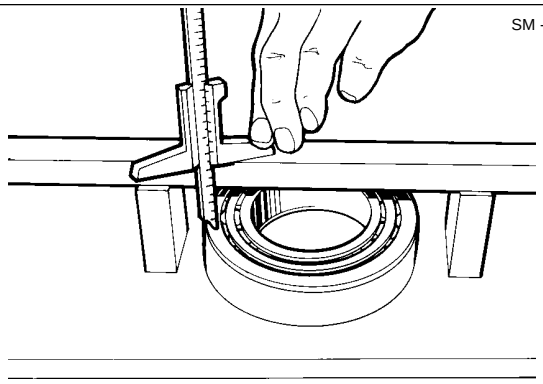


Fig. 20 - Determining Bearing Thickness

2. Next, determine the thickness of tapered roller bearing (16) as shown in Fig. 20. For example:

	(Straight edge + gauge blocks)	= 90.0 mm (3.543 in)
-	Measured Value	= 43.9 mm (1.728 in)
	Bearing Thickness	= 46.1 mm (1.815 in)

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3. The arrow in Fig. 21 is pointing to a dimension etched on the face of pinion gear (17). For example 159.90 mm (6.295 in).

Dimension 'XI' (Bearing Thickness)	=	46.10 mm (1.815 in)
	+	159.90 mm (6.295 in)
	=	206.00 mm (8.110 in)
Example:		
Dimension 'X'	=	206.80 mm (8.142 in)
- Dimension 'XI'	=	206.00 mm (8.110 in)
Shim Thickness	=	0.80 mm (0.032 in)

SM - 869

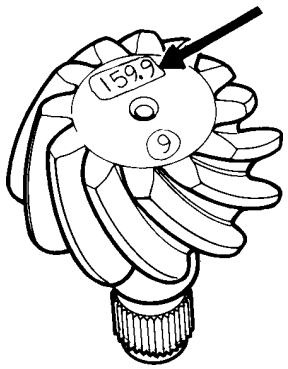


Fig. 21 - Dimension on Drive Pinion Face

4. Place shim (15), of the correct thickness as determined in Steps 1, 2 and 3 into differential housing (14) as shown in Fig. 22.

SM - 870

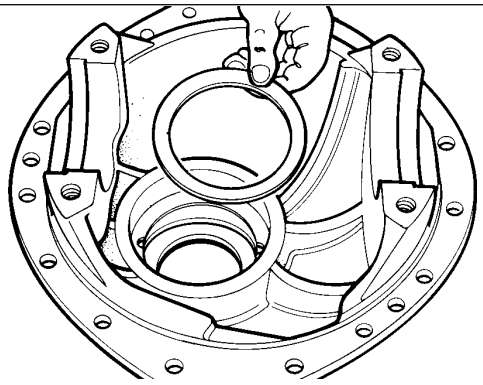


Fig. 22 - Placing Shim in Housing

5. Using a special driving tool, drive the outer race of tapered roller bearing (16) into differential housing (14) as shown in Fig. 23.

SM - 871

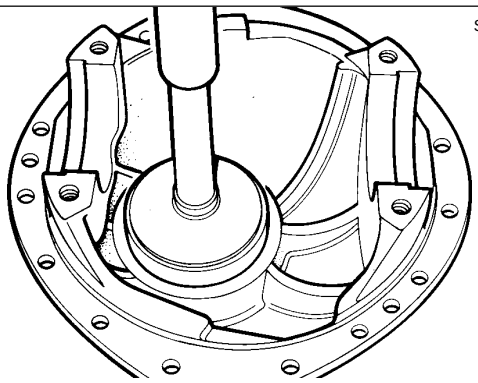


Fig. 23 - Installing Outer Race of Bearing

6. Turn differential housing (14) over and install outer race of tapered bearing (8) into its bore as shown in Fig. 24.

SM - 872

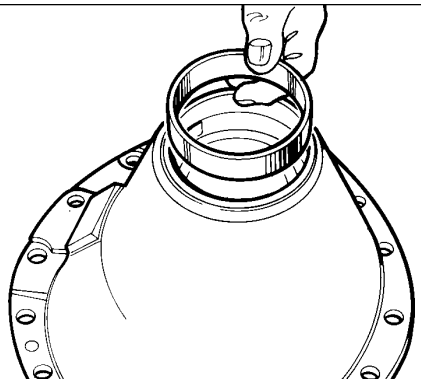


Fig. 24 - Installing Outer Race of Bearing

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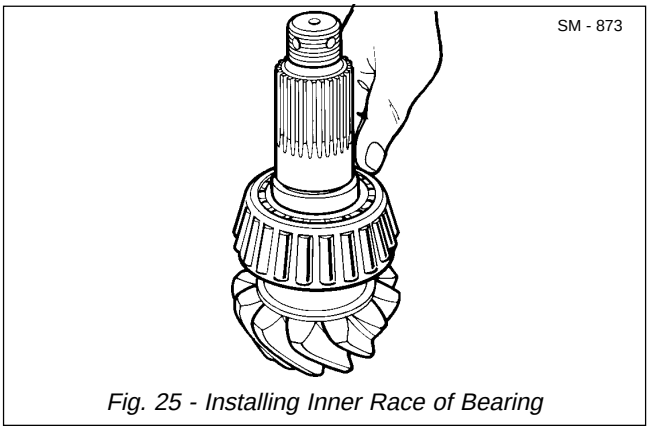


Fig. 25 - Installing Inner Race of Bearing

7. Heat the inner race of tapered roller bearing (16) to approximately 90° C (190° F) and install it on the shaft of pinion gear (17). Be sure it is seated against the shaft shoulder as shown in Fig. 25.

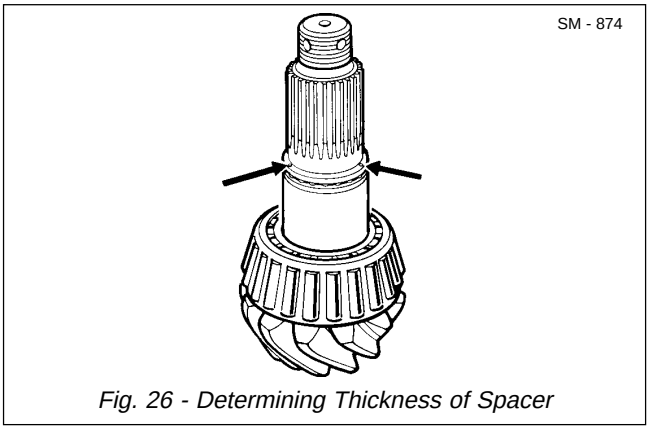


Fig. 26 - Determining Thickness of Spacer

8. The following steps are required to determine the thickness of spacing washer (9). Place the special measuring ring on the shoulder of pinion gear (17) as shown by the arrows in Fig. 26.

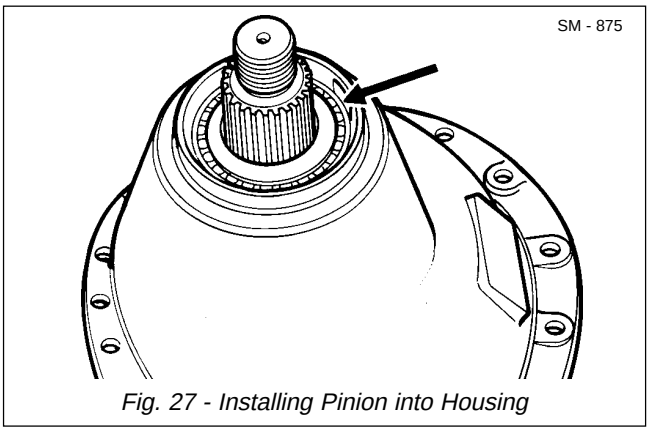


Fig. 27 - Installing Pinion into Housing

9. Place the pre-assembled pinion gear (17) on a suitable spacing tube. Lift up differential housing (14) and carefully place it over the pinion. Heat the inner race of bearing (8) to approximately 90° C (190° F) and install it on the shaft of pinion gear (17). Drive the inner bearing race until it is seated against the outer race as shown in Fig. 27.

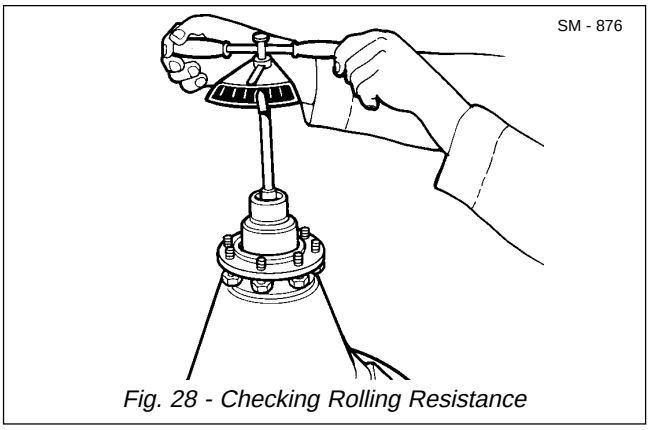


Fig. 28 - Checking Rolling Resistance

10. If dust shield (6) was removed from drive flange (4), press it back on the drive flange. Spline drive flange (4) to pinion (17). Install slotted nut (2) and tighten to a torque of 600 Nm (443 lbf ft). Check the rolling resistance as shown in Fig. 28. Rolling resistance should be 1.1 - 2.3 Nm (0.81 -1.70 lbf ft).

Note: Correct rolling resistance is obtained by loosening or tightening the slotted nut. Record the torque figure because it will be required later.

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11. Remove slotted nut (2), pull off drive flange (4) and remove pinion gear (17) from differential housing (14). Remove and measure the measuring ring with a micrometer. The thickness of the compressed measuring ring will be the thickness of spacing washer (9).

Place spacing washer (9) on the shoulder of the pinion shaft. Then install the assembled pinion gear into differential housing (14).

12. Coat the outer diameter of pinion shaft seal (7) with sealing compound. With the seal lip facing inward and using the seal driver shown in Fig. 29, drive seal (7) into differential housing (14).

13. Slide drive flange (4) on the shaft of pinion gear (17). Place washer (3) on the pinion shaft and thread on slotted nut (2). Torque slotted nut (2) to the setting determined in Step 10. Lock slotted nut (2) in place with cotter pin (1).

14. If ring gear (18) was removed from housing (33), make sure the ring gear and housing surfaces are clean and free from grease. Install two line-up studs, line up index marks and press the ring gear back on. Install bolts (34) and, with a dial indicator gauge, check ring gear run-out. Maximum allowable run-out is 0.08 mm (0.003 in).

15. Heat inner roller bearing (12) race to 90° C (190° F) and press it on to the hub of housing (33) until it is firmly seated.

16. Place one thrust washer (27) with the lubrication slot facing up.

17. Alternately, install an externally splined plate (28) and then an internally splined plate (29) until all plates have been installed.

18. Install thrust ring (35) on top of the internally splined plate (29). Install thrust ring (35) with open face up.

19. Install one side gear (30) into thrust ring (35). Make sure the side gear splines into the two internally splined plates (29).

20. Assemble axles (32) and pinion gears (31) together and install on the installed side gear (30), as shown in Fig. 30.

21. Install the other side gear (30) and the other thrust ring (35), flat side up, as shown in Figs. 31 and 32.

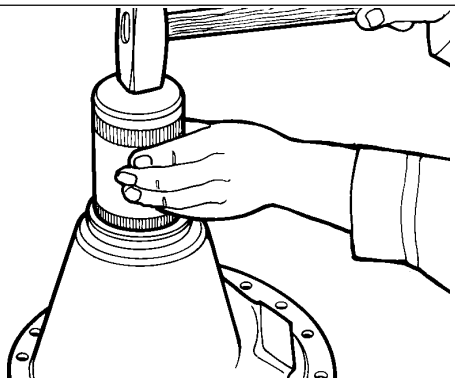


Fig. 29 - Installing Shaft Seal

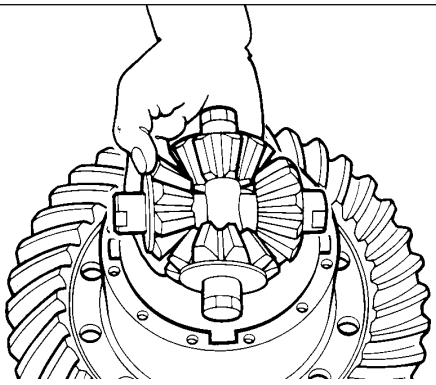


Fig. 30 - Installing Shaft and Pinion Gears

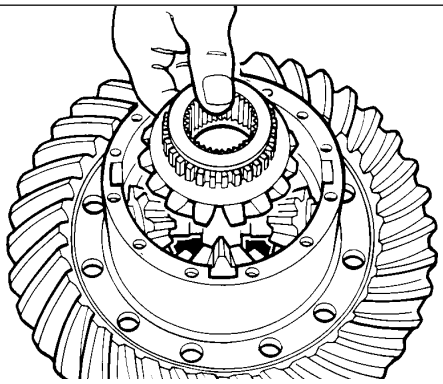


Fig. 31 - Installing Side Gear

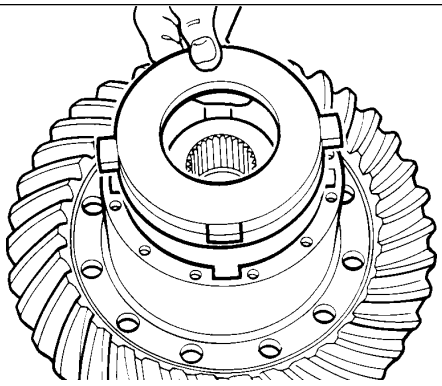


Fig. 32 - Installing Thrust Ring

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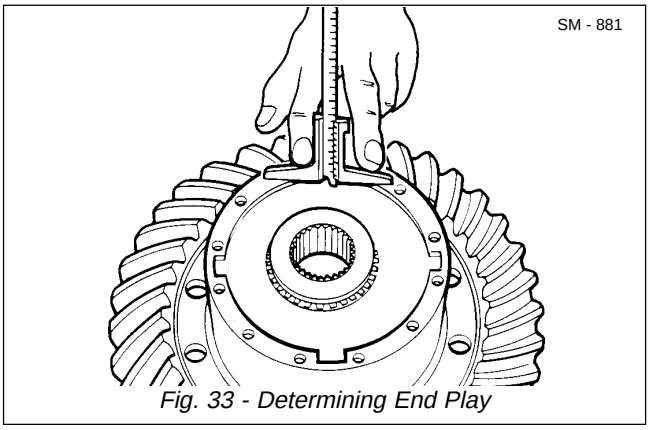


Fig. 33 - Determining End Play

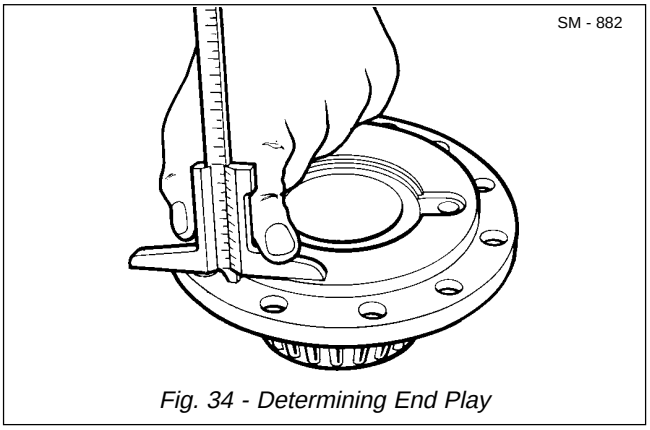


Fig. 34 - Determining End Play

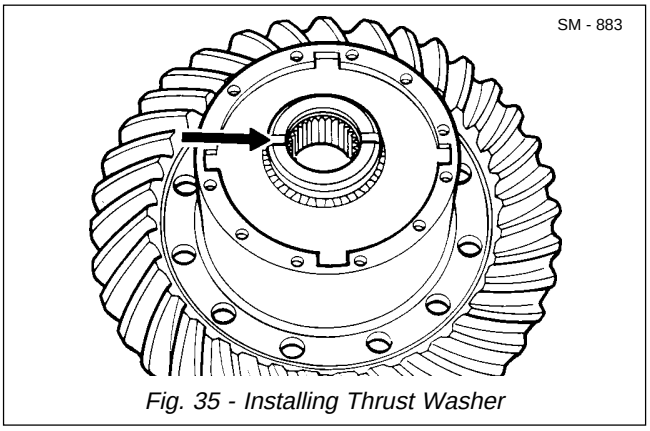


Fig. 35 - Installing Thrust Washer

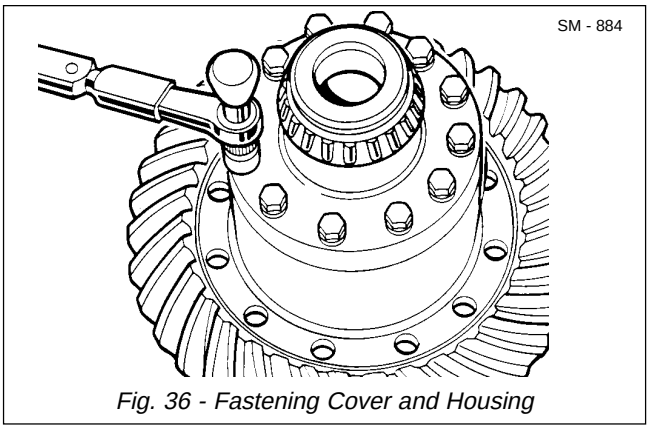


Fig. 36 - Fastening Cover and Housing

22. Alternately install an internally splined plate (29) and externally splined plate (28) until all plates are installed.

23. Determine the end play between the plates and the housing as shown in Figs. 33 and 34.

Step 1 - Determine the dimension between the housing face and the internally splined plate (29). For example - the measurement is 6.00 mm (0.236 in).

Step 2 - Determine the dimension between housing (33) and cover face (26). For example - the measurement is 5.80 mm (0.228 in).

Step 1 Dimension ..... 6.00 mm (0.236 in)
Step 2 Dimension ..... 5.80 mm (0.228 in)

Difference ..... 0.20 mm (0.008 in)

The correct end play between the housing cover and both plate packs should be between 0.20 - 0.80 mm (0.008 - 0.031 in). The end play should be as close to 0.20 mm (0.008 in) as possible. The end play is controlled by installing different thicknesses of internally splined plates. Refer to the parts book for different thicknesses of plates available.

24. Place thrust washer (27) on side gear (30), as shown in Fig. 35.

25. Heat inner race of roller bearing (11) to approximately 90° C (190° F) and press it on to the hub of cover (26) until it is firmly seated against the cover.

26. Place cover (26) on housing (33), cover threads of necked-down bolts (25) with Loctite 270 and fasten cover and housing together as shown in Fig. 36. Use only new necked-down bolts. Tighten bolts (25) to a torque of 110 Nm (82 lbf ft).

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27. Place outer races of roller bearings (11 & 12) on both differential ends. Using the special lifting tool install ring gear (18) assembly into differential housing (14), as shown in Fig. 37.

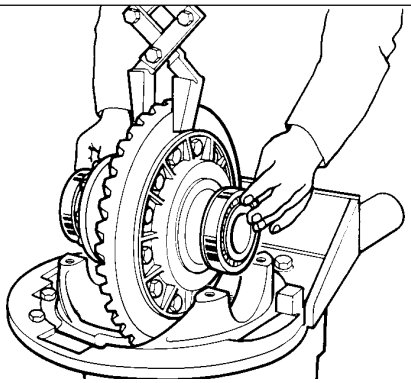


Fig. 37 - Installing Ring Gear Assembly

28. Coat the threads of adjusting nuts (10) with Molykote and loosely thread into lower bearing cups, as shown in Fig. 38.

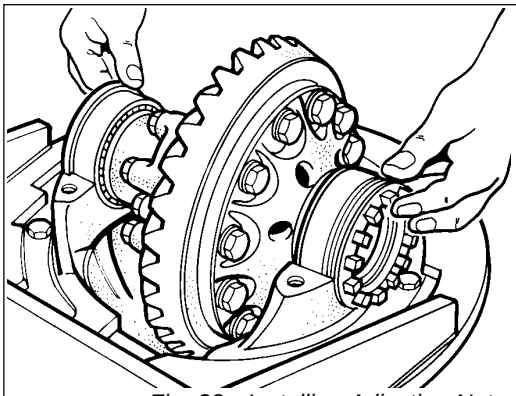


Fig. 38 - Installing Adjusting Nuts

29. Align the index marks and install bearing caps (22) with washer (19) and bolts (20), as shown in Fig. 39. Tighten bolts (20) to a torque of 295 Nm (218 lbf ft).

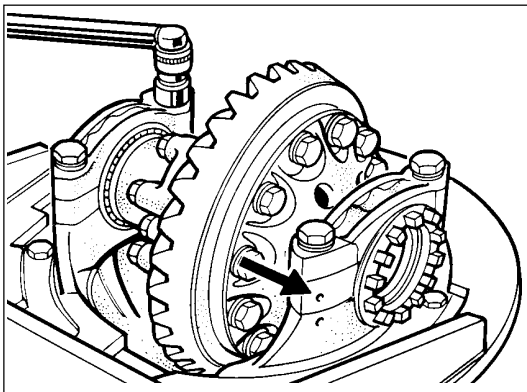


Fig. 39 - Installing Bearing Caps

30. Thread both adjusting nuts (10) into bearing caps (22) as shown, until the yoke width is between 340 - 340.30 mm (13.386 - 13.400 in) diagonally across the bearing cap lock pads, as shown in Fig. 40.

Note: Bearing adjusting nuts (10) have two basic functions: preloading the bearings and positioning ring gear (18) to obtain the correct backlash between it and pinion gear (17).

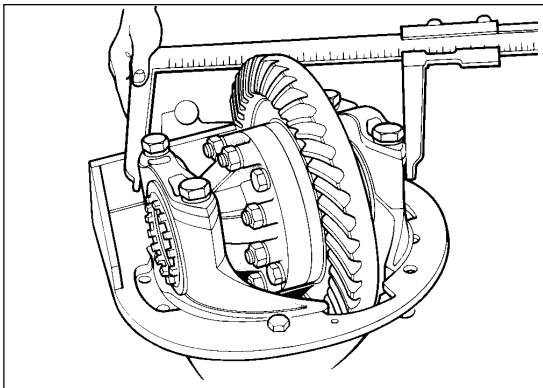


Fig. 40 - Measuring Yoke Width

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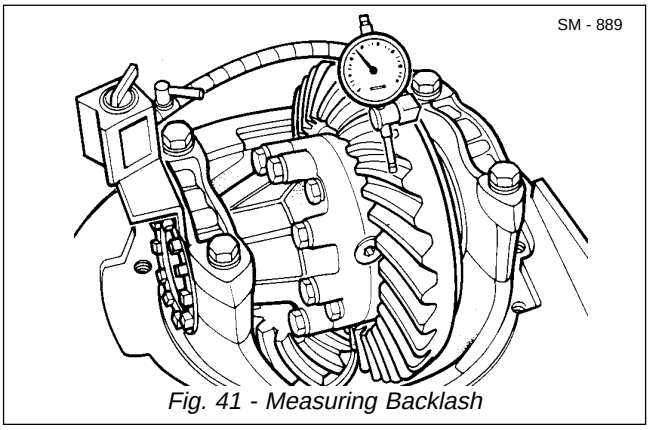


Fig. 41 - Measuring Backlash

31. To check the backlash between ring gear (18) and pinion gear (17), mount a dial indicator gauge at right angles to the outer diameter of the ring gear tooth flank as shown in Fig. 41. Rock the ring gear back and forth being careful not to move the pinion gear. Backlash should be 0.30 mm (0.012 in).

Note: Backlash can be adjusted without changing the bearing preload by loosening one bearing adjuster nut a certain number of notches and tightening the opposite adjuster nut the same number of notches.

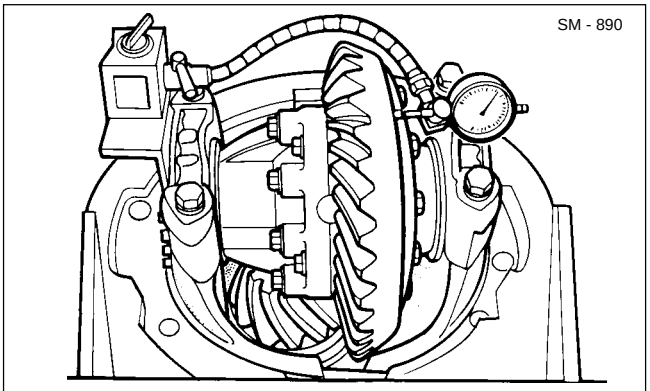


Fig. 42 - Measuring Ring Gear Runout

32. The ring gear run-out is measured by mounting a dial indicator gauge on the backside of ring gear (18) as shown in Fig. 42. Carefully rotate ring gear (18) and read the dial indicator. Maximum allowable run-out is 0.08 mm (0.003 in).

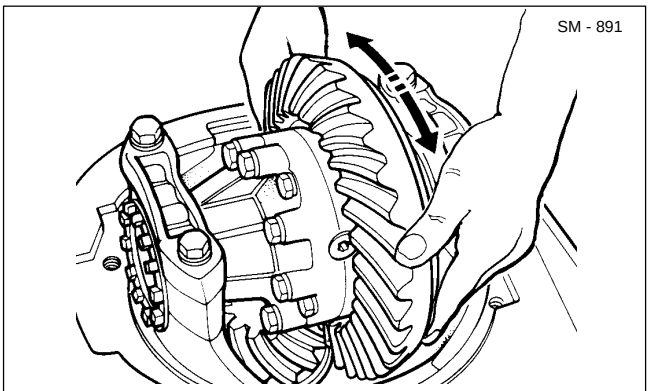


Fig. 43 - Checking Contact Pattern

33. To check the tooth pattern of ring gear (18), coat about twelve ring gear teeth with prussian blue, oiled red lead or some other easily removed print or dye. When the pinion is rotated, the paint is squeezed away by the contact of the teeth, leaving bare areas the exact size, shape and location of the contacts as shown in Fig. 43.

Gear tooth patterns for the Gleason Gear Tooth system are on the following pages.

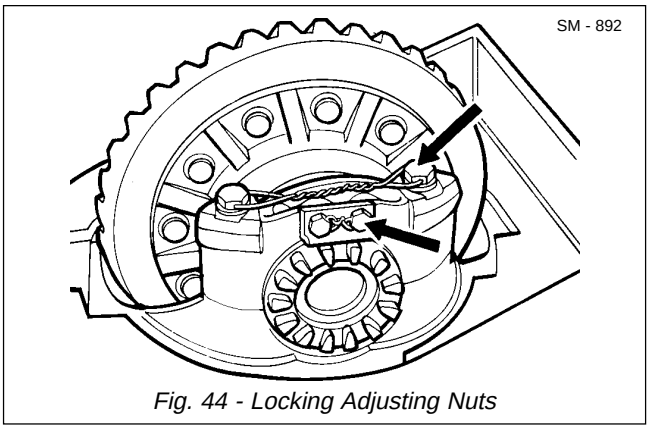


Fig. 44 - Locking Adjusting Nuts

34. After all adjustments and gear patterns are correct, secure adjusting nut lock plates (24) in place with bolts (23) and lockwire (21), as shown in Fig. 44.

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GLEASON GEAR TOOTH SYSTEM

Ideal tooth-contact pattern shown in Figs. 45 and 46 indicating the pinion distance is correct.

If the patterns obtained are the same as that shown in Figs. 47 and 48 then decrease the pinion distance (Fig. 49).

If the patterns obtained are the same as that shown in Figs. 50 and 51 then increase the pinion distance (Fig. 52).

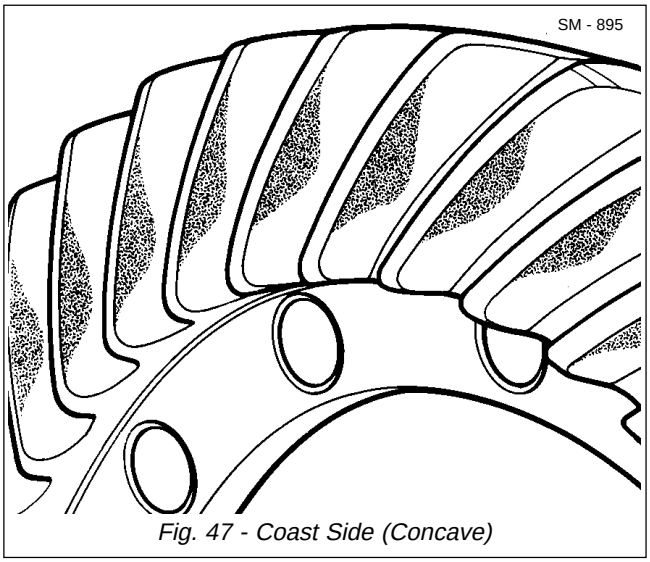


Fig. 47 - Coast Side (Concave)

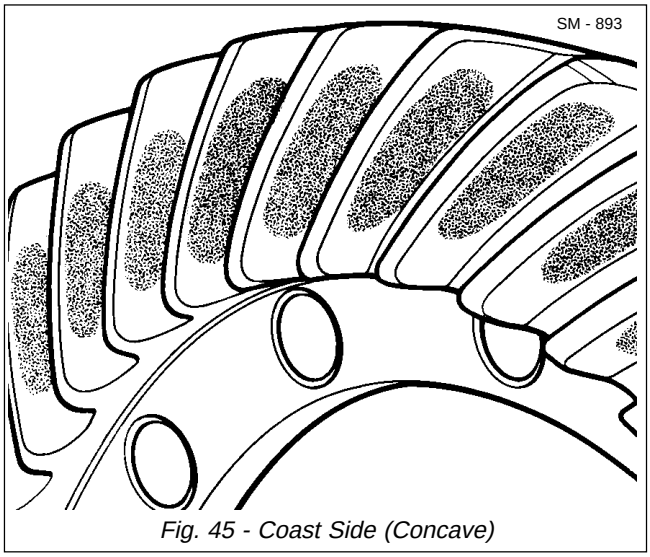


Fig. 45 - Coast Side (Concave)

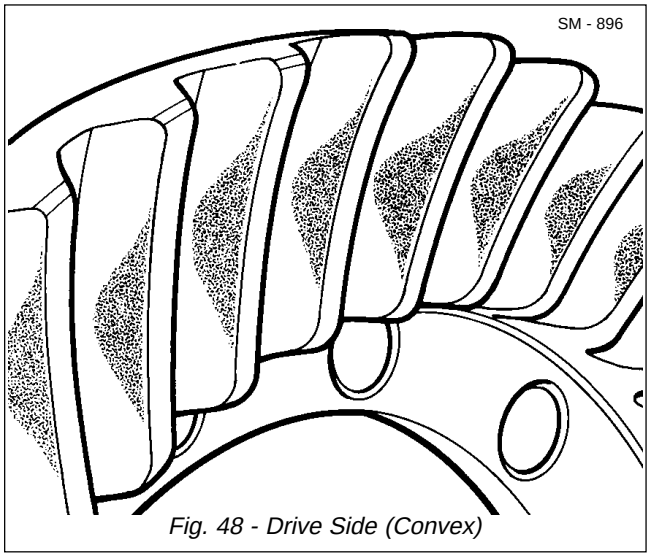


Fig. 48 - Drive Side (Convex)

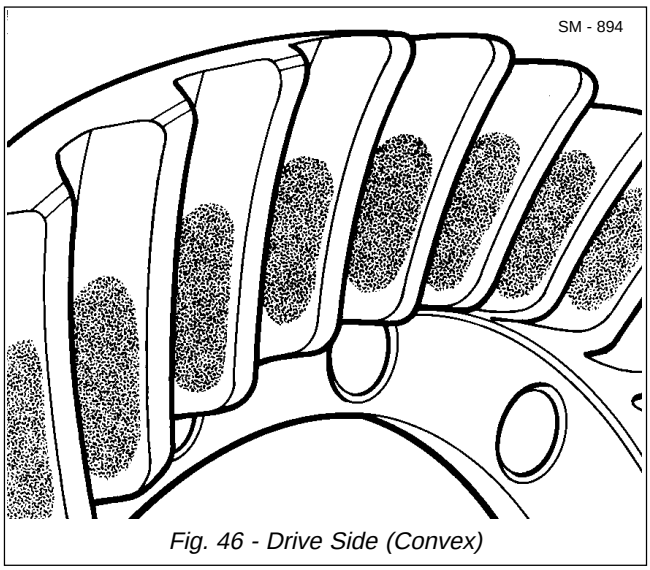


Fig. 46 - Drive Side (Convex)

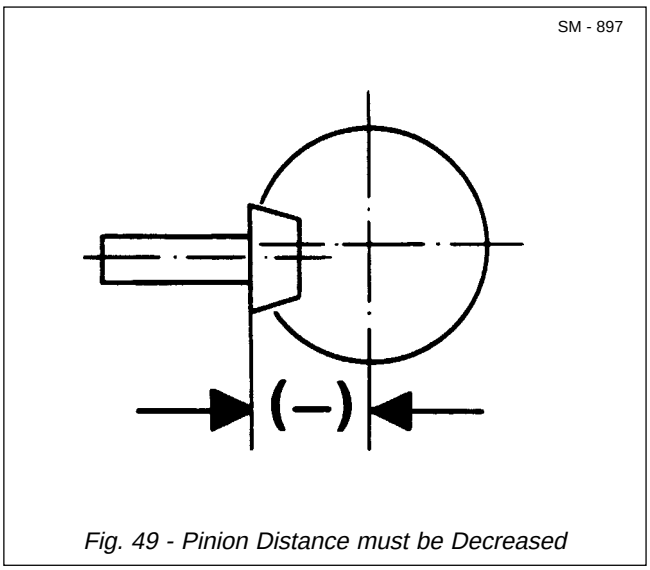


Fig. 49 - Pinion Distance must be Decreased

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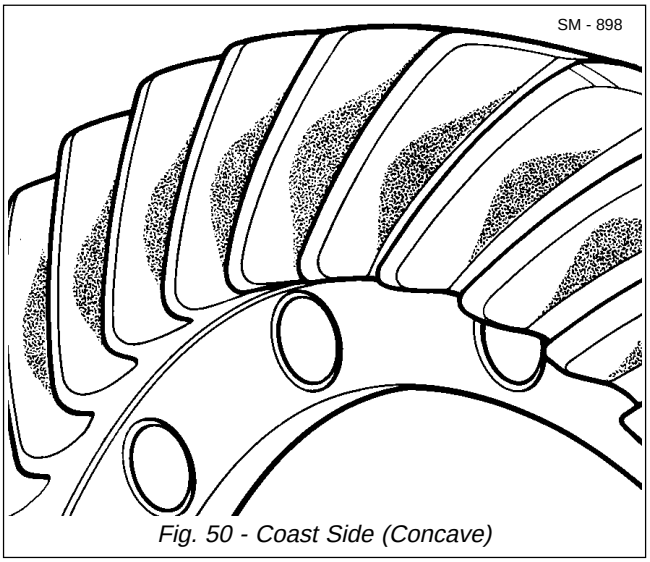


Fig. 50 - Coast Side (Concave)

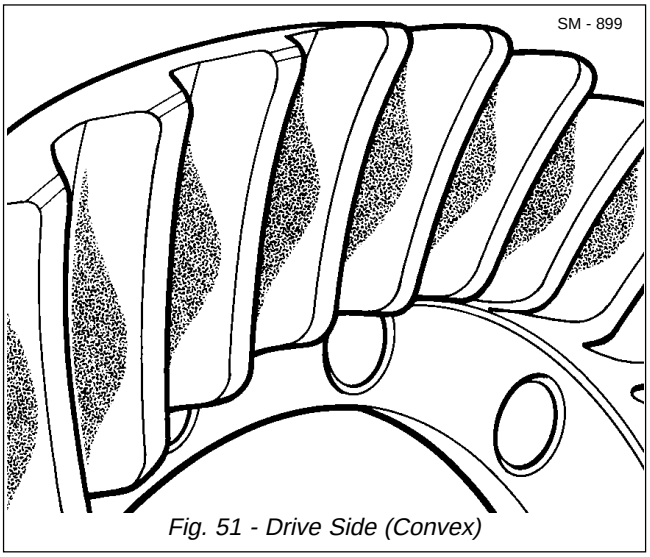


Fig. 51 - Drive Side (Convex)

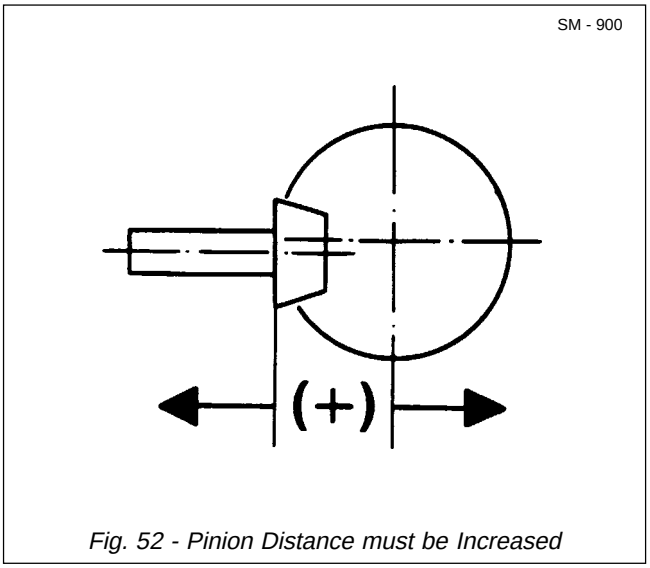


Fig. 52 - Pinion Distance must be Increased

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Rear Axle Group - Differential Drive Head

Section 160-0020

MAINTENANCE

Proper lubrication of the differential assembly is essential if the differentials are to deliver the service intended. Section 300-0020, LUBRICATION SYSTEM gives full information on the proper lubrication intervals and the lubricant which should be used.

SPECIAL TOOLS

The special tools referenced in this section are available from your dealer. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools and sealants required.

DIFFERENTIAL DIAGNOSIS

Noises and vibrations originating in the tyres, transmission, planetaries and drivelines are easily transmitted and may be erroneously attributed to the differential. Therefore, all possible sources of noise should be investigated before the differential is taken apart.

Whenever noises such as a grating or rattle are heard coming from the differential, stop the unit immediately. One tooth from a gear can cause damage to all gears and bearings. When the differential is definitely at fault, remove the axle shafts and disconnect the driveline before moving the vehicle.

⚠ WARNINGS

To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ Removing the axle shafts or drivelines will make the parking brake ineffective.

DIAGNOSIS CHART

CONDITION	REASON	REMEDY
Vibration	Broken gear teeth	Replace damaged gear
	Excessive run-out of pinion or flanged case	Disassemble, correct or replace faulty part
Continual noise	Bearing worn	Replace worn parts
	Gears damaged or worn	Replace gears
Noise on drive	Ring or pinion gear adjustment tight	Adjust
Noise on coast	Bearings damaged	Replace bearings
	Loose ring and pinion gear adjustment	Adjust
	Excessive pinion gear end play	Adjust
Noise on turns	Normal limited slip differential operation	Use an EP oil with limited slip additives. Refer to Section 300-0020, LUBRICATION SYSTEM
	Worn pinion gears or side gears	Replace gears
	Worn or damaged axles (spiders)	Replace axles (spiders)
Loss of lubricant	Oil seals worn	Replace seals
	Loose nuts or bolts	Tighten nuts or bolts to correct torque
	Cracked housing/case	Repair or replace housing/case

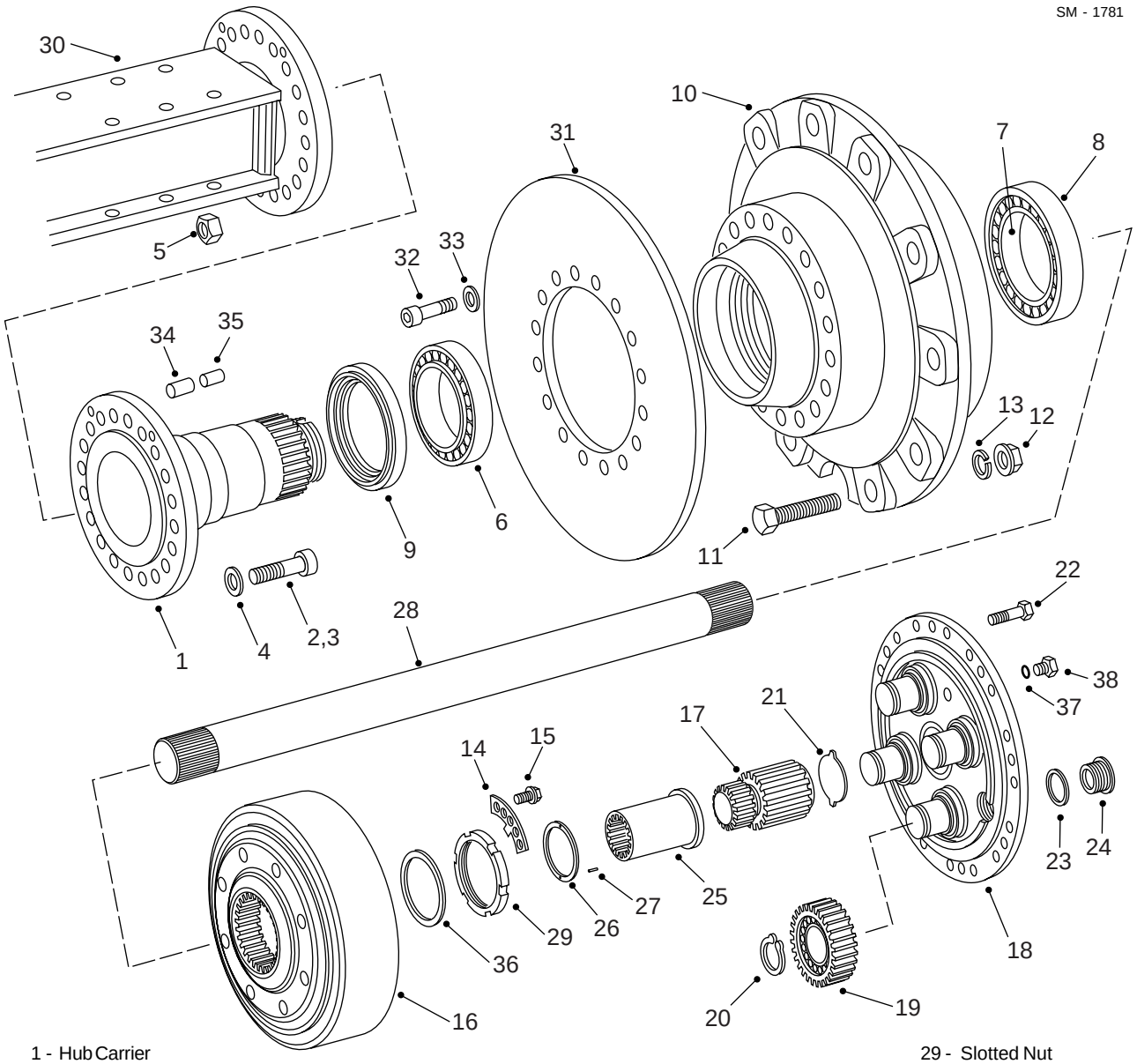
SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	PART NAME	TORQUE	
			Nm	lbf ft
3	2	Slotted Nut	600	443
3	20	Bolt	295	218
3	25	Bolt	110	82

* * * *

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1 - Hub Carrier
2 - Capscrew
3 - Capscrew
4 - Washer
5 -Nut
6 - Roller Bearing
7 - Bearing Inner Race
8 - Bearing Outer Race
9 - Shaft Seal
10 - Hub
11 - Wheel Bolt
12 - Wheel Nut
13 - Lockwasher
14 - Locking Plate
15 - Lock Screw
16 - Ring Gear
17 - Sun Gear Shaft
18 - Planet Carrier
19 - Planet Gear
20 - Retainer Ring
21 - Thrust Washer
22 - Bolt
23 - 'O' Ring
24 - Plug Screw
25 - Driver
26 - Thrust Washer
27 - Grooved Pin
28 - Axle Shaft
29 - Slotted Nut
30 - Axle Housing
31 - Brake Disc
32 - Capscrew
33 - Washer
34 - Split Pin
35 - Split Pin
36 - Shim
37 - 'O' Ring
38 - Plug

Fig. 1 - Exploded View of Planetary and Wheel

OPERATION

Numbers and letters in parentheses refer to Fig. 1.

Power from the differential is transmitted through a fully floating axle shaft connected to sun gear shaft (17) by driver (25). As sun gear shaft (17) rotates in a clockwise direction, the four planet gears (19) meshed with sun gear shaft (17) rotate anticlockwise. Ring gear (16) is splined to hub carrier (1) and does not rotate but causes planet gears (19), which are meshed with ring gear (16), to move around it in a clockwise direction. As planet carrier (18) is bolted to wheel hub (10) the wheel then rotates in a clockwise direction.

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REMOVAL AND DISASSEMBLY

Numbers in parentheses refer to Fig. 1**.**

Note: On dismantling, clean all parts in paraffin or other suitable cleaning agent and place on a clean work surface.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ To prevent personal injury and property damage, the procedure for removing tyre and rim assembly described in Section 160-0050, WHEEL, RIM AND TYRE, must be strictly followed.

⚠ When necessary to drive out components during disassembly, be sure to use a soft drift to prevent property damage and personal injury.

1. Before attempting to remove the road wheels, drive the vehicle onto a level, solid concrete floor, preferably after a short run to warm the oil.

2. Apply the parking brake and switch off the engine.

3. Block the appropriate road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

4. Whilst road wheels are still on the ground, loosen wheel nuts (12).

5. Jack up the axle and support with suitably placed stands or timbers.

6. Support tyre and rim assembly with a suitable sling and lifting device. Remove wheel nuts (12) and remove tyre and rim assembly from the machine. Remove opposite road wheel in the same way.

7. Place suitable containers under the differential and both hubs (10). Remove differential drain plug and drain oil from the differential.

8. Rotate hubs (10) until plug screws (24) are at their lowest points. Remove plug screws (24) and 'O' rings (23) and drain oil from hubs.

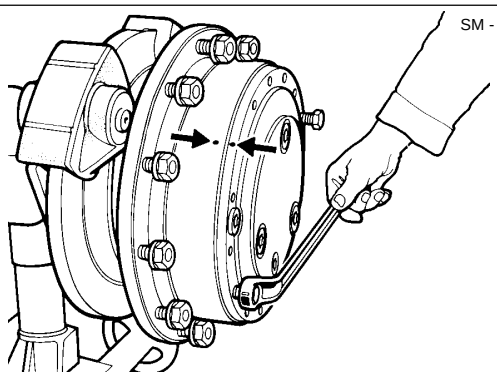


Fig. 2 - Jacking Planet Carrier Out Of Hub

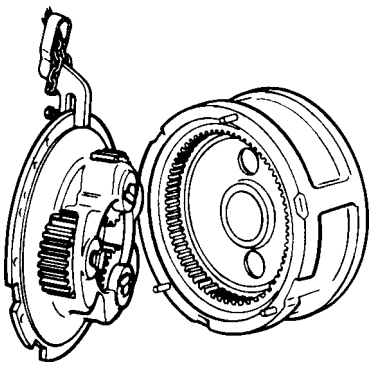


Fig. 3 - Removing Planet Carrier Assembly

9. Index mark planet carrier (18) and hub (10) to aid in installation.

10. Remove bolts (22) then prise planet carrier (18) from hub (10) and place on the floor with planet gears (19) facing upwards. If necessary, use jacking bolts in tapped holes provided, as shown in Fig. 2.

11. Remove bearing inner race (7) from hub carrier (1).

12. Lift out sun gear shaft (17) from planet carrier (18) assembly. Remove retainer rings (20) and pull planet gears (19) from planet carrier (18). Remove thrust washer (21).

13. Remove driver (25) from axle shaft (28). Remove thrust washer (26) from grooved pins (27) on hub carrier (1). Pull axle shaft (28) from axle housing (30).

14. Remove the brake calliper. Refer to Section 165-0010, BRAKE PARTS - REAR.

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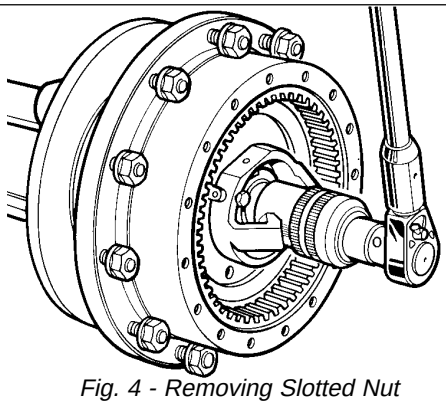


Fig. 4 - Removing Slotted Nut

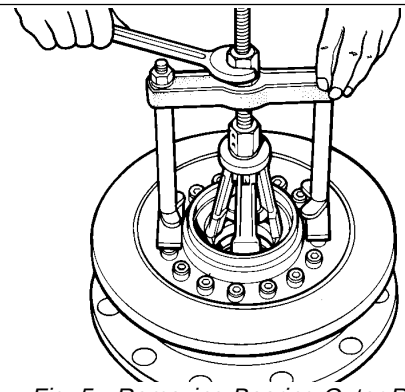


Fig. 5 - Removing Bearing Outer Race

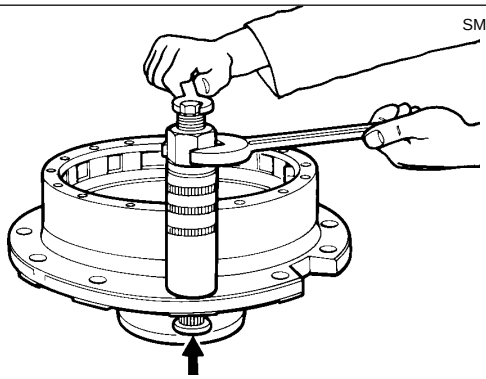


Fig. 6 - Installing Wheel Bolts

15. Remove two lock screws (15) and locking plate (14) from ring gear (16). Remove slotted nut (29) from hub carrier (1) with the special tool as shown in Fig. 4. Remove shims (36) from hub carrier (1).

16. Using suitable lifting equipment, remove ring gear (16), then hub (10) assembly from hub carrier (1).

17. If necessary, remove capscrews (32), washers (33) and brake disc (31) from hub (10).

18. Remove shaft seal (9), roller bearing (6) and bearing outer race (8) from hub (10) as shown in Fig. 5.

19. If it is necessary to remove hub carrier (1) from axle housing (30), index mark hub carrier and axle housing to aid in installation. Support hub carrier (1) with suitable lifting equipment and remove capscrews (2 & 3), washers (4), nuts (5) and slot pins (34 & 35). If necessary, tap hub carrier (1) loose from axle housing (30).

20. If necessary, drive or press wheel bolts (11) from hub (10).

INSPECTION

Numbers in parentheses refer to Fig. 1.

Thoroughly clean all parts with a suitable solvent and dry with compressed air. Inspect all parts for damage or excessive wear and replace where necessary. Inspect thrust washers (21 & 26) to make sure they are free of burrs and are absolutely flat. Replace all 'O' rings.

ASSEMBLY AND INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, AXLE BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.

1. Cover the mounting flange of axle housing (30) with Loctite 574 sealing compound and line up the index mark on hub carrier (1) with the mark on axle housing (30). Secure hub carrier (1) to axle housing (30) with capscrews (2 & 3), washers (4), nuts (5) and slot pins (34 & 35). Tighten capscrews (2 & 3) to a torque of 460 Nm (340 lbf ft).

2. If removed, install new wheel bolts (11) on hub (10) using the special tool shown in Fig. 6.

3. Place brake disc (31) on hub (10) and secure with capscrews (32) and washers (33). Tighten capscrews (32) to a torque of 295 Nm (220 lbf ft).

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4. Install roller bearing (6) in inner bore of hub (10). Coat outer diameter of shaft seal (9) with Loctite 574 sealing compound and, with the seal lip facing down, press shaft seal (9) into the bore of hub (10) with the special tool shown in Fig. 7. Turn the hub over and press bearing outer race (8) into the hub bore.

5. With a suitable lifting device, pick up hub (10) assembly, then, being careful to prevent damaging the lip of shaft seal (9), slide hub (10) assembly onto hub carrier (1). Be sure hub (10) assembly is firmly seated against the shoulder of hub carrier (1).

6. Install bearing inner race (7) on the splined end of hub carrier (1) as shown in Fig. 8. Be sure the inner race is firmly seated.

7. Slide ring gear (16) over the splines of hub carrier (1). Be sure it is pushed all the way in.

8. Select shim (36) and install over the splines of hub carrier (1) so that front edge of ring gear (16) is protruding by 0.03 - 0.30 mm (0.001 - 0.012 in).

9. Install slotted nut (29) on hub carrier (1) threads and, using special tool shown in Fig. 9, tighten slotted nut (29) to a torque of 1 000 Nm (738 lbf ft).

Note: During tightening the wheel hub must be spinning.

10. Check the rolling resistance of hub (10) by wrapping a length of string around hub (10) and pulling with a suitable scale as shown in Fig. 10. The rolling resistance (T) should be 12 - 18 Nm (9 - 13 lbf ft) for new bearings, or 6 - 9 Nm (4.5 - 6.5 lbf ft) for run-in bearings.

Formula to calculate F.
F = T/R

Where:
F = Pull in N (lbf)
T = Rolling resistance Nm (lbf ft)
R = Radius of hub m (ft)

Adjust shim (36) thickness to achieve the correct rolling resistance. If rolling torque not reached, select a thinner shim (36). If rolling torque is exceeded, select a thicker shim (36).

11. When rolling resistance is correct, remove slotted nut (29).

12. Using Loctite 243, coat the threads of hub carrier (1) and slotted nut (29). Thread slotted nut (29) on

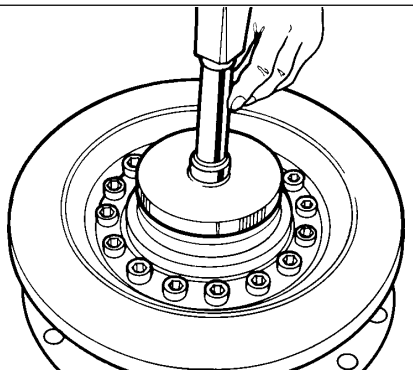


Fig. 7 - Installing Shaft Seal

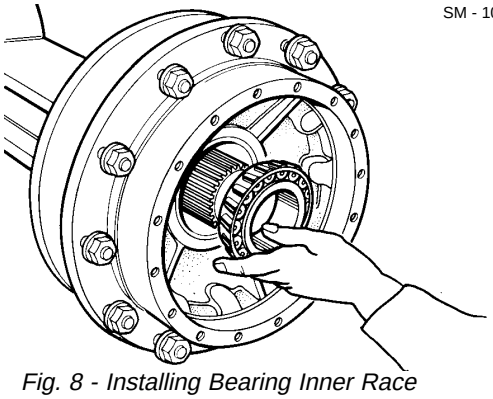


Fig. 8 - Installing Bearing Inner Race

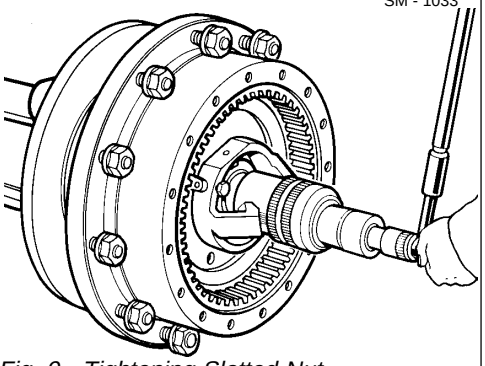


Fig. 9 - Tightening Slotted Nut

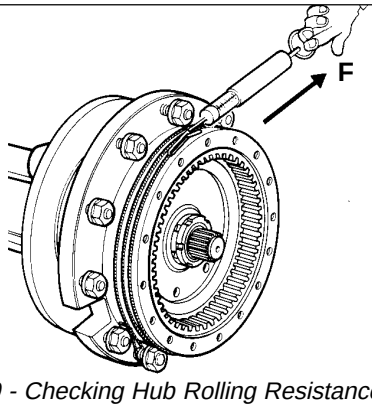


Fig. 10 - Checking Hub Rolling Resistance

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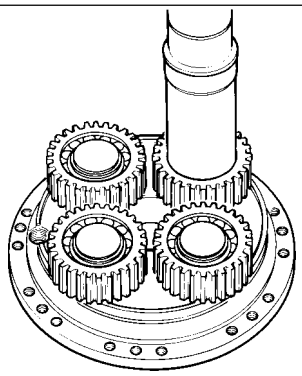


Fig. 11 - Installing Planet gear Assemblies

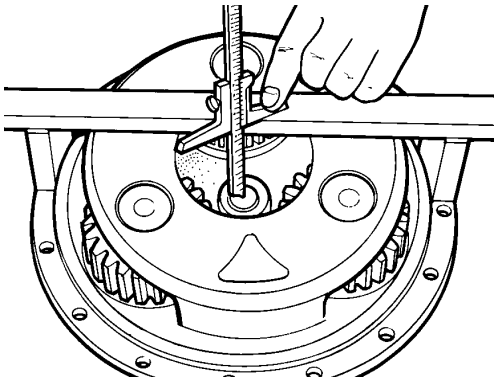


Fig. 12 - Measuring Dimension 'A'

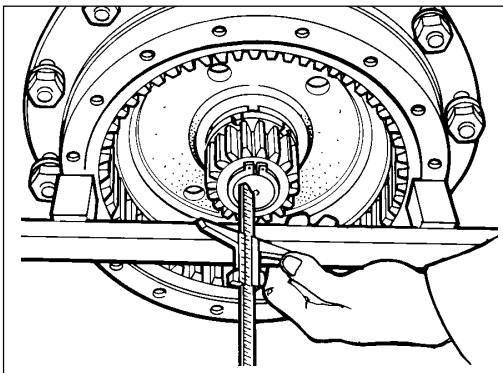


Fig. 13 - Measuring Dimension 'B'

hub carrier (1) threads and, using the special tool shown in Fig. 9, tighten slotted nut (29) to a torque of 1 000 Nm (738 lbf ft).

13. Install locking plate (14) and secure with lock screws (15). Tighten lock screws (15) to a torque of 79 Nm (58 lbf ft).

14. Re-check the rolling resistance of hub (10). The rolling resistance (T) should be 12 - 18 Nm (9 - 13 lbf ft) for new bearings, or 6 - 9 Nm (4.5 - 6.5 lbf ft) for run-in bearings.

15. Carefully slide axle shaft (28) through the bore of hub carrier (1) until the axle shaft splines into the differential side gears. Place thrust washer (26) onto grooved pins (27) on hub carrier (1). Slide driver (25) onto axle shaft (28).

16. Press planet gear assemblies (19) onto the pins of planet carrier (18) as shown in Fig. 11. Secure planet gears by installing retainer rings (20).

17. Position thrust washer (21) into the recess in planet carrier (18). Before positioning sun gear shaft (17) it is necessary at this stage to determine the end play of sun gear shaft (17) before installing the planetary assembly into the hub. The required end play should be 0.3 - 0.5 mm (0.012 - 0.020 in) and can be achieved by installing different thicknesses of thrust washer (21).

Note: Thrust washers are available in thicknesses of 6.5 mm (0.256 in), 6.3 mm (0.248 in), 6.0 mm (0.236 in), 5.0 mm (0.197 in), 3.5 mm (0.138 in), 3.3 mm (0.130 in), 3.1 mm (0.122 in), 2.9 mm (0.114 in) and 2.7 mm (0.106 in).

Determine end play of sun gear shaft (17) as follows:

a. Position the assembled planet carrier (18) as shown in Fig. 12. Place a straight edge and gauge blocks on the carrier mounting surface and measure the distance between the top of the straight edge and thrust washer (21). Record this as dimension 'A'.

Example:

Straight edge + gauge blocks	=	100.00 mm (3.937 in)
Measured distance	=	85.10 mm (3.350 in)
Dimension 'A'	=	14.90 mm (0.587 in)

b. Slide sun gear shaft (17) fully into driver (25). Place gauge blocks and straight edge across the mounting surface of hub (10) and measure the distance from the outer surface of the end of sun gear shaft (17) as shown in Fig. 13. Record this as dimension 'B'.

Example:

Straight edge + gauge block	=	100.00 mm (3.937 in)
Measured distance	=	85.40 mm (3.362 in)
Dimension 'B'	=	14.60 mm (0.575 in)

Example:

Dimension 'A'	=	14.90 mm (0.587 in)
Dimension 'B'	=	14.60 mm (0.574 in)
Difference (End play)	=	0.30 mm (0.012 in)

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18. Remove sun gear shaft (17) from driver (25) and position in planet carrier (18) in mesh with planet gears (19).

19. Coat the face of planet carrier (18) with Loctite 574 sealing compound. Install planet carrier (18) assembly into hub (10) and secure with bolts (22). Tighten bolts (22) to a torque of 190 Nm (140 lbf ft).

20. Place a new 'O' ring (23) on plug screw (24) and thread assembled plug screw into the outer face of planetary carrier (18). Tighten plug screw (24) to a torque of 80 Nm (60 lbf ft).

21. Install brake calliper. Refer to Section 165-0010, BRAKE PARTS - REAR.

22. Install differential drain plug. Add gear oil of the type specified in Section 300-0020, LUBRICATION SYSTEM, through the differential filler/level hole until the oil is level with the bottom of the filler/level hole.

23. Fill the planetary assemblies up to the 'Oil Level Check Line' with gear oil of the type specified in Section 300-0020, LUBRICATION SYSTEM.

24. Refit road wheels, securing with wheel nuts (12). Remove stands or timber supports and lower the machine to the ground. Fully tighten wheel nuts to a torque of 590 Nm (435 lbf ft). Remove blocks from the wheels.

Note: Wheel nuts should be checked and tightened if necessary, after the first 10 hours of operation. Check torque every 50 hours (weekly) thereafter.

MAINTENANCE

Proper lubrication of the axle group is essential if axles are to deliver the service intended. Section 300-0020, LUBRICATION SYSTEM gives full information on the proper lubrication intervals and the lubricant which should be used.

SPECIAL TOOLS

The special tools referenced throughout this section are available from your dealer. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools and sealants required.

AXLE DIAGNOSIS

Noises originating in the tyres, transmission, brakes or drivelines might be attributed by mistake to the axle components, therefore, all possible sources of noise should be investigated before deciding the axle is at fault.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

True axle noises may be located by lifting or jacking the machine up until all tyres are clear of the floor or ground. Securely block the machine in this position. Run power train at moderate speed. Be certain all tyres are off the ground to prevent damage to the differential and make sure that there is no brake drag.

AXLE DIAGNOSIS CHART

CONDITION	REASON	REMEDY
Noises	Insufficient or incorrect lubricant	Check level. Fill with proper type and grade of lubricant.
	Wheel bearings scored or rough	Replace wheel bearings
	Gear teeth in planetary chipped	Replace gear
Loss of lubricant	Lubricant foams excessively	Drain and fill with proper type and grade of lubricant
	Worn or broken oil seal	Replace oil seal
	Loose nuts or bolts	Tighten nuts or bolts
Gain of lubricant	Incorrect lubricant	Drain and fill with proper type and grade of lubricant
Planetaries running hot	Bearings seized	Replace bearings

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SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	2	Capscrew	460	340
1	3	Capscrew	460	340
1	12	Wheel Nut	590	435
1	15	Lock Screw	79	58
1	22	Bolt	190	140
1	24	Plug Screw	80	60
1	32	Capscrew	295	220

* * * *

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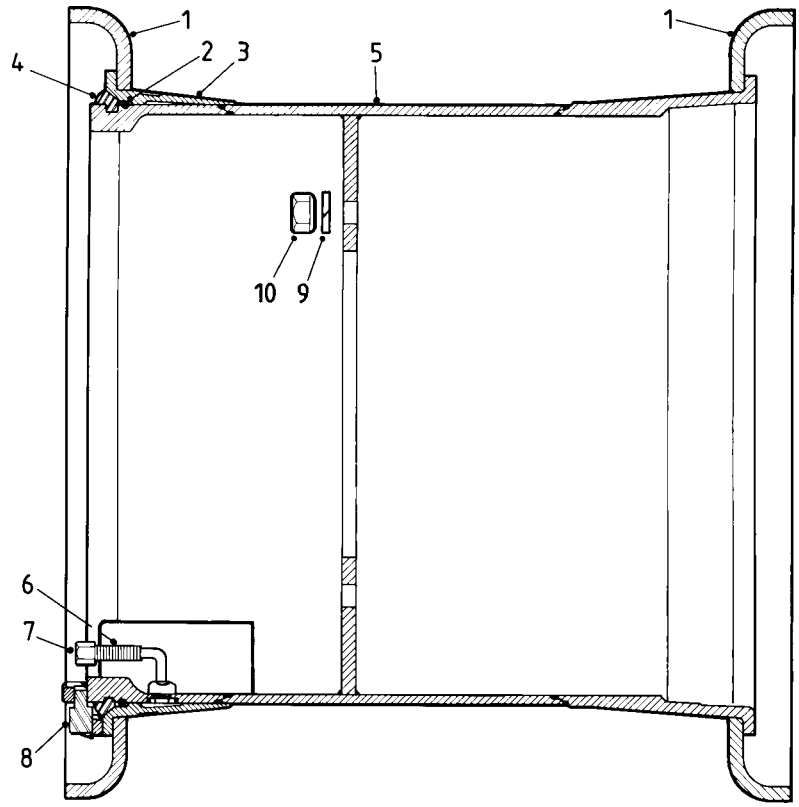
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SM - 1038



1 - Flanges
2 - 'O' Ring
3 - Bead Seat Band
4 - Lock Ring
5 - Wheel Rim
6 - Valve Assembly
7 - Valve Cap
8 - Driver (if used)
9 - Lock Washer
10 - Wheel Nut

Fig. 1 - Cutaway View of Wheel Rim

DESCRIPTION AND OPERATION

The rim and wheel assembly are designed to allow the tyre and rim assembly to be replaced with a pre-assembled tyre and rim. The tyre and rim may be removed from the machine as an assembly and transported to a more suitable location for removing the tyre from the rim.

Procedures for removing tyre and rim assembly from machine, and dismounting tyre from rim, the use of hand, hydraulic, and special tools, are described in this section.

The rim assembly consists of the following components which are illustrated in Fig. 1: rim, inner and outer flange, 'O' ring, bead seat band, driver, and lock ring.

When dismounting a tyre and rim assembly from the machine, special equipment and careful handling are required because of the size and weight of the tyres.

One of the following pieces of hoisting equipment should be used to lift the tyre and rim: chain block and tackle, overhead crane, fork lift truck, boom truck, or tripod tyre changing tool.

PREPARATION FOR SERVICING

⚠ WARNING
Before performing any service on the tyres or rim components, to prevent personal injury and property damage, completely deflate the tyre by removing the valve cap and core. Insert a thin wire through valve to be sure valve is not plugged. Even a flat tyre, in some cases, will retain sufficient air pressure to blow off a rim component with enough force to cause bodily injury or death.

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REMOVING TYRE AND RIM ASSEMBLY FROM MACHINE

Numbers in parentheses refer to Fig. 1.

Note: If tyre and rim assembly is to be replaced pre-assembled, it is not necessary to remove the tyre from the rim. It may be removed as an assembly.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and shutdown the engine.

2. Block all road wheels, except the one to be raised, and place the battery master switch in the 'Off' position.

3. Break wheel nuts (10) loose with tyre still on the ground, but do not remove from wheel studs.

4. Jack up the axle to the height required to allow removal of the tyre and rim assembly.

5. Place safety blocks under the axle.

6. Support tyre and rim assembly with a suitable sling and attach a suitable lifting device.

7. Remove wheel nuts (10) and lock washers (9) securing wheel rim (5) to the wheel.

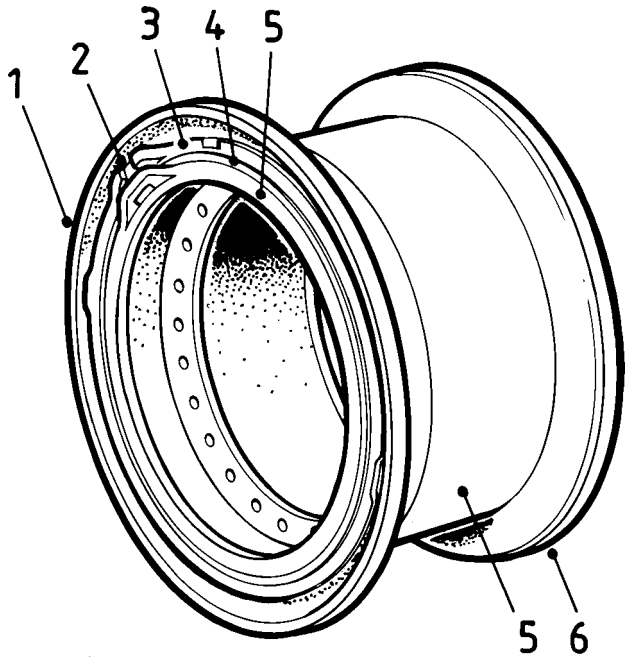
8. With lifting device, remove tyre and rim assembly from the wheel and lift clear of the vehicle.

DISMOUNTING TYRE FROM RIM

Numbers in parentheses refer to Fig. 2, unless otherwise specified.

Note: The following instructions apply to use of hand tools. For procedures and tooling required to dismount the tyre from the rim using hydraulic tools, contact the relevant tyre manufacturer.

SM - 1039



1 - Outer Flange
2 - Driver (if used)
3 - Bead Seat Band
4 - Lock Ring
5 - Wheel Rim
6 - Inner Flange

Fig. 2 - Typical Rim Assembly

SM - 205



Fig. 3 - Pry Bar

SM - 206

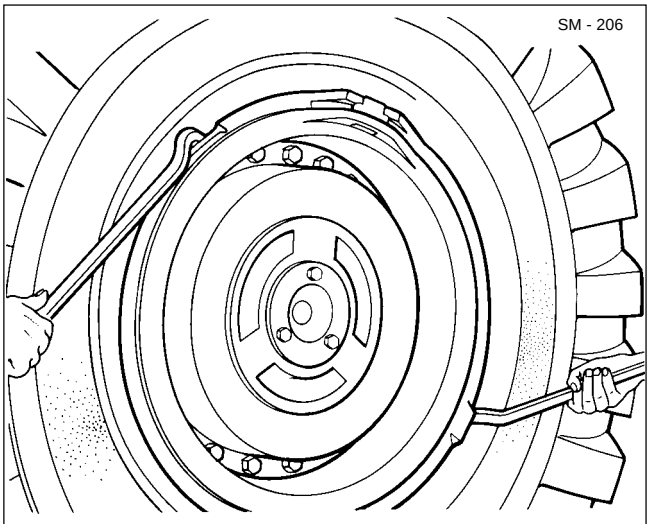


Fig. 4 - Breaking Typical Tyre Bead

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> **⚠ WARNING**
> **When lifting tyre from the rim, be sure the equipment is of sufficient capacity and properly secured to do the job safely.**

1. Remove valve cap (7, Fig. 1) and valve core and leave valve open to prevent trapping of air in tyre. Tape valve threads for protection.

2. If used, remove driver (2) from bead seat band (3) and wheel rim (5).

3. Break outer tyre bead loose with pry bar shown in Fig. 3.

4. Insert flat hooked end of pry bar into breaking slots between bead seat band (3) and outer flange (1). See Fig. 4. A pipe over the straight end of the pry bar will increase leverage.

5. Twist pry bar toward tyre to break bead.

6. A second pry bar may be inserted in the space between bead seat band (3) and outer flange (1). Twist the second pry bar to maintain the space gained by the first pry bar.

7. Move the first pry bar around wheel rim (5), twisting and following with the second pry bar, until the outer tyre bead is loose.

8. Pry bead seat band (3) away from lock ring (4) by placing hooked end of pry bar in the groove of wheel rim (5), between ends of lock ring (4), and prying up with the pry bar. Using two pry bars, as in Step 7, work completely around wheel rim (5).

9. Pry lock ring (4) out in the same manner by starting at prying notch in wheel rim (5) assembly, and work all the way around wheel rim (5) with two pry bars.

10. Remove and discard 'O' ring (2, Fig. 1).

11. Remove lock ring (4) then pry out and remove bead seat band (3).

12. Breaking slots are provided inside the rims. The inner bead may be broken as described in Steps 4 through 8. If the tyre and rim assembly is on the vehicle, the following procedure may be used for breaking the inner bead.

13. Place jack between inner flange (6) and vehicle frame. Extend jack until tyre bead is broken. Continue around the rim until tyre bead is broken at all points.

14. Using suitable lifting equipment, remove tyre from rim. This completes the removal of the tubeless tyre.

15. If necessary, remove inner flange (6).

Note: If tyre rim is on the vehicle, and no tyre lifting equipment is available, 'walk' the tyre off the rim as follows:

Force bottom of tyre outward as far as possible; lower jack enough to allow weight of tyre to rest on ground; force top of tyre out as far as possible; raise jack to original height and repeat the above until the tyre is off the rim.

INSPECTION

Tyre

Check the interior surface of the tyre to determine its condition. Inspect for cuts or fabric breaks that have penetrated the tyre body. The casing should be inspected closely for any sharp , pointed object that may have penetrated the tyre body but is invisible from the outside. All dust, dirt, water or other foreign matter should be cleaned from the inside of tyre.

Rim Assembly

Overloading, improper tyre inflation, rough terrain, high speed, accidents, dirt accumulation, and corrosion all tend to reduce the service life of rims and rim components. It is recommended that rims be inspected, as below, not less often than at every tyre change and that, as the warranty limit approaches, consideration be given to periodic replacement.

The rim and its components are designed with built-in safety factors, to prevent the components from flying off with killing force during inflation. Check components for cracks, bends, distortion, or other damage. If damage is found, the component must be replaced.

> **⚠ WARNING**
> **Never mix components of one manufacturer's rims with those of another. Using the rim base of one manufacturer with the lock ring of another or vice versa is dangerous. The lock ring of one may not fully engage with the lock ring groove of the other. Always consult the rim manufacturer for proper matching and assembly instructions.**

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⚠ WARNING (cont.)
Also, use and servicing of damaged, worn out, or improperly assembled rim assemblies is a very dangerous practice. Failure to comply with the above warnings could result in explosions from tyre pressure causing serious personal injury and property damage.

Clean all rust and dirt from the rim parts and wheel and apply a coat of good grade primer paint. Allow the paint to dry thoroughly before remounting tyre.

The rim parts used with tubeless tyres form an important part of the air chamber. Therefore, they should be carefully checked for distortion or mutilation that would prevent an effective air seal when the tyre and rim are reassembled.

Rubber 'O' rings are air seals for tubeless tyre and rim assemblies and therefore should be carefully handled to provide an airtight seal when the tyre is remounted on the rim. Always use new 'O' rings when mounting a tubeless tyre.

Note: Handle 'O' rings carefully, as damage will prevent an airtight seal for tyre inflation.

MOUNTING TYRE ON RIM

Numbers in parentheses refer to Fig. 2, unless otherwise specified.

For mounting a tyre with rim on or off machine, the procedure is basically the same.

⚠ WARNING
When lifting tyre onto the rim, be sure the equipment is of sufficient capacity and properly secured to do the job safely.

1. For off-machine installation, lay wheel rim (5) on blocks or mounting stand with 'O' ring groove up. Wheel rim (5) should be off the floor enough to allow tyre to rest on rim and not the floor. Blocks are not to extend more than 13 mm (0.50 in) beyond rim base.

2. If removed, install inner flange (6) over wheel rim (5).

3. Lubricate tyre beads and 'O' ring, with a thin solution of vegetable base soap and water.

4. Using suitable lifting equipment, lower tyre onto wheel rim (5). Seat tyre firmly against inner flange (6).

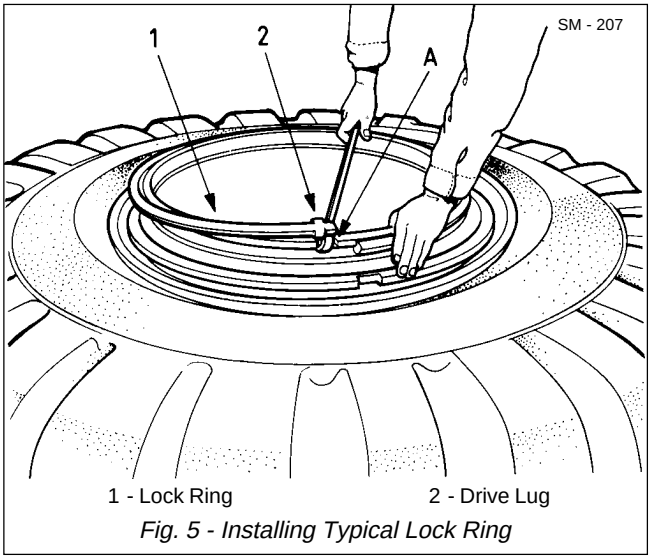


Fig. 5 - Installing Typical Lock Ring

5. Install outer flange (1) on wheel rim (5).

6. Align lock ring driver notch in bead seat band (3) with notch in wheel rim (5), and install bead seat band on rim.

7. On vehicles which use a driver (2), align driver slot of bead seat band (3) with driver pocket of wheel rim (5) and install bead seat band (3) on wheel rim (5).

8. Install lock ring (4) in groove of wheel rim (5) so that lock ring lug engages both notches. Notches and lock ring lug must line up correctly. If necessary, use only a soft hammer to rotate the lug. Use pry bar for installing lock ring (4), as shown in Fig. 5.

9. Force bead seat band (3) past 'O' ring groove in wheel rim (5) by prying, or with lift truck forks. Use blocking between the forks and tyre to prevent damage. Insert a new 'O' ring (2, Fig. 1) in groove of the rim behind lock ring (4). Lubricate area of front taper of bead seat band (3) adjacent to 'O' ring (2, Fig. 1), with a thin solution of soap and water or another approved lubricant which is not harmful to rubber. Avoid using an excessive amount of lubricant.

10. If used, install driver (2). Make sure all rim components are correctly assembled.

11. Lift the tyre upwards to effect a seal between bead seat band (3) and 'O' ring (2, Fig. 1). In some cases the tyre will automatically spring out, making this step unnecessary.

12. Refer to heading, 'Tyre Inflation' in this section for the proper procedure for inflating the tyre.

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MOUNTING TYRE AND RIM ASSEMBLY ON MACHINE

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Support tyre and rim assembly with a suitable chain, or rope sling. Attach sling to overhead lifting device. Slide assembly onto wheel of the vehicle, with lock ring (4) and bead seat band (3) facing outward.

2. Install lock washers (9) and wheel nuts (10) on wheel studs. Gradually tighten wheel nuts opposite each other until all wheel nuts are snug. Tighten wheel nuts (10) to a torque of 590 Nm (435 lbf ft). Tighten wheel nuts (10) again, after 10 hours of operation.

TYRE INFLATION

⚠ WARNING
To prevent personal injury and property damage, the tyre and rim assembly should be placed in a safety cage before inflating. If no safety cage is available or tyre is on the machine, the tyre and rim assembly should be wrapped with safety chains or with lash cables before inflating.

Even with these precautions remember that air-blast is a potential hazard. Tyre inflation should be carried out away from busy working areas.

⚠ WARNING
To avoid personal injury and property damage, never stand or sit in front of a mounted tyre during tyre inflation. Use a clip-on air chuck with a long hose and stand to one side while the tyre is being inflated.

⚠ WARNING
To prevent personal injury and property damage, always prevent flammable vapours that could produce tyre explosions, from being pumped into tyres during inflation, by observing the following precautions:

A.
Use an air compressor and reservoir located inside a heated building, when available, so that alcohol, methanol, or other flammable antifreeze liquids are not needed in the air tanks to prevent moisture freezing in the tank and lines in subfreezing outside temperatures.

B.
Make sure that paints, lacquers, paint thinners, or similar materials that produce volatile, flammable vapours are not used or stored near the air intake of the compressor that supplies the air for inflating tyres. The compressor should be isolated from all such sources of flammable vapours.

C.
Be sure to thoroughly flush and blow off all flammable solvents used for cleaning the air compressor inlet screen before using the compressor for tyre inflation, or any other purpose.

D.
Do not charge batteries, either in or out of a machine, near the air inlet of a compressor used for inflating tyres. Charging batteries produces highly explosive hydrogen gas which can be readily drawn into a nearby compressor inlet and pumped into the tyre.

E.
Never exceed the specified concentration of alcohol when adjusting the alcohol vaporizer, or adding alcohol to the auxiliary air tank, used on machine air systems to prevent freezing or moisture condensate in below-freezing temperatures. Excessive alcohol, added to the machines air tanks in this manner can produce flammable vapours that will be pumped into a tyre when this air supply is used for tyre inflation if the tyre inflation kit is not equipped with a moisture filter. Alcohol added to machine air systems in recommended concentration to prevent condensate freezing are below hazardous levels for tyre inflation.

F.
Another source of hazardous flammable vapours in tyres is the tyre bead lubricant. Always use bead lubricants that do not introduce flammable vapours into the tyre.

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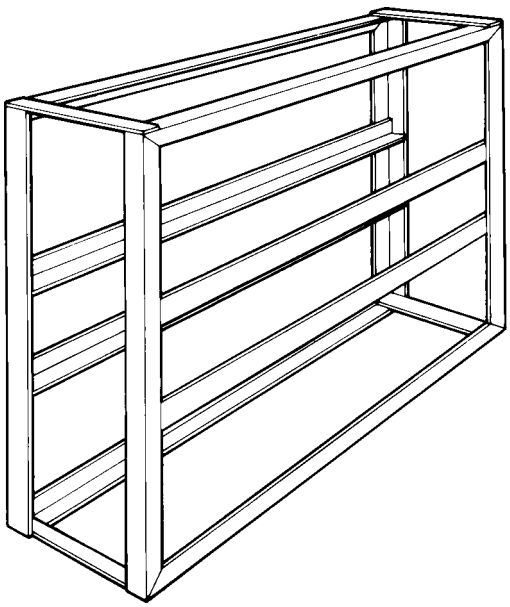


Fig. 6 - Typical Safety Cage

Inflation

Note: Always use tyre inflation equipment with an air filter that removes moisture from the air supply, when available, to prevent moisture corrosion of internal rim parts.

1. Inflate tyre to 1 bar (15 lbf/in²) initially to seat components and tap lock ring lightly to ensure correct seating. Visually check that all components are in place, then continue inflation observing all safety precautions. (See Step 2).

2. If the tyre is off the machine, place it in a safety cage after initially inflating to 1 bar (15 lbf/in²) to seat components. See Fig. 6.

3. Inflate tyres to 5.2 bar (75 lbf/in²) to seat beads and seal the 'O' ring, then adjust to the recommended inflation pressure.

4. For recommended operating air pressure, refer to the 'Tyre Inflation Pressures' table.

NITROGEN TYRE INFLATION

Note: All Warnings and procedures under 'Tyre Inflation' will apply, except for differences covered by this passage.

In certain environments it is recommended that tyres be inflated with dry nitrogen gas, and that the resulting oxygen content of the inflation does not exceed 5%.

All machines whose tyres are factory inflated with dry nitrogen gas will be identified by a decal on the body or frame.

Nitrogen gas improves tyre pressure retention, increases tyre life by reducing carcass oxidation from within, minimizes rim rust and has no detrimental effects on the tyre. It also reduces the potential of a tyre explosion because it is an inert gas and will not support combustion inside the tyre.

The same tyre inflation pressure used for air inflation should be used for nitrogen inflation. Tyre valves formerly used with air inflation are entirely satisfactory for use with nitrogen gas.

Nitrogen Tyre Inflation Kit

⚠ WARNINGS

DO NOT USE charging assembly, Part No. 9359489, for tyre inflation because this assembly does not include a pressure regulator, safety relief valve, and adequate pressure gauging which is mandatory for tyre inflation purposes. Tyre volume is as much as 90 times greater than the average accumulator volume and hence it takes very much longer to inflate a tyre - up to 40 minutes or more for very large tyres.

⚠ Nitrogen gas cylinders used to inflate tyres are generally charged to approximately 152 bar (2 200 lbf/in²). A tyre blowout and/or rim failure could occur if inflation equipment is not properly used. Proper nitrogen charging equipment and personnel training for its use is a must to avoid over inflation.

1. A nitrogen tyre inflation kit is available from your dealer and consists of the following. Refer to Fig. 7.

a. Pressure regulator, 0 - 13 bar (0 - 200 lbf/in²), with two dual pressure gauges.

b. Safety relief valve, 8.6 bar (125 lbf/in²), that will assure an upper limit to the pressure available for tyre inflation.

c. A 15.2 m (50 ft) length of flexible hose with interconnecting fittings. On the tyre end of the hose is a large bore quick connect/disconnect clip-on chuck.

2. The pressure regulator is connected to a nitrogen compressed gas cylinder available from local suppliers.

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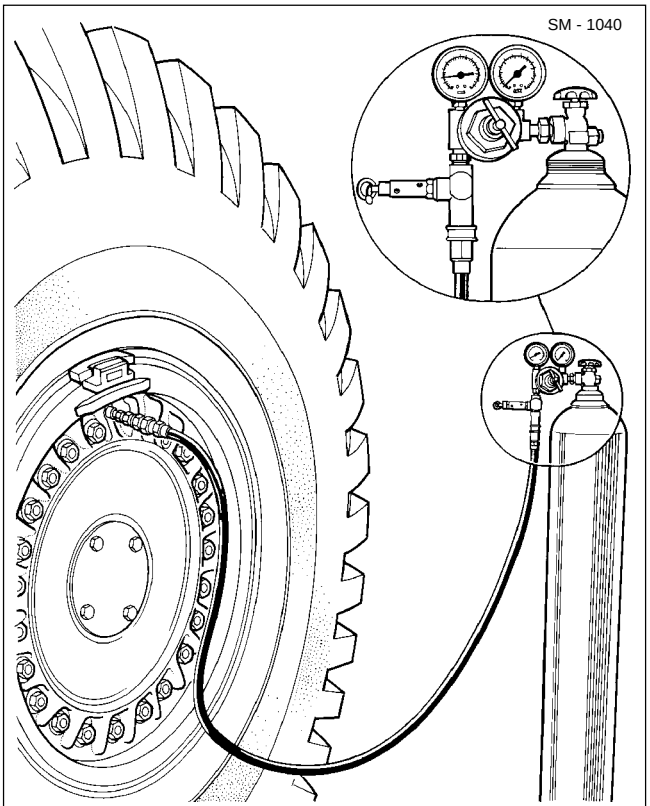


Fig. 7 - Nitrogen Tyre Inflation Kit

3. The usual procedure for using this type of equipment is as follows:

a. Connect nitrogen tyre inflation kit to nitrogen compressed gas supply. DO NOT connect clip-on chuck to the tyre valve at this time.

b. Open valve on nitrogen supply.

c. With flexible hose and clip-on chuck connected to nitrogen tyre inflation kit assembly but not connected to the tyre, adjust pressure regulator so that its output pressure is not more than 1.4 bar (20 lbf/in²) higher than the desired tyre inflation pressure.

d. Connect clip-on chuck to the tyre valve. The tyre will now inflate. Tyre pressure can be monitored by observing the gauge at the pressure regulator. STAY AWAY FROM THE TYRE.

e. When desired inflation pressure has been achieved, back off the regulator or close the valve on the compressed gas cylinder.

f. Remove the clip-on chuck and adjust the tyre pressure with the tyre gauge in the usual manner.

Re-inflation of a Mounted Tyre

To re-inflate a tyre with dry nitrogen gas which is now inflated with air, proceed as follows:

1. Exhaust the tyre until only air at atmospheric pressure remains in the tyre.

2. Re-inflate the tyre using only dry nitrogen gas to 4.15 bar (60 lbf/in²) gauge as a minimum, or to bead-seating pressure as a maximum.

3. Adjust to the service inflation pressure required:

a. If the required service inflation pressure is LESS than 4.1 bar (60 lbf/in²), remove the clip-on chuck and adjust the pressure with the tyre gauge in the usual manner.

b. If the required service inflation pressure is greater than 4.1 bar (60 lbf/in²), further inflate, with dry nitrogen gas only, to the pressure level required. Then remove the clip-on chuck and adjust the pressure with the tyre gauge in the usual manner.

New Tyre Mounts and Remounts

To newly mount or remount a tyre to its rim, use only dry nitrogen gas; this includes the pressure required to seat the beads. After seating the tyre beads, remove the clip-on chuck and adjust the pressure with the tyre gauge in the usual manner.

Note: Although a little more nitrogen gas is used to seat beads than that used for re-inflation of a mounted tyre, refer to 'Re-inflation of a Mounted Tyre', its cost is generally negligible in comparison to the time and labour saving and, longer tyre life achievable with the reduced oxygen content which results.

TYRE EXPLOSION HAZARD

⚠ WARNING
Whenever a machines tyre(s) is (are) exposed to excessive heat such as a machine fire or extremely hot brakes the hazard of a subsequent violent tyre explosion must be recognized. All persons must avoid approaching the machine so as not to be physically endangered in the event of an explosion of the tyre and rim parts.

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⚠ WARNING (cont.)
The machine should be moved to a remote area, but only when this can be done with complete safety to the operator operating or towing the machine. All other persons should stay clear of the machine. The fire or overheated brakes, wheel, etc. should be extinguished or cooled from a safe distance. Do not attempt to extinguish the fire or cool the machine by use of hand-held fire extinguishers.

⚠ If it is absolutely necessary to approach a machine with a suspect tyre, approach only from the front or the back. Stay at least 15 m (50 ft) from the tread area. Keep observers out of the area and at least 460 m (1 500 ft) from the tyre sidewall. Refer to Fig. 8. The tyre(s) should be allowed at least eight (8) hours cooling time after the machine is shut down or the fire extinguished before approaching closer.

⚠ There is always a possibility of a tyre explosion whenever the smell of burning rubber or excessively hot brakes is detected. The danger is also present when a fire on the machine reaches the tyre and wheel area. Under such conditions, all personnel must avoid approaching the machine in a manner that could result in injury should an explosion actually occur. Move the machine to a remote area only if it can be done without endangering the operator or other personnel in the area.

⚠ WARNING
DO NOT WELD ON OR HEAT RIM COMPONENTS. For several years the company and tyre and rim manufacturers have warned users never to weld rim components with the tyre mounted on the rim. The gases that build up inside the tyre during arc welding or heating on rim components can ignite, resulting in one of these explosive-like failures of the tyre and rim. This warning also applies to nitrogen inflated tyres. Ignition will not occur in the nitrogen atmosphere, but the pressure buildup from the heat of welding may be sufficient to cause a blowout severe enough to injure or kill. It is recommended to scrap the part if heat is necessary to repair any rim component.

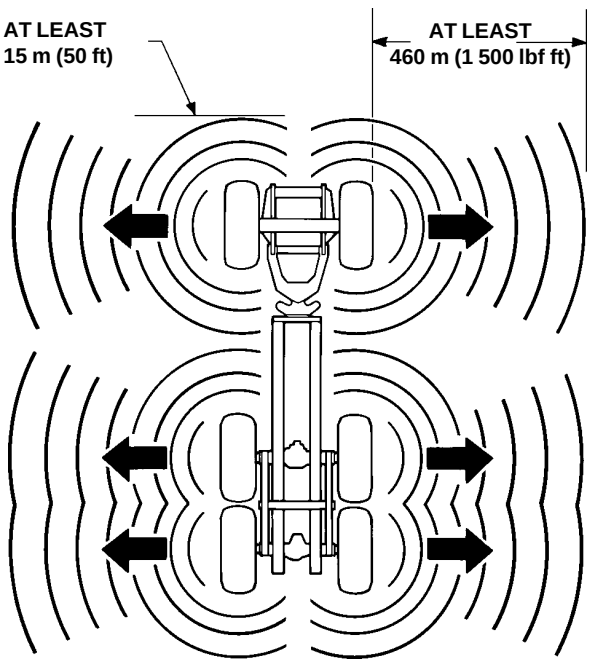


Fig. 8 - APPROACH AREA.
Do Not Approach Tyre in Shaded Area

TYRE AND WHEEL RIM MAINTENANCE

Tyre Repairs

Prompt repair of tyre injuries will prevent small injuries from enlarging and causing tyre failure. Use the best tyre facilities available. If good repair facilities are not available, have the nearest dealer make the necessary repairs.

Minor cuts, snags, or punctures should be repaired upon discovery. Skive with a sharp pointed knife around any cut in the tyre tread area that is of sufficient depth or shape to hold pebbles or dirt. The angle of the skive should be no more than sufficient to expel all foreign material and should extend no deeper than the breaker. The skive should go to the bottom of the hole. Tyres with shallow cuts, if treated promptly, may be allowed to continue in service. If the cut extends deeper into the tyre carcass, the tyre should be removed for repair.

The tyre must be removed from the rim to repair larger punctures or cuts. Irregular shaped punctures or cuts less than 13 mm (0.50 in) in size can be repaired with a plug and hot patch. Insert a repair plug into the hole to keep out moisture and to back up the hot patch. Trim the plug off flush with the inside of the casing, buff, and apply the hot patch according to the instructions supplied with the hot patch equipment.

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Punctures 13 mm (0.50 in) or larger, large cuts, or bruise breaks require sectional or reinforced vulcanized repair. Cover the repair patch with a layer of cushion gum after application to the tubeless tyre to ensure an airtight repair. Any cords of the inside ply that are exposed in buffing and are not covered with repair patch must be coated with cushion gum to prevent air leakage into the carcass plies on tubeless tyres.

Recapping and Retreading

There are two general methods employed in restoring the tread surface of off-the-highway tyres: recapping and retreading.

A recapped tyre has a new tread cured right over the old tread surface.

A retreaded tyre has the old tread removed entirely and a new tread cured directly onto the body of the tyre. A tyre can be recapped or retreaded if the cord body is free of cuts, bruises and separation, and is thoroughly sound, including previous repairs.

TYRE CARE

To obtain maximum service from off-highway tyres, the following common-sense precautions should be followed.

Maintain Correct Inflation

The most common cause of tyre damage is improper inflation. Both over-inflation and under-inflation are detrimental to tyre life. Tyre pressure should be checked daily, preferably before the machine is placed in operation. Refer to 'Tyre Inflation Pressures' table.

The valve cores should be checked for leaks. Keep in mind that valve cores are delicate mechanisms that wear out in service; therefore, they should be replaced with new ones when they become worn. Each tyre should be equipped with a valve cap to prevent dirt from damaging the valve core and causing air leakage.

Maintain Good Haul Roads

Because haul roads are considered temporary roads they are frequently neglected. The better the haul road, the longer the tyre and machine life of off-highway machines.

Although it takes time and effort to maintain good haul roads, the delay and cost of tyres and machine breakdowns caused by poor haul roads is many times greater.

Inspect Tyres Regularly

A systematic plan for tyre inspection will more than pay for itself in lowered tyre costs per hour of operation. All tyres should be checked regularly for cuts, bruises, ply material breaks, excessive or uneven wear, embedded foreign matter, and any other damage which can be repaired. A considerable increase in tyre service can be realized if tyre injuries are repaired before they have progressed to the irreparable stage.

The rim mounting nuts should also be checked periodically and tightened to the torque specified.

Prevent Overloading

Off-highway machines are designed to carry a maximum allowable payload. Excessive loading will overstress both the machine and tyres and shorten the life of both.

Prevent Contact with Oil

Prevent tyre contact with petroleum products. Rubber that is exposed to oil, gasoline, or grease becomes soft and spongy and deteriorates rapidly. Always avoid driving machine through a puddle of gasoline, fuel oil, lubricating oil, or grease. Never let a tyre stand in an oil or grease spot overnight.

Store Tyres Properly

The best of care given to tyres in service by operators and maintenance personnel can be completely nullified by careless storage. Time is not the only contributing factor to the deterioration of rubber products. Therefore, tyres that are to be stored must be protected from light, heat, oils, dirt, moisture, and ozone. Stored tyres should be carefully covered with a tarpaulin or some other suitable material, such as opaque plastic sheeting, to prevent contact with the contaminants listed above.

Proper Handling of Tyres and Wheel Rim Parts

Tyres should be stored vertically. Horizontal stacking may compress the tyre walls, making inflation difficult. If tyres are stored in racks, the lower supporting members should provide as broad a surface as possible to the tyre tread to avoid a concentration of load.

The beads of tubeless tyres must be protected from damage or a faulty air seal will result. Do not use hooks, cables, or chains in contact with the tyre beads

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when lifting these tyres. If forklift trucks are used for handling, they should be equipped with broad, well-rounded arms to distribute the load and prevent damage to the tyre bead. When handling tyres with the fork truck do not scrape the fork across the bead.

Tubeless tyre rims perform an important function as part of the assembly air seal. Proper care, therefore, must be taken not to distort or mutilate the rim parts because they must mate properly to form part of the basic air chamber. Since the rim base and bead seat band are mating surfaces, distortion may prevent easy assembly as well as possibly resulting in no seal.

Never drop, tumble, or roll rim parts.

If rim parts are stored outdoors, they should be given a protective coat of a good commercial primer.

Similar parts should be stacked neatly to prevent distortion.

Babbit or lead hammers, not sledge hammers, should be used in assembling rim parts.

'O' rings are seals and should be carefully stored in a cool, dry place where they will not be injured or damaged.

Valve cores should also be stored in a cool, dry and clean place.

MAINTENANCE

Check tyre pressures daily, preferably before the machine is placed in operation. Refer to 'Tyre Inflation Pressures' table.

Every 50 hours of operation (weekly), torque tighten wheel rim nuts to 590 Nm (435 lbf ft).

Check tyres regularly and replace or repair if required.

SERVICE TOOLS

The nitrogen tyre inflation kit shown in Fig. 7 is available from your dealer. Refer to Section 300-0070, SERVICE TOOLS for part numbers of general service tools required.

TYRE INFLATION PRESSURES (BRIDGESTONE)

MODEL	TYRE SIZE	FRONT		CENTRE AND REAR	
		bar	lbf/in^2	bar	lbf/in^2
TA30	23.5 R 25**	4	58	4.8	69
	30/65 R 25	4.3	62	4.3	62

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TUBELESS TYRE LEAK DIAGNOSIS

Occasionally a tubeless off highway tyre/rim assembly may leak in field service. To determine cause of leakage, the entire assembly including valve hardware, multi-piece rim assembly, 'O' ring and tyre should be checked using a soap solution.

This table lists various causes of air loss and possible remedy.

CAUSE	REMEDY
Defective valve	Tighten parts. Replace defective parts. Use valve caps.
Cracked rim or weld	Replace defective part ⚠ **WARNING** **Do not attempt repair of wheel components.**
Twisted or damaged 'O' ring	Replace 'O' ring (lubricate)
Tyre cuts and snags	Repair tyre damage
Bead area awl holes	Repair inner liner (preferred)
Leakage between tyre bead trim	With tyre removed from rim: Clean tyre beads in rim contact area Clean rim with wire brush Inspect 5 degree tapered bead seat band and the rim base in the bead seating area to determine if the transverse weld trims are flat or concave. Replace defective part(s). **Note:** Weld trim should follow rim contour. Mount tyre using a lubricant such as Murphy's Tyre and tube Mounting Compound, or equivalent, on tyre beads and rim bead seat area.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	10	Wheel Nut	590	435

* * * *

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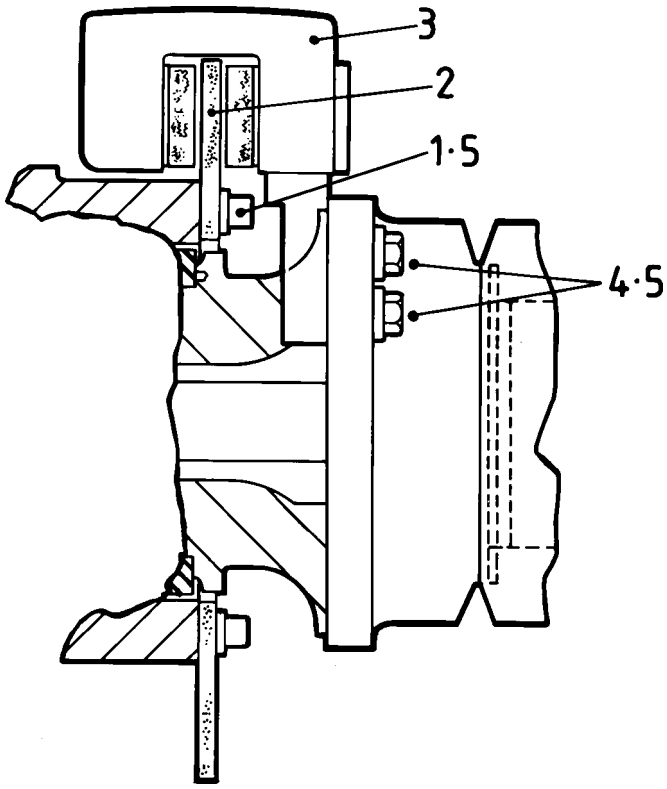
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1 - Capscrew
2 - Brake Disc
3 - Brake Heads
4 - Bolt
5 - Washer

Fig. 1 - Cutaway View of Typical Brake Head and Disc Mounting

DESCRIPTION AND OPERATION

The service brakes are of the calliper disc-type. The calliper brake head is designed for use with hydraulic brake fluid. The head is bolted to a mounting plate on the axle housing. The disc is bolted to the wheel. There is one brake head and one brake disc at each wheel.

Each calliper brake head assembly consists of a torque plate, two brake pads, one on each side of the brake disc, and four brake pistons, two on each side of the brake disc.

The brake is actuated by hydraulic brake fluid entering the brake head through one of the bleeder ports. The piston bores on each side of the torque plate are interconnected by internal passages.

When the brake is actuated, the hydraulic pressure forces the pistons against the brake pads which are, in turn, forced against each side of the brake disc, slowing or stopping the disc and wheel rotation.

GENERAL INSPECTION

1. Inspect brake pads for wear. If the brake pad friction material is worn down to 3 mm (0.12 in) thickness, the pads must be replaced.

2. Inspect brake disc as follows:

a. Measure original thickness of disc at outside diameter (this area is not contacted by brake pad friction material).

b. Measure thickness of disc at three points on the brake pad friction material contact circumference and determine the average disc thickness.

c. Subtract 'b' from 'a'. If difference is 3 mm (0.12 in) or greater, the disc must be replaced.

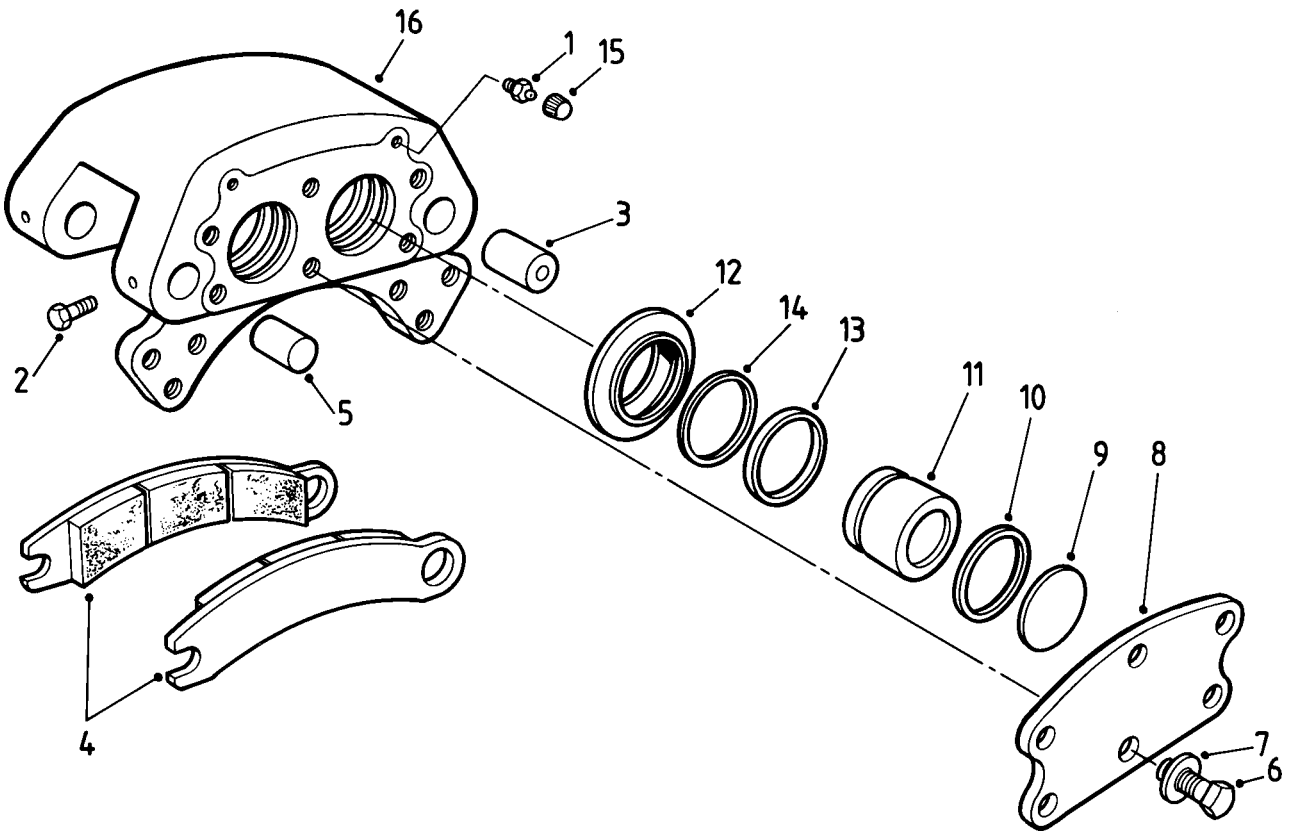
Note: Refer to Section 160-0030, AXLE GROUP (HUB), for brake disc replacement instructions.

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Brake Parts - Brake Parts - Rear

Section 165-0010



1 - Bleeder Valve
2 - Screw
3 - Torque Pin
4 - Brake Pads
5 - Torque Pin
6 - Bolt
7 - Washer
8 - Cover Plate
9 - Piston Plug
10 - Seal
11 - Piston
12 - Boot
13 - Packing
14 - Backup Ring
15 - Dust Cap
16 - Torque Plate

Fig. 2 - Exploded View of Typical Brake Head

BRAKE PAD REMOVAL AND INSTALLATION

Numbers in parentheses refer to Fig. 2.

⚠ WARNINGS

To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ To prevent personal injury and property damage, the procedure for removing tyre and rim assembly described in Section 160-0050, WHEEL RIM AND TYRE, must be strictly followed.

⚠ Keep brake fluid reservoir full at all times.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels, except the wheel to be removed, and place the battery master switch in the 'Off' position.

3. Remove wheel from the machine following instructions in Section 160-0050, WHEEL RIM AND TYRE.

4. Loosen bolts (2) securing large torque pins (3) at the end of torque plate (16). It is not necessary to loosen or remove the two smaller torque pins (5) at opposite end.

5. Move the two unlocked torque pins (3) away from brake disc (2, Fig. 1).

6. Remove dust cap (15) from bleeder valve (1) and

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attach a bleeder hose to bleeder valve. Open bleeder valve (1). Use a screwdriver or pry bar inserted between brake disc (2, Fig. 1) and brake pads (4) to press pistons (11) back as far as possible, into the piston bores of torque plate (16). Close bleeder valve.

7. Rotate brake pads (4) out of the opened end of torque plate (16).

8. Install new brake pads (4) by placing friction material next to the disc and rotating into position in torque plate (16).

9. Push the two unlocked pins (3) towards the disc.

10. Thread the two loosened bolts (2) in until bolts seat in grooves of torque pins (3). This can be checked by limited axial movement of pins as the bolts are being seated. Tighten bolts (2) to a torque of 30 - 38 Nm (22 - 28 lbf ft).

Note: Make sure torque pins (3 & 5) do not touch brake disc (2, Fig. 1). If they do, loosen bolts (2) and adjust torque pins to clear disc by 1.5 - 3.0 mm (0.06 - 0.12 in). Check to make sure that bolts (2) fully engage in torque pin grooves and retighten bolts.

11. Pump brake pedal until brake pads (4) contact brake disc (2, Fig. 1).

12. When new brake pads are installed on a machine, the brake pad friction material should be burnished in accordance with the following procedure to achieve maximum braking performance:

a. Drive vehicle at 8 - 30 km/h (5 - 20 mile/h) with brakes applied at just enough pressure to produce a noticeable drag. Heavy smoke and foul odour from the brake pad friction material is normal during this procedure.

b. Continue cycle until the brake disc achieves a temperature of 315° - 370° C (600° - 700° F). A surface pyrometer applied to the disc after stopping will determine temperature.

c. Permit disc to cool to less than 95° C (200° F).

d. Repeat Steps a and b.

e. Allow brake to cool to within 10° C (50° F) of ambient temperature.

f. Repeat Steps a and b until full braking performance (per applicable government regulations) is achieved.

BRAKE REMOVAL AND DISASSEMBLY

Numbers in parentheses refer to Fig. 2, unless otherwise specified.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ To prevent personal injury and property damage, the procedure for removing tyre and rim assembly described in Section 160-0050, WHEEL RIM AND TYRE, must be strictly followed.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels, except the wheel to be removed, and place the battery master switch in the 'Off' position.

3. Remove wheel from the machine following instructions in Section 160-0050, WHEEL RIM AND TYRE.

4. Remove hydraulic fluid inlet line at brake head assembly. Plug line and brake head to prevent ingress of dirt.

5. Remove bolts (4, Fig. 1) and washers (5, Fig. 1) from mounting at axle housing and remove brake head assembly to a clean working area.

⚠ WARNING
Hydraulic fluid may cause irritation. Avoid skin and eye contact with fluid.

6. Disassemble brake head assembly in sequence of index numbers in Fig. 2. Items (1, 2 & 3) may be left in torque plate (16) when servicing packings (13), seals (10), backup rings (14), and boots (12) if desired.

Note: Repair kits are available which include new boots (12), backup rings (14), packings (13) and seals (10), in quantities sufficient to rebuild a calliper brake head. Refer to vehicle parts book for repair kit part number. All parts included in a repair kit should be replaced each time a brake head is rebuilt.

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7. Inspect brake pads (4) per Step 1 in 'General Inspection' procedure.

8. Clean torque plate (16) making sure no solvent remains in fluid passages or grooves. Inspect boot (12) and seal (10) grooves, and land areas between grooves for damage or cracks. Minor nicks and scratches may be blended with crocus cloth. Replace torque plate (16) if corrosion is excessive or boot (12) and seal (10) grooves are damaged, prohibiting proper rebuild of the brake head.

9. Inspect pistons (11) for minor scratches and nicks and blend with crocus cloth. If piston (11) is badly nicked or scratched, or if the chrome plate is worn off, replace piston (11).

10. Torque pins (3 & 5) that are deeply grooved should be replaced.

ASSEMBLY

Numbers in parentheses refer to Fig. 2, unless otherwise specified.

1. Lubricate seals (10), packings (13) and pistons (11) with grease provided in seal kit or automotive brake fluid (SAE J 1703) or castor oil. Do not use petroleum type oils or lubricants.

2. Install backup rings (14), packings (13) and boots (12) in torque plate (16) piston bores. Lubricate per Step 1.

3. Install pistons (11) in torque plate (16) as follows: Position lubricated piston (11) into boot (12) and piston bore, holding piston at a slight angle. Insert forefinger between piston (11) and boot (12) and rotate forefinger around outside diameter of piston (11), lifting inside diameter of boot (12) over outside diameter of piston (11). Make sure outside diameter lip of boot (12) remains in the groove in piston (11) bore.

4. After piston (11) is through boot (12), centre piston by feel over packing (13). Apply by hand, a turning thrusting pressure, working piston (11) into and through packing (13).

5. When assured pistons (11) are through packings (13), pressure other than hand pressure may be used to press pistons the remainder of the way into the piston bores. Snap open end of boot (12) into groove of piston (11).

6. Lubricate seals (10) and install seals and piston plugs (9) in open end of piston bores of torque plate (16).

7. Attach cover plate (8) to torque plate (16) and secure with bolts (6) and washers (7). Tighten bolts (6) to a torque of 380 Nm (280 lbf ft).

8. When installing torque pins (3 & 5) and bolts (2) make sure the groove in the pin is directly under the bolt so the bolt can perform its locking and retaining function.

Note: Lubricate torque pins (3 & 5) with a corrosion resistant lubricant prior to installation to facilitate next pin removal.

9. Inspect brake disc (2, Fig. 1), if worn, per instructions under 'General Inspection' in this section. Refer to Section 160-0030, AXLE GROUP (HUB) for brake disc replacement instructions.

INSTALLATION

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

⚠ WARNINGS

To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ To prevent personal injury and property damage, the procedure for installing tyre and rim assembly described in Section 160-0050, WHEEL RIM AND TYRE, must be strictly followed.

1. Install washers (5) on bolts (4).

2. Position brake head (3) over brake disc (2) on brake mounting plate, aligning bolt holes. Install assembled bolts (4) and washers (5) through mounting plate and into torque plate. Tighten bolts (4) to a torque of 510 Nm (380 lbf ft).

Note: Make sure torque pins (3 & 5, Fig. 2) do not touch brake disc (2). If they do, loosen bolts (2, Fig. 2) and adjust pins to clear disc by 1.5 - 3.0 mm (0.06 - 0.12 in). Check to make sure that bolt (2, Fig. 2) fully engages in pin groove and tighten bolt (2, Fig. 2) to a torque of 30 - 38 Nm (22 - 28 lbf ft).

3. Attach hydraulic inlet lines at brake head assembly.

4. Install wheel on the vehicle following instructions in Section 160-0050, WHEEL RIM AND TYRE.

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BLEEDING

Numbers in parentheses refer to Fig. 2.

In order to obtain satisfactory braking, the system should be bled as follows to eliminate any air in the hydraulic brake lines.

1. Fill the hydraulic fluid reservoirs with hydraulic brake fluid specified in Section 300-0020, LUBRICATION SYSTEM.

2. Remove dust cap (15) from bleeder valve (1) and connect a bleeder hose to bleeder valve (1). Place loose end of hose in clean container.

Note: Keep fluid reservoirs filled during bleeding process.

3. Actuate brake treadle valve several times.

4. Apply brake and open bleeder valve (1). After fluid flow stops, close bleeder valve (1) and release the brake.

Note: If loose end of bleeder hose is kept submerged in brake fluid, bleeder valve (1) need not be closed each time brake is released.

5. Repeat procedure in Step 4 until no air bubbles are observed in fluid coming from bleeder valves.

6. Repeat Steps 1 through 5 at each brake head assembly.

MAINTENANCE

Numbers in parentheses refer to Fig. 2.

Every 10 Hours (Daily)
Inspect brake fluid level and add brake fluid if low. Refer to Section 300-0020, LUBRICATION SYSTEM.

Inspect brake head assembly to ensure that all bolts are tight and there are no leaks. Inspect for boot deterioration.

Every 250 Hours (Monthly)
Check pads and discs for wear and adjust or replace where necessary. Test for proper function.

Note: This service interval applies to normal driving. Check the pads more frequently under more severe conditions.

Thickness of pad friction material should never be allowed to wear below 3 mm (0.12 in).

Note: Repair kits are available which include new boots (12), backup rings (14), packings (13) and seals (10), in quantities sufficient to rebuild a calliper brake head. Refer to vehicle parts book for repair kit part number. All parts included in a repair kit should be replaced each time a brake head is rebuilt.

Every 2 000 Hours (Annually)
Drain brake fluid, refill reservoirs and bleed the brakes. Refer to Section 300-0020, LUBRICATION SYSTEM for brake fluid specification and system capacities.

SERVICE TOOLS

There are no special tools required for the procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools. These tools are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	4	Bolt	510	380
2	2	Bolt	30 - 38	22 - 28
2	6	Bolt	380	280

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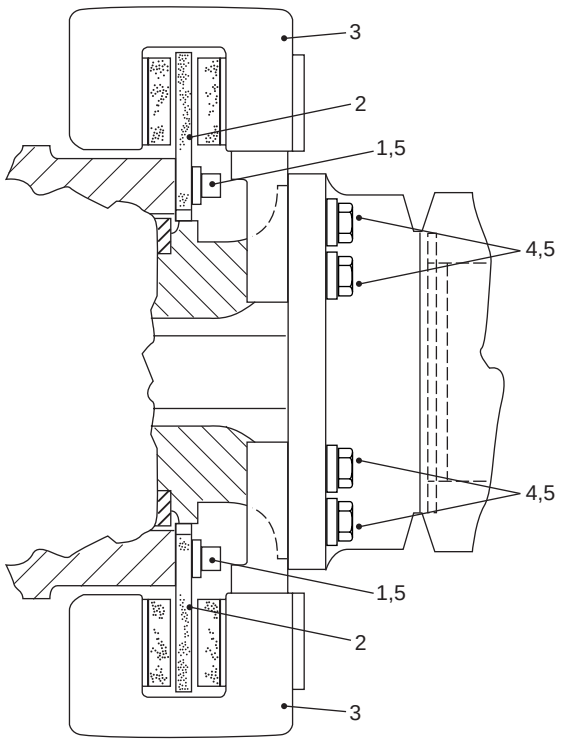
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1 - Capscrew
2 - Brake Disc
3 - Brake Head
4 - Bolt
5 - Washer

Fig. 1 - Cutaway View of Typical Brake Head and Disc Mounting

DESCRIPTION AND OPERATION

The service brakes are of the calliper disc-type. The calliper brake head is designed for use with hydraulic brake fluid. The head is bolted to a mounting plate on the axle housing. The disc is bolted to the wheel. There are two brake heads and one brake disc at each wheel.

Each calliper brake head assembly consists of a torque plate, two brake pads, one on each side of the brake disc, and four brake pistons, two on each side of the brake disc.

The brake is actuated by hydraulic brake fluid entering the brake head through one of the bleeder ports. The piston bores on each side of the torque plate are interconnected by internal passages.

When the brake is actuated, the hydraulic pressure forces the pistons against the brake pads which are, in turn, forced against each side of the brake disc, slowing or stopping the disc and wheel rotation.

GENERAL INSPECTION

1. Inspect brake pads for wear. If the brake pad friction material is worn down to 3 mm (0.12 in) thickness, the pads must be replaced.

2. Inspect brake disc as follows:

a. Measure original thickness of disc at outside diameter (this area is not contacted by brake pad friction material).

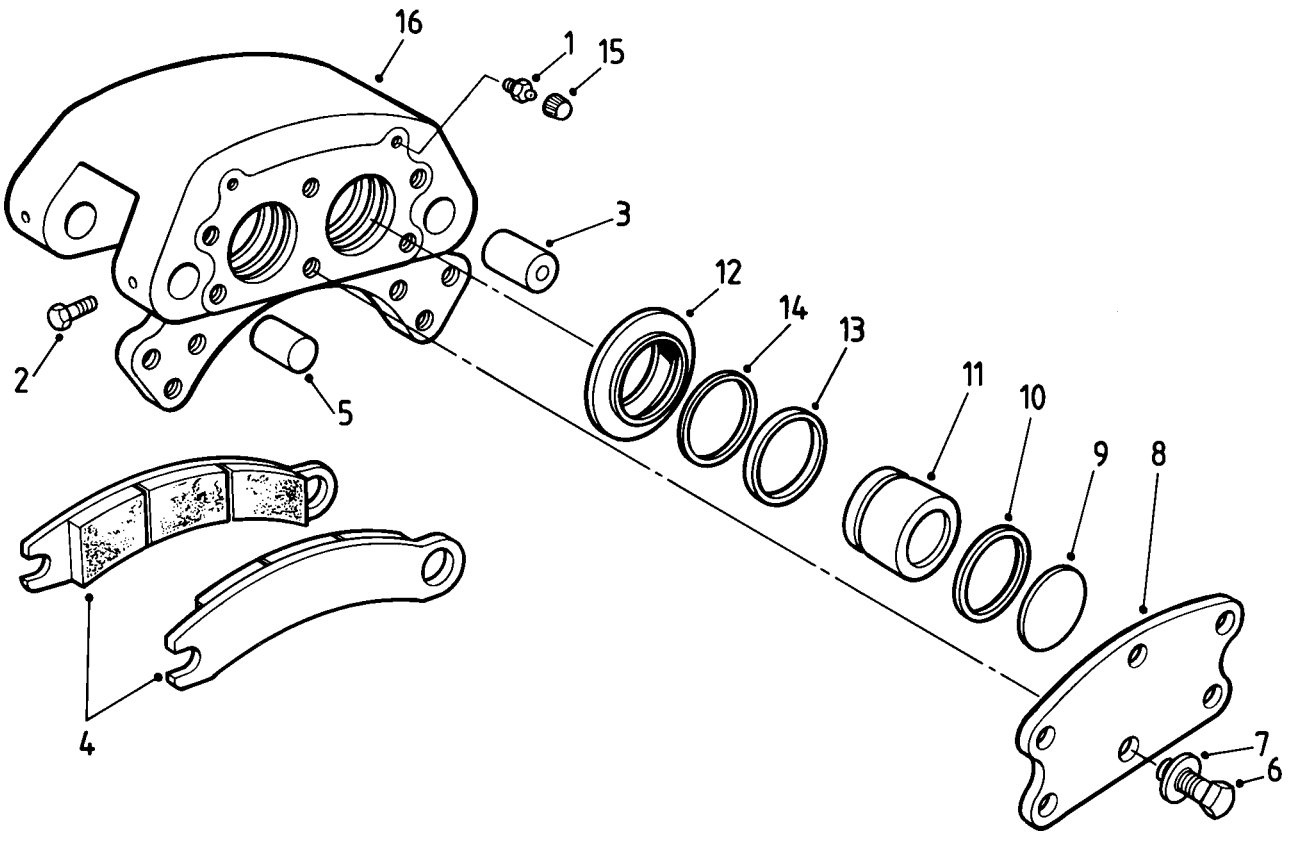
b. Measure thickness of disc at three points on the brake pad friction material contact circumference and determine the average disc thickness.

c. Subtract 'b' from 'a'. If difference is 3 mm (0.12 in) or greater, the disc must be replaced.

Note: Refer to Section 160-0030, AXLE GROUP (HUB), for brake disc replacement instructions.

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1 - Bleeder Valve
2 - Screw
3 - Torque Pin
4 - Brake Pads
5 - Torque Pin
6 - Bolt
7 - Washer
8 - Cover Plate
9 - Piston Plug
10 - Seal
11 - Piston
12 - Boot
13 - Packing
14 - Backup Ring
15 - Dust Cap
16 - Torque Plate

Fig. 2 - Exploded View of Typical Brake Head

BRAKE PAD REMOVAL AND INSTALLATION

Numbers in parentheses refer to Fig. 2.

⚠ WARNINGS

To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ To prevent personal injury and property damage, the procedure for removing tyre and rim assembly described in Section 160-0050, WHEEL RIM AND TYRE, must be strictly followed.

⚠ Keep brake fluid reservoir full at all times.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels, except the wheel to be removed, and place the battery master switch in the 'Off' position.

3. Remove wheel from the machine following instructions in Section 160-0050, WHEEL RIM AND TYRE.

4. Loosen bolts (2) securing large torque pins (3) at the end of torque plate (16). It is not necessary to loosen or remove the two smaller torque pins (5) at opposite end.

5. Move the two unlocked torque pins (3) away from brake disc (2, Fig. 1).

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6. Remove dust cap (15) from bleeder valve (1) and attach a bleeder hose to bleeder valve. Open bleeder valve (1). Use a screwdriver or pry bar inserted between brake disc (2, Fig. 1) and brake pads (4) to press pistons (11) back as far as possible, into the piston bores of torque plate (16). Close bleeder valve.

7. Rotate brake pads (4) out of the opened end of torque plate (16).

8. Install new brake pads (4) by placing friction material next to the disc and rotating into position in torque plate (16).

9. Push the two unlocked pins (3) towards the disc.

10. Thread the two loosened bolts (2) in until bolts seat in grooves of torque pins (3). This can be checked by limited axial movement of pins as the bolts are being seated. Tighten bolts (2) to a torque of 30 - 38 Nm (22 - 28 lbf ft).

Note: Make sure torque pins (3 & 5) do not touch brake disc (2, Fig. 1). If they do, loosen bolts (2) and adjust torque pins to clear disc by 1.5 - 3.0 mm (0.06 - 0.12 in). Check to make sure that bolts (2) fully engage in torque pin grooves and retighten bolts.

11. Repeat steps 4 to 10 for second brake calliper.

12. Pump brake pedal until brake pads (4) contact brake disc (2, Fig. 1).

13. When new brake pads are installed on a machine, the brake pad friction material should be burnished in accordance with the following procedure to achieve maximum braking performance:

a. Drive vehicle at 8 - 30 km/h (5 - 20 mile/h) with brakes applied at just enough pressure to produce a noticeable drag. Heavy smoke and foul odour from the brake pad friction material is normal during this procedure.

b. Continue cycle until the brake disc achieves a temperature of 315° - 370° C (600° - 700° F). A surface pyrometer applied to the disc after stopping will determine temperature.

c. Permit disc to cool to less than 95° C (200° F).

d. Repeat Steps a and b.

e. Allow brake to cool to within 10° C (50° F) of ambient temperature.

f. Repeat Steps a and b until full braking performance (per applicable government regulations) is achieved.

BRAKE REMOVAL AND DISASSEMBLY

Numbers in parentheses refer to Fig. 2, unless otherwise specified.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ To prevent personal injury and property damage, the procedure for removing tyre and rim assembly described in Section 160-0050, WHEEL RIM AND TYRE, must be strictly followed.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels, except the wheel to be removed, and place the battery master switch in the 'Off' position.

3. Remove wheel from the machine following instructions in Section 160-0050, WHEEL RIM AND TYRE.

4. Remove hydraulic fluid inlet line at brake head assembly. Plug line and brake head to prevent ingress of dirt.

5. Remove bolts (4, Fig. 1) and washers (5, Fig. 1) from mounting at axle housing and remove brake head assembly to a clean working area.

⚠ WARNING
Hydraulic fluid may cause irritation. Avoid skin and eye contact with fluid.

6. Disassemble brake head assembly in sequence of index numbers in Fig. 2. Items (1, 2 & 3) may be left in torque plate (16) when servicing packings (13), seals (10), backup rings (14), and boots (12) if desired.

Note: Repair kits are available which include new boots (12), backup rings (14), packings (13) and seals (10), in quantities sufficient to rebuild a calliper brake head. Refer to vehicle parts book for repair kit

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part number. All parts included in a repair kit should be replaced each time a brake head is rebuilt.

7. Inspect brake pads (4) per Step 1 in 'General Inspection' procedure.

8. Clean torque plate (16) making sure no solvent remains in fluid passages or grooves. Inspect boot (12) and seal (10) grooves, and land areas between grooves for damage or cracks. Minor nicks and scratches may be blended with crocus cloth. Replace torque plate (16) if corrosion is excessive or boot (12) and seal (10) grooves are damaged, prohibiting proper rebuild of the brake head.

9. Inspect pistons (11) for minor scratches and nicks and blend with crocus cloth. If piston (11) is badly nicked or scratched, or if the chrome plate is worn off, replace piston (11).

10. Torque pins (3 & 5) that are deeply grooved should be replaced.

ASSEMBLY

Numbers in parentheses refer to Fig. 2, unless otherwise specified.

1. Lubricate seals (10), packings (13) and pistons (11) with grease provided in seal kit or automotive brake fluid (SAE J 1703) or castor oil. Do not use petroleum type oils or lubricants.

2. Install backup rings (14), packings (13) and boots (12) in torque plate (16) piston bores. Lubricate per Step 1.

3. Install pistons (11) in torque plate (16) as follows: Position lubricated piston (11) into boot (12) and piston bore, holding piston at a slight angle. Insert forefinger between piston (11) and boot (12) and rotate forefinger around outside diameter of piston (11), lifting inside diameter of boot (12) over outside diameter of piston (11). Make sure outside diameter lip of boot (12) remains in the groove in piston (11) bore.

4. After piston (11) is through boot (12), centre piston by feel over packing (13). Apply by hand, a turning thrusting pressure, working piston (11) into and through packing (13).

5. When assured pistons (11) are through packings (13), pressure other than hand pressure may be used to press pistons the remainder of the way into the piston bores. Snap open end of boot (12) into groove of piston (11).

6. Lubricate seals (10) and install seals and piston plugs (9) in open end of piston bores of torque plate (16).

7. Attach cover plate (8) to torque plate (16) and secure with bolts (6) and washers (7). Tighten bolts (6) to a torque of 380 Nm (280 lbf ft).

8. When installing torque pins (3 & 5) and bolts (2) make sure the groove in the pin is directly under the bolt so the bolt can perform its locking and retaining function.

Note: Lubricate torque pins (3 & 5) with a corrosion resistant lubricant prior to installation to facilitate next pin removal.

9. Inspect brake disc (2, Fig. 1), if worn, per instructions under 'General Inspection' in this section. Refer to Section 160-0030, AXLE GROUP (HUB) for brake disc replacement instructions.

INSTALLATION

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

⚠ WARNINGS

To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ To prevent personal injury and property damage, the procedure for installing tyre and rim assembly described in Section 160-0050, WHEEL RIM AND TYRE, must be strictly followed.

1. Install washers (5) on bolts (4).

2. Position brake head (3) over brake disc (2) on brake mounting plate, aligning bolt holes. Install assembled bolts (4) and washers (5) through mounting plate and into torque plate. Tighten bolts (4) to a torque of 510 Nm (380 lbf ft).

Note: Make sure torque pins (3 & 5, Fig. 2) do not touch brake disc (2). If they do, loosen bolts (2, Fig. 2) and adjust pins to clear disc by 1.5 - 3.0 mm (0.06 - 0.12 in). Check to make sure that bolt (2, Fig. 2) fully engages in pin groove and tighten bolt (2, Fig. 2) to a torque of 30 - 38 Nm (22 - 28 lbf ft).

3. Attach hydraulic inlet lines at brake head assembly.

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4. Install wheel on the vehicle following instructions in Section 160-0050, WHEEL RIM AND TYRE.

BLEEDING

Numbers in parentheses refer to Fig. 2.

In order to obtain satisfactory braking, the system should be bled as follows to eliminate any air in the hydraulic brake lines.

1. Fill the hydraulic fluid reservoirs with hydraulic brake fluid specified in Section 300-0020, LUBRICATION SYSTEM.

2. Remove dust cap (15) from bleeder valve (1) and connect a bleeder hose to bleeder valve (1). Place loose end of hose in clean container.

Note: Keep fluid reservoirs filled during bleeding process.

3. Actuate brake treadle valve several times.

4. Apply brake and open bleeder valve (1). After fluid flow stops, close bleeder valve (1) and release the brake.

Note: If loose end of bleeder hose is kept submerged in brake fluid, bleeder valve (1) need not be closed each time brake is released.

5. Repeat procedure in Step 4 until no air bubbles are observed in fluid coming from bleeder valves.

6. Repeat Steps 1 through 5 at each brake head assembly.

MAINTENANCE

Numbers in parentheses refer to Fig. 2.

Every 10 Hours (Daily)
Inspect brake fluid level and add brake fluid if low. Refer to Section 300-0020, LUBRICATION SYSTEM.

Inspect brake head assembly to ensure that all bolts are tight and there are no leaks. Inspect for boot deterioration.

Every 250 Hours (Monthly)
Check pads and discs for wear and adjust or replace where necessary. Test for proper function.

Note: This service interval applies to normal driving. Check the pads more frequently under more severe conditions.

Thickness of pad friction material should never be allowed to wear below 3 mm (0.12 in).

Note: Repair kits are available which include new boots (12), backup rings (14), packings (13) and seals (10), in quantities sufficient to rebuild a calliper brake head. Refer to vehicle parts book for repair kit part number. All parts included in a repair kit should be replaced each time a brake head is rebuilt.

Every 2 000 Hours (Annually)
Drain brake fluid, refill reservoirs and bleed the brakes. Refer to Section 300-0020, LUBRICATION SYSTEM for brake fluid specification and system capacities.

SERVICE TOOLS

There are no special tools required for the procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools. These tools are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	4	Bolt	510	380
2	2	Bolt	30 - 38	22 - 28
2	6	Bolt	380	280

* * * *

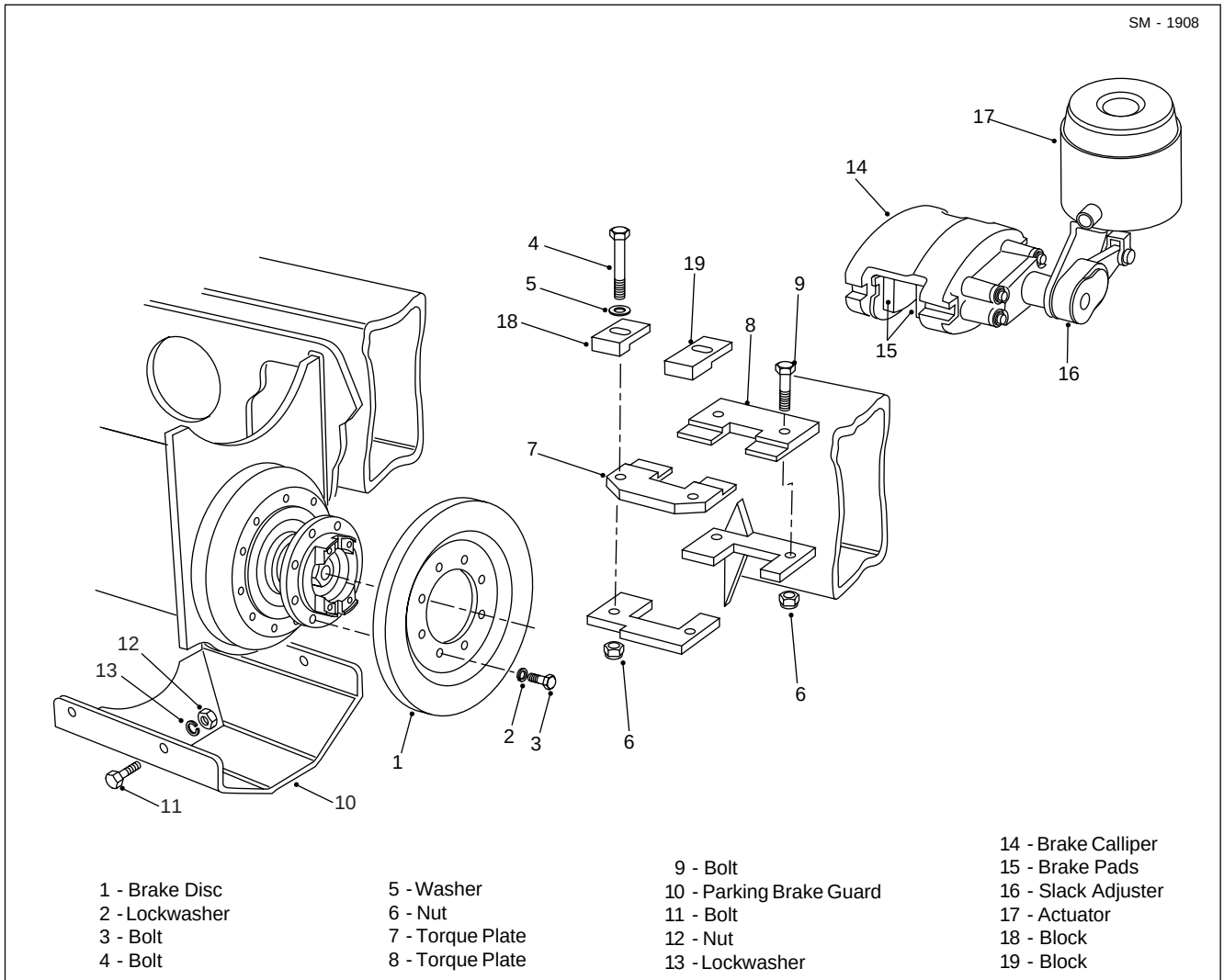
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1 - Brake Disc
2 - Lockwasher
3 - Bolt
4 - Bolt
5 - Washer
6 - Nut
7 - Torque Plate
8 - Torque Plate
9 - Bolt
10 - Parking Brake Guard
11 - Bolt
12 - Nut
13 - Lockwasher
14 - Brake Calliper
15 - Brake Pads
16 - Slack Adjuster
17 - Actuator
18 - Block
19 - Block

Fig. 1 - Parking Brake Mounting

⚠ WARNING
When servicing parking brake parts, do not create dust by grinding or sanding brake pads, or parking brake parts. A water dampened cloth should be used for cleaning parking brake parts. Some brake parts may contain asbestos fibres which can become airborne if dust is created during servicing. Breathing dust containing asbestos fibres may cause serious bodily harm.

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1.

The parking brake consists of a sliding calliper acting on a brake disc on a rear driveline. The parking brake is of 'Inverted Design' i.e. requiring air pressure to hold the parking brake off.

Operation is by air pressure directed from the parking brake control valve in the cab. When the control valve is in the 'RELEASE' position, air pressure compresses the coil spring in actuator (17), releasing brake pads (15) from brake disc (1).

Placing the brake control valve in the 'PARK' position cuts off air pressure and exhausts actuator (17) through the brake control valve, allowing the coil spring to expand. This movement exerts force on slack adjuster (16), which is splined to the operating shaft, to apply the parking brake.

Brake calliper (14), including brake pads (15), is free to float on torque plates (7 & 8) bolted to brackets welded on the trailer frame. It is important that torque plates (7 & 8) and brake calliper (14) slots are kept clean and

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lubricated regularly to avoid unequal wear on brake pads (15). It is also important that the lubricant does not contact the disc braking surfaces.

Placing the brake control valve in the 'EMERGENCY' position will apply the service brakes on the machine.

Note: The parking brake will automatically apply when air pressure in the primary air tank drops below 3.1 bar (45 lbf/in²).

REMOVAL

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel chocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ When necessary to drive out or drive on components during disassembly/assembly, be sure to use a soft drift to prevent property damage and personal injury.

1. Position the vehicle in a level work area, raise the body and install the body safety prop to secure body in partially raised position.

2. Switch off the engine and block all road wheels.

3. Position parking brake control lever in the 'RELEASE' position. Open drain cocks in the air tanks and drain air pressure from the machine.

4. Release spring tension on slack adjuster clevis pin (9, Fig. 2) by unscrewing tensioning bolt on slack adjuster (16) until clevis pin (9, Fig. 2) feels loose. Remove cotter pin (10, Fig. 2) and clevis pin (9, Fig. 2) from actuator (17).

5. Disconnect and cap air line from actuator (17). Plug port in actuator (17) to prevent ingress of dirt.

6. Remove nuts (12, Fig. 2), lockwashers (13, Fig. 2) and washers (14, Fig. 2) securing actuator (17) to cap assembly (25, Fig. 2). Remove actuator (17) from cap assembly (25, Fig. 2).

7. Support brake calliper (14) assembly and remove bolts (4), washers (5), blocks (18 & 19) and nuts (6) securing torque plates (7 & 8) to mounting bracket on the frame.

8. Remove torque plates (7 & 8) and brake calliper (14) assembly from the dumptruck. Set brake calliper (14) aside for 'Disassembly'.

DISASSEMBLY

Numbers in parentheses refer to Fig. 2.

1. Remove calliper head assembly as described under 'Removal'.

2. Remove snap ring (16) from power screw shaft (21).

3. Slide slack adjuster (17) from power screw shaft (21).

4. Remove and discard washer (19), wave spring washer (18) and packing (20) from power screw shaft (21).

5. Remove bolts (2) and washers (3) securing cap assembly (25) to calliper (7).

6. Remove as a unit, power screw shaft (21), piston (6) and cap assembly (22 thru 25) from calliper (7).

7. Slide power screw shaft (21) and piston (6) from cap assembly (25).

8. Unscrew piston (6) from power screw shaft (21).

9. Remove and discard thrust bearing (22) from power screw shaft (21) and gasket (23) from cap assembly (25).

10. Remove and discard piston seal (5) from calliper (7).

INSPECTION

Numbers in parentheses refer to Fig. 2.

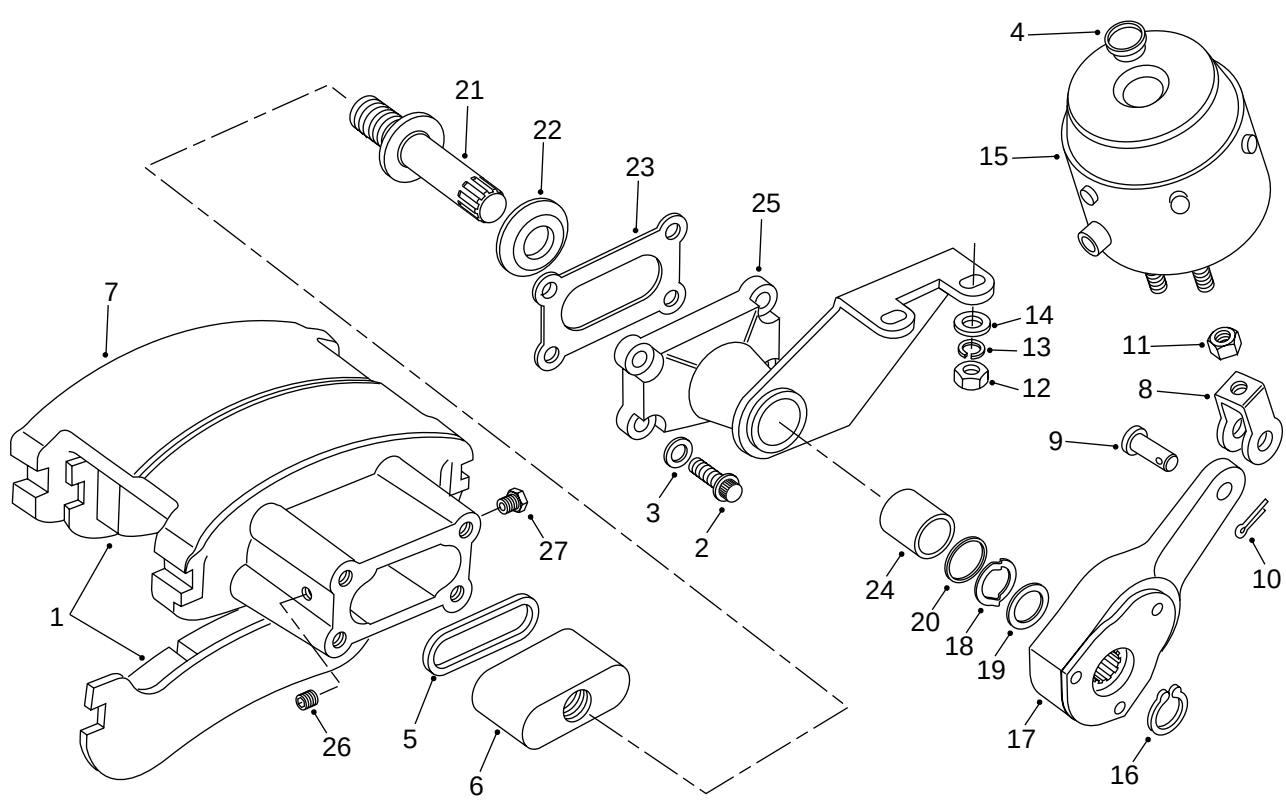
1. Thoroughly clean all parts. Inspect journal bearing (24) in cap assembly (25) for wear. Replace if necessary.

2. Replace cap assembly (25) if excessively worn.

3. Inspect all brake parts for cracks, excessive wear or scoring. Replace brake parts as required.

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1 - Brake Pad
2 - Bolt
3 - Washer
4 - Plug
5 - Piston Seal
6 - Piston
7 - Calliper
8 - Clevis
9 - Clevis Pin
10 - Cotter Pin
11 - Jam Nut
12 - Nut
13 - Lockwasher
14 - Washer
15 - Actuator
16 - Snap Ring
17 - Slack Adjuster
18 - Wave Spring Washer
19 - Washer
20 - Packing
21 - Power Screw Shaft
22 - Thrust Bearing
23 - Gasket
24 - Journal Bearing
25 - Cap Assembly
26 - Plug
27 - Pressure Relief Fitting

Fig. 2 - Exploded View of Parking Brake Assembly

ASSEMBLY

Numbers in parentheses refer to Fig. 2.

1. Install new piston seal (5) into seal groove in calliper (7).

2. Apply grease (Lubriplate Aero or equivalent) to flat face of new thrust bearing (22).

3. Install and seat new thrust bearing (22) over splined end of power screw shaft (21) with greased side of thrust bearing (22) against thrust collar of power screw shaft (21).

Note: Ensure correct installation of thrust bearing (22) by verifying that installation was made over the larger diameter end of power screw shaft (21), and, that thrust bearing (22) ID lip is towards splined end of power screw shaft (21).

4. Lubricate threads of power screw shaft (21) with grease (Lubriplate Aero or equivalent) and screw power screw shaft (21) into piston (6).

5. Coat outside of piston (6) with grease (Lubriplate Aero or equivalent) then slide assembled power screw shaft (21) and piston (6) into cap assembly (25), shaft end first.

6. Line up gasket (23) with holes in cap assembly (25) and bolt cap assembly (25), with assembled power screw shaft (21) and piston (6), to calliper (7) using bolts (2) and washers (3). Torque tighten bolts (2) to 176 - 203 Nm (130 - 150 lbf ft).

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Note: Care should be taken not to push piston seal (5) out of seal groove in calliper (7) when assembling cap assembly (25), with piston (6) and power screw shaft (21), to calliper (7).

7. Install new packing (20), wave spring washer (18) and washer (19) over power screw shaft (21), in the order as shown in Fig. 2.

8. Mount actuator (15) on cap assembly (25) and secure with nuts (12), lockwashers (13) and washers (14). Tighten nuts (12) finger tight only at this stage.

9. Apply coat of grease (Lubriplate Aero or equivalent) to mounting spline of slack adjuster (17).

10. With adjusting screw facing away from actuator (15) slide slack adjuster (17) onto power screw shaft (21) aligning slack adjuster (17) arm with clevis (8).

11. Install snap ring (16) on power screw shaft (21).

12. Remove nuts (12), lockwashers (13) and washers (14) securing actuator (15) to cap assembly (25). Remove actuator (15) from cap assembly (25) to aid in 'Installation'.

INSTALLATION

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: Tighten all fasteners without special torques specified, to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel chocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. If removed, install brake disc (1) on mounting flange and secure with bolts (3) and lockwashers (2). Torque tighten bolts (3) to 49 Nm (36 lbf ft).

2. Install torque plate (7) on rear frame mounting bracket and secure in place with bolts (4), washers (5), blocks (18 & 19) and nuts (6). Torque tighten nuts (6) to 278 Nm (205 lbf ft).

3. Using suitable lifting device, position brake calliper (14) assembly in position on torque plate (7). Install torque plate (8) on brake calliper (14) and secure to rear frame mounting bracket with bolts (4), washers (5) and nuts (6). Torque tighten nuts (6) to 278 Nm (205 lbf ft).

4. Re-mount actuator (17) on cap assembly (25, Fig. 2) and install washers (14), lockwashers (13) and nuts (12). Tighten nuts (12) finger tight at this stage.

5. Reconnect air line to actuator (17)

6. Place brake control lever in the 'RELEASE' position to retract actuator (17) cylinder when engine is started. Ensure drain cocks on air tanks are closed, start the engine and build up air pressure in the air tanks.

7. Connect slack adjuster (16) to actuator (17) by inserting clevis pin (9, Fig. 2) through clevis (8, Fig. 2) on actuator (17). Secure clevis pin (9, Fig. 2) with cotter pin (10, Fig. 2).

8. Align actuator (17) to slack adjuster (16) and tighten nuts (12) securely.

9. Rotate slack adjuster (16) adjusting screw until brake pads (15) in brake calliper (14) head assembly are tight against brake disc (1). Back off adjusting screw on slack adjuster (16) until a total clearance of 1 - 1.5 mm (0.04 - 0.06 in) is obtained. The parking brake is now operational.

10. If fitted, install parking brake guard (10) to mounting brackets and secure in place with bolts (11), lockwashers (13) and nuts (12). Torque tighten nuts (12) to 153 Nm (113 lbf ft).

MAINTENANCE

Brake Pad Replacement

Replace brake pads when lining thickness is 3 mm (0.12 in) or less.

1. Remove calliper head assembly as described under 'REMOVAL'.

2. Replace worn brake pad and carrier assemblies.

3. Install calliper head assembly and adjust slack adjuster as described in 'Installation'.

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SERVICE

Every 1 000 hours check pads and disc for wear. Lubricate slack adjuster as described in Section 300-0020, LUBRICATION SYSTEM.

Test parking brake for proper operating function. Replace parking brake pads when lining thickness is 3 mm (0.12 in) or less.

SPECIAL TOOLS

There are no special tools required for procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	3	Bolt	49	36
1	6	Nut	278	205
1	12	Nut	153	113
2	2	Bolt	176 - 203	130 - 150

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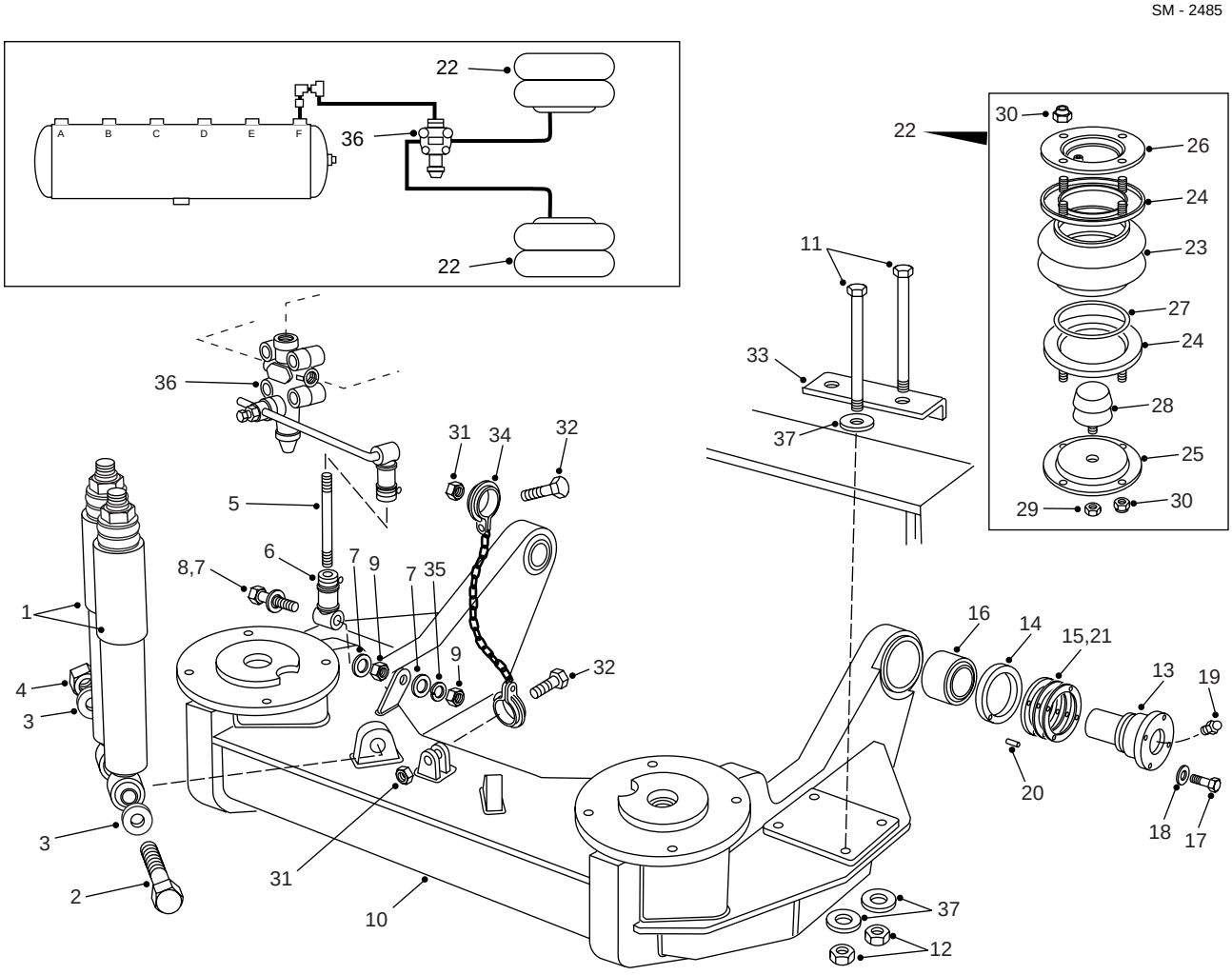
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1 - Shock Absorber
2 - Bolt
3 - Washer
4 - Locknut
5 - Rod
6 - Rubber Joint
7 - Washer
8 - Bolt
9 - Nut
10 - Suspension Frame
11 - Bolt
12 - Nut
13 - Mounting Pin
14 - Wear Washer
15 - Shim
16 - Spherical Bearing
17 - Bolt
18 - Lockwasher
19 - Lube Fitting
20 - Dowel Pin
21 - Shim
22 - Air Spring Assembly
23 - Bellows
24 - Clamp Ring
25 - Clamp Plate
26 - Clamp Plate
27 - Ring
28 - Bumpstop
29 - Nut
30 - Locknut
31 - Nut
32 - Bolt
33 - Bent Plate
34 - Chain
35 - Lockwasher
36 - Levelling Valve
37 - Gasket
38 - Adaptor
39 - Adaptor
40 - Adaptor Elbow
41 - Hardened Washer
42 - Nylon Tube
43 - Reducer Bushing

Fig. 1 - Exploded View of Front Suspension

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The front axle is carried on the leading arms of suspension frame (10), which pivots on the main frame. Suspension is by flexible air bellows (23) with four heavy duty shock absorbers (1). Air pressure through levelling valve (36) maintains a constant ride height. Refer to Section 180-0021, LEVELLING VALVE for air spring ride height adjusting instructions.

Note: Refer to Section 180-0022, AIR SPRING, for details on servicing items 22 through 30.

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REMOVAL

Numbers in parentheses refer to Fig. 1.

> **WARNING**
> **To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, lower body completely, apply the parking brake and switch off the engine.

2. Block rear wheels, place the steering lock bar and oscillation lock pin in the 'Locked position and the battery master switch in the 'Off' position.

3. Whilst the front road wheels are still on the ground, loosen the wheel nuts.

4. Using suitable lifting equipment, raise the tractor frame until both front tyres are off the ground. Support the vehicle with suitable stands and blocking equipment at the front frame and articulation pivot area.

5. Support one tyre and rim assembly with suitable lifting equipment and remove wheel nuts and lockwashers securing the rim to the axle. Remove tyre and rim assembly from the machine.

6. Repeat Step 5 for the opposite tyre and rim assembly.

7. Disconnect nylon tubes from air spring assemblies (22).

8. Jack up suspension frame (10) to allow removal of shock absorbers (1), air spring assemblies (22), chain (34) and levelling valve (36).

9. Remove locknuts (4), washers (3) and bolts (2) securing shock absorbers (1) to suspension frame (10) assembly.

10. Remove nuts (9), lockwasher (35), washers (7) and bolt (8) securing levelling valve rubber joint (6) to suspension frame (10) assembly.

11. Remove nut (31) and bolt (32) securing chain (34) to suspension frame (10) assembly.

12. Remove locknuts (30) securing air spring assemblies (22) to the front frame assembly.

13. Lower front end of suspension frame (10) assembly onto a suitable trolley.

14. Using suitable lifting equipment, support rear arms of suspension frame (10) assembly.

15. Remove bolts (17) and lockwashers (18) securing mounting pins (13) to the front frame assembly. Withdraw mounting pins (13) and shims (15 & 21) from front frame assembly and suspension frame (10) assembly.

16. Carefully lower suspension frame (10) assembly onto the trolley and remove suspension frame assembly out from under the front frame. Remove wear washers (14) and dowel pins (20) from the front frame assembly.

17. Remove cap from shock absorber (1) mounting nuts and remove nuts securing shock absorbers (1) to the front frame assembly.

18. Remove nut (31) and bolt (32) securing chain (34) to the front frame.

19. Remove mounting hardware securing levelling valve (36) to the front frame assembly and remove levelling valve.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

> **WARNING**
> **To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Remove locknuts (30) securing air spring assemblies (22) on suspension frame (10). Refer to Section 180-0021, AIR SPRING, for further disassembly, inspection and assembly of air spring assembly (22).

2. Remove nuts (12), bolts (11), hardened washers (37) and bent plates (33) securing front axle assembly on suspension frame (10).

3. Using suitable lifting equipment remove front axle assembly from suspension frame (10).

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4. If damaged, press spherical bearings (16) out of bores in suspension frame (10).

ASSEMBLY

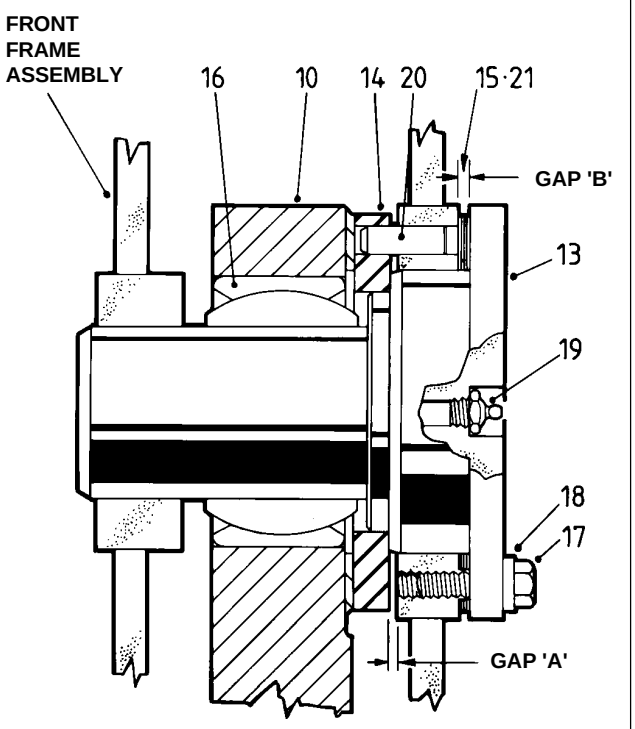
Numbers in parentheses refer to Fig. 1.

> **WARNING**
> **To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. If removed, install new spherical bearings (16) in suspension frame (10) ensuring bearings are centralised in suspension frame (10).

2. Position air spring assemblies (22) on suspension frame (10) and secure with locknuts (30). Tighten locknuts cape and corner to ensure even contact. Tighten locknuts (30) to a torque of 23 Nm (17 lbf ft).

3. Using suitable lifting equipment, position front axle assembly on suspension frame (10) and secure with bolts (11), hardened washers (37), bent plates (33) and nuts (12). Tighten nuts (12) to a torque of 610 Nm (450 lbf ft).



10 - Suspension Frame
13 - Mounting Pin
14 - Wear Washer
15 - Shim
16 - Spherical Bearing
17 - Bolt
18 - Lockwasher
19 - Lube Fitting
20 - Dowel

Fig. 2 - Sectional View of Pivot Arrangement

INSTALLATION

Numbers in parentheses refer to Figs. 1 & 2.

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

> **WARNING**
> **To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Secure levelling valve (36) assembly on the front frame with mounting hardware removed during removal.

2. Secure chain (34) on front frame assembly with bolt (32) and nut (31).

3. Install shock absorber (1) on front frame assembly and secure with locking nut. Hold dust cover on shock absorber (1) with a suitable strap wrench and tighten locking nut to a torque of 68 - 74 Nm (50 - 55 lbf ft). Repeat for remaining three shock absorbers.

4. Position suspension frame (10) assembly and trolley under front frame assembly with hinge lugs up and to the rear.

5. Install dowel pins (20) in the front frame assembly ensuring they protrude 12 mm (0.5 in) from front frame assembly. Hang wear washers (14) on dowel pins (20).

6. Using suitable lifting equipment, raise suspension frame and install to front frame assembly. Mark outside of mounting pins (13) to show position of grease outlet and install pins with grease outlet down in 6 o'clock position. Secure mounting pins (13) with bolts (17).

7. Position suspension frame (10) completely to one side and take a measurement of the gap between boss on the front frame and inside face of mounting

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pin (13). Half this size to obtain the thickness of shim pack required for Gap 'B' (Fig. 2) at both sides.

Note: Gap 'B' at both sides should be equalised within 0.25 mm (0.01 in) maximum.

8. Shim Gap 'B' at both sides with shims (15 & 21). Ensure that a small running clearance of 0.25 mm (0.01 in) maximum at wear washers (14) is obtained.

9. Remove bolts (17) and reinstall with lockwashers (18). Tighten bolts (17) to a torque of 74 Nm (55 lbf ft).

10. If removed, install and secure lube fittings (19) in mounting pins (13). Lubricate suspension frame spherical bearing (16) through lube fittings (19) with grease specified in Section 300-0020, LUBRICATION SYSTEM, until excess lube is seen.

11. Lift suspension frame (10) at front end ensuring that mounting studs on air spring assemblies (22) pass through holes in front frame assembly mounts. Secure air spring assemblies (22) to front frame assembly with nuts (30). Tighten nuts (30) to a torque of 23 Nm (17 lbf ft).

Note: Apply 'Adsil' to mounting bolts (2) and rubber mounts on shock absorbers (1) prior to fitting.

12. Install shock absorbers (1) between anchor brackets on suspension frame (10) and install bolts (2), washers (3) and locknuts (4). Install bolts (2) from inside with locknuts (4) on the outside. Tighten locknuts (4) until a measured distance of 47 mm (1.85 in) across the rubber is achieved on any one rubber.

13. Secure chain (34) on suspension frame (10) with bolt (32) and nut (31).

14. Secure levelling valve rubber joint to mounting bracket on suspension frame (10) with bolt (8), washers (7), lockwasher (35) and nuts (9). Refer to Section 180-0022, LEVELLING VALVE for adjustment and setting procedures.

15. Lower suspension frame (10) onto chain (34).

16. Install nylon tubes to air spring assemblies (22) with the long nylon to LH air spring and short nylon to the RH air spring.

17. Using suitable lifting equipment, position one tyre and rim assembly on the front axle and secure with wheel nuts and lockwashers.

18. Using suitable lifting equipment, position opposite tyre and rim assembly on the front axle and secure with wheel nuts and lockwashers.

19. Using suitable lifting equipment, raise front frame assembly sufficiently to remove stands and blocking equipment from front frame assembly and articulation pivot area. Lower vehicle to the ground and remove lifting equipment.

20. With the vehicle lowered to the ground, tighten all wheel nuts to a torque of 590 Nm (435 lbf ft).

21. Remove wheel blocks from the rear road wheels, place the steering lock bar and oscillation lock pin in the 'Stowed' position and the battery master switch in the 'On' position.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

Pre-Starting Inspection: Visually inspect shock absorbers (1), suspension frame (10) and air spring assemblies (22) for debris, leaks and damage.

Every 50 Hours: Lubricate suspension frame spherical bearing (16) through lube fittings (19) with grease specified in Section 300-0020, LUBRICATION SYSTEM, until excess lube is seen.

SERVICE TOOLS

There are no special tools required for the procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS for part numbers of general service tools required. These tools are available from your dealer.

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SPECIAL TORQUE SPECIFICATIONS				
FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	12	Nut	610	450
1	17	Bolt	74	55
1	30	Locknut	23	17
-	-	Shock Absorber Locking Nut	68 - 74	50 - 55
-	-	Wheel Nuts	590	435

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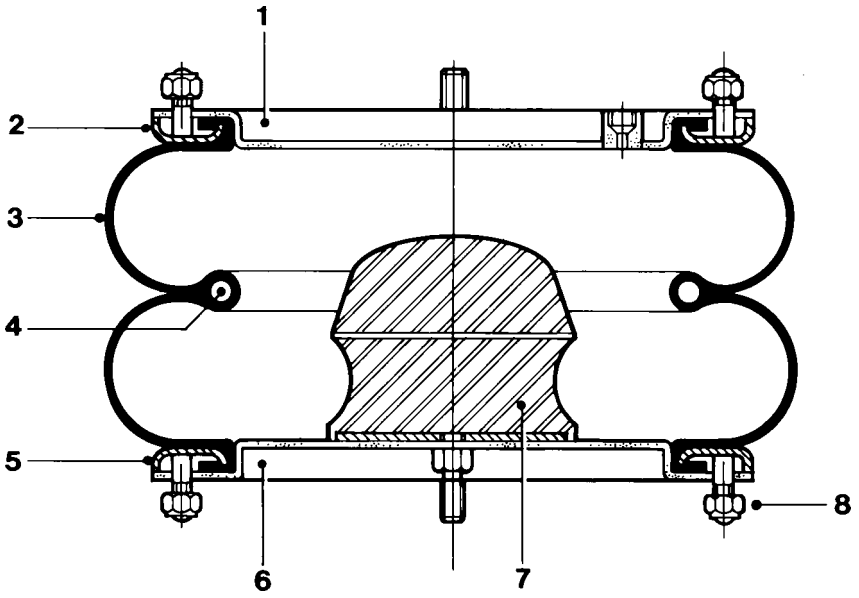
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1 - Top Clamp Plate
2 - Top Clamp Ring
3 - Bellows
4 - Centre Ring
5 - Bottom Clamp Ring
6 - Bottom Clamp Plate
7 - Bump Stop
8 - Nut

Fig. 1 - Sectional View of Air Spring

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The air springs are hermetically sealed assemblies which have flexible walls, no reciprocating parts and no sliding seals. The air springs are virtually frictionless in operation and maintenance free. Each spring consists of a top clamp plate (1), top clamp ring (2), bellows (3), centre ring (4), bottom clamp ring (5), bottom clamp plate (6) and bump stop (7).

The air springs are installed between the suspension frame and front frame cross member. The spring ride height is controlled by a levelling valve mounted to the frame cross member. Refer to Section 180-0022, LEVELLING VALVE for information and adjustment.

A rubber bump stop (7) is attached to bottom clamp plate (6). In the event of an air loss in the suspension system it is capable of supporting a fully loaded unit.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel chocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Drive machine onto a level, solid concrete floor, apply the parking brake and switch off the engine.

2. Chock the appropriate road wheels.

3. Using suitable lifting equipment, raise the frame until the suspension has reached its maximum rebound travel. Support the frame on workshop stands.

4. Open the primary tank drain valve and allow all of the air to drain out.

5. Disconnect and remove the connecting rod from the levelling valve control lever and lower mounting bracket. Store connecting rod in a safe place to prevent damaging it.

6. Move the levelling valve control lever approximately 30° below the neutral or horizontal position. Hold the lever in this position until all the air has been exhausted from the air springs.

7. Disconnect the air line to the air spring at the top clamp plate.

8. Remove mounting nuts (8) which attach the top and bottom clamp plates to the suspension frame and front frame cross member.

9. Remove the complete air spring assembly from the vehicle.

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Suspension System - Air Spring

Section 180-0021

DISASSEMBLY

Numbers in parentheses refer to Fig. 2.

1. Remove top and bottom clamp plates (4 & 3) and clamp rings (2) from bellows (1).

2. Remove centre ring (5) from bellows (1) convolutions.

3. If necessary, remove nut (7) and bump stop (6) from bottom clamp plate (3). A sealing compound is applied to bump stop mounting face at assembly, it is necessary to break the seal to remove bump stop.

INSPECTION

Numbers in parentheses refer to Fig. 2.

1. Clean clamp rings (2), bottom clamp plate (3), top clamp plate (4) and centre ring (5) in solvent to remove all contamination. Thoroughly dry all parts.

2. Inspect all parts for damage and excessive corrosion. Replace all worn or damaged parts.

ASSEMBLY

Numbers in parentheses refer to Fig. 2.

1. If bump stop (6) was removed from bottom clamp plate (3), coat the bump stop mounting face with sealing compound, such as 'Heldite' or equivalent. Bolt the bump stop to the lower clamp plate with nut (7). Torque tighten nut (7) to 23 Nm (17 lbf ft).

2. Install centre ring (5) on bellows (1).

3. Lightly coat the top and bottom beads of the bellows (1) with silicon or soapy water to aid in assembly of clamp rings (2) and clamp plates (3 & 4).

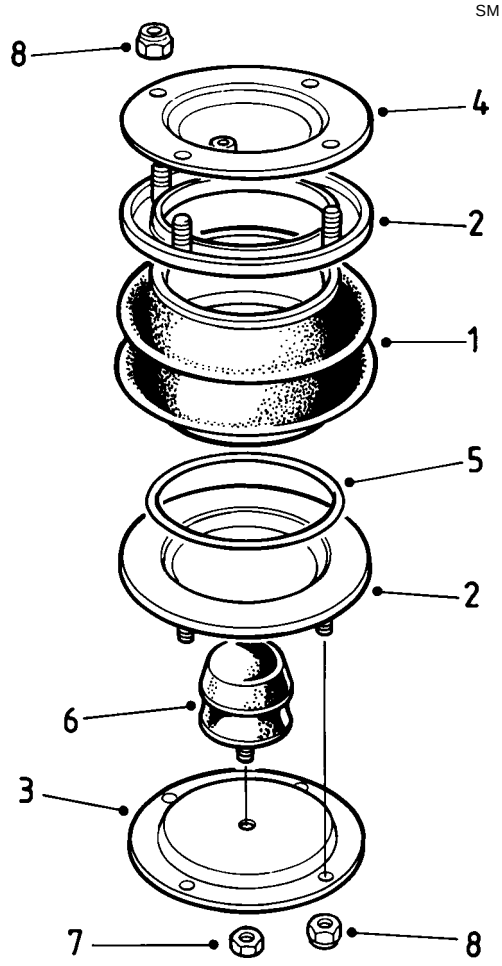
4. Install clamp rings (2) and bottom and top clamp plates (3 & 4) on bellows (1).

INSTALLATION

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel chocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

SM - 1068



1 - Bellows
2 - Clamp Ring
3 - Bottom Clamp Plate
4 - Top Clamp Plate
5 - Centre Ring
6 - Bump Stop
7 - Nut
8 - Nut

Fig. 2 - Exploded View of Air Spring

1. Install air spring assembly between the frame cross member and suspension frame. Torque tighten nuts (8) to 23 Nm (17 lbf ft). Do not overtighten.

2. Connect the air line to the air spring assembly.

3. Raise frame, remove workshop stands and lower frame.

4. Install levelling valve control lever on mounting bracket.

5. Close primary air tank drain cock and start engine to charge air system to system pressure. Check connections for air leaks.

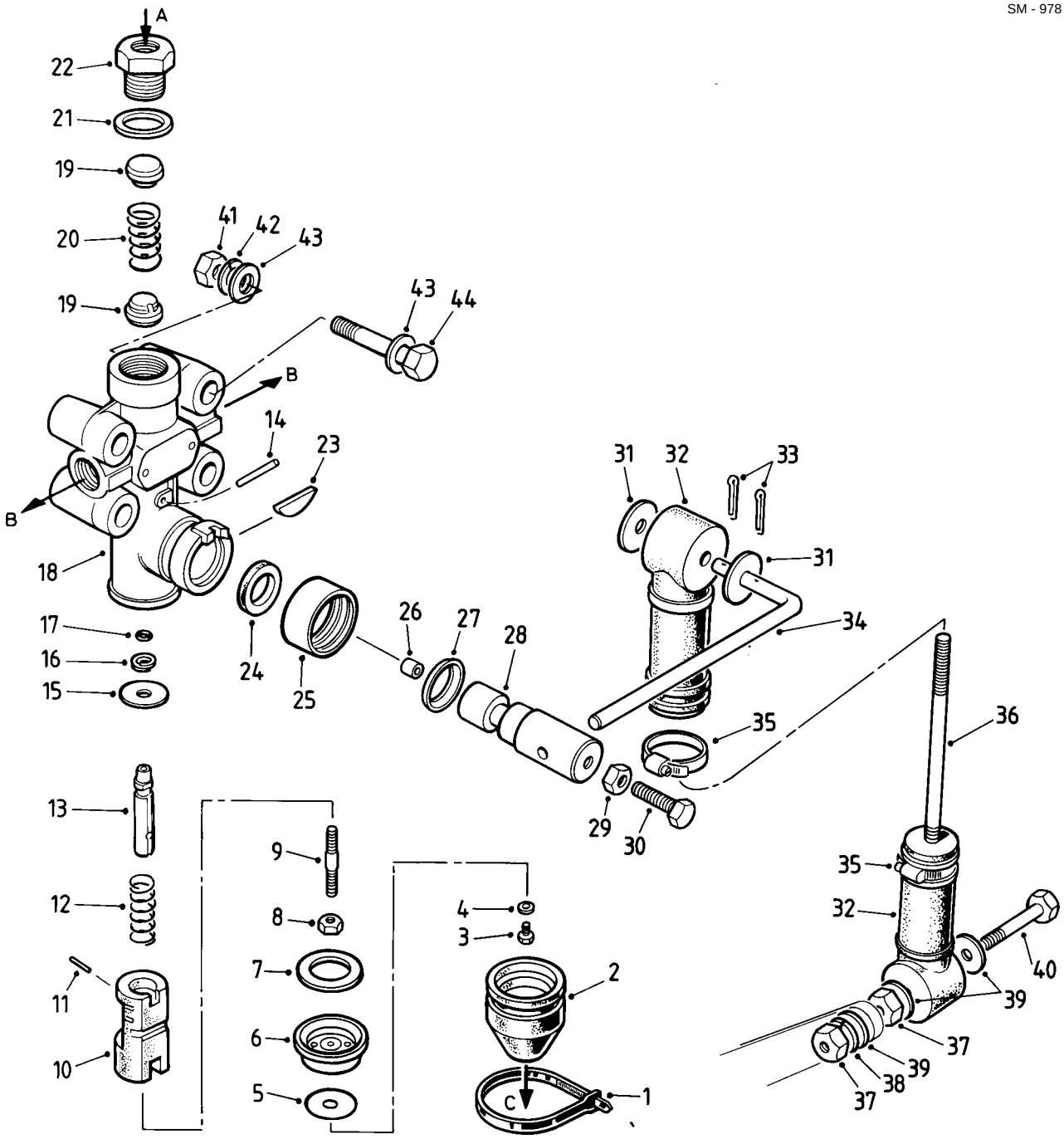
6. Refer to Section 180-0022, LEVELLING VALVE, for air spring ride height adjusting instructions.

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SM - 978



1 - Clamp Ring
2 - Protection Cap
3 - Screw
4 - Washer
5 - Diaphragm
6 - Supporting Ring
7 - Felt Ring
8 - Locknut
9 - Stud
10 - Piston
11 - Pin
12 - Compression Spring
13 - Piston Pin
14 - Grooved Pin
15 - Washer
16 - Spiral Back Ring
17 - 'O' Ring
18 - Housing
19 - Valve Head
20 - Compression Spring
21 - Sealing Ring
22 - Reducing Nipple
23 - Key
24 - Sealing Ring
25 - Reducer
26 - Roll
27 - Washer
28 - Driver
29 - Nut
30 - Bolt
31 - Washer
32 - Joint
33 - Split Pin
34 - Control Lever
35 - Clamp
36 - Connecting Rod
37 - Nut
38 - Lockwasher
39 - Washer
40 - Bolt
41 - Nut
42 - Lockwasher
43 - Washer
44 - Bolt

Fig. 1 - Exploded View of Levelling Valve

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Suspension System - Levelling Valve

Section 180-0022

DESCRIPTION

The levelling valve is an air operated valve mounted to a chassis crossmember and attached to the front suspension frame. Refer to Section 180-0020, FRONT SUSPENSION.

There are four ports on the valve as follows:

Port 'A' - Inlet from primary air tank
Ports 'B' - Supply ports to air springs
Port 'C' - Exhaust port

OPERATION

Numbers in parentheses refer to Fig. 1.

The purpose of the levelling valve is to control the air flow to and from the air springs to maintain a constant air spring stiffness under all load conditions. The valve control lever (34) is mechanically linked to the suspension frame by connecting rod (36).

The unloaded height is set by adjusting the length of connecting rod (36). Air passing through the levelling valve either deflates the air springs until control lever (34) assumes a horizontal (neutral) position. In the horizontal (neutral) position there is no air flow between the valve and the air springs.

Increasing or decreasing loads alter the height between the chassis and front suspension frame. This change is sensed by the levelling valve.

A load increase is sensed by connecting rod (36) which moves control lever (34) up. This upward movement permits air to flow from the primary air tank, through valve housing (18), to the air springs causing the springs to inflate until control lever (34) reaches its horizontal (neutral) position. There is no air flow through valve housing (18) in this position.

A load decrease causes connecting rod (36) to move control lever (34) downwards. This exhausts air from the air springs causing them to deflate until control lever (34) reaches its horizontal (neutral) position. There is no air flow through valve housing (18) in this position.

ADJUSTMENT

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage be sure wheel chocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

Checking and Adjusting Ride Height

The height of the air springs determines the ride height. This is initially set at 175 mm (7 in) and is measured directly at the air springs, as shown in Fig. 2. The ride height is adjusted by varying the length of connecting rod (36) between the levelling valve and the front suspension frame.

1. Position the unloaded machine on level ground, apply the parking brake and switch off the engine. Block all road wheels securely and drain the air from the primary air tank.

2. Using suitable lifting equipment, raise the front chassis until the front wheels are just clear of the ground. Block the chassis in this position.

3. Jack up front suspension frame until a measurement of 175 mm (7 in) is obtained at the air springs. Refer to Fig. 2. Control lever (34) should now be in the horizontal (neutral) position.

SM - 031

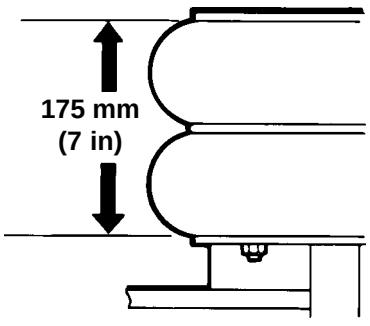


Fig. 2 - Measuring Ride Height

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4. If control lever (34) is not in the horizontal (neutral) position, disconnect connecting rod (36) and allow control lever (34) to return to the horizontal position. Alter length of connecting rod (36) until rod length is set to enable it to be fitted to control lever (34) in the horizontal position. Secure connecting rod (36) in this position to maintain set length.

MAINTENANCE

The air suspension levelling valve does not require any particular maintenance. It is recommended however that a visual inspection of the control lever, connecting rod and joints should be made at regular intervals. In the event of a continuous air loss from exhaust port 'C', it is recommended that the levelling valve should be replaced as an assembly.

* * * *

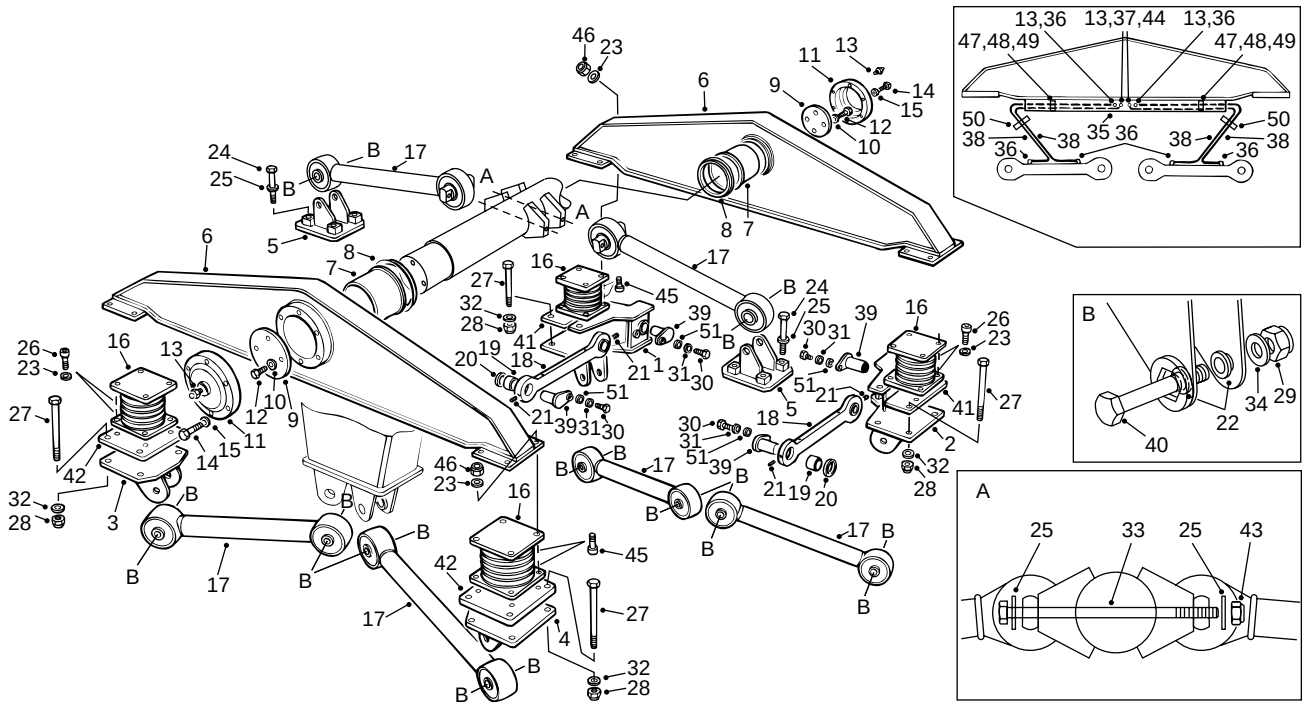
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1 - Bracket Assembly
2 - Bracket Assembly
3 - Bracket Assembly
4 - Bracket Assembly
5 - Bracket Assembly
6 - Equaliser Beam
7 - Bushing
8 - 'V' Seal
9 - Retainer
10 - Lockwasher
11 - End Cap
12 - Bolt
13 - Lube Fitting
14 - Bolt
15 - Lockwasher
16 - Interleaf Mount
17 - Control Link
18 - Panhard Rod
19 - Spherical Bearing
20 - Lockring
21 - Plug
22 - Suspension Bush
23 - Lockwasher
24 - Bolt
25 - Hardened Washer
26 - Socket Screw
27 - Bolt
28 - Locknut
29 - Locknut
30 - Bolt
31 - Lockwasher
32 - Hardened Washer
33 - Bolt
34 - Hardened Washer
35 - Manifold
36 - Elbow
37 - Nipple
38 - Hose Assembly
39 - Pin Assembly
40 - Bolt
41 - Plate
42 - Adaptor Plate
43 - Locknut
44 - Elbow
45 - Bolt
46 - Locknut
47 - Clip
48 - Washer
49 - Bolt
50 - Clip
51 - Washer

Fig. 1 - Exploded View of Rear Suspension

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

Each axle is coupled to the chassis by three rubber bushed control links (17) which provide longitudinal location and control torque reactions. Lateral location is by means of two panhard rods (18) fitted with spherical bearings (19). The centre and rear axles are linked by longitudinal equaliser beams (6) which pivot on either side of the chassis.

Loads acting on the axles are balanced by equaliser beams (6), with bonded rubber/metal laminated interleaf mounts (16) between the axles and beam ends providing the cushioning medium.

Lubrication of bushings (7) in equaliser beams (6) and spherical bearings (19) in panhard rods (18) is through lube fittings (13). Control links (17) are rubber bushed and do not require any lubrication.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

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Suspension System - Rear Suspension

Section 180-0040

1. Position the vehicle in a level work area, raise the body and install the body safety prop to secure the body in the partially raised position.

2. Apply the parking brake and switch off the engine.

3. Block the front road wheels, place the steering lock bar and oscillation lock pin in the 'Locked' position and the battery master switch in the 'Off' position.

4. Using suitable blocking equipment, block equaliser beams (6) to prevent movement when raising the trailer frame.

5. Whilst the rear road wheels are still on the ground, loosen the wheel nuts.

6. Using suitable lifting equipment, raise the trailer frame until the rear wheels are off the ground. Support the vehicle with suitable stands and blocking equipment at the trailer frame, articulation pivot area and centre and rear axles.

7. Support one tyre and rim assembly with suitable lifting equipment and remove wheel nuts and lockwashers securing the rim to the axle. Remove tyre and rim assembly.

8. Repeat step 7 for the remaining rear tyre and rim assemblies.

9. With a suitable container in position, disconnect hydraulic brake lines from the tee piece between the centre and rear axle assemblies. Cap lines and fittings to prevent entry of dirt. Remove clips securing brake lines to centre control rods (17).

10. Remove mounting hardware connecting brake line guards to axle brackets and remove brake line guards.

11. Disconnect hose assemblies (38) from elbows (36) in panhard rods (18) and plate on RH equaliser beam (6). Remove bolts (49), washers (48), clips (47 & 50) and hose assemblies (38) from the vehicle.

12. Remove blocking materials from equaliser beams (6). Remove locknuts (46), lockwashers (23) and bolts (45) securing interleaf mounts (16) to equaliser beams (6).

13. Remove socket screws (26) and lockwashers (23) securing interleaf mounts (16) to bracket assemblies (1 & 2), plates (41) and adaptor plates (42). Remove interleaf mounts (16).

14. Remove bolts (14) and lockwashers (15) securing end cap (11) to equaliser beam (6). Remove end cap (11).

15. Remove bolts (12) and lockwashers (10) securing retainer (9) to spindle on the frame. Remove retainer (9).

16. Using suitable lifting equipment, support equaliser beam (6) and withdraw from spindle on the frame.

17. Remove and discard 'V' seal (8) from bushing (7). If required, remove bushing (7) from spindle on the frame.

18. Repeat steps 13 through 16 to remove the opposite equaliser beam (6).

19. Remove locknuts (43), hardened washers (25) and bolts (33) securing centre control links (17) to cross shaft mounting brackets.

20. Remove locknuts (29), hardened washers (34) and bolts (40) securing centre control links (17) to bracket assemblies (5). Remove centre control links (17).

21. Remove locknuts (29), hardened washers (34) and bolts (40) securing control link (17) to bracket assembly (4) on the rear axle and the LH frame mounting bracket. Remove control link (17).

22. Remove locknuts (29), hardened washers (34) and bolts (40) securing control link (17) to bracket assembly (3) on the centre axle and the LH frame mounting bracket. Remove control link (17).

23. Remove locknuts (29), hardened washers (34) and bolts (40) securing control link (17) to bracket assembly (2) on the rear axle and the RH frame mounting bracket. Remove control link (17).

24. Remove locknuts (29), hardened washers (34) and bolts (40) securing control link (17) to bracket assembly (1) on the centre axle and the RH frame mounting bracket. Remove control link (17).

25. Remove bolts (30), lockwashers (31) and washers (51) securing pin assemblies (39) to bracket assemblies (1 & 2) and frame mounting brackets. Remove pin assemblies (39) and panhard rods (18) from bracket assemblies (1 & 2) and frame mounting brackets.

26. Remove bolts (24) and lockwashers (25) securing bracket assemblies (5) to the centre and rear axles. Remove bracket assemblies (5).

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27. Remove locknuts (28), hardened washers (32), bolts (27), bracket assemblies (2 & 4), plate (41) and adaptor plate (42) from the rear axle.

28. Remove locknuts (28), hardened washers (32), bolts (27), bracket assemblies (1 & 3), plate (41) and adaptor plate (42) from the centre axle.

29. If either axle assembly requires to be removed from under the vehicle; raise axle assembly with suitable lifting equipment, remove blocking from under the axle assembly and lower axle assembly onto a suitable trolley. Slide the axle assembly from under the vehicle to a suitable work area.

INSTALLATION

Numbers in parentheses refer to Figs. 1, 2 & 3.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Ensure centre and rear axle assemblies are correctly positioned and securely blocked below the frame.

2. Install bracket assembly (1) on RH side of the centre axle and secure with plate (41), bolts (27), hardened washers (32) and locknuts (28). Tighten bolts (27) to a torque of 610 Nm (450 lbf ft).

3. Install bracket assembly (3) to bottom LH side of the centre axle and secure with adaptor plate (42), bolts (27), hardened washers (32) and locknuts (28). Tighten bolts (27) to a torque of 610 Nm (450 lbf ft).

4. Install bracket assembly (2) on RH side of the rear axle and secure with plate (41), bolts (27), hardened washers (32) and locknuts (28). Tighten bolts (27) to a torque of 610 Nm (450 lbf ft).

5. Install bracket assembly (4) to bottom LH side of the rear axle and secure with adaptor plate (42), bolts (27), hardened washers (32) and locknuts (28). Tighten bolts (27) to a torque of 610 Nm (450 lbf ft).

6. Apply Loctite 243 to socket screws (26) and secure interleaf mounts (16) to bracket assemblies (1 & 2), plates (41) and adaptor plates (42) with socket screws (26) and lockwashers (23). Tighten socket screws (26) to a torque of 165 Nm (122 lbf ft).

7. Apply Loctite 243 to bolts (24) and secure brackets (5) to the centre and rear axles with bolts (24) and hardened washers (25). Tighten bolts (24) to a torque of 325 Nm (240 lbf ft).

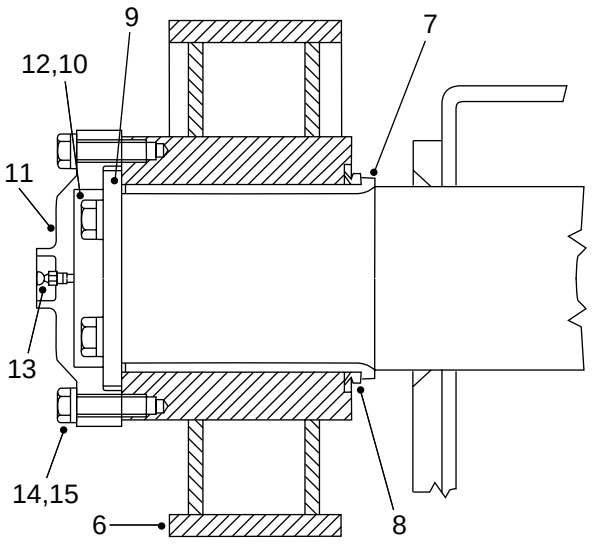
8. If bushings (7) were removed from spindle on the frame, thoroughly clean spindles with Loctite activator 'N' and allow to dry. Apply Loctite 638 retaining compound all over bushing (7) contact area of the spindles and install bushings (7) on the spindles.

Note: A curing time of fifteen minutes is required for acceptable handling strength.

9. Install new 'V' seals (8) over bushings (7) with the lip to the outside, as shown in Fig. 2.

10. Clean bores on equalising beams (6) and, using suitable lifting equipment, install beams onto bushings (7). Apply Loctite 243 to bolts (12) and secure retainers (9) to spindles with bolts (12) and lockwashers (10). Tighten bolts (12) to a torque of 150 Nm (110 lbf ft).

11. Apply Loctite 243 to bolts (14) and Loctite 574 gasket eliminator to mounting face of end caps (1). Secure end caps (1) to equalising beams (6) with bolts (14) and lockwashers (15). Tighten bolts (14) to a torque of 75 Nm (55 lbf ft).



6 - Equaliser Beam
7 - Bushing
8 - 'V' Seal
9 - Retainer
10 - Lockwasher
11 - End Cap
12 - Bolt
13 - Lube Fitting
14 - Bolt
15 - Lockwasher

Fig. 2 - Sectional View of Equaliser Beam Installation

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12. If removed, install lube fittings (13) in end caps (1). Lubricate with grease specified in Section 300-0020, LUBRICATION SYSTEM, until excess lube is seen.

13. Apply Loctite 243 to bolts (45) and secure interleaf mounts (16) to equaliser beams (6) with bolts (45), lockwashers (23) and locknuts (46). Tighten bolts (45) to a torque of 165 Nm (122 lbf ft).

14. Install suspension bushes (22) in bracket assemblies (1 to 5) and frame mounting brackets, as shown in Fig. 3.

15. Install centre control links (17) between bracket assemblies (5) and cross shaft mounting brackets and secure with bolts (33), hardened washers (25) and locknuts (52). Tighten bolts (33) to a torque of 556 Nm (410 lbf ft).

Note: Install bolts with bolt heads to the outside on RH and LH side control links (17).

16. Install control link (17) between bracket assembly (1) and RH frame mounting bracket and secure with bolts (40), hardened washers (34) and locknuts (43). Tighten bolts (40) to a torque of 1 085 Nm (800 lbf ft).

17. Install control link (17) between bracket assembly (3) and LH frame mounting bracket and secure with bolts (40), hardened washers (34) and locknuts (29). Tighten bolts (40) to a torque of 1 085 Nm (800 lbf ft).

18. Install control link (17) between bracket assembly (2) and RH frame mounting bracket and secure with bolts (40), hardened washers (34) and locknuts (29). Tighten bolts (40) to a torque of 1 085 Nm (800 lbf ft).

19. Install control link (17) between bracket assembly (4) and LH frame mounting bracket and secure with bolts (40), hardened washers (34) and locknuts (29). Tighten bolts (40) to a torque of 1 085 Nm (800 lbf ft).

20. Install panhard rod (18) between bracket assembly (1) and RH frame mounting bracket and install pin assemblies (39). Secure pin assemblies (39) to bracket assembly (1) and RH frame mounting bracket with bolts (30), lockwashers (31) and washers (51). Tighten bolts (30) to a torque of 75 Nm (55 lbf ft).

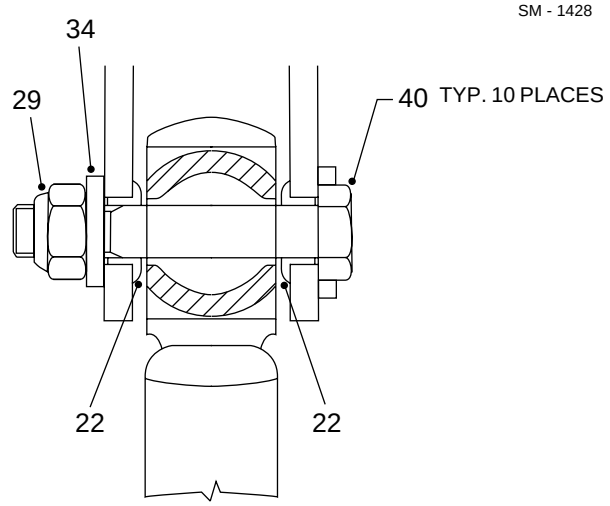


Fig. 3 - Sectional View of Typical Control Link Mounting

21. Install panhard rod (18) between bracket assembly (2) and RH frame mounting bracket and install pin assemblies (39). Secure pin assemblies (39) to bracket assembly (2) and RH frame mounting bracket with bolts (30), lockwashers (31) and washers (51). Tighten bolts (30) to a torque of 75 Nm (55 lbf ft).

22. Connect hose assemblies (38) to elbows (36) in panhard rods (18) and plate on RH equaliser beam (6) and secure hose assemblies (38) with bolts (49), washers (48) and clips (47 & 50).

23. If removed, install lube fittings (13) in plate on RH equaliser beam (6). Lubricate panhard rods (18) through lube fittings (13) with grease specified in Section 300-0020, LUBRICATION SYSTEM, until excess lube is seen.

24. Remove caps and connect hydraulic brake lines to the tee piece between the centre and rear axle assemblies. Clip brake lines to centre control rods (17) with clips removed during removal.

25. Connect brake line guards to axle brackets and secure with mounting hardware removed during removal.

26. Using suitable blocking equipment, block equaliser beams (6) to prevent movement when installing the rear tyre and rim assemblies.

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27. Using suitable lifting equipment, position one tyre and rim assembly on one rear wheel and secure with wheel nuts and lockwashers.

28. Repeat step 27 for remaining tyre and rim assemblies.

29. Using suitable lifting equipment, raise the trailer frame sufficiently to remove stands and blocking equipment from the centre and rear axles, articulation pivot area and trailer frame. Lower vehicle to the ground and remove the lifting equipment.

30. With the vehicle lowered to the ground, tighten all wheel nuts to a torque of 590 Nm (435 lbf ft).

31. Place the battery master switch in the 'On' position, start the engine and check hydraulic brake lines for leaks. Bleed all air from the hydraulic brake lines as described in Section 250-0020, HYDRAULIC BRAKING SYSTEM SCHEMATIC.

32. Remove wheel blocks from the front road wheels and place the steering lock bar and oscillation lock pin in the 'Stowed' position.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

Pre-Starting Inspection: Visually check condition and mounting of equaliser beams (6), interleaf mounts (16), control links (17) and panhard rods (18).

Every 50 Hours: Lubricate bushings (7) in equaliser beams (6) and spherical bearings (19) in panhard rods (18) through lube fittings (13), with grease specified in Section 300-0020, LUBRICATION SYSTEM, until excess lube is seen.

SERVICE TOOLS

There are no special tools required for the procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools and adhesives required during the removal and installation of the rear suspension. These tools and adhesives are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	12	Bolt	150	110
1	14	Bolt	75	55
1	24	Bolt	325	240
1	26	Socket Screw	165	122
1	27	Bolt	610	450
1	40	Bolt	1 085	800
1	30	Bolt	75	55
1	33	Bolt	556	410
1	45	Bolt	165	122
-	-	Wheel Nut	590	435

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COMPONENT DESIGNATIONS

A4 - Radio/Cassette
A5 - Radio/Cassette Speaker

B2 - Coolant Temp Sender
B8 - Fuel Level Sender
B9 - Air Pressure Sender
B13 - Rotational Speed Sensor
B21 - Trans Oil Temp Sender
B22 - Engine Oil Press Sender
B31 - Engine Load Sender
B32 - Trans Oil Ret Temp Sender
B33 - Air Cond Temp Sender

E3 - Interior Light
E5 - Reverse Light
E7 - Instrument Panel Lights
E11 - Side Marker Light, L
E12 - Taillight, L
E13 - Side Marker Light, R
E14 - Taillight, R
E15 - High/Low Beam H'lamp, L
E16 - High/Low Beam H'lamp, R
E19 - Rear Fog Lamp
E21 - Rotating Beacon
E23 - Work Light
E26 - High Beam H'lamp, L
E27 - High Beam H'lamp, R
E34 - Flashing Reverse Light
E35 - Heated Mirror

G1 - Generator
G2 - Battery

H2 - Warning Light
H5 - Direction Indicator w/l
H6 - Direction Indicator; F, L
H7 - Direction Indicator; B, L
H8 - Direction Indicator; F, R
H9 - Direction Indicator; B, R
H10 - Brake Light, L
H11 - Brake Light, R
H12 - High Beam w/l
H27 - Trans Stop w/l

K1 - Starter Relay
K4 - Dir Ind Flasher Unit
K5 - Air Cond Compress Clutch
K5 - Air Cond Compress Relay
K14 - Start Interlock Relay
K15 - Headlamp Relay
K17 - Reverse Relay
K21 - Trans Shift Clutch
K22 - Lockup Clutch
K23 - Ignition Relay
K34 - Horn Relay
K35 - Body up Relay
K36 - Body Float Relay
K37 - Body Hyd System Relay 12V
K43 - Radio/Cassette Relay

L3 - Reverse Alarm
L4 - Buzzer
L5 - Electric Horn

M1 - Starter Motor
M3 - Cab Vent Blower Motor
M4 - Washer Motor, F
M5 - Wiper Motor, F
M6 - Wiper Motor, B
M7 - Washer Motor, B
M10 - Cab Fan Motor
M13 - Air Seat Compressor

N3 - Voltage Convertor 12V
N4 - Frequency Divider

P1 - Speedometer/Odometer
P2 - Tachometer/Hourmeter
P3 - Coolant Temp Gauge
P4 - Fuel Gauge
P5 - Engine Oil Press Gauge
P6 - Air Press Gauge
P15 - Retarder Temp Gauge

S1 - Battery Master Switch
S2 - Starter Keyswitch
S4 - W/L Test Switch
S5 - Engine Oil Press Switch
S8 - Blower Switch
S9 - Washer Switch, F
S10 - Wiper Switch, F
S11 - Rear Wash/Wipe Switch
S13 - Horn Button
S14 - Hazard w/l Switch
S15 - Direction Ind Switch
S16 - Stoplight Switch
S18 - Lights Switch
S19 - Dipswitch
S20 - Headlamp Flash Switch
S22 - Body Up Switch
S24 - Low Fuel Level Switch
S26 - Brake O'travel Limit Sw
S27 - Low Air Press w/l Switch
S29 - Retarder Request Switch
S31 - Park Brake w/l Switch
S37 - Axle Difflock Switch
S38 - Filter Diff w/l Press Switch
S39 - Filter Diff w/l Temp switch
S40 - Gear Shift Selector
S41 - Auxiliary Lights Switch
S43 - Air Cond Press Switch
S57 - Steering Press Switch
S60 - Difflock Request Switch
S71 - Air Cond Rheostat/Switch
S74 - Kickdown Switch
S77 - Trans Difflock Switch
S78 - Body joystick Emergency Supply Switch
S79 - Heated Mirror Switch

X1 - Handlamp Socket

Y1 - Fuel Solenoid
Y3 - Retarder Valve
Y7 - Difflock Valve
Y26 - Body Raise Solenoid
Y27 - Body Lower Solenoid
Y28 - Radiator Fan Thermostat Bypass Solenoid

TERMINAL DESIGNATIONS IN ACCORDANCE WITH DIN 72 552

L - LEFT, R - RIGHT, F - FRONT, B - BACK





Wire Colours

B - Black
N - Brown
U - Blue
R - Red
G - Green
L - Light Green
O - Orange
Y - Yellow
P - Purple
W - White
S - Slate
K - Pink

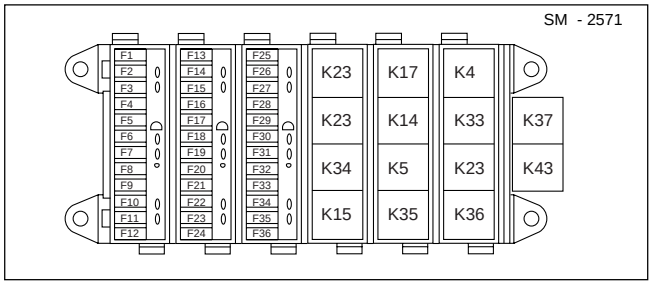
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Electrical System - Circuit Diagrams

Section 190-0000

FUSES			
Location	Fuse No.	Circuit	Current Rating
Fuse Box - Column A	1	Ignition Sensed Relay Contacts (Heater)	30A
	2	Keyswitch	15A
	3	Cab Fan Ventilator Blower	15A
	4	Rear Wash/Wipe	10A
	5	Horn Relay Coil, Front Wash/Wipe	10A
	6	Air Seat Compressor	10A
	7	Lights Supply	10A
	8	Main Beam	10A
	9	Wiper Park Front and Rear	7.5A
	10	Hazards	7.5A
	11	Transmission System Ignition Supply	7.5A
	12	Reverse System	7.5A
Fuse Box - Column B	13	Brake Lights	5A
	14	Interior Light, Handlamp	5A
	15	Direction Indicators/Rocker Switch Lights	5A
	16	Alarm Brake/Steering System	3A
	17	Warning Lights	3A
	18	Fuel Solenoid	3A
	19	Gauges/Ignition Sensed Relay Coils	3A
	20	Spare	-
	21	Neutral Start	3A
	22	Washers, Front	3A
	23	Washers, Rear	3A
	24	Horn	10A
Fuse Box - Column C	25	Ignition Sensed Relay Contacts (Air Conditioning)	30A
	26	Air Cond Compressor & Radiator Fan Solenoid	15A
	27	Spare	-
	28	Ignition Auxilary Supply Option	10A
	29	Rear Working Lights	15A
	30	Rotating Beacon	5A
	31	Cab Fan	3A
	32	Transmission System Battery Supply	7.5A
	33	Body Hydraulic System	5A
	34	Alternator Drive Signal	3A
	35	Heated Mirrors	15A
	36	Spare	-
Radio Harness	38	Radio/Cassette Supply (Glass Fuse)	7A
	39	Radio/Cassette Supply (Glass Fuse)	1A
Battery Box	43	Radio/Cassette Voltage Convertor Supply (Blade Fuse)	15A
	44	Alternator Charge Cable (Power Fuse)	100A
	45	Cab Busbar Supply Cable (Power Fuse)	100A



RELAYS	
K23 - Ign/Sense Opt.	K35 - Body Up
K23 - Ign/Sense	K4 - Flashers
K34 - Horn	K33 - Radiator Fan
K15 - Headlights	K23 - Engine Ignition
K17 - Rev. Alarm/Lts.	K36 - Body Float
K14 - Neutral/Start	K37 - Body Hyd (12V)
K5 - Air Conditioner	K43 - Radio/Cassette

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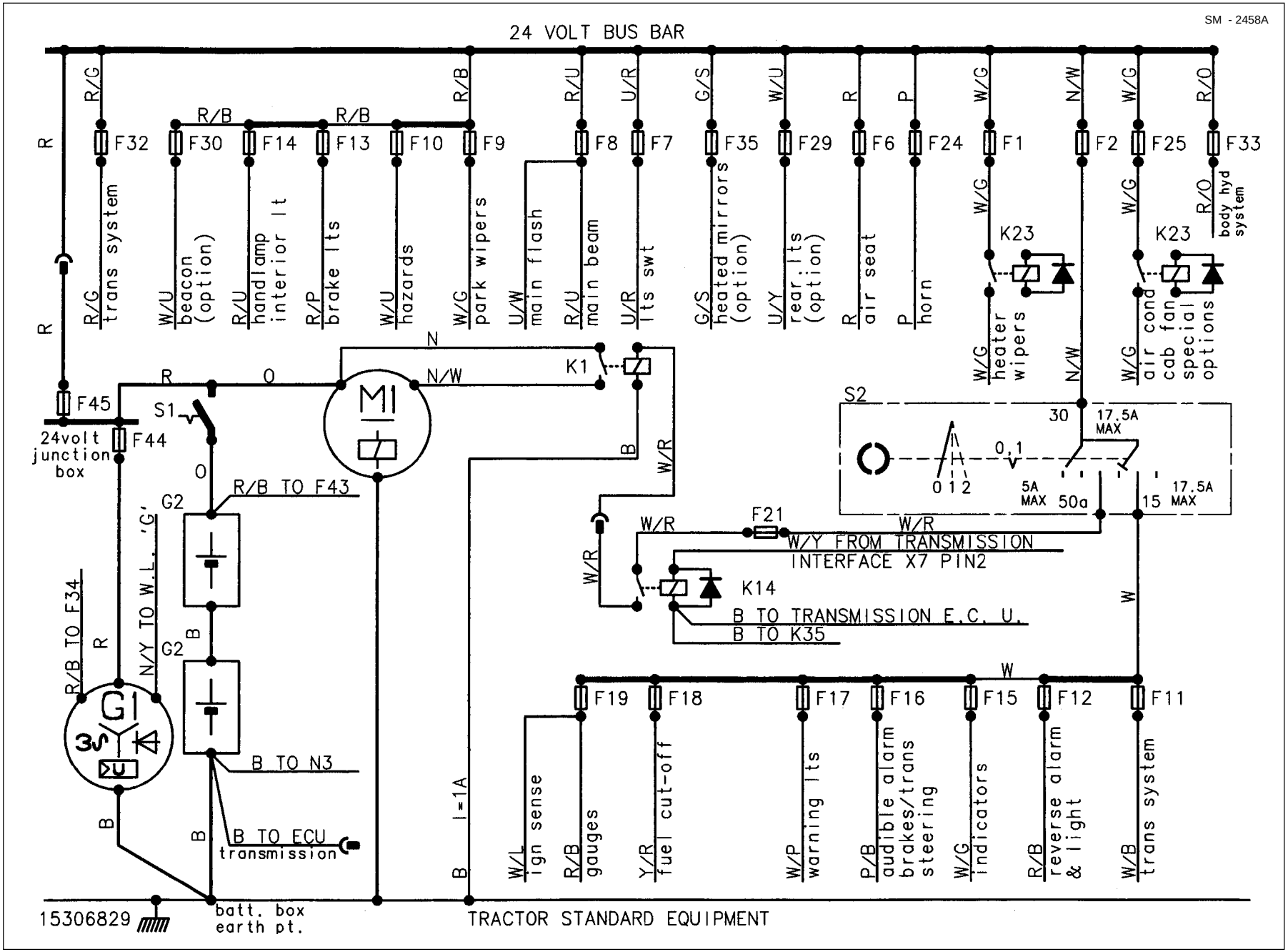
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ZF EST-37 ELECTRONIC MODULE HARNESS CABLE ROUTINGS

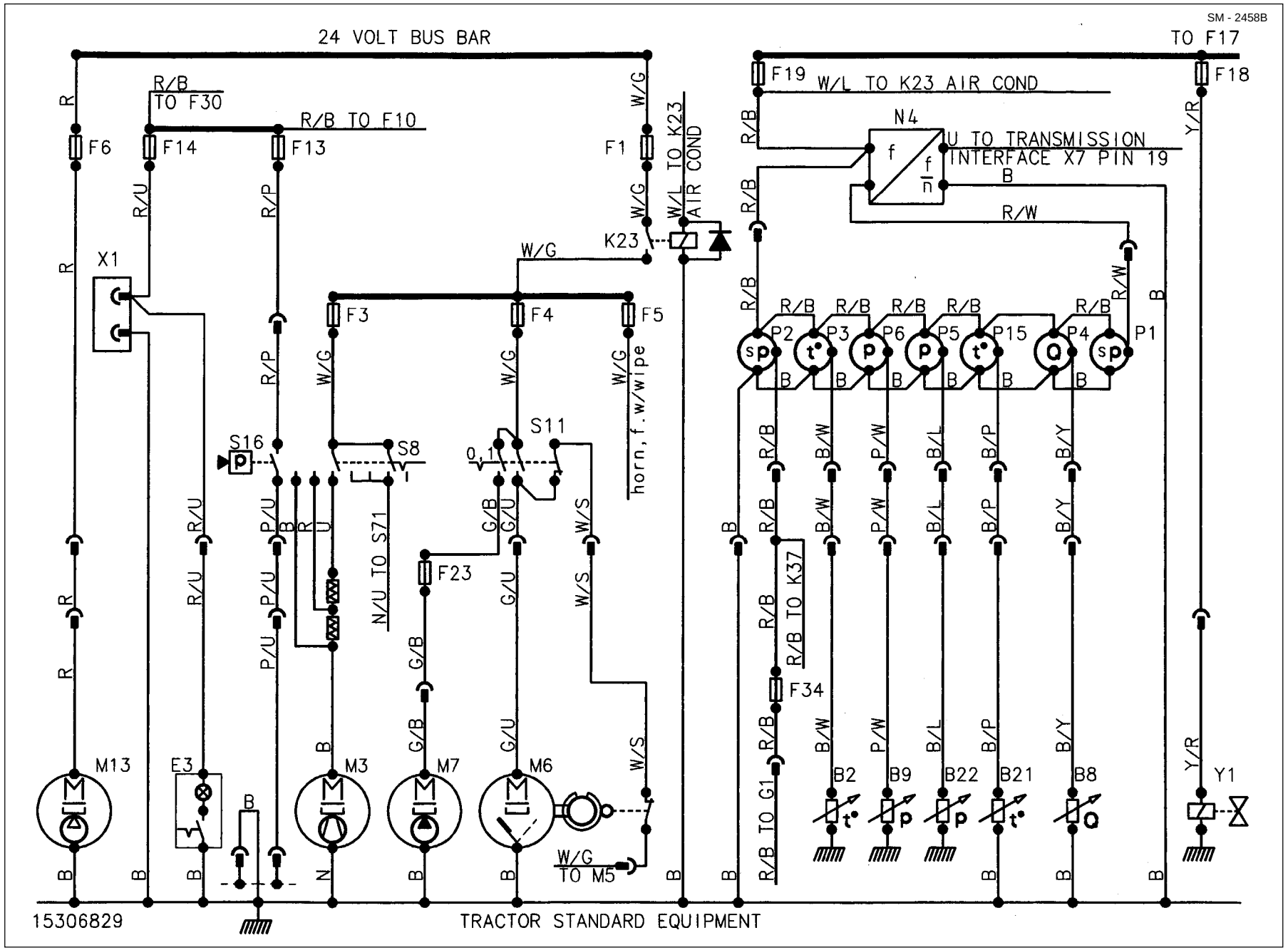
PLUG	PIN	WIRE	PLUG	PIN	PLUG	PIN	WIRE	PLUG	PIN
X 8	1	GE2	X 1	19	X25	1	630	X58	
X 8	2	BL2	X56		X25	2	634	X 1	15
X 8	3	SW3	X 1	41	X25	3	638	X51	
X 8	4	BL3	X56		X25	4	642	X 1	18
X 8	5	RT4	X 1	42	X 2	2	650	X58	
X 8	6	BL4	X56		X 2	4	654	X 1	43
X 8	7	430	X 1	10	X 2	5	658	X55	
X 8	8	434	X 1	56	X 2	6	662	X 1	64
X 8	9	438	X 1	32	X 2	7	666	X 1	63
X 8	10	442	X 1	55	X 2	8	670	X 1	65
X 8	11	446	X 1	9	X 2	10	674	X 1	29
X 8	12	450	X 1	51	X 7	1	800	X58	
X 8	13	454	X57		X 7	2	804	X55	
X 8	14	458	X 1	39	X 7	3	808	X 1	7
X 8	15	462	X59		X 7	6	820	X 1	21
X 8	17	484	X50		X 7	8	828	X 1	30
X 8	18	488	X50		X 7	9	832	X 1	23
X 8	19	492	X50		X 7	10	836	X 1	68
X 8	21	500	X 1	4	X 7	11	840	X 1	66
X 8	22	504	X 1	62	X 7	12	844	X 1	52
X 9	1	508	X58		X 7	14	852	X51	
X 9	2	510	X 1	24	X 7	15	856	X51	
X 9	3	514	X 1	37	X 7	16	860	X 1	22
X 9	4	518	X 1	38	X 7	19	872	X 1	36
X 9	7	530	X 1	34	X 7	20	876	X54	
X 9	8	534	X53		X 7	21	880	X54	
X 9	9	540	X 1	57	X 7	22	884	X54	
X 9	10	544	X53		X56		900	X 1	3
X 9	11	550	X 1	11	X57		904	X 1	12
X 9	12	554	X53		X57		908	X 1	13
X 9	15	570	X 1	49	X58		916	X 1	45
X 9	16	574	X59		X 1	1	920	X51	
X 9	17	580	X58		X 1	26	924	X52	
X 9	18	584	X 1	17	X 1	27	928	X52	
X 6	1	590	X58		X55		936	X 1	67
X 6	3	594	X51		X 1	8	948	X53	
X 6	2	598	X 1	14	X 1	2	952	X51	
X 4	1	610	X 1	25	X 1	53	980	X53	
X 4	2	614	X52		X59		984	X 1	46
X 4	4	622	X 1	28					

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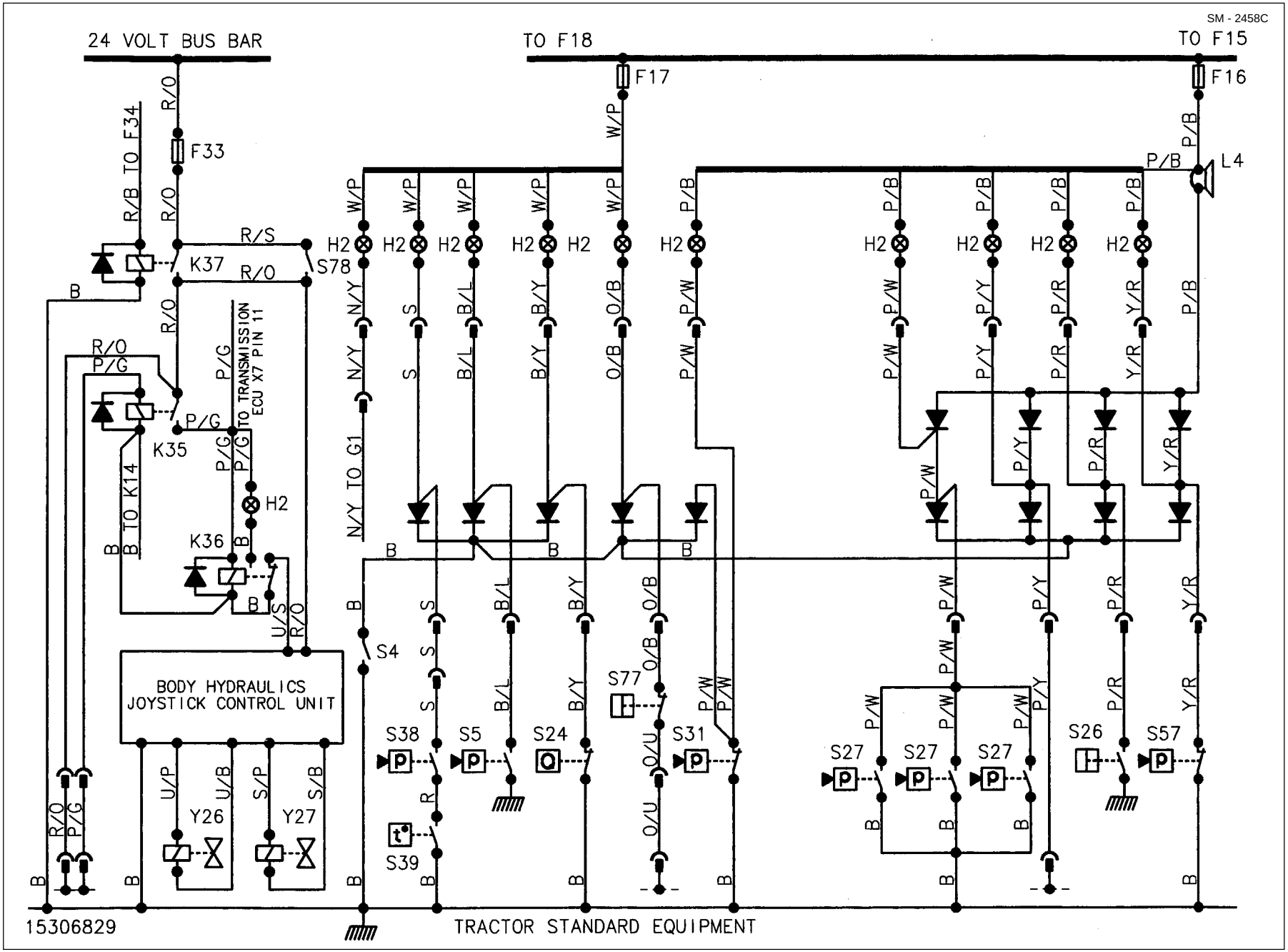


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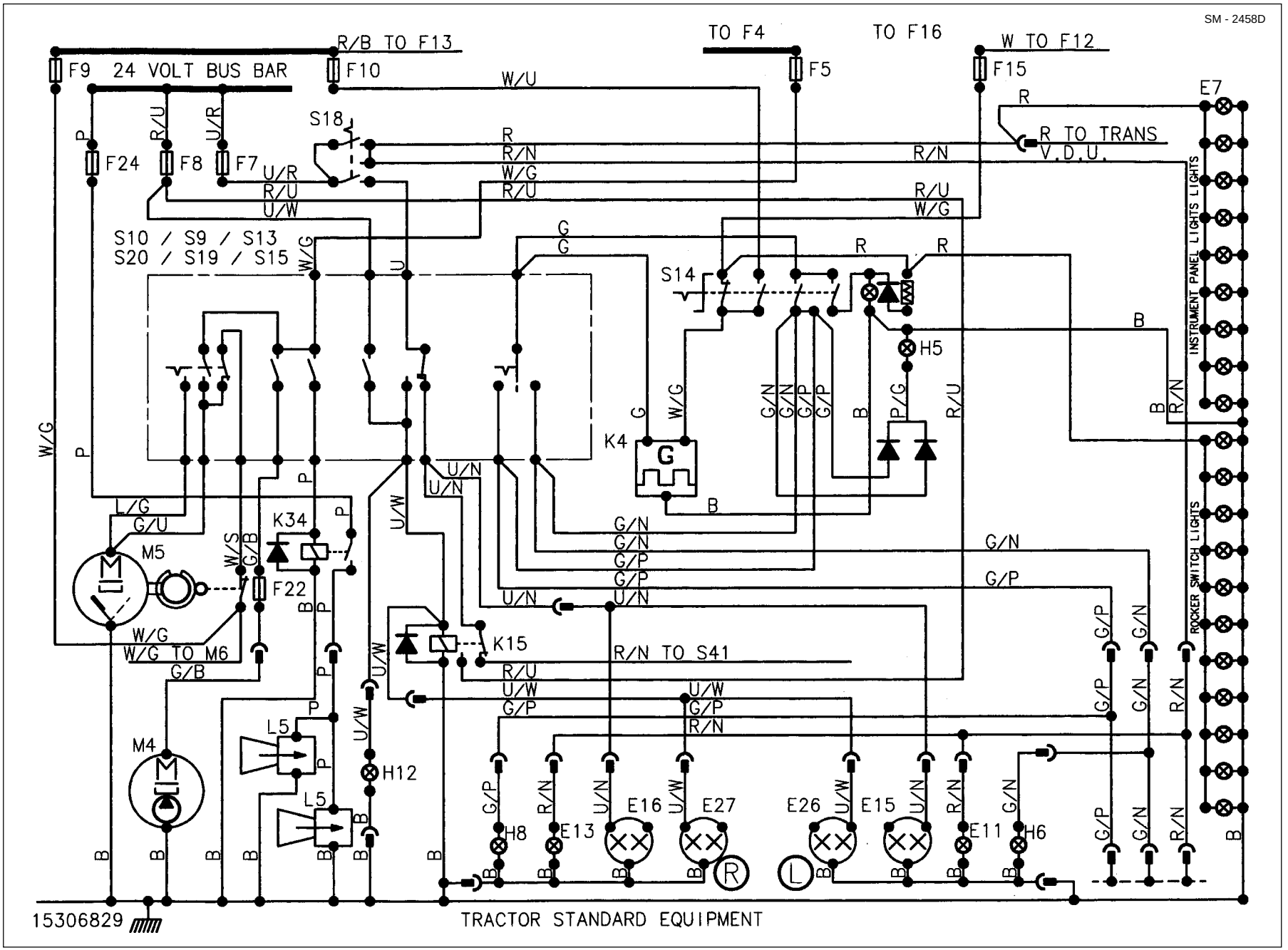
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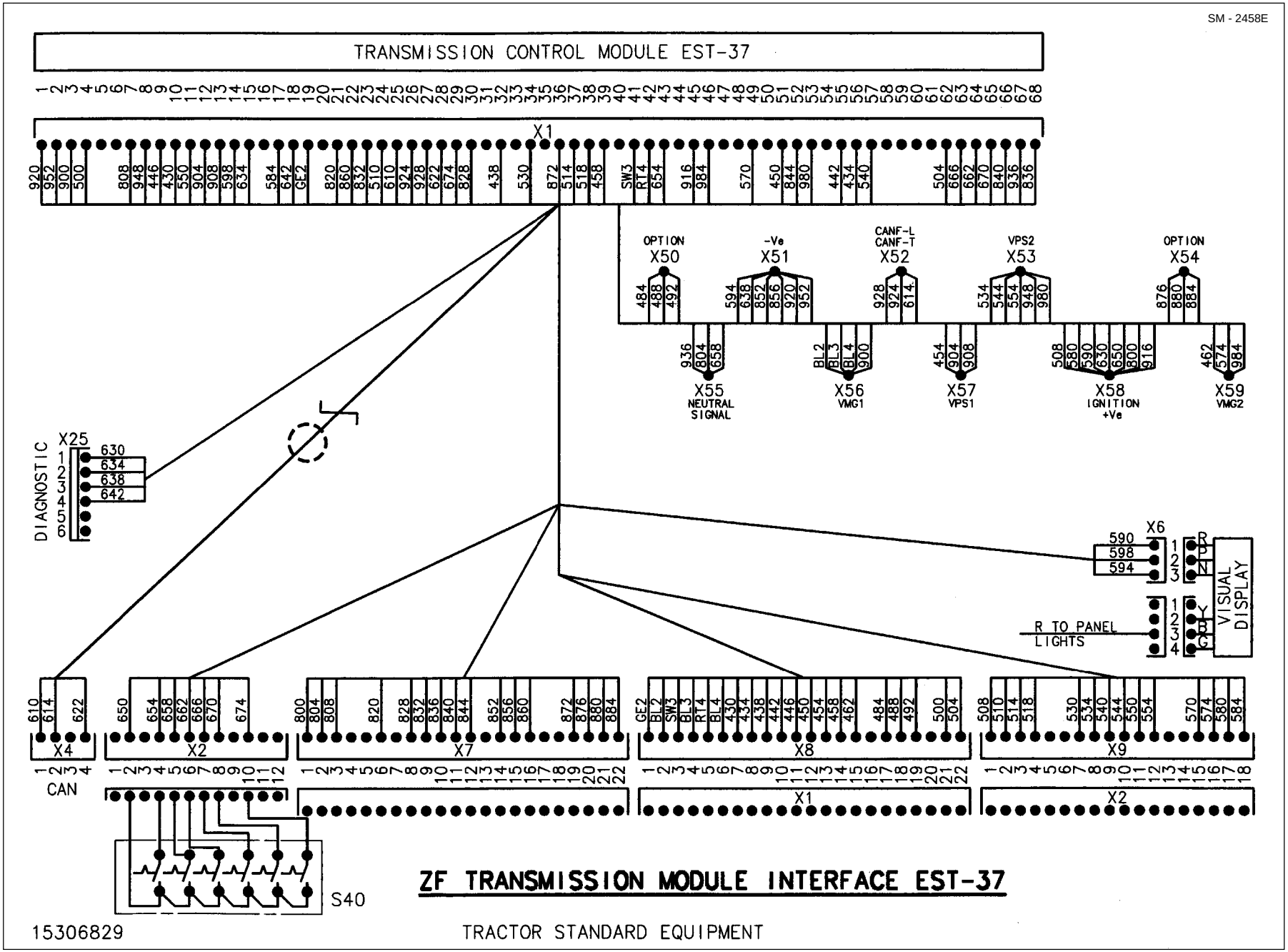
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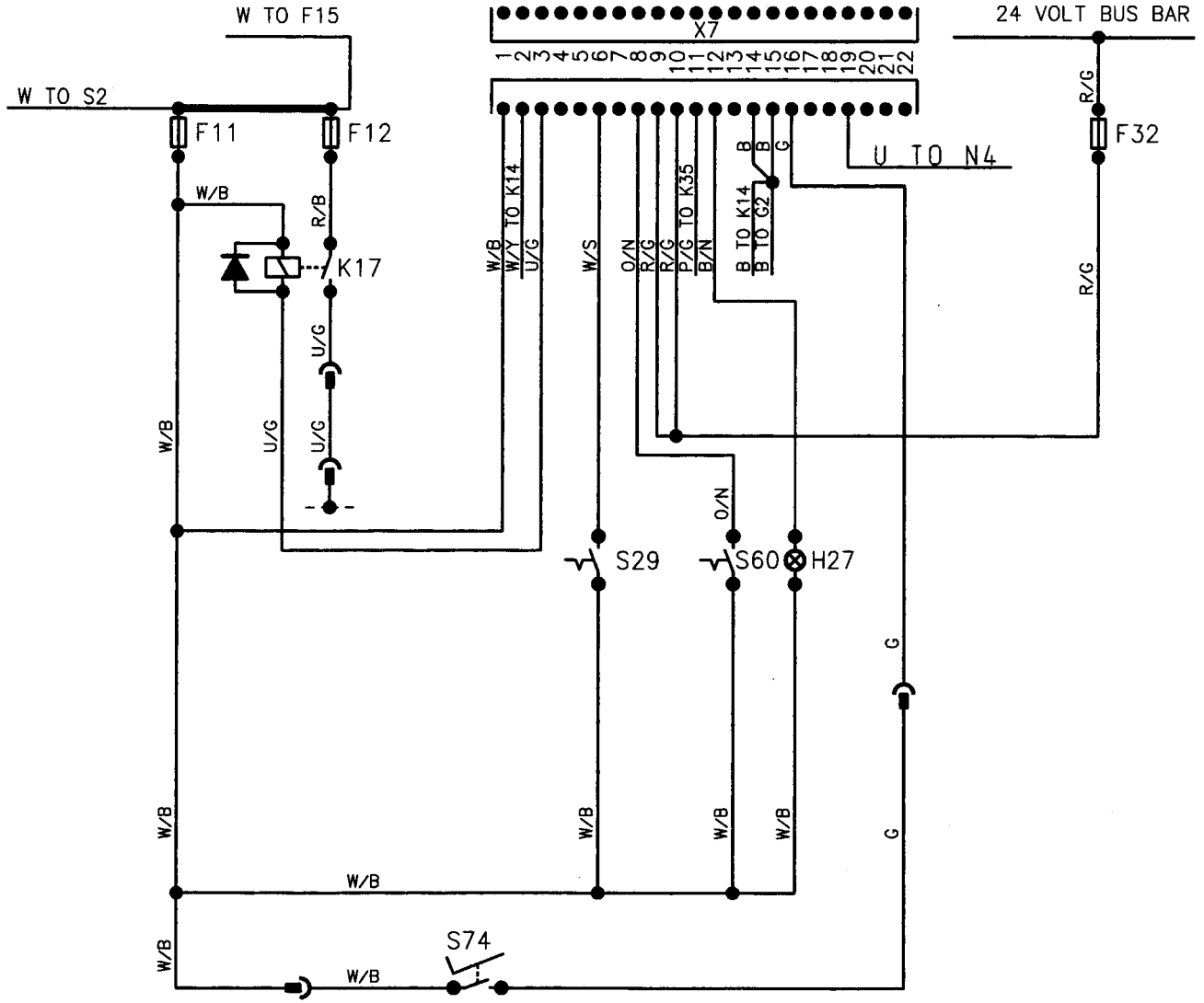
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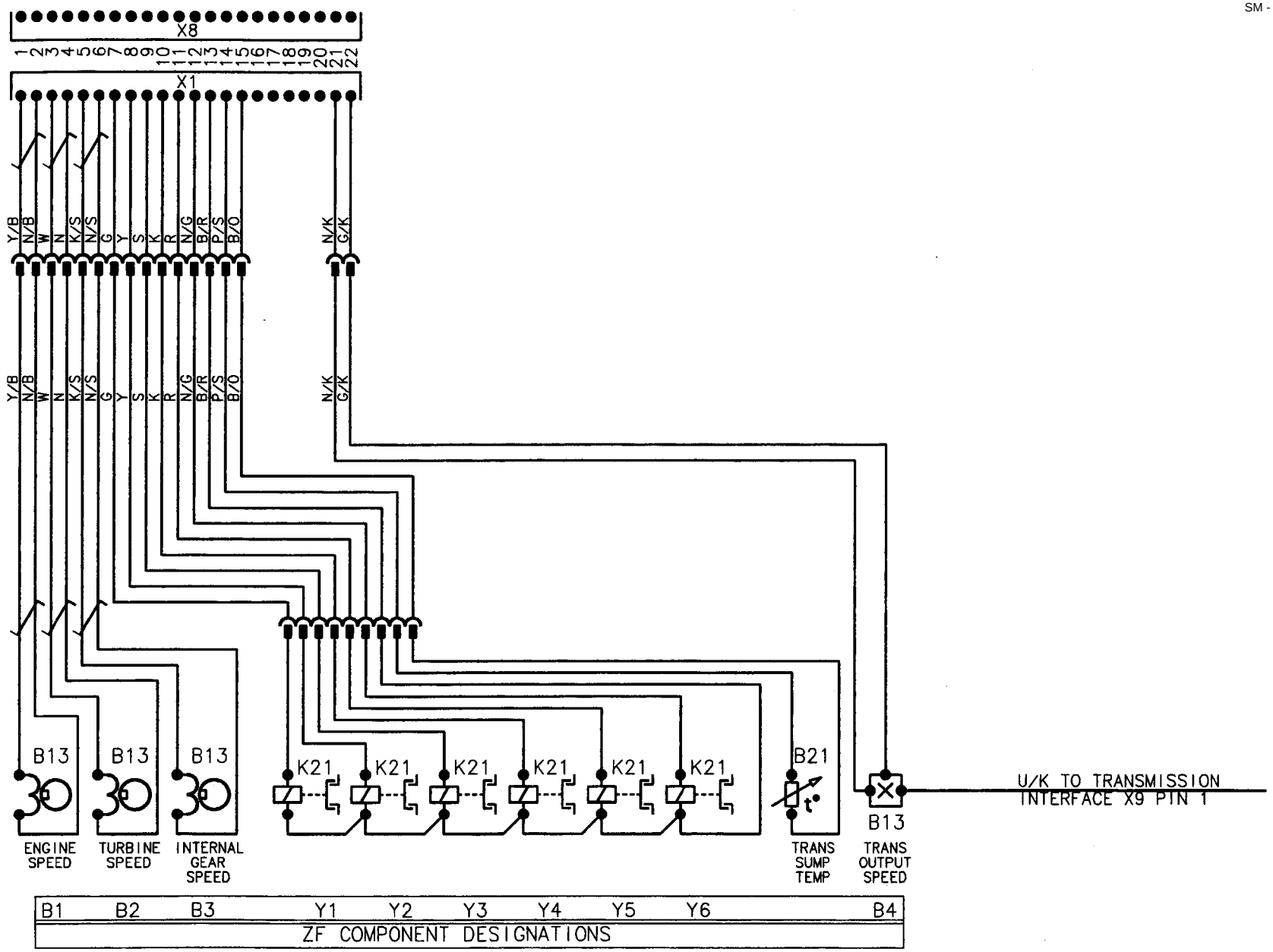
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ZF 6WG260 TRANSMISSION TEREX HARNESS INTERFACE EST-37

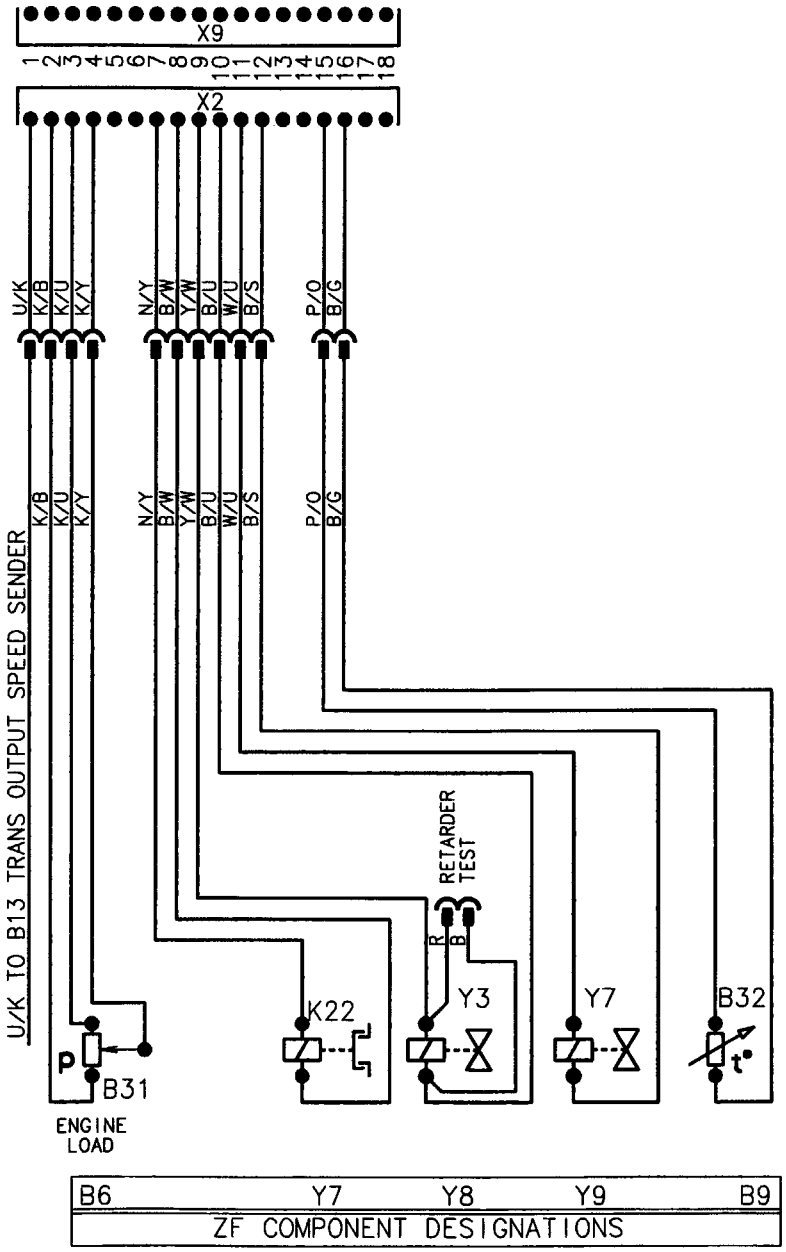
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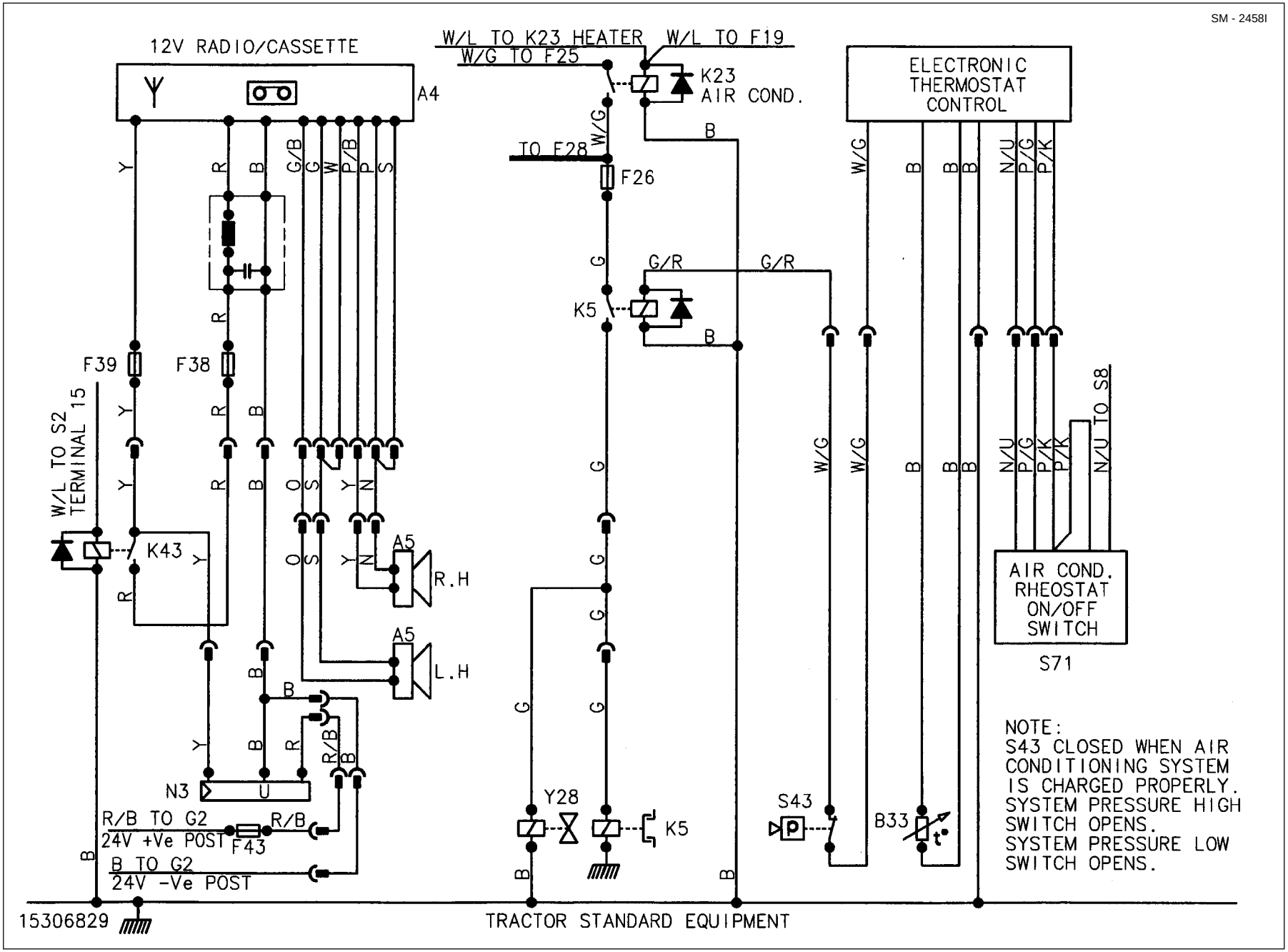
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15306829 ZF 6WG260 TRANSMISSION TEREX HARNESS INTERFACE EST-37

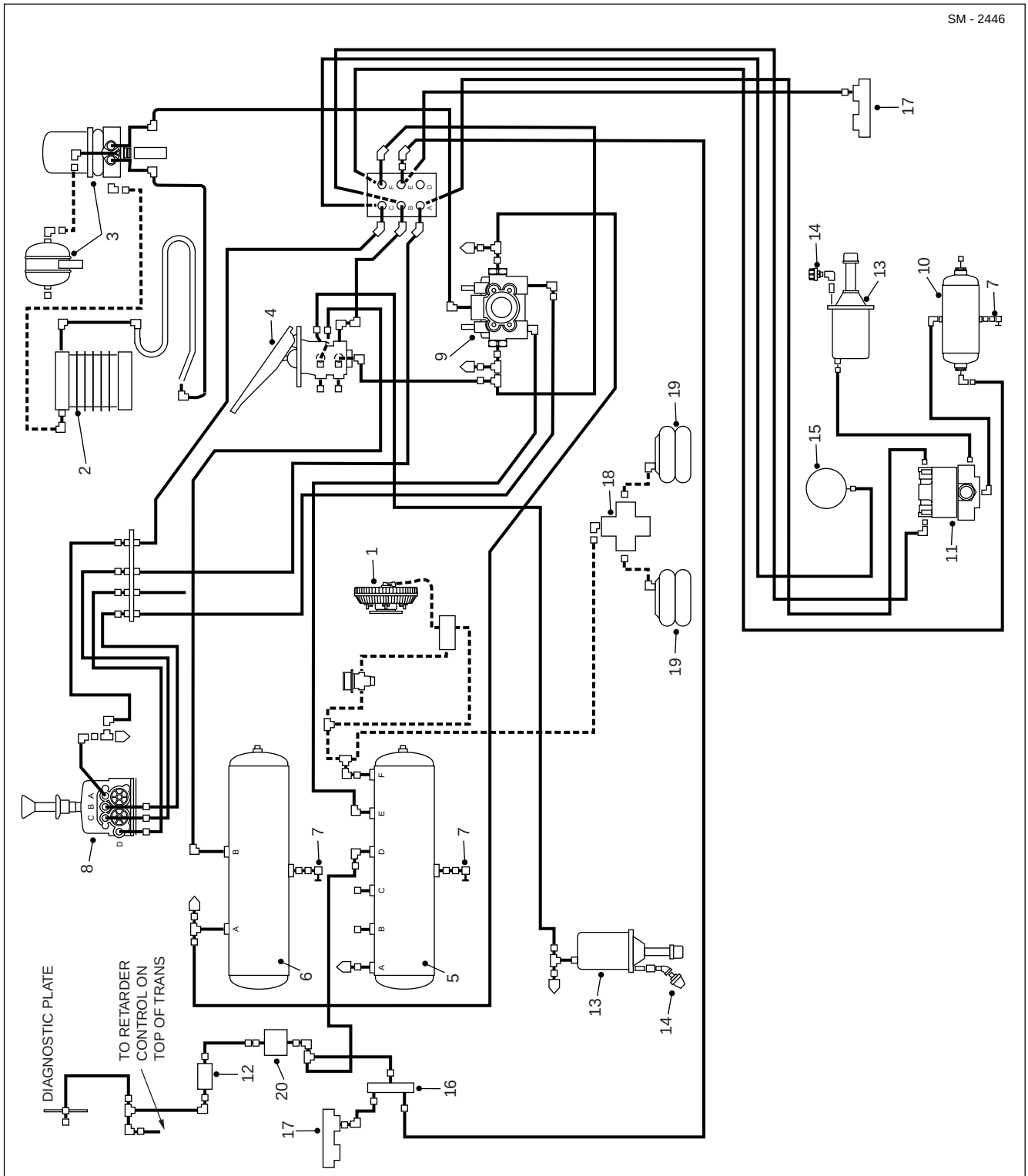
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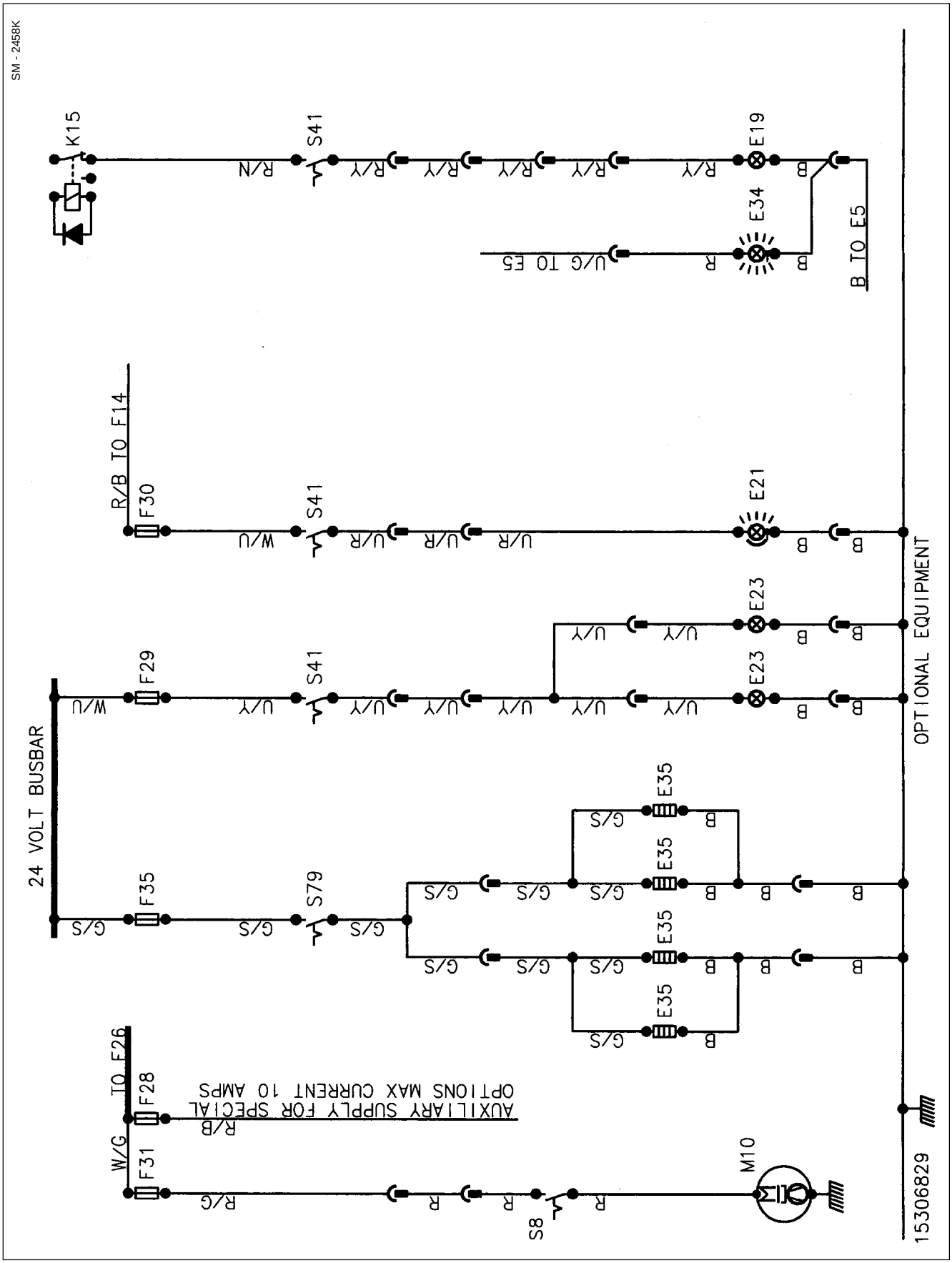


1 - Fan Clutch
2 - Air Compressor
3 - Air Drier and Purge Tank Kit
4 - Treadle Valve
5 - Primary Tank
6 - Front Brake Tank
7 - Drain Cock
8 - Park/Emergency Control Valve
9 - Pressure Protection Valve
10 - Rear Brake Tank
11 - Relay Emergency Valve
12 - Air Solenoid
13 - Pressure Converter
14 - Air Breather
15 - Parking Brake Actuator
16 - Solenoid Valve
17 - Differential Lock Cylinder
18 - Levelling Valve
19 - Air Spring
20 - Regulating Valve

Fig. 1 - Air Braking System Schematic

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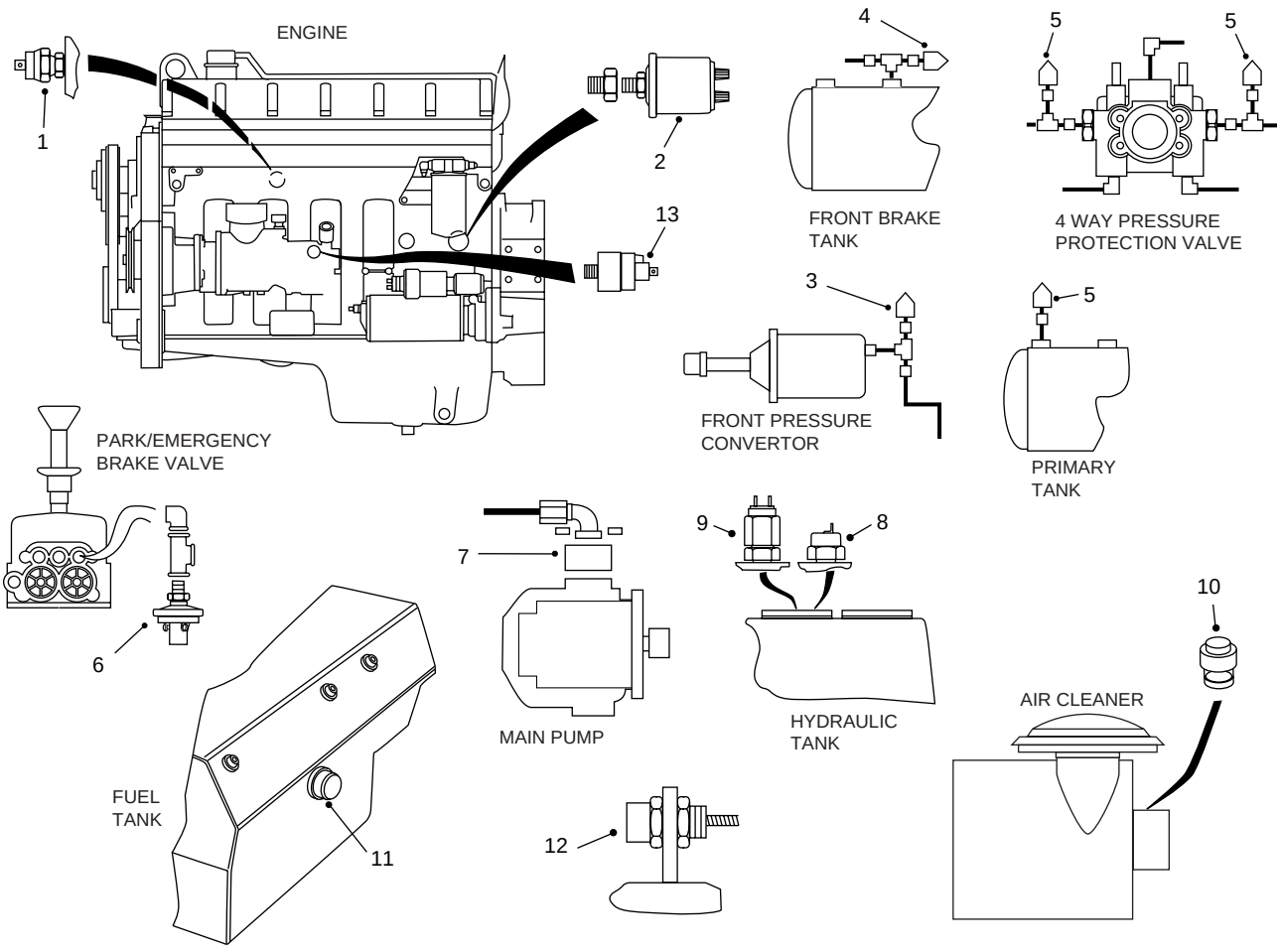
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1 - Engine Coolant Temperature Sender
2 - Switch - 5 bar Sender
3 - Stop Light Pressure Switch
4 - Air Pressure Sender
5 - Low Air Pressure Switch
6 - Parking Brake Pressure Switch
7 - Low Steering Pressure Switch
8 - Hydraulic Oil Temperature Switch
9 - Hydraulic Oil Pressure Switch
10 - Air Cleaner Restriction Gauge
11 - Fuel Level Transmitter
12 - Body Up Microswitch
13 - Engine Load Sensor

Fig. 1 - Layout View of Switches and Sensors

DESCRIPTION

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

This section describes the location and function of various switches and sensors fitted to the vehicle to monitor all major components and systems. Gauges and warning lights located in the dash panel, relay this information to the operator. Refer to Section 120-0010, TRANSMISSION AND MOUNTING, for switches and sensors fitted to the transmission.

Note: Always make sure all gauges, warning lights and controls are working properly before operating the vehicle.

Engine

Engine Coolant Temperature Sender (1) - Located in the right hand side of the engine. Sends a signal indicating engine coolant temperature to engine coolant temperature gauge (10, Fig. 2).

Engine Coolant Temperature Gauge (10, Fig. 2) - Indicates the engine coolant temperature. The gauge should read in the green zone after the engine has warmed. If the gauge reads in the red zone, stop the engine and investigate the cause.

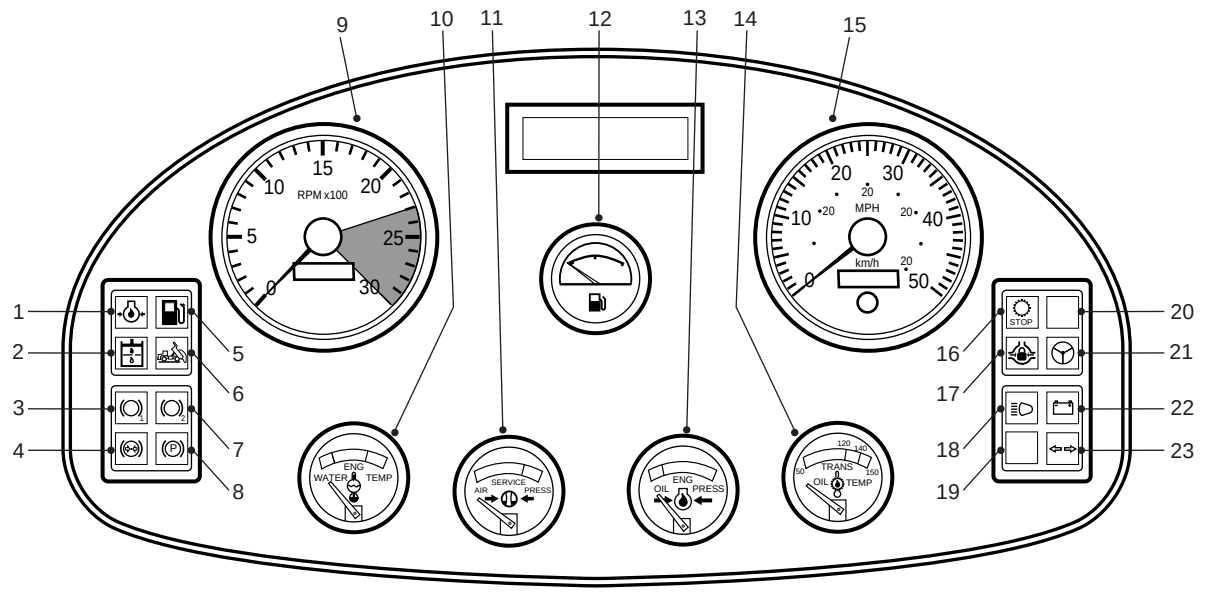
Switch, 5 Bar Sender (2) - The normally closed (NC) sender/switch is located in the engine oil rifle at the rear left hand side of the engine. This sender/switch

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Electrical System - Switches and Sensors

Section 190-0270



1 - Engine Oil Pressure W/L
2 - Hydraulic Oil Filter Restriction W/L
3 - Tractor Brakes Overstroke W/L
4 - Low Brake Air Pressure W/L
5 - Low Fuel W/L
6 - Body Up W/L
7 - Trailer Brakes Overstroke W/L
8 - Parking Brake Ind/L
9 - Tachometer/Hourmeter
10 - Engine Coolant Temperature Gauge
11 - Air Pressure Gauge
12 - Fuel Level Gauge
13 - Engine Oil Pressure Gauge
14 - Transmission Oil Temperature Gauge
15 - Speedometer/Odometer
16 - Transmission Stop W/L
17 - Differential Lock Ind/L
18 - Headlight Main Beam Ind/L
19 - Blank
20 - Blank
21 - Emergency Steering W/L
22 - Alternator Charging W/L
23 - Direction Indicators Ind/L

Fig. 2 - Layout View of Instruments and Indicator/Warning Lights

opens when engine oil pressure rises above 0.48 bar (7 lbf/in^2) and combines two functions:

a. Engine oil pressure sender sends a signal indicating oil pressure to engine oil pressure gauge (13, Fig. 2).

b. Engine oil pressure switch sends a signal to illuminate engine oil pressure warning light (1, Fig. 2) when the engine oil pressure drops below the safe operating pressure.

Engine Oil Pressure Gauge (13, Fig. 2) - Indicates the engine oil pressure. The gauge should read in the green zone during engine operation. If the gauge reads in the red zone, stop the engine and investigate the cause.

Engine Load Sensor (13) - Located on the left hand side of the engine, the engine load sensor sends a signal to the transmission ECU indicating the engine load (throttle position) thus allowing the transmission to shift up or down gear in accordance with the engine revs. To check the load sensor is operating within the required parameters, test the load sensor electrically. Insert a voltmeter between pins 2 & 4 on harness plug X9 (located to the right hand side of fuse box). Turn ignition 'On' and check for the following readings;

Idle: 0.5 Volts
Full Load: 3.4 Volts

Note: outwith these parameters, fault code 23 or 24 will occur. Refer to Section 120-0010, TRANSMISSION AND MOUNTING, for diagnostic code details.

Tachometer/Hourmeter (9, Fig. 2) - Driven from the alternator, the tachometer indicates the number of engine crankshaft revolutions per minute (rev/min). Never accelerate the engine to speeds indicated by the red zone on the dial face. A digital hourmeter is incorporated in the tachometer to record total hours of engine operation.

Tachometer Calibration
1. Determine the impulse setting required. Reference tachometer calibration table.

2. Using a suitable screwdriver, depress and hold calibration button at the rear of the tachometer and

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Tachometer Calibration Table - All units with standard tyres		
Unit	Engine	Pulses/revolution
TA25	Cummins C Series	17.40
TA27	Cummins C Series	17.40
TA30	Cummins M11	16.68
TA35	DD Series 60	18.66
TA40	DD Series 60	18.66

turn the ignition keyswitch to position '1'. Release button when PULSE is displayed.

3. After a few seconds, the digits will flash in sequence. Depress the button until the desired number is displayed the release the button for a few seconds until the next digit flashes.

4. Repeat step 3 to obtain the desired impulses/ revolution. The tachometer is now calibrated.

Speedometer/Odometer (15, Fig. 2) - Driven by a signal from the ECU, the speedometer indicates travel speed in kilometres per hour and miles per hour. A digital odometer is incorporated in the speedometer to record the distance travelled by the vehicle at any given time.

Speedometer Calibration
1. Determine the impulse setting required. Reference speedometer calibration table.

Speedometer Calibration Table - All units with standard tyres		
Unit	Transmission	Pulses
TA25	6 WG 210	333650
TA27	6 WG 210	333650
TA30	6 WG 260	232100
TA35	6 WG 310	231900
TA40	6 WG 310	217130

2. Depress and hold calibration button at the front of the speedometer and turn the ignition keyswitch to position '1'. Release button when PULSE is displayed.

3. After a few seconds, the digits will flash in sequence. Depress the button until the desired number is displayed the release the button for a few seconds until the next digit flashes.

4. Repeat step 3 to obtain the desired impulses/ revolution. The speedometer is now calibrated.

Braking System

Stop Light Pressure Switch (3) - The normally open (NO) pressure switch is located in a tee in the supply port of the front pressure convertor. As brake apply pressure increases to 0.28 bar (4 lbf/in^2) and above, the circuit closes and sends a signal to illuminate the brake lights at the rear of the vehicle. As pressure drops below 0.28 bar (4 lbf/in^2) the circuit opens and the brake lights go out.

Air Pressure Sender (4) - Located in port 'B' of the front brake air tank, the air pressure sender sends a signal indicating air reservoir pressure on air pressure gauge (11, Fig. 2).

Air Pressure Gauge (11, Fig. 2) - Indicates air reservoir pressure. During normal operation, the needle in this gauge should be showing in or approaching the centre of the green zone. Do not operate the vehicle if the needle remains in the red zone.

> ⚠ **WARNING**
> **Never release the parking brake or move the vehicle until the needle is at least approaching the centre of the green zone.**

Low Air Pressure Switch (5) - There are 3 normally open (NO) pressure switches located in air system. One located in port 'A' of the primary air tank and two on the pressure protection valve at ports '21' and '22'. The switches send a signal to illuminate low brake air pressure warning light (4, Fig. 2) if air pressure falls below 4.1 bar (60 lbf/in^2). If the warning light illuminates, stop the machine, apply the parking brake and investigate the cause.

Parking Brake Pressure Switch (6) - The normally closed (NC) pressure switch is located in a tee from the parking/emergency brake control valve. The pressure switch opens at a pressure of 0.7 bar (10 lbf/in^2) and sends a signal to illuminate parking brake indicator light (8, Fig. 2), indicating that the parking brake is applied.

Pressure Converter Overstroke Switches - A normally open (NO) contact switch assembly is located in both the front and rear pressure converter assemblies. When the pressure converter stroke has been exceeded, because of a loss of hydraulic pressure in the brake system, the switch in the contact assembly closes and sends a signal to illuminate front

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or rear brake system warning light (3 or 7, Fig. 2). An audible alarm also sounds. Refer to Section 250-0260, PRESSURE CONVERTER, for instructions on how to reset the pressure converter.

Steering System

Low Steering Pressure Switch (7) - The normally closed (NC) pressure switch is located in a block at the top port of the main hydraulic pump. The pressure switch sends a signal to illuminate steering pressure warning light (20, Fig. 2) when steering pressure drops to 4.8 bar (70 lbf/in^2) or lower. An audible alarm also sounds.

Hydraulic System

Hydraulic Oil Pressure Switch (8) - The normally open (NO) oil pressure switch is located beside hydraulic oil temperature switch (9) in the centre cover plate on top of the hydraulic tank. The oil pressure switch will close and illuminate hydraulic oil filter restriction warning light (2, Fig. 2) when the restriction pressure exceeds 2.7 bar (40 lbf/in^2), indicating a filter element change is required.

Hydraulic Oil Temperature Switch (9) - The normally open (NO) oil temperature switch closes when a temperature of 50° C (122° F) is reached. The oil temperature switch is connected in series with hydraulic oil pressure switch (8), therefore, hydraulic oil filter restriction warning light (2, Fig. 2) will not illuminate until the oil rises above 50° C (122° F).

Air Cleaner

Air Cleaner Restriction Gauge (10) - Mounted on the air cleaner, the restriction gauge indicates the degree of air cleaner element restriction as the red panel rises in the gauge window. The filter element should be replaced if the red band locks in place when the engine is shut down. Reset the gauge by pressing the button on the gauge with the engine running.

Fuel Tank

Fuel Level Transmitter (11) - Located in the left hand side of the fuel tank, the fuel level transmitter has two functions:

a. Sends a signal to fuel level gauge (12, Fig. 2) to indicate the amount of fuel left in the tank.

b. Sends a signal to illuminate low fuel warning light (5, Fig. 2) to indicate when the fuel tank content falls below 68 litres (18 US gal).

Body

Body Up Proximity Switch (12) - Mounted off the inside of the trailer right hand frame rail. When the body is raised off the trailer frame, the switch sends a signal to illuminate body up warning light (6, Fig. 2).

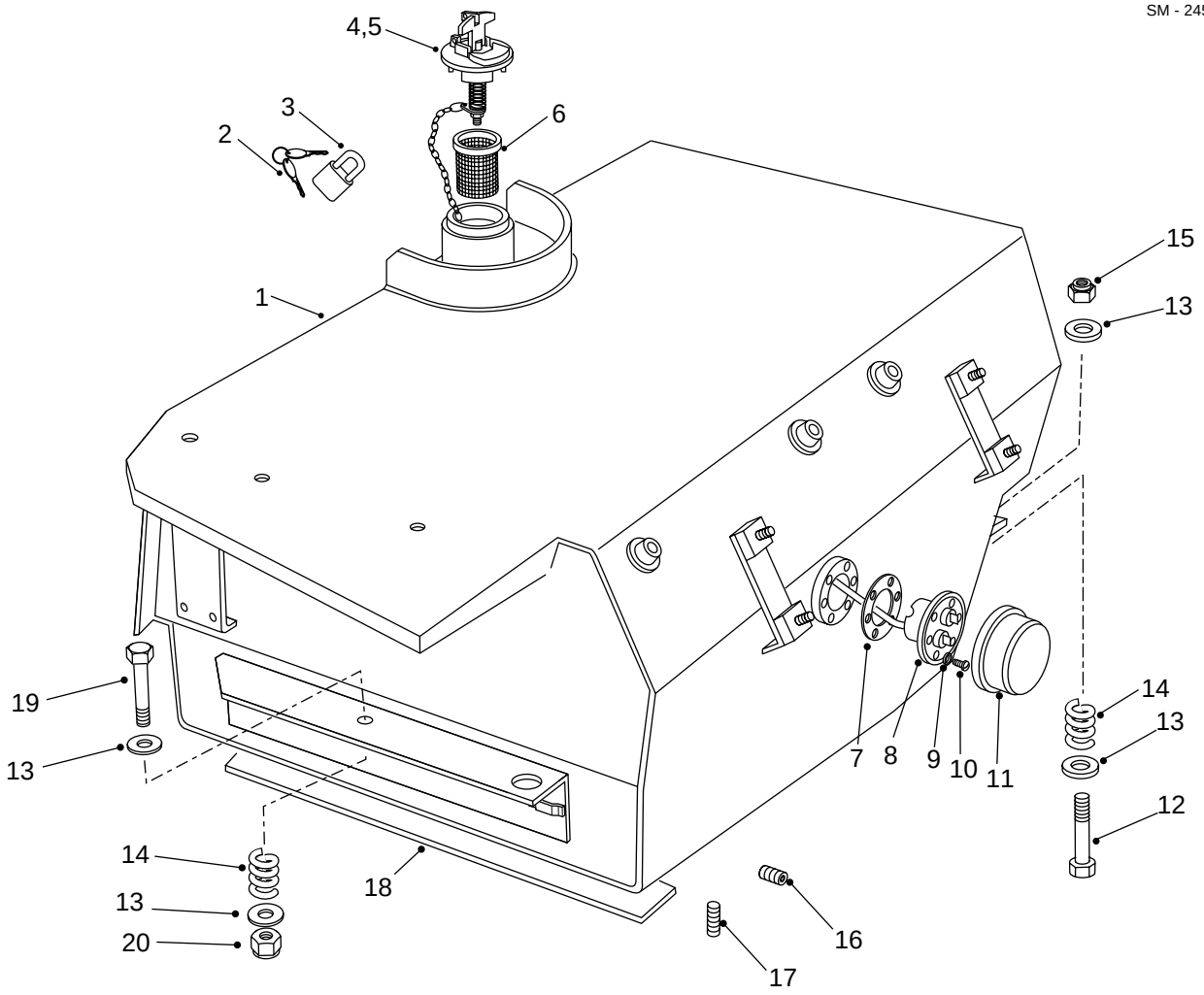
Note: Never move the vehicle until body up warning light (6, Fig. 2) goes out, indicating that the body is fully lowered onto the trailer frame.

Note: The proximity sensor prevents the body being fully powered down onto the chassis. At a predetermind height, the sensor automatically defaults the body control valve to the detented 'Float' condition.

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1 - Fuel Tank
2 - Key
3 - Padlock
4 - Filler Cap
5 - Filter Assembly
6 - Fuel Strainer
7 - Gasket
8 - Fuel Level Transmitter
9 - Washer
10 - Screw
11 - Cover
12 - Bolt
13 - Washer
14 - Spring
15 - Locknut
16 - Plug
17 - Drain Plug
18 - Rubber Pad
19 - Bolt
20 - Locknut

Fig. 1 - Standard Fuel Tank and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The fuel tank is installed in the front right hand of the tractor frame and secured with bolts (12 & 19), washers (13), springs (14) and locknuts (15 & 20), as shown in Fig. 1.

Integral with fuel tank (1) are fuel strainer (6) and fuel level transmitter (8). Fuel strainer (6) helps prevent foreign particles from entering fuel tank (1) during filling. Fuel level transmitter (8), located in the left hand side of fuel tank (1), has two functions:

a. Sends a signal to the fuel level gauge to indicate the amount of fuel left in the tank.

b. Sends a signal to illuminate the low fuel warning light to indicate when the fuel tank content falls below 68 litres (18 US gal).

Note: Refer to Section 300-0020, LUBRICATION SYSTEM for fuel tank capacities and fuel specifications.

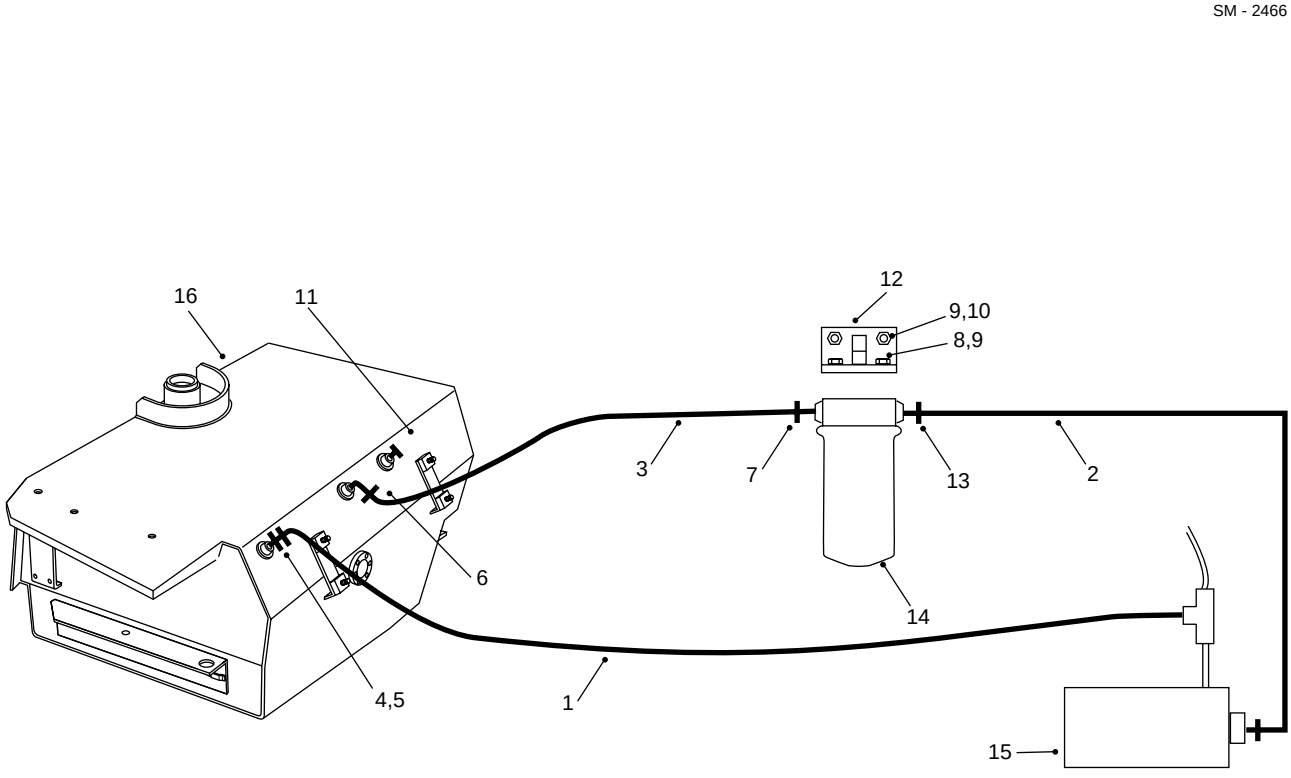
OPERATION

Numbers in parentheses refer to Fig. 2.

Fuel is drawn from fuel tank (16) through fuel line (3),

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1 - Fuel Line
2 - Fuel Line
3 - Fuel Line
4 - Elbow
5 - Reducer Bushing
6 - Elbow
7 - Elbow
8 - Bolt
9 - Lockwasher
10 - Bolt
11 - Plug
12 - Fuel Filter Bracket
13 - Connector
14 - Fuel Filter/Water Separator
15 - Fuel Pump
16 - Fuel Tank

Fig. 2 - Fuel Lines

fuel filter/water separator (14) and fuel line (2) by fuel pump (15). Leaving fuel pump (15) under pressure, the fuel flows to the fuel injectors in the cylinder head through passages integral with the cylinder head. Surplus fuel exits from the cylinder head, just above the fuel inlet, and returns to fuel tank (16) through fuel line (1).

A fuel tank breather/filter assembly (5, Fig.1) is incorporated into the fuel cap (4, Fig. 1), allowing fuel tank (16) to vent to atmosphere, preventing pressure from building up within fuel tank (16) assembly.

REMOVAL

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

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2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Remove padlock (3) and remove filler cap (4) from fuel tank (1).

4. Remove fuel strainer (6) from fuel tank (1) and clean with clean diesel fuel.

5. Remove cover (11) from fuel level transmitter (8) and disconnect electrical connections at fuel level transmitter (8).

6. With a suitable container in position, remove drain plug (17) from the underside of fuel tank (1) and drain fuel from fuel tank (1). Reinstall drain plug (17) and tighten securely when fuel tank (1) is completely drained.

7. Identify and tag fuel lines (1 & 3, Fig.2) and, with a suitable container available to catch leakage, disconnect fuel lines (1 & 3, Fig.2). Cap open line ends and elbows (4 & 6, Fig. 2) to prevent entry of dirt.

8. Remove locknuts (15 & 20), bolts (12 & 19), washers (13) and springs (14) securing fuel tank (1) assembly in the tractor frame. Using a suitable lifting device, remove fuel tank (1) assembly from the vehicle.

9. If required, remove rubber pads (18) from the tractor frame. Be sure to remove all rubber and adhesive from the tractor frame.

INSTALLATION

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

⚠ WARNING
To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.

1. If removed, apply a suitable adhesive to new rubber pads (18) and position on the tractor frame.

2. Using suitable lifting equipment, position fuel tank (1) assembly in the tractor frame.

3. Secure the front of fuel tank (1) assembly to the tractor frame with bolt (19), washer (13), spring (14), washer (13) and locknut (20), as shown in Fig. 1. Tighten locknut (20) until spring compresses to a length of 31.75 mm (1.25 in).

4. Secure the rear of fuel tank (1) assembly to the tractor frame with bolts (12), washers (13), springs (14), washers (13) and locknuts (15), as shown in Fig. 1. Tighten locknuts (15) until spring compresses to a length of 31.75 mm (1.25 in).

5. Remove blanking caps and secure fuel lines (1 & 3, Fig. 2) to elbows (4 & 6, Fig. 2), as identified at removal.

6. Connect electrical connections to fuel level transmitter (8) and install cover (11).

7. Install fuel strainer (6) in fuel tank (1).

8. Fill fuel tank (1) assembly with clean diesel fuel specified in Section 300-0020, LUBRICATION SYSTEM.

9. Install filler cap (4) assembly on fuel tank filler neck. Tighten filler cap (4) securely and secure in place with padlock (3).

10. Place the battery master switch in the 'On' position, start the engine and run for a few minutes to ensure fuel is being supplied to the engine. Check for leaks at fuel lines (1 & 3, Fig. 2) and tighten if required.

11. Remove wheel blocks from all road wheels.

MAINTENANCE

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks and blocking materials are properly secured and of adequate capacity to do the job safely.

General

Refill fuel tank (1) at the end of each day's operation to prevent condensation from contaminating the fuel. When filling fuel tank (1), check that there is no buildup of dirt and sludge at fuel strainer (6) and filler cap (4). Remove and clean fuel strainer and filler cap as required.

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From time to time, remove cover (11) and check condition of electrical connections at fuel level transmitter (8).

Every 10 Hours/Daily

Make a visual check for fuel leaks at all fuel lines and connections. Make sure that fuel lines (1, 2 & 3, Fig.2) are not resting on or touching rotating components, heated surfaces including exhaust manifolds, or sharp edges. If fittings have loosened or cracked, or if lines have ruptured or worn through, take corrective action immediately.

Fuel Filter/Water Separator (14, Fig. 2) - Drain the water and sediment from the separator daily.

Position the vehicle on a level work area, apply the parking brake, shut off the engine and, with a suitable container below the drain valve to catch spillage, open the drain valve by hand. Turn the valve anticlockwise approximately 1.5 to 2 turns until draining occurs. Drain the filter sump until clear fuel is visible. Turn the valve clockwise to close the drain valve.

Note: Do not overtighten the drain valve as overtightening can damage the threads.

Every 250 Hours

Fuel Filter/Water Separator (14, Fig. 2) - Clean the area around the filter head and replace the fuel filter/water separator.

Position the vehicle on a level work area, apply the parking brake and switch off the engine. Using a strap type filter wrench, remove the fuel filter/water separator and discard the thread adaptor sealing ring. Clean the gasket surface of the filter head.

Install the new thread adaptor sealing ring (supplied with new filter) and apply a film of clean engine oil to lubricate the filter seal. Fill the new fuel filter/water separator with clean fuel specified in Section 300-0020, LUBRICATION SYSTEM.

Install new fuel filter/water separator on the filter head and tighten by hand until the gasket contacts the filter head surface. Tighten fuel filter/water separator per filter manufacturer's instructions.

Note: Mechanical tightening of the filter is not recommended and may result in seal and/or cartridge damage. Tighten filter by hand only.

Every 500 Hours

Remove drain plug (17) from the underside of fuel tank (1) and drain off any water or sediment which has gathered. Check condition of filler cap (4) and clean fuel strainer (6) and filler cap (4) with clean fuel. Check the condition of all fuel lines and replace if required.

Every 1 000 Hours

Remove filler cap (4) from filler neck. With the handle in the up and rotated position, remove the two screws securing the filter assembly (5) to the cap. Discard 'O' rings. Clean top of filler cap (4) and valve cavity. Install new filter assembly (5) to filler cap (4) using new screws and 'O' rings (supplied with new filter). Tighten screws to 10 - 13 in lbs.

Diesel Fuel Oil

The sulphur content of diesel fuel oil should be as low as possible to avoid premature wear of piston rings and line, excessive deposit formation, and minimise sulphur dioxide exhausted into the atmosphere. Limited amounts can be tolerated, but the amount of sulphur in the fuel and engine operating conditions can influence corrosion and deposit formation tendencies. The use of diesel fuel oil with a MAXIMUM sulphur content of 0.5% is recommended for use. Refer to Section 300-0020, LUBRICATION SYSTEM.

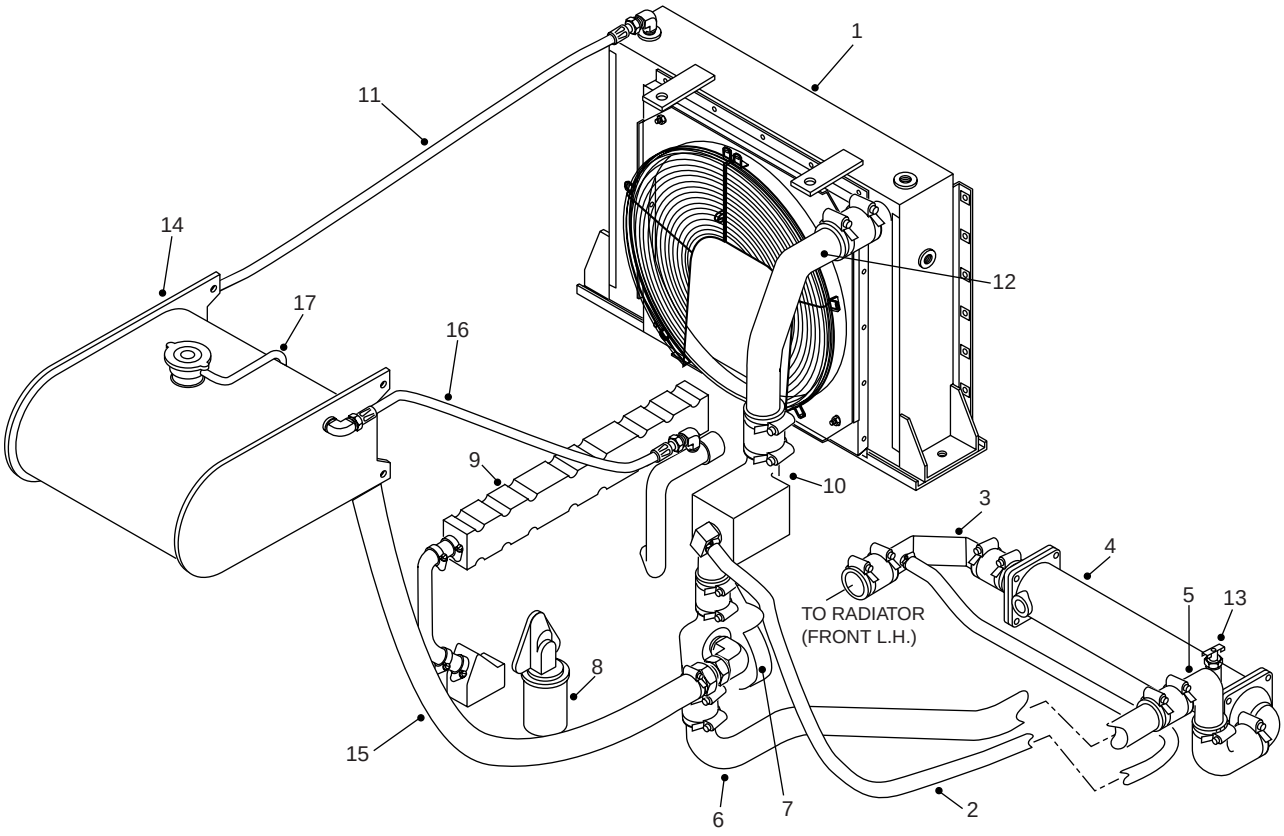
SERVICE TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools and adhesives required. These tools and adhesives are available from your dealer.

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1 - Radiator Assembly
2 - Make-up Line
3 - Coolant Outlet Pipe
4 - Transmission Oil Cooler
5 - Elbow
6 - Coolant Inlet Pipe
7 - Water Pump
8 - DCA4 Water Filter
9 - Aftercooler
10 - Thermostat Housing
11 - Deaeration Line
12 - Coolant Outlet Pipe
13 - Bleed Nipple
14 - Header Tank
15 - Make-up Line
16 - Deaeration Line
17 - Overflow Line

Fig. 1 - Cooling Lines

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

A water cooling system is installed in these vehicles to maintain desired engine operating temperatures.

The engine portion of the cooling system is covered in the engine 'Operation and Maintenance Manual'.

The main components of the cooling system are; radiator assembly (1), header tank (14), transmission oil cooler (4), water pump (7), DCA4 water filter (8), aftercooler (9) and thermostat housing (10).

OPERATION

Numbers in parentheses refer to Fig. 1.

The engine water pump (7) draws coolant from transmission oil cooler (4) through coolant inlet pipe (6) and also from header tank through make-up line (15). The coolant passes through DCA4 water filter (8), aftercooler (9) and through the engine block to thermostat housing (10).

When the coolant is below operating temperature, the engine thermostat remains closed and coolant flowing to thermostat housing (10) returns to engine water pump (7) and is re-circulated through the engine again.

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Aerated coolant is drawn off to header tank (14) from left hand radiator tank and engine vent port through deaeration lines (11 & 16). Excess coolant at header tank (14) is discharged through overflow line (17) on the filler neck.

When the coolant reaches proper operating temperature, the engine thermostat opens allowing coolant to flow through coolant outlet tube (12) and into the right hand radiator tank. Coolant travels through the radiator core, where heat is drawn off by air circulating through the core, and into the left hand radiator tank. Coolant then travels through coolant outlet pipe (3), into transmission oil cooler (4) and re-circulated back through the system.

Note: Refer to Section 210-0060, TRANSMISSION OIL COOLER, for transmission oil flow through transmission oil cooler (4).

The use of antifreeze is mandatory with the cooling system. The lack of radiator flow with the thermostats closed allows the coolant in the radiator to freeze under low ambient temperatures.

PREVENTIVE MAINTENANCE

To ensure the continued efficient functioning of the cooling system, certain checks and operations should be performed at regular intervals.

⚠ WARNING
Do not remove the filler cap from the radiator header tank or attempt to drain the coolant until the engine has cooled to below 50° C (120° F). When removing filler cap, always partially unscrew cap slowly to release pressure from the system. Remove filler cap slowly, as the sudden release of pressure from a heated cooling system can result in a loss of coolant and possible personal injury.

As Required

Tighten water manifold, water pump, oil coolers and radiator mounting bolts. Clean radiator core fins.

Note: Under extreme conditions it may be necessary to clean radiator core fins several times per shift.

Every 10 hours/Daily

Check coolant level and add if low. Fill the radiator header tank with coolant until the coolant reaches the bottom of the filler neck and holds at that level.

Note: Any time a significant amount of coolant is added, the DCA4 concentration MUST be checked and the appropriate action taken. Refer to instructions under 'Coolant Recommendations' in this section.

Note: Removal of the filler cap when the system is hot vents the pressure in the system; if the filler cap is reinstalled while the system is hot, normal system build up to the rated pressure will not take place. This may result in a serious temporary reduction of coolant flow due to cavitation at the water pump inlet, particularly if the machine is being operated at high altitude.

Check fan for cracks, loose rivets, and bent or loose blades. Check fan mounting and tighten if required. Replace the fan if damaged. Visually inspect the fan belt for wear and tension. Refer to Section 110-0030, ENGINE AND MOUNTING.

Check all coolant lines, pipes and components for leaks and wear.

Every 250 hours

Check and replenish the DCA4 concentration as described under 'Coolant Recommendations' in this section.

Replace DCA4 coolant filter if required. When testing the DCA4 concentration, depending on the level of DCA4, the coolant filter may not require to be changed. Refer to instructions under 'Coolant Recommendations' in this section.

Note: Under concentration of the DCA4 coolant additive can result in liner pitting and system corrosion. Over concentration can result in water pump seal leakage. Always maintain DCA4 concentration at recommended levels.

Note: Turn the coolant shut off valve to the 'Off' position before removing DCA4 water filter.

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Every 4 000 hours

Drain and flush the cooling system as described under 'Cleaning The Cooling System' in this section. Fill the cooling system with the correct mixture of antifreeze, water and DCA4 liquid as described under 'Coolant Recommendations' in this section.

Visibly inspect the water pump for indications of coolant or oil leakage at the weep hole.

Note: A streak or slight chemical build up at the weep hole is not justification for water pump replacement. If a steady flow of coolant or oil is observed, replace the water pump with a new or rebuilt unit.

Cleaning The Cooling System

WARNING
Do not remove the filler cap from the radiator header tank or attempt to drain the coolant until the engine has cooled to below 50° C (120° F). When removing filler cap, always partially unscrew cap slowly to release pressure from the system. Remove filler cap slowly, as the sudden release of pressure from a heated cooling system can result in a loss of coolant and possible personal injury.

Note: It is recommended to use a cleaner such as Fleetguard RESTORE, or equivalent, when cleaning the cooling system.

1. Drain the cooling system. Do not allow the cooling system to dry out or remove the DCA4 water filter.

2. Add 3.8 litres (1 US gal) of cleaner for each 38 - 57 litres (10 - 15 US gal) of cooling system capacity, and fill the system with plain water.

Note: Fleetguard RESTORE contains no antifreeze and the cooling system should not be allowed to freeze during the cleaning operation.

3. Slide the heater temperature control to high to allow maximum coolant flow through the heater core. The blower switch does not have to be on.

4. Operate the engine at normal operating temperature, at least 85° C (185° F) for 1 - 1.5 hours.

WARNING
Do not remove the filler cap from the radiator header tank or attempt to drain the coolant until the engine has cooled to below 50° C (120° F).

5. Shut off the engine and drain the cooling system.

Note: To greatly increase the radiator fill time, open bleed nipple (13, Fig. 1) on elbow (5, Fig. 1) at initial fill. The bleed nipple should be left open until coolant starts to leak from the nipple, indicating that all air in the system up to this level has escaped.

6. Fill the cooling system with clean water and operate the engine at high idle for 5 minutes with the coolant temperature above 85° C (185° F).

WARNING
Do not remove the filler cap from the radiator header tank or attempt to drain the coolant until the engine has cooled to below 50° C (120° F).

7. Shut off the engine and drain the cooling system.

Note: If the water being drained is still dirty, the system must be flushed again until the water is clean.

8. Refill the cooling system with the proper mix of antifreeze and water and install new precharge filter and correct concentration of DCA4 liquid. Refer to instructions under 'Coolant Recommendations'.

9. Install filler cap on the radiator header tank, operate the engine and check for coolant leaks.

COOLANT RECOMMENDATIONS

Heavy duty diesel engines installed in these vehicles require a heavy duty coolant for optimum performance. Heavy duty coolant is defined as a correct mixture of good quality water, low silicate antifreeze and supplemental coolant additives (SCA's).

Water quality is important for cooling system performance. Excessive levels of calcium and magnesium contribute to scaling problems, and excessive levels of chlorides and sulphates cause cooling system corrosion.

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It is recommended to use a low silicate antifreeze concentrate that meets ASTM D4985 specifications (less than 0.1% silicate). Low silicate antifreeze must be mixed with quality water at a 50/50 ratio (40 to 60% working range). A 50/50 mixture of antifreeze and water gives a -37° C (-34° F) freeze point and a boiling point of 109° C (228° F). The actual lowest freeze point of ethylene glycol antifreeze is at 68%. Using higher concentrations of antifreeze will raise the freeze point of the solution and increase the possibility of a silicate gel problem. A refractometer must be used to accurately measure the freeze point of the coolant. Refer to 'Special Tool and Test Kit'.

Supplemental coolant additives (DCA4), or equivalent, are used in conjunction with water and antifreeze to prevent liner pitting, corrosion and scale deposits in the cooling system. The cooling system must be precharged with the correct concentration of DCA4. Refer to the relevant 'Precharge Chart' in this section. When coolant is replaced in the field, it must be replaced with heavy duty coolant precharged with DCA4. In addition, a service coolant filter must be installed. Together, this will result in a total precharge of approximately 0.33 DCA4 units per litre of coolant.

Proper blending of heavy duty coolant is achieved as follows:

a. Pour water into a suitable clean container.

b. Add the same quantity of low silicate antifreeze to the water.

c. Add the correct quantity of DCA4 liquid for the cooling system capacity required. Refer to the relevant 'Precharge Chart' in this section for DCA4 quantities. Refer to Section 300-0020, LUBRICATION SYSTEM for cooling system capacity.

d. Thoroughly blend all components.

Note: Following the correct order for mixing the heavy duty coolant will prevent additive dropout during the mixing process.

Note: The cooling system must be clean before adding DCA4 liquid.

Note: Do not use soluble oils in the cooling system. The use of soluble oils will lead to cylinder lining pitting, corrode brass and copper, damage heat transfer surfaces and damage seals and hoses.

DCA4 Test Kit

The test kit must be used:

1. When excessive coolant loss occurs.

2. After every 250 hours of operation.

3. If the concentration is known to be above the high limit of 0.8 units per litre. Test at each subsequent oil change until the concentration decreases below the high limit.

Note: Do not use the test kit to omit or extend the service intervals unless the concentration is above 0.8 units per litre.

The test strip container is marked with an expiration date and the plastic container must be securely tightened to protect the moisture sensitive strips. Discard the strips if there is any doubt about the test strip quality.

Test Instructions

1. Collect coolant sample from the radiator or petcock. DO NOT collect from the coolant recovery or overflow system. Coolant must be between 10° C and 54° C when tested.

2. Remove one strip from the bottle and replace cap immediately. DO NOT touch the pads on the end of the strip.

Note: Discard kit if unused strips have turned light brown or pink.

3. Dip strip in coolant sample for one second, remove, and shake strip briskly to remove excess liquid.

4. **45 seconds** after dipping strip compare and record results in the following order:

a. Compare **Freeze Point** (end pad) to colour chart and record the result.

b. Next, compare **Sodium Molybdate** (middle pad) to colour chart and record the result.

c. Finally, compare **Sodium Nitrate** test to colour chart and record the result.

5. All three readings must be completed **no later than 75 seconds** after dipping the strip.

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6. It is okay to estimate a value between colour blocks, but if uncertain about the colour match, pick the lower numbered block.

7. Determine where the Sodium Molybdate level intersects the Sodium Nitrite level on the chart. The amount of SCA units per litre in the cooling system is given where the Sodium Molybdate row intersects the Sodium Nitrite column.

Note: For best results follow test times carefully. Use a stopwatch or clock with a sweep second hand. Comparing the test strip to the colour chart too soon before, or too late after, the required test time will result in incorrect readings and improper treatment, and could result in liner pitting and engine damage.

8. All readings should be recorded on the truck maintenance record for future reference.

Treatment Instructions

If the concentration is:

Below 0.3 units per litre - Add both the normal amount of DCA4 liquid as specified in the respective service chart' and the amount specified in the respective 'Precharge Chart'. Replace the DCA4 coolant filter.

Between 0.3 and 0.8 units per litre - Add the normal amount of DCA4 liquid as specified in the respective 'Service Chart'. Replace the DCA4 coolant filter.

Above 0.8 units per litre - Do not replace the DCA4 filter or add liquid DCA4 until the concentration drops below 0.8 units per litre. The concentration must be tested at every subsequent 250 hour service interval until concentration decreases below 0.8 units per litre.

SPECIAL TOOL AND TEST KIT

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of the refractometer and coolant test kit referenced in this section. These items are available from your dealer.

Precharge Chart

Cooling System Capacity - Litres	Amount of DCA4 Liquid Required	
	Units	Litres
78 - 115	40	3.8
116 - 191	60	5.7
192 - 285	90	8.5
286 - 380	120	11.4
381 - 569	180	17.0

Service Chart

Cooling System Capacity - Litres	Amount of DCA4 Liquid Required	
	Units	Litres
78 - 115	10	1.0
116 - 190	15	1.4
191 - 285	20	1.9
286 - 379	25	2.4
380 - 569	40	3.8

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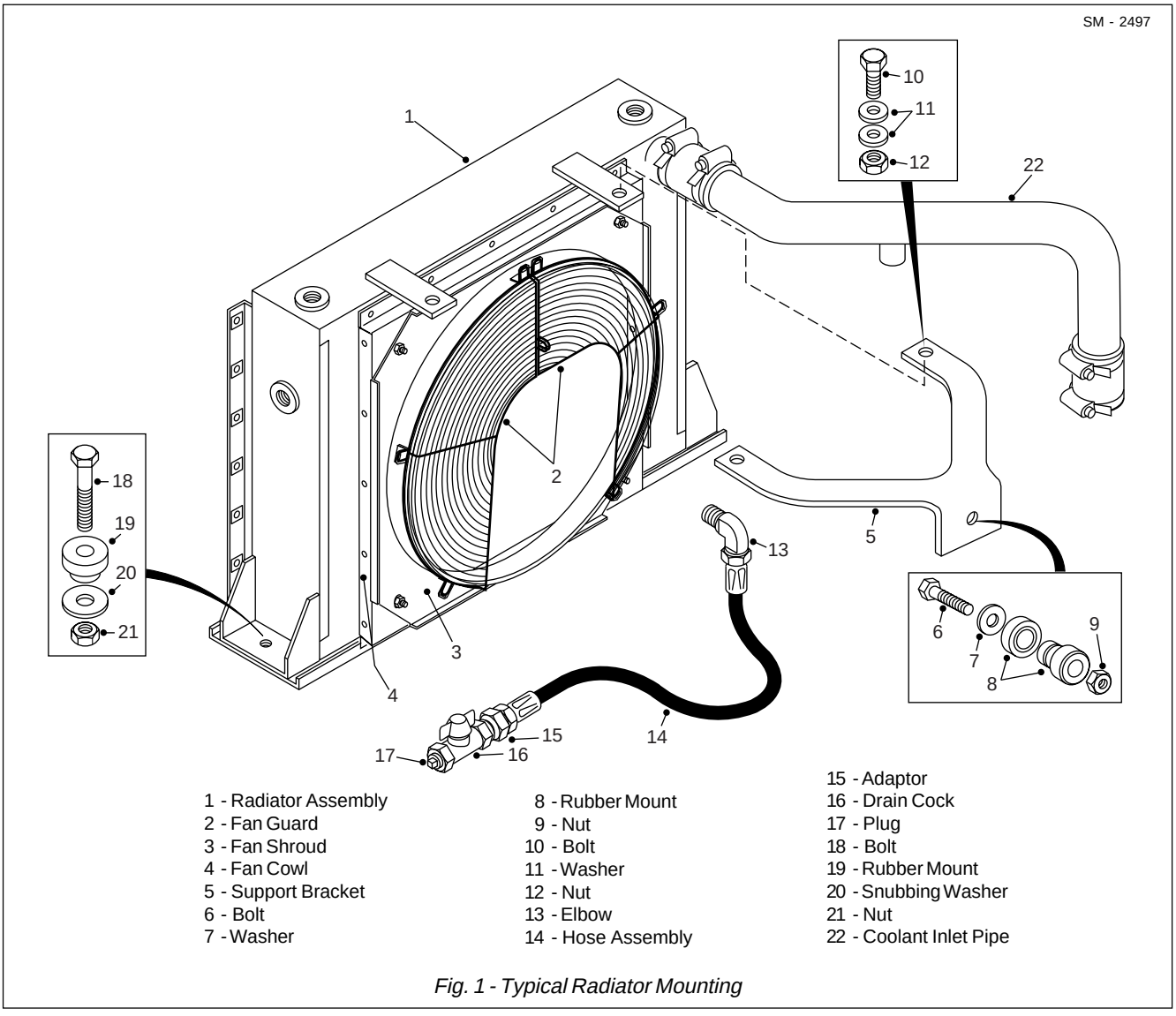
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COOLING SYSTEM DIAGNOSIS CHART		
CONDITION	REASON	REMEDY
Engine coolant temperature too high	Low coolant level	Fill cooling system to correct fill level
		Check for leaks and repair
	Front of radiator obstructed preventing free flow of air	Remove obstruction and clean radiator fins
	Fan drive belt broken or slipping	Adjust or replace fan belt if broken.
	Thermostat not opening	Replace thermostat
	Cooling system clogged with rust or scale	Flush cooling system
	Water pump not functioning properly	Repair or replace water pump
Engine coolant temperature too low	Thermostat remains open or opens at too low a temperature	Replace thermostat
	Extremely cold weather	Cover radiator or install radiator shutters

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1 - Radiator Assembly
2 - Fan Guard
3 - Fan Shroud
4 - Fan Cowl
5 - Support Bracket
6 - Bolt
7 - Washer
8 - Rubber Mount
9 - Nut
10 - Bolt
11 - Washer
12 - Nut
13 - Elbow
14 - Hose Assembly
15 - Adaptor
16 - Drain Cock
17 - Plug
18 - Bolt
19 - Rubber Mount
20 - Snubbing Washer
21 - Nut
22 - Coolant Inlet Pipe

Fig. 1 - Typical Radiator Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Radiator assembly (1) is mounted in front of the engine cooling fan at the front end of the vehicle. It is fed from header tank (8) located in front of the operators compartment and mounted to the goalpost support assembly.

A fan shroud (3) improves the engine cooling fan efficiency, provides a more uniform distribution of air over radiator core (7, Fig. 2) and helps restrict recirculation of air within the engine compartment.

Recirculation baffle plates around radiator assembly (1) prevent hot air from the engine cooling fan being reintroduced into the cooling air circuit.

REMOVAL

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

⚠ WARNING

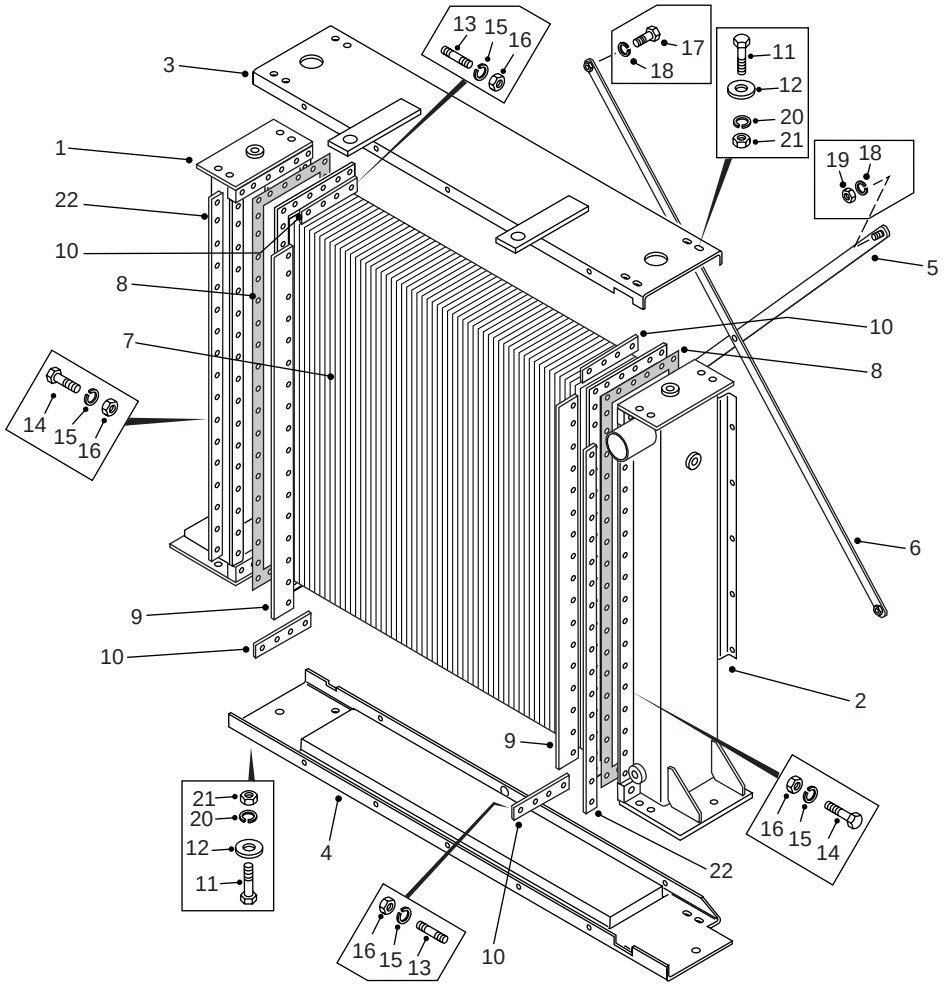
Do not remove the filler cap from the radiator header tank or attempt to drain the coolant until the engine has cooled to below 50° C (120° F). Once the engine has cooled, use extreme caution when removing the cap. When removing filler cap, always partially unscrew cap slowly to release pressure from the system. Remove filler cap slowly, as the sudden release of pressure from a heated cooling system can result in a loss of coolant and possible personal injury (scalding) from the hot liquid.

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Cooling System - Radiator, Header Tank and Mounting

Section 210-0040



1 - Left Hand Tank	7 - Radiator Core	13 - Stud	18 - Lockwasher
2 - Right Hand Tank	8 - Gasket	14 - Bolt	19 - Nut
3 - Top Support	9 - Stiffening Strip	15 - Lockwasher	20 - Lockwasher
4 - Bottom Support	10 - Stiffening Strip	16 - Nut	21 - Nut
5 - Cross Brace	11 - Bolt	17 - Bolt	22 - Stiffening Strip
6 - Cross Brace	12 - Washer		

Fig. 2 - Exploded View of Radiator Assembly

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Remove hood assembly from the vehicle. Refer to Section 100-0040, HOOD AND MOUNTING.

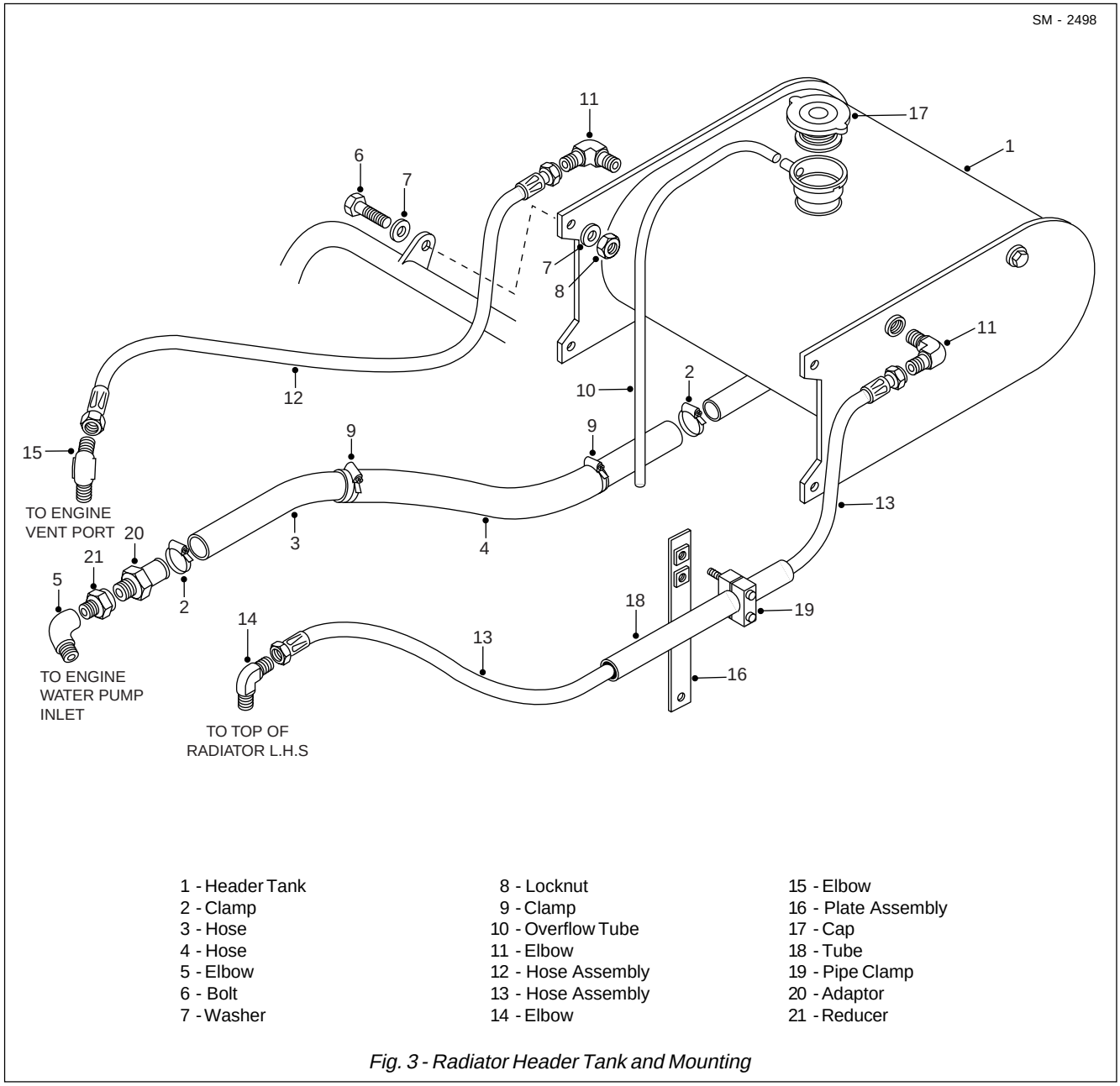
4. Remove filler cap carefully from filler neck on header tank (1, Fig. 3).

5. With a suitable container in position, remove plug (17) and open drain cock (16) at the bottom of radiator assembly (1) and drain the cooling system. Close drain cock (16) and reinstall plug (17) when coolant is completely drained.

6. Ensure hydraulic lines connected to hydraulic oil cooler mounted at front of radiator assembly (1) are

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1 - Header Tank	8 - Locknut	15 - Elbow
2 - Clamp	9 - Clamp	16 - Plate Assembly
3 - Hose	10 - Overflow Tube	17 - Cap
4 - Hose	11 - Elbow	18 - Tube
5 - Elbow	12 - Hose Assembly	19 - Pipe Clamp
6 - Bolt	13 - Hose Assembly	20 - Adaptor
7 - Washer	14 - Elbow	21 - Reducer

Fig. 3 - Radiator Header Tank and Mounting

identified for ease of installation and with suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to open lines and ports.

7. Slacken clamps and remove coolant inlet pipe (22) from radiator assembly (1) and engine thermostat housing.

8. Disconnect deaeration line (13, Fig. 3) from elbow (14, Fig. 3) at the top of radiator left hand tank. Fit blanking caps to open lines and ports.

9. Remove mounting hardware securing baffle plates and hydraulic oil cooler on the front of radiator assembly (1). Move baffle plates and hydraulic oil cooler clear from radiator core to facilitate removal.

10. Remove mounting hardware securing fan guards (2) to fan shroud (3) and remove fan guards (2) from the vehicle.

11. Remove bolt (6), washer (7) and locknut (9) securing radiator support bracket (5) to radiator steady bracket on engine.

12. If isolation mount (7) is damaged, remove and replace with a new rubber mount (7).

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13. Using suitable lifting equipment attached to lifting points on the radiator assembly (1), support radiator assembly.

Note: Under no circumstances should eye bolts be fitted to the bosses on the top of radiator (1) for the purpose of lifting complete radiator assembly (1).

14. If required, remove bolts (10), washers (11), nuts (12) and radiator support bracket (5) from radiator assembly (1).

15. Remove locknuts (21), snubbing washers (20) and bolts (18) securing radiator assembly (1) to the vehicle. Remove radiator assembly (1) from the vehicle.

Note: The thin fins and tubes of the radiator core are easily damaged, therefore, handle radiator assembly (1) with care.

16. If rubber mounts (19) are damaged, remove from mounting brackets on the frame and replace with new rubber mounts (19).

Header Tank

Numbers in parentheses refer to Fig. 3.

1. With suitable container in position, remove drain plug to ensure coolant has been drained from header tank (1).

2. Slacken band clamp (2) and pull hose (3) off of pipe at bottom of header tank (1).

3. Ensure deaeration lines (12 & 13) are identified for ease of installation and disconnect deaeration lines from elbows (11) in header tank (1). Fit blanking caps to open lines and fittings.

4. Disconnect overflow tubing (10) from filler neck.

5. Using suitable lifting equipment, support header tank (1) and remove bolts (6), washers (7) and nuts (8) securing header tank (1) to the goalpost support assembly.

6. Remove header tank (1) assembly from the vehicle.

DISASSEMBLY

Numbers in parentheses refer to Fig. 2, unless otherwise specified.

Note: Position radiator assembly on wooden blocks with fan shroud (3, Fig. 1) up to protect radiator core during 'Disassembly'.

1. Remove mounting hardware securing fan shroud (3, Fig. 1) and fan cowl (4, Fig. 1) to radiator assembly (1, Fig. 1). Remove fan shroud and cowl from radiator assembly.

2. Remove bolts (17) and lockwashers (18) from both ends of cross brace (6). Remove lockwashers (18) and nuts (19) from both ends of cross brace (5). Remove cross braces from radiator assembly (1, Fig. 1).

3. Remove bolts (11), washers (12), lockwashers (20) and nuts (21) securing top and bottom supports (3 & 4) to left hand tank (1) and right hand tank (2). Remove top and bottom supports (3 & 4).

4. Remove nuts (16), lockwashers (15), bolts (14), studs (13) and stiffening strips (9, 10 & 20) securing left hand tank (1) to core assembly (7).

5. Remove left hand tank (1) from core assembly (7) and discard gasket (8).

6. Remove nuts (16), lockwashers (15), bolts (14), studs (13) and stiffening strips (9, 10 & 20) securing right hand tank (2) to core assembly (7).

7. Remove right hand tank (2) from core assembly (7). Discard gasket (8).

8. If required, remove drain cock assembly (13 through 17, Fig. 1) assembly from bottom of right hand tank (2).

Header Tank

Numbers in parentheses refer to Fig. 1.

1. If required, remove elbows (11) from header tank (1) noting orientation of elbows to aid in assembly.

2. If required, remove filler cap (17) from filler neck.

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INSPECTION

Numbers in parentheses refer to Fig. 2.

1. Steam clean all parts thoroughly with a suitable solvent.

2. Examine radiator core (7) core carefully for possible damage. Repair any damage discovered if equipped to do so, or, have repairs made at a reputable radiator repair shop.

3. Clean radiator left hand tank (1) and right hand tank (2) of all traces of corrosion, scale and old joint material.

ASSEMBLY

Numbers in parentheses refer to Fig. 2, unless otherwise specified.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE.

Note: Use a gasket sealer such as Permatex No. 2, or equivalent, during assembly to ensure leakproof joints.

1. If removed, install drain cock assembly (13 through 17, Fig. 1) on bottom of right hand tank (2).

2. Install new gasket (8), coated with sealer, to right hand tank (2). Attach stiffening strips (9, 10 & 20) to core assembly (7) and right hand tank (2) with bolts (14), studs (13), lockwashers (15) and nuts (16).

3. Install new gasket (8), coated with sealer, to left hand tank (1). Attach stiffening strips (9, 10 & 20) to core assembly (7) and left hand tank (1) with bolts (14), studs (13), lockwashers (15) and nuts (16).

Note: Tighten left hand tank (1) and right hand tank (2) to core assembly (7) from the centre out to ensure an evenly spread load.

4. Secure top and bottom supports (3 & 4) to left and right hand tanks (1 & 2) with bolts (11), washers (12), lockwashers (20) and nuts (21).

5. Secure cross braces (5) to radiator assembly (1, Fig. 1) with lockwashers (18) and nuts (19). Secure cross braces (6) to radiator assembly (1, Fig. 1) with bolts (17) and lockwashers (18). Tighten all nuts (19) and bolts (17).

6. Install fan shroud (3, Fig. 1) and fan cowl (4, Fig. 1)to radiator assembly (1, Fig. 1) and secure with mounting hardware.

Header Tank

Numbers in parentheses refer to Fig. 1.

1. If removed, apply Loctite 225 to elbows (11) and install in header tank (1), noting orientation of elbows as identified at disassembly.

2. Install filler cap (17) on filler neck.

INSTALLATION

Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0020, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.

1. If removed, install new rubber isolation mounts (19) in mounting brackets on the frame. If removed, install new rubber isolation mount (8) in radiator support bracket.

2. Using suitable lifting equipment, position radiator assembly (1) on rubber mounts (19). Secure radiator assembly to mounting brackets with bolts (18), snubbing washers (20) and locknuts (21). Torque tighten bolts (18) to 74 Nm (55 lbf ft).

Note: The thin fins and tubes of the radiator core are easily damaged, therefore, handle radiator assembly (1) with care.

3. Secure radiator support bracket (5) to radiator assembly (1) with bolts (10), washers (11) and nuts (12). Secure radiator support bracket (5) to radiator

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steady bracket on engine with bolt (6), washer (7) and locknut (9). Tighten all nuts (9 & 12) and bolts (6 & 10) to secure radiator assembly (1) in position.

4. Remove lifting equipment and connect all lines and tubes to radiator (1) assembly, as tagged at Removal.

5. Secure baffle plates and hydraulic oil cooler assembly to the front of radiator (1) assembly with mounting hardware, as removed at Removal.

6. Install fan guards (2) to fan shroud (3) with mounting hardware, as removed at Removal.

7. Ensure drain cock assembly (13 through 17) and all lines and pipes are securely tightened to prevent leaks at initial fill and start up.

Note: If **Header Tank (1)** was removed and has not yet been installed, proceed from step 8, however, if header tank (1) was not removed or has been reinstalled, proceed from step 13.

8. Fit header tank (1) assembly to goal post support assembly and secure with bolts (6), washers (7) and nuts (8).

9. Remove blanking caps from deaeration lines (12 & 13) and connect to elbows (11) on header tank (1), as noted at Removal.

10. Connect hose (3) to pipe at bottom of header tank (1) and secure in place with band clamp (2).

11. Connect overflow tube (10) to filler neck.

12. Secure all lines with clips and tie clips as removed during Removal. Ensure no lines are chaffing on sharp edges or resting against areas where heat will be evident.

13. Refer to Section 210-0000, COOLING SYSTEM for correct selection of coolant. Fill the cooling system through filler neck in header tank (1) with coolant until coolant level stabilizes at the bottom of filler neck.

14. Check all line and pipe connections for leaks prior to starting the vehicle. Tighten as required.

15. Switch the battery master switch to the 'On' position, start up the engine and check for leaks. Tighten lines and fittings and top up coolant level as required.

16. Install filler cap (17) on filler neck after the coolant level has stabilized at the bottom of filler neck.

17. Install hood assembly on the vehicle. Refer to Section 100-0040, HOOD AND MOUNTING.

18. Remove wheel blocks from road wheels.

CLEANING

Internal Cleaning - Water Tubes

If scale deposits are present inside the water tubes of the radiator, it is necessary to use a suitable scale remover such as 'Powdered Scale Solvent', or equivalent. This material is a free-flowing powder, inhibited to prevent attack on the cooling system materials.

> ⚠ **WARNING**
> **Take care to avoid contact of skin or eyes with the solvent. If contact is made it should be washed off immediately with clean water and medical advice should be taken.**

For general cleaning use it is recommended to use a concentration of 50 - 100 kg/m³ of water at a temperature of up to 60° C. Rapid circulation or agitation with compressed air will reduce the time for cleaning.

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Note: If scale deposits within the radiator are exceptionally heavy, concentrations up to 200 kg/m³ may be used.

The most convenient method of use is to prepare a concentrated solution by mixing the powder in hot water in a tank and then adding the concentrated solution to water contained in the radiator.

Note: The solvent must always be added carefully to water, not water to solvent.

External Cleaning

Note: If a build up of dirt is apparent during routine inspection, the following cleaning procedure should be adopted.

> ⚠ **WARNING**
> **To prevent possible injury when using compressed air or steam jet, wear adequate eye protection and do not exceed pressure values stated.**

1. Direct a steam jet at 100 - 300 kN/m², or compressed air at 500 - 700 kN/m² on to the faces of the radiator core.

2. Liberally brush a liquid detergent on to those surfaces which were not satisfactorily cleaned at step 1. Leave to soak for at least 1 hour.

3. Apply a high pressure steam jet at 100 - 300 kN/m², or compressed air at 500 - 700 kN/m² on to the treated surfaces, forcing the fouling material out from the radiator core.

4. Leave radiator core to dry before reinstalling the cooling equipment.

Note: In the case of grossly fouled surfaces which are not cleaned adequately in steps 1 through 4, the following procedure may be used.

5. Ensure that the radiator core is dry.

6. Liberally brush on to both sides of the radiator core an emulsifying cleaner such as 'Gunk', or equivalent, and leave to soak for at least 1 hour.

7. Apply a high pressure steam jet at 100 - 300 kN/m², or compressed air at 500 - 700 kN/m² on to the treated surfaces, from several different angles, forcing the fouling material out from the radiator core.

8. For surfaces with stubborn deposits, it may be necessary to repeat steps 5 through 7, brushing the surfaces between stages using a stiff bristle brush.

9. Leave radiator core to dry before reinstalling the cooling equipment.

MAINTENANCE

Refer to Section 210-0000, COOLING SYSTEM for recommended preventive maintenance procedures, service intervals and coolant selection procedures.

SPECIAL TOOLS

There are no special tools required for procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools and adhesives required. These tools and adhesives are available from your dealer.

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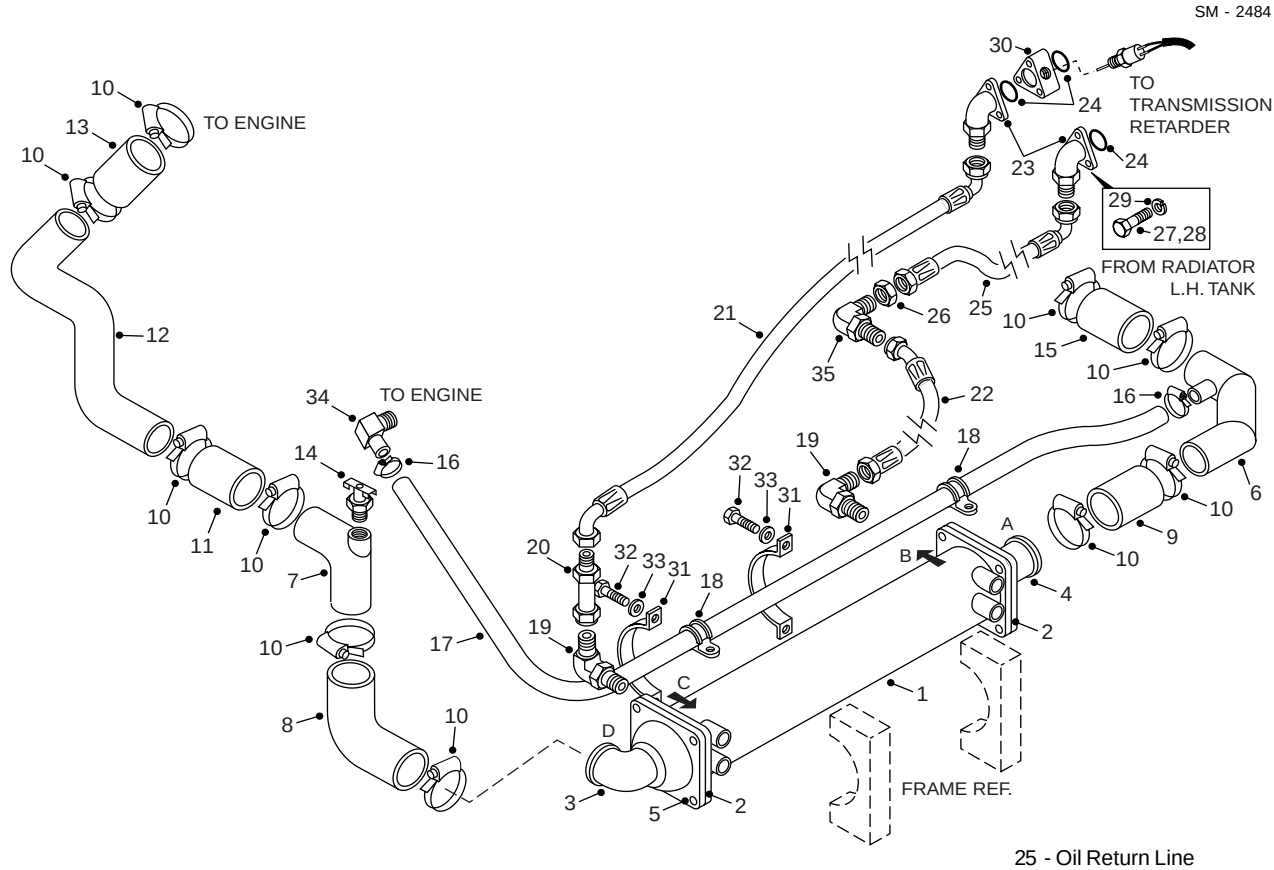
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SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	18	Bolt	74	55

* * * *

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1 - Heat Exchanger
2 - Viton Seal
3 - Cooler Flange - 90°
4 - Cooler Flange
5 - Socket Screw
6 - Coolant Inlet Tube
7 - Coolant Outlet Elbow
8 - Elbow
9 - Sleeve
10 - Clamp
11 - Sleeve
12 - Outlet Pipe
13 - Sleeve
14 - Bleed Nipple
15 - Sleeve
16 - Clamp
17 - Hose
18 - P- Clip
19 - Elbow - 90°
20 - Tube Assembly
21 - Oil Inlet Line
22 - Oil Return Line
23 - Elbow - 90°
24 - 'O' Ring
25 - Oil Return Line
26 - Locknut
27 - Bolt
28 - Bolt
29 - Lockwasher
30 - Block
31 - Clamp
32 - Bolt
33 - Lockwasher

Fig. 1 - Exploded View of Transmission Oil Cooler

DESCRIPTION AND OPERATION

Numbers and letters in parentheses refer to Fig. 1.

The transmission oil cooler is connected in the cooling and transmission oil circuits, between the radiator and transmission. The purpose of the transmission oil cooler is to maintain transmission oil within its required operating temperature range. Refer to Section 120-0010, TRANSMISSION AND MOUNTING and Section 210-0000, COOLING SYSTEM.

Coolant is drawn from port 'D', through coolant outlet elbow (7) by the engine water pump. It then circulates through the engine water jacket and, when thermostats are open, returns through coolant inlet tube (6) at port 'A'. Coolant circulates through cooler tubes in heat exchanger (1), cooling transmission oil around the tubes, and exits at port 'D'.

Transmission oil to be cooled enters heat exchanger (1), through oil inlet line (21) at port 'C', circulates around cooler tubes, exits at port 'B' through oil return line (22) to the transmission.

Note: Oil flow must always flow in the opposite direction to coolant flow through transmission oil cooler.

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Cooling System - Transmission Oil Cooler

Section 210-0060

REMOVAL

Numbers in parentheses refer to Fig. 1.

> **WARNING**
> **To prevent personal injury and property damage, be sure wheel blocks and lifting equipment are properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Open drain cock on the underside of the radiator and drain the coolant into a suitable container. Refer to Section 210-0000, COOLING SYSTEM.

4. Remove drain plug from underside of the transmission and drain the transmission oil into a suitable container. Refer to Section 120-0010, TRANSMISSION AND MOUNTING.

5. Remove mounting hardware securing front grille on the hood. Remove front grille from the hood.

6. Loosen clamp (10) and slide coolant inlet tube (6) and sleeve (9) from connection at port 'A'. Drain coolant from coolant inlet tube (6) and cooler flange (4) into a suitable container.

7. Loosen clamp (10) and slide coolant outlet elbow (7) and elbow (8) from connection at port 'D'. Drain coolant from coolant outlet elbow (7) and cooler flange (3) into a suitable container.

8. Remove drain plug from underside of heat exchanger (1) and drain oil into a suitable container. Reinstall drain plug in heat exchanger (1).

9. Remove oil inlet line (21) and tube assembly (20) from elbow (19) at port 'C' on heat exchanger (1). Drain any oil in the line into a suitable container.

10. Remove oil return line (22) from elbow (19) at port 'B' on heat exchanger (1). Drain any oil in the line into a suitable container.

11. Support transmission oil cooler assembly with a suitable lifting device and remove bolts (32), washers (33) and clamps (31). Remove transmission oil cooler assembly from the inside of the front bumper.

CLEANING AND DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

Note: In the event of a major mechanical failure, the transmission oil cooler assembly should be cleaned thoroughly or replaced. Do not attempt to clean cooler cores after a transmission failure in which metal particles from worn or broken parts are released into the oil. Replace the cooler cores.

In many areas, raw water is extremely corrosive or scale forming and should be treated to prevent damage to the transmission oil cooler. A properly maintained cooling system will significantly reduce cleaning intervals. Refer to Section 210-0000, COOLING SYSTEM.

Cleaning Oil Side

> **WARNING**
> **Dangerous fumes. To prevent personal injury, use trichloroethane only in the open or in a well ventilated room.**

1. Clean transmission oil cooler before sludge hardens. After transmission oil cooler is completely drained, circulate a solution of trichloroethane through the passages surrounding the cooler tubes in heat exchanger (1) to remove sludge.

2. If cooler tubes are badly clogged, circulate an oakite or alkaline solution through heat exchanger (1). Solution should be circulated through heat exchanger (1), in the reverse direction to normal flow, for approximately 15 minutes, after soaking for 10 minutes. The duration of circulation depends on how badly clogged the cooler tubes are. Flush thoroughly with clean hot water.

Cleaning Water Side

1. Match mark cooler flanges (3 & 4) and heat exchanger (1) to aid in assembly.

2. Remove socket screws (5) securing cooler flanges (3 & 4) to heat exchanger (1). Remove cooler flanges (3 & 4) from heat exchanger (1) and discard viton seals (2).

3. Make up a solution composed of 1/3 muriatic acid and 2/3 water. To each 9.5 litres (2.5 gal) of solution, add 227 g (0.5 lb) of oxalic acid.

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4. Immerse heat exchanger (1) in the cleaning solution. Cleaning action is noticeable by bubbling and foaming. The process must be carefully observed and when bubbling stops, usually between 30 - 60 sec., remove heat exchanger (1) from cleaning solution and flush thoroughly with clean, hot water. After cleaning, dip heat exchanger (1) in light oil.

Note: Severely fouled cooler tubes can be cleaned by use of a rotary brush if normal cleaning is not sufficient.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

1. Install new viton seals (2) to cooler flanges (3 & 4) and align cooler flanges to heat exchanger (1), as match marked at disassembly.

2. Secure cooler flanges (3 & 4) to heat exchanger (1) with socket screws (5). Tighten socket screws (5) alternately to give an even seal around cooler flange area.

INSTALLATION

Numbers and letters in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 220-0000, STEERING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Using suitable lifting equipment, position transmission oil cooler assembly on mounting points in the inside of the front bumper. Secure with bolts (32), washers (33) and clamps (31).

2. If removed, install elbows (19) in ports 'B' and 'C' on heat exchanger (1). Install oil inlet line (21) and tube assembly (20) on elbow (19) in port 'C', and oil outlet line (22) on elbow (19) in port 'B'.

4. Install coolant outlet elbow (7) and elbow (8) on connection at port 'D' and secure with clamps (10).

5. Install coolant inlet tube (6) and sleeve (9) on connection at port 'A' and secure with clamps (10).

6. If removed, install drain plug in underside of transmission and fill transmission with lubricant, as specified in Section 300-0020, LUBRICATION SYSTEM.

Note: Open bleed nipple (14) on coolant outlet elbow (7) at initial fill. The bleed nipple should be left open until coolant starts to leak from the nipple, indicating that all air in the system up to this level has escaped.

7. Ensure drain cock on underside of radiator is closed and fill radiator header tank with coolant specified in Section 210-0000, COOLING SYSTEM.

8. Place the battery master switch in the 'On' position, start the engine and check for leaks. Tighten lines and fittings as required.

9. Install front grille assembly to the hood with mounting hardware removed during removal.

10. Remove wheel blocks from all road wheels.

SERVICE TOOLS

There are no special service tools required for the procedures outlined in this Section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

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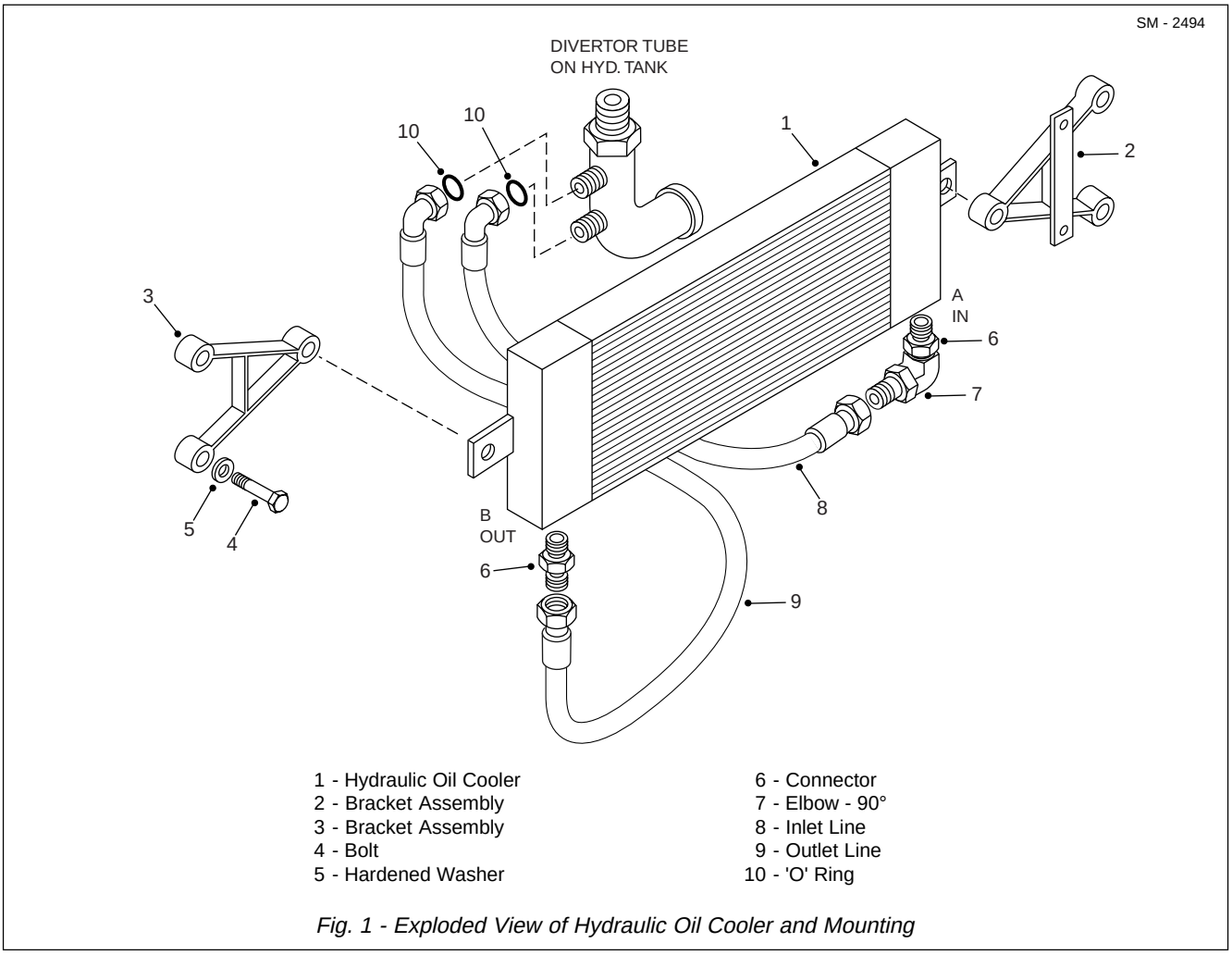
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1 - Hydraulic Oil Cooler
2 - Bracket Assembly
3 - Bracket Assembly
4 - Bolt
5 - Hardened Washer
6 - Connector
7 - Elbow - 90°
8 - Inlet Line
9 - Outlet Line
10 - 'O' Ring

Fig. 1 - Exploded View of Hydraulic Oil Cooler and Mounting

DESCRIPTION AND OPERATION

Numbers and letters in parentheses refer to Fig. 1.

The air cooled hydraulic oil cooler is mounted on the front of the radiator assembly, with the purpose of cooling hydraulic oil circulating through the hydraulic tank.

Hydraulic oil enters hydraulic oil cooler (1) at port 'A', through inlet line (8), from the diverter connector on the hydraulic tank.

The hydraulic oil is cooled by the air flow through the fins and exits from port 'B', through outlet line (9) and flows back to the opposite fitting on the diverter connector.

Note: The fitting closest to the spud on the diverter connector is the supply with the other fitting being the return.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, lower the body completely and apply the parking brake. Switch off the engine and secure shipping bar in the 'Locked' position.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Remove drain plug from hydraulic tank remote drain fitting. Drain oil in the hydraulic tank into a suitable container and re-install drain plug.

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4. Remove mounting hardware securing front grille on the hood assembly. Remove front grille from the hood.

5. Remove inlet line (8) from elbow (7) and connector (6) in port 'A' of hydraulic oil cooler (1). Drain oil from inlet line (8) into a suitable container. Plug inlet line and cap port 'A' to prevent ingress of dirt.

6. Remove outlet line (9) from connector (6) in port 'B' of hydraulic oil cooler (1). Drain oil from outlet line (9) into a suitable container. Plug outlet line and cap port 'B' to prevent ingress of dirt.

7. Remove remove mounting hardware securing hydraulic oil cooler (1) to bracket assemblies (2 & 3). Remove hydraulic oil cooler (1) from its mounting.

8. If required, remove bolts (4) and hardened washers (5) securing bracket assemblies (2 & 3) to the radiator assembly.

CLEANING AND INSPECTION

1. Inspect fins on hydraulic oil cooler carefully, for trapped debris and damage. If hydraulic oil cooler fins show signs of leakage or are excessively damaged, it must be replaced as an assembly.

2. Check connectors in hydraulic oil cooler ports for damaged threads. Replace if required.

⚠ WARNING
Dangerous fumes. To prevent personal injury, use trichloroethane only in the open or in a well ventilated room.

3. After hydraulic oil cooler is completely drained, circulate a solution of trichloroethane through the cooler tubes.

4. If cooler tubes are badly clogged, circulate an oakite or alkaline solution through the hydraulic oil cooler, in the reverse direction to normal flow, for approximately 15 minutes. The duration of circulation depends on how badly clogged the cooler tubes are. Flush thoroughly with clean hot water.

INSTALLATION

Numbers and letters in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 220-0000, STEERING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. If removed, secure bracket assemblies (2 & 3) to the radiator assembly with bolts (4) and hardened washers (5).

2. Secure hydraulic oil cooler (1) to bracket assemblies (2 & 3) with mounting hardware, as removed at 'Removal'.

3. Install inlet line (8) and outlet line (9) in their respective ports, as removed at 'Removal'.

4. Fill hydraulic tank with oil. Refer to Section 230-0040, HYDRAULIC TANK, for correct fill level and Section 300-0020, LUBRICATION SYSTEM for specifications of oil to be used.

5. Place the battery master switch in the 'On' position, start engine and operate the body hydraulics several times to circulate the oil. Check hydraulic oil cooler (1) and lines for leaks. Tighten fittings as required.

6. Install front grille assembly to the hood with mounting hardware, as removed at 'Removal'.

7. Secure shipping bar in the 'Stowed' position and remove wheel blocks from all road wheels.

MAINTENANCE

Check and clean hydraulic oil cooler every 4 000 hours, or more frequently, if required. Debris in the cooling fins can restrict the flow of air through the cooler which significantly reduces the cooling effect.

Note: In the event of a hydraulic failure, hydraulic oil cooler should be removed and cleaned of any debris, to prevent clogging.

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DESCRIPTION

Numbers in parentheses refer to Figs. 2 through 5.

The operation of the steering system is hydrostatic. That is to say, there is no mechanical connection between the steering column and the steered wheels. Instead there are hydraulic pipes and lines between the steering components and the steering cylinders. Actuating pressure for steering operation is supplied by main hydraulic pump (2).

When the steering wheel is turned, steering valve (4) meters an oil volume proportional to the amount of turn. This volume of oil flows to the appropriate side of steering cylinders (7). Steering valve (4) returns automatically to its neutral position when turning is completed.

Emergency steering pressure is provided by a ground driven emergency steering pump (3) on the transmission. A warning light (on the right hand bank of warning lights in the cab) illuminates to warn of a fault in the steering system supply pressure. If the light illuminates, stop the vehicle and investigate the cause.

Note: The steering system warning light illuminates when the ignition is turned on and should go out when the engine starts.

A brief description of the individual components shown in the steering system are listed below. Detailed service and operating instructions for the individual components can be found in their relative component sections in this manual.

Hydraulic Tank (1)

Refer to Section 230-0040, HYDRAULIC TANK.

Mounted off the tractor frame at the rear of the cab, the hydraulic tank is the common oil reservoir for the steering and body hydraulic systems.

Integral with the tank assembly are two suction screens, filter element, relief valve, adaptor plate, access covers and filler neck assembly. Two sight gauges on the right hand side of the tank assembly indicate hydraulic oil level. Located on top of the tank assembly are a breather, pressure switch and temperature switch.

Internally there is a baffle plate which divides the tank assembly into a body hoist compartment and a steering compartment. Should oil level drop below this baffle level, the tank assembly operates as two separate tanks.

Main Hydraulic Pump (2)

Refer to Section 230-0050, MAIN HYDRAULIC PUMP.

Mounted off the transmission power takeoff, the main hydraulic pump supplies hydraulic oil for operating the steering and body hoist systems.

Hydraulic oil is drawn from the hydraulic tank (1) and pumped through the priority valve (5). A priority spool within the priority valve (5) directs oil supply from the main hydraulic pump to the steering valve (4).

The main hydraulic pump is a multiple gear type pump which operates in the one direction only (it is assembled for right hand (clockwise) rotation, as viewed from the driveshaft end).

Note: Never drive a pump in the wrong direction of rotation, as pump seizure may result.

Steering Valve (4)

Refer to Section 220-0090, STEERING VALVE.

Mounted off the underside of the cab floor, the steering valve is connected to the steering column and controls hydraulic oil flow to the steering cylinders.

The steering valve is of a closed centre design, indicating oil is dead headed at the valve until it is operated.

There are five ports on the steering valve housing as follows:

Port 'P' - Supply from pump via priority valve
Port 'T' - Return to tank
Port 'R' - Cylinder supply for right hand turn
Port 'L' - Cylinder supply for left hand turn
Port 'LS' - From Load Sensing port on priority valve

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Steering System - Steering Schematic

Section 220-0000

Priority Valve (5)

Refer to Section 220-0105, PRIORITY VALVE.

The priority valve is mounted off the rear right hand fender support. The valve is installed in the lines between the steering valve (4) and body control valve. Hydraulic oil is pumped to the priority valve (5) and depending on the position of the spool within the priority valve (5), oil is directed to the steering or body hoist systems.

There are six ports on the priority valve housing as follows:

Port 'P' - Pump Inlet Port - Supply from pump
Port 'PP' - Pilot Pressure - Plugged
Port 'CF' - Control Flow - Supply to steering valve
Port 'EF' - Excess Flow - Supply to body hoist valve
Port 'LS' - Load Sensing - To LS port on steering valve
Port 'T' - Relief Return - Return to tank

Emergency Valve (6)

Refer to Section 220-0140, EMERGENCY VALVE.

Mounted off the right hand cab leg, the emergency valve forms part of the emergency steering system. It is connected to the main output line of the ground driven **Emergency Steering Pump (3)** mounted on the transmission.

Steering Cylinders (7)

Refer to Section 220-0120, STEERING CYLINDER.

There are two single stage, double acting steering cylinders on the machine. The cylinder base end is connected to the articulation and oscillation pivot, and, the piston rod end is connected to the front frame. Single stage double acting means that the piston rod can have oil applied to either side, extending or retracting the piston rod.

Cylinder mounting is by pins, spacers, seals and, spherical bearings secured with circlips. Spherical bearings permit a limited amount of cylinder misalignment when travelling over rough terrain.

Diagnostic Test Point

Mounted on the rear right hand side of the tractor frame are diagnostic test points. The steering system has one diagnostic test point which enables the service engineer to obtain an accurate steering system pressure reading.

Steering system pressure is set at 241 bar (3 500 lbf/in²).

'O' RING FACE SEALS (ORFS)

Where hydraulic lines are fitted with ORFS connections, the following procedure should be carried out during 'Installation'. Refer to Fig. 1.

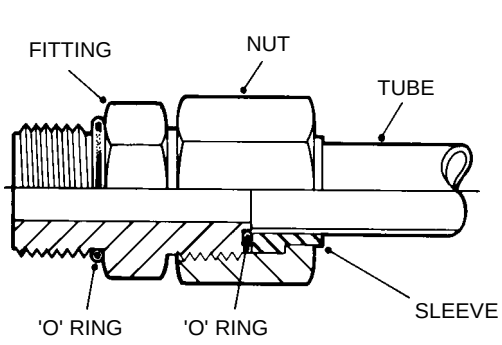


Fig. 1 - Assembly of Typical ORFS Connector

a. Ensure 'O' ring/seal is in place and that the joining surfaces are clean. If necessary, retain 'O' ring/seal in place with a light coating of grease or vaseline.

b. Initially, the nuts should be tightened by hand.

c. Where a hose is fitted, ensure that it is not twisted or kinked when the nuts are tightened so that it is allowed to adopt a natural position.

d. Where a tube is fitted, ensure that the connection is aligned correctly.

e. Tighten the nut a further 1/4 to 1/2 a turn using the correct size spanner (wrench).

f. Check that a satisfactory hose or tube routing has been achieved.

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FILLING AND BLEEDING THE STEERING SYSTEM

1. Fill hydraulic tank to maximum level. Be ready to add oil when the engine is started. Do not let oil drop below the pump suction line to prevent air entering the system.

2. Start engine and let it idle. Immediately add oil to the tank as required. When no more oil can be added and oil is clear, proceed as follows:

a. Turn the steering wheel from lock to lock to bleed the air in the steering cylinders and lines.

Note: Immediately upon valve spool actuation oil must be added to the hydraulic tank to replenish the oil moving into the circuit.

⚠ WARNING
Do not operate the machine until all air is bled from the oil.

b. When the oil in the tank is clear (not cloudy or creamy), the system is free of air.

Note: Slight creep or drift of the steering wheel is normal.

c. Fill hydraulic tank to the recommended level and install the filler cap.

Hydraulic Oil

The steering system should be kept filled with hydraulic oil as listed in Section 300-0020, LUBRICATION SYSTEM.

MAINTENANCE

Maintenance instructions, intervals and warnings, in the individual steering and body hydraulic component sections of this manual, should be adhered to at all times.

SERVICE TOOLS

It is recommended that the following service tools are used when carrying out pressure and temperature checks during maintenance procedures. These tools, along with other general service tools, are available from your dealer. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of these tools.

Multi-Gauge

The multi-gauge is basically four pressure gauges in one. Continuous system pressure readings are indicated on one of three simultaneously reading gauges through a pressure range of 30 in of vacuum to 5 000 lbf/in².

Non-contact Infrared Thermometer

The infrared thermometer can be used to spot heat problems early in electrical, mechanical and hydraulic systems. Hand held and easy to use, you simply aim, pull the trigger, and read the temperature. Since there is no need to touch what you are measuring, temperatures of hard-to-reach or moving components can be taken without getting burned or shocked.

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Steering System - Steering Schematic

Section 220-0000

SM - 2455A

COMPONENTS
1 - Hydraulic Tank
2 - Main Hydraulic Pump
3 - Emergency Steering Pump
4 - Steering Valve
5 - Priority Valve
6 - Emergency Valve
7 - Steering Cylinder
8 - Oil Pressure Switch

COLOUR CODES
Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

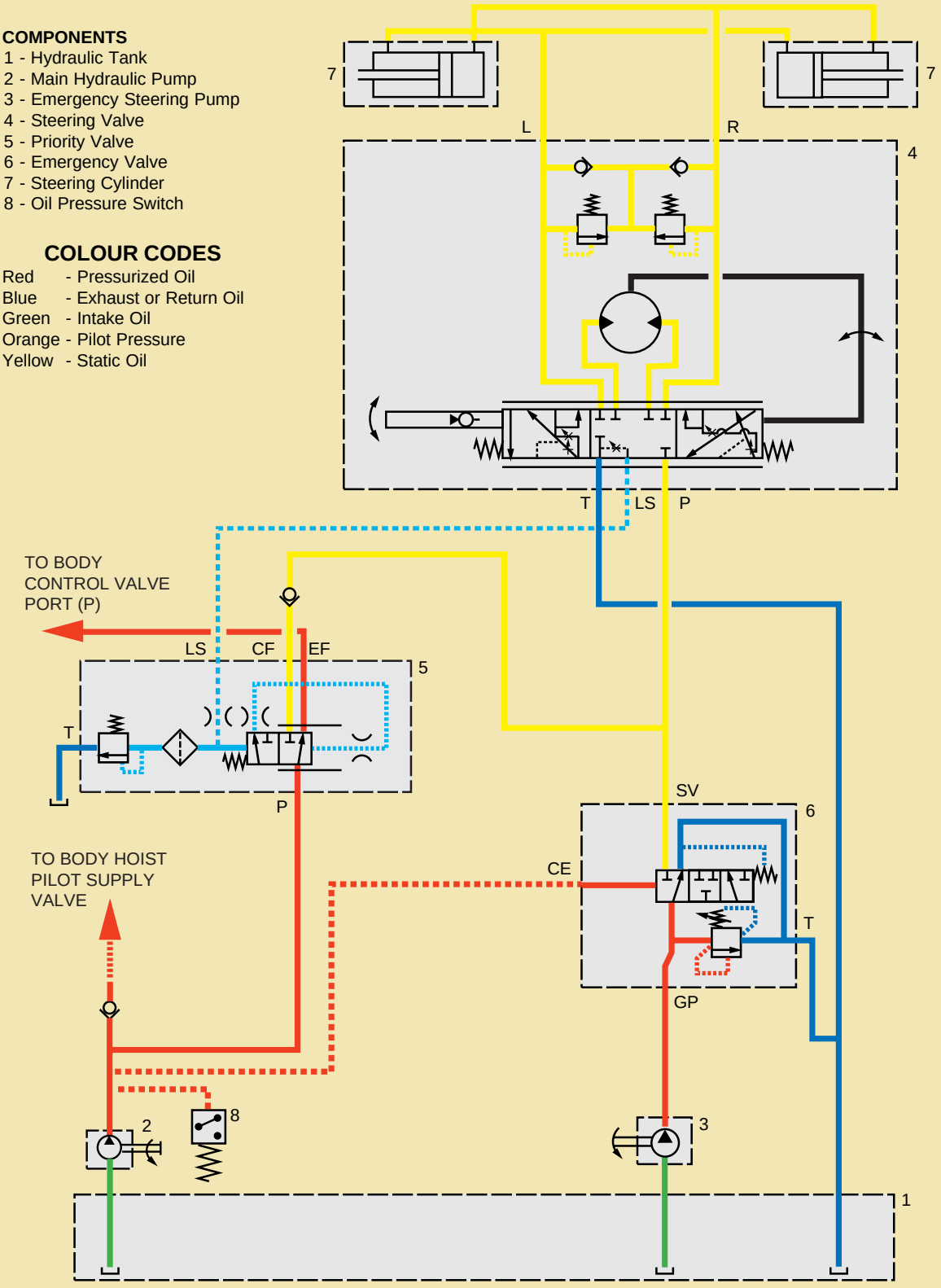


Fig. 2 - Steering System Schematic Diagram - Engine Running, Steering Valve Neutral

Courtesy of Machine.Market

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SM - 2455B

COMPONENTS
1 - Hydraulic Tank
2 - Main Hydraulic Pump
3 - Emergency Steering Pump
4 - Steering Valve
5 - Priority Valve
6 - Emergency Valve
7 - Steering Cylinder
8 - Oil Pressure Switch

COLOUR CODES
Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

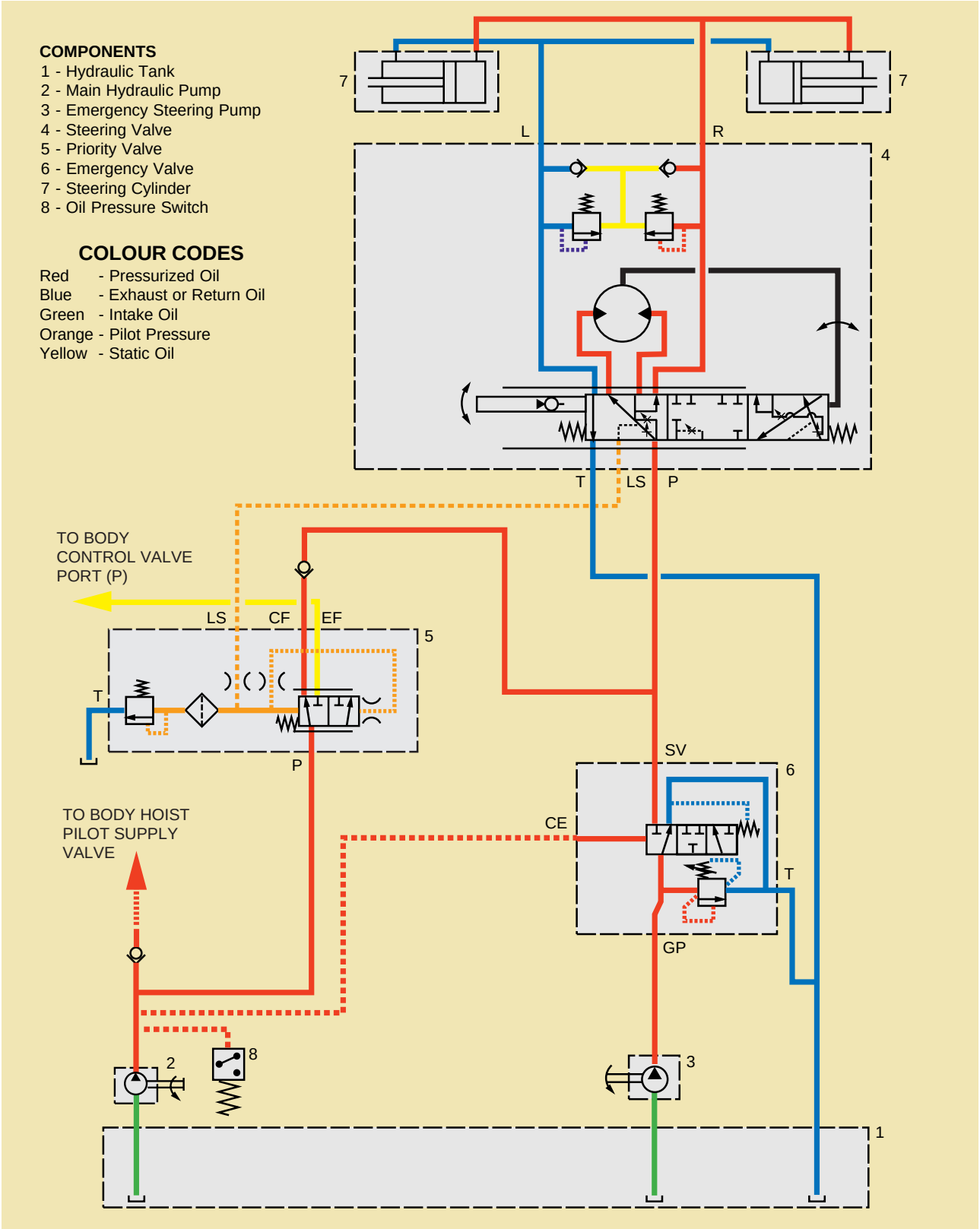


Fig. 3 - Steering System Schematic Diagram - Engine Running, Steering Valve Right Turn

Courtesy of Machine.Market

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Steering System - Steering Schematic

Section 220-0000

SM - 2455C

COMPONENTS
1 - Hydraulic Tank
2 - Main Hydraulic Pump
3 - Emergency Steering Pump
4 - Steering Valve
5 - Priority Valve
6 - Emergency Valve
7 - Steering Cylinder
8 - Oil Pressure Switch

COLOUR CODES
Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

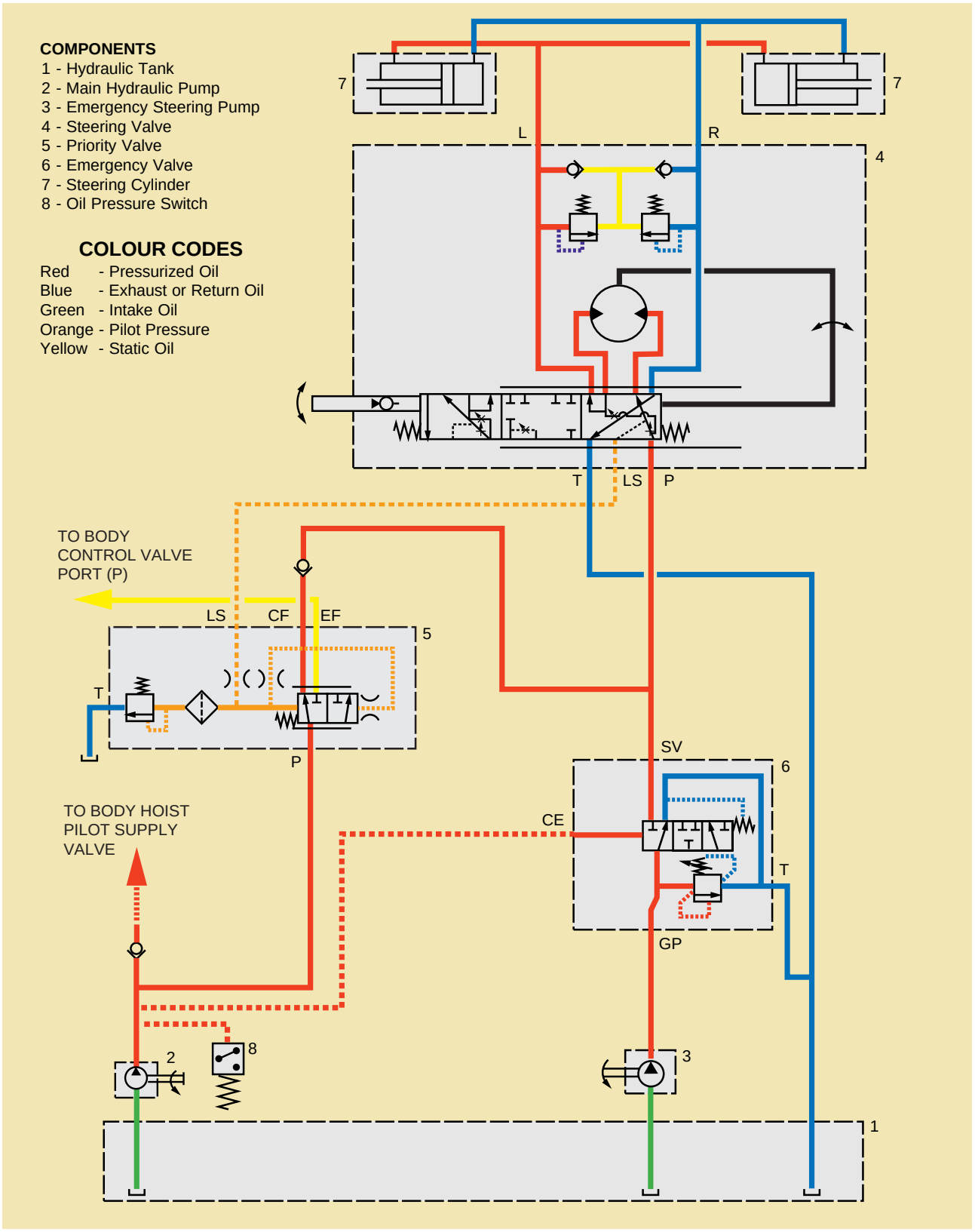


Fig. 4 - Steering System Schematic Diagram - Engine Running, Steering Valve Left Turn

Courtesy of Machine.Market

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SM - 2455D

COMPONENTS
1 - Hydraulic Tank
2 - Main Hydraulic Pump
3 - Emergency Steering Pump
4 - Steering Valve
5 - Priority Valve
6 - Emergency Valve
7 - Steering Cylinder
8 - Oil Pressure Switch

COLOUR CODES
Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

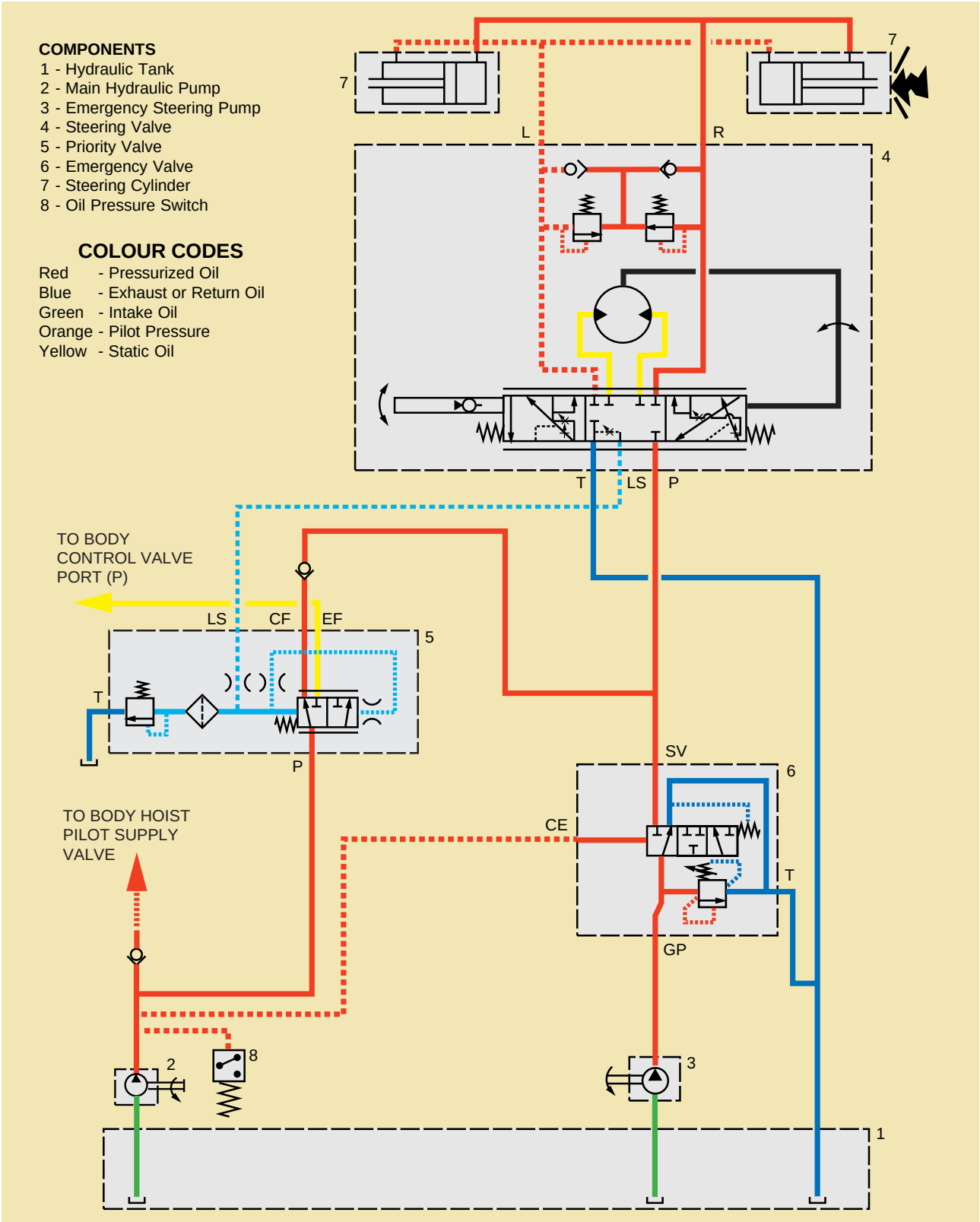


Fig. 5 - Steering System Schematic Diagram - Engine Running, Steering Cylinder Shock Load

* * * *

Courtesy of Machine.Market

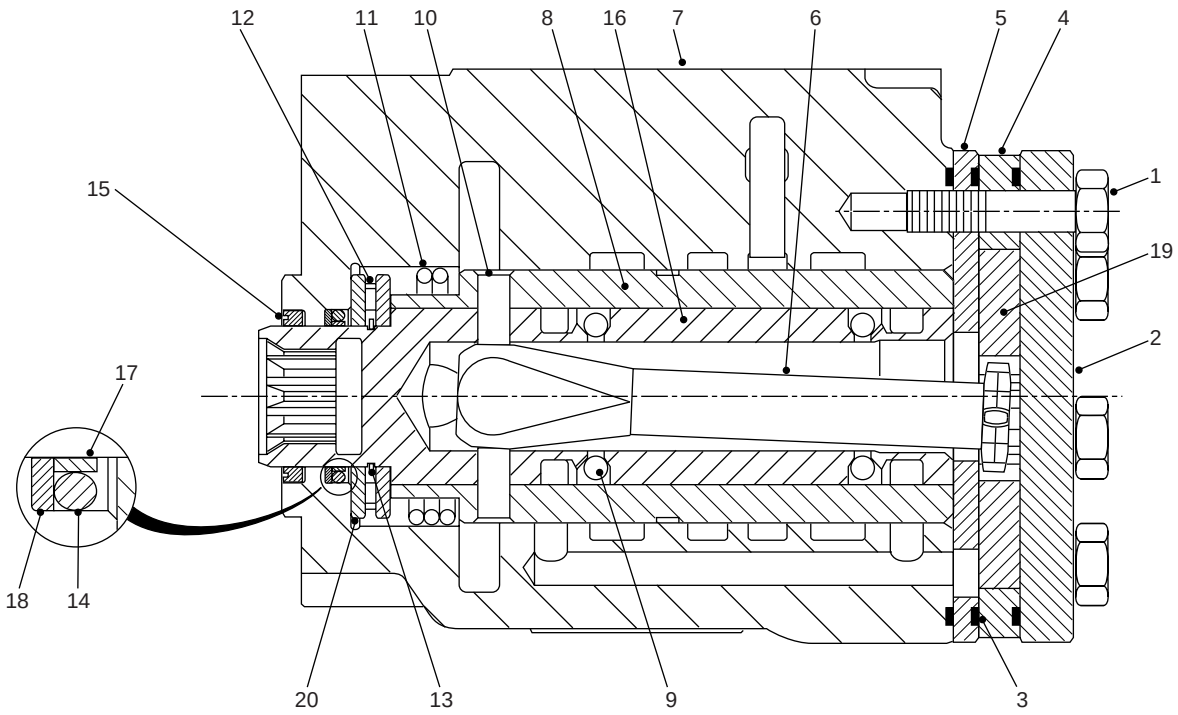
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SM - 2016



1 - Capscrew	7 - Valve Housing	13 - Bearing Race	19 - Gerotor Gear
2 - End Cap	8 - Sleeve	14 - 'O' Ring	20 - Retainer
3 - 'O' Ring	9 - Ball - Check	15 - Dust Seal	21 - 'O' Ring
4 - Gerotor Housing	10 - Pin	16 - Spool	22 - 'O' Ring
5 - Spacer Plate	11 - Centring Springs	17 - Seal	23 - Roll Pin
6 - Driveshaft	12 - Needle Bearing	18 - Backup Ring	24 - Ball valve

Fig. 1 - Sectional View of Steering Valve

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The steering valve can be identified as item 4 in Section 220-0000, STEERING SYSTEM SCHEMATIC.

The steering valve, mounted off the underside of the cab floor and connected to the steering column, controls hydraulic flow in the steering system. The steering valve is of a closed centre design, which means that the valve does not have any flow through it when it is in the neutral or no steering position. The steering valve has integral cylinder relief valves which relieve shock loads on the steering cylinders by transferring excessive pressure applied to the oil by the road shock, to the opposite end of the cylinders. This shock, if left unchecked, might damage steering linkage components.

The main components of the steering valve are valve housing (7), gerotor housing (4), gerotor gear (19), driveshaft (6), sleeve (8) and spool (16).

There are five ports on valve housing (7) as follows:

Port 'P' - Supply from pump via priority valve
Port 'T' - Return to tank
Port 'R' - Cylinder supply for right hand turn
Port 'L' - Cylinder supply for left hand turn
Port 'LS' - Load Sensing

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Turning action of the steering wheel is transmitted through the steering column to sleeve (8) and driveshaft (6), which is fastened to the sleeve with centring pin (10). Rotation of driveshaft (6) causes gerotor gear (19) to rotate in gerotor housing (4). When gerotor gear (19) rotates, oil in gerotor housing (4) pockets (see Fig. 2) is forced out and flows through spool (16) and sleeve (8) to the steering cylinder port.

Spool (16) contains porting matched to sleeve (8) and rotates within sleeve (8) to provide directional control of the oil. See Fig. 3.

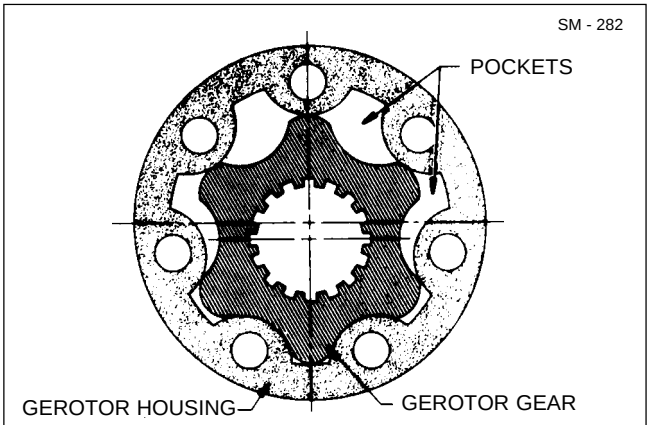


Fig. 2 - Gerotor Gear Set

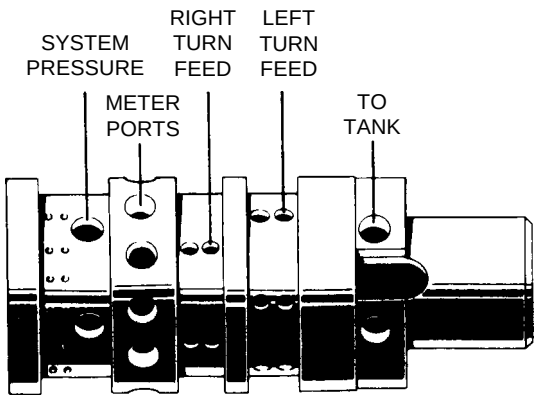


Fig. 3 - Porting of Spool and Sleeve

OPERATION

Numbers in parentheses refer to Fig. 1.

When the operator turns the steering wheel a certain number of degrees for either a left or right hand turn, the movement is transmitted through the steering column to spool (16). After a minimum rotation of 2.5 degrees, the ports in spool (16) start to align with ports in sleeve (8). When the steering wheel is rotated to a maximum of 10 degrees the ports are fully aligned allowing full oil flow. After 10 degrees of travel in either direction the spool and sleeve rotate as an assembly through centring pin (10).

Oil from the priority valve flows into valve housing (7) at port 'P' and is channelled through sleeve (8) and spool (16) to gerotor housing (4). Porting in gerotor housing (4) permits oil to flow into pockets formed by gerotor housing (4) and gerotor gear (19). As spool (16) rotates, driveshaft (6) also rotates which, in turn, rotates gerotor gear (19) to which it is splined. When gerotor gear (19) rotates it progressively forces oil out of the pockets (see Fig. 2) of gerotor housing (4). The oil is channelled through sleeve (8) and spool (16) and exits valve housing (7) through port 'R' for a right hand turn, or port 'L' for a left hand turn. Oil then travels through steering lines to the steering cylinders.

As the steering cylinder pistons move, oil forced out of the steering cylinders returns to valve housing (7). The return oil passes through valve sleeve (8) and spool (16) and exits through port 'T' to tank.

When the steering effort is released, centring spring (11) which was put under tension by the rotation of spool (16), forces sleeve (8) to rotate back to its original position. This puts the ports out of alignment and stops pump oil flow to the steering cylinders. The vehicle stops turning further but will hold the present turning radius until spool (16) is rotated past the 2.5 degree minimum.

REMOVAL

Numbers in parentheses refer to Fig. 4.

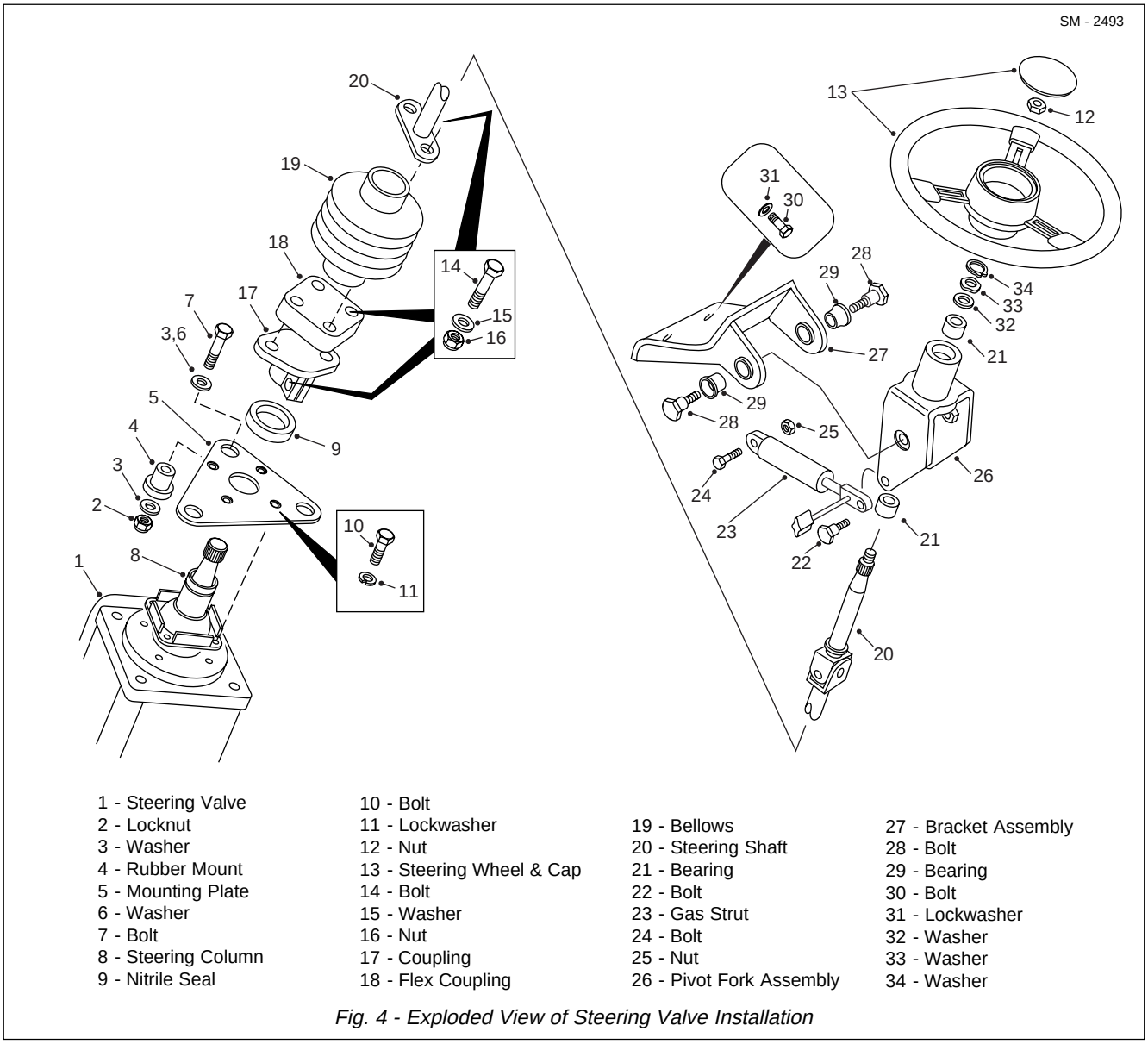
⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels, except the front right hand and place the battery master switch in the 'Off' position.

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1 - Steering Valve	10 - Bolt	19 - Bellows	27 - Bracket Assembly
2 - Locknut	11 - Lockwasher	20 - Steering Shaft	28 - Bolt
3 - Washer	12 - Nut	21 - Bearing	29 - Bearing
4 - Rubber Mount	13 - Steering Wheel & Cap	22 - Bolt	30 - Bolt
5 - Mounting Plate	14 - Bolt	23 - Gas Strut	31 - Lockwasher
6 - Washer	15 - Washer	24 - Bolt	32 - Washer
7 - Bolt	16 - Nut	25 - Nut	33 - Washer
8 - Steering Column	17 - Coupling	26 - Pivot Fork Assembly	34 - Washer
9 - Nitrile Seal	18 - Flex Coupling		

Fig. 4 - Exploded View of Steering Valve Installation

3. Remove hydraulic tank remote drain plug and drain hydraulic oil into a suitable container. Reinstall drain plug in hydraulic tank remote drain fitting.

4. Remove front right hand wheel from the vehicle, as described in Section 160-0050, WHEEL RIM AND TYRE.

5. Clean outer area of steering valve (1) with a suitable solvent. Ensure all hydraulic lines connected to steering valve (1) are identified for ease of installation and with suitable containers available to catch leakage, disconnect hydraulic lines. Cap all lines and plug all ports to prevent entry of dirt.

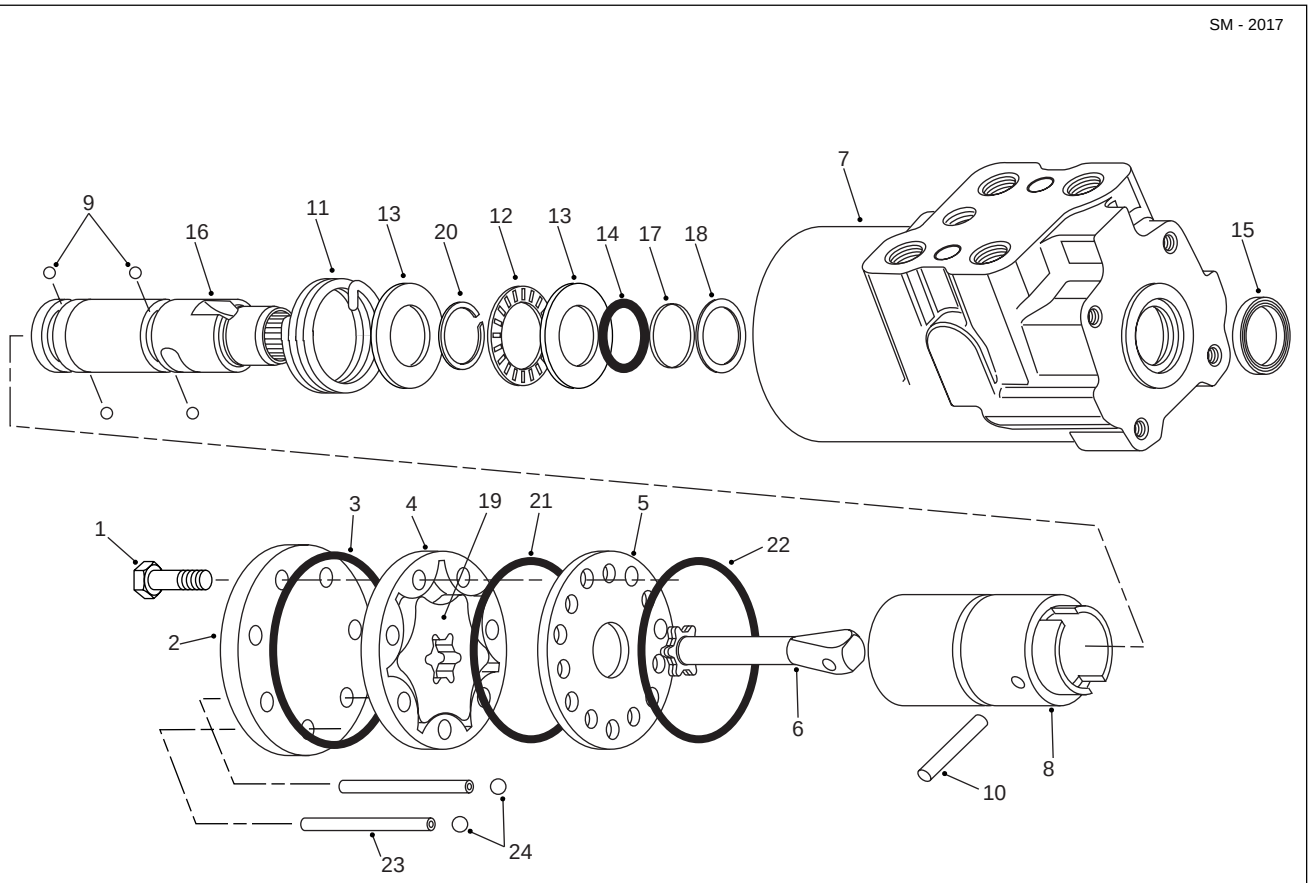
6. Slide bellows (19) over steering column (8) to allow access and loosen bolt (14), washer (15) and nut (16) which tightens coupling (17) onto steering column (8).

7. Support steering valve (1) and remove mounting bolts (10) and lockwashers (11) securing steering valve (1) to mounting plate (5). Remove steering valve (1) to a clean area for disassembly.

8. If required, remove bolts (7), washers (3 & 6), locknuts (2), rubber mounts (4) and mounting plate (5) from the floor plate. Discard rubber mounts (4), if damaged.

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1 - Capscrew
2 - End Cap
3 - 'O' Ring
4 - Gerotor Housing
5 - Spacer Plate
6 - Driveshaft
7 - Valve Housing
8 - Sleeve
9 - Ball - Check
10 - Pin
11 - Centring Springs
12 - Needle Bearing
13 - Bearing Race
14 - 'O' Ring
15 - Dust Seal
16 - Spool
17 - Seal
18 - Backup Ring
19 - Gerotor Gear
20 - Retainer
21 - 'O' Ring
22 - 'O' Ring
23 - Roll Pin
24 - Ball valve

Fig. 5 - Exploded View of Steering Valve

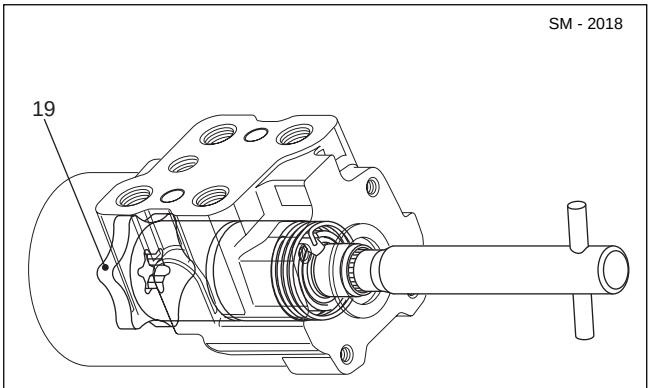
DISASSEMBLY

Numbers in parentheses refer to Fig. 5, unless otherwise specified.

Note: Steering valves fitted with anti-cavitation valves must be disassembled and assembled in the vertical postion to prevent ball valves (24) becoming trapped in the wrong cavities within the valve housing (7).

1. Clamp steering valve assembly horizontally in a soft jawed vice and break loose the seven capscrews (1). With capscrews (1) loosened, place steering valve vertically in vice, end cap (2), up.

Note: Hidden pin. If tension on this pin is released

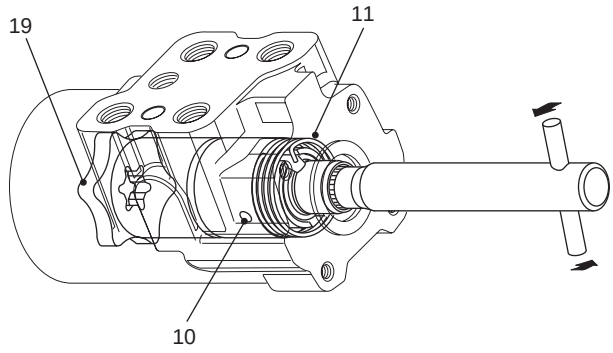


19 - Gerotor Gear

Fig. 6 - Gerotor Gear and Splined Drive Engaged

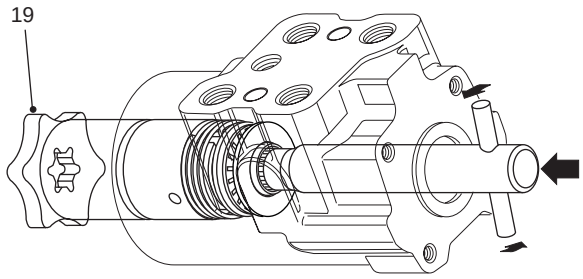
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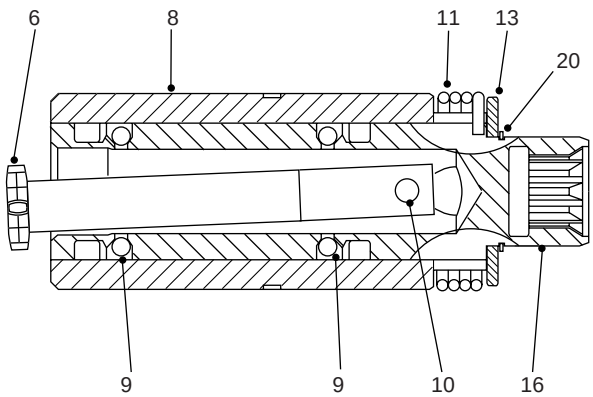
10 - Pin
11 - Centring Springs
19 - Gerotor Gear

Fig. 7 - Compressing Centering Spring



19 - Gerotor Gear

Fig. 8 - Removing Spool and Sleeve Assembly



6 - Driveshaft
8 - Sleeve
9 - Ball - Check
10 - Pin
11 - Centring Springs
13 - Bearing Race
16 - Spool
20 - Retainer

Fig. 9 - Sectional View of Spool and Sleeve Assembly

before these parts are fully disengaged and the pin is not horizontal, the pin can drop and lockup can occur.

2. Remove cap screws (1) securing end cap (2), gerotor housing (4) and spacer plate (5) to valve housing (7). Remove end cap (2) from valve housing (7) and discard 'O' ring (3).

3. Remove gerotor housing (4) and gerotor gear (19) from valve housing (7). Remove and discard 'O' ring (21) from gerotor housing (4).

4. Remove spacer plate (5) from valve housing (7).

5. Remove and discard 'O' ring (22) from valve housing (7).

6.Using a cloth to protect the hand, place gerotor gear (19) over end of drive shaft (6) and engage special tool with splined end of spool (16). Refer to Fig. 6.

7. Hold gerotor gear (19) and prevent drive shaft (6) from turning. Twist special tool to compress centering spring (11) radially CW or CCW, decreasing the coil diameter of the centering spring (11) allowing spool and sleeve assembly to be removed. Refer to Fig. 7.

8. With drive held stationary and centering spring (11) compressed, carefully push spool (16), sleeve (8), ball checks (9), drive shaft (6), pin (10), bearing races (13), retainer (20) and needle thrust bearing (12), as a complete assembly, from valve housing (7). Refer to Fig. 8.

9. Remove bearing race (13) and needle thrust bearing (12) from spool and sleeve assembly.

10. Using suitable pliers, remove retainer (20) and bearing race (13) from spool (16) and sleeve (8) assembly. Refer to Fig. 9.

11. Remove centering spring (11) from spool (16) and sleeve (8) assembly. Refer to Fig. 9.

12. Remove pin (10) and slide drive shaft (6) from spool (16) and sleeve (8) assembly. Refer to Fig. 9.

13. Carefully remove spool (16) and ball checks (9) from sleeve (8). Refer to Fig. 9.

14. Use a soda straw as a guide tool to remove the roll pin (23) and ball valve (24) from the anti-cavitation valve ports. Insert two soda straws, one in each anti-cavitation valve bore. Remove valve housing (7) from vice and tilt until roll pins (23) and ball valves (24) slide

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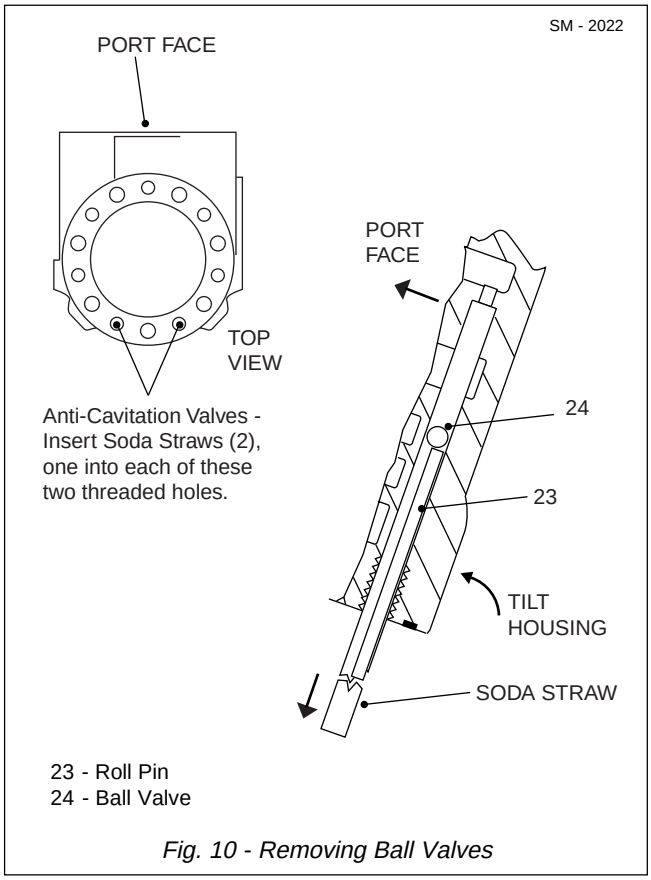


Fig. 10 - Removing Ball Valves

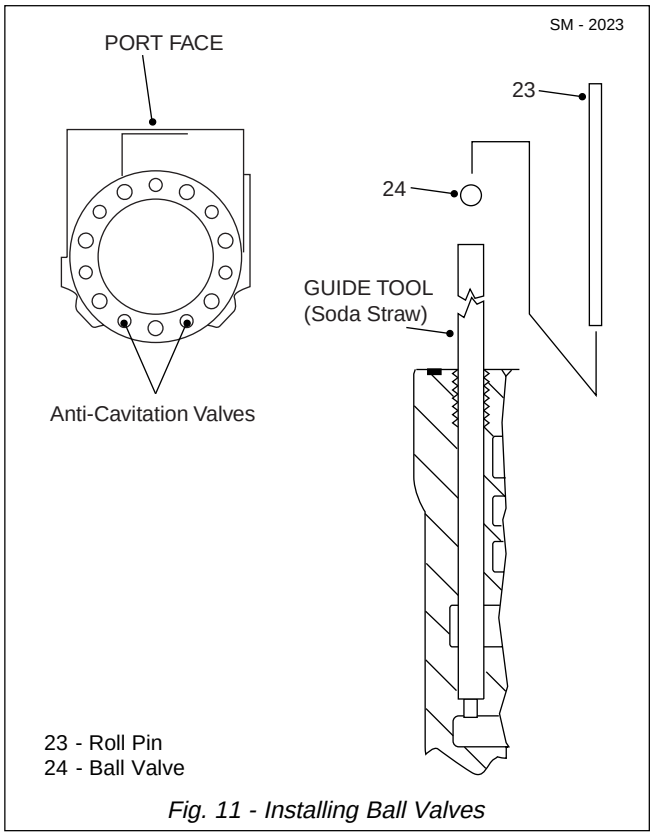


Fig. 11 - Installing Ball Valves

through the straws and out of the valve housing (7). Refer to Fig. 10.

15. Remove and discard 'O' ring (14), seal (17) and backup ring (18) from valve housing (7).

16. Using a thin blade screwdriver, pry dust seal (15) from valve housing (7). Take care not to damage dust seal seat.

INSPECTION

1. Clean all metal parts in a suitable solvent and blow dry with compressed air. Do not wipe dry with cloth or paper towel as lint or other matter may get into the hydraulic system and cause damage.

2. Check all mating surfaces and replace any parts that have scratches or burrs that could cause leakage.

3. Do not use course grit or try to file any metal parts.

Note: Replace all 'O' rings and seals with new 'O' rings and seals at 'Assembly'. Lubricate all 'O' rings and seals with a petroleum jelly.

ASSEMBLY

Numbers in parentheses refer to Fig. 5, unless otherwise specified.

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Steering valves fitted with anti-cavitation valves must be disassembled and assembled in the vertical postion to prevent ball valves (24) becoming trapped in the wrong cavities within the valve housing (7).

1. Use a soda straw as a guide tool to insert the roll pin (23) and ball valve (24) into the anti-cavitation valve ports. Insert soda straw, into anti-cavitation valve bore. Drop ball valve (24) through straw into bore. Remove straw and drop roll pin (23) into bore. Repeat for second anti-cavitation valve bore. Refer to Fig. 11.

2. Apply a light coating of clean hydraulic fluid to spool (16). Slide spool (16) and ball checks (9) into sleeve (8). Refer to Fig. 12.

3. Insert drive shaft (6) into spool (16) in sleeve (8)

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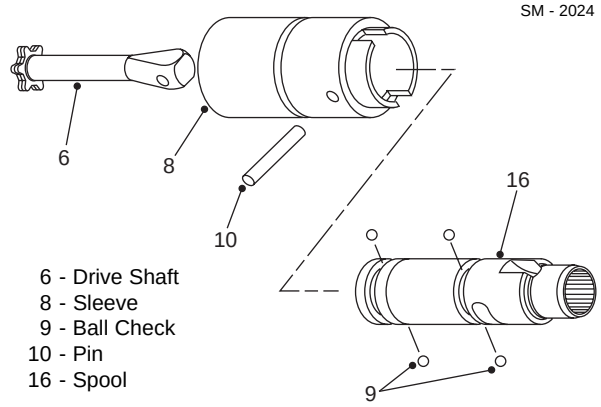


Fig. 12 - Installing Spool and Ball Checks

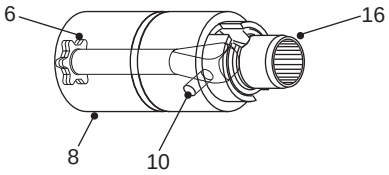


Fig. 13 - Installing Centring Pin and Drive Shaft

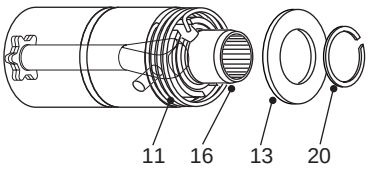


Fig. 14 - Installing Bearing Race and Retainer

carefully so that holes line up. Install pin (10) through sleeve (8), spool (16) and drive shaft (6) assembly until pin (10) becomes flush at both sides of sleeve (8). See Figs. 12 & 13.

4. Position one end of centring spring (11) into slotted end of spool (16). Compress centring spring (11) radially (CCW) and engage free end of spring into slot in spool (16). See Fig. 14.

5. Install bearing race (13) onto spool (16). Using suitable pliers install retainer (20) onto spool (16). See Fig. 14.

6. Apply a light coating of petroleum jelly to the inside diameter of dust seal (15) and install in valve housing (7).

7. Apply a light coating of petroleum jelly to needle thrust bearing (12), bearing race (13), 'O' ring (14), seal ring (17) and backup ring (18). Install each item onto spool (16), as shown in Fig. 15.

Note: Needle thrust bearing is positioned between the two bearing races (13) and must be centerd around retainer (20).

Note: Clamp steering valve housing (7) vertically in a soft jawed vice.

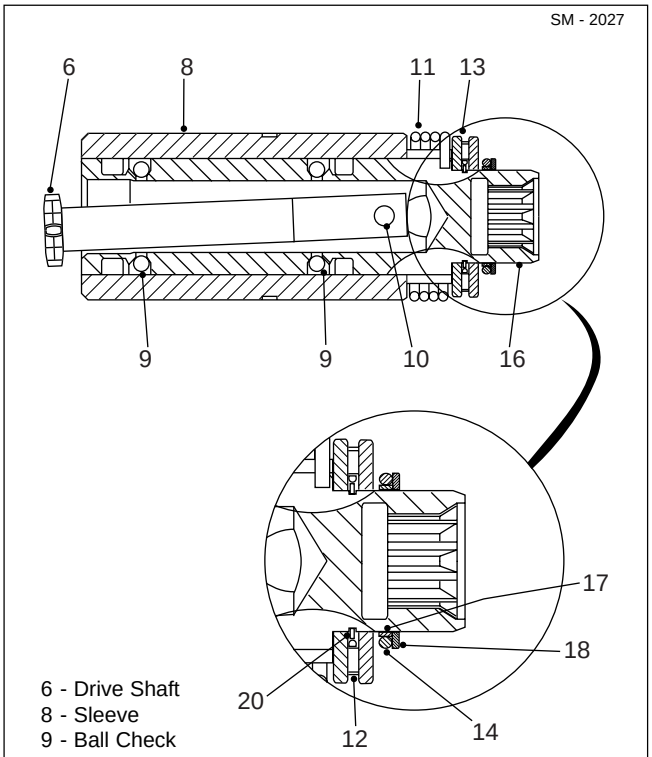


Fig. 15 - Sectional View of Seals and Bearings

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SM - 2028

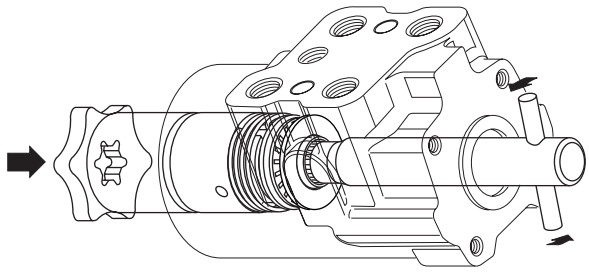


Fig. 16 - Compressing Centering Spring

SM - 2029

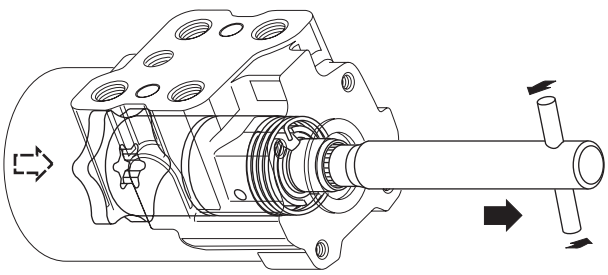
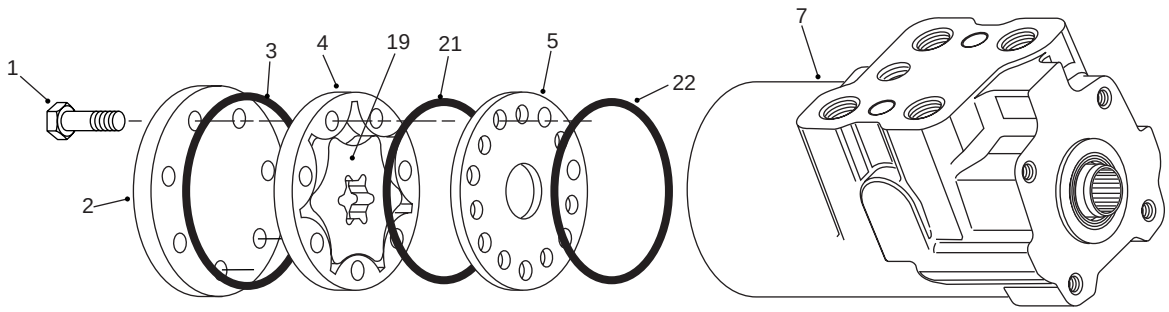


Fig. 17 - Installing Spool and Sleeve Assembly

SM - 2030



1 - Capscrew
2 - End Cap
3 - 'O' Ring
4 - Gerotor Housing
5 - Spacer Plate
7 - Valve Housing
19 - Gerotor Gear
21 - 'O' Ring
22 - 'O' Ring

Fig. 18 - Installing Seals and Gerotor Assembly

8. Using a cloth to protect the hand, place gerotor gear (19) over end of drive shaft (6). Insert special tool through valve housing (7) and engage with splined end of spool (16) and sleeve (8) assembly. Twist tool to compress centering spring (11) radially CW or CCW. Refer to Fig. 16.

9. Keep centering spring (11) compressed and carefully insert assembled parts into valve housing (7), as shown in Fig. 17.

10. Release tension on centering spring (11) and remove special tool and gerotor gear (19).

11. Lubricate and install new 'O' ring (22) in groove in valve housing (7). Refer to Fig. 18.

12. Install spacer plate (5) with the 'O' ring groove up, on valve housing (7). Align bolt holes in spacer plate (5) with tapped holes in valve housing (7). Refer to Fig. 18.

13. Lubricate and install new 'O' ring (21) in groove in spacer plate (5). Refer to Fig. 18.

14. Install gerotor housing (4) on valve housing (7). Align bolt holes in gerotor housing (4) with tapped holes in valve housing (7). Refer to Fig. 18.

15. Align gerotor gear (19) on driveshaft (6) and gerotor housing (4), as shown in Fig. 18.

16. Lubricate and install new 'O' ring (3) in groove in gerotor housing (4).

17. Install end cap (2) on gerotor housing (4), as shown in Fig. 18.

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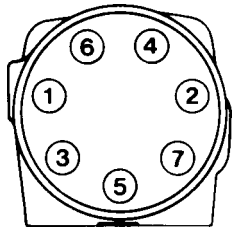


Fig. 19 - Cap Screw Tightening Sequence

18. Align cap screw (1) holes and install seven dry cap screws (1) in end cap (2). Pre-tighten cap screws (1) to 17 Nm (12.5 lbf ft) then tighten to a torque of 34 Nm (25 lbf ft), in the sequence shown in Fig. 19.

INSTALLATION

Numbers in parentheses refer to Fig. 4.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 220-0000, STEERING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Make certain, area of installation is clean.

2. If removed, secure rubber mounts (4) and mounting plate (5) to cab floor plate with bolts (7) washers (3 & 6) and locknuts (2).

3. Install nitrile seal (9) to steering column (8). Install steering valve (1) through mounting plate (5) and secure to steering column (8) and mounting plate (5) with bolts (10) and washers (11).

4. Tighten bolt (14), washer (15), nut (16) and coupling (17) onto steering column (8). Slide bellows (19) down over steering column (8) and tuck lower lip under cab floor plate.

5. Remove plugs from steering valve ports and caps from steering lines and install steering lines to steering valve (1), as identified at removal.

6. Fill hydraulic tank with hydraulic oil, as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to 'Filling and Bleeding The Steering System'.

7. Install the front right hand wheel on the machine, as described in Section 160-0050, WHEEL RIM AND TYRE. Lower the machine from blocking equipment.

8. Remove wheel blocks from all road wheels, place the battery master switch in the 'On' position and start the engine. Operate the steering and check hydraulic lines for leaks. Tighten lines and fittings as required.

FILLING AND BLEEDING THE STEERING SYSTEM

1. Fill hydraulic tank to Maximum level. Be ready to add oil when the engine is started. Do not let oil drop below the pump suction line to prevent air entering the system.

2. Start engine and let it idle. Immediately add oil to the steering and brake control tank as required. When no more oil can be added and oil is clear, proceed as follows:

a. Turn the steering wheel from lock to lock to bleed the air in the steering cylinders and lines.

Note: Immediately upon valve spool actuation oil must be added to the hydraulic tank to replenish the oil moving into the circuit.

⚠ WARNING
Do not operate the vehicle until all air is bled from the oil.

b. When the oil in the tank is clear (not cloudy or creamy), the system is free of air.

Note: Slight creep or drift of the steering wheel is normal.

c. Fill hydraulic tank with hydraulic oil specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK, for correct fill level. Install filler cap on tank.

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Steering System - Steering Valve

Section 220-0090

Hydraulic Oil

The steering system should be kept filled with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part number of the special tool referenced in this section. This tool are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
5	1	Capscrew	34	25

STEERING CONTROL DIAGNOSIS

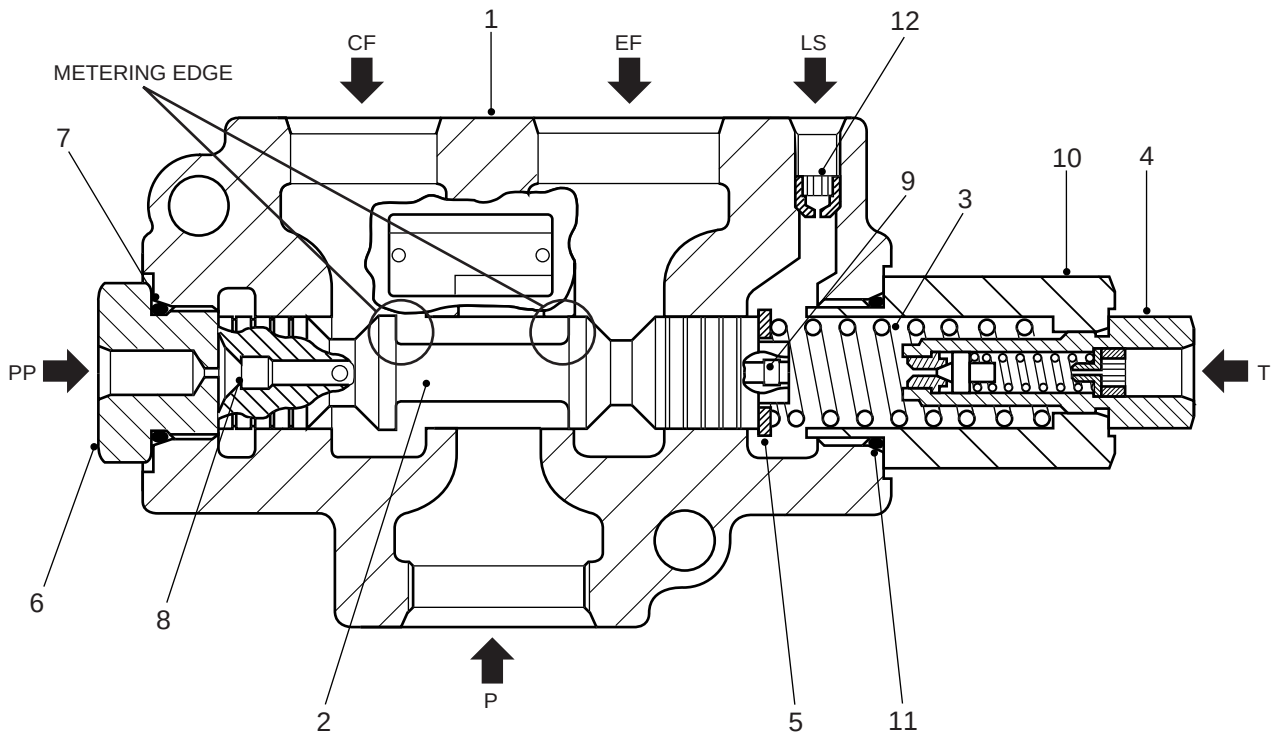
CONDITION	REASON	REMEDY
Steering wheel does not centre	Binding in steering linkage to valve	Align as required
	Worn gerotor	Replace parts
	Broken centring springs	Replace centring springs, drain and flush system
	Burrs on sleeve or spool	Disassemble and repair or replace parts
Apparent inability to steer when wheel is turned slowly	Dirt in system	Drain and flush system. Refill with clean oil
Slow steering	Excessive wear in sleeve and spool	Replace sleeve and spool
	Excessive wear in gerotor	Replace gerotor
Hard steering	See 'Slow Steering'	
Opposite steering	Lines hooked up incorrectly	Reconnect correctly
	Wrong orientation between gerotor and gerotor drive	Realign per instructions
Steering wheel rocking back and forth	See 'Opposite Steering'	
Steering wheel continues to turn	Input linkage binding	Align as required
	Burr on sleeve or spool	Disassemble and repair or replace
	Dirt in system	Drain and flush system. Refill with clean oil
	Broken centring springs	Replace centring springs, drain and flush system
No steering action	Sleeve and spool locked together	Disassemble and repair or replace

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SM - 1954



1 - Valve Body
2 - Spool
3 - Spring
4 - Relief Valve
5 - Washer
6 - Plug
7 - 'O' Ring
8 - Damping Orifice
9 - Damping Orifice
10 - Case
11 - 'O' Ring
12 - Damping Orifice

Fig. 1 - Sectional View of Priority Valve

DESCRIPTION

The priority valve can be identified as item 5 in Section 220-0000, STEERING SYSTEM SCHEMATIC.

The priority valve is mounted off the right hand fender support bracket. The valve is installed in the lines between the main hydraulic pump, steering valve and body control valve. Hydraulic oil is pumped to the priority valve and depending on the position of the spool within the priority valve, oil is directed to the steering or body hoist systems.

The spool in the priority valve has 2 metering edges. This allows the valve to modulate flow and pressure to the steering circuit and body hoist circuit to meet each circuits flow and pressure requirements.

There are six ports on the priority valve housing as follows:

Port 'P' - Pump Inlet Port - Supply from pump
Port 'PP' - Pilot Pressure - Plugged
Port 'CF' - Control Flow - Supply to steering valve
Port 'EF' - Excess Flow - Supply to body hoist valve
Port 'LS' - Load Sensing - To LS port on steering valve
Port 'T' - Relief Return - Return to tank

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OPERATION

Numbers in parentheses refer to Fig. 1.

Steering valve in neutral position
With the steering valve in the neutral position, oil from the main hydraulic pump enters the priority valve at port 'P'. Oil pressure within the internal galleries of the priority valve act on the spool, moving it to the right.

The oil flows from port 'P' through the 'EF' port, to the body hoist control valve. The oil at the load sensing 'LS' port is open to the tank return port in the steering valve.

Steering valve operating
When the steering valve is actuated left or right, oil at the load sensing 'LS' port is pressurised causing the spool in the priority valve to move to the left.

The oil from the main hydraulic pump is then directed from port 'P' to the 'CF' port in the priority valve. The oil is then directed to port 'P' on the steering valve.

In this position all oil flow is directed to the steering system giving it priority.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels, except the front right hand, and place the battery master switch in the 'Off' position.

3. Remove hydraulic tank anti-spill drain cap, install drain tube connection and drain oil into a suitable container. Remove drain tube connection and reinstall cap.

4. Remove the front right hand wheel from the machine, as described in Section 160-0050, WHEEL RIM AND TYRE.

5. Clean priority valve housing (1) and surrounding area with a suitable solvent. Identify and tag all hydraulic lines connected to priority valve, to aid in 'Installation'.

6. With suitable containers available to catch spillage, disconnect hydraulic lines from priority valve. Drain the oil from the lines into the container and discard all 'O' rings. Cap hydraulic lines and priority valve ports to prevent ingress of dirt.

7. Support priority valve and remove mounting hardware securing priority valve and mounting bracket to the right hand cab leg. Remove priority valve and mounting bracket from the machine and transfer to a clean area for disassembly.

DISASSEMBLY

Numbers and letters in parentheses refer to Fig. 1.

⚠ WARNING
Spring loaded parts. Use care when removing end cap, retainers and plugs to prevent sudden release of spring tension behind these parts. Personal injury or property damage could result if care is not taken.

Note: Clean entire priority valve assembly with a suitable solvent and dry thoroughly prior to disassembly.

Valve Body

1. If required, remove mounting hardware securing priority valve to mounting bracket. Remove mounting bracket.

2. If required, remove adaptor and elbow from port 'P' in valve housing (1). Discard 'O' rings.

3. If required, remove elbow, adaptors and check valve from port 'CF' in valve housing (1). Discard 'O' rings.

4. If required, remove adaptor and elbow from port 'EF' in valve housing (1). Discard 'O' rings.

5. If required, remove adaptor from port 'LS' in valve housing (1). Discard 'O' ring.

6. If required, remove elbow from port 'T' in valve housing (1). Discard 'O' ring.

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Relief Valve

1. Clean the entire priority valve assembly with a suitable solvent and dry thoroughly. Remove caps from valve housing (1) ports.

2. If desired, clamp priority valve assembly in a soft jawed vice. Take care to avoid damaging valve housing (1) machined surfaces.

3. Release and withdraw relief valve (4) assembly from case (10) bore in valve housing (1). Discard 'O' rings.

INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Clean all parts thoroughly and examine for wear and/or damage.

2. Inspect valve housing (1) bores for grooves, deep scratches or excessive wear.

Note: If condition of valve housing (1) bores indicate that they require to be replaced, the priority valve should be replaced as an assembly.

3. If relief valve (4) is damaged, it should be replaced.

ASSEMBLY

Numbers and letters in parentheses refer to Fig. 1.

Note: Lightly lubricate all components with hydraulic oil. Refer to Section 300-0020, LUBRICATION SYSTEM, for recommended oil specifications.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Relief Valve

1. If removed, install new 'O' ring on relief valve (4) assembly and secure in case (10) bore in valve housing (1).

Valve Body

1. If removed, secure priority valve to mounting bracket using mounting hardware as removed at 'Disassembly'.

2. If removed, install new 'O' rings on adaptor and elbow and secure in port 'P' of valve housing (1).

3. If removed, install new 'O' rings on elbow, adaptors and check valve and secure in port 'CF' of valve housing (1).

4. If removed, install new 'O' ring on adaptor and elbow and secure in port 'EF' of valve housing (1).

5. If removed, install new 'O' ring on adaptor and secure in port 'LS' of valve housing (1).

6. If removed, install new 'O' ring on elbow and secure in port 'T' of valve housing (1).

INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

1. Position valve and mounting bracket and secure to right hand cab leg with mounting hardware as removed at 'Removal'.

2. Reconnect all hydraulic lines to priority valve, as tagged at removal.

3. Fill hydraulic oil tank with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK, for hydraulic oil levels. Install filler cap on hydraulic tank filler neck.

4. Adjust the system relief valve according to the instructions in 'Adjustments'.

5. Place the battery master switch in the 'On' position, start the engine and bring hydraulic oil to operating pressure.

Note: The front right hand wheel is still removed from machine at this point.

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6. Check priority valve and hydraulic line connections for leaks and tighten as required.

7. Install front right hand wheel on the machine, as described in Section 160-0050, WHEEL RIM AND TYRE.

8. Remove wheel blocks from all road wheels.

ADJUSTMENTS

Numbers in parentheses refer to Fig. 1.

Steering System Pressure Adjustment

Steering system pressure setting and adjustment can be carried out as follows:

> ⚠ **WARNING**
> **To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.**

1. Connect a hydraulic gauge, capable of recording a pressure of 0 - 345 bar (0 - 5 000 lbf/in²), to remote diagnostic pressure point and take a note of the reading before continuing.

Note: Steering system pressure should be set at 241 bar (3 500 lbf/in²).

2. Position the vehicle in a level work area, apply the parking brake and leave the engine running.

3. With suitable containers available to catch spillage, disconnect hydraulic line from priority valve port 'T', relief valve. Remove adaptor from port and cap hydraulic line to prevent ingress of dirt.

4. Operate the steering, against either steering stop with the engine at wide open throttle. Check system pressure.

5. Turn allen screw, located inside relief valve port, to adjust pressure setting.

Note: Turning allen screw 'IN' will increase relief valve pressure, turning allen screw 'OUT' will reduce relief valve pressure. One turn is approximately 62 - 69 bar (900 - 1 000 lbf/in²).

6. Install adaptor and re-connect hose in relief valve port 'T'.

7. Check oil level in hydraulic tank and top up with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK, for hydraulic oil levels. Install filler cap on hydraulic tank filler neck.

8. Check priority valve assembly and hydraulic lines for leaks. Tighten as required.

MAINTENANCE

Limited repair of the priority valve is with replacement of parts only.

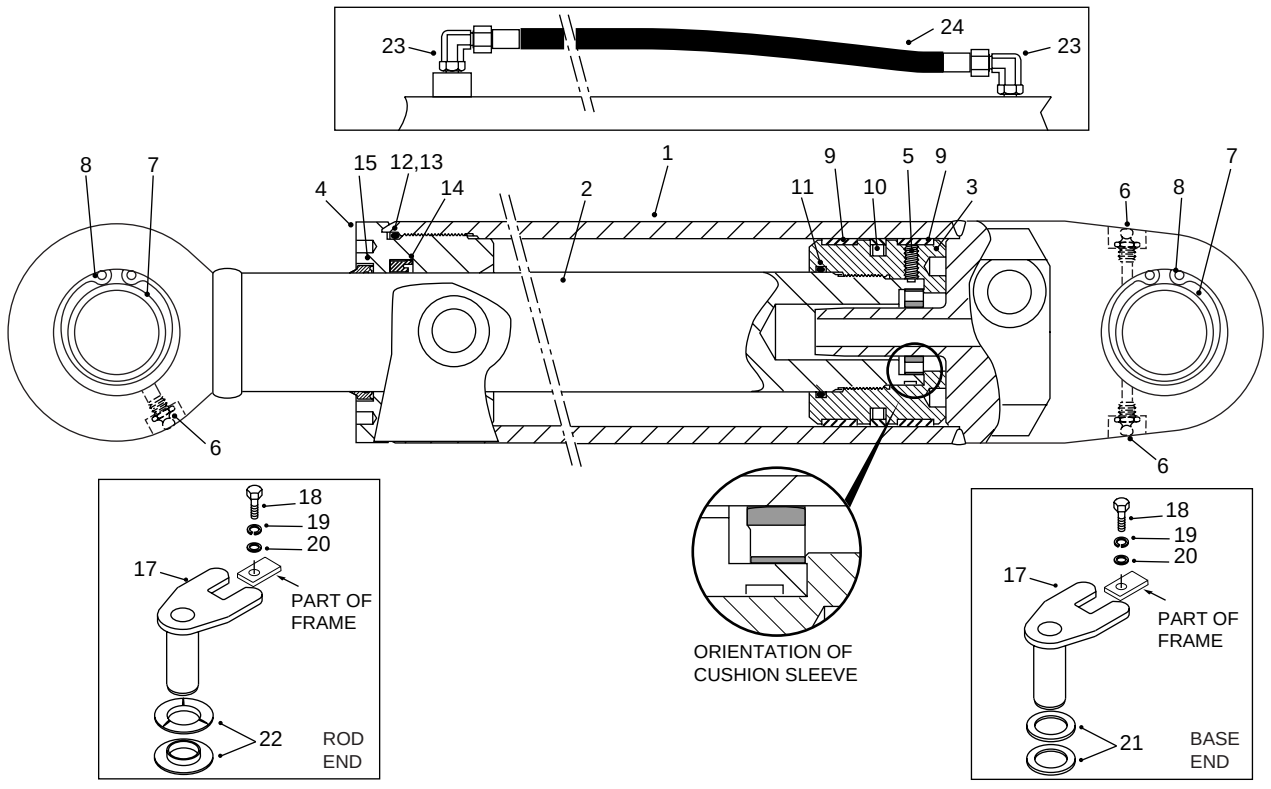
SERVICE TOOLS

There are no special tools required for the procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools and adhesives. These tools and adhesives are available from your dealer.

* * * *

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1 - Cylinder Body
2 - Piston Rod
3 - Piston
4 - End Cap
5 - Grub Screw
6 - Lube Fitting
7 - Spherical Bearing
8 - Circlip
9 - Wear Ring
10 - Piston Seal
11 - 'O' Ring
12 - 'O' Ring
13 - Back Up Ring
14 - Rod Seal
15 - Wiper
16 - Cushion Sleeve
17 - Pin
18 - Bolt
19 - Lockwasher
20 - Hardened Washer
21 - Spacer
22 - Seal
23 - Elbow
24 - Hose Assembly

Fig. 1 - Sectional View of Steering Cylinder and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The steering cylinders can be identified as item 7 in Section 220-0000, STEERING SYSTEM SCHEMATIC.

There are two single stage, double acting cushioned steering cylinders on the machine. The cylinder base end is connected to the articulation and oscillation pivot, and, piston rod (2) end is connected to the front frame. Single stage double acting means that piston rod (2) can have oil applied to either side, extending or retracting the piston rod.

Rod end cylinder mounting is by pins (17), seals (22) and spherical bearings (7) secured with circlips (8). Base end cylinder mounting is by pins (17), spacers (21) and spherical bearings (7) secured with circlips (8). Spherical bearings (7) permit a limited amount of cylinder misalignment when travelling over rough terrain.

OPERATION

When the operator turns the steering wheel for a steering operation, movement of the piston rod generates force required to pivot the tractor frame.

In the neutral position, with the steering valve centralized, oil movement between the steering cylinders and the steering valve is stopped. Trapped oil in the system locks both steering cylinders and the angle of steering set by the operator is maintained. Refer to Section 220-0090, STEERING VALVE, for operation of the steering valve.

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Steering System - Steering Cylinder

Section 220-0120

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Identify, tag and with a suitable container in position to catch the spillage, disconnect all hydraulic lines on one steering cylinder. Cap all lines and fittings to prevent ingress of dirt.

4. Support steering cylinder with a suitable lifting device.

5. Remove bolt (18), lockwasher (19) and hardened washer (20) securing pin (17) at piston rod (2) end of the cylinder. Remove pin (17) securing piston rod (2) end to the front frame.

6. Remove bolt (18), lockwasher (19) and hardened washer (20) securing pin (17) at base end of the cylinder. Remove pin (17) securing base end to the articulation and oscillation pivot.

7. Remove cylinder assembly from the machine. Spacers (21) and seals (22) will come free at this time.

8. Remove cylinder assembly to a clean area for disassembly. Drain oil from cylinder assembly into a suitable container.

9. Repeat steps 3 through 8 for opposite steering cylinder assembly.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.

1. Ensure clean working conditions, remove any port plugs thus allowing easy entry of air into the cylinder, preventing a vacuum when parts are withdrawn from cylinder body (1).

2. Remove circlips (8) from base end of cylinder body (1) and piston rod (2) end. Press out spherical bearings (7).

3. Using special tool which can be fabricated as shown in Fig. 2, unscrew end cap (4) until thread is disengaged from cylinder body (1).

4. Pull end cap (4) and piston rod (2) out of cylinder body (1) as an assembly.

5. Place piston rod (2) on supports which will not damage the chrome piston rod diameter.

6. Remove and discard piston seal (10) and wear rings (9) from piston (3).

7. Remove grub screw (5) from wear ring groove in piston (3).

8. Provide an anti-torsion device through piston rod (2) eye to allow unscrewing of piston (3). Using special tool which can be fabricated as shown in Fig. 3, unscrew piston (3) from piston rod (2).

9. Remove and discard 'O' ring (11) from piston (3). Remove and retain cushion sleeve (16) from piston rod (2).

10. Pull end cap (4) assembly off piston rod (2). Remove and discard back up ring (13) and 'O' ring (12) from end cap (4) outer grooves. Remove and discard wiper (15) and rod seal (14) from end cap (4) inner grooves.

11. If damaged, remove lube fitting (6) from cylinder body (1) and piston rod (2).

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INSPECTION

Numbers in parentheses refer to Fig. 1

1. Clean all parts of the cylinder with a suitable solvent and dry with clean, lint-free cloths. Clean all grooves carefully to remove any foreign material.

2. Check cylinder body (1), end cap (4) grooves and outer diameter of piston (3) for scratches, cracks or other signs of damage. Remove ridges, nicks and scratches with a fine stone and re-clean. Replace any components which cannot be repaired.

3. Inspect piston rod (2) for distortion, cracks or other defects. Replace piston rod (2) if defective area is irreparable.

4. Check spherical bearings (7) for wear and replace if necessary.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.

1. Press spherical bearings (5) in base end of cylinder body (1) and piston rod (2) end. Secure spherical bearings (5) with circlips (6).

2. Install new rod seal (14) into bore of end cap (4) with the lip pointing towards the internal face of end cap (4). Install new wiper (15) into bore of end cap (4).

3. Install new back up ring (13) and 'O' ring (12) in xternal groove of end cap (4).

4. Guide end cap (4) assembly onto piston rod (2), taking care not to damage rod seal (14) on the thread.

5. Install cushion sleeve (16) into piston rod (2) counter bore. Note correct orientation, spigot face abuts counter bore face (see Fig. 1).

6. Install new 'O' ring (11) into internal groove of piston (3).

7. Using special tool which can be fabricated as shown in Fig. 3, screw piston (3) on piston rod (2). Tighten piston (3) to a torque of 746 - 813 Nm (550 - 600 lbf ft).

8. Insert piston grub screw (5), through wear ring groove in piston (3), into groove machined in piston rod (2). Tighten grub screw (5) to a torque of 49 Nm (36 lbf ft). Ensure the extreme of grub screw (5) is below the level of wear ring groove.

9. Insert new piston seal (10) and new wear rings (9) in piston (3) external grooves.

10. Fully grease piston (3) OD and 'O' ring (12) in end cap (4).

11. Ensure bore of cylinder is well lubricated with hydraulic oil. Carefully insert piston rod (2) and end cap (4) assembly into cylinder body (1).

12. Engage end cap (4)/cylinder body (1) thread screw up fully. Using special tool which can be fabricated as shown in Fig. 2, tighten end cap (4) to a torque of 542 - 610 Nm (400 - 450 lbf ft).

13. Replace lube fittings (6) if required.

INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 220-0000, STEERING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

⚠ WARNING
To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.

1. Install a suitable strap, or other lifting device, around one cylinder assembly and position cylinder assembly on the vehicle, with base end of cylinder ready for mounting.

2. Install spacers (21) on base end of cylinder and insert pin (17). Secure pin (17) to articulation and oscillation pivot with bolt (18), lockwasher (19) and hardened washer (20).

3. Install seals (22) on piston rod (2) end of cylinder and insert pin (17). Secure pin (17) to front frame with bolt (18), lockwasher (19) and hardened washer (20).

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4. Connect hydraulic lines to steering cylinder ports, as tagged during removal.

5. Repeat steps 1 through 4 for installation of opposite steering cylinder.

6. Lubricate pins (17) through lube fittings (6) with lubricant, as specified in Section 300-0020, LUBRICATION SYSTEM.

7. Check oil level in hydraulic tank and add oil if low. Refer to Section 230-0040, HYDRAULIC TANK, for correct fill level. Refer to Section 300-0020, LUBRICATION SYSTEM, for the type of oil used.

8. Remove wheel blocks.

9. Place the battery master switch in the 'On' position, start the engine and operate the steering, from lock to lock several times, to purge air out of the hydraulic lines. Check hydraulic lines and fittings for leaks. Tighten lines and fittings as required.

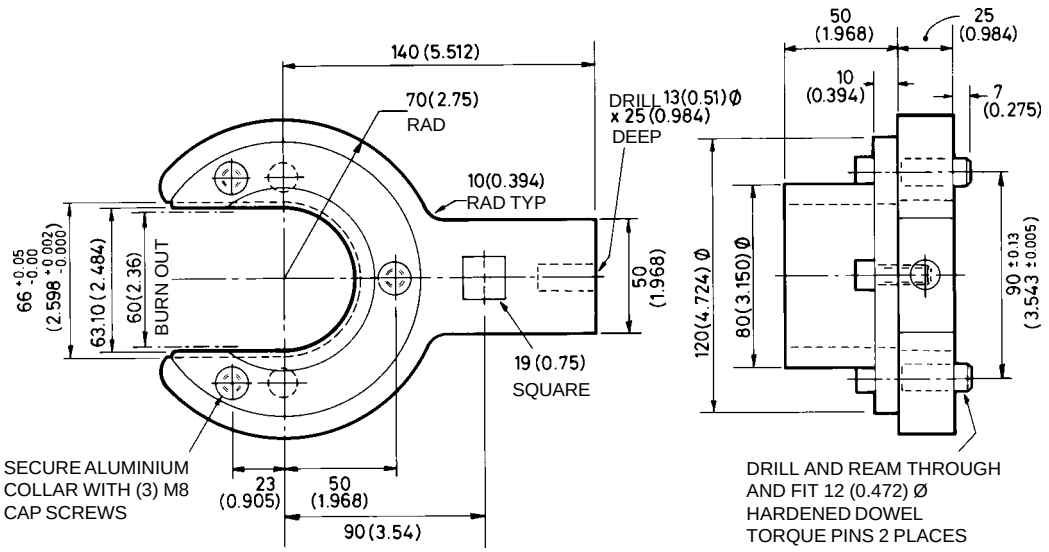
MAINTENANCE

Inspect steering cylinders regularly for leaks or damage, repair as required. Lubricate cylinder pins every 50 hours, as specified in Section 300-0020, LUBRICATION SYSTEM.

SPECIAL TOOLS

Special tools can be fabricated as shown in Figs. 2 & 3. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

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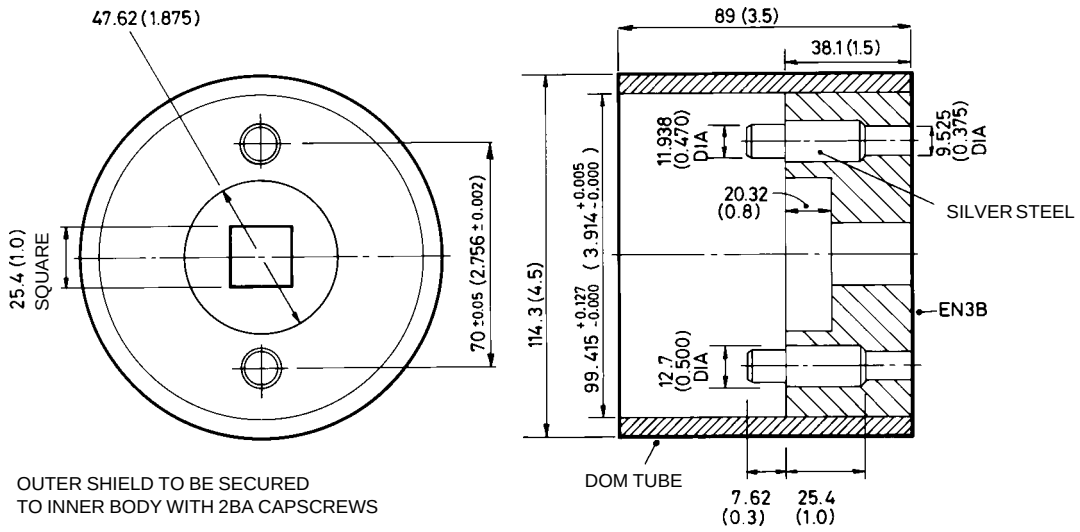
Dimensions in mm (inches)

Fig. 2 - End Cap Torque Tool

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Dimensions in mm (inches)

Fig. 3 - Piston Torque Tool

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	3	Piston	746 - 813	550 - 600
1	4	End Cap	542 - 610	400 - 450
1	5	Grub Screw	49	36

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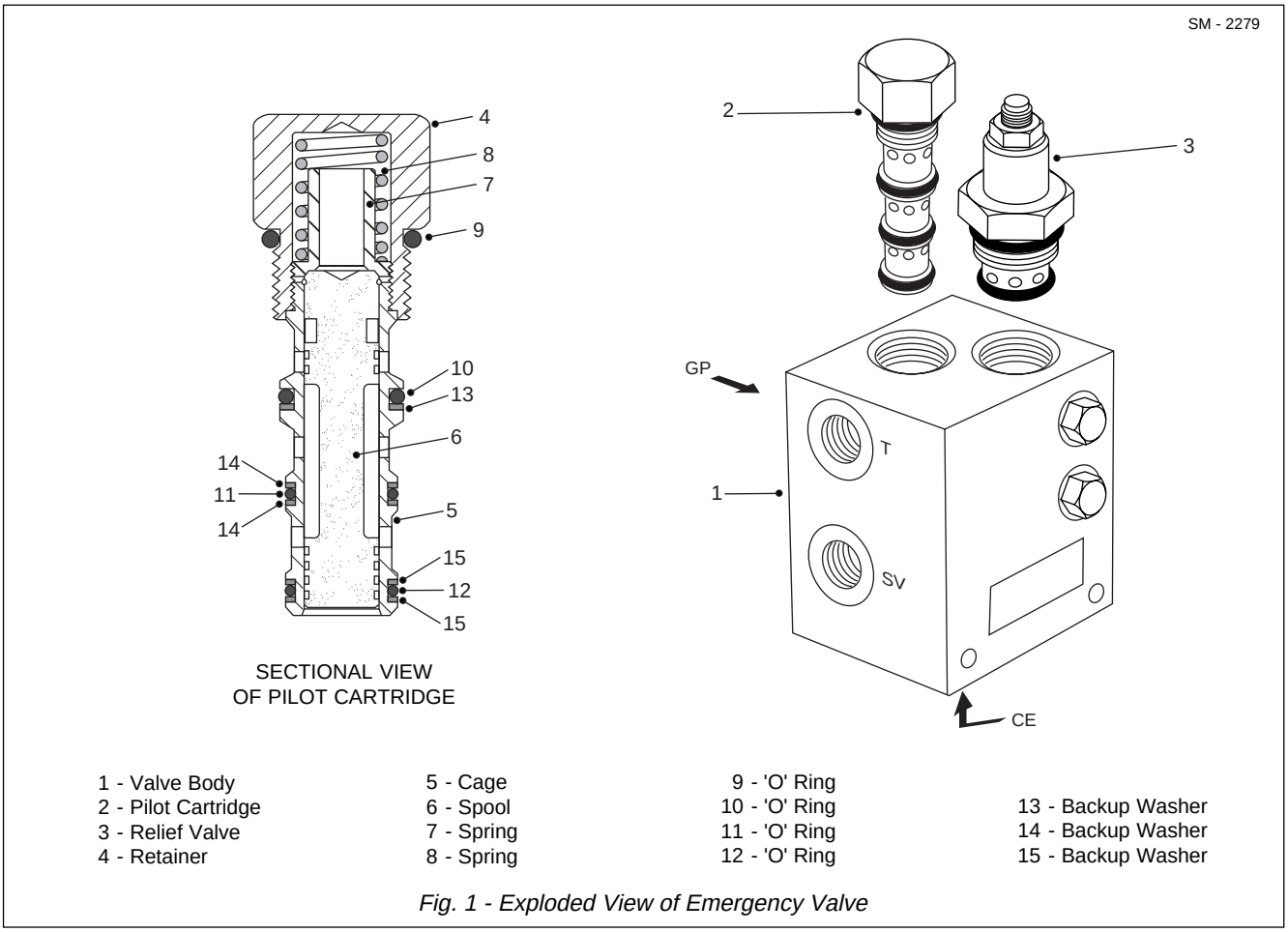
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1 - Valve Body
2 - Pilot Cartridge
3 - Relief Valve
4 - Retainer
5 - Cage
6 - Spool
7 - Spring
8 - Spring
9 - 'O' Ring
10 - 'O' Ring
11 - 'O' Ring
12 - 'O' Ring
13 - Backup Washer
14 - Backup Washer
15 - Backup Washer

Fig. 1 - Exploded View of Emergency Valve

DESCRIPTION

The Emergency Valve can be identified as item 6 in Section 220-0000, STEERING SYSTEM SCHEMATIC.

Mounted off the right hand cab leg, the emergency valve forms part of the emergency steering system. It is connected to the main output line of the gear driven emergency steering pump on the transmission.

Relief valve (3) assembly opens and allows oil to flow back to the hydraulic tank when pressure exceeds 207 bar (3 000 lbf/in²)

OPERATION

Normal Steering

Numbers and letters in parentheses refer to Fig. 1.

During normal operation, pilot pressure from the main hydraulic pump enters the valve body (1) at port 'CE', pushing spool (6), within pilot cartridge assembly (2) to the right. The emergency steering pump draws oil from the hydraulic tank and pumps it to port 'GP' of the emergency valve. The oil is directed through the emergency valve, exits at port 'T' and returns to the hydraulic tank.

Emergency Steering

Numbers and letters in parentheses refer to Fig. 1.

In the event of loss of pressure from the main hydraulic pump, spool (6) will spring return to the left. The emergency steering pump draws oil from the hydraulic tank and pumps it to port 'GP' of the emergency valve. The oil is directed through the emergency valve and exits at port 'SV' to supply the steering system.

A pressure switch, installed in the block at the outlet port on the main hydraulic pump, sends a signal to illuminate the steering pressure warning light to indicate a fault in the steering system supply pressure.

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Steering System - Emergency Valve

Section 220-0140

REMOVAL

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place battery master switch in the 'Off' position.

3. Clean outer area of the emergency valve with a suitable solvent. Ensure all hydraulic lines connected to the emergency valve are identified for ease of installation and, with suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to all open lines.

4. Remove mounting hardware securing emergency valve assembly and remove emergency valve assembly.

INSTALLATION

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 220-0000, STEERING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

1. Install emergency valve assembly to the mounting bracket and secure with mounting hardware removed during removal.

2. Remove blanking caps and connect hydraulic lines to the emergency valve as tagged at removal.

3. Check oil level in hydraulic tank and add oil as required. Refer to Section 230-0040, HYDRAULIC TANK, for correct fill level and Section 300-0020, LUBRICATION SYSTEM, for oil specification.

4. Place the battery master switch in the 'On' position, remove all wheel blocks and start the engine. Check all lines and fittings for leaks and tighten as required.

MAINTENANCE

Limited repair of the emergency valve is with replacement of parts only. Refer to vehicle parts book for list of kits available.

* * * *

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DESCRIPTION

Numbers in parentheses refer to Fig. 2 through 5.

The body system schematic primarily covers operation of the body hoist system. However, as the hydraulic tank and main hydraulic pump are common to the body hoist and steering circuit, several components of the steering system are also covered in the schematic.

A brief description of the individual components shown in the body system schematic are listed below. Detailed service and operating instructions for the individual components can be found in their relevant component sections in this manual.

Hydraulic Tank (1)

Refer to Section 230-0040, HYDRAULIC TANK

Mounted off the tractor frame at the rear of the cab, the hydraulic tank is the common oil reservoir for the steering and body hydraulic systems.

Integral with the tank assembly are two suction screens, filter element, relief valve, adaptor plate, access covers and filler neck assembly. Two sight gauges on the right hand side of the tank assembly indicate hydraulic oil level. Located on top of the tank assembly are a breather, pressure switch and temperature switch.

Internally there is a baffle plate which divides the tank assembly into a body hoist compartment and a steering compartment. Should oil level drop below this baffle level, the tank assembly operates as two separate tanks.

Main Hydraulic Pump (2)

Refer to Section 230-0050, MAIN HYDRAULIC PUMP.

Mounted off the transmission power takeoff, the main hydraulic pump supplies hydraulic oil for operating the body hoist and steering systems.

Hydraulic oil is drawn from the hydraulic tank (1) and pumped through the priority valve (5). A priority spool within the priority valve (5) directs oil supply from the main hydraulic pump to the body control valve (3).

The main hydraulic pump is a multiple gear type pump which operates in the one direction only (it is assembled for right hand (clockwise) rotation, as viewed from the driveshaft end).

Note: Never drive a pump in the wrong direction of rotation, as pump seizure may result.

Body Control Valve (3)

Refer to Section 230-0060, BODY CONTROL VALVE.

The single spool body control valve is mounted behind the front right hand wheel, on a mounting bracket mounted to the frame rail. The main components of the control valve assembly are a four position control spool, check valve plunger, relief valve and valve housing.

The four positions of the control spool are 'Raise', 'Hold', 'Lower' (Power Down) and 'Float'. The 'Float' position is detented and control spool should be kept in this position at all times, except when Raising or Lowering the body.

A relief valve assembly, at pressure inlet, opens and allows oil to flow through hydraulic oil cooler (7) and back to the hydraulic tank when pressure in the hydraulic system exceeds 221 bar (3 200 lbf/in^2).

Movement of control spool (1) is controlled by electrical signals from the body control joystick in the operators compartment. Refer to Section 230-0081, BODY CONTROL JOYSTICK.

Pilot Supply Valve (4)

Refer to Section 230-0121, PILOT SUPPLY VALVE.

Mounted off the rear right hand cab leg, the pilot supply valve is a direct acting pressure reducing valve which steps down the supply pressure to 30 bar (435 lbf/in^2). Intregal of the pilot supply valve is a relief valve which opens at 45 bar (652 lbf/in^2).

Mounted off the hydraulic tank, above the pilot supply valve, the accumulator (6) is pre-charged with nitrogen, to a pressure of 30 bar (435 lbf/in^2).

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Body System - Body System Schematic

Section 230-0000

Body Cylinders (5)

Refer to Section 230-0130, BODY CYLINDER.

There are two single stage, double acting body hoist cylinders on the vehicle. The cylinder base end is connected to the trailer frame and the piston rod end is connected at the body. Single stage double acting means that the piston rod can have oil applied to either side, extending or retracting the piston rod.

Cylinder mounting is by pins, spacers and spherical bearings secured in place with circlips. Spherical bearings permit a limited amount of cylinder misalignment.

Pressure Test Points

There are two pressure check points within the body hoist system. Pressure readings at these points should be as follows:

Test Point A - Mounted on diagnostic plate at rear right hand side of the tractor.
System Relief Pressure - 221 bar (3 200 lbf/in²)

Test Point B - Located in tee piece at port 'U' of pilot supply valve (4).
Pilot Valve Pressure - 30 bar (435 lbf/in²)

Body Control Valve - Pilot Pressures		
Position	Port 'P1'	Port 'P2'
Raise	30 bar	0 bar
Hold	0 bar	0 bar
Float	0 bar	30 bar
Lower	0 bar	13.5 bar

'O' RING FACE SEALS (ORFS)

Where hydraulic lines are fitted with ORFS connections, the following procedure should be carried out during 'Installation'. Refer to Fig. 1.

a. Ensure 'O' ring/seal is in place and that the joining surfaces are clean. If necessary, retain 'O' ring/seal in place with a light coating of grease or vaseline.

b. Initially, the nuts should be tightened by hand.

c. Where a hose is fitted, ensure that it is not twisted or kinked when the nuts are tightened so that it is allowed to adopt a natural position.

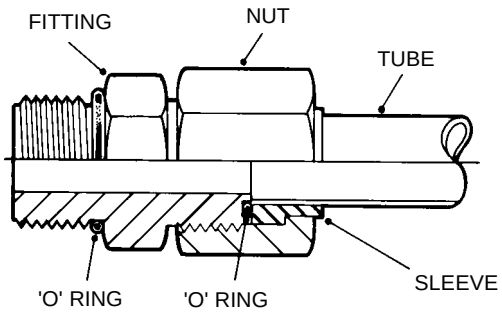


Fig. 1 - Assembly of Typical ORFS Connector

d. Where a tube is fitted, ensure that the connection is aligned correctly.

e. Tighten the nut a further 1/4 to 1/2 a turn using the correct size spanner (wrench).

f. Check that a satisfactory hose or tube routing has been achieved.

Hydraulic Oil

The hydraulic oil tank should be kept filled with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK, for correct fill level and procedure.

MAINTENANCE

Maintenance instructions, intervals and warnings, in the individual hydraulic component sections of this manual, should be adhered to at all times.

SERVICE TOOLS

It is recommended that the following service tools are used when carrying out pressure and temperature checks during maintenance procedures. These tools, along with other general service tools, are available from your dealer. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of these tools.

Multi-Gauge

The multi-gauge is basically four pressure gauges in one. Continuous system pressure readings are indicated on one of three simultaneously reading gauges through a pressure range of 30 in of vacuum to 5 000 lbf/in².

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Non-contact Infrared Thermometer

The infrared thermometer can be used to spot heat problems early in electrical, mechanical and hydraulic systems. Hand held and easy to use, you simply aim, pull the trigger, and read the temperature. Since there is no need to touch what you are measuring, temperatures of hard-to-reach or moving components can be taken without getting burned or shocked.

BODY SYSTEM DIAGNOSIS

CONDITION	REASON	REMEDY
Body raise time too slow, should be 12 sec, loaded. Hydraulic oil pressure too low, should be 221 bar (3 200 lbf/in²).	Worn pump. Pump output should be as specified in Section 000-0000, GENERAL INFORMATION.	Repair or replace pump.
		Check pump driveshaft.
	Pump cavitation	Check oil level in hydraulic tank. Refer to Section 230-0040, HYDRAULIC TANK.
		Check for suction leak at pump inlet port.
		Check for obstruction in hydraulic lines.
	Dirt or foreign particles lodged between relief valve control poppet and seat	Replace relief valve assembly. Refer to Section 230-0060, BODY CONTROL VALVE.
	Relief valve worn	Check relief valve setting, as described in Section 230-0060, BODY CONTROL VALVE. Replace relief valve assembly if worn.
	Control valve spool not stroking completely	Check spool travel, as described in Section 230-0060, BODY CONTROL VALVE.
	Body cylinder binding or obstruction in oil passage	Repair or replace body cylinder.
	Incorrect pilot pressure from the pilot control valve	Check pilot pressure. Replace valve if necessary (non-servicable item).
Body lower time too slow, should be 7.5 sec in 'Power Down'	Return oil from body cylinders is being restricted in hydraulic lines or body control valve	Check hydraulic lines for restrictions.
		Check control valve spool for correct 'Float' position. Refer to Section 230-0060, BODY CONTROL VALVE.
	Incorrect pilot pressure from the pilot control valve	Check pilot pressure. Replace valve if necessary (non-servicable item).
Body will not hold	Oil bypassing between control spool and control valve body	Replace body control valve assembly.
	Control spool not centred	Repair body control valve.
	Oil bypassing body cylinder seals	Repair body cylinders.
Body will not raise or lower	Pump failure	Repair or replace pump.
	Relief valve pressure too low	Check and adjust relief valve setting, as described in Section 230-0060, BODY CONTROL VALVE.
	Electrical failure at joystick or body control valve solenoids	Check and replace joystick and/or control solenoids.

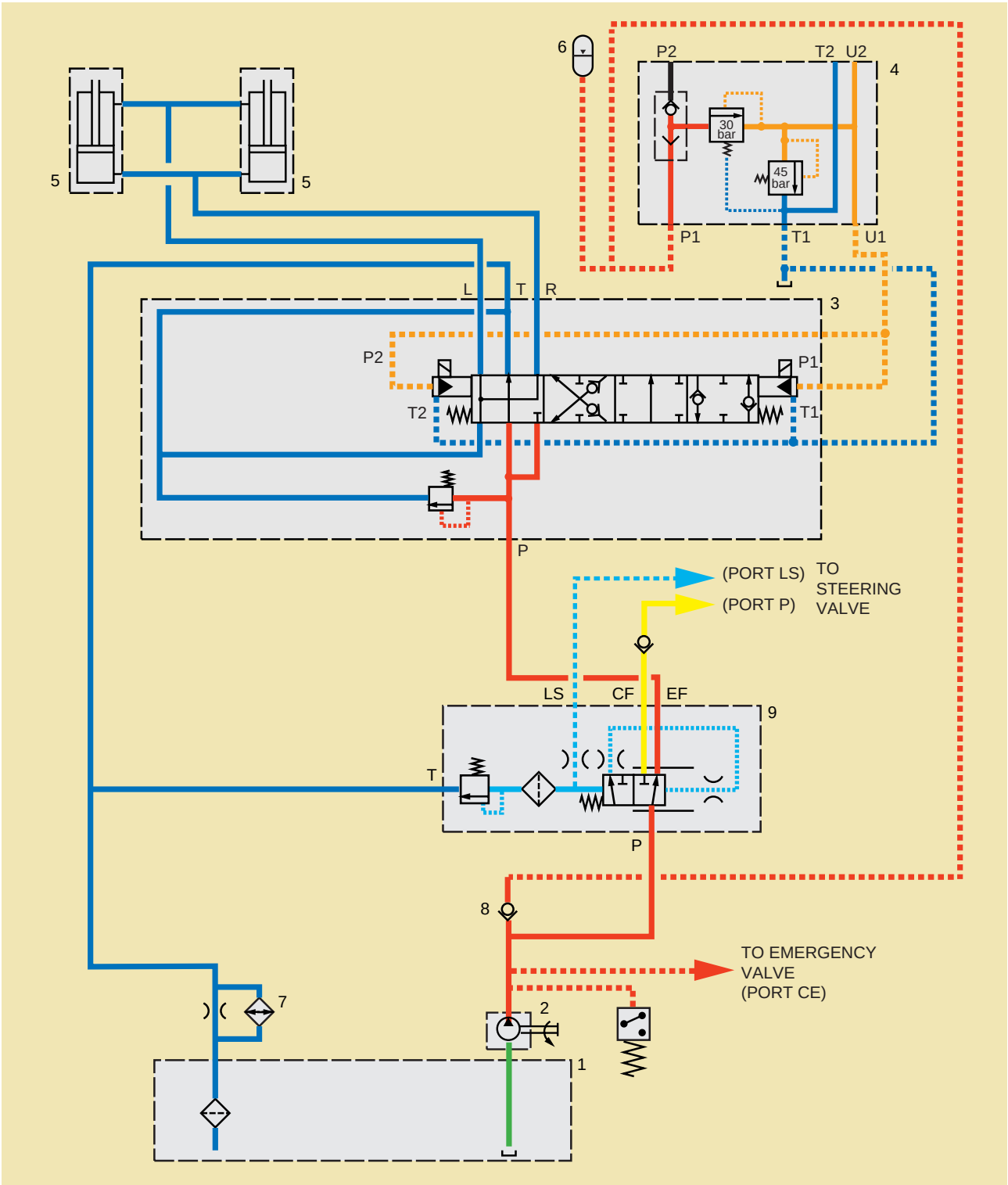
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Body System - Body System Schematic

Section 230-0000

SM - 2459A



COMPONENTS

1 - Hydraulic Tank
2 - Main Hydraulic Pump
3 - Body Control Valve
4 - Pilot Supply Block
5 - Body Cylinder
6 - Accumulator
7 - Hydraulic Oil Cooler
8 - Check Valve
9 - Priority Valve

COLOUR CODES

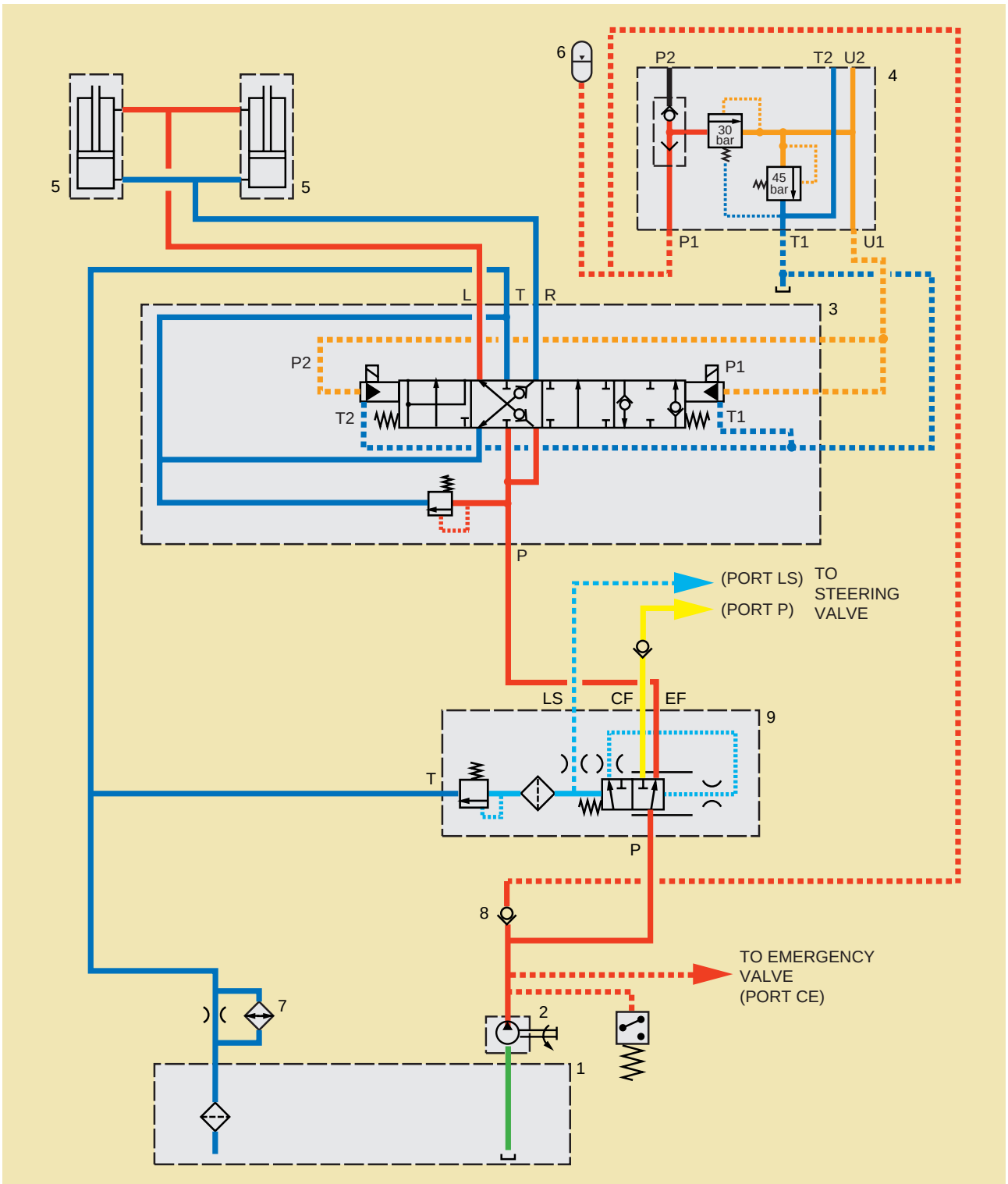
Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

Fig. 2 - Body Hoist System Schematic - Body Control Valve in the 'Float' Position

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SM - 2459B



COMPONENTS

1 - Hydraulic Tank
2 - Main Hydraulic Pump
3 - Body Control Valve
4 - Pilot Supply Block
5 - Body Cylinder
6 - Accumulator
7 - Hydraulic Oil Cooler
8 - Check Valve
9 - Priority Valve

COLOUR CODES

Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

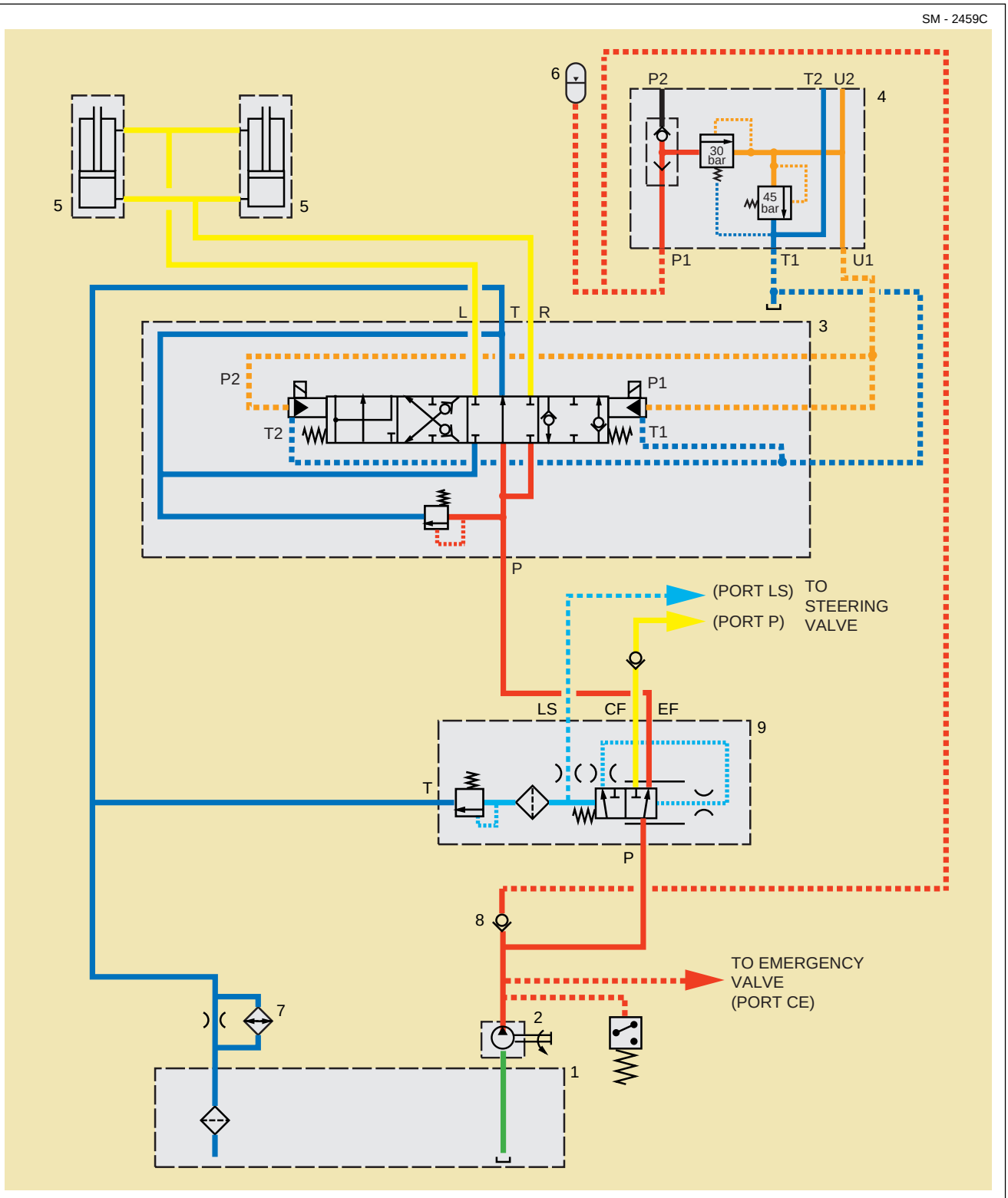
Fig. 3 - Body Hoist System Schematic - Body Control Valve in the 'Lower' Position

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Body System - Body System Schematic

Section 230-0000



COMPONENTS

1 - Hydraulic Tank
2 - Main Hydraulic Pump
3 - Body Control Valve
4 - Pilot Supply Block
5 - Body Cylinder
6 - Accumulator
7 - Hydraulic Oil Cooler
8 - Check Valve
9 - Priority Valve

COLOUR CODES

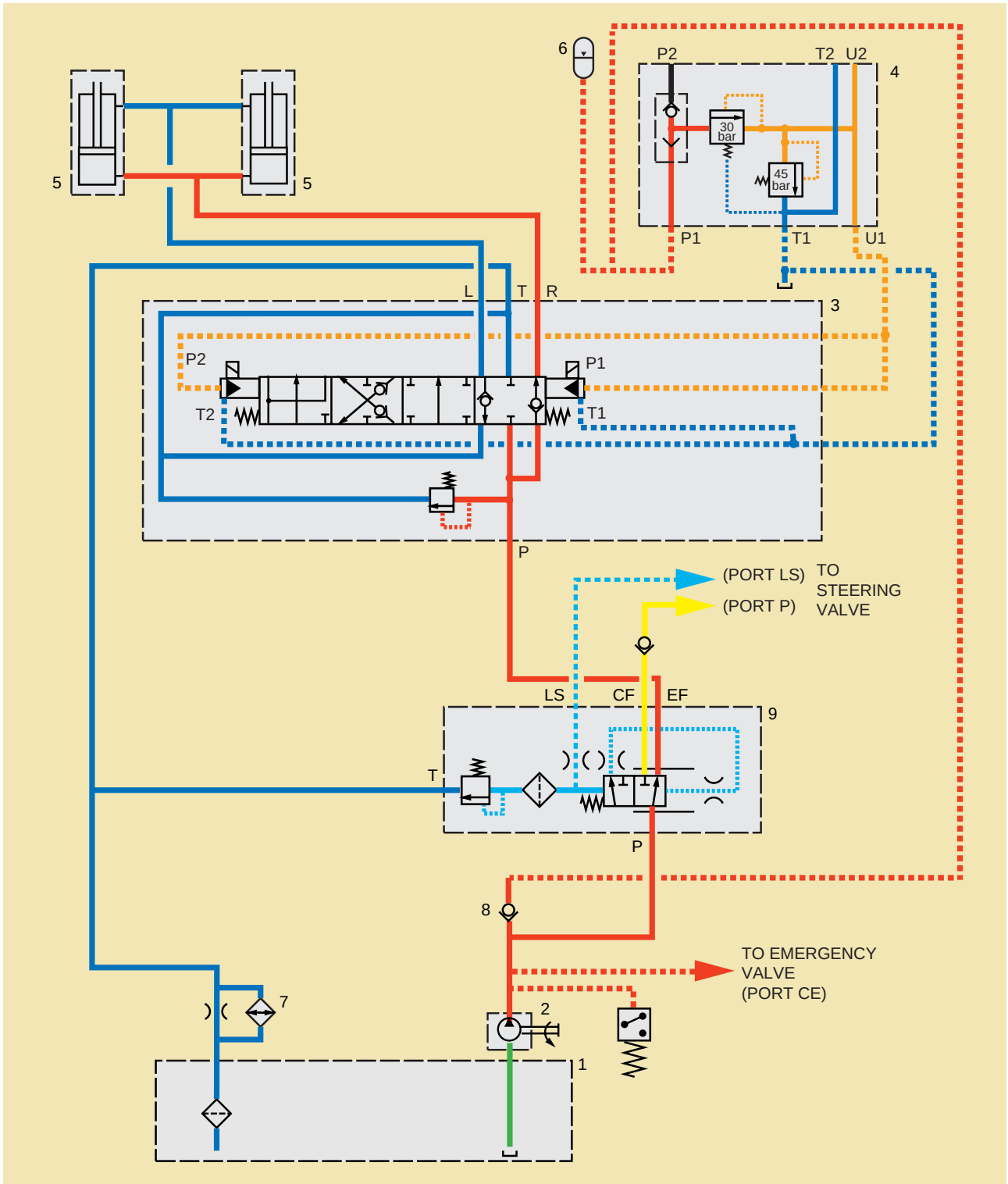
Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

Fig. 4 - Body Hoist System Schematic - Body Control Valve in the 'Hold' Position

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SM - 2459D



COMPONENTS

1 - Hydraulic Tank
2 - Main Hydraulic Pump
3 - Body Control Valve
4 - Pilot Supply Block
5 - Body Cylinder
6 - Accumulator
7 - Hydraulic Oil Cooler
8 - Check Valve
9 - Priority Valve

COLOUR CODES

Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

Fig. 5 - Body Hoist System Schematic - Body Control Valve in the 'Raise' Position

* * * *

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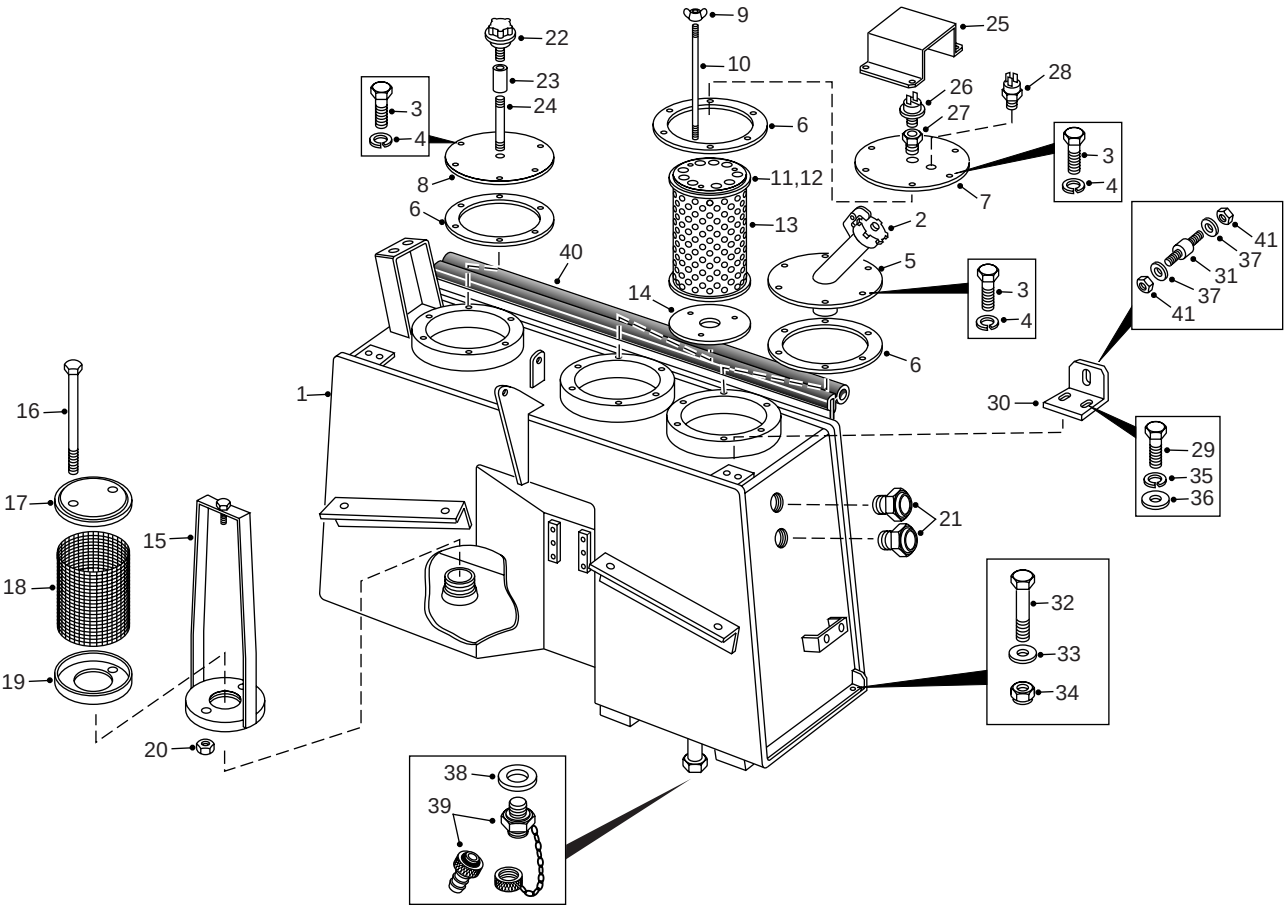
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SM - 2461



1 - Tank Assembly
2 - Filler Cap
3 - Bolt
4 - Lockwasher
5 - Filler Neck Assembly
6 - Gasket
7 - Access Cover
8 - Access Cover
9 - Wing Nut
10 - Rod
11 - Relief Valve
12 - Adaptor Plate
13 - Filter Element
14 - Gasket
15 - Carrier
16 - Bolt
17 - End Cap
18 - Suction Screen
19 - End Cap
20 - Locknut
21 - Sight Gauge
22 - Breather
23 - Coupling
24 - Nipple
25 - Cover
26 - Pressure Switch
27 - Reducer
28 - Temperature Switch
29 - Bolt
30 - Bracket
31 - Isolation Mount
32 - Bolt
33 - Washer
34 - Locknut
35 - Lockwasher
36 - Washer
37 - Washer
38 - Washer
39 - Anti Spill Drain Plug
40 - Sealing Strip
41 - Nut

Fig. 1 - Exploded View of Hydraulic Tank and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The hydraulic tank is the common oil reservoir for the steering and body hoist systems. It is mounted to the tractor frame, at the rear of the cab, and secured with four bolts (32), washers (33) and locknuts (34).

Integral with tank assembly (1) are two suction screens (18), filter element (13), relief valve (11), adaptor plate (12), access covers (7 & 8) and filler neck assembly (5). Two sight gauges (21) on the right hand side of tank assembly (1) indicate hydraulic oil level. Located on top of tank assembly (1) are breather (22), pressure switch (26) and temperature switch (28).

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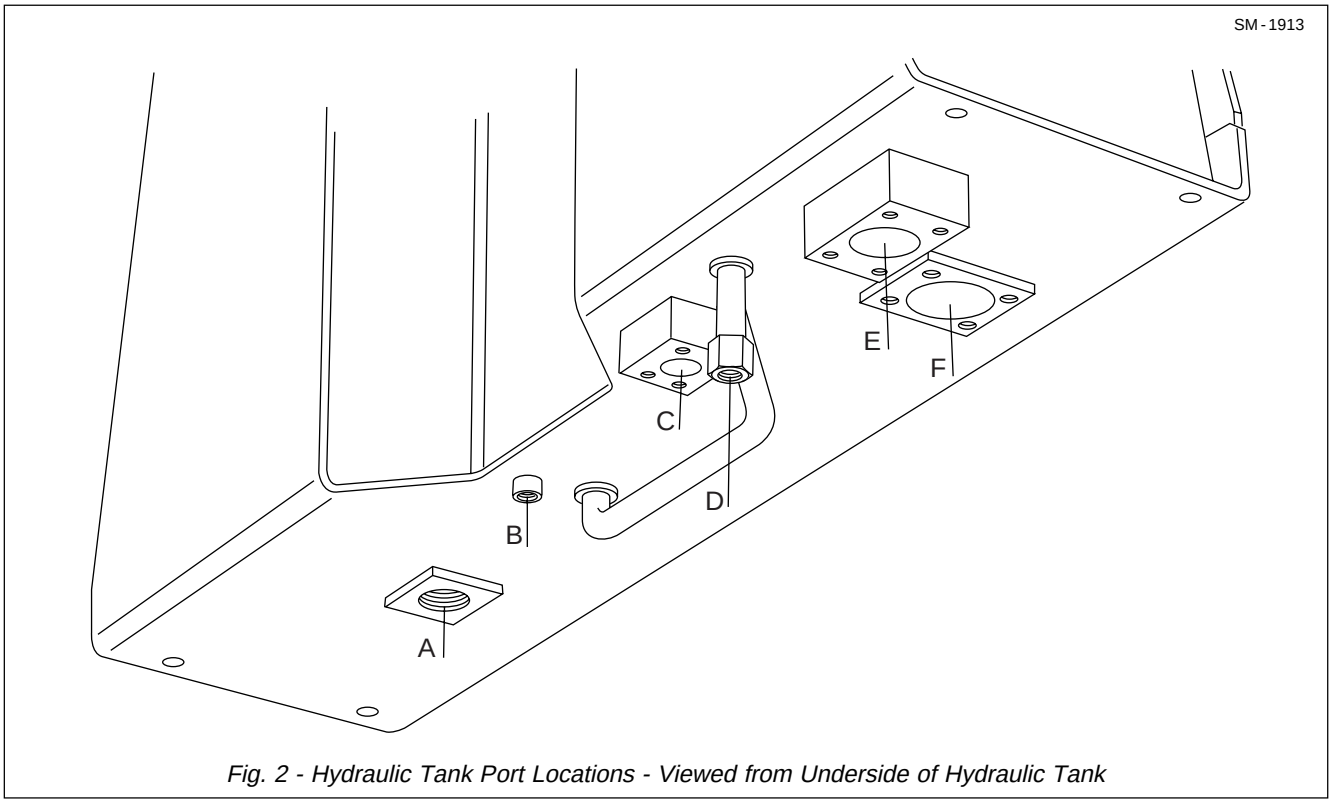


Fig. 2 - Hydraulic Tank Port Locations - Viewed from Underside of Hydraulic Tank

Internally there is a baffle plate which divides tank assembly (1) into a steering compartment and a body hoist compartment. Should oil level drop below this baffle level, tank assembly (1) operates as two separate tanks.

OPERATION

Numbers in parentheses refer to Fig. 1. Refer to Fig. 2 for port locations.

Hydraulic oil is drawn from port 'A', through suction screen (18), by the emergency steering pump mounted at the front of the transmission. Oil is then pumped to the emergency steering valve in the steering system.

Port 'B' is plugged.

Return oil from the steering valve and emergency steering valve enters tank assembly (1) at port 'C'. The oil is filtered through filter element (13) before entering tank assembly (1) storage area. Relief valve (11) allows the oil to bypass filter element (13) when it is cold or blocked.

An anti-spill drain cap is fitted at port 'D'. Install an anti-spill drain connector to drain hydraulic oil from tank assembly (1).

A tube connected at port 'E' allows return oil from the body control valve to enter tank assembly (1). The oil is filtered through filter element (13) before entering tank assembly (1) storage area. Relief valve (11) allows the oil to bypass filter element (13) when it is cold or blocked.

Hydraulic oil from tank assembly (1) is cooled through a hydraulic oil cooler mounted on the front of the radiator. These lines are connected to the tube assembly at port 'E'. Refer to Section 210-0100, HYDRAULIC OIL COOLER, for oil flow through the cooler.

Hydraulic oil is drawn from port 'F', through suction screen (18), by the main hydraulic pump mounted at the rear of the transmission. Oil is then pumped through the priority valve to the body hoist system or the steering system, depending on the priority valve spool position.

Should filter element (13) become blocked, relief valve (11) assembly will open, allowing oil to flow around filter element (13) and into the body of tank assembly (1). Restriction pressure is picked up by pressure switch (26), installed in access cover (7) which registers on the hydraulic oil filter warning light on the dash.

Note: Hydraulic oil filter warning light illuminates at

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2.75 bar (40 lbf/in²) restriction, indicating filter element (13) requires to be changed.

Temperature switch (28), installed in access cover (7), opens when a temperature of 50° C (122° F) is reached. Temperature switch (28) is connected in series with pressure switch (26), therefore, hydraulic oil filter warning light on the dash will not illuminate until the hydraulic oil temperature rises above 50° C (122° F).

Relief valve (11) in filter element (13) will open when a pressure of 3.5 bar (50 lbf/in²) is reached within the filter compartment of the hydraulic tank.

Installed in access cover (8) is a breather which allows any air entering tank assembly (1) to escape to atmosphere, preventing air pressure build up within tank assembly (1).

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of sufficient capacity to do the job safely.

Checking Oil Level

1. Operate the body hoist and steering systems several times to bring the oil to correct operating temperature.

2. Position the vehicle in a level work area, be sure the body is completely lowered, apply the parking brake and switch off the engine.

3. Check oil level and add oil if low. The bottom sight gauge (21) should show full. If oil is required, remove filler cap (2) and fill tank assembly (1) with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (2) on filler neck assembly (5).

Replacing Hydraulic Oil

The hydraulic tank should be drained, cleaned and hydraulic oil changed every 2 000 hours. Refer to Section 300-0020, LUBRICATION SYSTEM, for hydraulic oil used in the system.

Replacing Filter Element

Clean filter housing and install new filter element (13) when hydraulic oil filter warning light illuminates, or after every 2 000 hours of operation, whichever comes first.

Note: When hydraulic oil in tank assembly (1) is being replaced due to a hydraulic failure, or at recommended change interval, filter element (13) should be replaced.

1. Position the vehicle in a level work area, be sure the body is completely lowered, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Lift window guard from tank (1) to allow access to access cover (7).

4. Remove bolts (3) and lockwashers (4) securing access cover (7) to tank (1). Remove and discard gasket (6) from tank (1).

5. Remove cap from anti-spill drain plug (39), install drain tube connection and drain hydraulic oil, to below the level of filter element (13), into a suitable container. Remove drain tube connection and reinstall cap.

6. Remove wing nuts (9) from rods (10). Slide relief valve (11), adaptor plate (12), filter element (13) and gasket (14) over rods (10) and remove from tank assembly (1). Discard filter element (13) and gasket (14).

⚠ WARNING
Splashing liquid. Wear a suitable face shield when using compressed air to dry hydraulic tank and components.

7. Clean out filter element (13) compartment in tank assembly (1) with a suitable solvent and dry with compressed air.

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8. If damaged, remove and replace rods (10) from tank assembly (1).

9. Install new gasket (14), new filter element (13), adaptor plate (12) and relief valve (11) over rods (10) and into filter element compartment in tank assembly (1). Secure relief valve (11), adaptor plate (12) and filter element (13) in position with wing nuts (9).

10. Install new gasket (6) on access cover (7) mounting flange. Secure access cover (7) to tank assembly (1) with bolts (3) and lockwashers (4).

11. Refill tank assembly (1) with hydraulic oil, as specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (2) on filler neck assembly (5).

12. Place the battery master switch in the 'On' position, remove wheel blocks, start the engine and operate steering and body hoist systems to circulate the hydraulic oil.

13. Switch off the engine and check for leaks. Tighten lines and fittings as required. Check hydraulic oil tank level as described under 'Checking Oil Level'.

Replacing or Cleaning Suction Screens

Suction screens (18) should be cleaned every time tank assembly (1) is fully drained for any reason. Refer to 'Replacing Hydraulic Oil' for oil change interval.

1. Position the vehicle in a level work area, be sure the body is completely lowered, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Lift window guard from tank assembly (1) to allow access to access cover (8) and filler neck assembly (5).

4. Remove bolts (3) and lockwashers (4) securing access cover (8) and filler neck assembly (5) to tank assembly (1). Remove and discard gaskets (6) from tank assembly (1).

5. Remove cap from anti-spill drain plug (39), install drain tube connection and drain hydraulic oil, to below the level of the top of carrier (15) assembly, into a suitable container. Remove drain tube connection and reinstall cap.

6. Unscrew and remove both carrier assemblies (15 through 20) from the interior of tank assembly (1).

7. Remove bolts (16) and locknuts (20) securing end caps (17 & 19) and suction screen (18) to one carrier (15).

> **⚠ WARNING**
> **Splashing liquid. Wear a suitable face shield when using compressed air to dry hydraulic tank and components.**

8. Clean carrier (15), end caps (17 & 19) and suction screen (18) in a suitable solvent and dry with compressed air.

9. Inspect suction screen (18) for damage and replace if required.

10. Install end caps (17 & 19) and suction screen (18) on carrier (15). Secure carrier (15) assembly together with bolts (16) and locknuts (20).

11. Install carrier assembly (15 through 20) in tank assembly (1) and secure.

12. Repeat steps 7 through 11 for other carrier (15) assembly.

13. Install new gaskets (6) on access cover (8) and filler assembly (5) mounting flanges. Secure access cover (8) and filler assembly (5) to tank (1) assembly with bolts (3) and lockwashers (4).

14. Refill tank assembly (1) with hydraulic oil, as specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (2) filler neck assembly (5).

15. Place the battery master switch in the 'On' position, remove wheel blocks, start the engine and operate steering and body hoist systems to circulate the hydraulic oil.

16. Switch off the engine and check for leaks. Tighten lines and fittings as required. Check hydraulic oil tank level as described under 'Checking Oil Level'.

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TANK ASSEMBLY

Numbers in parentheses refer to Fig. 1.

Removal

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ Hydraulic fluid pressure will remain **within the body hoist system after engine shutdown. To prevent personal injury and property damage, press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the system.**

1. Position the vehicle in a level work area, be sure the body is completely lowered, apply the parking brake and switch off the engine.

2. Press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the body hoist system.

3. Block all road wheels and place the battery master switch in the 'Off' position.

4. Remove cap from anti-spill drain plug (39), install drain tube connection and drain hydraulic oil into a suitable container. Remove drain tube connection and reinstall cap.

5. Remove window guard assembly from tank assembly (1) and cab to allow access to tank assembly (1).

6. Disconnect supports securing hydraulic lines to pivot guard, and secure clear of tank assembly (1). Support pivot guard and remove mounting hardware securing guard to tank assembly (1). Remove guard to allow access to tank assembly (1).

7. Tag and disconnect all hydraulic lines and fittings attached to tank assembly (1), to aid in 'Installation'. Plug all lines and fittings to prevent ingress of dirt. Remove all wiring connections from tank assembly (1).

8. Disconnect exhaust mounting hardware from tank assembly (1).

9. Secure a suitable lifting device on tank assembly (1) and remove bolts (32), washers (33) and locknuts (34) securing tank assembly (1) to tank mountings on the frame.

10. Carefully remove tank assembly (1) from the vehicle to a clean area for disassembly.

Disassembly

1. Remove internal components from tank assembly (1) as previously described under maintenance.

2. Remove breather (22), coupling (23) and nipple (24) from access cover (8).

3. Remove pressure switch (26), reducer (27) and temperature switch (28) from access cover (7).

4. Remove sight gauges (21) from tank assembly (1).

5. If required, remove bolts (29), washers (36 & 37), lockwashers (35), bracket (30), nuts (41) and isolation mounts (31) from tank assembly (1).

Inspection

⚠ WARNING
Splashing liquid. Wear a suitable face shield when using compressed air to dry hydraulic tank and components.

1. Clean tank assembly (1) and components with a suitable solvent and dry with compressed air.

2. Inspect tank assembly (1) for weld cracks and security of internal pipes and weld fitments.

3. Inspect filter element (13), suction screens (18) and breather (22) for damage. Replace if required.

Assembly

1. Renew all gaskets and install all internal components in tank assembly (1), as previously described under 'Maintenance'.

2. Install nipple (24), coupling (23) and breather (22) on access cover (8).

3. Install reducer (27), pressure switch (26) and temperature switch (28) on access cover (7).

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4. Install sight gauges (21) on tank assembly (1).

5. If removed, install bolts (29), washers (36 & 37), lockwashers (35), bracket (30), nuts (41) and isolation mounts (31) on tank assembly (1).

Installation

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 230-0000, BODY SYSTEM SCHEMATIC. Renew all 'O' rings where used.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Using a suitable lifting device, position tank assembly (1) carefully in position on the vehicle.

2. Secure tank assembly (1) to tank mounting brackets on the frame with bolts (32), washers (33) and locknuts (34).

3. Secure exhaust to tank assembly (1) with mounting hardware as disconnected at 'Removal'.

4. Install all hydraulic lines and fittings to tank assembly (1) as tagged at 'Removal'. Connect all wiring lines to tank assembly (1) as disconnected at 'Removal'.

5. Install pivot guard to tank assembly (1) and secure using mounting hardware removed at 'Removal'. Secure hydraulic lines to pivot guard using supports as removed at 'Removal'.

6. Install window guard assembly to cab and tank assembly (1) and secure.

7. Remove filler cap (2) from filler neck assembly (5) and refill tank assembly (1) with hydraulic oil, as specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (2) on filler neck assembly (5).

8. Place the battery master switch in the 'On' position, remove wheel blocks, start the engine and operate steering and body hoist systems to circulate the hydraulic oil.

9. Switch off the engine and check for leaks. Tighten lines and fittings as required. Check hydraulic oil tank level as described under 'Checking Oil Level'.

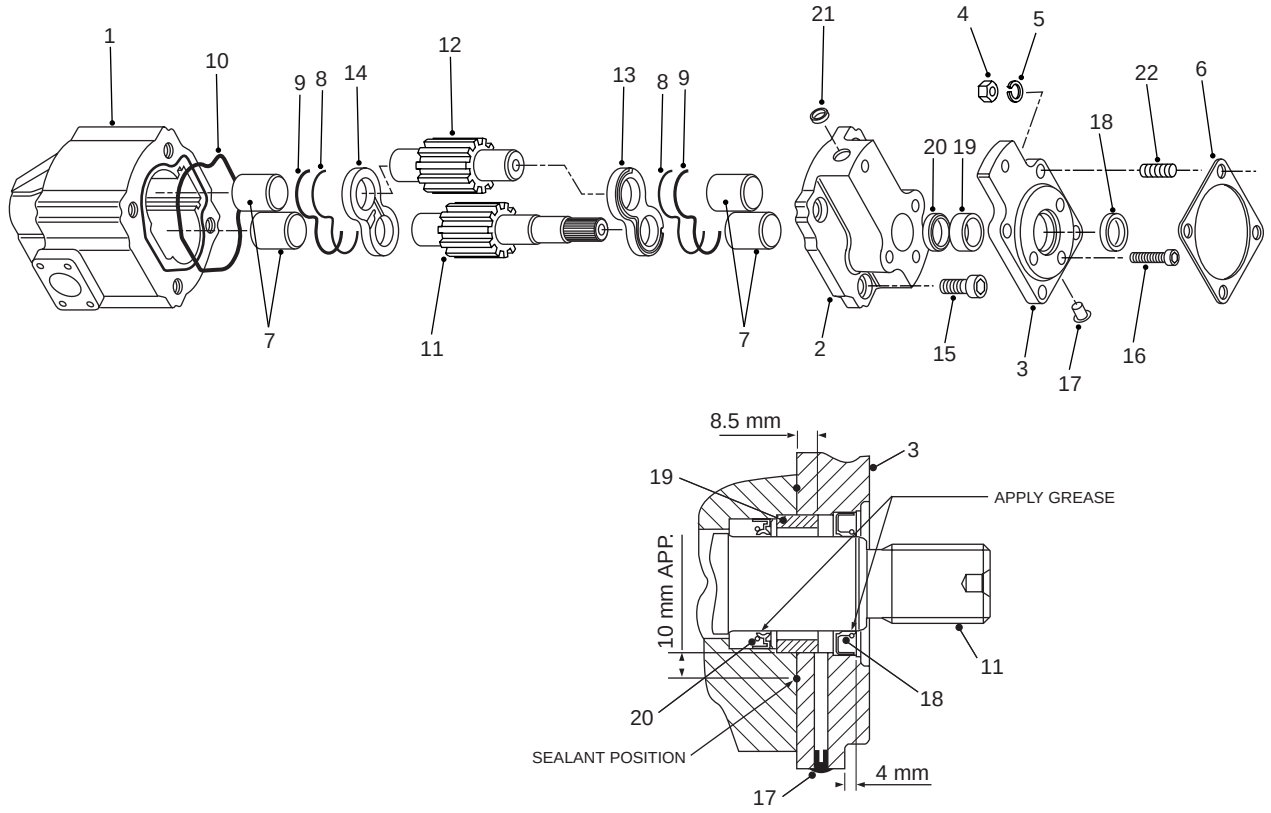
SERVICE TOOLS

There are no special tools required for the procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

* * * *

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1 - Body Housing
2 - Front Cover
3 - Mounting Flange
4 - Nut
5 - Washer
6 - Gasket
7 - Bearing
8 - Wear Plate Seal
9 - Backup Seal
10 - Ring Seal
11 - Driveshaft and Gear
12 - Driven Gear
13 - Wear Plate
14 - Wear Plate
15 - Capscrew
16 - Capscrew
17 - Multistep Push Clip
18 - Seal
19 - Location Sleeve
20 - Seal
21 - Seal
22 - Stud

Fig. 1 - Exploded View of Hydraulic Pump

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The main hydraulic pump can be identified as item 2 in Section 230-0000, BODY SYSTEM SCHEMATIC.

Mounted off the transmission power takeoff (PTO), the main hydraulic pump supplies hydraulic oil for operating the body hoist and steering systems.

The major pump components are; body (1), front cover (2), mounting flange (3), driveshaft and gear (11), driven gear (12), wear plates (13 & 14), wear plate seals (8) and bearings (7).

There are two ports on the hydraulic pump:

Port 'A' - Suction side from hydraulic tank
Port 'B' - Pressure supply to body control valve via priority valve

OPERATION

Numbers in parentheses refer to Fig. 1. Refer to Fig. 2 for typical pump operation.

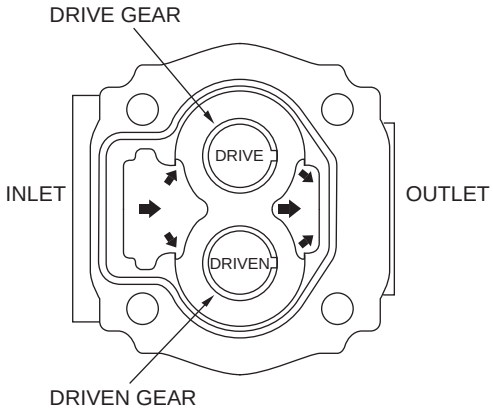


Fig. 2 - Typical Gear Pump Operation

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As driveshaft and gear (11) rotates, driven gear (12) rotates in the opposite direction. Pockets between the drive and driven gear teeth carry oil from inlet port 'A', around gear housing (2) ID, to outlet port 'B'. As the gear teeth re-mesh, oil is forced out of outlet port 'B' to the priority valve. Refer to Section 220-0105, PRIORITY VALVE.

The maximum oil delivery of the hydraulic pump is fixed by the width of its respective gear set and the speed at which driveshaft and gear (11) rotates.

Note: Never drive a pump in the wrong direction of rotation, as pump seizure may result.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ Hydraulic fluid pressure will remain within the body hoist system after engine shutdown. To prevent personal injury and property damage, press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the system.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the body hoist system.

3. Block all road wheels and place the battery master switch in the 'Off' position.

4. Remove hydraulic tank anti-spill drain cap, install drain tube connection and drain oil into a suitable container. Remove drain tube connection and reinstall cap.

5. Clean pump housing and tag and disconnect inlet and outlet lines from pump assembly. Drain oil in hydraulic lines into a suitable container. Cap hydraulic lines and plug pump ports to prevent ingress of dirt.

6. Support pump assembly with suitable lifting equipment. Remove nuts (4) and lockwashers (5) securing pump assembly to the transmission PTO. Remove pump assembly from the transmission PTO and discard gasket (6).

7. Wash outside of the pump assembly thoroughly, with a suitable solvent, and move to a clean work area for disassembly.

DISASSEMBLY

Numbers in parentheses refer to Figs. 1.

1. Place pump assembly in a soft-jawed vice, and clamp on body (1) casing. Match mark port body (1), front cover (2) and mounting flange (3) to aid in assembly.

Note: Do not clamp vice on machined surfaces of the pump at any time.

2. Remove capscrews (16) securing mounting flange (3) and front cover (2) together.

3. Tap mounting flange (3) with a soft hammer and remove it from front cover (2).

Note: Do not attempt to pry the pump units apart with a large screwdriver or pry bar. The machined surfaces of the mounting flange (3) or front cover (2) may be damaged.

4. Remove and discard shaft seals (18 & 20).

5. Remove capscrews (15) securing front cover (2) and body housing (1) together.

6. Tap front cover (2) with a soft hammer and remove from body housing (1).

Note: Do not attempt to pry the pump units apart with a large screwdriver or pry bar. The machined surfaces of the body housing (1) or front cover (2) may be damaged.

7. Remove and discard ring seal (10) from body housing (1).

8. Remove wear plate (13), wear plate seal (8) and backup seal (9) from shaft front cover (2). Note the position of wear plate seal (8) in wear plate (13) groove, for proper assembly.

9. Remove driveshaft gear (11) and driven gear (12) from body housing (1).

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10. Remove wear plate (14) and wear plate seal (8) from body housing (1). Note the position of wear plate seal (8) in wear plate (14) groove, for proper assembly.

11. Using a suitable puller, remove bearings (7) from shaft front cover (2), only if they are being replaced.

INSPECTION

Numbers in parentheses refer to Figs. 1.

1. Clean all parts in a suitable solvent and dry with compressed air.

2. Check driveshaft and gear (11) and driven gear (12) carefully for wear. Remove burrs or light score marks from gear faces and teeth with an India stone. Heavy scoring, grooving or burring of gear teeth OD requires gear replacement. Nicked, grooved or fretted gear tooth mating surfaces also requires gear replacement. Any wear of gear hubs in excess of 0.025 mm (0.001 in), or detectable by touch, requires gear replacement.

Note: Since both driveshaft and gear (11) and driven gear (12) of a set are matched, they must be replaced as a set if one is worn or damaged.

3. If gears are replaced, bearings (7) must be replaced at the same time. Bearings (7) should fit into their bores with a heavy press fit.

4. Check the centre of wear plates (13 & 14) at the point of meshing of driveshaft and gear (11) and driven gear (12). Erosion indicates contaminated oil. Pitting indicates cavitation or aeration of the oil supply. Discoloured wear plates are a sign of the pump over heating.

Wear plate (13 & 14) side wear permits oil to bypass gears and allows internal oil slippage and reduced pump efficiency. Check wear plate (13 & 14) wear against the size of new wear plates. Replace wear plates (13 & 14) if worn in excess of 0.05 mm (0.002 in).

5. Deburr all machined surfaces of port end body housing (1), front cover (2) and mounting flange (3) with a medium grit India stone. Replace gear housing (2) if wear on machined surfaces exceeds 0.127 mm (0.005 in).

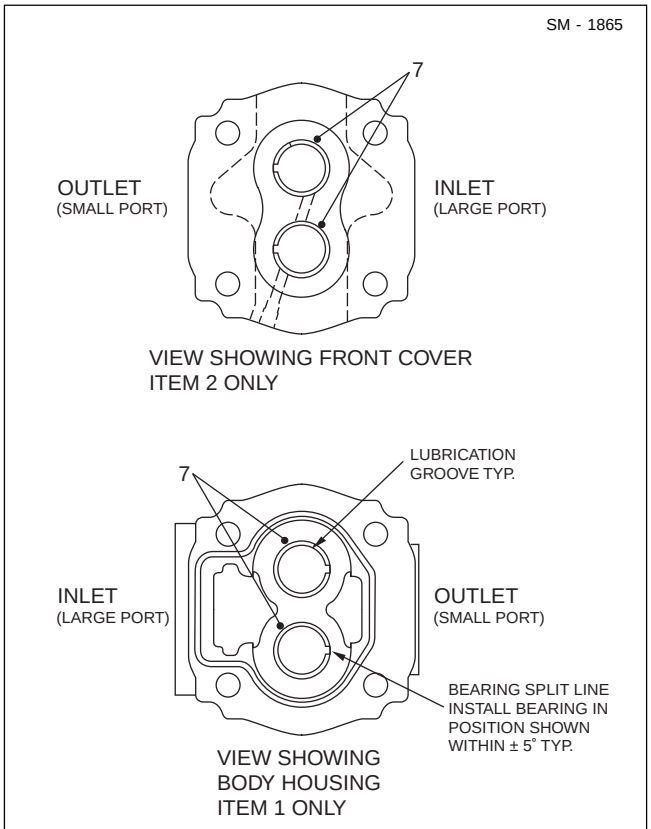


Fig. 3 - Bearing Lubrication Groove Position

6. Replace all wear plate seals (8), backup seals (9), ring seal (10) and lip seals (18 & 19).

7. Clean parts in a suitable solvent and dry with compressed air after deburring surfaces.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. If removed, install bearings (7) in front cover (2) and body housing (1) using an arbor press. Lightly oil bearing (7) outside diameter with mineral oil prior to insertion.

Note: Assemble bearings (7) in body housing (1) bores with the bushing split line positioned at 3 o'clock. The lubrication groove will be positioned at 1 o'clock.

Note: Assemble bearings (7) in the front cover (2) bores with the bushing split line positioned at 9 o'clock. The lubrication groove will be positioned at 11 o'clock, as shown in Fig. 3.

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Note: Ensure bearings (7) are pressed to insertion depth indicated in Fig. 4.

2. Install new lip seals (20) and location sleeve (19) to front cover (2), as shown in Fig. 1.

3. Apply a thin film of grease on new wear plate seal (8) and backup seal (9) and install in wear plate (14), as shown in Fig. 5.

4. Install wear plate (14) into body housing (1) bore, with wear plate seal (8) facing down.

Note: The relief groove in wear plate (14) should face the outlet side of the pump.

5. Lightly oil gear faces, gear flanks and journals with mineral oil prior to assembly.

6. Slide driven gear (12) and drive shaft (11) into its bearing in body housing (1).

Note: When installing the original gear sets, align as match marked at disassembly.

7. Apply a thin film of grease on second wear plate seal (8) and backup seal (9) and install in second wear plate (13), as shown in Fig. 5.

8. Install wear plate (13) assembly on gear shaft end (11) and body housing (1) bore, with wear plate seal (8), and backup seal (9) facing up.

Note: The relief groove in wear plate (13) should face the outlet side of the pump.

9. Fit ring seal (10) to body housing (1) machined face. Ring seal (10) to be fitted dry.

10. Coat special sleeve tool, which can be fabricated as shown in Fig. 8, with grease and install driveshaft and gear (11) in the sleeve tool, as shown in Fig. 6.

11. Position assembled front cover (2) over gear shaft ends (11 & 12). Tap front cover (2) with a soft hammer until it rests against wear plate (14) in body housing (1), as shown in Fig. 7. Take care not to damage ring seal (10) and seal (20).

Note: Make sure index marks on front cover (2) and body housing (1) match up, as marked at disassembly.

12. Remove sleeve tool from drive of driveshaft and gear (11) and cover the gear set with hydraulic oil specified in Section 300-0020, LUBRICATION SYSTEM.

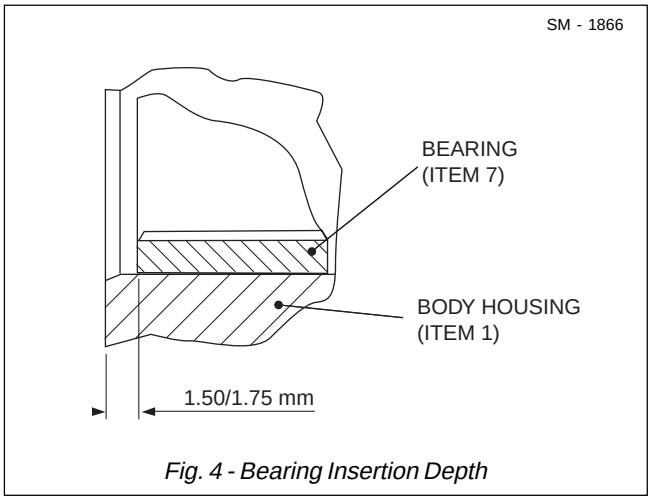


Fig. 4 - Bearing Insertion Depth

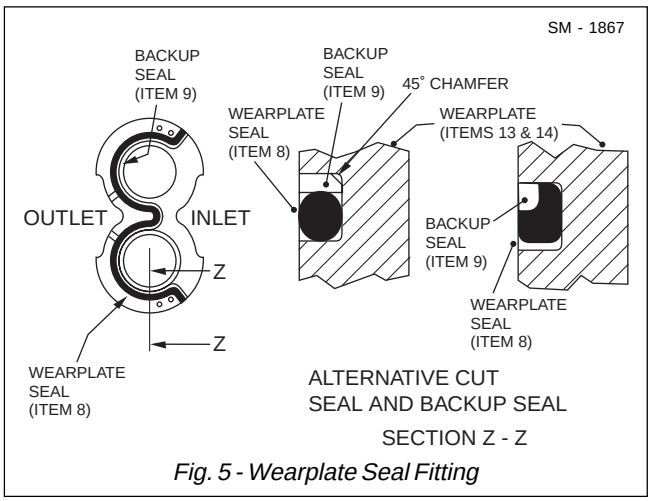


Fig. 5 - Wearplate Seal Fitting

13. Secure body housing (1) and front cover (2) together with four capscrews (15). Tighten capscrews (15) alternately to ensure correct alignment of parts. Rotate driveshaft (11) to check for internal binding of parts. If no binding is evident, tighten capscrews (15) alternately to a torque of 772 Nm (569 lbf ft).

14. Apply a continuous beading (1 - 1.5 mm dia.) of sealant to flange mounting (3) face, approximately 10 mm from locating sleeve (19) before installing mounting flange (3). Tap mounting flange (3) with soft hammer until it rests against front cover (2).

15. Secure mounting flange (3) to front cover (2) together with three capscrews (16). Tighten capscrews (16) alternately to ensure correct alignment of parts. Rotate driveshaft (11) to check for internal binding of parts. If no binding is evident, tighten capscrews (16) alternately to a torque of 162 Nm (119 lbf ft).

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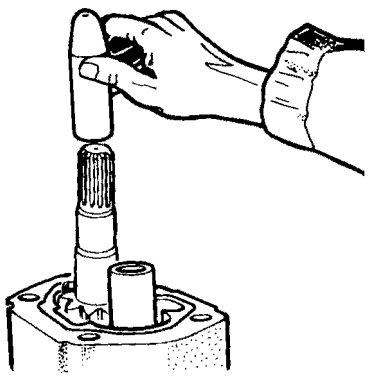


Fig. 6 - Installing Driveshaft and Gear in Body Housing

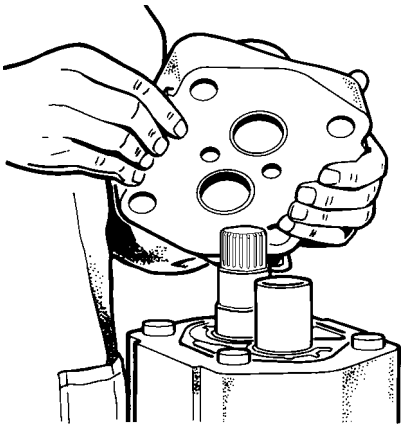


Fig. 7 - Installing Front Cover

INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
To prevent personal injury and property damage, be sure blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Coat pump driveshaft spline with high grade plating-type molybdenum disulphide grease 15% minimum (typical) and install gasket (20) on mounting face of the pump assembly.

2. With suitable lifting equipment position pump on mounting studs. Secure with nuts (4) and lockwashers (5), as removed during removal.

3. Remove cap from the inlet line and install a new 'O' ring in the split flange fitting. Secure inlet line to inlet port 'A' on the pump with bolts and lockwashers, as removed during removal.

4. Before connecting the outlet line to outlet port 'B' on the pump, fill the pump with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM.

5. Remove cap from the outlet line and install a new 'O' ring in the split flange fitting. Secure outlet line to outlet port 'B' on the pump with bolts and lockwashers, as removed during removal.

Note: It is very important that the pump cavity is filled with hydraulic oil. This will ensure proper lubrication of the internal parts of the pump when it is initially operated.

6. Fill hydraulic tank to the proper level. Refer to Section 230-0040, HYDRAULIC TANK for correct oil level and, Section 300-0020, LUBRICATION SYSTEM for oil specification.

START-UP PROCEDURE

Before starting the engine and running the pump, back-off the system relief valve on the priority valve, until the adjusting screw spring tension is relieved. Refer to Section 220-0105, PRIORITY VALVE, for details. This avoids the possibility of immediate damage to the pump if the relief valve pressure setting had been increased, beyond the recommended operating pressure, before removal of the pump. Loosen the bolts at flange fitting on outlet line at port 'B' on the pump to allow entrapped air to bleed out at initial start-up.

Start the engine and operate the pump at least two minutes at zero pressure at engine idle speed. When oil runs out of pump outlet port 'B' in a steady stream, tighten outlet line flange fittings. During the break-in period, the pump should run free and not develop an excessive amount of heat. If the pump becomes hot to touch, it is binding and might seize. In this instance the pump will have to be rebuilt with extra care to prevent binding.

If the pump is running properly, engine speed and hydraulic system pressures can gradually be increased to normal operating values. Adjust the system relief valve to the proper setting as described in Section 220-0060, PRIORITY VALVE.

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Note: Always use accurate pressure gauges when adjusting the relief valve.

Check pump mounting and hydraulic line connections for leaks. Tighten lines and fittings as required.

Remove wheel blocks from all road wheels.

LUBRICATION

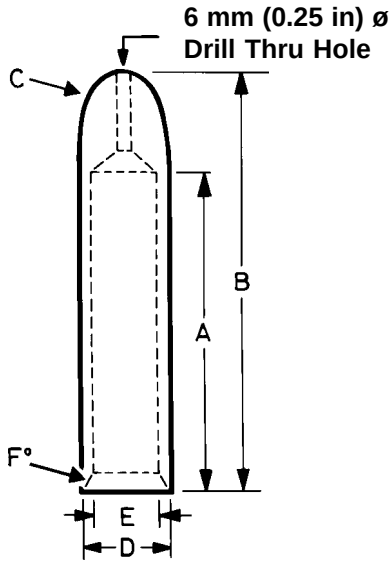
All pump parts are lubricated by the hydraulic oil. The oil, therefore, must be kept clean to minimize pump wear. Whenever there is a hydraulic system failure, the oil should be drained, the entire system flushed, oil filters replaced, oil screens thoroughly cleaned and fresh hydraulic oil installed to eliminate all metal particles or foreign matter.

Refer to Section 300-0020, LUBRICATION SYSTEM, for recommended periodic oil change periods and oil specifications.

SPECIAL TOOL

The special sleeve tool for installing the driveshaft and gear in the pump can be fabricated from steel bar as shown in Fig. 8. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

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SPECIAL SLEEVE TOOL DIMENSIONS		
DIMENSION	mm	in
A	85.7	3.375
B	114.3	4.50
C Radius	14.3	0.56
D Diameter	34.9758 + 0.000 - 0.0508	1.377 + 0.000 - 0.002
E Diameter	31.75 + 0.050 - 0.000	1.250 + 0.002 - 0.000
F° Chamfer	1.6 x 60°	0.063 x 60°

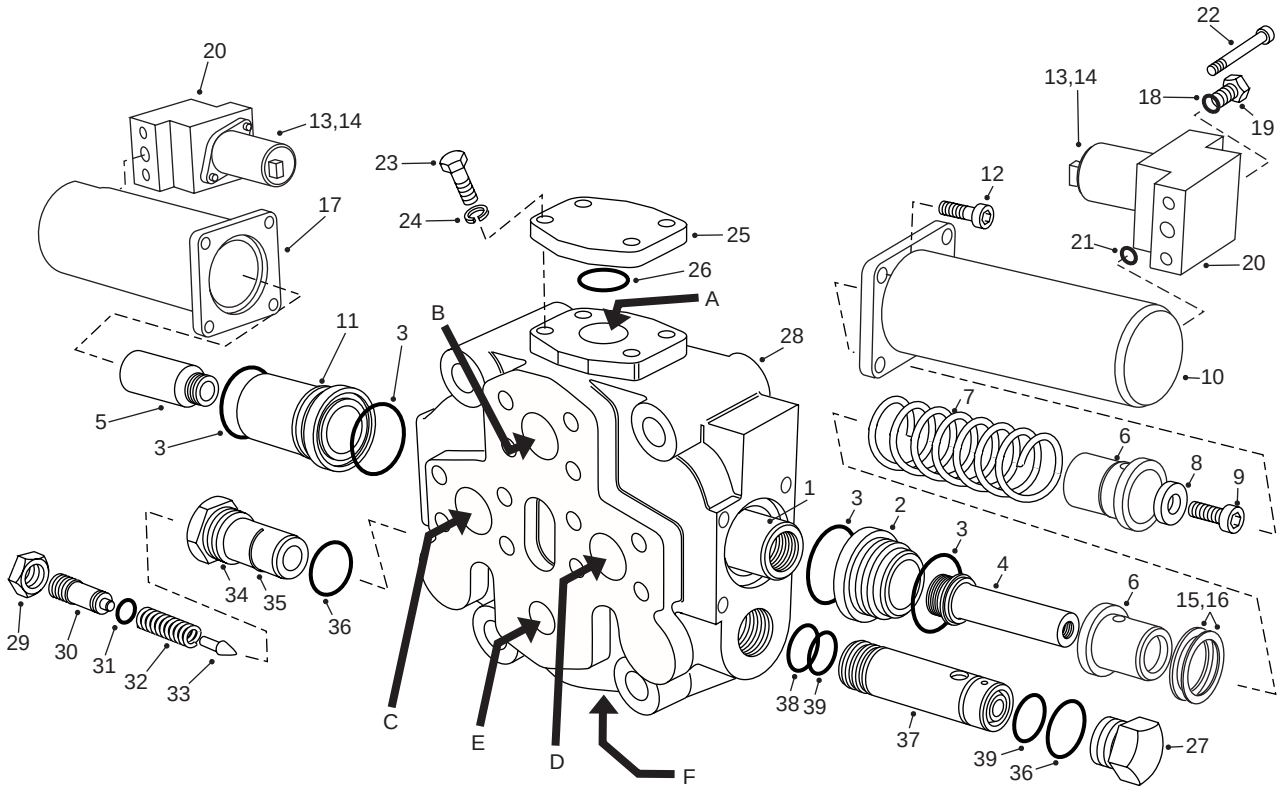
Fig. 8 - Special Sleeve Tool Dimensions

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	15	Capscrew	772	569
1	16	Capscrew	162	119

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1 - Control Spool
2 - Retainer
3 - 'O' Ring
4 - Spool Cap
5 - Spool Cap
6 - Spring Retainer
7 - Spring
8 - Washer
9 - Capscrew
10 - End Cap
11 - Seal Retainer
12 - Capscrew
13 - Pressure Reducing Valve
14 - Capscrew
15 - Shim
16 - Shim
17 - End Cap
18 - Seal
19 - Plug
20 - Mounting Block
21 - 'O' Ring
22 - Capscrew
23 - Capscrew
24 - Lockwasher
25 - Blanking Plate
26 - 'O' Ring
27 - Cap
28 - Valve Housing
29 - Locknut
30 - Adjusting Screw
31 - 'O' Ring
32 - Spring
33 - Poppet
34 - Cap
35 - Ring
36 - 'O' Ring
37 - Relief Valve
38 - 'O' Ring
39 - 'O' Ring

Fig. 1 - Exploded View of Body Control Valve

DESCRIPTION

Numbers and letters in parentheses refer to Fig. 1.

The body control valve can be identified as item 3 in Section 230-0000, BODY SYSTEM SCHEMATIC.

The single spool body control valve, which is fitted with electro hydraulic operation, is mounted behind the front right hand wheel, onto a bracket mounted to the frame rail. The main components of the control valve assembly are a four position control spool (1), relief valve (37), check valve assembly and valve housing (28).

The position of the control spool is controlled by the body control joystick by means of electrical signals to

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the pressure reducing valves (13). Refer to Section 230-0081, BODY CONTROL JOYSTICK. The body control joystick has a pre-feel ramp which controls the current to the pressure reducing valve such that the pressure into the end cap moves the spool to the 'Power Down' position. Further selection of the joystick, beyond the ramp position, allows full current to reach the pressure reducing valve such that full pilot pressure is seen in the end cap. Full selection then occurs and the 'Float' position is achieved.

The four positions of the control spool are 'Raise', 'Hold', 'Lower' (Power Down) and 'Float'. The 'Float' position is detented and control spool (1) should be kept in this position at all times, except when Raising or Lowering the body.

Control valve housing (28) has six ports as follows:

Port 'A' - Capped with blanking plate (25).
Port 'B' - Tank Return Port and return lines from pilot supply valve and steering priority valve.
Ports 'C' & 'D' - Body Cylinder Ports.
Port 'E' - Fitted with adaptor and connected to hydraulic system diagnostic test point.
Port 'F' - Supply from main hydraulic pump via steering priority valve.

Relief valve (37) assembly at the pressure inlet opens and allows oil to flow back to the hydraulic tank when pressure in the hydraulic system exceeds 221 bar (3 200 lbf/in²).

OPERATION

Hold Position

Numbers in parentheses refer to Fig. 1.

When control spool (1) is in the 'Hold' position, oil from the pump enters port 'F', flows around relief valve (37) assembly and control spool (1), and out of port 'B' to the hydraulic tank. Cylinder ports 'C' and 'D' are blocked by control spool (1) and oil is trapped between the control valve and the cylinders. In this position the body can be in any partially raised position.

Raise Position

Numbers in parentheses refer to Fig. 1.

Pushing the body control joystick into the 'Raise' position and holding it there, moves control spool (1) position within the valve housing (28).

Oil from the pump enters port 'F', flows around relief valve (37) assembly, into the right hand side of control spool (1), unseats check valve plunger, flows out of port 'D' and into the base end of the cylinders.

Oil returning from the rod end of the cylinders enters control valve housing at port 'C', flows into and out of control spool (1) and into the tank return passage. Oil exits from port 'B' to the hydraulic oil tank.

When the body control joystick is released, spring (7) returns control spool (1) to the 'Hold' position.

Lower Position (Power Down)

Numbers in parentheses refer to Fig. 1.

The 'Lower' or 'Power Down' position is only used to start lowering the body. Once the body has started to come down, the control joystick should be placed into the detented 'Float' position.

Oil from the pump enters valve housing (28) at port 'F', flows around relief valve (37) assembly, into the left hand side of control spool (1), exits from port 'C' and flows into the rod end of the cylinders.

Oil from the base end of the cylinders enters control valve housing (28) at port 'D'. The returning oil unseats check valve plunger and flows into the tank return passage. Oil exits from port 'B' to the hydraulic oil tank.

Float Position

Numbers in parentheses refer to Fig. 1.

Moving the body control joystick to the 'Float' position, moves control spool (1) to a position within the valve housing (28) which allows the body to lower by it's own weight.

In the 'Float' position, because of the design of control spool (1), the body cylinder rod and base end ports are connected together at the control valve.

Oil from the pump enters valve housing (28) at port 'F', flows around relief valve (37) assembly, past control spool (1), and, if the oil is not required by the cylinders, exits from port 'B' to the hydraulic oil tank.

Relief Valve

Numbers in parentheses refer to Fig. 1.

Relief valve (37) assembly, in valve housing (28), is set to relieve oil pressure in excess of 221 bar (3 200 lbf/in²).

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Should oil at the inlet side of the valve exceed 221 bar (3 200 lbf/in²), pilot poppet (33) will be forced off its seat. Oil will flow through an internal passage and exit from port 'B' to the hydraulic oil tank. When pressure is relieved, tension of spring (32) will force pilot poppet (33) to re-seat.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ Hydraulic fluid pressure will remain within the body hoist system after engine shutdown. To prevent personal injury and property damage, press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the system.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the body hoist system.

3. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

4. Remove hydraulic tank anti-spill drain cap, install drain tube connection and drain oil into a suitable container. Remove drain tube connection and reinstall cap.

5. Clean body control valve housing (28) and surrounding area with a suitable solvent. Identify and tag all hydraulic and servo control lines connected to body control valve, to aid in 'Installation'.

6. With suitable containers available to catch spillage, disconnect hydraulic and servo control lines from control valve. Drain the oil from the lines into the container and discard all 'O' rings. Cap hydraulic lines and control valve ports to prevent ingress of dirt.

7. Support body control valve with a suitable lifting device and remove mounting hardware securing body control valve to mounting bracket on the frame. Remove body control valve from the machine and transfer to a clean area for disassembly.

DISASSEMBLY

Numbers and letters in parentheses refer to Fig. 1.

⚠ WARNING
Spring loaded parts. Use care when removing end cap, retainers and plugs to prevent sudden release of spring tension behind these parts. Personal injury or property damage could result if care is not taken.

Note: Clean entire control valve assembly with a suitable solvent and dry thoroughly prior to disassembly.

Valve Body

1. If required, remove adaptor and 'O' ring from port 'E' in valve housing (28). Discard 'O' ring.

2. If required, remove bolts (23), lockwashers (24), blanking plate (25) and 'O' ring (26) from port 'A' in valve housing (28). Discard 'O' ring (26).

Control Spool

1. Clean the entire body control valve assembly with a suitable solvent and dry thoroughly. Remove caps from valve housing (28) ports.

2. If required, clamp body control valve assembly in a soft jawed vice. Take care to avoid damaging valve housing (28) machined surfaces.

3. Remove capscrews (14) securing pressure reducing valve (13) from mounting block (20). Withdraw pressure reducing valve (13) from mounting block (20).

4. Remove capscrews (22) securing mounting block (20) to end cap (10). Remove mounting block (20) and discard 'O' ring (21).

5. If required, remove plug (19) from mounting block (20) and discard 'O' ring (18).

6. Repeat steps 3 to 5 for opposite end of valve housing (28), end cap (17).

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7. Remove capscrews (12) securing end cap (10) to valve housing (28). Remove end cap (10).

8. Carefully withdraw spool and spring pack assembly from valve housing (28). Remove and discard 'O' rings (3).

Note: 'O' rings (3) can be replaced without disassembly of the spring mechanism.

9. If necessary, the centring mechanism can be removed from the spool assembly. Remove capscrew (9) to release washer (8), spring seats (6), spring (7) and shims (15 & 16).

Relief Valve

1. Clean the entire body control valve assembly with a suitable solvent and dry thoroughly. Remove caps from valve housing (28) ports.

2. If desired, clamp body control valve assembly in a soft jawed vice. Take care to avoid damaging valve housing (28) machined surfaces.

3. Release locking nut (29) and slacken adjusting screw (30) until loose.

4. Remove cap (34) from valve housing (28) and discard 'O' ring (36).

5. Withdraw spring (32) and poppet (33) from valve housing (28) bore.

6. Remove cap (27) from the opposite end of valve housing (28) and discard 'O' ring (36).

7. Push out relief valve (37) assembly from bore in valve housing (28). Discard 'O' rings (38 & 39).

INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Clean all parts thoroughly and examine for wear and/or damage.

2. Inspect valve housing (28) bores and control spool (1) for grooves, deep scratches or excessive wear.

Note: If condition of valve housing (28) bores or control spool (1) indicates that they require to be replaced, the body control valve should be replaced as an assembly.

3. If either poppet (33) or relief valve (37) are damaged, BOTH parts should be replaced by new parts.

Note: Do not lap or grind poppet (33) to relief valve (37) assembly.

ASSEMBLY

Numbers and letters in parentheses refer to Fig. 1.

Note: Lightly lubricate all components with hydraulic oil. Refer to Section 300-0020, LUBRICATION SYSTEM, for recommended oil specifications.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Valve Body

1. If removed, install new 'O' ring (26) on port 'A' of valve housing (28). Install blanking plate (25) and secure using bolts (23) and lockwashers (24).

2. If removed, install new 'O' ring on adaptor and secure in port 'E' of valve housing (28).

Control Spool

1. If required, reassemble spring seats (6), shims (15 & 16), spring (7) and washer (8) and secure assembly to spool cap (4) using capscrew (9).

Note: Apply 3 drops of Loctite 243 to the spool cap (4) threads prior to reassembly.

2. Replace 'O' rings (3) on spool and spring pack assembly.

3. Refit spool and spring pack assembly to valve housing (28).

4. Install end cap (10) to valve housing (28) and secure using capscrews (12).

5. If removed, install end cap (17) to valve housing (28) and secure using capscrews (12).

6. If required, install new 'O' ring (18) on plug (19) and refit to mounting block (20).

7. Install new 'O' rings (21) and secure mounting blocks (20) to end caps (10 & 17) using capscrews (22).

8. Install pressure reducing valves (13) to mounting blocks (20) and secure using capscrews (14). Tighten capscrews (14) to a torque of 2 Nm (1.5 lbf ft).

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Relief Valve

1. Install new 'O' rings (38 & 39) on relief valve (37) assembly. Install relief valve (37) assembly into relief valve bore in valve housing (28).

Note: Push relief valve (37) assembly fully in until the snap ring on the outer sleeve locates in the recess in the relief valve bore.

2. Install a new 'O' ring (36) on plug (27) and install cap (27) in valve housing (28). Tighten plug (27) to a torque of 40 - 45 Nm (30 - 34 lbf ft).

3. Install poppet spring (32) and poppet (33) in cap (34). Install a new 'O' ring (36) on cap (34).

4. Install cap (34) assembly, adjusting screw (30) and locking nut (29) in valve housing (28) bore. Tighten cap (34) to a torque of 40 - 45 Nm (30 - 34 lbf ft).

5. Leave adjusting screw loose prior to pressure setting. Refer to 'Adjustments' for correct pressure setting.

INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 220-0000, STEERING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Using a suitable lifting device, position body control valve on the machine and secure to mounting bracket with mounting hardware as removed at 'Removal'.

2. Reconnect all servo control lines to body control valve, as tagged at 'Removal'.

3. Install new 'O' rings in split flange line fittings and install all hydraulic lines to body control valve, as tagged at 'Removal'.

Note: Be sure to use new 'O' rings with the split flange fittings.

4. Fill hydraulic oil tank with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK, for hydraulic oil levels. Install filler cap on hydraulic tank filler neck.

5. Adjust the system relief valve according to the instructions in 'Adjustments'.

ADJUSTMENTS

Numbers in parentheses refer to Fig. 1.

Relief Valve Adjustment

This type of relief valve is very sensitive to adjustment. Relief valve setting and adjustment can be carried out as follows:

WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place steering lock bar in the locked position.

3. Connect a hydraulic gauge, capable of recording a pressure of 0 - 345 bar (0 - 5 000 lbf/in²), to remote diagnostic pressure point.

4. Start engine and raise body completely.

5. Check reading on pressure gauge. Slacken locking nut (29) and turn adjusting screw (30) until a pressure reading of 221 bar (3 200 lbf/in²) is recorded on the pressure gauge.

Note: Turning adjusting screw (30) 'IN' will increase relief valve pressure, turning adjusting screw (30) 'OUT' will reduce relief valve pressure.

6. Secure locking nut (29) in place and operate body. Re-check relief valve pressure and adjust if required.

7. Check body control valve assembly and hydraulic lines for leaks. Tighten as required.

8. Remove all blocking from road wheels and place

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steering lock bar in the stowed position.

MAINTENANCE

Relief valve pressure should be checked on a regular basis to ensure correct operating pressures are being maintained. Limited repair of the control valve is with replacement of parts only.

SERVICE TOOLS

There are no special tools required for the procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools and adhesives. These tools and adhesives are available from your dealer.

BODY CONTROL VALVE DIAGNOSIS

CONDITION	REASON	CHECK AND/OR REMEDY
Valve leaks at 'O' rings	Defective 'O' ring	Partially pull out control spool and replace the defective 'O' ring.
Control spool does not return to 'Hold' position	Faulty return spring	Replace return spring.
	Corrosion or contamination	Disassemble control spool assembly, clean parts and replace any worn parts.
System does not build up pressure	Defective relief valve	Check relief valve pressure. Adjust as required.
Load drops with control spool in 'Hold' position	Excessive clearance between control spool and bore	Replace control valve assembly.

* * * *

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DESCRIPTION

The body control joystick is mounted on the right hand side dash panel, between the transmission shift controller and the document location.

OPERATION

The body control joystick controls the hydraulic control valve operation, by means of electrical signals to the pressure reducing valves, which in turn operates the body hoist cylinders. The four operating positions of the joystick from front to rear are as follows:

'FLOAT' - The joystick should be moved to this position while the body is lowering by gravity and should remain in this position until the body must be operated again. The control joystick should always be kept in 'FLOAT' while the machine is in motion.

'LOWER' - Pushing the joystick forward and holding it in this position provides hydraulic force to power-down the body. It is needed when the body cannot be started downward from the fully raised position by gravity. When the body starts lowering by gravity, the joystick can be released and internal valve springs will move the joystick to the 'HOLD' position.

'HOLD' - Moving the joystick to this position while the body is being raised or lowered traps the oil in the body hoists to stop and hold the body at any desired height. The joystick will remain in the 'HOLD' position when released.

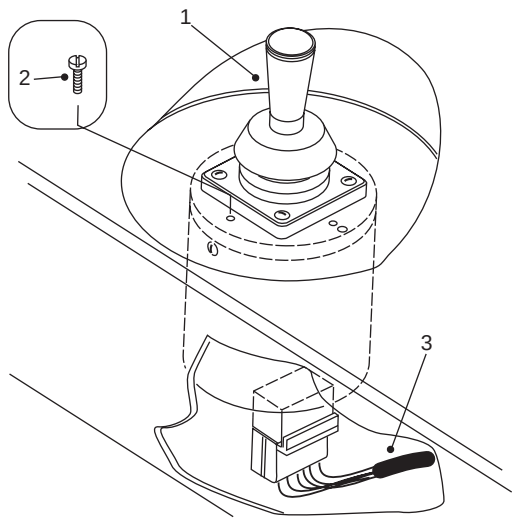
'RAISE' - Pushing the joystick back and holding it in this position directs oil to extend the body hoists and raise the body. When released, the joystick will be spring-returned to the 'HOLD' position.

Note: The body control lever must remain in the 'FLOAT' position until it is necessary to operate the body again. Failure to comply to this could result in overheating the hydraulic oil and failure of the hydraulic system components.

Note: A proximity sensor prevents the body being fully powered down onto the chassis. At a predetermined height, the sensor automatically defaults the body control valve to the detented 'FLOAT' condition.

Note: If an electrical failure occurs, 12V relay (K37 - engine signal) ensures the body control valve automatically defaults to the 'HOLD' condition. The cause of the electrical fault must be investigated and corrected. Refer to Section 190-0000, CIRCUIT DIAGRAMS.

SM - 2718



1 - Body Control Joystick
2 - Screw
3 - Harness

Fig. 1 - Body Control Joystick Installation

WARNING
Always disconnect body control joystick before welding on the machine.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

The body control joystick is a non-serviceable item and should be replaced completely, if damaged, as follows:

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

WARNINGS
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

Hydraulic fluid pressure will remain within the body hoist system after engine shutdown. To prevent personal injury and property damage, press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the system.

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Body System - Body Control Joystick

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the body hoist system.

3. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

4. Disconnect harness (3) from connector port on the bottom of body control joystick (1).

5. Support body control joystick (1) and remove screws (2) securing body control joystick (1) to mounting bracket on the underside of the right hand dash panel.

6. Remove body control joystick (1) from mounting location.

7. Secure new body control joystick (1) to mounting bracket on the underside of the right hand dash panel with screws (2).

Note: Ensure identifying mark on the body control joystick casing is orientated towards the rear of the cab.

8. Reconnect harness (3) to connector port on the bottom of the body control joystick (1).

9. Place the battery master switch in the 'On' position, start the engine and bring hydraulic oil to operating temperature. Operate the body control joystick (1) to ensure correct operation.

10. Remove wheel blocks and place the steering lock bar in the 'Stowed' position.

SPECIAL TOOLS

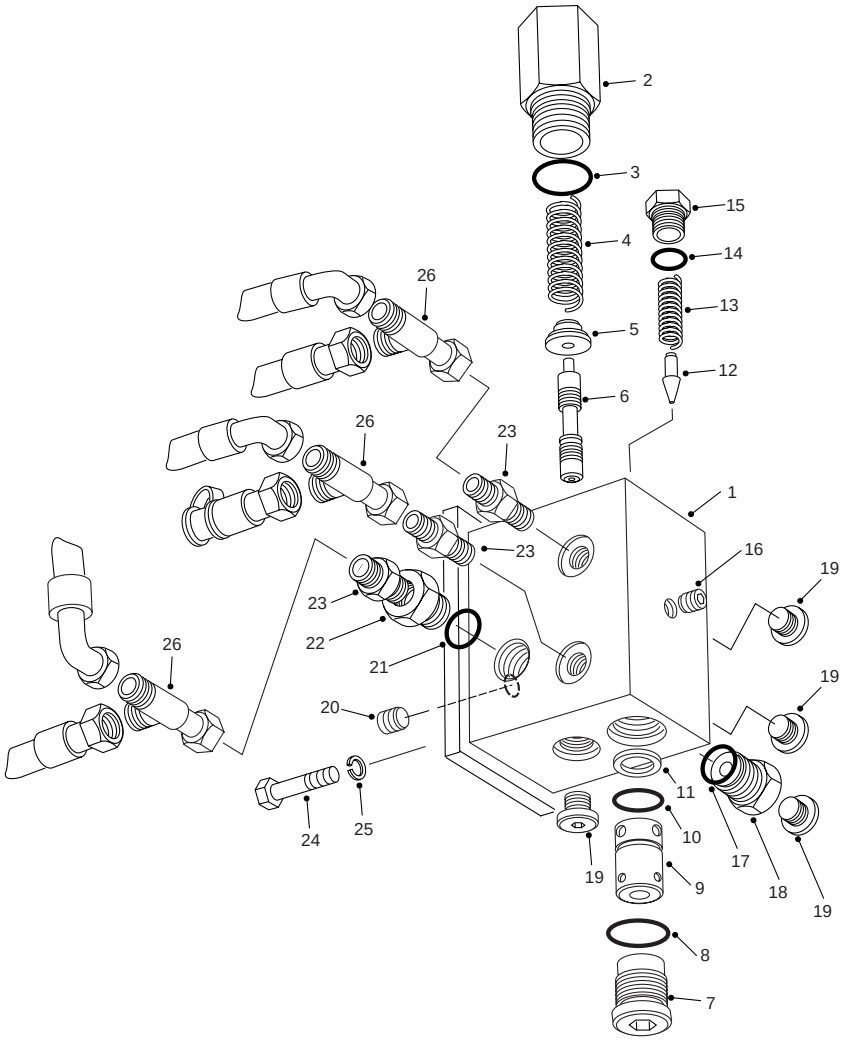
There are no special tools required for procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

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SM - 1941



1 - Valve Body
2 - Spring Cover
3 - 'O' Ring
4 - Control Spring
5 - Spring Guide
6 - Control Spool
7 - Plug
8 - 'O' Ring
9 - Seat
10 - 'O' Ring
11 - Spacer
12 - Pilot
13 - Spring
14 - 'O' Ring
15 - Plug
16 - Plug
17 - 'O' Ring
18 - Adaptor
19 - Plug
20 - Plug
21 - 'O' Ring
22 - Reducer
23 - Adaptor
24 - Bolt
25 - Lockwasher
26 - Tee Piece

Fig. 1 - Exploded View of Pilot Valve

DESCRIPTION

The pilot supply valve can be identified as item 4 in Section 230-0000, BODY SYSTEM SCHEMATIC.

Mounted off a bracket on the rear right hand cab leg, the pilot supply valve is located in the hydraulic servo control lines between the accumulator and the body control valve. See Fig. 2 for schematic symbol.

The pilot supply valve is a direct acting pressure reducing valve which steps down the supply pressure to 30 bar (435 lbf/in²). Intregal of the pilot supply valve is a relief valve which opens at 45 bar (652 lbf/in²).

SM - 1871

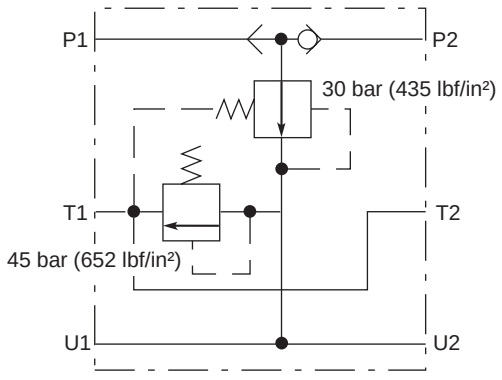


Fig. 2 - Pilot Supply Valve Schematic Symbol

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Body System - Pilot Supply Valve

Section 230-0121

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ Hydraulic fluid pressure will remain within the body hoist system after engine shutdown. To prevent personal injury and property damage, press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the system.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the body hoist system.

3. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

4. Remove hydraulic tank anti-spill drain cap, install drain tube connection and drain oil into a suitable container. Remove drain tube connection and reinstall cap.

5. Clean pilot valve (1) and surrounding area with a suitable solvent. Ensure all hydraulic lines connected to pilot valve (1) are identified for ease of installation and, with suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to all open lines.

6. Remove bolts (24) and lockwashers (25) securing pilot valve (1) to mounting bracket. Remove pilot valve (1).

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Note location of tee pieces (26) and adaptors (23) and remove from valve body (1) and reducer (22).

2. Remove reducer (22) and 'O' ring (21) from valve body (1). Discard 'O' ring (21).

3. Remove plug (7) and 'O' ring (8) from valve body (1). Remove valve seat (9), 'O' ring (10) and spacer (11) from valve body (1). Discard 'O' rings (8 & 10).

4. Remove adaptor (18) and 'O' ring (17) from valve body (1). Discard 'O' ring (17). If necessary remove plug (19) from adaptor (18).

5. Remove spring guide (15) and 'O' ring (14) from valve body (1). Discard 'O' ring (14).

6. Withdraw spring (13) and pilot (12) from valve body (1).

7. Remove spring cover (2) and 'O' ring (3) from valve body (1). Discard 'O' ring (3).

8. Withdraw control spring (4), spring guide (5) and control spool (6) from valve body (1).

INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Clean all parts with a suitable solvent and dry with compressed air.

2. Check ports threads and make sure they are not damaged or stripped.

3. Check valve seat (9), pilot (12), control spool (6) and spring guide (5). Ensure they are not worn, nicked, cracked or scored.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Install new 'O' ring (3) to spring cover (2). Install control spool (6), spring guide (5) and control spring (4) into its bore in valve body (1).

2. Install pilot (12) and spring (13) into its bore in valve body (1). Install new 'O' ring (14) to spring guide (15) and install in valve body (1).

3. Install new 'O' ring (8) to plug (7). Install spacer (11), new 'O' ring (10) and valve seat (9) into its bore in valve body (1). Install plug (7) in valve body (1).

4. Install new 'O' ring (17) to adaptor (18). Install adaptor (18) in valve body (1). If removed, install plug (19) in adaptor (18).

5. Install new 'O' ring (21) to reducer (22). Install reducer (22) in valve body (1).

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6. Install adaptors (23) and tee pieces (26) in valve body (1) and reducer (22).

INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 230-0000, BODY SYSTEM SCHEMATIC. Renew all 'O' rings where used.

1. Secure pilot valve (1) to mounting bracket with bolts (24) and lockwashers (25).

2. Remove blanking caps from hydraulic lines and install lines to pilot valve (1) as identified during removal.

3. Fill hydraulic oil tank with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK, for hydraulic oil levels. Install filler cap on hydraulic tank filler neck.

4. Place the battery master switch in the 'On' position, start the engine and bring hydraulic oil to operating temperature.

5. Check pilot valve (1) and hydraulic line connections for leaks and tighten as required.

6. Remove all blocking from road wheels and place steering lock bar in the stowed position.

SPECIAL TOOLS

There are no special tools required for procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

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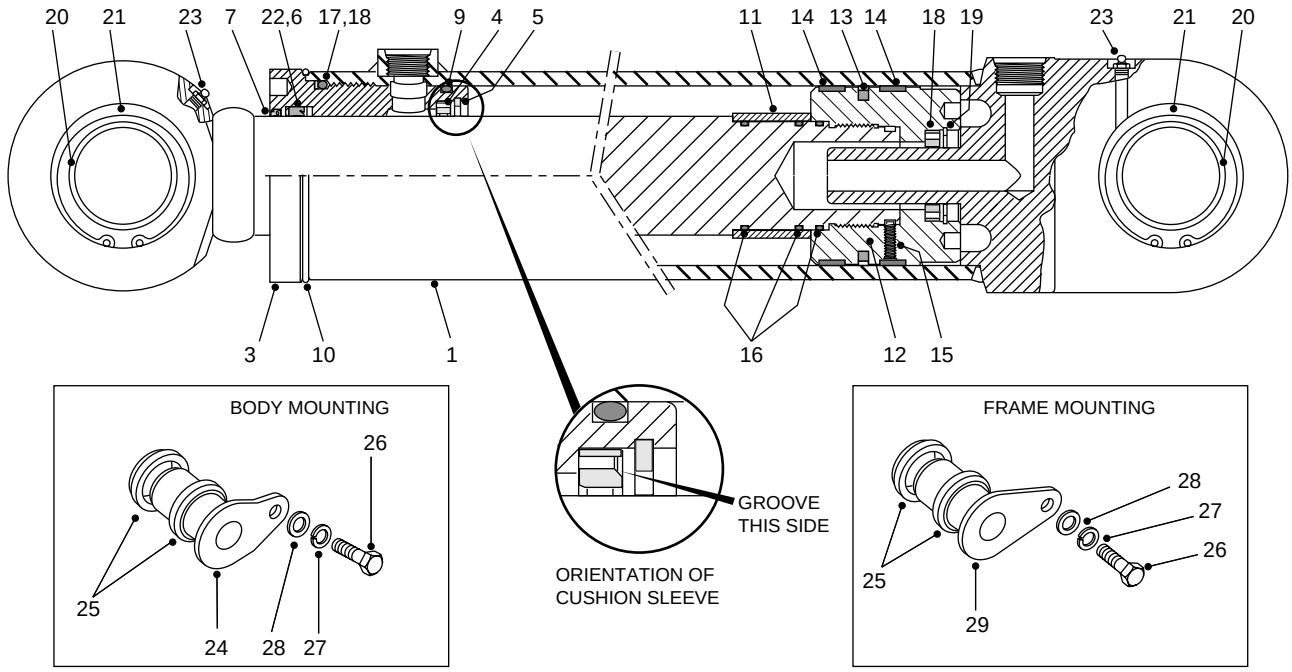
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1 - Cylinder Body
2 - Piston Rod
3 - End Cap
4 - Cushion Sleeve
5 - Circlip
6 - Rod Seal
7 - Wiper
8 - 'O' Ring
9 - 'O' Ring
10 - Lock Ring
11 - Cushion Spear
12 - Piston
13 - Piston Seal
14 - Wear Ring
15 - Grub Screw
16 - 'O' Ring
17 - Back Up Ring
18 - Cushion Sleeve
19 - Circlip
20 - Spherical Bearing
21 - Circlip
22 - Nylon Ring
23 - Lube Fitting
24 - Upper Pin
25 - Spacer
26 - Bolt
27 - Lockwasher
28 - Washer
29 - Lower Pin

Fig. 1 - Sectional View Of Body Cylinder and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The body cylinders can be identified as item 5 in Section 230-0000, BODY SYSTEM SCHEMATIC.

There are two single stage, double acting body hoist cylinders, cushioned at both ends of the stroke on the vehicle. The cylinder base end is connected to the trailer frame and piston rod (2) end is connected at the body. Single stage double acting means that piston rod (2) can have oil applied to either side, extending or retracting the piston rod.

Cylinder mounting is by pins (24 & 29), spacers (25) and spherical bearings (20) secured in place with circlips (21). Spherical bearings (20) permit a limited amount of cylinder misalignment.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNINGS

To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ Hydraulic fluid pressure will remain within the body hoist system after engine shutdown. To prevent personal injury and property damage, press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the system.

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Body System - Body Cylinder

Section 230-0130

WARNING
Exercise extreme caution when lowering the cylinders from the body. The cylinders will swing out sharply as they leave their mountings.

1. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine.

2. Press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the body hoist system.

3. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

4. Install a suitable strap around the cylinder and attach to a lifting device.

5. Position a suitable container at the base end of one cylinder. Identify and remove the hydraulic lines. Cap hydraulic lines and cylinder ports to prevent entry of dirt.

6. Remove bolt (26), lockwasher (27), washer (28) and upper pin (24) connecting piston rod (2) end of the cylinder to the body.

7. Lower cylinder slowly and remove spacers (25).

Note: Cylinder will swing out sharply as it leaves its mounting.

8. Remove bolt (26), lockwasher (27), washer (28) and lower pin (29) connecting base end of the cylinder to the frame.

9. Remove spacers (25) and remove cylinder assembly to a clean area for disassembly.

10. Repeat steps 4 through 9 for opposite cylinder.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

WARNING
To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.

1. Ensure clean working conditions, remove any port plugs thus allowing easy entry of air into cylinder body (1), preventing a vacuum when parts are withdrawn from cylinder body (1).

2. Remove circlips (21) from base end of cylinder body (1) and piston rod (2) end. Press out spherical bearings (20).

3. Remove lock ring (10) from end cap (3).

4. Using special tool which can be fabricated as shown in Fig. 2, unscrew end cap (3) until thread is disengaged from cylinder body (1).

5. Support piston rod (2) at the rod eye and withdraw piston rod (2) from cylinder body (1). Ensure centre lines of piston rod (2) and cylinder body (1) remain coincidental during removal of piston rod (2).

6. Place piston rod (2) on supports which will not damage the piston rod diameter.

7. Remove and discard piston seals (13) and wear rings (14) from piston (12).

8. Remove grub screw (15) from wear ring (14) groove in piston (12).

9. Provide an anti-torsion device through piston rod (2) eye to allow unscrewing of piston (12). Using special tool which can be fabricated as shown in Fig. 3, unscrew piston (12) from piston rod (2).

10. Remove cushion spear (11) and 'O' rings (16) from piston rod (2). Discard 'O' rings (16).

11. Remove cylinder end cap (3) from piston rod (2). Remove and discard cushion sleeve (4), circlip (5), rod seal (6), nylon ring (22), wiper (7), 'O' rings (8 & 9) and back up ring (17).

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INSPECTION

Numbers in parentheses refer to Fig. 1

1. Clean all parts of the cylinder with a suitable solvent and dry with clean, lint-free cloths. Clean all grooves carefully to remove any foreign material.

2. Check cylinder body (1) and outer diameter of piston (12) for scratches, cracks or other defects. Remove ridges, nicks and scratches with a fine stone and re-clean. Replace any components which cannot be repaired.

3. Inspect piston rod (2) for distortion, cracks or other defects. Replace piston rod if defective area is irreparable.

4. Check spherical bearing (20) for wear and replace if necessary.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.

1. Press spherical bearing (20) in base end of cylinder body (1) and piston rod (2) end. Secure spherical bearings (20) with circlips (21).

2. Install new cushion sleeve (4), circlip (5), rod seals (6), nylon ring (22), 'O' rings (8 & 9) and back up (17) in end cap (3). Load end cap (3) over piston rod (2) thread, taking care not to damage rod seal (6) on the thread.

3. Install new 'O' rings (16) on piston rod (2) and replace cushion spear (11).

4. Apply Loctite 243 to first two threads of piston (12). Using special tool which can be fabricated as shown in Fig. 3, screw on piston (12) and tighten to a torque of 1 356 Nm (1 000 lbf ft).

5. Insert piston grub screw (15) through wear ring (14) groove in piston (12) and into groove machined in piston rod (2). Tighten grub screw (15) to a torque of 49 Nm (36 lbf ft). Ensure the extreme of grub screw (15) is below the level of wear ring (14) groove.

6. Ensure cushion sleeve (18) and circlip (19) are secure in piston (12).

7. Insert new piston seal (13) and new wear rings (14) in piston (12).

8. Fully grease piston (12) OD and 'O' rings (8 & 9) in end cap (3).

9. Sling assembled piston rod (2) in a manner to allow careful leading of the assembled piston rod into cylinder body (1). Take care not to damage piston seal (13) on cylinder body (1) threads.

10. After piston (12) is inserted in cylinder body (1), push the piston rod assembly into cylinder body (1) maintaining coincidental centre lines of piston rod and cylinder body.

11. Before piston rod (2) is fully home and, with slings still taking some of piston rod (2) weight, engage end cap (3) thread and screw home.

12. Push piston rod (2) to the fully retracted position and tighten end cap (3) to a torque of 237 Nm (175 lbf ft).

13. Re-drill end cap (3) for lock ring (10), 3 x 12 mm (0.125 x 0.50 in) deep, if necessary. Insert lock ring (10) in end cap (3).

INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 230-0000, BODY SYSTEM SCHEMATIC. Renew all 'O' rings where used.

⚠ WARNING
To prevent personal injury and property damage, be sure lifting equipment is properly secured and of adequate capacity to do the job safely.

1. Install a suitable strap around the cylinder and position cylinder on unit with base end of cylinder ready for mounting.

2. Install spacers (25) in base end of cylinder and insert lower pin (23) through mounting bores, spacers (25) and cylinder. Secure lower pin (23) with washer (28), lockwasher (27) and bolt (26). Tighten bolt (26) to a torque of 66 Nm (49 lbf ft).

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3. Install spacers (25) in rod end of cylinder, align spherical bearing with bores in body and install upper pin (24) through mounting bores, spacers (25) and cylinder. Secure upper pin (24) with washer (28), lockwasher (27) and bolt (26). Tighten bolt (26) to a torque of 66 Nm (49 lbf ft).

4. Connect the hydraulic oil lines to the cylinder ports as tagged during removal.

5. Lubricate pins at lube fittings (22) with lubricant as specified in Section 300-0020, LUBRICATION SYSTEM.

6. Check oil level in hydraulic tank and add if low. Refer to Section 230-0040, HYDRAULIC TANK, for correct fill level. Refer to Section 300-0020, LUBRICATION SYSTEM, for the type of oil used.

7. Place the battery master switch in the 'On' position, start the engine, operate the body and check cylinder lines for leaks. Tighten lines and fittings as required.

8. Remove wheel blocks from road wheels.

MAINTENANCE

Every 50 hours: Lubricate cylinder pins as described in Section 300-0020, LUBRICATION SYSTEM. Inspect cylinders for leaks, if leaks are found, replace seals with seals contained in the Service Repair Kit, as specified in the parts book.

SPECIAL TOOLS

Special tools can be fabricated as shown in Figs. 2 & 3. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

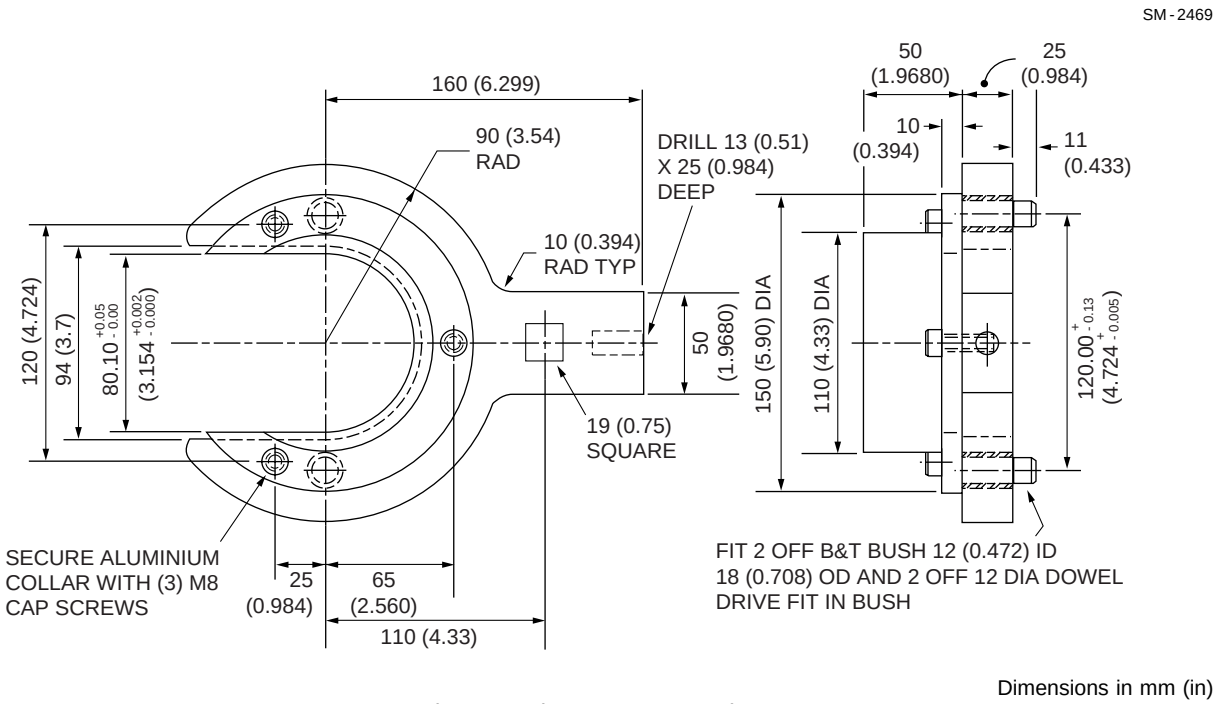


Fig. 2 - End Cap Torque Tool

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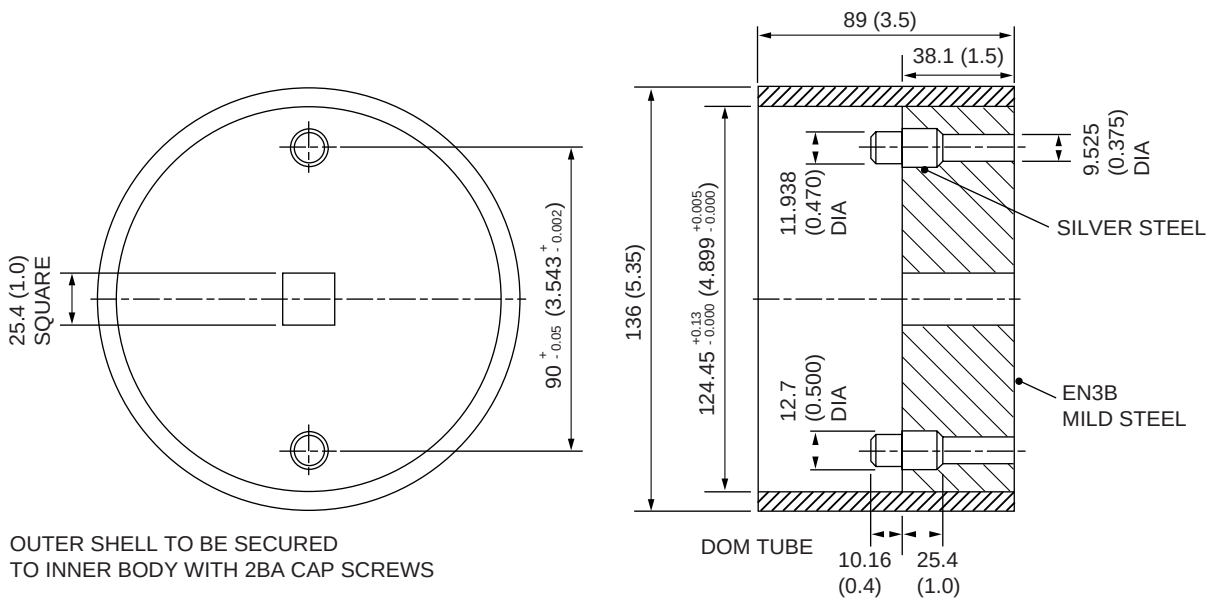


Fig. 3 - Piston Torque Tool

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	3	End Cap	237	175
1	12	Piston	1 356	1 000
1	15	Grub Screw	49	36
1	26	Bolt	66	49

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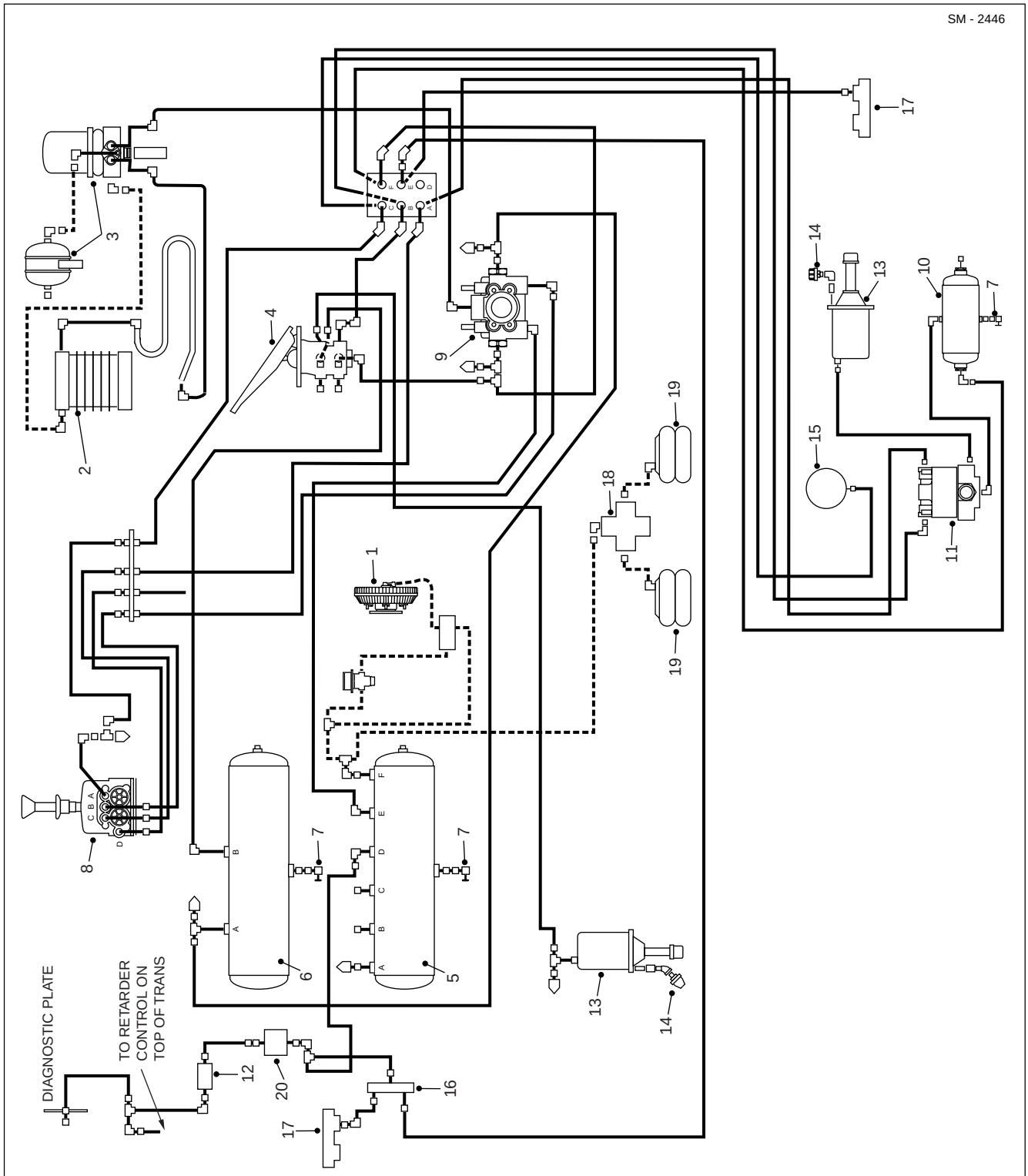
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1 - Fan Clutch
2 - Air Compressor
3 - Air Drier and Purge Tank Kit
4 - Treadle Valve
5 - Primary Tank
6 - Front Brake Tank
7 - Drain Cock
8 - Park/Emergency Control Valve
9 - Pressure Protection Valve
10 - Rear Brake Tank
11 - Relay Emergency Valve
12 - Air Solenoid
13 - Pressure Converter
14 - Air Breather
15 - Parking Brake Actuator
16 - Solenoid Valve
17 - Differential Lock Cylinder
18 - Levelling Valve
19 - Air Spring
20 - Regulating Valve

Fig. 1 - Air Braking System Schematic

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Braking System - Air Braking System Schematic

Section 250-0000

DESCRIPTION

The air brake system is an integral part of the service brake system. The system is used to supply air pressure for operating the front and rear pressure converters which in turn, actuate the front and rear brake hydraulic systems for applying the disc brakes. The air system also supplies pressure for operating air actuated accessories such as the transmission and inter-axle differential locks, fan clutch, transmission retarder and the suspension system.

The safety air brake system on the machine has the following features:

1. Low air pressure warning light which illuminates when air pressure drops below 4.1 bar (60 lbf/in²).

2. Automatic brake apply when system air pressure falls below 3.1 bar (45 lbf/in²).

3. Separate front and rear braking circuits with individual warning lights to warn if system pressure falls. A buzzer also sounds when pressure falls.

4. Service brake apply to temporarily hold the machine stationary by moving the park/emergency control valve lever into the 'EMERGENCY' position. When parking the machine for an extended period of time apply the parking brake.

5. Air released - spring applied parking brake controlled by the park/emergency control valve. Parking brake is applied when the control valve lever is in the 'PARK' position.

6. Pressure converters which are equipped with an overstroke indicator.

AIR SYSTEM AUXILIARY COMPONENTS

Numbers in parentheses refer to Fig. 1.

The following is a list of auxiliary components used in the air system, with a brief description of each:

Kysor DST Fan Clutch (1) - Direct temperature sensing fan. Refer to Section 110-0040, KYSOR DST FAN, for detailed operating and servicing procedures.

Pressure Protection Valve (9) - Supplies air to all three air tanks for the service brakes, secondary braking and accessory devices. Refer to Section 250-0290, PRESSURE PROTECTION VALVE, for detailed operating and servicing procedures.

Solenoid Valve (16) - When the solenoid valve is activated by the differential lock switch, air pressure from the primary tank is directed to the differential lock cylinders. The valve also exhausts air pressure from the differential lock cylinders.

Differential Lock Cylinders (17) - There are two differential lock cylinders on each machine. One mounted on the frame, adjacent to the transmission and the other integral with the centre differential. When actuated, the cylinders lock the transmission and inter-axle differentials. The transmission differential lock requires air pressure to hold it 'Off', whereas, the centre axle differential lock requires pressure to hold it 'On'.

Levelling Valve (18) - Maintains the front suspension at the proper ride height. Refer to Section 180-0022, LEVELLING VALVE, for detailed operating and servicing procedures.

Air Springs (19) - Expand or retract according to the air flow from the levelling valve. Refer to Section 180-0021, AIR SPRING, for detailed operating and servicing procedures.

Differential Lock Warning Light (Amber) - Illuminates when the differential lock switch is activated to the 'ON' position to indicate transmission and inter-axle differential locks are applied.

Note: Refer to operators handbook for location and identification of warning light.

Air Pressure Gauge - Located on the instrument panel it indicates system air pressure.

OPERATION

Numbers in parentheses refer to Figs. 1.

Air from the engine driven air compressor (2) travels through air drier kit (3) and into primary tank (5) and front brake tank (6) via pressure protection valve (9). Primary tank (5) is the outside tank positioned at the front left-hand side of the tractor frame.

Air is supplied to the suspension system levelling valve (18) and coolant sensor valve from port 'F' in the primary tank (5). Air is supplied to solenoid valve (16) and regulating valve (20) via port 'D' in the primary tank (5). If air pressure in primary tank (5) falls below 4.1 bar (60 lbf/in²), low pressure switch fitted in port 'A' sends a signal and the low pressure warning light illuminates in the cab.

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Air compression is controlled by unloader valve on air drier (3) stopping and starting delivery of air from air compressor (2), when maximum 8.4 bar (122 lbf/in²) and minimum 6.5 bar (95 lbf/in²) pressures are reached.

The pressure in the system should not exceed 8.4 bar (122 lbf/in²) if the system is operating normally. However, if unloader valve malfunctions and the pressure continues to rise, safety valve on air drier (3) will open to protect the air system by relieving the pressure at 10.7 bar (155 lbf/in²).

Suspension System

The suspension ride height is maintained by levelling valve (18) controlling air flow to or from air springs (19). If the ride height drops then air will flow from levelling valve (18) and into air springs (19). When the proper ride height is reached the lever on levelling valve (18) shuts off the air flow to air springs (19). Refer to Section 180-0021, AIR SPRING and Section 180-0022, LEVELLING VALVE.

Differential Lock

When the differential lock switch in the operators compartment is activated, solenoid valve (16) will open allowing air from primary tank (5) to flow through the valve and into differential lock cylinders (17). This applies the transmission and inter-axle differential locks. Deactivating the differential lock switch releases the differential locks.

AIR BRAKING SYSTEM COMPONENTS

Numbers in parentheses refer to Fig. 1.

The following is a list of air control devices in the air safety brake system, with a brief description of each:

Air Compressor (2) - Delivers air, through the air drier kit, to the air tanks to operate the pressure converters and air operated accessories. The air compressor is mounted on the engine and has a capacity of 6.23 litres/s (13.2 ft³/min).

Air Drier and Purge Tank Kit (3) - Filters the air from the compressor to remove any oil and moisture in the air system. The intregal unloader valve controls supply of air to the system, by stopping and starting delivery of air by the compressor when maximum and minimum pressures are reached. Refer to Section 250-0200, AIR DRIER, for detailed operating and servicing procedures.

Treadle Valve (4) - Directs and controls air to the front pressure converter and rear relay emergency valve which controls air delivery to the rear pressure converter. Refer to Section 250-0070, TREADLE VALVE, for detailed operating and servicing procedures.

Air Tanks (5, 6 & 10) - Store compressed air until it is needed for brake or accessory operation. Brake tanks maintain an air supply for normal brake application. Air pressure in the tanks is indicated on the air system pressure gauge on the instrument panel in the operators compartment. Refer to Section 250-0170, AIR TANKS AND MOUNTING, for detailed operating and servicing procedures.

Park/Emergency Control Valve (8) - In the 'EMERGENCY' position, it controls air pressure delivery to the rear relay emergency valve for actuation of the rear pressure converter to apply the rear brakes and also exhausts the air from the spring applied parking brake actuator, to apply the parking brake in an emergency. In the 'PARK' position it continues to exhaust the air from the spring applied parking brake actuator, keeping the parking brake applied, and also exhausts air pressure from the rear relay emergency valve releasing the rear brakes. Refer to Section 250-0190, PARK/EMERGENCY CONTROL VALVE, for detailed operating and servicing procedures.

Relay Emergency Valve (11) - Speeds the application and release of air pressure converter. Automatically applies rear service brakes when emergency line pressure falls to approximately 3.1 bar (45 lbf/in²). Refer to Section 250-0280, RELAY EMERGENCY VALVE, for detailed operating and servicing procedures.

Pressure Converters (13) - Apply pressure to front and rear brake hydraulic systems to operate wheel brakes when energized with air pressure directed by the treadle valve or park/emergency control valve. Refer to Section 250-0260, PRESSURE CONVERTER, for detailed operating and servicing procedures.

Air Breather (14) - There are two non-pressurised air breathers used in the air brake system, one on each of the brake pressure converters. Air displaced on the atmospheric side of the air piston in the pressure converter exhausts through the air breather. Refer to Section 250-0270, AIR BREATHER, for detailed operating and servicing procedures.

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Parking Brake Actuator (15) - Applies disc type parking brake when park/emergency control valve lever is moved into the 'PARK' position by exhausting the air in the actuator.

Brake Light Switch - Turns on the brake lights when the brakes are applied.

Warning Lights (Air System)

The following warning lights are controlled by pressure switches and are located on the warning light panels in the operators compartment:

Note: Refer to operators handbook for location and identification of warning lights.

Low Brake Air Pressure (Red) - Illuminates if air pressure falls below approximately 4.1 bar (60 lbf/in^2). If light illuminates while operating, stop the machine, apply the parking brake and do not operate until the fault has been corrected.

Parking Brake (Green) - Illuminates until the park/emergency control lever is placed in either the 'EMERGENCY' or 'RELEASE' positions indicating that the parking brake is released.

Tractor Brakes Overstroke (Red) - Illuminates if the front brake system pressure is low. A buzzer also sounds. If light illuminates, stop the machine and investigate the cause.

Trailer Brakes Overstroke (Red) - Illuminates if the rear brake system pressure is low. A buzzer also sounds. If light illuminates, stop the machine and investigate the cause.

OPERATION

Numbers in parentheses refer to Fig. 1.

Air from the engine driven air compressor (2) travels through air drier kit (3) via pressure protection valve (9) and into all three air tanks (5, 6 & 10).

Air flows from primary tank (5) to the park/emergency brake valve (8). Air from front brake tank (6) flows to the supply port of treadle valve (4), and, to port '21' of pressure protection valve (9). The rear brake tank (10) supplies air to the rear relay valve (11). Air is supplied to the auxiliary components via port '23' of the pressure protection valve (9).

Air compression is controlled by unloader valve on air drier (3) stopping and starting delivery of air from air compressor (2) when maximum 8.4 bar (122 lbf/in^2) and minimum 6.5 bar (95 lbf/in^2) pressures are reached.

The pressure in the system should not exceed 8.4 bar (122 lbf/in^2) if the system is operating normally. However, if unloader valve malfunctions and the pressure continues to rise, safety valve on air drier (3) will open to protect the air system by relieving the pressure at 10.7 bar (155 lbf/in^2).

Service Brake

Depressing treadle valve (4) allows air to flow directly from front brake tank (6) into the air chamber part of front pressure converter (13). This applies pressure to the brake hydraulic fluid to apply the front service brakes. At the same time, air flows through the service ports of rear relay emergency valve (11). This causes rear relay emergency valve (11) pistons to move and unseat their inlet valves allowing the air from rear brake tank (10) to flow into the air chamber part of rear pressure converter (13). This applies pressure to the brake hydraulic fluid to apply the rear service brakes.

The amount of air that flows to pressure converters (13) depends on how far treadle valve (4) pedal is depressed. The farther the pedal is depressed the greater the air pressure released by relay emergency valve (11), and the greater the braking force.

The brakes are released when the treadle pedal is released. Application pressure is exhausted through relay emergency valve (11) exhaust port. Air pressure is exhausted through treadle valve (4) exhaust port.

Park/Emergency Control Valve

Air line from port 'E' on primary tank (5) directs a constant supply of air to park/emergency control valve (8), via pressure protection valve (9), from primary tank (5).

With park/emergency control valve (8) lever in the 'RELEASE' position, air flows from ports 'A' and 'C'. The air from port 'A' flows to parking brake actuator (15), preventing the spring in the actuator from applying the parking brake. The air from port 'C' flows to the emergency port of rear relay emergency valve (11). For operation of relay emergency valve, refer to Section 250-0280, RELAY EMERGENCY VALVE. The park/emergency control lever should always be in the 'RELEASE' position when driving the machine.

With park/emergency control valve (8) lever in the 'EMERGENCY' position, port 'B' is vented through port 'C'. This allows the air in the lines from brake tank (10)

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to flow into the air chamber part of rear pressure converter (13). This applies pressure to the brake hydraulic fluid to apply the rear service brakes. At the same time, port 'A' is vented through port 'C', allowing the spring in parking brake actuator (15) to apply the parking brake. The air from port 'C' flows to the emergency port of relay emergency valve (11). For operation of relay emergency valve, refer to Section 250-0280, RELAY EMERGENCY VALVE. The 'EMERGENCY' position should only be used in an EMERGENCY. For normal brake operation use the treadle valve.

With the park/emergency control valve (8) lever in the 'PARK' position, port 'A' continues to vent through port 'C' keeping the parking brake applied. At the same time, air is exhausted from the rear pressure converter releasing the rear service brakes.

Automatic Brake Application

The first indication of a loss of air pressure in the system is that the low air pressure warning light on the instrument panel will illuminate when the pressure falls below 4.1 bar (60 lbf/in^2). If the pressure falls below 3.1 bar (45 lbf/in^2), relay emergency valve (11) opens and allows the air in the line from rear brake tank (10) to flow into the air chamber part of rear pressure converter (13). This applies pressure to the brake hydraulic fluid to apply the rear service brakes.

BRAKE SYSTEM SAFETY PRECAUTIONS

When working on or around brake systems and components, the following precautions, should be observed:

1. Always block vehicle wheels. Stop engine when working under a vehicle. Keep hands away from actuator push rods and slack adjusters; they may apply as air system pressure drops.

2. Always carry out ALL servicing operations in conjunction with WARNINGS and procedures outlined in the individual component sections.

3. Always ensure there is no pressure in the air system before attempting to replace brake pads or shoes; the brakes will automatically apply as air pressure drops.

4. Never connect or disconnect a pipe or line containing pressure; it may whip. Never remove a component or pipe plug unless you are certain all system pressure has been released.

5. Never exceed recommended pressure and always wear safety glasses when working.

6. Never attempt to disassemble a component until you have read and understood recommended procedures. Some components contain powerful springs and injury can result if not properly disassembled. Use only proper tools and observe all safety precautions pertaining to use of those tools.

7. Use only genuine factory replacement parts and components.

a) Only components, devices and mounting and attaching, specifically designed for use in hydraulic brake systems, should be used.

b) Replacement hardware, tubes, lines, fittings, etc. should be of equivalent size, type and strength as the original equipment.

8. Devices with stripped threads or damaged parts should be replaced. Repairs requiring machining should not be attempted.

BRAKE FUNCTION CHECKS

⚠ WARNING
Make sure the area around the machine is clear of personnel and obstructions before carrying out these checks.

Note: The following checks are not intended to measure maximum brake holding ability. If NEW brake pads are fitted, they MUST be burnished as per the manufacturers recommendations before carrying out the checks.

Service Brake Holding Ability

1. Depress service brake treadle pedal and move transmission gear shift selector to 1st gear.

2. Move park/emergency control lever to 'EMERGENCY' position, then move to 'RELEASE' position.

3. Depress accelerator control and accelerate engine to 1 350 rev/min. The machine should not move.

4. Decelerate engine, shift transmission to 'NEUTRAL' and apply the parking brake before releasing the service brake.

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Emergency Brake Holding Ability

1. Move park/emergency control lever to 'EMERGENCY' position and move transmission gear shift selector to 1st gear.

2. Depress accelerator control and accelerate engine to 1 350 rev/min. The machine should not move.

3. Decelerate engine, shift transmission to 'NEUTRAL' and apply the parking brake.

General

Note: Brake holding effort required to hold a machine stationary at a specific rev/min can vary from machine to machine due to differences in engine performance, powertrain efficiency, etc., as well as differences in brake holding ability.

Note: As an indication of system deterioration, the engine rev/min at which point the machine moved, with the service or emergency brakes applied, can be compared against the engine rev/min your specific machine was able to hold to on a previous check.

⚠ WARNING
If the machine moves during the above checks, stop the machine, apply the parking brake and do not operate until the fault has been corrected.

MAINTENANCE

General

Perform all maintenance as outlined in individual air component sections, at the service intervals specified in those sections.

Every Year

Check accuracy of air pressure gauge on the instrument panel with a test gauge. Replace if difference is more than 0.3 bar (5 lbf/in²).

BRAKING SYSTEM DIAGNOSIS

CONDITION	REASON	REMEDY
Inadequate braking	Low air pressure in brake system only	Trace brake lines by referring to Fig. 1. Install a test gauge at various points in the system to determine location of trouble. Test operation of faulty components as outlined in air brake control component sections. Repair or replace, as recommended. Check brake air lines for leaks.
	Treadle valve delivery pressure below normal	Check operation of air compressor, air drier, unloader and safety valve. Check air lines for leaks.
	Brake pads need replaced	Refer to Section 165-0010, BRAKE PARTS.
Brakes do not apply with normal treadle valve application	No air pressure in break system	Trace brake lines by referring to Fig. 1. Install a test gauge at various points in the system to to determine location of trouble. Test operation of faulty component as outlined in air brake control component sections. Check brake air lines for leaks.
	Restricted or broken tubing or hose line	Replace tubing or hose line.

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BRAKING SYSTEM DIAGNOSIS (Continued)		
CONDITION	REASON	REMEDY
Brakes do not apply with normal treadle valve application	Defective treadle valve	Repair or replace faulty component as recommended in Section 250-0070, TREADLE VALVE.
	Defective relay emergency valve	Repair or replace faulty component as recommended in Section 250-0280, RELAY EMERGENCY VALVE.
Brakes apply too slowly	Low air pressure in the brake system	Trace brake lines by referring to Fig. 1. Install a test gauge at various points in the system to determine location of trouble. Test operation of faulty component as outlined in air brake control component sections. Repair or replace, as recommended. Check brake air lines for leaks.
	Treadle valve delivery pressure below normal	Check operation of air compressor, air drier unloader valve and safety valve. Check air lines for leaks.
	Excessive leakage with brakes applied	Trace brake lines by referring to Fig. 1. Install a test gauge at various points in the system to determine location of trouble. Test operation of faulty component as outlined in air brake control component sections. Repair or replace, as recommended. Check brake air lines for leaks.
	Restriction in tubing or hose line	Replace tubing or hose lines.
Brakes do not release	Defective pressure converter	Repair or replace faulty component as recommended in Section 250-0260, PRESSURE CONVERTER.
	Treadle valve not in fully released position	Repair or replace faulty component as recommended in Section 250-0070, TREADLE VALVE.
	Restriction in tubing or hose line	Replace tubing or hose lines.
Brakes grab or pull	Faulty operation of one or more brake air control components	Trace brake lines by referring to Fig. 1. Install a test gauge at various points in the system to determine location of trouble. Test operation of faulty component as outline in air control component sections. Repair or replace, as recommended. Check brake air lines for leaks.
	Calliper pistons binding	Check calliper operation as described in Section 165-0010, BRAKE PARTS.
Air pressure too high	Pressure gauge registering incorrectly	Replace gauge and/or gauge sender unit.
	Faulty air drier, unloader valve	Repair of replace faulty component. Refer to Section 250-0200, AIR DRIER.

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BRAKING SYSTEM DIAGNOSIS (Continued)		
CONDITION	REASON	REMEDY
Air pressure too low	Pressure gauge registering incorrectly	Replace gauge and/or gauge sender unit.
	Defective compressor	Repair or replace air compressor. Refer to ENGINE MAINTENANCE MANUAL.
	Excessive leakage.	Trace brake lines by referring to Fig. 1. Install test gauge at various points in the system to determine location of trouble. Test operation of faulty component as outlined in air brake control component sections. Repair or replace, as recommended. Check brake air lines for leaks.
	Air tank drain cock open or leaking	Tighten or install new drain cock.
	Faulty air drier unloader valve	Repair or replace air drier unloader valve. Refer to Section 250-0200, AIR DRIER.
Compressor knocks continuously or intermittently	Excessive backlash in drive gears or drive coupling	Correct backlash. Refer to ENGINE MAINTENANCE MANUAL.
	Worn or burnt out bearings	Replace faulty components or compressor. refer to ENGINE MAINTENANCE MANUAL.
	Excessive carbon deposits in compressor cylinder head	Remove the compressor head and clean. Refer to ENGINE MAINTENANCE MANUAL.
Brakes release too slowly	Defective pressure convertor	Repair or replace faulty component as recommended in Section 250-0260, PRESSURE CONVERTOR.
	Treadle valve not returning to fully released position	Repair or replace faulty component as recommended in Section 250-0070, TREADLE VALVE.
	Exhaust port of treadle valve or relay valve restricted or plugged	Repair or replace faulty component as recommended in Section 250-0070, TREADLE VALVE and 250-0280, RELAY EMERGENCY VALVE.
Air pressure drops quickly with engine stopped and brakes released	One or more faulty air control components in brake air line, or leak in lines	Trace brake lines by referring to Fig. 1. Install a test gauge at various points in the system to determine location of trouble. Test operation of faulty component as outlined in air brake control component sections. Repair or replace, as recommended. Check brake air lines for leaks.
Air pressure rises to normal reading too slowly	Excessive leakage	Trace brake lines by referring to Fig. 1. Install a test gauge at various points in the system to determine location of trouble. Test operation of faulty component as outlined in air brake control component sections. Repair or replace, as recommended. Check brake air lines for leaks.
	Engine speed too slow	Correct condition. Refer to ENGINE MAINTENANCE MANUAL.

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BRAKING SYSTEM DIAGNOSIS (Continued)		
CONDITION	REASON	REMEDY
Air pressure rises to normal reading too slowly	Worn compressor	Repair or replace. Refer to ENGINE MAINTENANCE MANUAL.
	Excessive carbon in compressor cylinder head or discharge line.	Clean the head and lines. Refer to ENGINE MAINTENANCE MANUAL.
Safety valve 'blows off'	Safety valve out of adjustment	Adjust as recommended in Section 250-0200, AIR DRIER.
	Air pressure in system above normal	Check air drier unloader valve, adjust as recommended. Refer to Section 250-0200, AIR DRIER.
Excessive oil or water in the system	Compressor passing excessive oil	Service compressor as recommended in ENGINE MAINTENANCE MANUAL.
	Air drier not performing adequately	Check desiccant cartridge, replace if required Refer to Section 250-0200, AIR DRIER.
	Air tanks not being drained often enough	Drain all air tanks.
Air pressure drops quickly with engine stopped and brakes fully applied	One or more faulty air control components in brake air lines, or leak in lines	Trace brake lines by referring to Fig. 1. Install test gauge at various points in the system to determine location of trouble. Test operation of faulty component as outlined in air control component sections. Repair or replace, as recommended. Check brake air lines for leaks.

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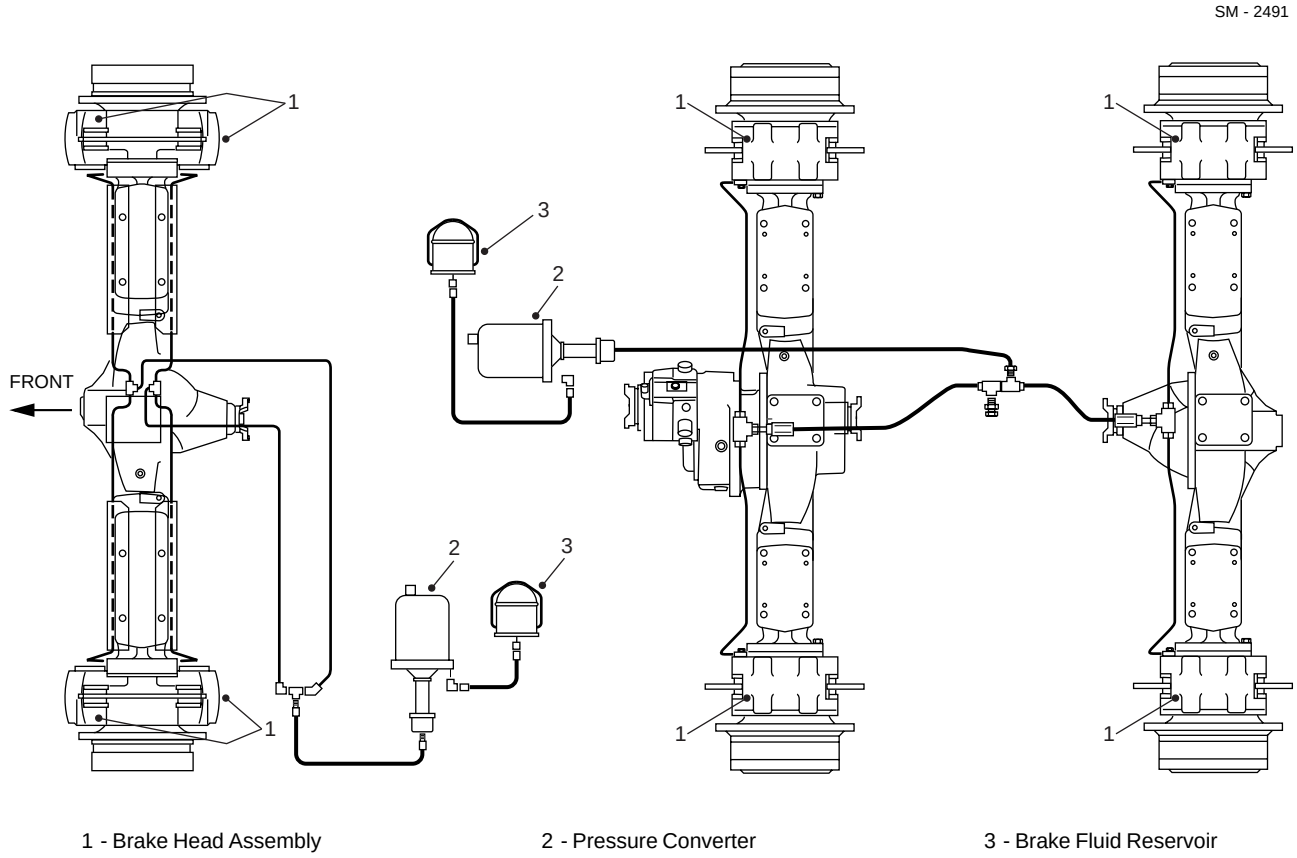


Fig. 1 - Hydraulic Braking System Schematic

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The hydraulic braking system is an integral part of the service brake system with independent circuits for the front and rear brake systems. Air pressure applied to one end of the front and rear pressure converters (2) results in hydraulic pressure at the other end. Refer to Section 250-0000, AIR BRAKING SYSTEM SCHEMATIC and Section 250-0260, PRESSURE CONVERTER.

The service brakes are of the calliper disc type with one hydraulic dry disc on each wheel with two heavy-duty callipers per disc at the front and a single heavy-duty calliper per disc at the rear. Refer to Section 165-0010, BRAKE PARTS - REAR and Section 165-0020, BRAKE PARTS - FRONT.

The brake is actuated by hydraulic brake fluid entering brake head assembly (1) through the inlet port. The piston bores on each side of the torque plate are interconnected by internal passages. Refer to Section 300-0020, LUBRICATION SYSTEM, for hydraulic brake fluid used in the system.

When the brake is actuated, the hydraulic pressure forces the pistons against the brake pads which are in turn forced against each side of the brake disc, slowing or stopping the disc and wheel rotation.

BLEEDING

Numbers in parentheses refer to Fig. 1.

In order to obtain satisfactory braking, the system should be bled as follows to eliminate any air in the hydraulic brake lines.

1. Fill the hydraulic brake fluid reservoirs (3) with hydraulic brake fluid specified in Section 300-0020, LUBRICATION SYSTEM.

⚠ WARNING
To prevent personal injury and property damage, ensure wheel blocks are properly secured and of adequate capacity to do the job safely.

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Braking System - Hydraulic Braking System Schematic

Section 250-0000

2. Start up the engine, place the park/emergency control valve in the 'Emergency' position, block all road wheels and place the steering lock bar in the 'Locked' position.

3. Remove dust cap from bleeder valve on brake head assembly (1) and connect a clear bleeder line to the bleeder valve. Place loose end of the line in a clean container.

Note: Keep brake fluid reservoirs (3) filled during bleeding process.

4. Actuate brake treadle valve several times.

5. Apply brake and open bleeder valve. After fluid flow stops, close the bleeder valve and release the brake.

Note: If loose end of bleeder line is kept submerged in brake fluid, the bleeder valve need not be closed each time the brake is released.

6. Repeat procedure in step 4 until no air bubbles are observed in fluid coming from bleeder valve.

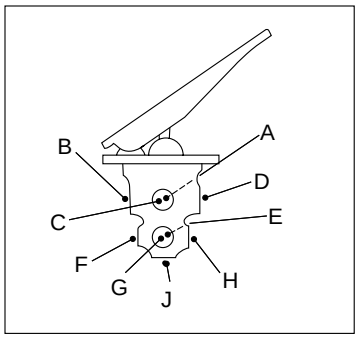
7. Repeat Steps 1 through 5 at each brake head assembly (1).

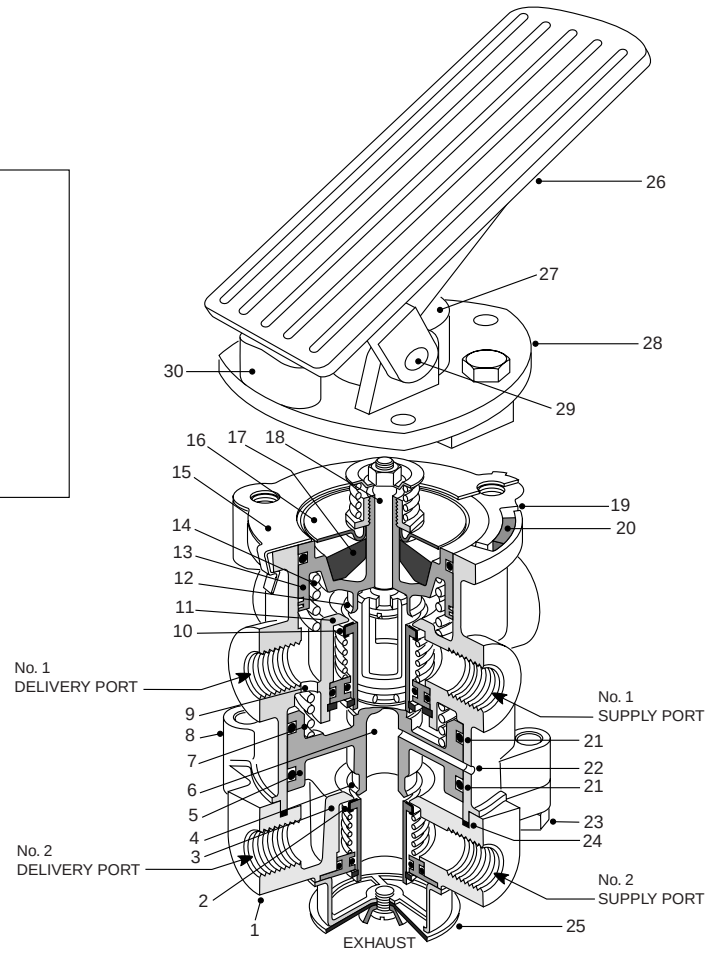
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1 - Valve Body
2 - Inlet Valve
3 - Inlet Valve Seat
4 - Exhaust Valve Seat
5 - Relay Piston
6 - Exhaust Passage
7 - Spring
8 - Valve Body
9 - Transfer Holes
10 - Inlet/ Exhaust Valve
11 - Inlet Valve Seat
12 - Exhaust Valve Seat
13 - Primary Piston
14 - Return Spring
15 - Retainer Plate
16 - Spring Seat
17 - Rubber Graduating Spring
18 - Valve Stem
19 - Vent
20 - Air Filter
21 - Seal
22 - Passage
23 - Screw
24 - Sealing Ring
25 - Rubber Exhaust Flap
26 - Treadle
27 - Boot
28 - Mounting Plate
29 - Fulcrum Pin
30 - Stop Button

Fig. 1 - Cutaway View of Treadle Valve

DESCRIPTION

The treadle valve can be identified as item 4 in Section 250-0000, AIR BRAKING SYSTEM SCHEMATIC.

The treadle valve is mounted alongside the accelerator pedal on a mounting plate bolted to the cab floor. The treadle valve is the left hand pedal.

The treadle valve directs and controls air to the front pressure protection valve and rear relay emergency valve which control air delivery to the brake chambers.

There are 9 ports on the treadle valve as follows:
Port 'A' - Plugged
Port 'B' - Delivery to front pressure convertor and stop light switch
Port 'C' - Supply line from front brake tank
Port 'D' - Plugged
Port 'E' - Plugged
Port 'F' - Delivery to relay emergency valve (rear)
Port 'G' - Supply line from rear brake tank
Port 'H' - Plugged
Port 'J' - Exhaust port

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OPERATION

Numbers in parentheses refer to Fig. 1.

When treadle is pressed down, force is exerted on spring seat (16), rubber graduating spring (17) and primary piston (13). Primary piston (13) moves down, its exhaust valve seat (12) closes exhaust passage (6) in inlet/exhaust valve (10). The continued movement of primary piston (13) then pushes inlet/exhaust valve (10) off inlet valve seat (11). The No. 1 circuit supply air now passes to the delivery port.

As the air flows to the No. 1 delivery port it also passes through transfer holes (9) to the relay piston (5). Owing to the downwards force of spring (7) on relay piston (5), the exhaust valve seat (4) has already closed the exhaust passage in inlet valve (2). The air pressure through transfer holes (9) now move relay piston (5) further down to push inlet valve (2) off the inlet valve seat (3). The No. 2 circuit supply air now passes to the delivery port.

Because only a small volume of air needs to pass through transfer holes (9) to move relay piston (5), the action of the No. 2 circuit is almost simultaneous with that of the No. 1 circuit. The No. 1 circuit leads with a maximum differential of 0.2 bar (2.9 lbf/in²) at a delivery pressure of 1 bar (14.5 lbf/in²). The differential diminishes until perfect balance is achieved at about 5 bar (72 lbf/in²).

The No. 1 delivery air flow continues until the increasing air pressure under primary piston (13) together with the upward forces of return spring (14) and the spring in inlet/exhaust valve (10) overcomes the brake application force on primary piston (13). Primary piston (13) then lifts sufficiently to allow inlet/exhaust valve (10) to close on inlet valve seat (11) and cut off the No. 1 supply air without letting exhaust valve seat (12) uncover exhaust passage (6). The No. 1 circuit is now 'lapped' with both inlet/exhaust valve (10) and exhaust passage (6) closed.

Similarly, the No. 2 delivery air flow continues until the increasing air pressure under relay piston (5) and the upward force of the spring in inlet valve (2) overcome the downward forces of spring (7) and the air pressure above relay piston (5). Relay piston (5) then lifts sufficiently to allow inlet valve (2) to close on inlet valve seat (3) and cut off the No. 2 supply air without letting exhaust valve seat (4) uncover exhaust passage (6). The No. 2 circuit is now 'lapped' with both theinlet valve (2) and the exhaust passage (6) closed.

When the brake application force is reduced primary piston (13) will rise. Inlet/exhaust valve (10) remains closed but exhaust valve seat (12) will uncover exhaust passage (6) until the No. 1 delivery pressure falls sufficiently to restore the balance of forces on primary piston (13). Primary piston (13) and exhaust valve seat (12) will then descend to close exhaust passage (6) again. As the No. 1 circuit delivery pressure falls relay piston (5) will rise. Inlet valve (2) remains closed but exhaust valve seat (4) will uncover exhaust passage (6) until the No. 2 delivery pressure falls sufficiently to restore the balance of forces on relay piston (5). Relay piston (5) and exhaust valve seat (4) will then descend to close exhaust passage (6) again.

If the brake application force is increased, inlet/exhaust valve (10) will open and the No. 1 circuit delivery pressure will rise until a balance of forces again exists across primary piston (13). The increased delivery pressure will be transmitted via transfer holes (9) to relay piston (5). Relay piston (5) will descend to open inlet valve (2). The No. 2 delivery pressure then rises until a balance of forces again exists across relay valve (5).

The No. 1 and No. 2 circuit delivery pressures are therefore maintained at levels in proportion to the degree of mechanical force exerted by the operator. This self-lapping action will take place whenever the brake application force is increaded or decreased.

Removal of the brake application force allows primary piston (13) and valve stem (18) to make a full upstroke. The No. 1 delivery pressure is then swiftly and completely released through exhaust passage (6). As primary piston (13) rises, the head of valve stem (18) takes up the limited free movement between itself and relay piston (5). Relay piston (5) is then pulled up against spring (7) to ensure a swift and complete release of the No. 2 circuit delivery pressure through exhaust passage (6).

Should air pressure be lost from the No. 2 circuit, the No. 1 circuit will continue to function as described above. The seals (21) will effectively separate the two brake circuits.

If air pressure is lost from the No. 1 circuit, the No. 2 circuit will continue to function as follows:
The brake application force will be transmitted to the No. 2 circuit by primary piston (13) acting directly on relay piston (5) after taking up the limited movement between relay piston (5) and valve stem (18).

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Thereafter, relay piston (5) will operate the inlet/ exhaust valve (2) as previously described.

Apart from the reduced vehicle braking efficiency, the effect of a loss of air pressure from No. 1 circuit will be a small increase in the operating plunger travel and a moderate increase in the effort required to depress the brake treadle.

REMOVAL AND DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, be sure wheel blocks are properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Open drain cocks on air tanks and drain air from three main air tanks and auxiliary air tank. Close drain cocks on air tanks when air is exhausted.

4. Remove mounting hardware securing toe plate assembly to the cab floor.

5. Manoeuvre the toe plate assembly to allow access and tag and remove all air lines from the treadle valve assembly.

6. Release and remove mounting hardware securing treadle valve assembly to the toe plate assembly.

7. Remove treadle valve assembly from the vehicle.

8. If required, separate valve body (1 & 8) assembly and treadle (26) assembly.

Note: The treadle valve assembly should not be disassembled further as replacement of parts is by treadle (26) assembly and/or valve body (1 & 8) assembly only. Refer to 'Maintenance' procedures.

ASSEMBLY AND INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

1. If removed, install treadle (26) assembly on valve body (1 & 8) assembly.

2. If removed, install treadle valve assembly to the toe plate with mounting hardware, as removed at 'Removal and Disassembly'.

Note: Treadle valve is the left hand pedal on the toe plate.

3. Install all air lines to the treadle valve assembly, as tagged at removal.

4. Place the battery master switch in the 'On' position, start the engine and allow air pressure in the tanks to build up to correct operating pressure. Check for leaks at air lines and tighten as required.

5. Secure toe plate assembly to the cab floor with mounting hardware, as removed at 'Removal and Disassembly'.

6. Remove wheel blocks from all road wheels.

ADJUSTMENTS

Numbers in parentheses refer to Fig. 1.

If the treadle valve does not release promptly or does not fully release, it indicates that exhaust valve is not opening sufficiently. This can be caused by:

1. Lack of lubrication in valve body causing piston and spring assembly to bind.

2. Dirt or other foreign matter between the heel of treadle (26) and mounting plate (28).

If the treadle valve does not apply promptly, or does not apply fully, it indicates that inlet valve (10) is not opening sufficiently. Check for correct operation and replace valve assembly, if required.

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MAINTENANCE

Numbers in parentheses refer to Fig. 1.

Every 250 hours

Lubricate treadle roller and pin (29) with engine oil as specified in Section 300-0020, LUBRICATION SYSTEM.

Lift boot (27) away from mounting plate (28) and place a few drops of oil between mounting plate (28) and plunger. Discard boot (27) and replace with a new boot.

Coat valve body and exhaust port 'J' with soap suds to check for leakage and make and hold a full pressure brake application. Any leakage from the exhaust port 'J' must not exceed a 25 mm (1 in) diameter soap bubble in less than three seconds. If excessive leakage is found, the treadle valve must be repaired or replaced.

SPECIAL TOOLS

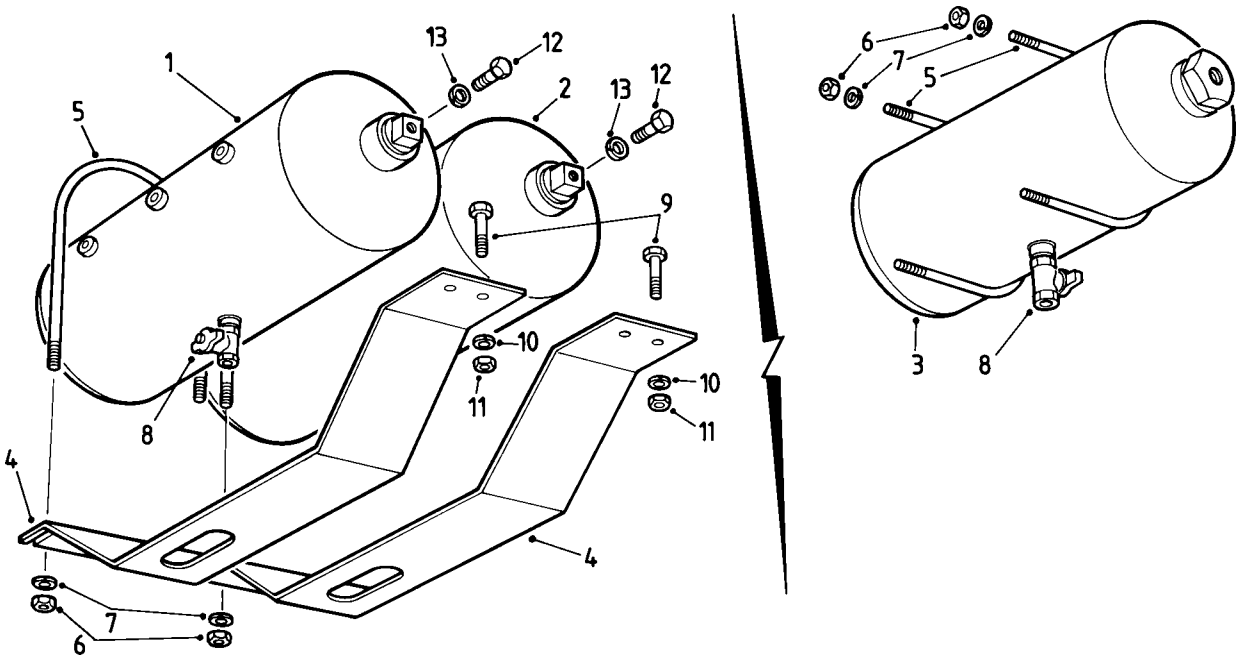
There are no special tools required for procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

* * * *

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SM - 819



1 - Primary Tank
2 - Front Brake Tank
3 - Rear Brake Tank
4 - Guard
5 - 'U' Bolt
6 - Nut
7 - Lockwasher
8 - Drain Cock
9 - Bolt
10 - Lockwasher
11 - Nut
12 - Bolt
13 - Lockwasher

Fig. 1 - Air Tanks and Mounting

DESCRIPTION AND OPERATION

There are three air tanks in the air system; primary tank, front brake tank and rear brake tank. The primary and front air tanks are located at the front left hand side of the tractor frame, with the primary tank to the outside. The rear brake tank is located on the left hand side of the trailer frame, forward of the frame cross channel.

Air tanks store compressed air from the engine compressor until it is required for brake or accessory operation. Brake tanks maintain an air supply for normal brake application or for automatic safety brake application, if pressure drops in the primary tank.

Air pressure in the tanks is indicated on the air system pressure gauge located on the instrument panel in the operators compartment.

There are 7 ports on the primary tank, 3 ports on the front brake tank and 4 ports on the rear brake tank, as follows:

Primary Tank:
Port 'A' - Pressure Switch
Port 'B' and 'C' - Plugged
Port 'D' - Supply to diff lock solenoid valve and regulating valve
Port 'E' - Supply to pressure protection valve port '24'
Port 'F' - Supply to suspension levelling valve and coolant sensor valve
Drain Port

Front Brake Tank:
Port 'A' - Supply to pressure protection valve port '21' and air pressure sender (gauge)
Port 'B' - Supply to treadle valve
Drain Port

Rear Brake Tank:
Port 'A' - Supply to pressure protection valve port '22'
Port 'B' - Supply to relay emergency valve
Port 'C' - Plugged
Drain Port

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Braking System - Air Tanks and Mounting

Section 250-0170

REMOVAL

Numbers in parentheses refer to Fig. 1.

1. Switch off engine, apply parking brake and place the battery master switch in the 'Off' position.

2. Open drain cocks (8) and drain air from all three air tanks.

3. Tag all air lines attached to air tanks for easy identification at 'Installation'. Remove all air lines from air tanks.

4. Remove nuts (6) and lockwashers (7) from 'U' bolts (5) securing primary tank (1) to front frame and guard (4). Remove bolts (9), nuts (11) and lockwashers (10) securing guards (4) to frame crossmember. Remove guards (4) from the machine.

5. Remove bolt (12) and lockwasher (13) securing primary tank (1) to mounting bracket on the frame. Remove primary tank (1) from the machine.

6. Remove bolt (12) and lockwasher (13) securing front brake tank (2) to mounting bracket on the frame. Remove front brake tank (2) from the machine.

7. Remove nuts (6) and lockwashers (7) from 'U' bolts (5) securing rear brake tank (3) to trailer frame mounting brackets. Remove rear brake tank (3) from the machine.

INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0020, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

1. Install rear brake tank (3) on mounting brackets on trailer frame and secure with 'U' bolts (5), lockwashers (7) and nuts (6).

2. Install all air lines to rear brake tank (3), as tagged at 'Removal'.

3. Install front brake tank (2) in place on the machine and secure to mounting bracket with bolt (12) and lockwasher (13).

4. Position guard (4) in place under front brake tank (2) and secure in place with 'U' bolt (5), bolts (9), lockwashers (7 & 10) and nuts (6 & 11).

5. Install primary tank (1) in place on the machine and secure to mounting bracket with bolt (12) and lockwasher (13).

6. Position guard (4) in place under primary tank (1) and secure in place with 'U' bolt (5), bolts (9), lockwashers (7 & 10) and nuts (6 & 11).

7. Install all air lines on primary tank (1) and front brake tank (2), as tagged at 'Removal'.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

The air tanks should be drained daily to prevent excessive water build up in the system. It is also important that the air tanks are drained after each shift.

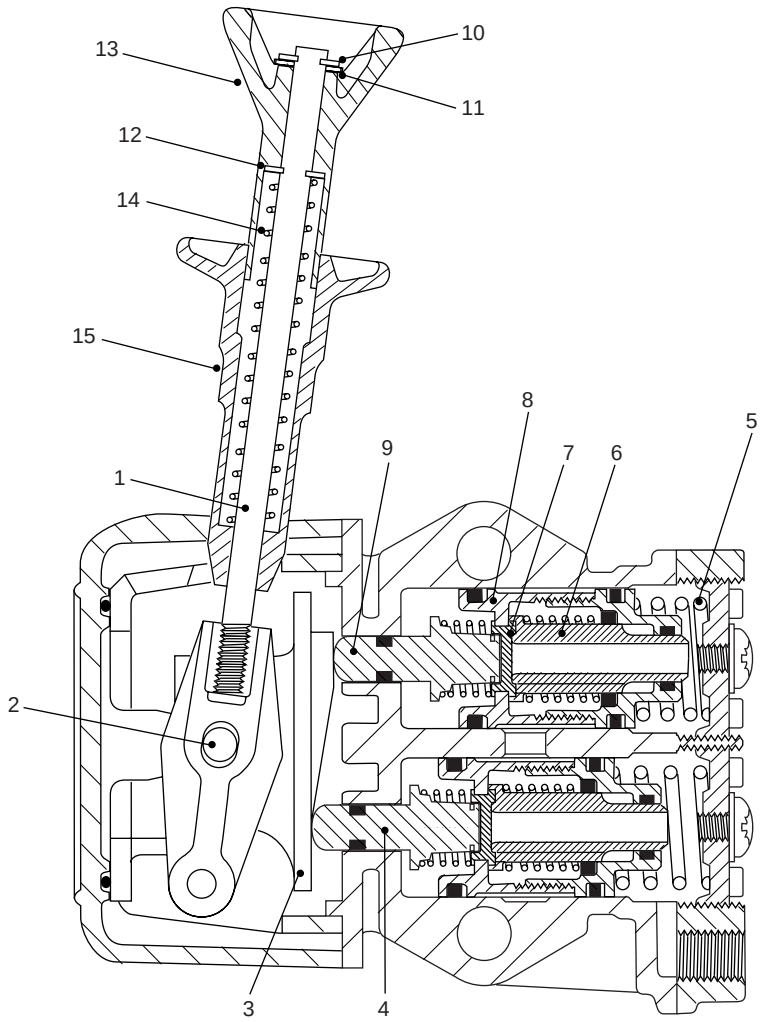
Before starting the shift make sure that drain cocks (8) are tightly closed.

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SM - 1947



1 - Control Lever
2 - Pivot
3 - Cam
4 - Plunger 'Inverse Side'
5 - Graduating Spring
6 - Inlet Valve
7 - Exhaust Valve
8 - Upper Piston
9 - Plunger 'Upright Side'
10 - Outer Circlip
11 - Washer
12 - Circlip
13 - Handle
14 - Return Spring
15 - Locking Sleeve

Fig. 1 - Sectional View of Park/Emergency Control Valve - Lever in 'Emergency' Brake Position

DESCRIPTION

Note: Refer to Fig. 2 for port identification.

The park/emergency control valve can be identified as item 8 in Section 250-0000, AIR BRAKING SYSTEM SCHEMATIC.

The park/emergency control valve is mounted on the right hand side dash panel in the operators compartment.

There are 4 ports on the park/emergency control valve as follows:
Port 'A' - Supply to parking brake actuator
Port 'B' - Supply from front brake air tank via pressure protection valve (port '23')

SM - 1948

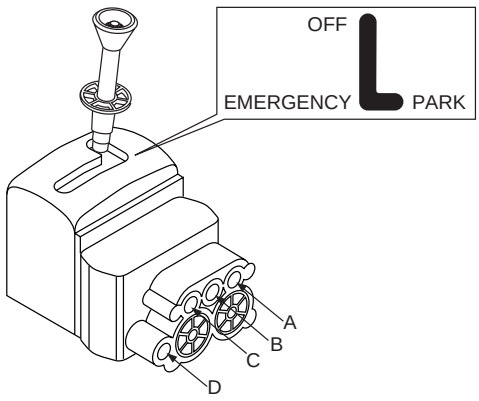


Fig. 2 - Park/Emergency Control Valve Ports

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Port 'C' - Supply to relay emergency valve (rear)
Port 'D' - Exhaust

The valve comprises an aluminium cover and an aluminium body. The cover contains the actuating mechanism and a control lever incorporating a spring loaded locking mechanism which allows it to be locked in the 'Park' position.

The body contains two graduating valve units, one upright and one inverse. The output from each unit can be set by means of adjusters in the bottom manifold.

Incorporated in the body are two air supply ports, one in the bottom manifold, the other in the rear manifold. These supply ports provide a common feed to both graduating units. There are two delivery ports from each graduating unit, one in the bottom manifold, the other in the rear manifold.

OPERATION

Numbers in parentheses refer to Fig. 1.

When control lever (1) is in the 'Off' position, the 'upright side' of the valve is delivering zero air pressure to the brake chambers and the 'inverse side' of the valve is delivering hold off pressure to the spring brakes in order to maintain them in the brakes released condition.

As the control lever (1) is moved to make a 'Emergency' brake application, it rotates the cam (3), depressing the 'upright side' plunger (9), closing the exhaust valve (7) and opening the inlet valve (6) allowing air to pass to the brake chambers. As the pressure in the brake chambers increases, the air pressure acting on the upper piston (8) causes it to move down against the pressure exerted by the graduating spring (5), closing the inlet valve (6). This procedure is repeated for further control lever (1) movement until full 'Emergency' brake position is reached, when the air pressure delivered to the brake chambers is maximum.

During this operation, the 'inverse side' of the valve, which was delivering maximum pressure when the control lever (1) was in the 'Off' position, is exhausting, until, with the control lever (1) in the 'Emergency' brake position the delivered pressure is zero.

When control lever (1) is moved from the 'Emergency' brake position to the 'Park' position, the cam (3) is lifted by the control lever (1) and the pivot (2) allowing the 'upright side' plunger (9) and the 'inverse side' plunger (4) to lift and allowing the air pressure in the brake chambers to exhaust. The vehicle is now parked by the mechanical force exerted by the spring brakes.

REMOVAL

Numbers in parentheses refer to Fig. 1.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, be sure wheel blocks are properly secured and of adequate capacity to do the job safely.**

1. Switch off the engine, move control lever (1) to the 'Park' position and place the battery master switch in the 'Off' position.

2. Block all road wheels, open drain cocks on air tanks and drain air from all three air tanks. Close drain cocks on air tanks when air is exhausted.

3. Tag and disconnect air lines and electrical connection from valve body, to aid in installation.

4. Support valve body and remove mounting hardware securing valve body to mounting bracket on underside of dash panel. Remove valve body from the dash panel.

INSPECTION

Numbers in parentheses refer to Fig. 1.

To check the control lever shaft for damage or deformation:

1. Move the control lever (1) into the 'Park' position.

2. Remove the outer circlip (10), washer (11) and handle (13).

3. Grip return spring (14) firmly and ease off circlip (12).

4. Remove spring (14) and locking sleeve (15).

5. Inspect control lever shaft.

Note: If control lever shaft is bent then the complete valve must be replaced.

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INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATION.

1. Secure valve body to mounting bracket on underside of dash panel using mounting hardware as removed at 'Removal'.

2. Install air lines and electrical connection to valve body, as tagged at 'Removal'.

3. Start engine and allow air pressure in the tanks to build up to correct operating pressure. Check for leaks at air lines and tighten as required.

4. Check operation of park/emergency control valve for correct operation in all three positions.

TESTING

Numbers in parentheses refer to Figs. 1 and 2.

Block all road wheels and ensure air tanks are fully charged. With control lever (1) in 'Emergency' position, the air pressure at port 'C' should be the same as the inlet pressure at port 'B' and there should be no pressure at port 'A'.

When control lever (1) is moved to the 'Release' position, the pressure reading at port 'A' should be the same as the inlet pressure at port 'B' and there should be no pressure at port 'C'.

Finally, when control lever (1) is moved to the 'Park' position, there should be no pressure at ports 'A' and 'C'.

When testing for air leaks, start with the control lever (1) in th 'Release' position. After the initial exhaust of air, apply a soap solution to the exhaust port and valve housing and check for leakage. No leakage is permitted from the valve housing and any leakage from the exhaust port must not exceed a 13 mm (0.5 in) diameter soap bubble in 5 seconds. Repeat test for 'Emergency' and 'Park' positions.

If the valve is found to be leaking, it must be replaced.

MAINTENANCE

The park/emergency control valve is a non-serviceable item and should be replaced completely if damaged.

SPECIAL TOOLS

There are no special tools required for procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

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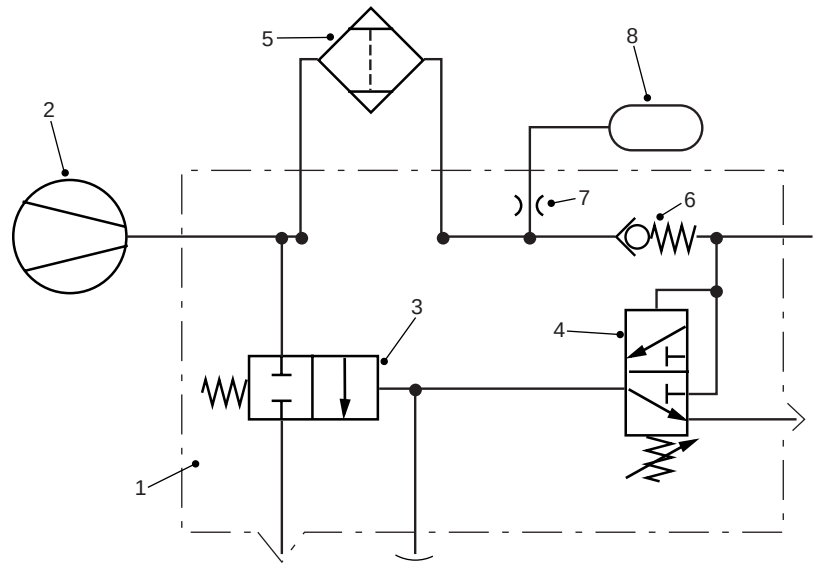
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SM - 1942



1 - Air Drier
2 - Air Compressor
3 - Safety Valve
4 - Unloader Valve
5 - Desiccant Cartridge
6 - Check Valve
7 - Orifice
8 - Purge Tank

Fig. 1 - Air Drier Schematic

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The air drier is mounted on the left hand side platform, with the purge tank located inboard of the hood assembly, mounted off the right hand side of the goalpost support assembly.

The purpose of the air drier is to filter the air from the compressor to remove any oil and moisture before it enters the air reservoirs.

Note: An air system maintained to proper specification can lead to prolonged component life. It is important therefore to follow the servicing procedures contained in this section.

The external components of the air drier system are air compressor (2), purge tank (8) and air drier (1).

Contained in air drier (1) body is a safety valve (3), unloader valve (4), desiccant cartridge (5) and orificed check valve (6 & 7).

Safety valve (3) limits the maximum system pressure to 10.75 bar (156 lbf/in^2).

Air drier unloader valve (4) controls the supply of air to the system by stopping and starting delivery of air by the compressor (2), when maximum and minimum system operating pressures are reached.

Orificed check valve (6 & 7) meters compressed air flowing into purge tank (8) and traps air in the primary air tank during the purging cycle.

OPERATION

Delivery Air Flow

Numbers in parentheses refer to Fig. 1.

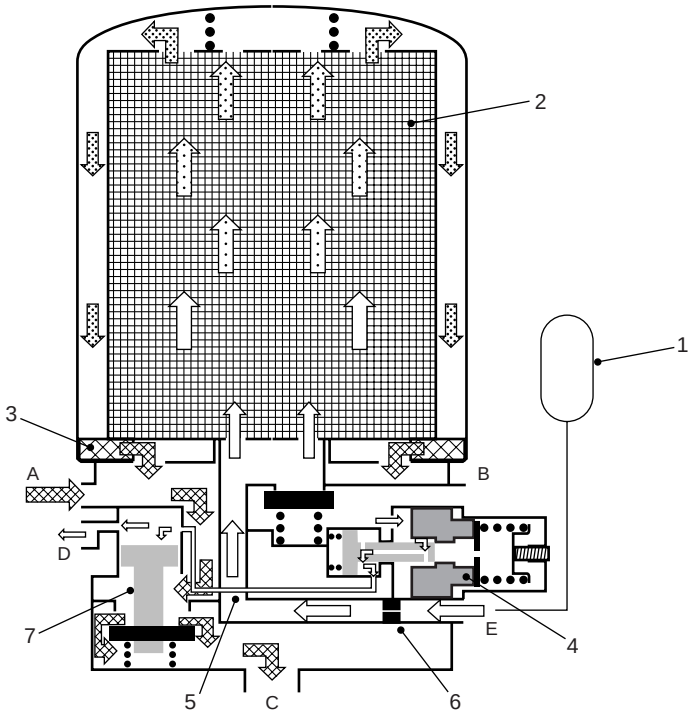
Air from air compressor (2) enters air drier (1) inlet port, flows past safety valve (3), through desiccant cartridge (5), orificed check valve (6 & 7) into purge tank (8) and air tank reservoirs via the pressure protection valve.

Humid air from the compressor passes up and down the air drier cartridge. The dirt in the air is collected in the filter and water molecules adhere to the desiccant. Air flows through the desiccant and out of air drier (1) which results in clean dry air flowing into purge tank (8) and the air reservoirs.

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SM - 2280



1 - Purge Tank
2 - Desiccant
3 - Oil Filter
4 - Unloader Valve
5 - Check Valve
6 - Purge Choke
7 - Purge Valve
A - Supply from Compressor
B - Delivery to Press Protection Valve
C - Exhaust
D - Output to Compressor Unloading Device
E - Delivery to Purge Tank

Fig. 2 - Typical Purging Air Flow

Purging Air Flow

Numbers in parentheses refer to Fig. 1.

When system pressure reaches 8.4 bar (122 lbf/in²), the air pressure overcomes spring tension in purge valve which forces the spool down. This unloads air compressor (2) by opening unloader valve (4) and allowing the air to flow out of purge tank (8), through orifice (7), unloader valve (4) and air drier (1) drain to atmosphere.

Numbers in parentheses refer to Fig. 2.

When air pressure reaches 8.3 bar (120 lbf/in²), air enters unloader valve (4) moving the piston, allowing air through to the purge valve (7). Once the purge valve (7) is open, the air compressor now pumps air at low pressure directly to atmosphere. Dirt and water collected around unloader valve (4) flows out of exhaust port (C) to atmosphere.

Dry air from purge tank (1) flows through the purge choke (6) and desiccant (2) carrying the water molecules out of exhaust port (C) to atmosphere.

SM - 1944

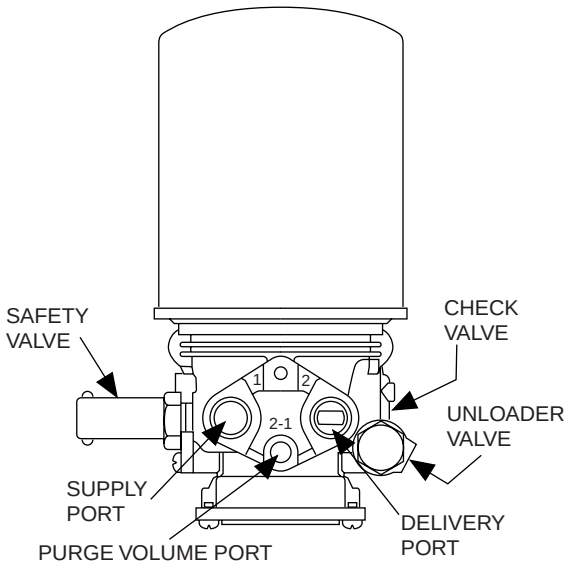
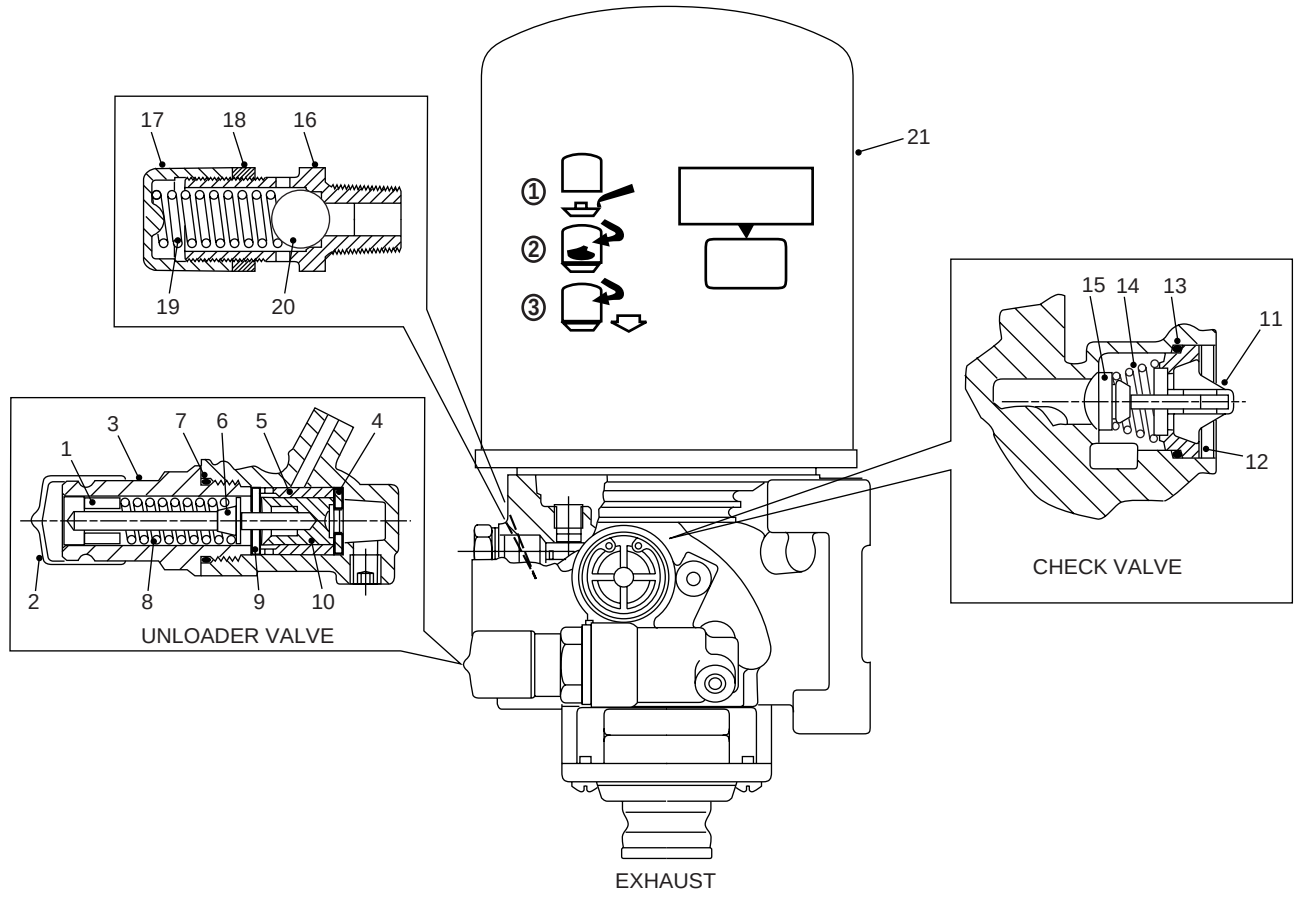


Fig. 3 - Port and Valve Identification

This purging process continues until purge tank (1) pressure is zero or until unloader valve (4) closes at 7.5 bar (109 lbf/in²) and once again compressed air passes through the desiccant cartridge.

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1 - Adjusting Bush
2 - Protection Cap
3 - Valve Retaining Cap
4 - Bonded Valve (Inner)
5 - Pilot Valve Piston Bush
6 - Control Rod
7 - 'O' Ring
8 - Control Spring
9 - Bonded Valve (Outer)
10 - Pilot Valve Piston
11 - Check Valve Guide
12 - Circlip
13 - 'O' Ring
14 - Conical Spring
15 - Check Valve
16 - Safety Valve Body
17 - Adjusting Screw
18 - Locknut
19 - Regulating Spring
20 - Ball
21 - Desiccant Cartridge

Fig. 4 - Air Drier Components

REMOVAL

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks are properly secured and of adequate capacity to do the job safely. Ensure steering lock bar is in place.

1. Place the parking brake in the 'Park' position, switch off the engine and place the battery master switch in the 'Off' position.

2. Place the steering lock bar in the 'Locked' position, block all road wheels, open drain cocks on air tanks and drain air from all three air tanks. Close drain cocks on air tanks when air is exhausted. Carefully loosen the union nuts at purge port (2-1, Fig. 3) and delivery port (2, Fig. 3) on air drier to relieve any trapped air.

3. Tag and carefully disconnect all air lines from the air drier body ports.

Note: All ports on air drier have numbers cast into housing for identification purposes.

4. Remove mounting hardware securing the air drier to the left hand side platform. Move the air drier assembly to a clean work area for 'Disassembly'.

5. Remove desiccant cartridge and 'O' ring from air drier body. Discard 'O' ring.

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UNLOADER VALVE

Disassembly/assembly

Numbers in parentheses refer to Fig. 4, unless otherwise specified.

Note: Unloader valve components should be replaced as a complete assembly when removed from air drier assembly. Do not reassemble using old components.

1. Pull off and discard protection cap (2) from unloader valve assembly.

2. Unscrew and discard valve retaining cap (3). Remove and discard adjusting bush (1) and 'O' ring (7).

3. Remove and discard control spring (8) and control rod (6).

4. Remove and discard outer bonded valve (9) and pilot valve piston bush (5).

5. Remove and discard pilot valve piston (10) and inner bonded valve (4).

Note: Air driers date coded 9401 onwards may have a filter located at the end of the air passage of delivery port (2, Fig. 3). Should the filter appear to be blocked or contaminated, it should be removed (which will destroy it) and replaced.

The entire body assembly should be cleaned using a suitable cleaning fluid and thoroughly dried.

6. Install inner bonded valve (4), ensuring that the flat solid surface is facing outwards.

7. Install pilot valve piston bush (5), ensuring that the two small holes are facing outwards.

8. Install pilot valve piston (10).

9. Install outer bonded valve (9), ensuring that the flat solid surface faces inwards and is in contact with pilot valve piston (10).

10. Install control rod (6) and control spring (8).

11. Install 'O' ring (7) to valve retaining cap (3). Using special tool which can be fabricated as shown in Fig. 6, screw in adjusting bush (1) and fit to main body assembly.

12. If necessary, fit new filter in port 1, use a 7 mm (0.38 in) dowel to push filter home.

CHECK VALVE

Disassembly/assembly

Numbers in parentheses refer to Fig. 4.

Note: Check valve components should be replaced as a complete assembly when removed from air drier assembly. Do not reassemble using old components.

1. Using suitable circlip pliers, remove and discard circlip (12) from check valve assembly.

2. Remove and discard check valve guide (11) and 'O' ring (13).

3. Remove and discard spring (14) and check valve (15).

4. Install new check valve (15) and spring (14) in valve housing.

5. Grease new 'O' ring (13) and fit to new check valve guide (11).

6. Lower check valve guide (11) and 'O' ring (13) into recess, ensuring that the check valve stem locates in the recess in the centre of the check valve guide (11).

7. Using suitable circlip pliers, install new circlip (12).

SAFETY VALVE

Description

The safety valve protects the air brake system against excessive air pressure build up. The valve consists of a spring loaded ball valve subjected to reservoir pressure which will permit air to exhaust reservoir pressure to atmosphere if reservoir pressure rises above the valves' pressure setting. The safety valve is set to open at a pressure of 11 bar (160 lbf/in^2).

Operation

Numbers in parentheses refer to Fig. 4.

When primary tank air pressure under ball (20) exceeds the maximum valve setting of 10.75 bar (156 lbf/in^2), ball (20) is forced off its seat, permitting air to escape through exhaust port 'A' to atmosphere. As soon as sufficient air is bled from the reservoir so that the pressure drops below the maximum valve setting, regulating spring (19) forces ball (20) back on its seat, preventing any further loss of air.

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Testing

Operating Test - The valve must open (exhaust) when the pressure applied at the supply port 'P-1' is above 10.75 bar (156 lbf/in²). The valve should exhaust sharply, with a 'pop' action. If the valve does not relieve, ball (20) must be stuck on its seat. The complete valve should be replaced.

Leakage Test - With the air system at operating pressure, test for leakage by applying soap suds to valve body (16) and exhaust port. If leakage exceeds a 25 mm soap bubble in 5 seconds, replace the valve assembly.

Adjustment

Adjust the safety valve opening pressure to 10.75 bar (156 lbf/in²) by loosening locknut (18) and turning adjusting screw in to raise the pressure setting or out to reduce the setting. Always tighten locknut (18) after making adjustment.

Maintenance

Note: This is a non-serviceable item and should be replaced with a new safety valve assembly, if damaged.

PURGE VALVE

Removal

Numbers in parentheses refer to Fig. 5.

1. Remove 4 screws (5), silencer cover (15) and perforated plate (3) from base of air drier.

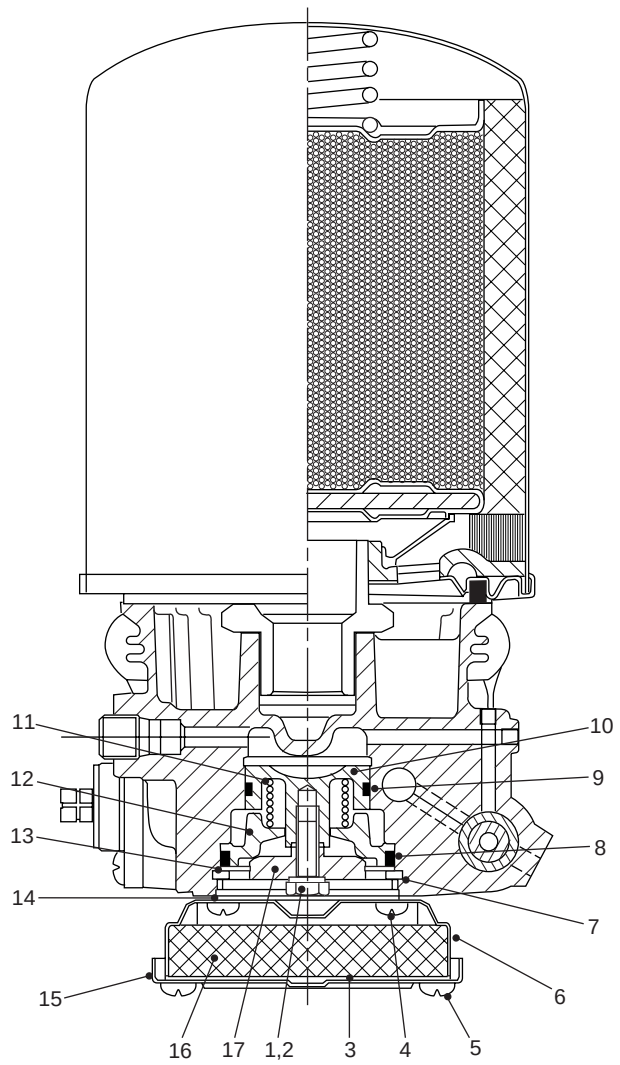
2. Remove and discard silencer element (16).

3. Remove 4 screws (4) and silencer housing (6) from air drier body. Remove and discard gasket (14).

4. Using suitable circlip pliers, remove and discard circlip (7).

5. Remove retaining ring (13) and 'O' ring (8) from recess. Discard 'O' ring (8).

6. Using suitable pliers, grip screw (1) head and pull gently to remove purge valve assembly complete.



1 - Screw
2 - Lockwasher
3 - Perforated Plate
4 - Screw
5 - Screw
6 - Silencer Housing
7 - Circlip
8 - 'O' Ring
9 - 'O' Ring
10 - Purge Valve Piston
11 - Return Spring
12 - Purge Valve Housing
13 - Retaining Ring
14 - Gasket
15 - Silencer Cover
16 - Silencer Element
17 - Purge Valve

Fig. 5 - Sectional View of Air Drier

Disassembly/assembly

Numbers in parentheses refer to Fig. 5.

1. Remove and discard 'O' ring (9) from purge valve assembly.

2. Remove screw (1) and lockwasher (2) from bottom of purge valve assembly.

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3. Remove and discard the bonded rubber/metal purge valve (17) and nylon purge valve housing (12).

4. Remove and discard return spring (11).

5. Using a suitable fluid, clean purge valve piston (10), screw (1) and lockwasher (2) and dry thoroughly. Clean purge valve body if necessary.

6. Assemble new bonded rubber/metal purge valve (17), purge valve housing (12), return spring (11), purge valve piston (10) and secure using screw (1) and lockwasher (2). Tighten screw (1) to a torque of 5.1 - 6.2 Nm (45 - 55 lbf ins).

7. Grease the groove on purge valve piston (10) and fit new 'O' ring (9). Grease 'O' ring (9).

8. Grease bores in air drier housing, position purge valve assembly and push home.

9. Grease recess and new 'O' ring (8). Manoeuvre 'O' ring (9) into recess.

10. Install retaining ring (13) and using suitable circlip pliers, install new circlip (7).

11. Lightly smear surface of silencer housing (6) with grease to hold and retain new gasket (14) in place.

12. Refit silencer housing (6) to the air drier body with screws (4).

13. Install new silencer element (16), perforated plate (3), silencer cover (15) and secure using screws (5).

ASSEMBLY/INSTALLATION

Numbers in parentheses refer to Fig. 4.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATION.

1. Install new 'O' ring on desiccant cartridge (21).

2. Install desiccant cartridge (21) assembly on drier body.

Note: The new desiccant cartridge (21) must be kept in its plastic bag until it is installed. If not the desiccant will absorb moisture and lose its efficiency.

3. Position air drier assembly on the left hand side platform and secure in place with mounting hardware as removed at 'Removal'.

4. Connect all air lines to the air drier body, as tagged at 'Removal'.

5. Start the engine and allow the air pressure in the air tanks to build up to correct operating pressure. Refer to Section 250-0000, AIR BRAKING SYSTEM SCHEMATIC. Check for leaks at air lines and tighten as required.

CHECKING AIR DRIER OPERATION

1. Charge the air system until the unloader valve cut-out pressure is reached. Refer to Section 250-0000, AIR BRAKING SYSTEM SCHEMATIC. At this point the air drier unloader valve opens allowing air compressor output, purge tank air and collected water, dirt and oil to flow out of the silencer at the bottom of the air drier. If this does not happen, then check for a plugged drain, unloader valve pressure setting.

2. Using a test quality gauge, check the system pressure at which the unloader valve operates. It should be 8.3 ± 0.2 bar (117 - 123 lbf/in²), if it is outside this range then adjust the valve using the special tool shown in Fig. 6, (screw in to increase the pressure). To check the adjustment deplete the system pressure by repeatedly applying the brakes, then allow the system to recharge.

3. The unloading phase continues until the unloader valve cut-in pressure is reached. Refer to Section 250-0000, AIR BRAKING SYSTEM SCHEMATIC. This closes the unloader valve and the compressor starts charging the air system again. At this point air flow coming out of the air drier silencer stops. If air flow does not stop, check for a partially open unloader valve or check cut-in pressure setting. Cut-in pressure should be 7.1 to 7.9 bar (103 to 115 lbf/in²) and is not adjustable. If pressure is outside these limits, check cut-out pressure and re-adjust.

4. Every 2 000 hours/12 months replace the desiccant cartridge. The desiccant cartridge service life is determined by the air quality delivered by the air compressor and the compressor charging time. Polluted air and long charging times reduce desiccant cartridge service life.

5. If water is present, the desiccant cartridge must be replaced and the components in the air drier body checked for proper operation.

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AIR DRIER DIAGNOSIS

The following table lists some of the conditions which could prove responsible for air drier malfunctioning. The reasons and remedies to correct these conditions are listed opposite each condition.

⚠ WARNING
Always shut off the engine, completely drain the air system, and make sure the air drier is completely purged of all air pressure before loosening air lines or fittings to prevent personal injury.

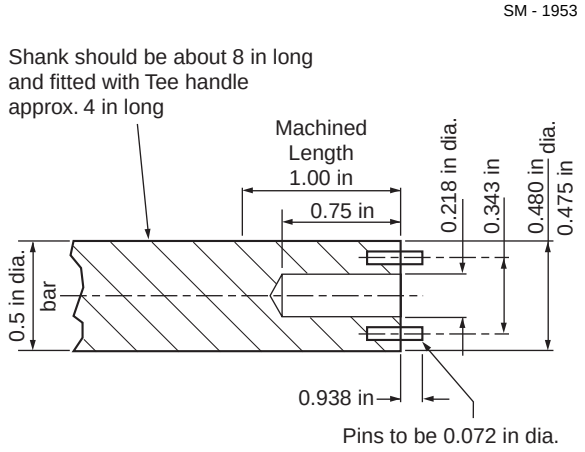


Fig. 6 - Unloader Valve Adjusting Bush Installation Tool

SERVICE TOOLS

Special tool can be fabricated as shown in Fig. 6. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools. These tools are available from your dealer.

AIR DRIER DIAGNOSIS CHART

CONDITION	REASON	REMEDY
Air continually blows out of drain port while compressor is pumping	Unloader valve held open by foreign particles on the valve seat	Disassemble and clean unloader valve assembly.
	Faulty unloader valve	Disconnect pilot line from the air drier to compressor. If leak stops and air is being expelled from the unloader valve line, unloader valve is the problem. Repair or replace unloader valve.
Leakage occurs while air compressor is unloaded:		
A - Continuous leakage	Faulty check valve at air drier	Clean or replace check valve.
B - Pulsating leakage	Faulty unloader valve	Clean, rebuild or replace unloader valve.
Continuous on-off purge cycle	No/Faulty check valve at air drier	Install or replace check valve.
	Primary tank drain cock open	Close drain cock
	Unloader valve malfunction	If cycling occurred when air compressor was unloaded, check unloader valve for by-pass leakage. Check unloader valve high-low limits.
Safety valve blowing - air drier not unloading	Check system pressure when safety valve blows off	If pressure is below 9 bar (130 lbf/in²) check safety valve.
		If pressure is above 9 bar (130 lbf/in²) check unloader valve.
Large amount of water in primary tank	Desiccant cartridge plugged	Replace desiccant cartridge.
	Desiccant saturated with water	Not enough cooling of air. Check for air line too near engine exhaust, etc.
		Excessive duty cycle. Check for leakage in air system.

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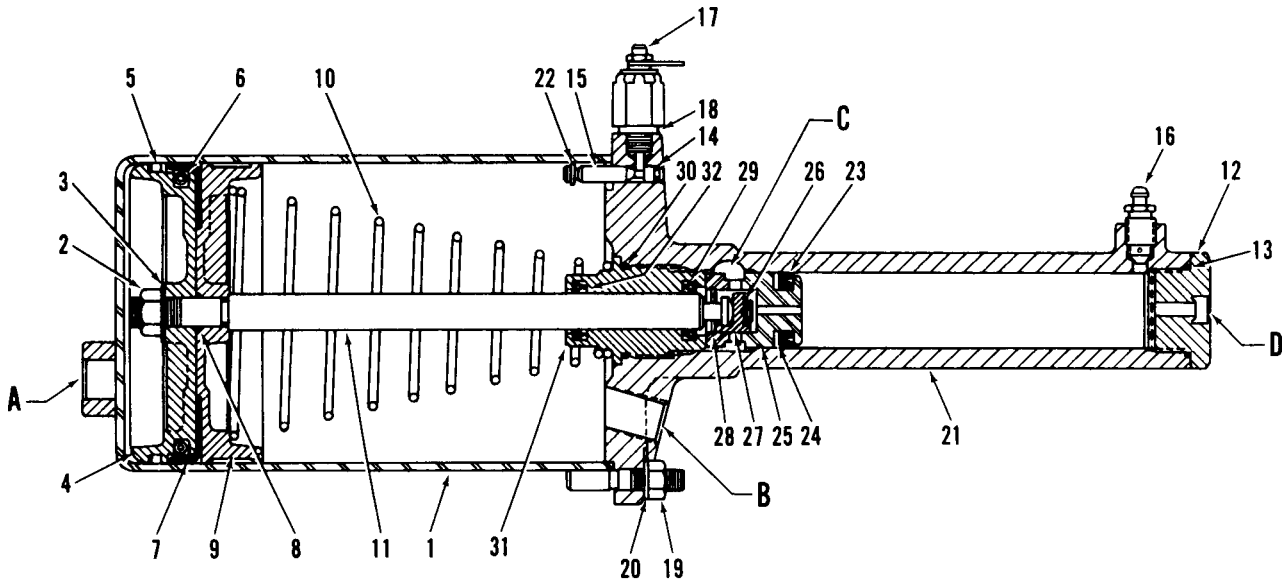
SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ins
5	1	Bolt	5.1 - 6.2	45 - 55

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1 - Air Cylinder Body
2 - Nut
3 - Washer
4 - Piston Follower
5 - Felt Wiper
6 - Expander Spring
7 - Leather Cup
8 - 'O' Ring
9 - Air Piston
10 - Return Spring
11 - Push Rod
12 - End Cap
13 - Seal Ring
14 - 'O' Ring
15 - Indicator Rod
16 - Bleeder Screw
17 - Contact Assembly
18 - Shim (if used)
19 - Nut
20 - Lockwasher
21 - Hydraulic Cylinder Body
22 - Retainer Ring (if used)
23 - 'V' Seal
24 - Back-up Ring (if used)
25 - Hydraulic Piston
26 - Valve Insert
27 - Valve
28 - Retainer Ring
29 - 'V' Seal
30 - 'O' Ring
31 - Bushing
32 - 'V' Seal

Fig. 1 - Cutaway View of Pressure Converter

DESCRIPTION

There are two pressure converters used in the air system one for the front brake tank and the other for the rear. The front pressure converter is mounted off of a bracket on the front left hand cab leg. The rear pressure converter is mounted alongside the rear brake tank in the trailer frame.

The pressure converters are used to convert air pressure to hydraulic pressure. Air pressure applied to one end of the pressure converter results in hydraulic pressure at the other end. The pressure converter consists of an air cylinder group and a hydraulic group.

There are 4 line connections to each pressure converter as follows:

Port 'A' - Supply air line from relay emergency valve
Port 'B' - Air line to air breather
Port 'C' - Hydraulic line to brake fluid reservoir
Port 'D' - Supply line to hydraulic brake lines

OPERATION

Numbers in parentheses refer to Figs. 1 and 2.

When the operator depresses the brake treadle valve, air from the treadle valve enters inlet port 'A' of air cylinder body (1), via the relay emergency valves. The air then forces piston follower (4), air piston (9) and push rod (11) to stroke hydraulic cylinder (21) and compress return spring (10). Piston follower (4) contains a leather cup (7) and a felt wiper (5) that cleans and lubricates air cylinder body (1) housing. Air displaced on the atmospheric side of air piston (9) passes through port 'B' in hydraulic cylinder body (21) to the air breather. Refer to Section 250-0270, AIR BREATHER.

When air is released, return spring (10) forces push rod (11), air piston (9) and piston follower (4) back to the static position. In the static position, valve (27) is open, allowing fluid in hydraulic cylinder body (21) to pass through hydraulic piston (25) and port 'C' to the remote brake fluid reservoir to compensate the closed

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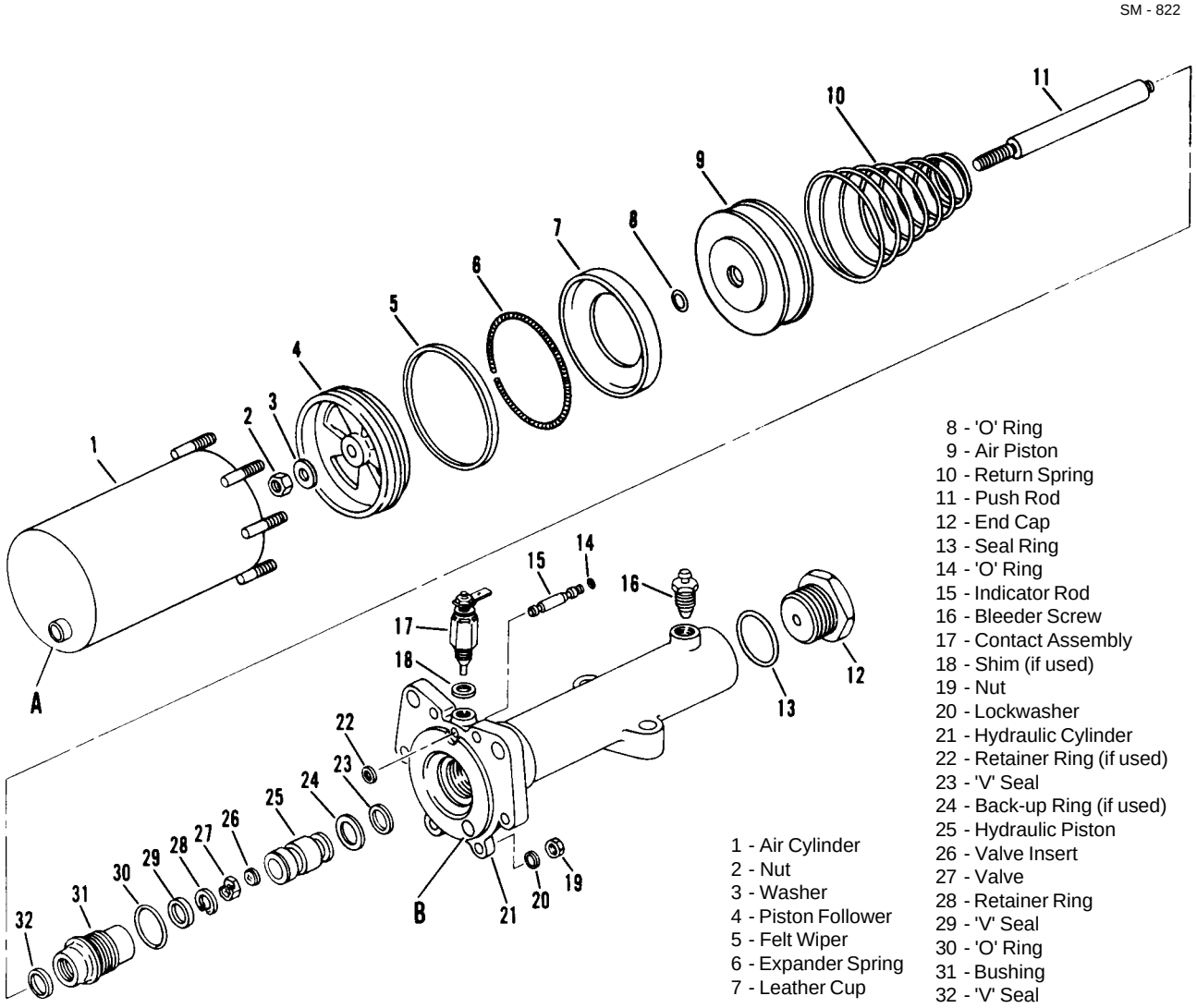


Fig. 2 - Exploded View of Pressure Converter

hydraulic system for temperature expansion and contraction or seepage. During an application, initial push rod (11) movement seats valve (27) against hydraulic piston (25) and seals passage to port 'C', then the stroke displaces fluid into the brake system. Pressure builds when this fluid movement ceases. 'V' seal (23) on hydraulic piston (25) seals the pressure system and hydraulic pressure is directed to the brakes through outlet port 'D'.

Upon release, return spring (10) forces push rod (11) to unseat valve (27) and return hydraulic piston (25) to its stop. Displaced fluid passes through hydraulic piston (25) to equalize hydraulic pressure and the system returns to the static position.

When the pressure converter stroke has been exceeded, because of a loss of hydraulic pressure in the brake system, air piston (9) strokes indicator rod (15), closing switch in contact assembly (17) causing converter overstroke warning light to illuminate. This will continue until switch is reset by manually pushing indicator rod (15) into hydraulic cylinder body (21) until flush.

REMOVAL

Numbers in parentheses refer to Figs. 1 and 2.

Note: When removing rear pressure converter from the machine, it is advisable to raise the body and secure in place with the body safety prop.

> ⚠ **WARNING**
> **To prevent personal injury, be sure body prop is in place before working under a raised body.**

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1. If required, to remove the rear pressure converter, raise body and secure in place with the body safety prop.

2. Switch off the engine, install steering lock bar in the 'locked' position and drain the air tanks. Close air tank drain cocks when air has exhausted from the air tanks.

3. If required, to remove the front pressure converter, open the hood to gain access.

4. Remove electrical wire from contact assembly (17) on hydraulic cylinder body (21) of pressure converter.

5. Remove breather hose assembly from port 'B' of hydraulic cylinder body (21).

6. Remove air supply line from port 'A' of air cylinder body (1).

7. Remove hydraulic line from port 'D'.

8. Using a suitable container to catch brake fluid, remove brake fluid reservoir line from port 'C' of hydraulic cylinder body (21).

9. Remove mounting hardware securing pressure converter to its mounting on the machine. Remove pressure converter assembly to a clean work area for 'Disassembly'.

DISASSEMBLY

Numbers in parentheses refer to Figs. 1 and 2.

Note: When it is necessary to clamp the pressure converter in a vice or equivalent mechanism, do not clamp on air cylinder body (1) or on the cylindrical portion of hydraulic cylinder body (21).

> ⚠ **WARNING**
> **Use care to prevent damaging seal grooves, push rod and cylinder bores. Defects on these surfaces will cause leakage. One mark could mean loss of pressure and brake failure which could cause personal injury and property damage.**

1. Using a suitable solvent, clean pressure converter assembly thoroughly.

2. Drain hydraulic fluid from pressure converter into a suitable container.

3. Remove contact assembly (17) and shim (18), if used, from hydraulic cylinder body (21).

4. Remove bleeder screw (16), end cap (12) and seal ring (13) from hydraulic cylinder body (21). Discard seal ring (13).

5. Match mark air cylinder body (1) and hydraulic cylinder body (21) and remove nuts (19) and lockwashers (20). Remove air cylinder body (1).

6. Remove retainer ring (22), if used, indicator rod (15) and 'O' ring (14). Discard 'O' ring (14) and retainer ring (22), if used.

> ⚠ **WARNING**
> **Return spring (10) is under tension. Remove nut (2) slowly, being careful to control expansion of return spring (10) to avoid property damage or personal injury.**

7. Remove nut (2), washer (3), piston follower (4), leather cup (7), 'O' ring (8), air piston (9) and return spring (10) from air cylinder body (1). Discard leather cup (7), 'O' ring (8) and return spring (10).

8. Remove expander spring (6) and felt wiper (5). Discard felt wiper (5).

9. Unscrew bushing (31), push rod (11) and hydraulic piston (25) as an assembly from hydraulic cylinder body (21). Do not remove bushing (31) from push rod (11) at this time.

10. Disconnect retainer ring (28). Remove hydraulic piston (25), valve (27), valve insert (26) and retainer ring (28). Discard retainer ring (28) and seal (26).

11. Slide bushing (31) off push rod (11) end. Remove and discard 'V' seals (29 & 32) and 'O' ring (30) from bushing (31).

12. Remove and discard 'V' seal (23) from hydraulic piston (25). Back-up ring (24), if used, should not be removed

INSPECTION

Numbers in parentheses refer to Figs. 1 and 2.

1. Using mineral spirits, clean air cylinder body (1), piston follower (4), expander spring (6), air piston (9), push rod (11), hydraulic cylinder body (21), hydraulic piston (25), valve (27) and bushing (31).

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2. Inspect cleaned parts for nicks, scratches, grooves, wear, pits, corrosion or foreign material which could cause leaks. Damaged parts should be replaced.

ASSEMBLY

Numbers in parentheses refer to Figs. 1 and 2.

Note: When it is necessary to clamp the pressure converter in a vice or equivalent mechanism, do not clamp on air cylinder body (1) or on the cylindrical portion of hydraulic cylinder body (21).

> ⚠ **WARNING**
> **Use care to prevent damaging seal grooves, push rod and cylinder bores. Defects on these surfaces will cause leakage. One mark could mean loss of pressure and brake failure which could cause personal injury and property damage.**

1. Lubricate 'V' seals (23, 29 & 32) with hydraulic fluid used in brake system. Refer to Section 300-0020, LUBRICATION SYSTEM.

2. Install new 'V' seal (23) on hydraulic piston (25). Make sure 'V' seal (23) is installed in the direction as shown in Fig. 1.

3. Install new 'V' seals (29 & 32) into bushing (31). Make sure 'V' seal (29 & 32) lips face opposite directions, as shown in Fig. 1. Exercise care as these seals are difficult to insert.

4. Install new 'O' ring (30) on bushing (31).

5. Install new valve insert (26) into valve (27). Make sure valve insert (26) is installed as shown in Fig. 1.

6. Lubricate push rod (11) and valve (27) with hydraulic fluid used in brake system. Refer to Section 300-0020, LUBRICATION SYSTEM. Slide bushing (31) over hydraulic end of push rod (11), as shown in Fig. 1. Be careful to avoid damage to 'V' seals (29 & 32).

7. Slip new retainer ring (28) over hydraulic end of push rod (11). Attach valve (27) and then slide hydraulic piston (25) over the valve. Install retainer ring (28) to secure hydraulic piston (25) to push rod (11).

8. Lubricate hydraulic piston (25) with hydraulic fluid used in brake system. Refer to Section 300-0020, LUBRICATION SYSTEM. Carefully insert hydraulic piston (25) into bore of hydraulic cylinder body (21).

9. Screw bushing (31) into hydraulic cylinder body (21). Torque tighten bushing (31) to 7 - 40 Nm (5 - 30 lbf ft).

10. Install new seal ring (13) on end cap (12). Install end cap (12) assembly on hydraulic cylinder body (21). Torque tighten end cap (12) to 80 - 105 Nm (60 - 80 lbf ft).

11. Install new return spring (10), air piston (9) and new 'O' ring (8) on push rod (11).

12. Install expander spring (6) and new leather cup (7) on piston follower (4). Install piston follower (4) washer (3) and nut (2) on push rod (11). Extra help may be required to overcome the spring load. Torque tighten nut (2) to 7 - 14 Nm (5 - 10 lbf ft).

13. Apply a coating of grease to new felt wiper (5) and install felt wiper on piston follower (4).

14. Install new 'O' ring (14) on indicator rod (15) and install in hydraulic cylinder body (21). Install new retainer ring (22), if used.

15. Install contact assembly (17) and shim (18), if used, in hydraulic cylinder body (21). Torque tighten contact assembly (17) to 5 - 10 Nm (4 - 8 lbf ft).

16. Apply a coating of grease to leather cup (7), air piston (9), piston follower (4) and air cylinder body (1) bore. Slide air piston assembly into air cylinder body (1). Push air cylinder body (1) in place, with the six studs extending through hydraulic cylinder body (21). Make sure match marks are aligned.

17. Secure air cylinder body (1) to hydraulic cylinder body (21) with lockwashers (20) and nuts (19). Alternately torque tighten nuts (19) to 8 - 16 Nm (6 - 12 lbf ft).

18. Install bleeder screw (16) into hydraulic cylinder body (21). Torque tighten bleeder screw (16) to 14 - 28 Nm (10 - 20 lbf ft).

INSTALLATION

Numbers in parentheses refer to Figs. 1 and 2.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

1. Install pressure converter in machine and secure with mounting hardware, as removed at 'Removal'.

2. Install brake fluid reservoir line in port 'C' of

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hydraulic cylinder body (21).

3. Install hydraulic line in port 'D' of end cap (12).

4. Install breather hose assembly in port 'B' of hydraulic cylinder body (21).

5. Install air supply line in port 'A' of air cylinder body (1).

6. Install electrical wire on contact assembly (17) in hydraulic cylinder body (21).

7. Fill remote mounted brake fluid reservoir with fluid, as specified in Section 300-0020, LUBRICATION SYSTEM. Bleed brakes as described in Section 165-0010, BRAKE PARTS.

MAINTENANCE

Note: Maintenance and adjustment of the brake system is contained in Section 165-0010, BRAKE PARTS.

Every 10 hours/Daily
Inspect brake fluid level in remote mounted brake fluid reservoirs and add if low. Refer to Section 300-0020, LUBRICATION SYSTEM, for fluid specification.

Check air and hydraulic lines to the pressure converters for leaks and/or wear. Tighten line fittings or replace as required.

PRESSURE CONVERTER DIAGNOSIS

CONDITION	REASON	REMEDY
Air cylinder leak, other than at inlet fitting	Worn leather cup	Replace cup.
	Dent or corrosion in cylinder body	Repair or replace cylinder body.
	Loose piston on push rod	Replace piston and push rod assembly.
Internal pressure leak in hydraulic cylinder. This is indicated by creep or stroke travel during extended holding application at low pressure.	Pitted cylinder, worn valve seal or worn hydraulic piston seal	Replace cylinder assembly if pitted. Replace worn seals.
Fluid leak at rear of hydraulic cylinder	Cylinder pitting	Replace cylinder.
	Worn end cap seal	Replace seal.
Hydraulic pressure builds and fails to release (brakes lock up)	Hydraulic piston passage blocked by dirt or corrosion	Clean or replace hydraulic piston.
	Swollen valve insert which expands over hydraulic piston passage. Caused by improper or contaminated brake fluid.	Replace valve insert. Drain and flush brake hydraulic system. Fill with clean brake fluid, as specified in Section 300-0020, LUBRICATION SYSTEM. Bleed brake system, as specified in Section 165-0010, BRAKE PARTS.
Stroke too long	Air in hydraulic lines	Bleed brake system, as specified in Section 165-0010, BRAKE PARTS.

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Braking System - Pressure Converter

Section 250-0260

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1 & 2	2	Nut	7 - 14	5 - 10
1 & 2	12	End Cap	80 - 105	60 - 80
1 & 2	16	Bleeder Screw	14 - 28	10 - 20
1 & 2	17	Contact Assembly	5 - 10	4 - 8
1 & 2	19	Nut	8 - 16	6 - 12
1 & 2	31	Bushing	7 - 40	5 - 30

* * * *

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DESCRIPTION AND OPERATION

There are two non-pressurised air breathers used in the air system, one on each of the brake pressure converters. Air displaced on the atmospheric side of the air piston in the pressure converter exhausts through the air breather. Refer to Section 250-0000, AIR BRAKING SYSTEM SCHEMATIC, for relationship of breathers to pressure converters.

MAINTENANCE

The air breather is manufactured in glass-filled nylon and glass-coupled polypropylene, ensuring the product does not corrode even in the most arduous applications.

Note: An air system maintained to proper specification can lead to prolonged component life. Refer to Section 250-0200, AIR DRIER, for correct air filtration service procedures.

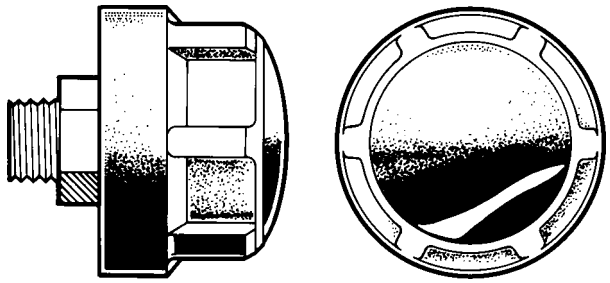


Fig. 1 - Typical Air Breather Assembly

Every 500 Hours

Inspect air breather assembly and check for correct operation. It may be necessary to clean or replace the air breather if excessive oil vapour has been present.

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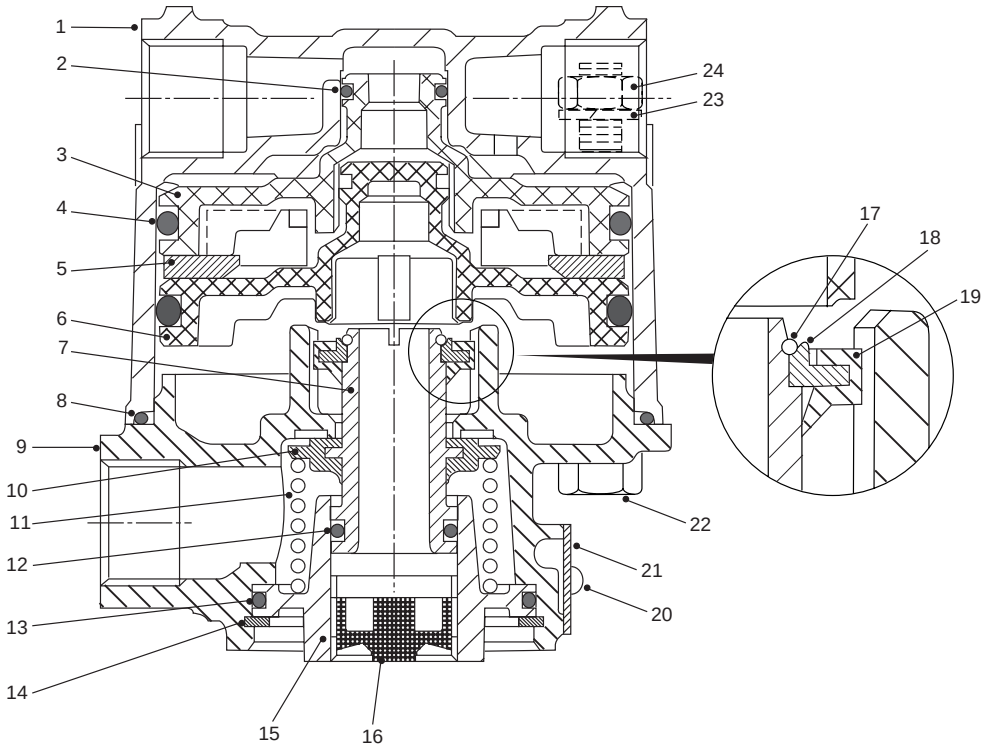
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1 - Valve Body - Upper
2 - 'O' Ring
3 - Piston - Upper
4 - 'O' Ring
5 - Distance Piece
6 - Piston - Lower
7 - Inlet/Exhaust Valve
8 - 'O' Ring
9 - Valve Body - Lower
10 - Spring Seat
11 - Spring
12 - 'O' Ring
13 - 'O' Ring
14 - Circlip
15 - Valve Guide
16 - Exhaust Check Valve
17 - Circlip
18 - Valve Ring
19 - Valve Rubber
20 - Rivet
21 - Part Number Label
22 - Bolt
23 - Lockwasher
24 - Nut

Fig. 1 - Cutaway View of Relay Emergency Valve

DESCRIPTION

The relay emergency valve can be identified as item 11 in Section 250-0000, AIR BRAKING SYSTEM SCHEMATIC.

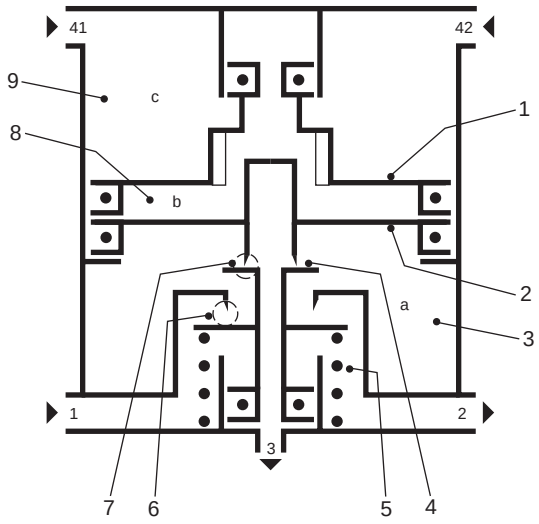
The relay emergency valve speeds the application and release of air pressure to and from the rear pressure converter. The relay emergency valve is also used as a means of preventing the force from the spring brake and service diaphragm being applied to the foundation brake at the same time.

OPERATION

Numbers in parentheses refer to Fig. 2.

Pressure from the park/emergency control valve is supplied via port '42' to chamber 'C' where it acts upon piston (1). Under the action of the pressure in chamber 'C', piston (1) moves down and contacts the back of piston (2); they then move down together and close the exhaust seat (7). The application of further pressure causes pistons (1 & 2) to move the inlet/

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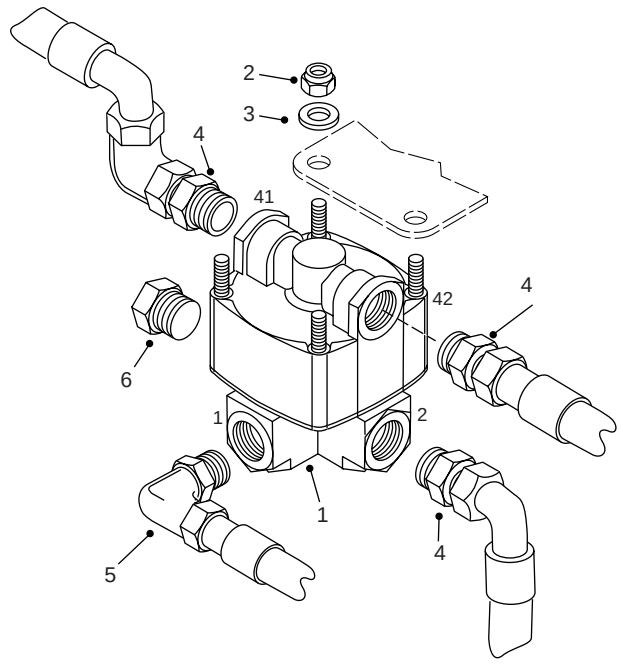


1 - Piston
2 - Piston
3 - Chamber A
4 - Inlet/Exhaust Valve
5 - Spring
6 - Inlet Seat
7 - Exhaust Seat
8 - Chamber B
9 - Chamber C

Fig. 2 - Operational View of Relay Emergency Valve

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1 - Relay Emergency Valve
2 - Locknut
3 - Washer
4 - Adaptor
5 - Elbow - 90°
6 - Plug

Fig. 3 - Relay Emergency Valve Installation

exhaust valve (4) down again and open the inlet seat (6) thereby permitting air to flow from the supply port '1' into chamber 'A' and out through delivery port '2' to the pressure converters. The pressure in chamber 'A' acts on the underside of piston (2) and forces the pistons up until the inlet/exhaust valve (4), under the action of spring (5), is in a lapped condition (both the inlet (6) and exhaust (7) seats closed).

When the pressure from the park/emergency control valve is reduced the pressure in chamber 'C' falls and the pressure in chamber 'A' forces pistons (1 & 2) up and the exhaust seat (7) is opened allowing air from the delivery port and the pressure converters to flow out of the exhaust port. The pressure in chamber 'A' continues to fall until the pressure in chamber 'C' is sufficient to close the exhaust seat (7).

When the vehicle is running the power spring in the pressure converter is held compressed by air pressure from the relay emergency valve and, when the vehicle is required to be parked, the park/emergency control valve delivery is vented and pressure in the spring brake is exhausted through the relay emergency valve allowing the force from the power spring to apply the vehicle foundation brakes. Should the service brake be applied in this condition then air pressure is supplied from the treadle valve to both the service diaphragm of the spring brake chamber and to chamber 'B' of relay emergency valve via port '41'. This forces piston (2) down to close exhaust seat (7) and open inlet seat (6) thereby reinstating air pressure to the pressure converters to compress the power spring and prevent its force compounding that from the service brake diaphragm. If the service brake pressure from the treadle valve is released then the pressure in the spring brake will be exhausted through the relay valves and the parking brake will be reapplied.

REMOVAL/INSTALLATION

Numbers in parentheses refer to Fig. 3.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel chocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Block all road wheels and place the battery master switch in the 'Off' position.

2. Open drain cocks on air tanks and drain air from all three air tanks. Close drain cocks on air tanks when air is exhausted.

3. Clean relay emergency valve (1) and surrounding area with a suitable solvent. Ensure all lines connected to relay emergency valve (1) are identified for ease of installation and disconnect lines. Fit blanking caps to all open lines and ports.

4. Support valve body and remove locknuts (2) and washers (3) securing relay emergency valve (1) to its mounting. Remove relay emergency valve (1) from the vehicle.

5. Note location of adaptors (4), elbow (5) and plug (6) and remove from relay emergency valve (1) for use on the new valve.

6. Replace all 'O' rings and install adaptors (4), elbow (5) and plug (6) in new relay emergency valve (1) ports as removed from the old valve.

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7. Secure relay emergency valve (1) to its mounting using locknuts (2) and washers (3).

8. Remove blanking caps from air lines and install lines to relay emergency valve (1) as identified during removal.

9. Place master switch in the 'On' position, start the engine and allow air pressure in the tanks to build up to correct operating pressure. Check for leaks at air lines and tighten as required.

10. Remove wheel blocks.

MAINTENANCE

Inspect the relay emergency valve regularly for any signs of leakage or damage and repair/replace as required.

Note: Limited repair of the relay emergency valve is by replacement of parts only. Refer to vehicle Parts Book for part numbers of kits.

Leak Checking

Block all road wheels, ensure air tanks are fully charged and apply the parking brake. Apply a soap solution to the valve housing and pipe joints and check for leakage. No leakage is permitted from the valve housing or joints.

SPECIAL TOOLS

There are no special tools required for procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

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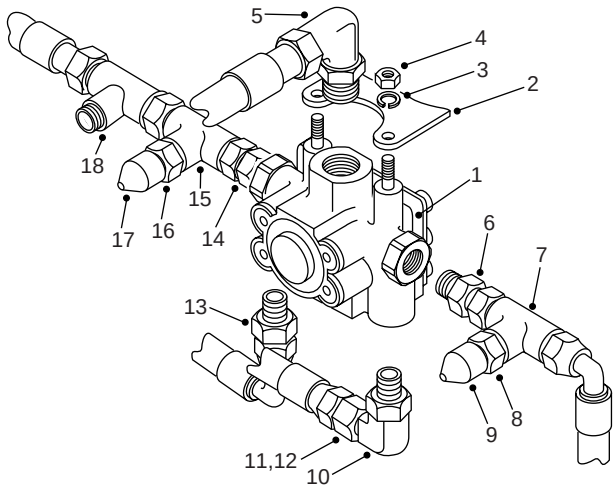
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1 - Pressure Protection Valve
2 - Mounting Bracket
3 - Lockwasher
4 - Nut
5 - Elbow - 90°
6 - Adaptor
7 - Tee Piece
8 - Pressure Switch
9 - Adaptor
10 - Elbow - 90°
11 - Adaptor
12 - Tee Piece
13 - Pressure Switch

Fig. 1 - Pressure Protection Valve Installation

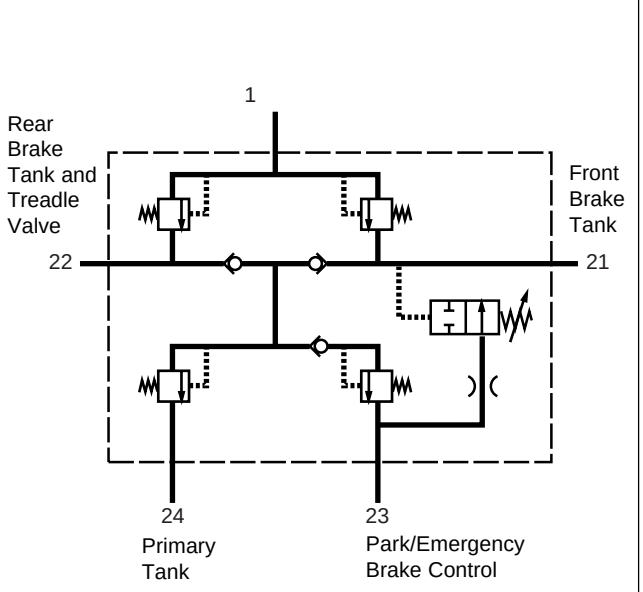


Fig. 2 - Pressure Protection Valve Schematic

DESCRIPTION

The 4 way pressure protection valve can be identified as item 9 in Section 250-0000, AIR BRAKING SYSTEM SCHEMATIC.

Mounted off the front left hand side of the tractor frame, adjacent to the primary air tank, the pressure protection valve is located in the air compressor and air drier delivery line, immediately prior to the air tanks.

The pressure protection valve supplies air to all three tanks for the service brakes, secondary braking and accessory air devices. If a pressure drop or failure is experienced in one circuit of the air system, the valve closes, isolating the circuit, enabling the compressor to continue to recharge the unfailed circuits.

The pressure protection valve also has a built in safety function which does not allow the spring brakes to be released, unless there is sufficient pressure in the service brake system to at least provide the prescribed residual braking performance of the laden vehicle by application of the service brakes.

OPERATION

Numbers in parenthesis refer to Fig. 2.

The pressure protection valve takes air from the compressor and supplies it to the separate circuits of the vehicle's brake and auxiliary systems.

The valve has elements which feed circuits '21' and '22' which, when the vehicle system is being charged, are designed to remain closed until the supply pressure to them reaches 6.0 to 6.3 bar, after which they open to supply the appropriate circuit and then remain in the open state allowing air to flow back through the element ('Feedback') thereby equalising the pressures in circuits '21' and '22'.

This feedback will continue unless the supply pressure falls to 4 bar minimum at which point the valve element will close preventing any further feedback ('Limited Feedback').

Air flows from circuits '21' and '22' through non-return valves to the elements feeding circuits '23' and '24', both designed to open at 6.0 to 6.3 bar. Circuit '24' is fed through a feedback element the same as circuits

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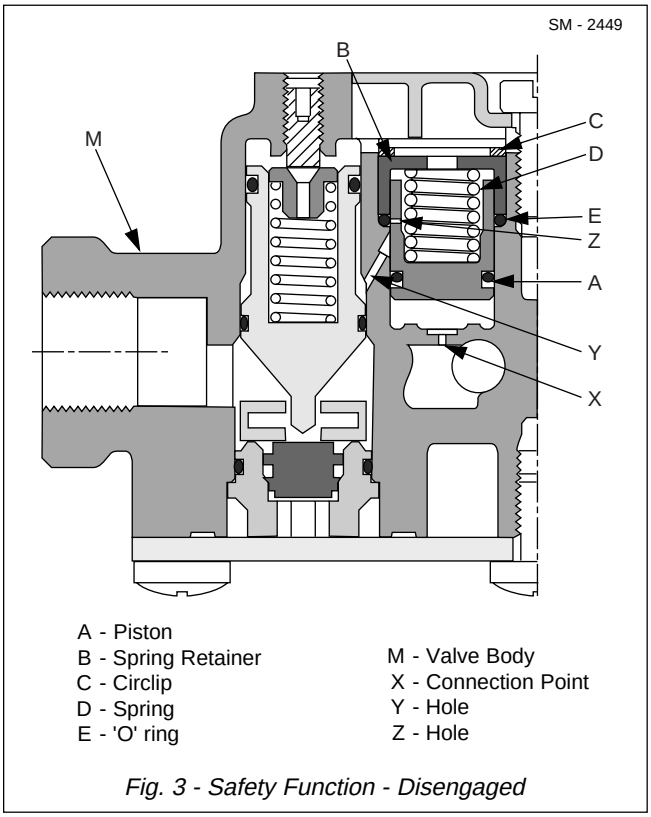


Fig. 3 - Safety Function - Disengaged

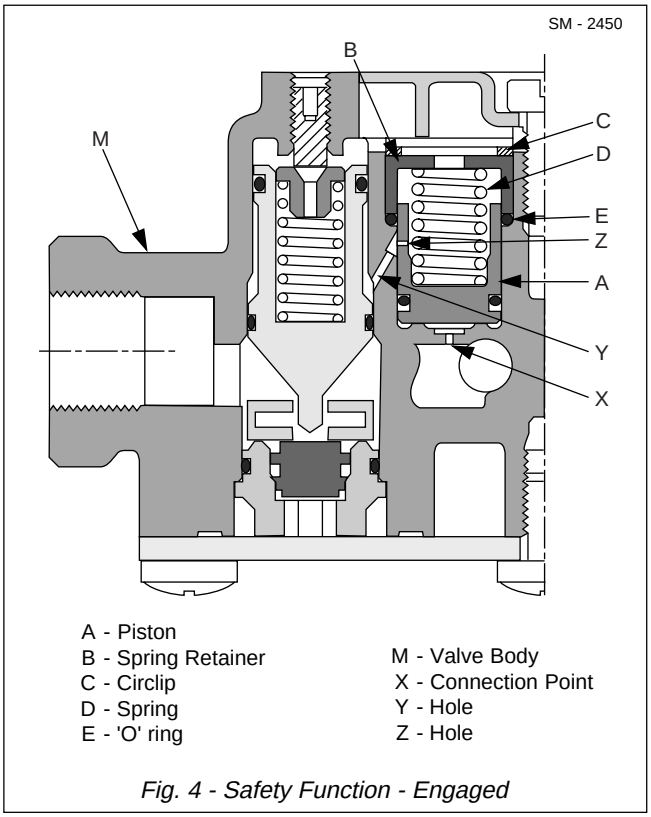


Fig. 4 - Safety Function - Engaged

'21' and '22', while circuit '23' is fed through an element which incorporates a non-return valve (Non-Feedback Element). Should there be a failure in either of circuits '21' or '22' then the pressures in circuits '23' and '24' will be unaffected as their supply comes through non-return valves. Similarly if there is a failure in circuit '24' and circuit '23' will be unaffected because of its Non-feedback element (i.e. it is protected to a minimum of 6 bar). However, if there is a failure in circuit '23' then the pressure in circuit '24' will fall to 4 bar minimum at which its element will close protecting it from any further drop. As with circuits '21' and '22', the element feeding the failed circuit will tend to remain closed allowing the non-failed circuit to recharge.

Safety Function Operation

Letters in parenthesis refer to Fig. 3 & 4.

Under normal running conditions with all circuits pressurised there is pressure on piston (A), fed from circuit '21', which is sufficient to lift piston (A) and compress spring (D) (refer to Fig. 3). In this condition, hole (Z) in piston (A) is above 'O' ring (E) thereby sealing off connection (Y), therefore the operation of the pressure protection valve is unaffected by the safety function.

However, if while the vehicle is stationary there is a leak in the service reservoirs which is sufficient to deplete the pressure in those reservoirs to below 3.5 bar ± 0.5 bar, then piston (A) will move down under the force of spring (D) and hole (Z) will move below 'O' ring (E) (refer to Fig. 4). In this condition, holes (Y & Z) will be connected allowing air to pass from circuit '23' to atmosphere through the hole in spring retainer (B). The rate of air loss through is 16 to 35 Nl/min at 8 bar.

It is this action of the safety function which will drop the pressure in the spring brake reservoir, thereby preventing release of the spring brakes until the pressure in the service reservoirs has built up sufficiently to move up piston (A) to close off hole (Z).

REMOVAL AND INSTALLATION

Numbers in parentheses refer to Fig. 1.

The pressure protection valve is a non-serviceable item and should be replaced completely, if damaged, as follows:

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

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⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position. Open drain cocks on air tanks and drain air from all three air tanks. Close drain cocks on air tanks when air is exhausted.

3. Tag and disconnect air lines and electrical connections from pressure protection valve (1), to aid in installation.

4. Support valve body and remove nuts (4) and lockwashers (3) securing pressure protection valve (1) to mounting bracket (2). Remove pressure protection valve (1) from vehicle.

5. If required, remove elbow (5 & 10), adaptors (6, 9 & 11), tee pieces (7 & 12) and pressure switches (8 & 13) from pressure protection valve (1) ports.

6. If removed, replace all 'O' rings and install elbows (5 & 10), adaptors (6, 9 & 11), tee pieces (7 & 12) and pressure switches (8 & 13) to pressure protection valve (1) ports.

7. Secure pressure protection valve (1) to mounting bracket (2) using nuts (4) and lockwashers (3).

8. Install air lines and electrical connection to pressure protection valve (1), as tagged at 'Removal'.

9. Start engine and allow air pressure in the tanks to build up to correct operating pressure. Check for leaks at air lines and tighten as required.

10. Remove wheel blocks.

SPECIAL TOOLS

There are no special tools required for procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

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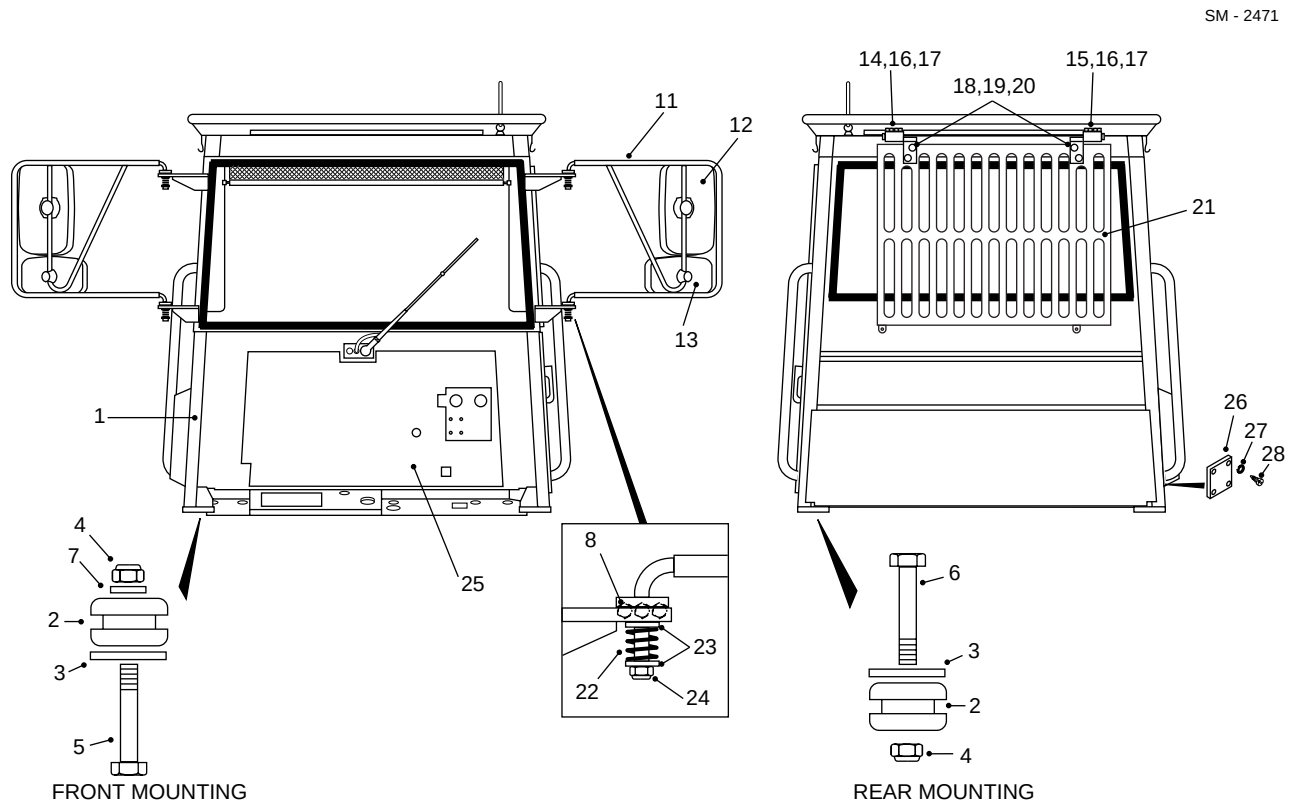
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1 - Cab Assembly	8 - Ball Bearing	15 - Hinge	22 - Spring
2 - Isolation Mount	9 - Hardened Washer	16 - Bolt	23 - Hardened Washer
3 - Washer	10 - Locknut	17 - Locknut	24 - Locknut
4 - Locknut	11 - Mirror Arm	18 - Bolt	25 - Firewall Barrier Mat
5 - Bolt	12 - Mirror	19 - Lockwasher	26 - Plate
6 - Bolt	13 - Mirror - Wide Angle	20 - Washer	27 - Lockwasher
7 - Hardened Washer	14 - Hinge	21 - Rear Window Guard	28 - Screw

Fig. 1 - Cab and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The cab is fully insulated and mounted on rubber isolation mounts (2) to damp structure-borne noise and vibration. It conforms with ISO/SAE, ROPS (Roll Over Protective Structure) and FOPS (Falling Object Protective Structure) requirements as standard.

ROPS - ISO 3471, SAE J1040 APR 88
FOPS - ISO 3449, SAE J231

⚠ WARNING
The protection offered by the roll over and falling object protective structure may be impaired if it has been subjected to any modification or damage.

Cab assembly (1) is spacious and offers outstanding visibility through large areas of tinted safety glass. Access to cab assembly (1) is from the left hand side with open tread steps, platform and handrail.

The cab interior, trimmed with noise-absorbent material, is extensively thermally insulated and a heater/filter/pressurizer and demisting unit keeps internal air fresh and dust free. Sliding windows provide additional ventilation. A side mounted air conditioner is also fitted. Refer to Section 260-0130, AIR CONDITIONING.

Note: Access from the cab, in the case of an emergency, can be gained by breaking any of the windows using the hammer provided (mounted on the right hand cab pillar).

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Operators Compartment - Cab and Mounting

Section 260-0010

REMOVAL

Numbers in parentheses refer to Fig. 1.

Note: Identify and tag all cables, harnesses, lines and linkages disconnected from cab assembly (1) during removal to aid in installation.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel chocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ Hydraulic fluid pressure will remain within the body hoist system after engine shutdown. To prevent personal injury and property damage, press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the system before disconnecting any hoses.

⚠ High electrical current. Turn the battery master switch 'Off' before disconnecting any electrical components. Disconnect electrical connections in the correct order given to prevent damage to the electrical components.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the body hoist system.

3. Block all road wheels, except the front right hand, and place the battery master switch in the 'Off' position.

4. Disconnect the electrical cables in the following order to prevent damage to the electrical components.

a. Disconnect battery ground cables from terminal posts.
b. Disconnect battery supply cables from terminal posts.
c. Disconnect alternator ground cables.
d. Disconnect alternator supply cables.
e. Disconnect electrical connections at the ECU.

5. Open drain cocks on air tanks and drain air from all three air tanks. Close drain cocks on air tanks when air is exhausted.

⚠ WARNING
Before disconnecting any air conditioner lines, refer to Section 260-0130, AIR CONDITIONING. Refrigerant will rapidly freeze all objects with which it comes into contact. It can cause serious and permanent damage to the eyes and skin.

5. Evacuate the refrigerant from the air conditioning system and disconnect the lines. Refer to Section 260-0130, AIR CONDITIONING. Fit blanking caps to all open lines and fittings.

6. Ensure heater lines are identified for ease of installation and with suitable containers available to catch leakage, disconnect heater lines. Fit blanking caps to open line ends and fittings.

7. Remove the front right hand tyre and rim assembly for access. Refer to Section 160-0050, WHEEL RIM AND TYRE.

8. Disconnect electrical harnesses from cab bulkhead.

9. Loosen the steering coupling attaching the upper column to the lower column. Remove mounting hardware securing the steering valve mounting plate to the cab floor and lower the assembly from the cab.

10. Remove mounting hardware securing the treadle valve and accelerator pedal mounting plate to the cab floor and lower the assembly from the cab.

11. Tag and disconnect the harnesses and hoses at the underside of the manifold on the right-hand side of the cab. Disconnect earth strap at rear right hand cab leg.

12. With a suitable container in position, drain the cooling system. Refer to Section 210-0000, COOLING SYSTEM.

13. Pull on handle (inside cab) to release hood catch and lift up hood assembly.

14. Disconnect ball joint and clips securing hood release cable to lock mechanism.

15. Release rear screen guard from its retainers on the hydraulic tank and disconnect the linkage between the guard and the tank.

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16. Attach suitable slings to the cab lifting points and raise lifting equipment to take up the slack.

17. Remove locknuts (4), washers (3), hardened washers (7) and bolts (5 & 6) securing the cab assembly (1) to isolation mounts (2) and cab mounting brackets on the tractor frame.

18. Check to make certain that all necessary disconnections have been made, before lifting cab assembly (1). Taking care to prevent damaging the insulating material, lift cab assembly (1) from the frame and place on suitable stands.

INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
To prevent personal injury and property damage, be sure blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Inspect isolation mounts (2) for damage and replace if necessary. If installing rubber mounts, lubricate them with water or a suitable rubber lubricant and install them from above into the cab mounting brackets on frame. Use a driver of the same diameter as the internal metal sleeve in the mount to drive the mounts fully home.

2. Attach suitable slings to the cab lifting points and raise and position cab on frame.

3. Secure front of cab assembly (1) to cab mounts with bolts (5), washers (3), hardened washers (7) and locknuts (4), as shown in Fig. 1. Tighten locknuts (4) to a torque of 380 Nm (280 lbf ft).

4. Secure rear of cab assembly (1) to cab mounts with bolts (6), washers (3) and locknuts (4), as shown in Fig. 1. Tighten locknuts (4) to a torque of 380 Nm (280 lbf ft).

5. Reconnect ball joint to lock mechanism and secure hood release cable using clips removed during removal.

6. Connect the linkage between the rear screen guard and the hydraulic tank. Secure the guard to its retainers.

7. Install treadle valve and accelerator pedal mounting plate assembly and secure to cab floor with mounting hardware removed during removal.

8. Install steering valve assembly and secure to cab floor with mounting hardware removed during removal. Secure the steering coupling to the lower steering column with mounting hardware removed during removal.

9. Pass the heater hoses up through the cutout in cab floor and connect them to the heater as identified at removal.

10. Connect air conditioning lines and charge air conditioning system. Refer to Section 260-0130, AIR CONDITIONING.

11. Connect the harnesses and hoses at the underside of the manifold on the right-hand side of the cab as noted on removal. Connect earth strap at rear right hand cab leg.

12. Connect electrical harnesses at cab bulkhead.

13. Install front right hand tyre and rim assembly. Refer to Section 160-0050, WHEEL RIM AND TYRE.

14. Fill the cooling system with coolant specified in Section 300-0020, LUBRICATION SYSTEM.

15. Connect cables to battery terminal posts (ground cable last).

16. Place the battery master switch in the 'On' position, start the engine and check for leaks. Tighten fittings if necessary. Allow engine to warm up and recheck all connections for leaks. Ensure electrical systems and gear shift are functioning properly.

17. Ensure parking brake is applied and remove wheel blocks from all road wheels.

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MIRROR ARMS

Removal

Numbers in parentheses refer to Fig. 1.

> **WARNING**
> **To prevent personal injury and property damage, be sure blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.**

1. Support mirror arm bracket (11) and remove locknuts (24), hardened washers (23) and springs (22) securing mirror arm assembly to mounting brackets.

2. Remove mirror arm bracket (11) and ball bearings (8) from mounting brackets.

3. Repeat steps 1 and 2 for other mirror arm bracket (11).

MIRROR ARMS

Installation

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

> **WARNING**
> **To prevent personal injury and property damage, be sure blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.**

1. Coat ball bearings (8) with grease and locate in mounting brackets.

2. Locate mirror arm bracket (11) to mounting brackets and install hardened washers (23), springs (22) and locknuts (24) as shown in Fig. 1.

3. Set mirror bracket spring (22) pressure as follows;
   a. rotate mirror arm (11) until ball bearings (8) are out of their detent.
   b. tighten locknut (24) until spring (22) is almost completely compressed (typical two places).
   c. swing arm until it seats in detent.
   d. check the other two detent positions

4. Repeat steps 1, 2 and 3 for other mirror arm bracket (11).

REPLACING GLASS

Note: When replacing broken glass, it is the user's responsibility to ensure that the replacement glass meets the required specifications. Replacement glass can be purchased from your dealer.

The rear glass, left and right hand side glasses and front windscreen are held in place by a bonding adhesive. The rear glass and right hand side glass also have two mounting blocks to support the glass.

To replace a glass assembly, proceed as follows:

Note: Ensure the glass is supported adequately before starting to cut the adhesive seal.

1. Using a pointed tool, pierce a hole in the adhesive seal, it is advisable to start at the top edge of the glass. Unscrew one handle of the special tool and feed the wire through the opening. Pierce a second hole in the adhesive on the side directly opposite the first.

2. From inside the cab pull the wire through and feed it back out through the second hole.

3. Re-fit the handle on the special tool. Pull both handles outwards until wire is taut.

4. Manouver the special tool around the edge of the glass, keeping the wire taut, to cut the adhesive seal. Ensure the glass is supported adequately before completing the cut.

5. If fitted, loosen mounting blocks to allow the glass to be removed from window aperture. Remove the mounting blocks if necessary.

6. Clean the remains of the adhesive from the edge of the panel opening using a suitable solvent.

7. If removed, re-fit window mounting blocks, do not tighten.

8. Coat the edge of the replacement glass with primer and apply adhesive around the lip of the window aperture, as per the manufacturers recommendations.

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9. Position glass onto panel opening, pressing firmly so that adhesive bonds sufficiently to allow the glass to be moved or straightened up as required.

10. Ensuring the glass is adequately supported, allow the sealing adhesive to set properly.

11. Clean off any excess adhesive using a suitable solvent.

12. If necessary, tighten window mounting blocks.

Water Leaks

Test for leaks by directing a stream of water along the adhesive seal, while an assistant marks the spot of leakage inside the cab. Care should be taken to note whether the leak is between adhesive and glass. Then apply a sealing compound from the outside. Start from a point near the leak and continue applying the sealer until well beyond the suspected point of entry.

This should stop the leak immediately, but since some sealing compounds should be allowed to set before getting wet, wait a few minutes before testing.

SERVICE TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of the glass removal tool, adhesive bonding kit and other general service tools required. These tools are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	4	Locknut	380	280

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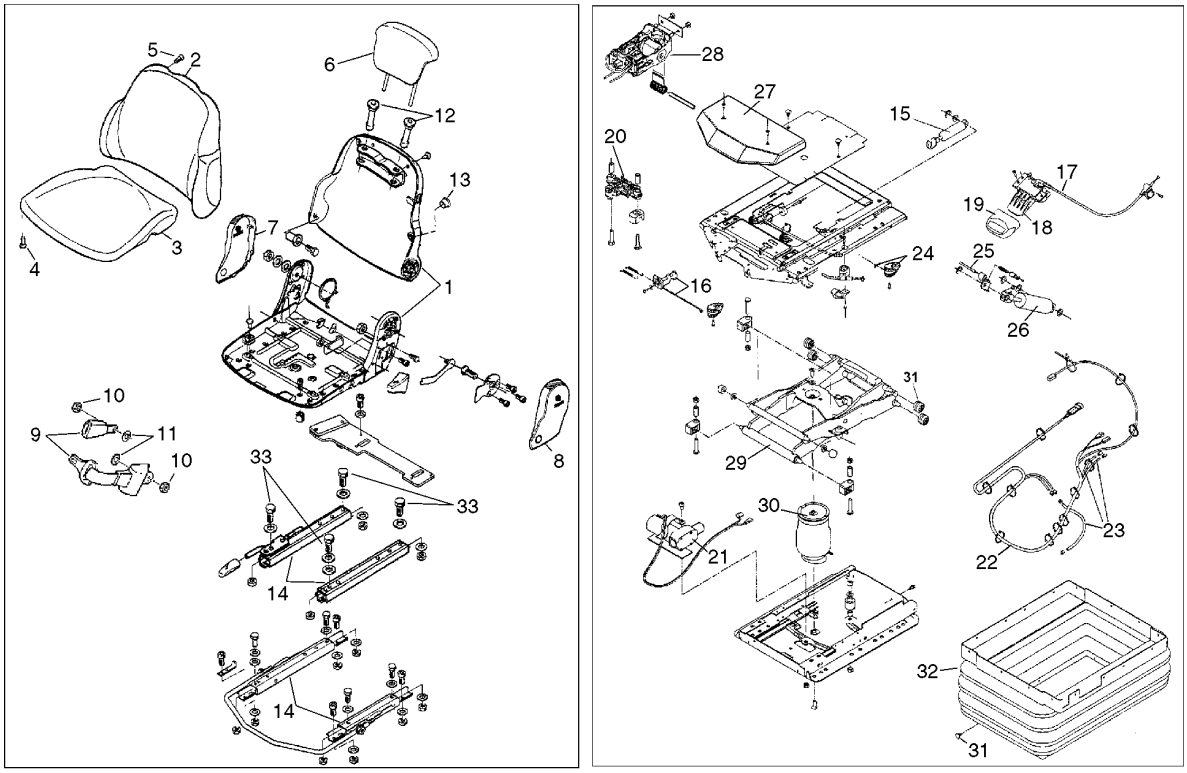
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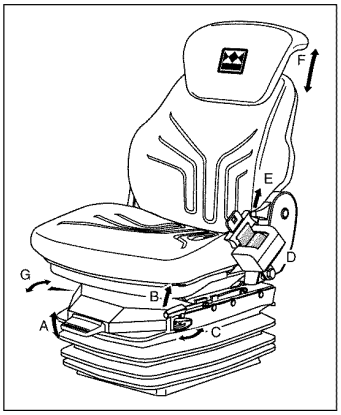
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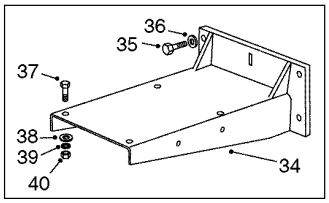
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SM - 2486







1 - Seat Frame
2 - Backrest Cushion
3 - Seat Cushion
4 - Screw
5 - Screw
6 - Backrest
7 - Cover
8 - Cover
9 - Lap Belt
10 - Nut
11 - Spacer
12 - Bushing
13 - Plug
14 - Slide Adjuster Rail
15 - Shock Absorber - Horizontal
16 - Locking Lever
17 - Bowden Cable
18 - Adjuster Control Unit
19 - Handle
20 - Horizontal Isolator Unit
21 - Compressor
22 - Connecting Cable
23 - Air Hose
24 - Lever
25 - Bowden Cable
26 - Shock Absorber - Vertical
27 - Cover
28 - Level Controller
29 - Swing Arm
30 - Air Spring
31 - Pop-out Button
32 - Suspension Skirt
33 - Allen Screw
34 - Seat Base
35 - Bolt
36 - Washer
37 - Bolt
38 - Washer
39 - Lockwasher
40 - Nut

Fig. 1 - Exploded View of Driver Seat

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
By Law, seat belts must be provided. Always wear seat belts when travelling in the vehicle.

The driver seat is secured to the cab wall with bolts (35) and washers (36). The seat assembly consists of a seat cushion (3) and backrest cushion (2) mounted to seat frame (1). Seat frame (1) is attached to seat base (34) by means of a suspension assembly. The air seat only reacts when the driver sits on the seat.

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When unoccupied, the seat sinks to the lowest position to allow easier access.

A retractable lap belt (9) is secured to the seat assembly using nuts and spacers. A push button allows quick release of lap belt (9).

The following is the list of controls to adjust the seat:
A. Height and weight adjustment.
B. Horizontal adjustment (sliderails).
C. Fore/aft isolator (forward position - unlocked, rearmost position - locked).
D. Seat belt.
E. Backrest angle adjustment.
F. Backrest height adjustment.
G. Damper adjustment (4 positions; forward position - hardest setting, rearmost position - softest setting).

⚠ WARNING
Do not attempt to adjust the seat or seat belt while the machine is moving. Loss of control may result. Stop the machine; apply the brakes; then adjust.

OPERATION

To achieve the most comfortable driving position, adjust the seat as follows;

1. Sit in seat.

2. Pull up and release height and weight adjustment (A) handle - this will reset the seat to the predetermined height setting - 'bounce' lightly until a 'click' is heard, the seat position in now engaged properly.

3. Pull up horizontal adjustment handle (B) and move seat forwards or backwards, release handle when required position is achieved.

4. Pull up (or push down) height and weight adjustment (A) handle and hold until the require height position is achieved, release handle - 'bounce' lightly until a 'click' is heard, the seat position in now engaged properly.

5. Pull up handle (E) and adjust backrest to the required angle, release handle when required position is achieved.

6. Pull up (or push down) backrest (F) to the required height.

7. Set damper adjustment (G) position to suit driving conditions, (4 positions; forward position - hardest setting, rearmost position - softest setting).

8. Set fore/aft isolator (C) position to suit driving conditions, (forward position - unlocked, rearmost position - locked).

9. Engage seat belt (D).

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel chocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Disconnect harness connector at the rear of the seat.

4. Push down height and weight adjustment (A) handle to release the air from the seat air suspension system.

6. Using suitable lifting equipment, support seat and remove bolts (35) and washers (36) securing complete seat assembly to the cab wall. Remove seat assembly from vehicle.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

Note: The disassembly and assembly procedures will cover only basic subassemblies due to the multitude of parts. If a subassembly must be disassembled, use the exploded view in Fig. 1 for reference.

1. Remove bolts (37), washers (39), lockwashers (39) and nuts (40) securing seat base (34) to seat assembly. Remove seat base (34) from seat assembly.

2. Remove covers (7 & 8) from seat assembly. Remove nuts and spacers securing lap belt (9) to seat assembly. Remove lap belt (9).

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3. Pull up and remove backrest (6) from seat frame (1).

4. Remove screws (5) securing backrest cushion (2) to seat frame (1). Remove backrest cushion (2).

5. Remove screws (4) securing seat cushion (3) to seat frame (1). Remove seat cushion (3).

6. Pull up horizontal adjustment (B) lever and slide seat assembly rearwards. Hold captive nuts using a suitable spanner and remove front allen screws (33).

7. Pull up horizontal adjustment (B) lever and slide seat assembly forwards. Hold captive nuts using a suitable spanner and remove rear allen screws (33).

8. Remove seat assembly from suspension base.

Horizontal Shock Absorber

Numbers in parentheses refer to Fig. 2.

Note: Remove seat assembly as described in 'Disassembly'

1. Remove pop-out buttons (1) and remove access cover (2) to allow access to suspension assembly.

2. Unclip hooked end of shock absorber (4) from horizontal spring assembly.

3. Remove circlip (3) and lever out shock absorber (4) from rocker shaft and slide off of mounting pin.

4. Remove spacer (5) from mounting pin.

5. Reassembly is done in the reverse order.

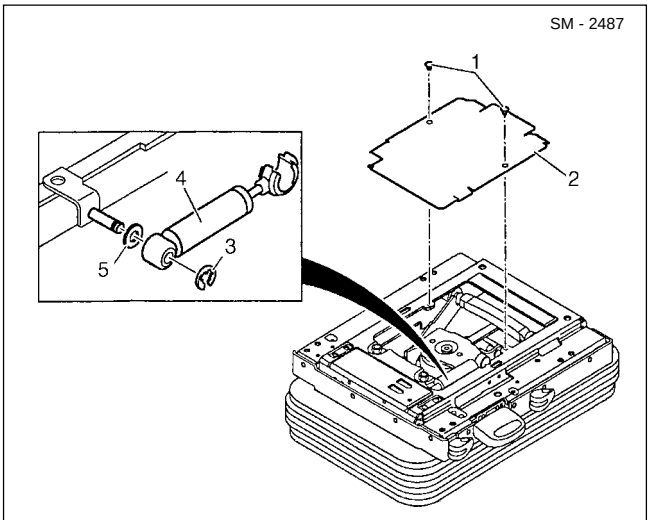


Fig. 2 - Exploded View of Horizontal Shock Absorber

Vertical Shock Absorber

Numbers in parentheses refer to Fig. 3.

Note: Remove seat assembly as described in 'Disassembly'

1. Remove pop-out buttons (1) and remove access cover (2) to allow access to suspension assembly.

2. Unhook Bowden wire (5) and damper adjuster (6) assembly from the top of shock absorber (7).

3. Remove circlips (3) and lever out shock absorber (7) from mounting pins (4).

4. Remove spacers (8) from lower mounting pin (4).

5. Reassembly is done in the reverse order.

Note: Inscription must face upwards when assembling shock absorber (7).

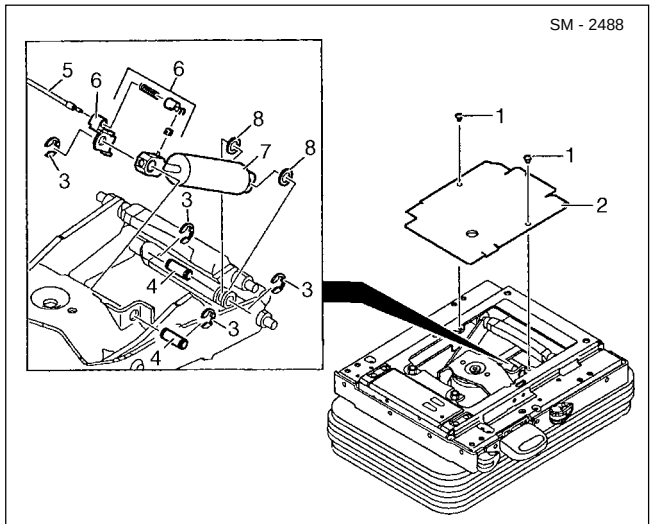


Fig. 3 - Exploded View of Vertical Shock Absorber

Compressor

Numbers in parentheses refer to Fig. 4.

Note: Remove seat assembly as described in 'Disassembly'

1. Remove pop-out buttons (1) and remove access cover (2) to allow access to suspension assembly.

2. Remove pop-out buttons (3) and push down suspension skirt (4) to allow further access to suspension assembly.

3. Remove pressurised airline (5) from compressor (6).

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4. Identify and tag and disconnect electrical plug connections (7 & 8). Unfasten cable tie on the rocker.

5. Pull suspension assembly up to its highest position and block securely.

6. Unscrew lower nut (9) and remove micro encapsulated cylinder screw (10) and retaining clamp (11).

7. Remove compressor (6) and felt mat (12) from suspension base.

8. Reassembly is done in the reverse order.

Note: Replace micro encapsulated cylinder screw (10).

Note: Centralise compressor (6) and felt mat (12) between rocker arms.

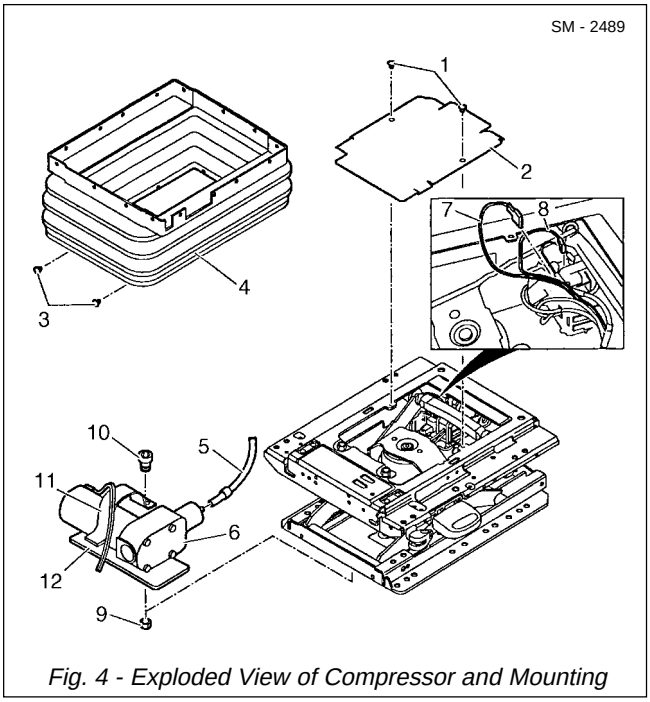


Fig. 4 - Exploded View of Compressor and Mounting

Level Controller

Numbers in parentheses refer to Fig. 5.

Note: Remove seat assembly as described in 'Disassembly'

1. Remove pop-out buttons (1) and remove access cover (2) to allow access to suspension assembly.

2. Remove pop-out buttons (3) and push down suspension skirt (4) to allow further access to suspension assembly.

3. Pull suspension assembly up to its highest position and block securely.

4. Unhook bowden wires (5 & 6) from level controller (7).

5. Identify and tag and disconnect electrical plug connections (8 & 9).

6. Identify and tag and disconnect pressurised airlines (10) from air suspension unit (11). Unfasten cable tie on the rocker.

7. Remove screw (12), push out pin (13) and release roll up belt (17).

8. Remove nuts (14) and manoeuvre level controller (7) until studs are free from mounting holes.

9. Remove screws (15) and remove bowden wire (16) retainer from level controller (7).

10. Remove level controller (7) from suspension base.

11. Reassembly is done in the reverse order.

Note: Tighten nuts (14) to a torque of 25 Nm (18 lbf ft).

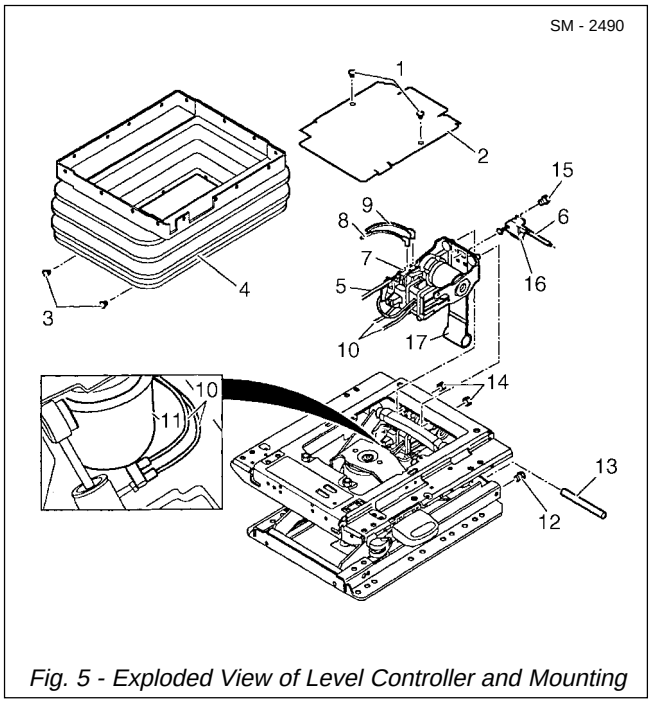


Fig. 5 - Exploded View of Level Controller and Mounting

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INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Inspect air lines, shock absorbers (15 & 26), compressor (21), level controller (28) and air spring (30) for leaks and damage and replace if required.

2. Check all brackets and frame for cracks and/or damage. Repair or replace as necessary.

3. Check springs for fatigue or damage and replace as required.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners without special torques specified to torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

1. Position seat assembly onto suspension base. Hold captive nuts using a suitable spanner and install rear allen screws (33). Tighten allen screws (33) to a torque of 25 Nm (18 lbf ft).

2. Pull up horizontal adjustment (B) lever and slide seat assembly rearwards. Hold captive nuts using a suitable spanner and install front allen screws (33). Tighten allen screws (33) to a torque of 25 Nm (18 lbf ft).

3. Install seat cushion (3) to seat frame (1) and secure using screws (4).

4. Install backrest cushion (2) to seat frame (1) and secure using screws (5).

5. Refit backrest (6) to seat frame (1).

6. Position lap belt (9) to seat assembly and secure using nuts (10) and spacers (11) as removed at 'Disassembly'. Tighten nuts (10) to a torque of 50 Nm (36 lbf ft). Refit covers (7 & 8).

7. Position seat assembly onto seat base (34) and secure using bolts (37), washers (38), lockwashers (39) and nuts (40).

INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners without special torques specified to torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel chocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Using suitable lifting equipment, position seat assembly on the cab wall and secure with bolts (35) and washers (36).

2. Reconnect harness at the rear of the seat.

3. Place battery master switch in the 'On' position, start the engine and charge the air system. Check seat for proper operation, refer to 'Operation'.

4. Remove wheel chocks from road wheels.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

The care of the upholstery on seat cushion (3) and backrest cushion (2) is a relatively simple, but important matter. Accumulation of dirt on the surface eventually turns into a hard gritty substance which cuts into the surface of the upholstery.

To clean seat cushion (3) and backrest cushion (2), use warm water and a mild soap, such as Castile. Work up thin soap suds on a piece of soft cloth and rub the upholstery briskly. Remove the suds with a damp cloth, using no soap, and finish by wiping the upholstery dry with a soft, dry cloth.

Lap belt (9) assembly should be inspected by the user on a regular basis. Replace lap belt (9) immediately if hardware is worn or damage, straps are nicked or frayed, buckle is not functioning correctly, loose stitching is found, or if the strap material has lost strength due to the effects of ultraviolet rays.

Note: Regardless of appearance, lap belt (9) must be removed and replaced at least once every three years.

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Operator's Compartment - Driver Seat and Mounting

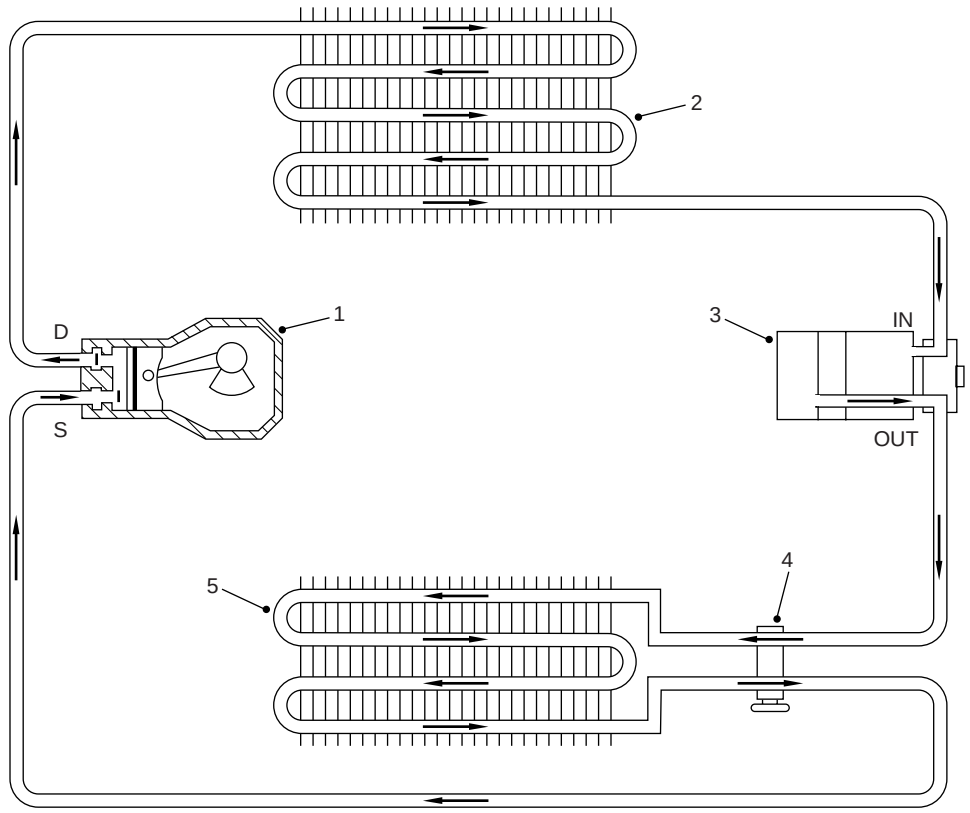
Section 260-0090

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	10	Nut	50	36
1	33	Allen Screw	25	18
5	14	Nut	25	18

* * * *

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1 - Compressor
2 - Condenser
3 - Receiver Drier
4 - Expansion Valve
5 - Evaporator

Fig. 1 - Typical Air Conditioning Flow Diagram

DESCRIPTION

Temperature Control Switch

A thermostat switch senses the temperature of the evaporator and engages or disengages the compressor clutch. The control for this switch is located in the cab.

Compressor

The compressor is designed to compress vapour and can be damaged by non-compressibles such as dirt, moisture, liquid refrigerant (R-134a), etc. The compressor draws vaporized R-134a from the evaporator (which maintains the low pressure necessary for proper evaporation) and compresses the vapour to a high pressure, which is necessary for condensation. The high pressure vapour then moves into the condenser where heat can be radiated to change the R-134a back to liquid.

Note: R-134a designates the type of refrigerant used in heavy duty vehicle air conditioning systems.

Compressor Drive Clutch

The R-134a compressor systems use an electronically actuated clutch to engage and disengage drive to the compressor. The 'V' belt pulley is mounted on a bearing and is free to rotate without turning the compressor crankshaft any time electrical power is disconnected. The compressor is not operating when the pulley is freewheeling. The field coil is energized by supplying electrical current to the exposed wire. The other end of the coil winding is grounded to the compressor and equipment frame. Energizing the coil creates a magnetic force that locks the driven disk to the pulley and drives the compressor.

Condenser

The purpose of the condenser is to radiate enough heat energy from the compressed high pressure vaporized R-134a so that the R-134a changes from vapour to liquid. During normal operation all the high pressure section of the system will be warm or hot, but large quantities of heat should be radiating from the condenser. Nothing should be permitted to stop or

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slow down this radiation of heat. Cooling fins are located on the condenser tubes and fans are used to circulate cool air around the condenser tubes. Keep all leaves, paper, dirt, etc. clear from the condenser and condenser filter. The cooling fins should be straight to permit free flow of air. The condenser is sometimes located ahead of the engine radiator and blockage of air flow through the radiator also affects the condenser. Bent fan blades, slipping fan drive, inoperable condenser fan motors, or any other fault that lessens the amount of cool air circulated through the condenser, should be corrected. The oil, dirt, or antifreeze will act as an insulator that will inhibit the radiation of heat.

Since the purpose of the condenser is to radiate heat energy, anything that prevents or inhibits this action may affect cooling, but the temperature and pressure of the R-134a raise and lower together. Heat energy that has not been radiated will remain in the R-134a and the result will be pressure that is too high. The condenser, hoses, connections and seals can be damaged by the high pressure. Pressure sensing safety switches may be activated by the high pressure caused by the condenser not radiating enough heat.

Receiver Drier

The high pressure liquid R-134a moves from the condenser to the receiver drier, where the R-134a is stored and filtered. Moisture is the major enemy of the air conditioning system and the desiccant inside the receiver drier will absorb only a small amount. The container of desiccant inside the receiver drier may break open and contaminate the system if any attempt is made to dry the desiccant, or, if more moisture is inside the system than the desiccant can absorb.

Every effort should be made to remove all moisture from the system and install a new receiver drier if its condition is questionable. Installation of a new receiver drier is recommended each time any part of the R-134a system is open to the atmosphere. Bubbles are observed in the sight glass on top of the receiver drier during the charging procedure.

A filter screen is located in the receiver drier to stop solid contaminates from leaving the unit. Blockage of the filter will result in a drop in pressure that will be indicated by a drop in temperature. Connections of the new receiver drier should be securely capped before installation to prevent the entrance of moisture (air) while in storage.

Thermostatic Expansion Valve

An expansion valve is installed in the system to lower the pressure before the R-134a enters the evaporator. The reduction in pressure is done by passing the R-134a through a small hole (orifice). The size of the orifice must be controlled to compensate for changes in pressure and temperature. The temperature of R-134a leaving the evaporator is sensed by a thermostatic sensor that moves the valve seat via a diaphragm and actuating pin.

Evaporator - Heat/Cool

The evaporator is the low pressure, low temperature component where liquid R-134a absorbs heat from surrounding air. The expansion valve bleeds high pressure R-134a into the low pressure evaporator. The R-134a expands rapidly in the evaporator and its temperature is quickly reduced. The R-134a absorbs heat from the air when the blower fan circulates air over the evaporator coil fins. The exchange of heat from the air to the R-134a depends upon the difference in temperature. During high heat load, such as usually encountered when the system is first turned on, the temperature difference is great and the R-134a will absorb heat quickly. The blower fan can be set at its highest setting to circulate large quantities of warm air around the evaporator. After the cab has cooled, the fan speed should be reduced so that the already cool air will have a longer time to yield heat to the R-134a as it passes the evaporator coils. The heater circuits utilize engine coolant at approximately 82° C (180° F).

High Pressure and Low Pressure Switches

The pressure switches are electric switches that monitor air conditioner operation. The high pressure and low pressure switches are activated at preset pressures and engage and disengage the compressor clutch.

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REMOVAL

Numbers in parentheses refer to Fig. 2, unless otherwise stated.

⚠ WARNINGS

Always wear goggles or glasses to protect your eyes when working around R-134a. R-134a boils at sea level temperatures of -29.8° C (-21.6° F), which means that direct contact with your skin will produce frostbite. Exercise extreme care when handling R-134a.

⚠ If you get the slightest trace of R-134a in your eye, flood the eye immediately with cool water; then treat with mineral oil or clear petroleum jelly followed by boric acid rinse. Report to a hospital or doctor as soon as possible.

⚠ The chemicals of R-134a change when burned and become a poison phosgene gas that will damage the respiratory system if inhaled. NEVER SMOKE in an area where R-134a is used or stored. Use hot water or an approved heated charge cylinder as a heat source if required to force R-134a into the system. If using water, do not exceed 52° C (125° F). Never use direct flame or electric heaters in direct contact with the R-134a container. High temperatures may result in raising the pressure to a dangerous level.

⚠ To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Pull on handle (inside cab) to release hood catch and raise the hood.

4. Discharge the air conditioning system as described under 'Discharging The System'.

5. Remove screws (2) and lockwashers (3) securing cover on air conditioner (1) outer box to gain access to refrigerent hosing.

6. When satisfied that the system is completely discharged, tag refrigerant hoses (5 & 6) to aid in installation and carefully disconnect hoses from air conditioner (1). Cap air conditioner (1) fittings and refrigerant hoses (5 & 6) to prevent foreign matter from entering the system.

7. Remove bolts (47, Fig. 3) and lockwashers (48, Fig. 3) securing front cover and filter assemblies on air conditioner (1) outer box.

8. Disconnect harness (4, Fig. 3) and unhook control cable (49, Fig. 3) from water valve (50, Fig. 3).

9. Remove bolts (42, Fig. 3), lockwashers (43, Fig. 3) and washers (44, Fig. 3) securing air conditioner (1) outer box to cab assembly and withdraw box.

10. Tag refrigerant hoses (5 & 9) to aid in installation and carefully disconnect hoses from receiver/drier (16). Cap receiver/drier (16) fittings and refrigerant hoses (5 & 9) to prevent foreign matter from entering the system.

11. Support receiver/drier (16) and remove bolts (38) and nuts (39) securing receiver/drier (16) to mounting bracket (17). If necessary, remove bolts (21), lockwashers (22), nuts (25) and mounting bracket (17) from bracket (20).

12. Tag refrigerant hoses (7, 8, 9 & 10) to aid in installation and carefully disconnect hoses at radiator cowl and condenser (11). Cap condenser (11) fittings and refrigerant hoses to prevent ingress of foreign matter.

13. If required, support air conditioner condenser (11) and remove bolts (13), lockwashers (14) and washers (15) securing condenser (11) to radiator assembly. Remove condenser (11) from vehicle.

14. Tag refrigerant hoses (6 & 7) to aid in installation and carefully disconnect hoses from compressor (12). Cap compressor (12) fittings and refrigerant hoses (6 & 7) to prevent foreign matter from entering the system.

15. Disconnect electrical connection from compressor (12) clutch.

16. Slacken nut (26) and bolt (24). Adjust bolt (24) to release tension on 'V' belt (18).

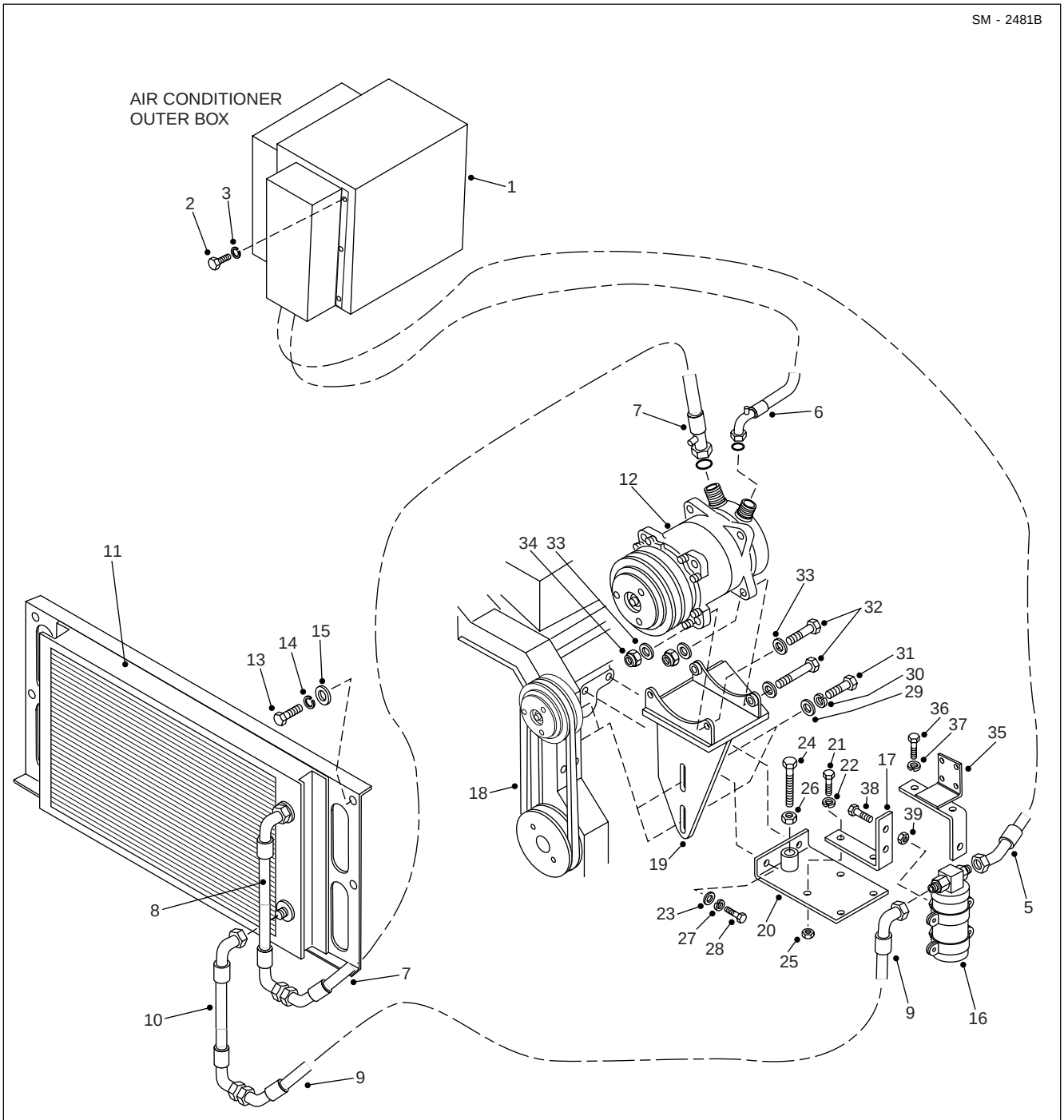
17. 'V' belt (18) should now be free to slide off the groove in compressor (12).

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Operators Compartment - Air Conditioning

Section 260-0130



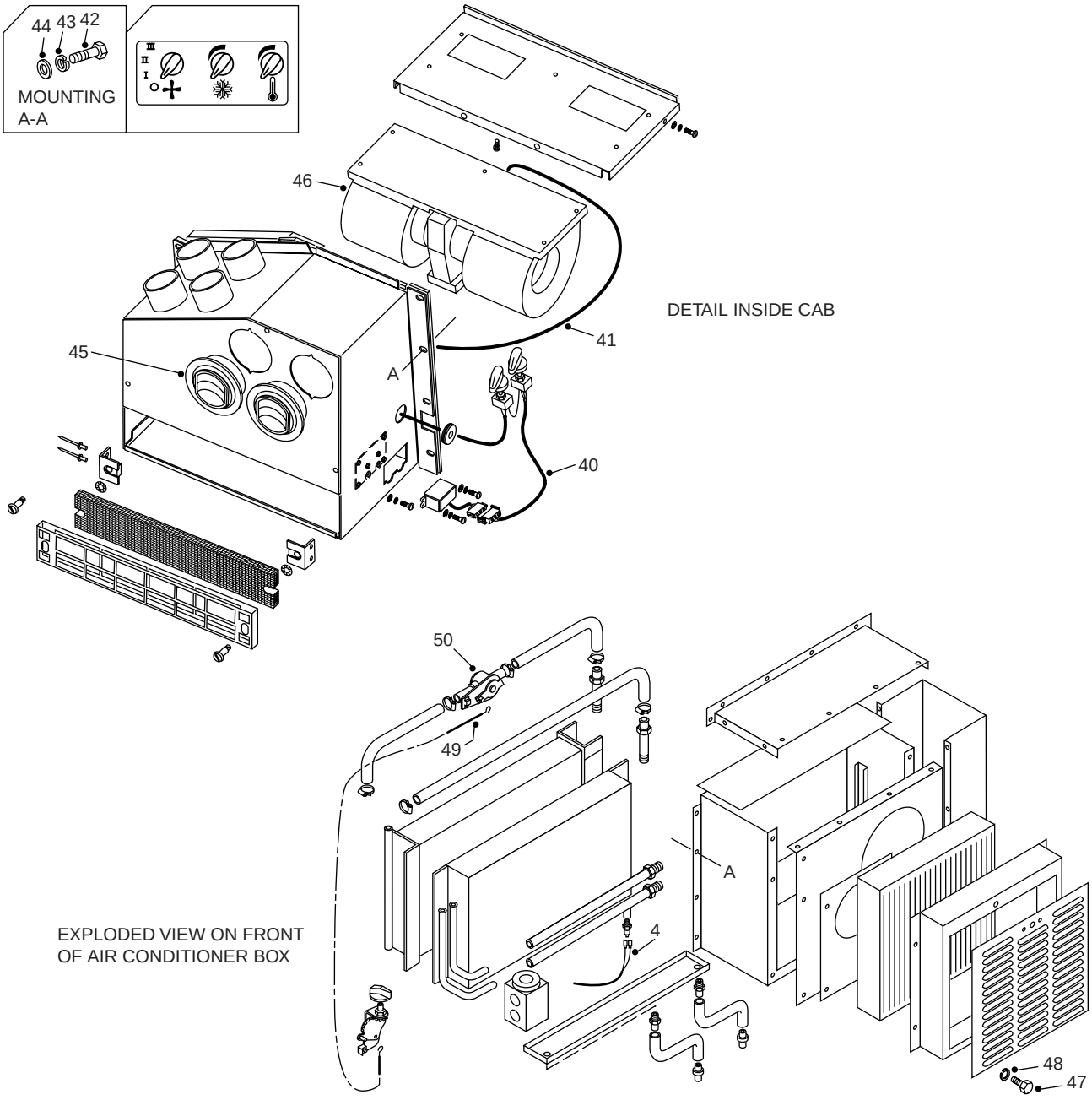
1 - Air Conditioner
2 - Screw
3 - Lockwasher
5 - Refrigerant Hose
6 - Refrigerant Hose
7 - Refrigerant Hose
8 - Refrigerant Hose
9 - Refrigerant Hose
10 - Refrigerant Hose
11 - Condenser
12 - Compressor
13 - Bolt
14 - Lockwasher
15 - Washer
16 - Receiver/Drier
17 - Bracket
18 - 'V' Belt
19 - Bracket
20 - Adjuster Bracket
21 - Bolt
22 - Lockwasher
23 - Washer
24 - Bolt
25 - Nut
26 - Nut
27 - Lockwasher
28 - Bolt
29 - Washer
30 - Lockwasher
31 - Bolt
32 - Bolt
33 - Washer
34 - Locknut
35 - Bracket
36 - Bolt
37 - Lockwasher
38 - Bolt
39 - Nut

Fig. 2 - Air Conditioner Lines and Mounting

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SM - 2481A



4 - Harness
40 - Harness
41 - Harness
42 - Bolt
43 - Lockwasher
44 - Washer
45 - Cover
46 - Blower Unit
47 - Bolt
48 - Lockwasher
49 - Control Cable
50 - Water Valve

Fig. 3 - Air Conditioner Lines and Mounting

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18. Support compressor (12) and remove bolts (32), washers (33) and locknuts (34) securing compressor (12) to bracket (19). Remove compressor (12) from the vehicle.

Note: If 'V' belt (18) does not require replacement do not remove from engine fan pulley. If 'V' belt (18) requires replacement, proceed with steps 19 and 20.

19. If required, remove mounting hardware securing fan guard assembly to radiator shroud assembly. Refer to SECTION 210-0040, RADIATOR AND MOUNTING.

20. Release tension on Poly 'V' fan belt and remove from fan pulley. Remove compressor 'V' belt (18) from the rear groove of the fan pulley. Refer to Section 110-0030, ENGINE AND MOUNTING.

21. If required, remove bolts (31), lockwashers (30), washers (29) and bracket (19) from engine.

22. If required, disconnect all clamps and clips securing refrigerant hoses and harnesses to the vehicle. Remove hoses and harnesses from the vehicle.

23. If necessary to gain access to blower unit (46, Fig. 3), disconnect harnesses (40 & 41, Fig. 3) and air ducting tubes from air conditioning unit (located in the right hand side of the cab). Remove bolts (42, Fig. 3), lockwashers (43, Fig. 3), washers (44, Fig. 3) and slide cover (45, Fig. 3) from air conditioning unit.

INSTALLATION

Numbers in parentheses refer to Fig. 2, unless otherwise stated.

Note: Tighten all fasteners to standard torques specified in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

⚠ WARNING
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. If removed, connect harnesses (40 & 41, Fig. 3) and air ducting tubes. Slide air conditioner cover (45, Fig. 3) into position inside the cab and secure cover (45, Fig. 3) with bolts (42, Fig. 3), lockwashers (43, Fig. 3) and washers (44, Fig. 3)

2. Connect harness (4, Fig. 3) and attach control cable (49, Fig. 3) to water valve (50, Fig. 3).

3. Position front cover and filter assemblies on air conditioner (1) outer box and secure using bolts (47, Fig. 3) and lockwashers (48, Fig. 3).

4. Remove caps from end of refrigerant hoses (5 & 6) and ports on air conditioner (1) and connect hoses to ports as tagged at removal.

5. Route refrigerant hoses (5 & 6) behind the engine and along the LH side of the engine securing with clamps removed during removal.

6. If removed, install receiver/drier (16) to mounting bracket (17) and secure with bolts (38) and nuts (39). Secure assembly to bracket assembly (20) with bolts (21), lockwashers (22) and nuts (25).

7. Remove caps from end of refrigerant hoses (5 & 9) and ports on receiver/drier (16) and connect hoses to ports as tagged at removal.

8. If removed, install condenser unit (11) to radiator assembly and secure with bolts (13), washers (15) and lockwashers (14).

9. Remove caps and connect refridgerant hoses (7, 8, 9 & 10) to radiator cowl and condenser unit (11) ports as tagged at removal.

10. If removed, install mounting bracket (19) to engine and secure using bolts (31), washers (29) and lockwashers (30) as shown in Fig. 2.

11. Fit compressor (12) to mounting bracket (19) and secure with bolts (32), washers (33) and locknuts (34). Do not fully tighten at this stage.

Note: If fan guard, Poly 'V' fan belt and compressor 'V' belt (18) were removed, proceed with steps 12 & 13.

12. Install new 'V' belt (18) onto rear groove on engine fan pulley and fit to rear groove on compressor (12).

13. Refit Poly 'V' fan belt and adjust tension. Refer to Section 110-0030, ENGINE AND MOUNTING. Refit fan guard and secure with mounting hardware as removed during removal. Refer to Section 210-0040, RADIATOR AND MOUNTING.

14. Adjust tension of compressor 'V' belt with nuts (26) on adjuster bolt (24) until there is approximately an inward deflection of 10 mm (0.4 in) at the centre of 'V' belt (18). Fully tighten all mounting hardware.

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15. Remove caps from end of refrigerant hoses (6 & 7) and ports on compressor (12) and connect hoses to ports as tagged at removal.

16. Connect electrical connection to compressor (12) clutch.

17. Secure all lines with clips and clamps as removed during removal. Ensure no lines are chaffing on sharp edges or resting against areas where heat will be evident.

18. Charge the air conditioning system as described under 'Charging Procedure'.

19. Switch the battery master switch to the 'On' position, start up the engine and check for correct operation of the air conditioning system.

20. Secure cover to air conditioner (1) outer box using screws (2) and lockwashers (3). Lower hood assembly and remove wheel chocks.

MAINTENANCE

⚠ WARNINGS
Always wear goggles or glasses to protect your eyes when working around R-134a. R-134a boils at sea level temperatures of -29.8° C (-21.6° F), which means that direct contact with your skin will produce frostbite. Exercise extreme care when handling R-134a.

⚠ If you get the slightest trace of R-134a in your eye, flood the eye immediately with cool water; then treat with mineral oil or clear petroleum jelly followed by boric acid rinse. Report to a hospital or doctor as soon as possible.

⚠ The chemicals of R-134a change when burned and become a poison phosgene gas that will damage the respiratory system if inhaled. NEVER SMOKE in an area where R-134a is used or stored. Use hot water or an approved heated charge cylinder as a heat source if required to force R-134a into the system. If using water, do not exceed 52° C (125° F). Never use direct flame or electric heaters in direct contact with the R-134a container. High temperatures may result in raising the pressure to a dangerous level.

1. Periodically clean the condenser coil of debris and dirt using water or air pressure. A partially blocked condenser coil can reduce the life of the compressor belt and/or clutch.

2. If the system has a heater in the same location as the air conditioning evaporator core, heater valves should be closed.

3. To check the refrigerant level, run the engine at 1 200 rev/min with fans on high speed and thermostat fully open for a minimum of five minutes. If the clutch is engaged in this situation, there should be very few bubbles visible in the receiver-drier sight glass.

Note: Unit can operate with some bubbles visible, but not milky looking.

4. Ensure all hoses and hose clamps are free from contact with sharp metal, moving parts or near to manifolds.

5. Inspect condensation drain lines for debris, sharp bends or breaks.

6. Inspect the clutch wire from the thermostat for bare spots.

7. Inspect bolts and nuts on the compressor and mounting bracket for proper tightness.

8. Inspect and clean outside and inside cab air filters periodically, depending on dust conditions. Replace the outside filter when it becomes saturated to the point it won't come clean.

Maintenance of 'V' belt Drives

1. Listen for 'ticking' sound - they mean interference with the belts. Visually inspect for bent or damaged belt guards.

2. Replace all belts in a mismatched set at one time to ensure even load distribution.

3. Periodically check tension and keep belts tight.

- The ideal tension is the lowest tension at which the belt will not slip under peak load conditions.
- Check belt tension frequently during the first 24 - 48 hours of run-in operation.
- Initial belt tension should be 445 N (100 lbf) dropping to 334 N (75 lbf) after the first 48 hours.
- There should be a freeplay of 10 mm in the 'V' belt.

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- Do not over tension belts.
- Keep belts free from foreign material that may cause slippage.
- Inspect the V-drive periodically. Re-tension belts if they are slipping.
- Maintain sheave alignment with a strong straight edge tool while tensioning belts.

4. Never attempt to correct belt slippage by using a belt dressing. The dressing may cause softening and deterioration.

5. If belt slips, even when properly tensioned, check for overload, worn sheave grooves or oil or grease on the belts.

6. Never pry a 'V' belt or force it into the sheave groove. Loosen the 'V' belt tightener prior to installation.

7. A belt that has operated while rolled over in the sheave groove may be damaged - replace it.

8. Store belts in a cool, dry place. If stored on a machine, relieve all belt tension by loosening the 'V' belt tightener.

9. Never attempt to check or adjust belts while they are running.

Refrigerant Oil

⚠ WARNINGS
To prevent personal injury always wear rubber gloves when handling refrigerant oils.

⚠ Too much refrigerant oil will dampen the cooling effect and too little refrigerant oil may lead to compressor failure. If in doubt flush the system.

Oil is required to lubricate the compressor. The oil mixes with the refrigerant and is carried around the system. The compressor is supplied with an oil charge. However, additional oil is required, the amount depending on the length of refrigerant hose being used. The quantity added should be calculated using the following equation:

Amount of oil to add in fl oz. =
(0.47 x total length of hoses in m) - 2.15

If any component is replaced the following amount of oil should be added to the system;

Condenser	add 1 fl oz (28.4 ml)
Drier	add 1 fl oz (28.4 ml)
Evaporator	add 3 fl oz (85.2 ml)
Compressor	add 4.4 fl oz (125 ml)

The oil should be added to the oil filling port of the compressor before the evacuation procedure is started or by using an oil injector when the system is being charged, observing the following good practises:

a. Only pour the amount required from the container straight into a CLEAN measuring jug and immediately pour the oil into the compressor.
b. Re-cap container tightly as soon as the required amount has been taken (never leave an oil container open).
c. Do not mix different oils.

Only new oil should be used, because oil that has been exposed to the air will have absorbed water (hygroscopic).

Use only refrigerant oil as specified in Section 300-0020, LUBRICATION SYSTEM.

System Leak Testing

Recommended Equipment Required:
Electronic Leak Detector

Switch off the engine and check all connections throughout the system for leaks. A large leak point will have an oily or greasy appearance. The refrigerant carries compressor oil with it and deposits it around the leak area. Check all such points for loose connections and tighten.

Using a suitable leak detector, search for leaks around all joints, connections, seals and control devices. If a leak is located, purge the system of refrigerant and repair. Fully evacuate and charge the system to make it operational.

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DISCHARGING THE SYSTEM

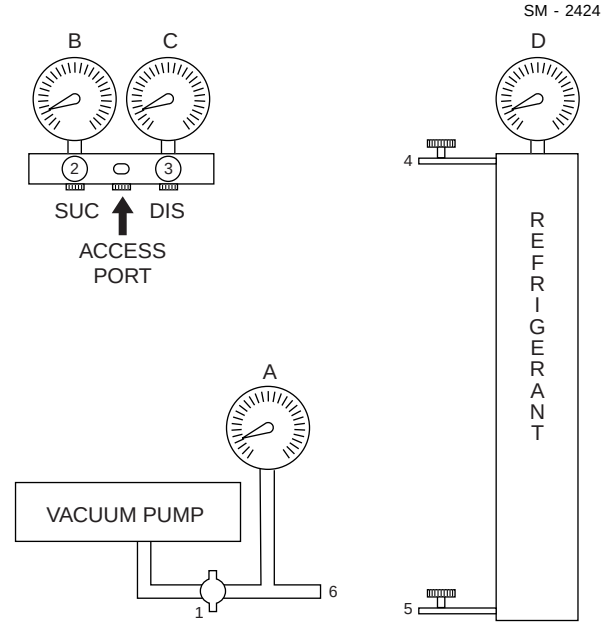
Note: Refer to all WARNINGS listed under 'Maintenance' prior to discharging the system.

Recommended Equipment Required:
Portable High Vacuum Charging Station
Suitable Canister
or Standard Service Manifold (Refer to Fig. 4)

To eliminate system contaminants from an air conditioning system requires discharging the entire system. This means removing all of the refrigerant and cleansing all contamination (air and moisture) from the system components. If any of the major system components are to be repaired or replaced, the system must also be completely discharged.

⚠ WARNING
The vehicle must not be running during this procedure. Be sure to have adequate ventilation during this operation. Do not discharge refrigerant near an open flame.

Numbers and letters in parentheses refer to Fig. 4.



Gauges:
- A - Vacuum Gauge
- B - Low Pressure Gauge
- C - High Pressure Gauge
- D - Charging Cylinder Pressure Gauge

Valves:
- 1 - Vacuum Pressure
- 2 - Suction Line
- 3 - Discharge Line
- 4 - Refrigerant Gas
- 5 - Refrigerant Liquid

Port:
- 6 - Vacuum Connection

Fig. 4 - Standard Service Manifold

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.

2. Block all road wheels and place the battery master switch in the 'Off' position.

3. Pull on handle to release hood catch and raise the hood.

4. Connect the service hose (yellow) to the centre access port on the manifold gauge and to the vacuum connection (6) on vacuum pump. Ensure that the system is empty before connecting the vacuum so that refrigerant does not enter the pump.

5. Tighten down (turn clockwise) both high and low side valves on the gauge manifold to the closed position. Remove protective caps from the service ports on the compressor.

6. Connect both service hoses from the two fittings (2 & 3) in the bottom of the manifold to the two service ports on the compressor. High side (red) to compressor discharge valve, low side (blue) to compressor suction valve.

7. Switch vacuum pump on, open vacuum pressure valve (1) until less than 6 mb is reached on vacuum gauge (A). The vacuum gauge (A) should remain at this value when vacuum pressure valve (1) is closed to indicate that there are no leaks.

8. Open the low side hand valve on the manifold and vacuum pressure valve (1) and watch that the gauges start to register that a vacuum is being drawn. If the gauges do not register the vacuum thena blockage is present. Open the high side and pump down until a vacuum of 10 mb is achieved.

9. After 10 - 15 minutes close vacuum pressure valve (1) and allow the system to settle, vacuum gauge (A) should not alter. If the vacuum is held, no leaks or refrigerant contaminated oil is present. If not, open the vacuum pressure valve (1) and continue pumping, checking at regular intervals. If there is a leak, check all fittings and tighten if necessary.

10. Tighten down (turn clockwise) both high and low side valves on the gauge manifold to the closed position, remove the service hose (yellow) from the vacuum connection (6) on vacuum pump and switch the pump 'Off'.

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11. Connect the service hose (yellow) to the R-134a cylinder. Open the cylinder valve and then purge air from the hose at the manifold connection.

12. Open the low side hand valve on the manifold slowly, until low pressure gauge (B) is at bottle pressure. Watch the high side manifold gauge (C) rise to ensure that no blockage is present. Close the manifold valve and cylinder, then disconnect the hose from the cylinder.

13. Connect the service hose (yellow) to the Nitrogen cylinder. Open the neck valve on the cylinder and set the regulator pressure such that it is higher than the system pressure then purge the hose. Open the low side hand valve on the manifold, as the pressure rises open the high side hand valve on the manifold and allow a system pressure of 10 bar (150 psig) to be reached. Close all the valves. Using a suitable electronic leak detector, check all joints in the air conditioning system for leaks. Tighten any loose joints and re-test if necessary.

14. Vent the refrigerant mix to atmosphere by removing the service hose (yellow) from the Nitrogen cylinder and opening the low side hand valve on the manifold. Re-evacuate the system to below 6 mb (steps 7 to 10).

15. Lower hood assembly and remove wheel blocks.

CHARGING THE SYSTEM

Note: Refer to all WARNINGS listed under 'Maintenance' prior to charging the system.

Recommended Equipment Required:
Portable High Vacuum Charging Station
Electronic Leak Detector
or Standard Service Manifold (Refer to Fig. 4)

For New Or Completely Empty System

Note: The charging procedure must be done in ambient temperatures above 15.5° C (60° F) with the R-134a canister temperature equal to the outside ambient temperature.

1. Shut off engine and block all road wheels.

2. Pull on handle to release hood catch and raise the hood.

3. Remove protective caps from 'quick coupler' valves on rear of compressor.

4. Connect low pressure gauge hose (blue hose and gauge) to suction side or low side fitting on compressor. The suction side can be identified by the size of the hose connected to the fitting. This will be the largest diameter hose of the system.

5. Connect the high pressure gauge hose (red hose and gauge) to discharge or high side fitting on compressor.

6. Connect yellow supply hose to suction port on vacuum pump.

7. Open both sides of gauges, low and high, completely.

8. Start vacuum pump to evacuate the complete air conditioning system.

9. Run vacuum pump for approximately 30 minutes. Ideal gauge readings should be 29.92 inches of mercury. The pressure will vary with altitude; it will be approximately 0.03 bar (0.5 lbf/in²) less for each 305 m (1 000 ft) of elevation.

10. Before disconnecting power supply from vacuum pump, close both high and low side gauges. Remove yellow hose from vacuum pump and connect to R-134a source.

11. Open R-134a source. Loosen, but do not remove, yellow supply hose at manifold on gauges to remove all air in the yellow supply hose, replacing the air with R-134a. This is done in a few seconds. Tighten yellow supply hose.

12. Open low side of R-134a gauges slowly. When gauge reads zero open both sides completely. Vacuum in the system will draw R-134a gas into the system. Hold until both gauge readings equalize.

Note: Never charge with liquid R-134a. Charge on the low pressure side only.

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Final Charging Of The System

1. Start the engine and run at engine idle speed.

2. Turn the air conditioning system on with the thermostat set on maximum cooling and fan on high speed.

3. At this point a visual inspection must be made of the sight glass on top of the receiver-drier. As charging continues, the sight glass will appear milky coloured as the bubbles in the system circulate. As the system continues the charging process, the regularity of the bubbles in the sight glass will gradually diminish. When no bubbles are seen in the sight glass, close the low pressure valve (blue side) completely.

4. Increase the engine idle speed while observing the sight glass. If many bubbles are seen resulting from the increased engine speed, open the low pressure side valve. Allow the system to continue the charging procedure until the sight glass is clear. If the sight glass remains clear, with the increased engine speed, do not add any more R-134a.

Note: Occasionally bubbles are noticed during clutch cycling or system start-up. This is a normal condition.

5. With the system completely charged, shut off the engine. Close the valve on the R-134a canister and remove the yellow supply hose. Remove both the low pressure (blue) hose and high pressure (red) hose from the filling ports on the compressor.

Note: Some R-134a will escape as the hoses are being removed.

The system is completely charged when;

a. the sight glass is free from bubbles.
b. the suction pressure on the gauge is approx. 20 - 30 psig at 25° C ambient.
c. the correct weight of refrigerant has been added (3.75 lbs.)
d. the correct superheat can be measured at the evaporator, approx. 3 - 6° C.
e. the correct sub-cooling can be measured at the condenser, approx. 5 - 7° C.

6. Replace protective caps on hoses and valve fittings.

7. Lower hood assembly and remove wheel blocks.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of special tools referenced in this section and general service tools and sealants required. These tools and sealants are available from your dealer.

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Operators Compartment - Air Conditioning

Section 260-0130

AIR CONDITIONING DIAGNOSIS		
CONDITION	PROBLEM	REMEDY
1. Belt Trouble		
Slipping	Loose	Adjust belt to 12 mm (0.5 in) depression
	Overcharge	Correct the charge
	Air in system	Evacuate and re-charge
Excessive wear	Pulley not aligned	Align pulley
	Belt too tight	Adjust or replace
	Bad idler bearing	Replace idler bearing
	Belt wrong width	Replace with correct belt
2. Vibration/Noise in Compressor area		
Vibration/noise	Stuck compressor or clutch	Replace
Vibration	Overcharge	Correct the charge
	Air in system	Evacuate system and re-charge
	Compressor mounting or belts loose	Tighten
	Drive pulley loose	Tighten
	Belt tension incorrect	Correct tension
	Faulty compressor	Replace compressor
Noise with clutch engaged	Faulty clutch bearing	Replace bearing
Noise with clutch engaged or disengaged	Clutch loose	Tighten
Noise	Clutch rubbing field coil	Align clutch
	Faulty belt	Replace belt
	Compressor oil level low	Add oil
Chatter/Knock	Valve plate broken	Repair or replace

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AIR CONDITIONING DIAGNOSIS (CONTINUED)		
CONDITION	PROBLEM	REMEDY
3. Noise - Evaporator		
Rubbing/scraping	Fan blade or blower	Repair or replace
Hissing	Low charge/leak	Correct charge/repair leak
Chatter/Knocking	Expansion valve	Replace
Noisy case	Loose brackets/screws	Tighten
Motor squeal	Dry bearings	Replace
4. Air Conditioning Inadequate After Short Period Of Operation		
Cooling quits	Loss of refrigerant	Charge system/check for leaks
	Moisture in system	Replace drier
	Thermostat	Replace thermostat
	Clutch	Check pull-in of clutch or replace
Cooling intermittent	Moisture in system	Replace drier
5. Electrical Trouble		
Blower motor or condenser fan motor inoperable	Defective circuit breaker or bad wiring connections	Replace. Clean and tighten connections
	Tight motor bearing	Repair or replace motor
	Switch open or shorted	Repair or replace switch
Slow running blower	Shaft binding	Replace motor - worn bearings
	Wheel misaligned	Replace
	Bad blower switch	Replace blower
	Insufficient current	Install larger alternator
Clutch inoperable	Defective circuit breaker	Replace
	Loose connection	Clean and tighten connection
	Broken wire - ground	Repair wire
	Shorted or open field	Replace field

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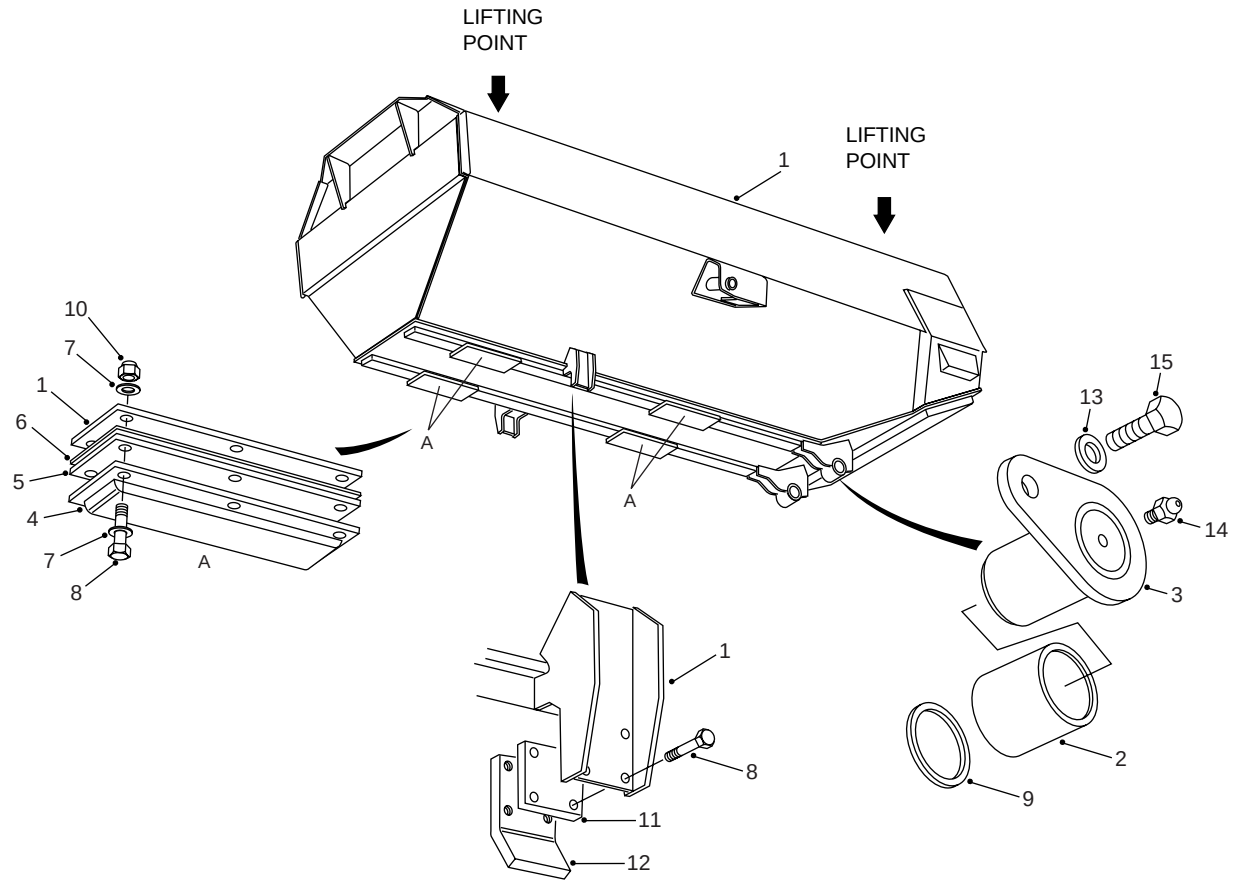
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AIR CONDITIONING DIAGNOSIS (CONTINUED)		
CONDITION	PROBLEM	REMEDY
6. Air Conditioning System Trouble - Gauges must be connected		
High head pressure	Overcharge of refrigerant	Purge system as necessary
	Air in system	Evacuate and re-charge
	Condenser clogged	Clean condenser
Low head pressure	Undercharge of refrigerant	Complete charge
	Bad compressor valve plate or gasket	Repair or replace
	Restriction in drier	Replace drier
Low suction pressure	Restriction in lines	Clean lines
	Restriction in expansion valve	Replace expansion valve and drier
	Improper expansion valve in charge	Replace expansion valve
	Refrigerant leak	Inspect lines and fittings. Tighten, repair or replace

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1 - Body
2 - Bushing
3 - Hinge Pin
4 - Body Pad
5 - Shim
6 - Shim
7 - Washer
8 - Bolt
9 - Shim
10 - Locknut
11 - Spacer
12 - Plate
13 - Washer
14 - Lube Fitting

Fig. 1 - Exploded View of Body and Mounting

DESCRIPTION

The standard body is an all welded construction with all wear plates fabricated from high hardness (min. 360 BHN) 1 000 MPa (145 000 lbf/in^2) yield strength steel. Angled lower body sides reduce body impacts when loading and a tailshute angle of 25° provides good retention when travelling without a tailgate. Refer to Section 000-0000, GENERAL INFORMATION for body capacities.

The body is pivoted at the rear of the trailer frame and is operated by two single stage, double acting hoist cylinders which are cushioned at both ends of the stroke to reduce impact shocks. The hoist cylinders raise the body to a tipping angle of 65° in 12 seconds and powerdown the body in 7.5 seconds.

OPERATION

The body control joystick, mounted on the right hand dash panel, controls the hydraulic control valve operation, by means of electrical signals to the pressure reducing valves, which in turn operates the body hoist cylinders. The four operating positions of the joystick from front to rear are as follows:

'FLOAT' - The joystick should be moved to this position while the body is lowering by gravity and should remain in this position until the body must be operated again. The control joystick should always be kept in 'FLOAT' while the machine is in motion.

'LOWER' - Pushing the joystick forward and holding it in this position provides hydraulic force to power-down the body. It is needed when the body cannot be

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started downward from the fully raised position by gravity. When the body starts lowering by gravity, the joystick can be released and internal valve springs will move the joystick to the 'HOLD' position.

'HOLD' - Moving the joystick to this position while the body is being raised or lowered traps the oil in the body hoists to stop and hold the body at any desired height. The joystick will remain in the 'HOLD' position when released.

'RAISE' - Pushing the joystick back and holding it in this position directs oil to extend the body hoists and raise the body. When released, the joystick will be spring-returned to the 'HOLD' position. the lever fully into the detented float position.

Note: The body control lever must remain in the 'FLOAT' position until it is necessary to operate the body again. Failure to comply to this could result in overheating the hydraulic oil and failure of the hydraulic system components.

Note: A proximity sensor prevents the body being fully powered down onto the chassis. At a predetermined height, the sensor automatically defaults the body control valve to the detented 'FLOAT' condition.

Note: If an electrical failure occurs, the body control valve will automatically default to the 'HOLD' condition. The cause of the electrical fault must be investigated and corrected.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNINGS
To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

⚠ Hydraulic fluid pressure will remain within the body hoist system after engine shutdown. To prevent personal injury and property damage, press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the system.

⚠ WARNING
Exercise extreme caution when lowering the cylinders from the body. The cylinders will swing out sharply as they leave their mountings.

1. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine.

2. Press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the body hoist system.

3. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

4. Remove upper pins securing the body cylinders to body (1) assembly and secure body cylinders clear of the body. Refer to Section 230-0130, BODY CYLINDER.

Note: Body lifting lugs can be fabricated as shown in Fig. 2.

5. Secure lifting lugs to body (1) using suitable bolts. Using appropriate lifting equipment, sling body (1) assembly at the four lifting points and take an initial strain.

Note: Approximate weight of body (1) assembly is 4 000 kg (8 820 lb).

6. Remove bolts (15) and washers (13) securing hinge pins (3) in place. Remove hinge pins (3) and shims (9) from body (1).

7. Remove body (1) assembly from the vehicle.

8. Remove bushing (2) from body hinge bores.

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INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, be sure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.**

1. Inspect bushing (2) for damage and replace if necessary. Install bushing (2) in body hinge bores.

Note: Body lifting lugs can be fabricated as shown in Fig. 2.

2. Secure lifting lugs to body (1) using suitable bolts. Using appropriate lifting equipment, sling body (1) assembly and position over the trailer frame.

Note: Approximate weight of body (1) assembly is 4 000 kg (8 820 lb).

3. Align hinge pin bores in body (1) assembly with bores in the trailer frame. Install hinge pins (3) and shims (9) and secure with bolts (15) and washers (17).

4. Secure body cylinders to body (1) assembly with pins and mounting hardware removed during removal. Refer to Section 230-0130, BODY CYLINDER for instructions.

5. Lubricate hinge pins (3) through lube fitting (14) with lubricant specified in Section 300-0020, LUBRICATION SYSTEM. Lubricate slowly until excess lube is seen.

6. Install body pads (4) and body guide plates (12) on body (1) assembly as described under 'Body Shimming Procedure'.

7. Remove lifting equipment from body (1) assembly and blocks from all road wheels.

8. Place the battery master switch in the 'On' position, start the engine and check for correct operation of body (1) assembly.

BODY SHIMMING PROCEDURE

Numbers in parentheses refer to Fig. 1.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: When it becomes necessary, body pads (4) should be replaced as a set to maintain load distribution along the frame. Existing body pads will have taken a compression 'set' and a new pad, shimmed to match existing pads, will not carry its share of the load, resulting in uneven load distribution along the frame.

1. Raise body (1) clear of the trailer frame and lay body pads (4) (metal face down) roughly in position on the frame.

2. Lower body (1) assembly onto body pads (4).

3. Centralise body (1) assembly to the frame and place shims (5 & 6) under the front two body pads (4) until all other pads are clear of body (1) assembly.

4. Slide shims (5 & 6) under remaining body pads (4) until they just make contact with body (1) assembly.

5. Raise body (1) assembly and install body pads (4) and shim packs (5 & 6) to their relative brackets on body (1) assembly securing with bolts (8), washers (7) and locknuts (10).

6. Lower body (1) assembly to the frame and check the shimming.

7. Install body guide plates (12) with spacers (11) to mounting brackets on body (1) assembly. Set gap between plates (12) and the frame at 5 - 10 mm (0.2 - 0.4 in). Secure plates (12) and spacers (11) to mounting brackets with bolts (8).

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MAINTENANCE

Lubricate the body hinge pins and body cylinder pins at the intervals stated and with lubricant specified in Section 300-0020, LUBRICATION SYSTEM. Lubricate slowly until excess lube is seen.

SPECIAL TOOLS

Special tools can be fabricated as shown in Fig. 2. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of the general service tools required. These tools are available from your dealer.

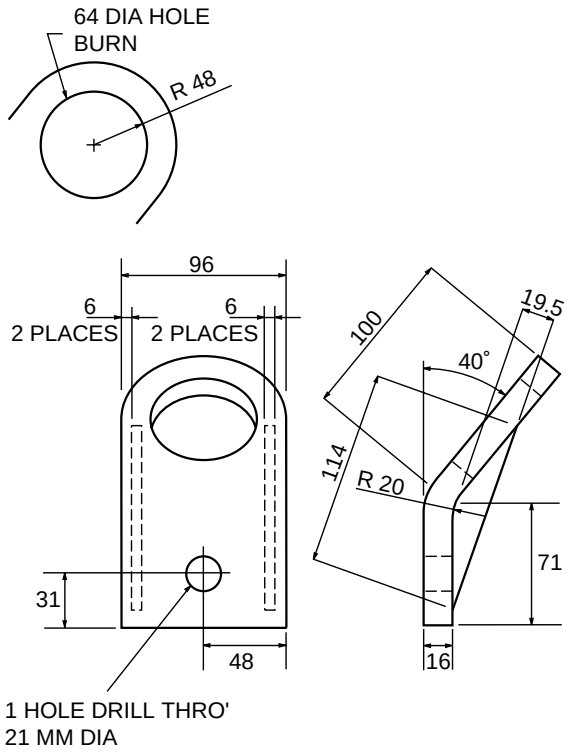


Fig. 2 - Body Lifting Lug

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⚠ SAFETY PRECAUTIONS

Do not allow unauthorized personnel to service or maintain this vehicle. Study the Operators Handbook and Maintenance Manual before starting, operating or servicing this vehicle. Always follow procedures and safety precautions detailed throughout this manual.

Always attach a DO NOT OPERATE or similar warning sign to the ignition switch or a prominent control before cleaning, lubricating or servicing the vehicle.

Never allow anyone to work on the vehicle while it is moving. Make sure there is no one on the vehicle before working on it.

Do not work under or near an unblocked or unsupported body. Always use the body prop. The body prop must only be used when the body is empty.

Always install the steering lock bar before making adjustments or servicing the vehicle with the engine running.

Do not work under or near any unblocked or unsupported linkage, part or vehicle.

Always relieve pressure before servicing any pressurized system. Follow the procedures and safety precautions detailed in the relevant Maintenance Manual section.

When changing oil in the engine, transmission and hydraulic system, or removing hydraulic lines, remember that the oil may be hot and can cause burns to unprotected skin.

When working on or around exhaust components, remember that the components may be hot and can cause burns to unprotected skin.

Always deflate the tyre before trying to remove any embedded objects or removing the tyre and rim assembly from the vehicle.

Always use a self-attaching chuck with a long airline, and stand to one side while inflating the tyre. Refer to Section 160-0050, WHEEL RIM AND TYRE.

LUBRICATION AND SERVICE

⚠ WARNING
These vehicles are equipped with engine and transmission oil pans which permit operation at maximum gradeability as designated in the 'Performance Data' section of the relevant Sales Specification Sheet.

Lubrication is an essential part of preventive maintenance. It is important that the instructions regarding lubricant specifications, and the frequency of their application, be followed to prolong the useful life of the vehicle. Periodic lubrication of moving parts reduces to a minimum the possibility of mechanical failures.

All change periods are recommendations based on average operating conditions. Lubricants showing evidence of excessive heat, oxidation or dirt should be changed more frequently to prevent these conditions.

Lubricant change and service periods must be established on the basis of individual job conditions utilizing oil sampling and recommendations from lubricant suppliers.

Thoroughly clean all fittings, caps, plugs etc., to prevent dirt from entering any system while carrying out servicing procedures. Lubricants must be at normal operating temperature when draining.

Note: Do not operate any system unless oil level is within the recommended operating levels as indicated on oil level dipstick, sight gauge or level plug.

Small circles on the following illustration represent points at which lubrication and/or servicing must take place, at the intervals indicated on the left hand side of the lubrication and service chart.

The numbered circles on the illustration contain reference numbers which correspond to the reference numbers in the 'Ref. Points' column of the lubrication and service chart.

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Miscellaneous - Lubrication System

Section 300-0020

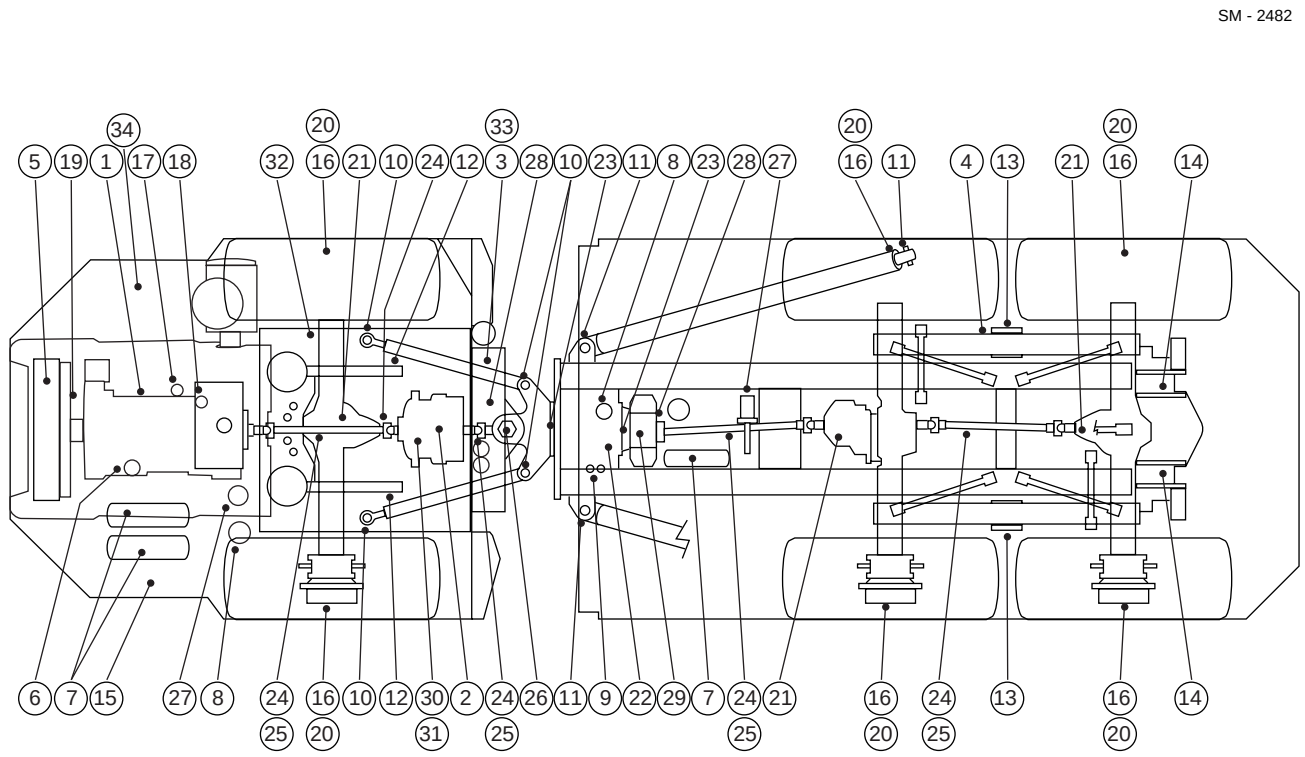


Fig. 1 - Lubrication and Servicing Points

LUBRICATION AND SERVICE CHART

Interval Hours	Ref. Points	Identification	Service Instructions	No. of Points	Lubricant	Service/Quantities
	1	Engine	Check oil level. Add if low.	1	EO	As Required
	2	Transmission	Check oil level. Add if low.	1	*	As Required
	3	Hydraulic Tank	Check oil level. Add if low.	1	HO	As Required
	-	Radiator Header Tank	Check coolant level. Add if low.	1	-	See Page 4
10	6	Fuel Filter/Water Separator	Drain.	1	-	-
(Daily)	7	Air Reservoirs	Drain.	3	-	-
	8	Brake Fluid Reservoirs	Check fluid level. Add if low.	2	HBF	As Required
	9	Oscillation Bushes	Lube.	2	EP, NLGI	See Note 1
	34	Fuel Tank	Check fuel level. Add if low.	1	-	As Required
	-	Air Filter Restriction Gauge	Check. Replace element if required.	1	-	-
	-	Hydraulic Filter Warning Light	Check. Replace element if required.	1	-	-
	-	Tyres	Check condition and pressure.	6	-	Refer Sec 160-0050
	-	General	Check for debris, leaks and damage.	-	-	-
	10	Steering Cylinder Pins	Lube.	4	EP, NLGI	See Note 1
	11	Body Cylinder Pins	Lube.	4	EP, NLGI	See Note 1
	12	Suspension Frame Spherical Bearings	Lube.	2	EP, NLGI	See Note 1
50	13	Suspension Beam Bushings	Lube.	2	EP, NLGI	See Note 1
(Weekly)	4	Panhard Rod Spherical Bearings	Lube.	4	EP, NLGI	See Note 1 & 2
	14	Body Hinge Pins	Lube.	2	EP, NLGI	See Note 1
	15	Battery Electrolyte	Check level. Add if low.	2	-	As Required
	16	Wheel Rim Nuts	Check torque.	72	-	590 Nm (435 lbf ft)
	32	Cab Ventilation Filter	Inspect and clean if required.	1	-	-

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LUBRICATION AND SERVICE CHART

Interval Hours	Ref. Points	Identification	Service Instructions	No. of Points	Lubricant	Service/Quantities
	1	Engine	Drain oil and refill.	1	EO	See Page 6
	-	Engine Crankcase Breather	Clean.	1	-	-
	-	Transmission Breather	Clean.	1	-	-
	6	Fuel Filter/Water Separator	Replace.	1	-	-
	17	Engine Oil Filter	Replace.	1	-	-
	18	DCA4 Coolant Filter	Replace.	1	-	-
250	-	DCA4 Coolant Additive	Check DCA4 concentration.	-	-	Ref Engine Manual
(Monthly)	19	Drive Belts	Check tension. Adjust if required.	-	-	Ref Engine Manual
	20	Wheels Planetaries	Check oil level. Add if low.	6	EPL	As Required
	21	Differentials	Check oil level. Add if low.	3	EPL	As Required
	-	Differential Breathers	Clean if required.	3		
	22	Oscillation Pivot	Check end float. Adjust if required.	1		
	23	Driveshaft Bearings	Lube.	2	EP, NLGI	Four Shots (each)
	24	Driveline Universal Joints	Lube.	10	EP, NLGI	See Note 1
	25	Driveline Slip Joints	Lube.	4	EP, NLGI	See Note 1
	26	Pivot Pins	Lube.	2	EP, NLGI	See Note 1
	28	Park Brake Slack Adjuster	Adjust if required.	1	-	-
	29	Parking Brake Pads	Check wear. Replace if required.	2	-	See Page 5
	-	Service Brake Pads	Check wear. Replace if required.	12		See Page 5
500	27	Pressure Convertor	Clean.	2		
(3 Monthly)	34	Fuel Tank	Clean filler neck, screen & cap.	1		
	-	Engine Air Cleaner	Clean inlet screen.	-		
	2	Transmission	Drain oil and refill.	1	*	See Page 6
	20	Wheel Planetaries	Drain oil and refill.	6	EPL	See Page 6
	21	Differentials	Drain oil and refill.	3	EPL	See Note 2
1 000	28	Park Brake Slack Adjuster	Lube.	1	EP, NLGI	See Note 1
(6 Monthly)	29	Parking Brake Pads	Check wear. Replace if required.	2	-	See Page 5
	30	Transmission Oil Filter	Replace.	1	-	-
	31	Transmission Internal Oil Filter	Clean.	1	-	-
	32	Cab Ventilation Filter	Replace.	1	-	-
	-	Door Hinges	Lube.	2	-	See Note 1
	34	Fuel Tank	Replace cap filter/cartridge.	1	-	-
	1	Engine	Steam clean.	1	-	-
	3	Hydraulic Tank	Drain oil and refill.	1	HO	See Page 6
	8	Brake Fluid Reservoirs	Drain fluid and refill.	2	HBF	See Page 5
	26	Articulation Pivot Nut	Check torque.	1	-	1 425 Nm (1 050 lbf ft)
2 000						
(Annually)	33	Hydraulic Oil Filter	Replace.	1		See Page 5
	-	Engine Mounting Bolts	Check torque.			298 Nm (220 lbf ft)
	-	Transmission Mounting Bolts	Check torque.			Refer Sec 120-0010
	-	Turbocharger Mounting Bolts	Check torque.			65 Nm (50 lbf ft)
	-	Drivelines (Low Maintenance)	Check for leaks and damage.	-		See Page 5
	-	Air Drier	Replace desiccant cartridge.	1		
4 000	5	Cooling system	Drain, flush and refill.			See Page 6
	-	Air Conditioning Compressor	Drain, flush and refill.	1	Pag Oil	See Page 6

Note - Capacities given are approximate - work to dipstick, sight gauges or level plugs.

Note 1 - Lubricate slowly until excess lube is seen.

Note 2 - Capacity of front and rear differentials is 11 litres (2.9 US gal). Capacity of centre differential is 14 litres (3.7 US gal). This includes 1 litre (2 pints) for priming the 3rd. differential unit.

EO - Engine Oil. Refer to 'Recommended Lubricants'.

* - Refer to chart under 'Recommended Lubricants'.

HO - Hydraulic Transmission Oil. Refer to 'Recommended Lubricants'.

EPL - Extreme Pressure Gear Lubricant spec. MIL-L-2105 D.

HBF - Hydraulic Brake Fluid (heavy duty) SAE J 1703.

EP, NLGI - Extreme Pressure Lithium No. 2 Grease (without 'Molybdenum')

PAG Oil - Polyalklene Glycol (PAG) Compressor Lubricating Oil - Low Viscosity (ISO46)

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MISCELLANEOUS SERVICING

WHEN REQUIRED

Seat Belts - Inspect for damage and replace if required.
Note: Replace seat belts at least once every three years, regardless of appearance.

Windscreen Wipers and Washers - Inspect wiper blades and replace if damaged. Top up washer reservoir.

Wheel Rim Nuts - After first 10 hours of operation re-torque nuts to 590 Nm (435 lbf ft). Check torque every 50 hours (weekly) thereafter.

EVERY 10 HOURS OF OPERATION (DAILY)

Walk Around Inspection - Inspect the machine as described in Section 4 of the Operator's Handbook.

Engine - Visually check engine for damage, loose or frayed belts and listen for any unusual noises.

Engine Air Cleaners - Change air cleaner element only when air restriction gauge locks up in the red. Service vacuator valves daily. Inspect and remove any obstructions from the vacuator valve lips which should be open and pliable with the engine stopped.
Note: Service air cleaners more often when operating under extremely dusty conditions.

Engine Crankcase - Check oil level and add if low. With the engine off, the oil should be between the lower and upper marks on the dipstick, up to the upper mark is preferable.

Transmission - Check oil level and add if low. Refer to Section 120-0010, TRANSMISSION AND MOUNTING, for correct oil level check procedure.

Hydraulic Tank - Check oil level and add if low. With the engine off and the body down the oil should be visible in the bottom of the top sight gauge.

Radiator Header Tank - Check coolant level and add if low. Fill the radiator header tank with coolant until coolant reaches the bottom of the filler neck and holds at that level.
Note: Any time a significant amount of coolant is added, the DCA4 concentration MUST be checked. If the concentration is low, engine damage will result. Conversely, over-inhibiting antifreeze solutions can result in silicate dropout. Refer to Section 210-0000, COOLING SYSTEM.

AFTER FIRST 100 HOURS OF OPERATING NEW OR REBUILT COMPONENTS

Transmission - Drain oil, replace filter, clean internal filter and finger magnet. Refill transmission.

Differentials - Drain oil and refill to level plug.
Note: When refilling centre axle ensure that the 3rd. differential unit is primed with 1 litre (2 pints) of oil before filling drivehead.

Planetaries - Drain lubricant and refill to level plug.

EVERY 250 HOURS OF OPERATION (MONTHLY)

Oil Can Points - Oil brake treadle rollers and other working parts with engine oil.

General Inspection - Check entire vehicle for leaks, loose bolts and nuts or damaged parts. Examine the vehicle, particularly the chassis, for cracks or broken welds. Repair where necessary.

Engine Air Intake - Check air intake system for wear points or damage to piping, loose clamps and leaks.

Drive Belts - Visually check the belts and replace if they are cracked or frayed. Adjust belts that have a glazed or shiny surface which indicates belt slippage. Correctly installed and tensioned belts will show even pulley and belt wear. Refer to 'Engine Operation and Maintenance Manual' for drive belt tension and adjustment of new and used belts.

Service Brakes - Check pads and discs for wear and adjust or replace where necessary. Test for proper function.
Note: This service interval applies to normal driving. Check the pads more frequently under more severe conditions. Thickness of pad friction material should never be allowed to wear below 3 mm (0.12 in).

Parking Brake - Check pads and disc for wear. Adjust or replace if required. Test for proper function. Friction material thickness should never be allowed to wear below 3 mm (0.12 in).

Coolant Additive - Check and replenish DCA4 concentration as described in Engine 'Operation and Maintenance Manual'.

Coolant Filter - Replace coolant filter if required. When testing the DCA4 concentration, depending on the level of DCA4 the coolant filter may not

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necessarily have to be changed. If concentration is:

Below 0.3 units per litre (1.2 units per US gallon) - Add both the normal amount of DCA4 liquid as specified in the respective 'Service Chart' and the amount specified in the respective 'Precharge Chart'. Replace the DCA4 coolant filter.

Between 0.3 and 0.8 units per litre (1.2 and 3 units per US gallon) - Add the normal amount of DCA4 liquid as specified in the respective 'Service Chart'. Replace the DCA4 coolant filter.

Above 0.8 units per litre (3 units per US gallon) - Do not replace the DCA4 filter or add liquid DCA4 until the concentration drops below 0.8 units per litre (3 units per US gallon). The concentration must be tested at every subsequent 250 hour service interval until the concentration decreases below 0.8 units per litre (3 units per US gallon).

EVERY 1 000 HOURS OF OPERATION (6 MONTHS)

Differential - Drain oil and refill to level plug.
Note: When refilling centre axle ensure that the 3rd. differential unit is primed with 1 litre (2 pints) of oil before filling drivehead.

Parking Brake - Check pads and disc for wear. Adjust or replace if required. Test for proper function. Friction material thickness should never be allowed to wear below 3 mm (0.12 in).

EVERY 2 000 HOURS OF OPERATION (ANNUALLY)

Hydraulic Oil Tank - Drain oil, remove and clean filter screen assemblies. Reinstall filter screens and refill tank.

Hydraulic Oil Filter - Clean filter housing and install new element when filter restriction indicator light illuminates, or after 2 000 hours of operation, whichever comes first.

Brake Fluid Reservoirs - Drain brake fluid, refill reservoirs and bleed the brakes. Refer to Section 165-0010, BRAKE PARTS.
Note: Each reservoir (2 off) has a capacity of 0.66 litres (0.17 US gal). System capacity, as listed in the 'Recommended Lubricants' table, takes into account brake fluid contained in the brake lines.

Drivelines - Visually check Low Maintenance drivelines for leaking or damaged seals.
Note: Low Maintenance drivelines can be identified by having plugs fitted to the spiders, not grease nipples.
Note: When service is required, remove plug and fit grease nipple. Grease spider and refit plug when finished. Use Type K lubricating grease in accordance to DIN 51825-KP2-K-40.

ENGINES AND TRANSMISSIONS

All information contained in the 'Lubrication and Service Chart' was extracted from the relevant manufacturers Operators Manual and was correct at time of publication. User should ensure that information contained in this chart, regarding engines and transmissions, reflects the information shown in the relevant manufacturers Operators Manuals supplied with the machine. Maintenance procedures should be carried out in conjunction with any additional procedures contained in the relevant manufacturers Operators Manuals at the intervals specified.

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Miscellaneous - Lubrication System

Section 300-0020

SERVICE CAPACITIES

		Service Capacities	
		TA30	
Identification	Lubricant	litres	US gal
Engine Crankcase and Filters	EO	40	10.5
Transmission and Filters (dry fill)	EO	52	13.8
Transmission and Filters (wet fill)	EO	26	6.9
Hydraulic System (Hoist & Steering)	HO	200	52.8
Cooling System	Coolant	59	15.6
Fuel Tank	Diesel	330	87
Differential - Front and Rear (each)	EPL	11	2.9
Differential - Centre	EPL	14	3.7
Planetaries (each)	EPL	3.5	0.9
Service Brakes	HBF	3	0.79
Air Conditioning Compressor	PAG Oil	0.125	0.033

Note: Capacities given are approximate, work to dipstick, sight gauges or level plugs. Use table in conjunction with 'Recommended Lubricants' table.

RECOMMENDED LUBRICANTS

COMPONENT	LUBRICANT	SPECIFICATIONS	API CODE	SAE GRADE
Engine Crankcase and Filter	Engine Oil with 1.00% sulphated ash is recommended. Sulphated ash must not exceed 1.85% limit		CG-4 or CF-4	15W-40 (See Note 1*)
Transmission and Filters	Engine Oil with 1.85% max. sulphated ash limit	MIL-L-2104 C/D/E MIL-L-46152 C/D/E (See Note 2*)	CD, CE, CF, SF & SG	See Trans. Oil Table
Hydraulic System (Hoist and Steering)	Hydraulic Transmission Oil	See Hydraulic Oil Table (See Note 3*)		
Cooling System	Antifreeze, Ethylene Glycol			
Fuel Tank	Diesel Fuel Oil with max. Sulphur 0.5%	DIN EN590		
Differentials - Front & Rear	Extreme Pressure Gear Lubricant	MIL-L-2105 D (See Note 4*)	GL-5	80W-90 LS
Differentials - Centre	Extreme Pressure Gear Lubricant	MIL-L-2105 D (See Note 4*)	GL-5	80W-90 LS
Planetaries	Extreme Pressure Gear Lubricant	MIL-L-2105 D (See Note 4*)	GL-5	80W-90 LS
Service Brakes	Hydraulic Brake Fluid	Heavy Duty		J1703
Grease Nipples	Extreme Pressure Lithium (No 'Molybdenum')			No. 2 Consistency
Air Conditioning Compressor	Polyalklene Glycol (PAG) Compressor Lubricating Oil - Low Viscosity	ISO46 SP 10		

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Notes on Recommended Lubricants and Lubricant Grade Selection Tables

Note 1 - The use of low viscosity oils, such as 10W or 10W-30, can be used to aid in starting the engine and providing sufficient oil flow at ambient temperatures below -5° C (23° F). Continuous use of low viscosity oils can decrease engine life due to wear.

Note 2 - Operation below the minimum temperatures listed for the oil used without proper preheat or warm-up results in greatly reduced transmission life. Proper warm-up requires 20 minutes minimum operation in neutral (with engine at part throttle) before operating the transmission in gear.

Note 3 - Hydraulic Transmission Oil meeting Specification EMS19058 is suitable for use in the hydraulic system.

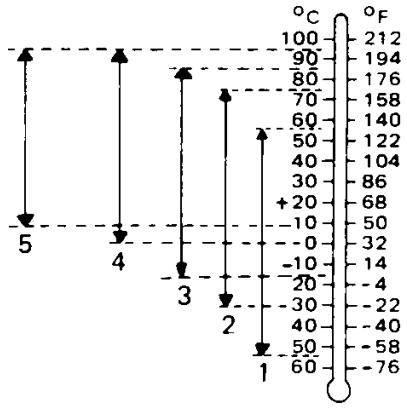
Note 4 - Axles have limited slip differentials. If use of standard SAE 90 oil results in very loud noise and jerking of wheels when driving slowly round sharp corner, an Extreme Pressure Gear Lubricant with limited slip additives should be used.

Note 5 - Automatic Transmission Fluids (ATF) may only be used when the ambient temperature is less than -10° C (14° F). Should the temperature increase, it is necessary to switch to engine oil.

LUBRICANT GRADE SELECTION GUIDE AT AMBIENT (START-UP) TEMPERATURE

HYDRAULIC OIL

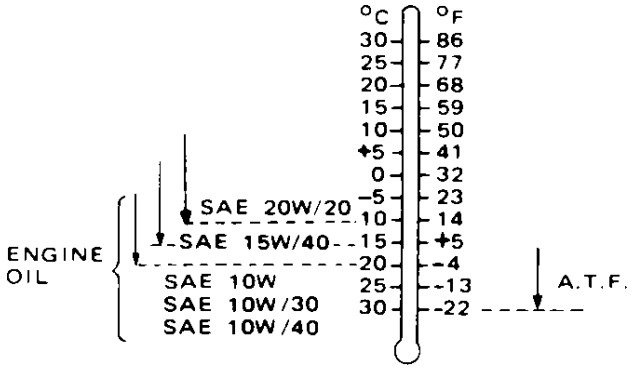
SM - 803



	SAE	API CODE	MIL-SPEC
1	-	-	MIL-H-5606A
2	DEXRON Auto Trans. Fluid		
3	10W	CC/CD	MIL-L-2104 B/C
4	20W/20	CC/CD	MIL-L-2104 B/C
5	30	CC/CD	MIL-L-2104 B/C

TRANSMISSION OIL

SM - 804



(See Note 5)

Note: Consult your lubricant supplier for correct viscosity of lubricant when ambient temperatures are consistently above or below those listed.

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INTRODUCTION

Contained in this section are recommended service tools and equipment required for maintenance, overhaul and troubleshooting. In certain instances, both Metric and Imperial equivalents of the same tools are listed.

Note: A tool may be of one piece construction or consist of a number of parts.

General

*15269784 - Multi-Gauge - Pressure range of 30 in of vacuum to 5 000 lbf/in²
15269785 - Non-contact Infrared Thermometer
15268968 - Strap Type Filter Wrench
15268969 - Socket Type Filter Wrench
15268970 - Universal Belt Tension Gauge
15269858 - Digital Tachometer
15269859 - Multimeter
15269813 - Water Manometer
15269802 - Dial Indicator Gauge - Metric
15269803 - Dial Indicator Gauge - Imperial
15269804 - Magnetic Base for Dial Indicator Gauge
15269805 - Micrometer - 0 to 25 mm
15269806 - Micrometer - 0 to 1 in
15269860 - 92 Piece Heavy Equipment Tool Kit
15269861 - Torque Wrench - 3/8 in drive, 20 - 100 Nm (15 - 80 lbf ft) range
15269862 - Torque Wrench - 1/2 in drive, 60 - 330 Nm (45 - 250 lbf ft) range
15269863 - Torque Wrench - 3/8 in drive, 4 - 20 Nm (40 - 180 lbf in) range
15269864 - Torque Wrench - 3/4 in drive, 300 - 1 000 Nm (200 - 750 lbf ft) range
15269865 - Torque Wrench - 3/4 in drive, 700 - 1 500 Nm (500 - 1 000 lbf ft) range
15269866 - Torque Multiplier - 1/2 in to 1 in drive, 25:1 Ratio, 3 000 Nm (2 200 lbf ft) range

* - The following items should be added to the multi-gauge to enable the gauge to be used on diagnostic test points:
15018226 - Diagnostic Coupling
00118748 - Connector (2 off)
15004085 - Hose Assembly (-4 HP, 84 in long)

Engine

The following tools are recommended for Engine Maintenance Procedures. These tools should be used in conjunction with procedures outlined in the engine manufacturers service manual.

15270076 - Vacuum Gauge
15270075 - Dial Depth Gauge
15270006 - Connecting Rod Checking Fixture
15269956 - Standard Puller
15269958 - Piston Ring Expander
15270078 - Manometer
15269959 - Main Bearing Cap Puller
15270081 - Pressure Gauge
15269960 - Dial Gauge Attachment
15270009 - Threaded Insert Kit
15269962 - Dial Bore Gauge Kit
15270079 - Manometer Tool
15270042 - Pressure Gauge (0 - 160 lbf/in²)
15270010 - Crack Detection Kit
15270082 - Pressure Gauge (0 - 300 lbf/in²)
15269971 - Connecting Rod Guide Pins
15269966 - Cylinder Liner Puller Plate
15269961 - Dial Indicator Gauge
15269973 - Oil Seal Guide
15269974 - Oil Seal Guide
15269975 - Pulley Installation Tool
15269980 - Regulator Retainer Plug Driver
15269981 - Oil Seal Guide
15269982 - Torque Wrench - lb in
15269985 - Flywheel Housing Alignment Plate
15270070 - Coupling Puller
15270004 - Magnetic Base
15269994 - Cylinder Head Lifting Bracket
15270084 - Blowby Check Tool
15269996 - Injector Puller
15269997 - Piston Ring Compressor
15269999 - Gauge Block
15270072 - Drive Gear Driver
15270020 - Needle Bearing Kit
15270021 - Bearing Installation Tool
15269984 - Engine Barring Tool
15270003 - Cylinder Liner Clamping Tool
15274125 - Cooling System Test Kit
15274126 - Refractometer
15274129 - Hose Adaptor
15274130 - Hose Adaptor
15274127 - Belt Tension Gauge
15274128 - Hose Assembly Tools
15274060 - Heavy Duty Cam Gear Puller Kit
15274131 - Wrench, Air Impact
15274138 - Installer, Valve Guide
15274146 - Adaptor, Fuel Restriction
15274141 - Lubriplate 105 Lubricant
15274136 - Kit, Torque Wrench
15274139 - Pliers, Boot
15274142 - Lamp, 100W Black Light Kit
15274143 - Charger Set International
15274135 - Kit, Guide Pin
15274140 - Fixture, Pulley Alignment
15274134 - Kit, Inline II Datalink Adaptor
15274059 - Liner Puller

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15274061 - Injector Protrusion Comparator
15274062 - Tube, Fuel Line Sight #12
15274063 - Pilot, Oil Seal Puller Drills
15274064 - Kit, Turbo Rebuild
15274065 - Digital Tachometer Kit
15274066 - Bent Wrench
15274067 - Adaptor, Fuel Line Sight #16 Hose
15274068 - Gear Puller, Jaw
15274069 - Guide, Valve Installation
15274070 - Expander, Fan Hub Seal
15274071 - Capscrew, Pulley Puller
15274072 - Driver, Regulator Valve Seat
15274073 - Gauge, Cylinder Liner Ring
15274074 - Tube, Fuel Line Sight
15274075 - Cam Guide Expander - Large Dia
15274076 - Fluorescent Tracer
15274077 - Expander, Accessory Drive Shaft Seal
15274078 - Fuel Pump S Wrench
15274079 - Kit, Torque Wrench
15274080 - Fitting Quick Connect
15274081 - Fitting Quick Connect
15274082 - Tube, Cooling System Sight
15274083 - Tube, Cooling System Sight
15274084 - Tube, Cooling System Sight
15274148 - Wrench, Dial Type Torque
15274144 - Wrench, Nylon Strap Filter
15274145 - Gauge, Torque Angle
15274147 - Wrench, Crows Foot 13 mm
15274124 - Set, Torx Plus Driver
15274137 - Bit, Screw Driver
15274085 - Engine Parts Rack
15274086 - Gauge, Belt Tension
15274087 - Socket, Engine Position Sensor
15274088 - Kit, Combustion Gas Leak Test
15274132 - Test Fluid
15274089 - Thermocouple Wire Kit
15274090 - Engine Coolant Analyser
15274091 - Gauge, Belt Tension
15274092 - Wrench, CELECT Torque
15274093 - Screwdriver, CELECT
15274094 - Puller, Water Pump Pulley
15274095 - Adjuster, STC Tappet
15274096 - Super Chip Vacuum Kit
15274097 - Gauge, Cyl. Head Capscrew Length
15274098 - Kit, Counterbore Ledge Cutter
15274099 - Cutter Plate
15274100 - Clamp On Current Probe
15274101 - Injector Puller/driver
15274102 - Kit, Hydraulic Actuator
15274103 - Kit, Hydraulic Cylinder Support
15274104 - Kit, Cam Bushing I/R
15274105 - Kit, Rail Pressure Response
15274106 - Kit, Pulley Installation Adaptor
15274107 - Socket, Deep Flank Drive
15274108 - Template, Cylinder Head Capscrew
15274109 - Torque Angle Gauge
15274110 - Small Bushing Driver Set
15274111 - Kit,CNG Wastegate Test
15274112 - Fixture, Cam Follower Assy R/I
15274113 - Validator, Torque Wrench
15274114 - Kit, Cylinder Head Leak Test
15274115 - Kit, Charge Air Cooler Tester
15274116 - Module, Vacuum Pressure
15274117 - Meter, Automotive
15274118 - Puller, STC Injector
15274119 - Driver, Thermostat Seal
15274120 - Sensor Break-out Kit
15274121 - Counterbore Salvage Kit
15274122 - Installer, Oil Capacitor
15274123 - Kit, Wiring Repair, Basic
15274133 - Cable, Throttle Breakout

Transmission

The following tools are recommended for Transmission Maintenance Procedures. These tools should be used in conjunction with procedures outlined in the transmission manufacturers service manual.

15270087 - Straight Pin
15270088 - Back-off Device
15270089 - Puller Device
15270090 - Puller
15270091 - Puller
15270092 - Puller
15270093 - Puller
15270094 - Driver
15270095 - Driver
15270096 - Driver
15270097 - Driver
15270098 - Driver
15270099 - Driver
15270100 - Driver
15270101 - Driver
15270102 - Driver
15270103 - Driver
15270104 - Driver
15270105 - Driver
15270106 - Driver
15270107 - Driver
15270108 - Driver
15270109 - Driver
15270110 - Driver
15270111 - Pressure Piece
15269948 - Straightedge
15270112 - Measuring Pin
15269804 - Magnetic Base
15269802 - Dial Indicator
15270113 - Gauge Blocks

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15270114 - Digital Depth Gauge
15270115 - Set of Eye Bolts
15270116 - Adjusting Screws - M8
15270117 - Adjusting Screws - M5
15270118 - Adjusting Screws - M6
15270119 - Adjusting Screws - M10
15269899 - Hot Air Blower 220 V, 50 Hz
15269900 - Hot Air Blower 110 V, 60 Hz
15270120 - Clamping Yoke
15269942 - Handle
15270121 - Driver
15270122 - Backup Tool
15270123 - Internal Puller
15270124 - Internal Puller
15270125 - Internal Puller
15270126 - Internal Puller
15270127 - Guide Plate
15270128 - Assembly Jig
15270129 - Assembly Aid
15270130 - Expanding Ring
15270131 - Pry Bar
15270132 - Crow Bar
15270133 - Profiled Bush
15270134 - Drift
15270135 - Lifting Device
15270136 - Drift
15270137 - Drift
15270138 - Rubber Cap
15270139 - Striker
15270140 - Installer
15270141 - Installer
15270142 - Pre-heating Sleeve
15270143 - Brake Spring Pliers
15270144 - Clamping Pliers
15270145 - External Snap Ring Pliers
15270146 - External Snap Ring Pliers
15270147 - Circlip Pliers
15270148 - Circlip Pliers
15270149 - Two Leg Puller
15270150 - Three Leg Puller
15270151 - PR-78A Tester
15270152 - Harness
15270153 - Foil
15270154 - Test Box II
15270155 - Flowmeter
15270725 - PR-68 Tester

Axles and Differentials

15269893 - Pin Spanner - M95 x 1.5
15269894 - Wheel Bolt Puller - Basic Set
15269895 - Insert - M22 x 1.5
15269896 - Driver
15269897 - Driver
15269898 - Driver Handle
15269899 - Hot Air Blower - 220 V, 50 Hz
15269900 - Hot Air Blower - 127 V, 60 Hz
15269928 - Back-off Screw - M14
15269929 - Lifting Pliers
15269930 - Grab Sleeve
15269931 - Sleeve
15269932 - Basic Set Rollex 1
15269933 - Grab Sleeve 'Super'
15269934 - Measuring Shaft
15269935 - Thrust Washer
15269936 - Measuring Piston
15269937 - Shims - 120 mm Diameter
15270204 - Driver
15269939 - Measuring Ring
15269940 - Driver
15269941 - Driver
15269942 - Driver Handle
15269943 - Spanner
15269944 - Hook Spanner
15269945 - Insert
15269946 - Puller Set
15269947 - Shims
15269948 - Straightedge - 600 mm
15269949 - Pry Bars - Set of 2
15269950 - Driver

Nitrogen Charging/Inflation

15269121 - Nitrogen Tyre Inflation Kit
09359489 - Charging Assembly

Cooling and Air Conditioning

15269814 - DCA4 Test Kit - Metric Version
15269815 - DCA4 Test Kit - US gallon Version
15269816 - Refractometer - °C Scale
15269817 - Refractometer - °F Scale
15269844 - Portable High Vacuum Charging Station - R-134a Gas
15269845 - Halogen Leak Tester

Cab

15271016 - Glass Removal Tool
15271017 - Bonding Kit (Quick Dry)

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Miscellaneous - Service Tools

Section 300-0070

Adhesives and Sealants

15269103 - Loctite 221
09362529 - Loctite 225
09029849 - Loctite 243
09244598 - Loctite 270
09985300 - Loctite 271
15269104 - Loctite 275
15269245 - Loctite 277
15233715 - Loctite Prism 406
15269111 - Loctite Prism 410
15269105 - Loctite 515
09007209 - Loctite 574 (50 ml)
09379518 - Loctite 574 (160 ml)
15269106 - Loctite 577 (Superflex)
15270244 - Loctite 592 - Pipe Sealer with Teflon
15023696 - Loctite 635
09371048 - Loctite 638
15269107 - Loctite 641
15269108 - Loctite Superclean Safety Solvent 706
15229541 - Loctite Activator 'N'
09243825 - Loctite Activator 'T'
09175039 - General Adhesive
15269114 - Tectyl 280 Wax Based Rust Preventive
09380475 - Hylosil RTV Silicone Compound

Fabricated Tools

The service tools shown in Figs. 1 through 8 can be fabricated as shown.

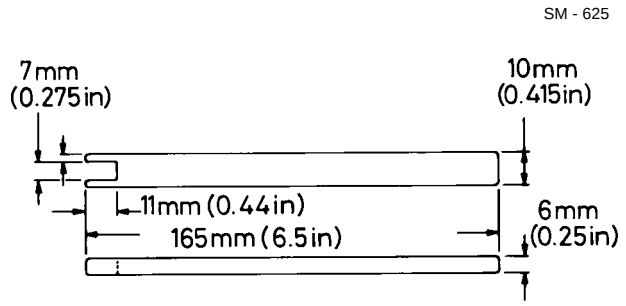


Fig. 1 - Centring Spring Installation Tool (Section 220-0090, STEERING VALVE)

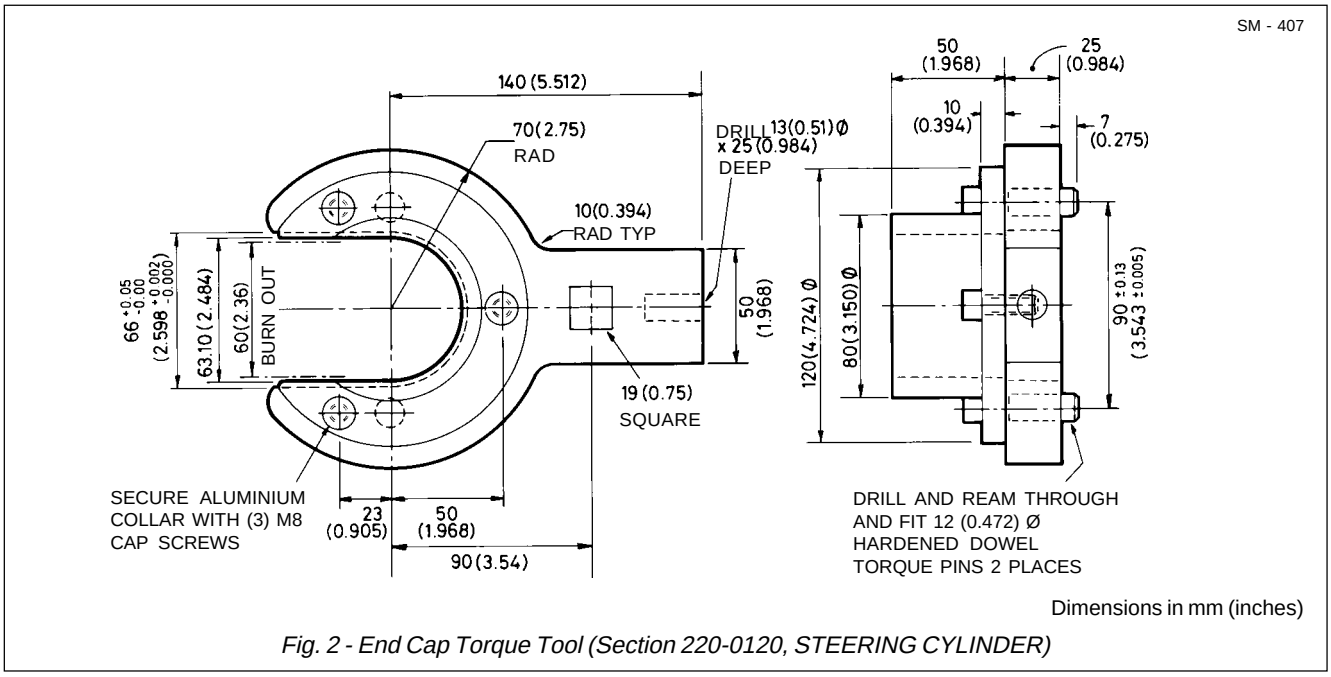


Fig. 2 - End Cap Torque Tool (Section 220-0120, STEERING CYLINDER)

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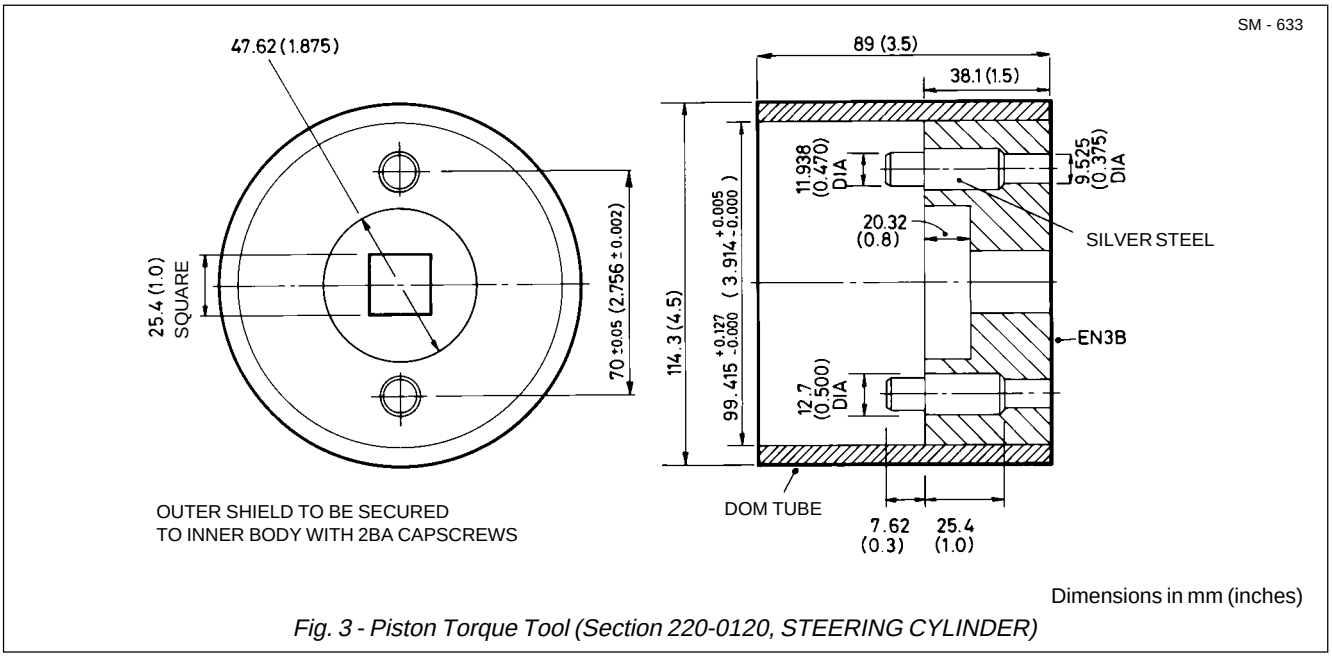


Fig. 3 - Piston Torque Tool (Section 220-0120, STEERING CYLINDER)

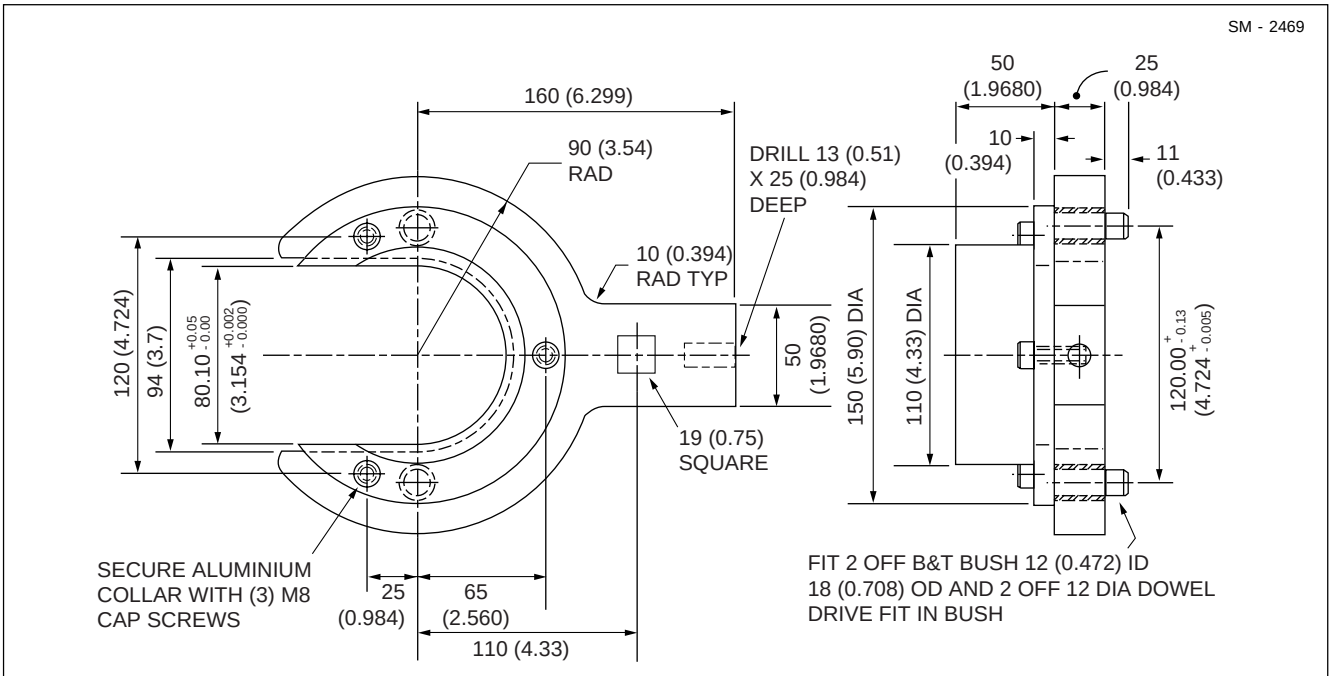
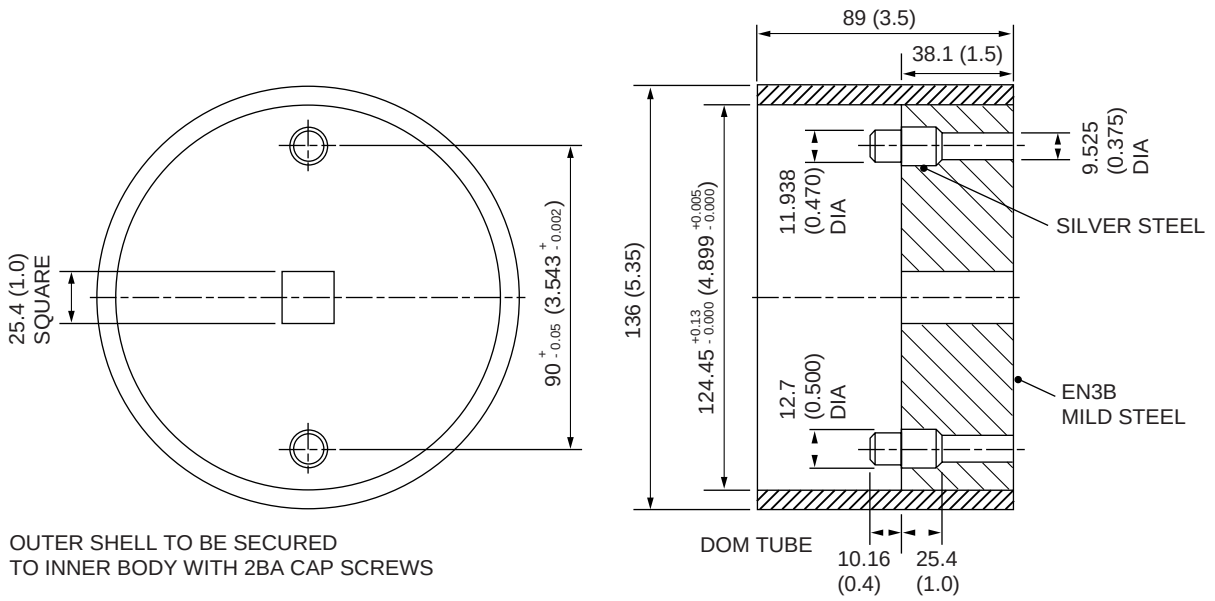


Fig. 4 - End Cap Torque Tool (Section 230-0130, BODY CYLINDER)

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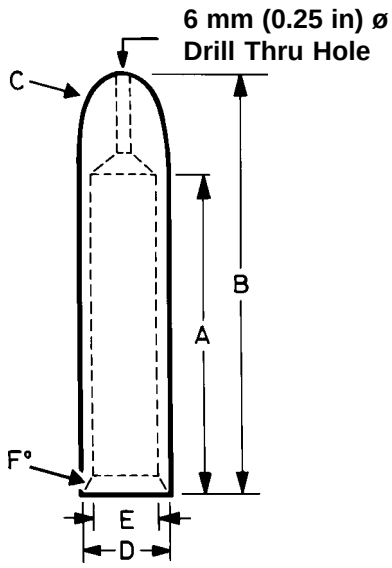
SM - 2470



Dimensions in mm (in)

Fig. 5 - Piston Torque Tool (Section 230-0130, BODY CYLINDER)

SM - 647



SPECIAL SLEEVE TOOL DIMENSIONS		
DIMENSION	mm	in
A	85.7	3.375
B	114.3	4.50
C Radius	14.3	0.56
D Diameter	34.9758 + 0.000 - 0.0508	1.377 + 0.000 - 0.002
E Diameter	31.75 + 0.050 - 0.000	1.250 + 0.002 - 0.000
F° Chamfer	1.6 x 60°	0.063 x 60°

Fig. 6 - Special Sleeve Tool Dimensions (Section 230-0050 MAIN HYDRAULIC PUMP)

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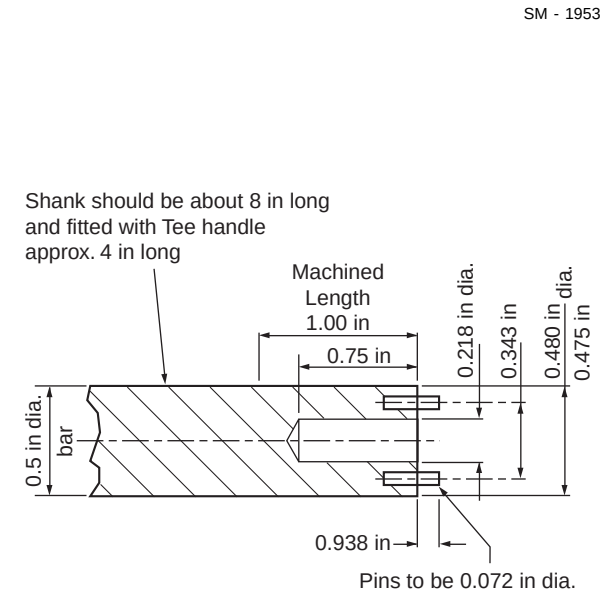


Fig. 7 - Unloader Valve Adjusting Bush Installation Tool (Section 250-0200, AIR DRIER)

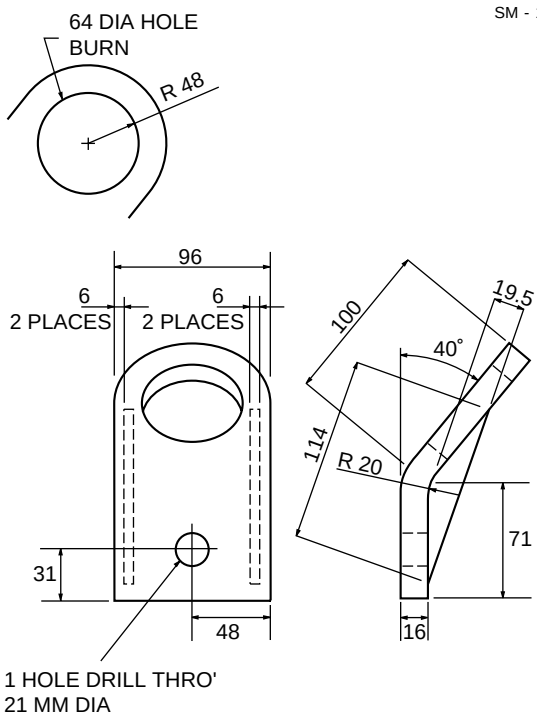


Fig. 8 - Body Lifting Lug Dimensions (Section 270-0010, BODY AND MOUNTING)

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TORQUE LIMITS IN Nm (lbf ft)

Friction coefficient total 0.125 for screws and nuts without after treatment as well as for phosphated nuts.
Tighten by hand!

If nothing special is indicated, select correct Torque Limits from the following tabulations -

Metric ISO Thread DIN 13 TABLE161

Size	6.9		8.8		10.9		12.9	
	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)
M 6	8	(5.9)	9.5	(7)	13	(9.6)	16	(11.8)
M 8	19	(14)	23	(16.9)	32	(23.6)	39	(28.8)
M 10	39	(28.8)	46	(33.9)	64	(47.2)	77	(56.8)
M 12	67	(49.4)	80	(59)	110	(81.1)	135	(99.6)
M 14	105	(77)	125	(92)	180	(133)	215	(159)
M 16	165	(122)	195	(144)	275	(203)	330	(243)
M 18	225	(166)	270	(199)	390	(288)	455	(336)
M 20	325	(240)	385	(284)	540	(398)	650	(479)
M 22	435	(321)	510	(376)	720	(531)	870	(642)
M 24	560	(413)	660	(487)	930	(686)	1 100	(812)
M 27	830	(612)	980	(723)	1 400	(1 033)	1 650	(1 217)
M 30	1 100	(811)	1 350	(996)	1 850	(1 365)	2 250	(1 660

Metric ISO Fine Thread DIN 13 TABLE162

Size	6.9		8.8		10.9		12.9	
	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)
M 8 x 2	21	(15.5)	25	(18.4)	35	(25.8)	42	(31)
M 10 x 1.25	41	(30.3)	49	(36.1)	68	(50.2)	82	(60.5)
M 12 x 1.25	74	(54.6)	88	(64.9)	125	(92.2)	150	(110.6)
M 12 x 1.5	70	(51.6)	83	(61.2)	115	(84.8)	140	(103.3)
M 14 x 1.5	115	(85)	140	(103)	195	(144)	235	(173)
M 16 x 1.5	175	(129)	210	(155)	295	(218)	340	(251)
M 18 x 1.5	255	(188)	305	(225)	425	(314)	510	(376)
M 20 x 1.5	360	(266)	425	(314)	600	(443)	720	(531)
M 22 x 1.5	480	(354)	570	(420)	800	(590)	960	(708)
M 24 x 2	610	(450)	720	(531)	1 000	(738)	1 200	(885)
M 27 x 2	890	(656)	1 050	(774)	1 500	(1 106)	1 800	(1 328)
M 30 x 2	1 250	(922)	1 450	(1 070)	2 050	(1 512)	2 500	(1 844)

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Miscellaneous - Axle Bolt and Nut Torque Specifications

Section 300-0080

Friction coefficient total 0.14 for screws and nuts without after treatment as well as for phosphated nuts.
Tighten by hand!

If nothing special is indicated, select correct Torque Limits from the following tabulations -

Metric ISO Thread DIN 13 TABLE163

Size	6.9		8.8		10.9		12.9	
	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)
M 6	8.5	(6.3)	10	(7.4)	14	(10.3)	17	(12.5)
M 8	21	(15.5)	25	(18.4)	35	(25.8)	41	(30.2)
M 10	41	(30.2)	49	(36.1)	69	(50.9)	83	(61.2)
M 12	72	(53.1)	86	(63.4)	120	(88.5)	145	(106.9)
M 14	115	(85)	135	(100)	190	(140)	230	(170)
M 16	180	(133)	210	(155)	295	(218)	355	(262)
M 18	245	(181)	290	(214)	400	(295)	485	(358)
M 20	345	(255)	410	(302)	580	(428)	690	(509)
M 22	465	(343)	550	(406)	780	(575)	930	(686)
M 24	600	(443)	710	(524)	1 000	(738)	1 200	(885)
M 27	890	(656)	1 050	(774)	1 500	(1 106)	1 800	(1 328)
M 30	1 200	(885)	1 450	(1 070)	2 000	(1 475)	2 400	(1 770)

Metric ISO Fine Thread DIN 13 TABLE164

Size	6.9		8.8		10.9		12.9	
	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)
M 8 x 1	23	(17)	27	(19.9)	38	(28)	45	(33.2)
M 10 x 1.25	44	(32.5)	52	(38.4)	73	(53.8)	88	(65)
M 12 x 1.25	80	(59)	95	(70)	135	(99)	160	(118)
M 12 x 1.5	76	(56.1)	90	(66.4)	125	(92)	150	(111)
M 14 x 1.5	125	(92)	150	(111)	210	(155)	250	(184)
M 16 x 1.5	190	(140)	225	(166)	315	(232)	380	(280)
M 18 x 1.5	275	(203)	325	(240)	460	(339)	550	(406)
M 20 x 1.5	385	(284)	460	(339)	640	(472)	770	(568)
M 22 x 1.5	520	(384)	610	(450)	860	(634)	1 050	(774)
M 24 x 2	650	(479)	780	(575)	1 100	(811)	1 300	(959)
M 27 x 2	970	(715)	1 150	(848)	1 600	(1 180)	1 950	(1 438)
M 30 x 2	1 350	(997)	1 600	(1 180)	2 250	(1 660)	2 700	(1 991)

* * * *

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MISCELLANEOUS - Standard Bolt and Nut Torque Specifications

⚠ WARNING
Some fasteners are important attaching parts which could affect the performance of vital components and systems, and/or, could result in major repair expense. Fasteners should be replaced with parts of the same part number, or with equivalent parts, if replacement becomes necessary. Do not use replacement parts of lesser quality or substitute design. The torque values shown in the following tables should be used in all cases, unless otherwise specified elsewhere in this manual, in order to avoid possible personal injury or property damage.

The following torque specification tables are based on GM Standard Materials for bolts, nuts, studs and self-locking fasteners based on SAE bolt steel classifications, or, prevailing torque specifications for self-locking fasteners.

To prevent the threaded bolts and nuts used on this equipment from being overstressed during assembly, and to establish a uniform value to which these fasteners can be safely tightened, the following torque tables have been compiled.

The torque values listed in the tables have been established over a period of years and cover all conditions of assembly. The maximum torque values for standard bolts and nuts are based on 75% of the specified minimum proof strength of the bolt steel in order to provide a safety factor to compensate for the variation in the accuracy of torque wrenches, skill of the assembler, and variance in fractional conditions. **All torque values are for lubricated threads**. The term 'lubricated' includes the application of thread lubricants, cadmium plating or the use of hardened washers.

To provide a quick method for determining the GM material classification of a particular standard bolt or nut, compare the bolt head markings to those in the appropriate tables, then locate the maximum torque value for that bolt size in the column under that marking.

RECOMMENDED MAXIMUM TORQUES (IMPERIAL) ± 10% TABLE144

	SAE Symbol GM 260-M Steel (SAE GR 2)		SAE Symbol GM 280-M Steel (SAE GR 5)		SAE Symbol GM 290-M Steel (SAE GR 7)		SAE Symbol GM 300-M Steel (SAE GR 8)		12 Point Cap Screws	
Size	Nm	lbf ft	Nm	lbf ft	Nm	lbf ft	Nm	lbf ft	Nm	lbf ft
0.25 - 20	5	4	8	6	11	8	12	9	14	10
0.25 - 28	7	5	10	7	12	9	14	10	15	11
0.31 - 18	11	8	18	13	22	16	24	18	27	20
0.31 - 24	12	9	19	14	24	18	27	20	30	22
0.38 - 16	20	15	31	23	38	28	43	32	49	36
0.38 - 24	23	17	34	25	43	32	49	36	56	41
0.44 - 14	33	24	47	35	59	43	68	50	75	55
0.44 - 20	37	27	54	40	68	50	79	58	87	64
0.50 - 13	50	37	75	55	94	69	106	78	119	88
0.50 - 20	56	41	88	65	106	78	122	90	134	99
0.56 - 12	75	55	108	80	136	100	156	115	171	126
0.56 - 18	81	60	122	90	149	110	176	130	191	141
0.62 - 11	102	75	149	110	190	140	217	160	237	175
0.62 - 18	115	85	169	125	210	155	244	180	270	199
0.75 - 10	176	130	271	200	332	245	380	280	420	310
0.75 - 16	203	150	298	220	366	270	420	310	472	348
0.88 - 9	169	125	434	320	536	395	610	450	679	501
0.88 - 14	190	140	488	360	590	435	678	500	751	554
1.00 - 8	258	190	651	480	800	590	915	675	1 021	753
1.00 - 12	285	210	719	530	881	650	1 003	740	1 119	825
1.00 - 14	285	210	732	540	902	665	1 030	760	1 148	847

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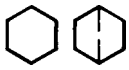
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Miscellaneous - Standard Bolt and Nut Torque Specifications

Section 300-0080

RECOMMENDED MAXIMUM TORQUES (IMPERIAL) ± 10%										TABLE145
	SAE Symbol GM 260-M Steel (SAE GR 2)		SAE Symbol GM 280-M Steel (SAE GR 5)		SAE Symbol GM 290-M Steel (SAE GR 7)		SAE Symbol GM 300-M Steel (SAE GR 8)		12 Point Cap Screws	
Size	Nm	lbf ft	Nm	lbf ft	Nm	lbf ft	Nm	lbf ft	Nm	lbf ft
1.12 - 7	366	270	800	590	1 132	835	1 302	960	1 447	1 067
1.12 - 12	407	300	902	665	1 274	940	1 451	1 075	1 624	1 198
1.25 - 7	515	380	1 132	835	1 600	1 180	1 830	1 350	2 043	1 507
1.25 - 12	569	420	1 254	925	1 776	1 310	2 034	1 500	2 267	1 672
1.38 - 6	664	490	1 478	1 090	2 095	1 545	2 400	1 770	2 676	1 974
1.38 - 12	759	560	1 688	1 245	2 393	1 765	2 739	2 020	3 056	2 254
1.50 - 6	881	650	1 966	1 450	2 786	2 055	3 186	2 350	3 556	2 623
1.50 - 8	936	690	2 088	1 540	2 962	2 185	3 390	2 500	3 781	2 789
1.50 - 12	990	730	2 217	1 635	3 145	2 320	3 593	2 650	4 010	2 958
1.75 - 5	-	-	-	-	4 393	3 240	5 016	3 700	5 604	4 133
1.75 - 12	-	-	-	-	5 091	3 755	5 830	4 300	6 497	4 792
1.88 - 8	-	-	-	-	6 006	4 430	6 874	5 070	7 664	5 653
1.88 - 12	-	-	-	-	6 304	4 650	7 213	5 320	8 048	5 936
2.00 - 4.5	-	-	-	-	6 623	4 885	7 565	5 580	8 448	6 231
2.00 - 8	-	-	-	-	7 342	5 415	8 406	6 200	9 367	6 909
2.00 - 12	-	-	-	-	7 687	5 670	8 786	6 480	9 811	7 236
2.25 - 4.5	-	-	-	-	9 701	7 155	11 090	8 180	12 377	9 129
2.25 - 8	-	-	-	-	10 629	7 840	12 148	8 960	13 566	10 006
2.25 - 12	-	-	-	-	11 050	8 150	12 636	9 320	14 102	10 401
2.50 - 12	-	-	-	-	15 280	11 270	17 463	12 880	19 500	14 383

Note: Where materials other than GM Standards are used, refer to the conversion table below.

Types of Steel	Rockwell Hardness Range	Applicable Torque Values	SAE Bolt Head Symbols
Plain Low Carbon (eg. SAE 1018 or 1020)	Rockwell "B" 85-100	GM 260-M	
Plain Medium Carbon (eg. SAE 1035, 1038 & 1045)	Rockwell "C" 19-30	GM 280-M	
Medium Carbon Alloy (eg. SAE 4140, 8642 & 5157)	Rockwell "C" 28-34	GM 290-M	
Medium Carbon Alloy (eg. SAE 4140, 8642 & 5147)	Rockwell "C" 32-38	GM 300-M	

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RECOMMENDED MAXIMUM TORQUES (METRIC) ± 10%

TABLE146

	Class 8.8		Class 9.8		Class 10.9		Class 12.9	
Size	Nm	lbf ft	Nm	lbf ft	Nm	lbf ft	Nm	lbf ft
M 1.6 - 0.35	-	-	0.20	0.15	-	-	0.20	0.15
M 1.6 - 0.20	-	-	0.25	0.20	-	-	0.40	0.30
M 2.0 - 0.40	-	-	0.25	0.20	-	-	0.45	0.30
M 2.0 - 0.25	-	-	0.45	0.30	-	-	0.45	0.30
M 2.0 - 0.45	-	-	0.25	0.20	-	-	0.45	0.30
M 2.5 - 0.35	-	-	1	0.75	-	-	1	0.75
M 3.0 - 0.50	-	-	1	0.75	-	-	2	1.5
M 3.0 - 0.35	-	-	1	0.75	-	-	2	1.5
M 3.5 - 0.60	-	-	2	1.5	-	-	3	2
M 4.0 - 0.70	-	-	3	2	-	-	4	3
M 4.0 - 0.35	-	-	3	2	-	-	5	3
M 5.0 - 0.80	-	-	5	4	-	-	8	6
M 5.0 - 0.50	-	-	6	4	-	-	9	6
M 6.0 - 1.00	-	-	9	6	-	-	13	10
M 6.3 - 1.00	-	-	10	8	13	10	16	11
M 6.0 - 0.75	-	-	10	7	12	9	14	10
M 8.0 - 1.25	-	-	21	15	27	20	32	23
M 8.0 - 1.00	-	-	23	17	29	21	34	25
M 10.0 - 1.50	-	-	42	31	54	39	63	46
M 10.0 - 1.25	-	-	45	32	57	41	67	48
M 12.0 - 1.75	-	-	74	53	94	68	110	80
M 12.0 - 1.25	-	-	81	58	103	74	121	87
M 14.0 - 2.00	-	-	118	85	151	109	176	127
M 14.0 - 1.50	-	-	128	92	163	118	190	137
M 16.0 - 2.00	169	122	-	-	234	169	274	197
M 16.0 - 1.50	181	130	-	-	250	180	292	211
M 18.0 - 2.50	234	169	-	-	323	234	378	273
M 18.0 - 1.50	263	190	-	-	363	262	425	307
M 20.0 - 2.50	330	239	-	-	457	330	531	386
M 20.0 - 1.50	367	265	-	-	507	366	593	423
M 22.0 - 2.50	451	325	-	-	623	450	728	526
M 22.0 - 1.50	495	357	-	-	684	494	800	577
M 24.0 - 3.00	571	412	-	-	790	570	923	667
M 24.0 - 2.00	623	450	-	-	861	622	1 007	727
M 27.0 - 3.00	837	605	-	-	1 158	836	1 354	977
M 27.0 - 2.00	903	652	-	-	1 250	902	1 461	1 055
M 30.0 - 3.00	1 135	820	-	-	1 570	1 134	1 835	1 325
M 30.0 - 2.00	1 258	908	-	-	1 740	1 256	2 034	1 468
M 30.0 - 1.50	1 300	939	-	-	1 799	1 299	2 102	1 516
M 36.0 - 4.00	1 985	1 433	-	-	2 745	1 982	3 208	2 317
M 36.0 - 3.00	2 102	1 517	-	-	2 907	2 099	3 398	2 453

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SELF-LOCKING FASTENERS

Self-locking fasteners develop a measured gripping action or torque and provide a renewed locking action after being removed and reinstalled to their original mating part. The self-locking fasteners used on this equipment meet specifications necessary to allow the fasteners to be reused up to five times. Whenever a self-locking fastener is removed, the head of the fastener should be deeply scribed or otherwise marked to record the number of times the fastener has been used. Do not use a self-locking fastener more than five times.

The following table shows the minimum torque specifications allowed to remove self-locking fasteners after the initial break-away torque has been achieved. Any self locking fastener that can be removed with less than the prevailing torque value shown in the table should be discarded, even if the fastener has not yet been reused five times.

MINIMUM PREVAILING TORQUE - REMOVAL TABLE537

	Lockscrews		Locknuts			
	SAE Grade 5 & 8 and ASTM A-574		SAE Grade 5		SAE Grade 8	
Size	Nm	lbf in	Nm	lbf in	Nm	lbf in
0.25 - 20	0.3	3	0.4	3.5	0.5	4.5
0.25 - 28	0.3	3	0.4	3.5	0.5	4.5
0.31 - 18	0.6	5	0.6	5.5	0.9	7.5
0.31 - 24	0.6	5	0.6	5.5	0.9	7.5
0.38 - 16	1.0	9	1.0	8.5	1.3	11.5
0.38 - 24	1.0	9	1.0	8.5	1.3	11.5
0.44 - 14	1.4	12	1.4	12	1.8	16
0.44 - 20	1.4	12	1.4	12	1.8	16
0.50 - 13	1.8	16	1.7	15	2.3	20
0.50 - 20	1.8	16	1.7	15	2.3	20
0.56 - 12	2.5	22	2.4	21	3.2	28
0.56 - 18	2.5	22	2.4	21	3.2	28
0.62 - 11	3.4	30	3.1	27	4.1	36
0.62 - 18	3.4	30	3.1	27	4.1	36
0.75 - 10	5.1	45	4.6	41	6.1	54
0.75 - 16	5.1	45	4.6	41	6.1	54
0.88 - 9	7.3	65	7.0	62	9.3	82
0.88 - 14	7.3	65	7.0	62	9.3	82
1.00 - 8	9.6	85	9.5	84	12.7	112
1.00 - 12	9.6	85	9.5	84	12.7	112
1.00 - 14	-	-	9.5	84	12.7	112

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GENERAL

The storage of machines for short periods of time or during the off-season is an important item if major damage to components is to be avoided. Failure to take the necessary steps to protect the various assemblies while the machine is being stored can result in an expensive overhaul job and delay in returning the machine to work.

TEMPORARY STORAGE

When storing a machine for a period of 30 days or less, the following precautions must be taken:

1. INSPECTION AND REPAIR - Thoroughly inspect and test the machine and make any necessary repairs or adjustments which may be necessary to prepare the machine for service. This will enable you to put the machine back into use immediately at the end of the storage period.

2. LUBRICATION - Lubricate the machine completely according to the instructions given in Section 300-0020, LUBRICATION SYSTEM of this manual.

3. PARKING - After thoroughly cleaning the entire machine, park it on a hard, dry, level surface that is free from grease and oil. The oil and grease would cause tyre deterioration. Apply the parking brake.

4. BATTERIES - Where moderate temperatures are expected, the batteries may be left in the machine. Up to 30 days, the batteries may require a boost at the end of the storage period. Preferably place the batteries in the shop where they can be inspected, brought up to full charge and placed on a trickle charge to keep them at full charge. In very cold or hot climates, store the batteries where they will be protected from temperature extremes.

5. RUST PREVENTION - Remove all evidence of rust from the machine and repaint. In addition, cover all exposed machine surfaces with a good rust preventive.

6. SUPPLY TANKS - Fill fuel and hydraulic tanks to prevent moisture condensation within the tanks.

7. TYRES - Inflate all tyres to correct pressure. During storage, check inflation pressure approximately once every two weeks.

8. ENGINE - Consult the relevant Engine Maintenance Manual for complete information on storing the engine for periods shorter than 30 days.

9. TRANSMISSION - Fill transmission sumps to the proper level.

EXTENDED STORAGE - Under Six Months

When storing a machine for periods of longer than 30 days, but under six months, the following procedure must be followed:

1. INSPECTION AND REPAIR - Same as Step 1 given under 'Temporary Storage'.

2. LUBRICATION - Same as Step 2 given under 'Temporary Storage'.

3. PARKING - Same as Step 3 given under 'Temporary Storage'. Machines should be blocked up so the tyres are off the ground or floor.

4. BATTERIES - Remove batteries from the machine and store them in a suitable place where they can be inspected and charged at least every 30 days or placed on a trickle charger.

5. RUST PREVENTION - Same as Step 5 given under 'Temporary Storage'.

6. SUPPLY TANKS - Same as Step 6 given under 'Temporary Storage'.

7. TYRES - With the machine on blocks, as called for in Step 3, deflate the tyres to 0.7 bar (10 lbf/in^2) pressure. Remove all traces of grease and oil and protect the tyres from direct sunlight and water with a suitable cover.

8. TRANSMISSION - Consult the relevant Transmission Maintenance Manual for storage data involving periods longer than 30 days.

9. ENGINE - Consult the relevant Engine Maintenance Manual for storage data involving periods longer than 30 days.

10. VENTS AND BREATHERS - Remove all vents and breathers and plug openings with pipe plugs. If it is not possible to do this, seal vents and breathers with waterproof tape.

Courtesy of Machine.Market

Miscellaneous - Unit Storage

Section 300-0090

EXTENDED STORAGE - Over Six Months

When a machine is to be stored for a period over SIX MONTHS, the following procedure must be followed:

Note: These steps are in addition to those given previously under 'Extended Storage - Under Six Months'.

1. LUBRICATION - Completely lubricate the machine according to the instructions contained in Section 300-0020, LUBRICATION SYSTEM of this manual.

2. WHEEL BEARING - Remove, clean, inspect and repack all wheel bearings.

Note: The above steps must be repeated for every Six Month period the machine is in storage.

REMOVAL FROM EXTENDED STORAGE

General

1. LUBRICATION - Completely lubricate the machine according to the instructions in Section 300-0020, LUBRICATION SYSTEM of this manual.

2. BATTERIES - Install batteries and check for a full charge. Charge batteries as required.

3. TYRES - Inflate tyres to the proper pressures. Refer to Section 140-0040, WHEEL RIM AND TYRE, of this manual.

4. FUEL AND HYDRAULIC TANKS - Drain off condensation and fill tanks to proper level, remove breather covers and install air breathers. Be sure breathers are clean before installation.

5. VENTS AND BREATHERS - Remove seals and plugs from all breather openings, then install all breathers and vents.

6. ENGINES - Consult the relevant Engine Maintenance Manual for instructions on removing an engine from storage.

7. PAINT - Check machine for rust. Remove all rust spots and repaint rusted areas.

8. TRANSMISSION - Consult the relevant Transmission Maintenance Manual for instructions on removing from storage.

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Courtesy of Machine.Market