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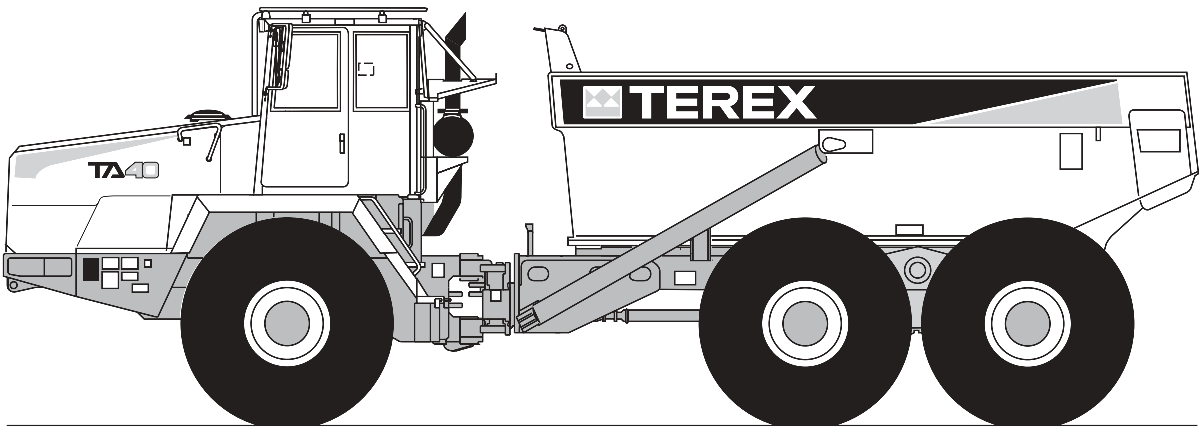
TEREX

TA40 OCDB (A820) Articulated Dumptruck Maintenance Manual



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Part No. 15275763

CUSTOMER SUPPORT DEPARTMENT
TEREX EQUIPMENT LIMITED
MOTHERWELL, SCOTLAND ML1 5RY
REF. NO. SM820

SM 2345 06-05

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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.

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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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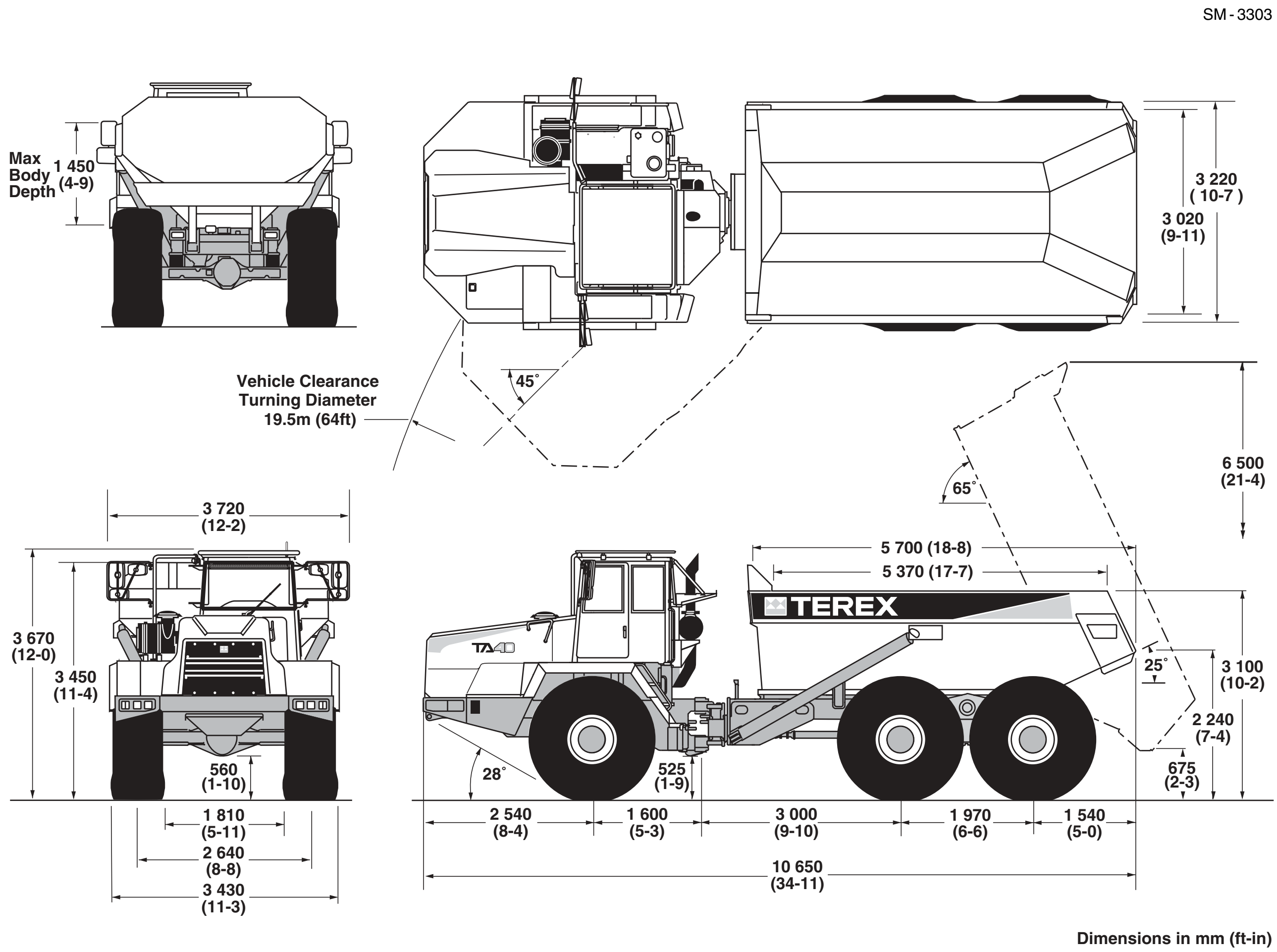

Fig. 1 - Machine Dimensions

ENGINE

Make/Model .... Detroit Diesel Series 60
Type .... Four cycle diesel, turbocharged with air-to-air charge cooling, water cooled. Electronic management.
Gross power at 2 200 rev/min ...... 332 kW (445 hp, 451 PS)
Net power at 2 200 rev/min .... 291 kW (390 hp, 395 PS)

Note: Net power is after deductions for alternator. Engine emission meets Tier II USA EPA/CARB MOH 40 CFR 89 and EU NRMM (non-road mobile machinery) directive.

Maximum Torque .... 2 000 Nm (1 475 lbf ft) at 1 350 rev/min
Number of cylinders/configuration .... 6 cylinder, in line
Bore and Stroke .... 130 x 160 mm (5.12 x 6.30 in)
Total Displacement .... 12.7 litres (774 in³)
Air cleaner .... Dry type, double element
Starting .... Electric
Maximum Speed (No load) .... 2 325 rev/min
Maximum Speed (Full load) .... 2 200 rev/min
Idle Speed .... 700 rev/min
Maximum Operating Slope .... 30° (57% Grade)

TRANSMISSION

Make/Model .... ZF 6WG 310 Automatic with manual override. The transmission consists of a torque converter close-coupled to a 6 speed gearbox with integral output transfer gearing. Automatic shifting throughout the range, with kickdown feature. Lockup 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. Integral hydraulic retarder.

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 .... 6 bar (87 lbf/in²)

Temperatures:
- Normal .... 80° - 110° C (176° - 230° F)
- Maximum .... 120° C (248° F)

Stall Speed .... 1 835 ± 50 rev/min

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

Forward						
Gear	1	2	3	4	5	6
Ratio	5.35	3.45	2.21	1.42	0.97	0.62
km/h	6.0	9.3	14.6	22.7	33.3	51.7
mile/h	3.7	5.8	9.1	14.1	20.7	32.1
Reverse						
Gear	1	2	3			
Ratio	5.35	2.21	0.97			
km/h	6.0	14.6	33.3			
mile/h	3.7	9.1	20.7			

Note: 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).

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 gearing.

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

Ratios:
Differential 4.86:1
Planetary 4.94:1
Total Reduction 24.0:1

SUSPENSION

Front: Axle located by a leading A-frame permitting both vertical movement and oscillation. Rubber cone suspension medium with heavy duty hydraulic dampers.

Axle Vertical Travel .... 105 mm (4.2 in)

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

Axle Vertical Travel .... ± 115 mm (± 4.5 in)
Axle Oscillation .... ± 9°

BRAKES

Full hydraulic braking system with enclosed, forced oil-cooled multiple discs on each wheel. Independent circuits for front and rear brake systems. Warning lights and audible alarm indicate low brake system pressure. Brake system conforms to ISO 3450, SAE J1473.

Actuating Pressure .... 138 ± 6.2 bar (2 000 ± 90 lbf/in²)
Pump Type .... Triple stage gear
Capacity at 2 200 rev/min ...... 2.02 litre/s (32 US gal/min) combined

Braking surface (tractor) ..... 802837 mm² (1244.4 in²)/brake
Braking surface (trailer) .... 535225 mm² (829.6 in²)/brake

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

Emergency: Automatic application of driveline brake should pressure fall in main brake hydraulic system. Service brakes may also be applied using the parking-emergency brake control.

Retardation: Hydraulic retarder integral with transmission.

WHEELS AND TYRES

Wheels ...... Five-piece Earthmover rims with 23 Stud Fixing
Size:
Standard .... 25 x 25.00 in for 29.5 R25** tyres
Tyres:
Standard .... 29.5 R25** Radial

Inflation Pressures (Bridgestone):

	Front	Rear
29.5 R25**	3.5 bar (51 lbf/in²)	4.25 bar (62 lbf/in²)

Inflation Pressures (Continental):

	Front	Rear
29.5 R25**	3.5 bar (51 lbf/in²)	4.25 bar (62 lbf/in²)

Inflation Pressures (Michelin):

	Front	Rear
29.5 R25**	3.0 bar (44 lbf/in²)	3.65 bar (53 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 hydraulic systems are supplied with oil from a common tank by the main hydraulic gear pump. Pump is driven from power takeoff on transmission. The components are protected by advanced full flow filtration to 5 micron particle size on the return line.

Pump capacity (at 2258 rpm)....................... 7.03 litre/s (111 US gal/min)

Steering

Hydrostatic power steering by two double-acting, cushioned steering cylinders. Actuating pressure for steering operation is supplied by the main hydraulic gear pump.

Emergency steering pressure is provided by a ground driven pump mounted on the transmission. An indicator lamp signals should the emergency system activate. Conforms to SAE J53.

System pressure .... 206 bar (3000 lbf/in²)
Steering Angle (left and right) .... 45°
Lock to Lock Turns, steering wheel 4
Clearance Turning Diameter (SAE) .... 19.5 m (64 ft)

Body

Two single-stage, double-acting hoist cylinders, cushioned at both ends of stroke. Electro servo assisted hoist control. Actuating pressure for body hoist is supplied by the main hydraulic gear pump.

System pressure .... 172 bar (2500 lbf/in²)
Control Valve .... Pilot Operated, Open Centre
Body Raise Time (loaded) .... 16 sec
Body Lower Time (power down) .... 12 sec

ELECTRICAL SYSTEM

Type .... 24 volt, Negative Ground.
Battery .... Two, 12 Volt, 175 Ah each, Maintenance Free
Accessories .... 24 Volt
Alternator .... 70 Amp

BODY

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 .... 15.0 mm (0.59 in)
Sides .... 12.0 mm (0.47 in)
Front .... 10.0 mm (0.39 in)
Volume:
Struck (SAE) .... 17.0 m³ (22.2 yd³)
Heaped 2:1 (SAE) .... 22.0 m³ (28.8 yd³)

SERVICE CAPACITIES

Fuel tank .... 463 litres (122 US gal)
Hydraulic System
(Steering, Braking & Body) .... 209 litres (55 US gal)
Brake Cooling System .... 199 litres (52.6 US gal)
Cooling System .... 80 litres (21.1 US gal)
Engine Crankcase (with filters) .... 37 litres (9.8 US gal)
Transmission (with filters) .... 56 litres (14.8 US gal)
Differential - Dana (Front) .... 37.5 litres (9.9 US gal)
Differential - Dana (Centre) .... 38 litres (10 US gal)
Differential - Dana (Rear) .... 31.5 litres (8.3 US gal)
Planetaries - Dana .... 8.5 litres (2.2 US gal)
Driveshaft Bearings .... 1.5 litres (0.4 US gal)
Air Conditioning Compressor .... 0.125 litres (0.033 US gal)

VEHICLE WEIGHTS		
Standard Vehicle	kg	lb
Net Distribution		
Front Axle	15 275	33 675
Centre Axle	7 750	17 085
Rear Axle	7 705	16 985
Net Weight	**30 730**	**67 745**
Payload	**36 500**	**80 470**
Gross Distribution		
Front Axle	20 170	44 465
Centre Axle	23 530	51 875
Rear Axle	23 530	51 875
Gross Weight	**67 230**	**148 215**
Bare Chassis	24 670	54 390
Body	5 400	11 905
Body Hoists (pair)	660	1 455

Ground Pressures

At 15% sinkage of unloaded radius and specified weights

29,5 R25	**Net**	**Loaded**
Front	102 kPa (14.8 psi)	135 kPa (19.6 psi)
Rear	52 kPa (7.5 psi)	158 kPa (22.9 psi)

* * * *

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.

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.

*   *   *   *

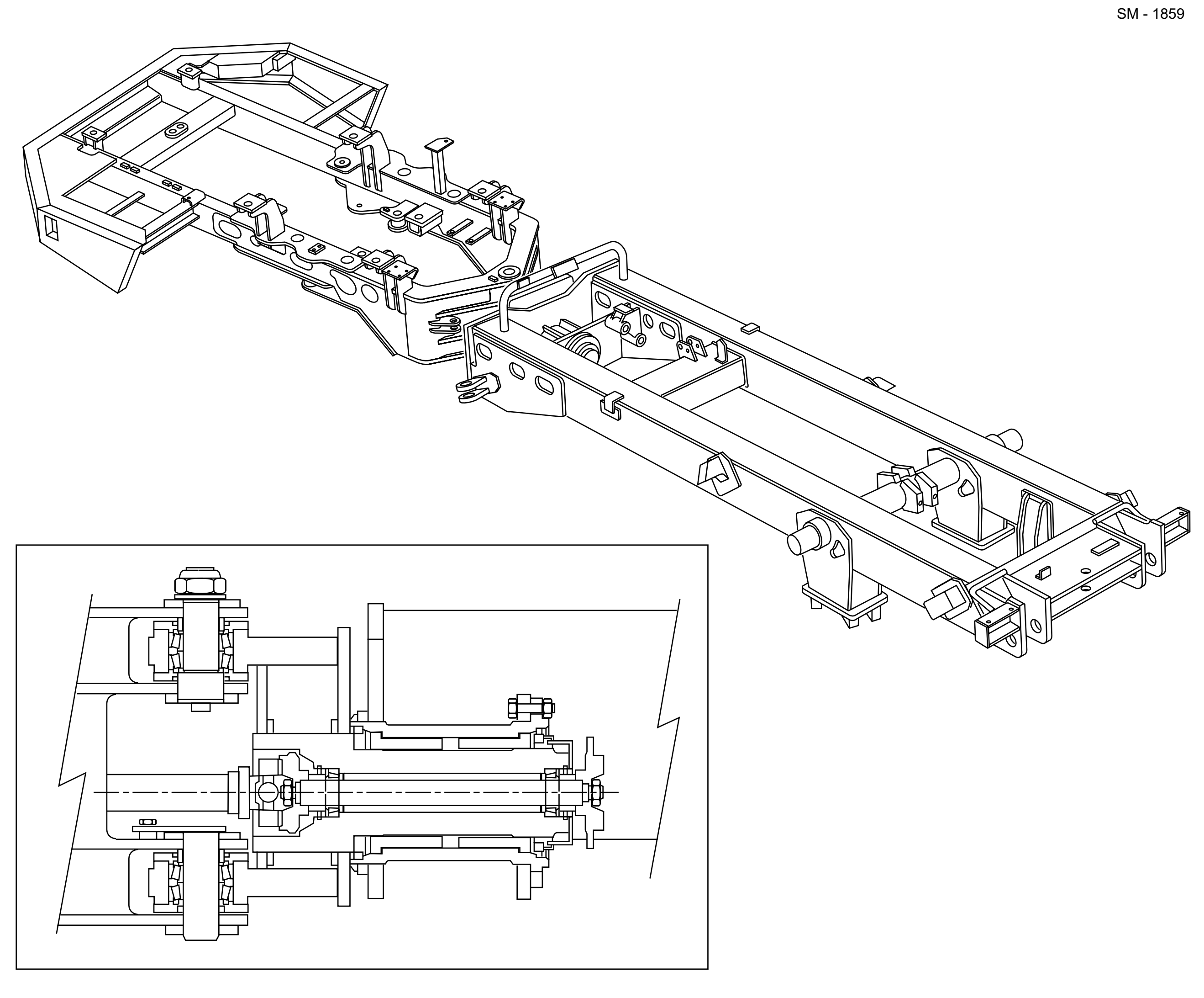

Fig. 1 - General Arrangement of Frame Assemblies

DESCRIPTION

The front and rear frames are all-welded high grade steel fabrications, with rectangular box section beams forming the main side and cross-members. These heavy duty structures are designed to withstand the severe loadings incurred when operating over rough terrain.

The front frame houses engine, transmission, hydraulic and fuel tanks and carries the cab, front suspension and front drive axle. The rear frame carries the body, body cylinders, rear suspension system and the rear drive axles.

Inter-frame oscillation is provided by a robust cylindrical coupling, carried on large nylon bushes. Steering is by frame articulation to 45 degrees either side by two widely spaced vertical pivot pins in taper roller bearings.

Note: For details on the articulation and oscillation pivot and procedures for separating the front and rear frames, refer to Section 100-0020, ARTICULATION AND OSCILLATION PIVOT.

MAINTENANCE

Note: This section covers maintenance of the front and rear frames only.

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

If the frame is not too badly sprung or twisted, hydraulic straightening and aligning equipment can be used to straighten the frame without dismantling the machine. However, if the frame is severely damaged, it will be necessary to disassemble the machine in order to repair or replace the frame assembly.

All straightening operations should be performed without application of heat if possible. If heat must be applied, do not heat the metal beyond a dull cherry red colour, as it will result in serious weakening of the frame by decreasing the tensile strength of the steel. When it is necessary to apply heat, apply it uniformly over the area to be straightened until the metal reaches a uniform colour. Protect the heated surface from drafts to prevent sudden cooling of the metal. If the frame or frame parts cannot be straightened they must be replaced.

Welding

WARNINGS
Before any welding is done on a machine equipped with the DDEC system, disconnect wiring harnesses at the ECM, 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
i - ECM interface harness connector (30 pin RHS)
j - ECM power harness connector (5 pin RHS)
k - ECM sensor harness connector (30 pin LHS)
l - ECM engine to transmission datalink connector (6 pin RHS)

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.

Reinforcement

Frame reinforcement can be made with channel, 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

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 synthetic red oxide and then a finish coat of synthetic enamel.

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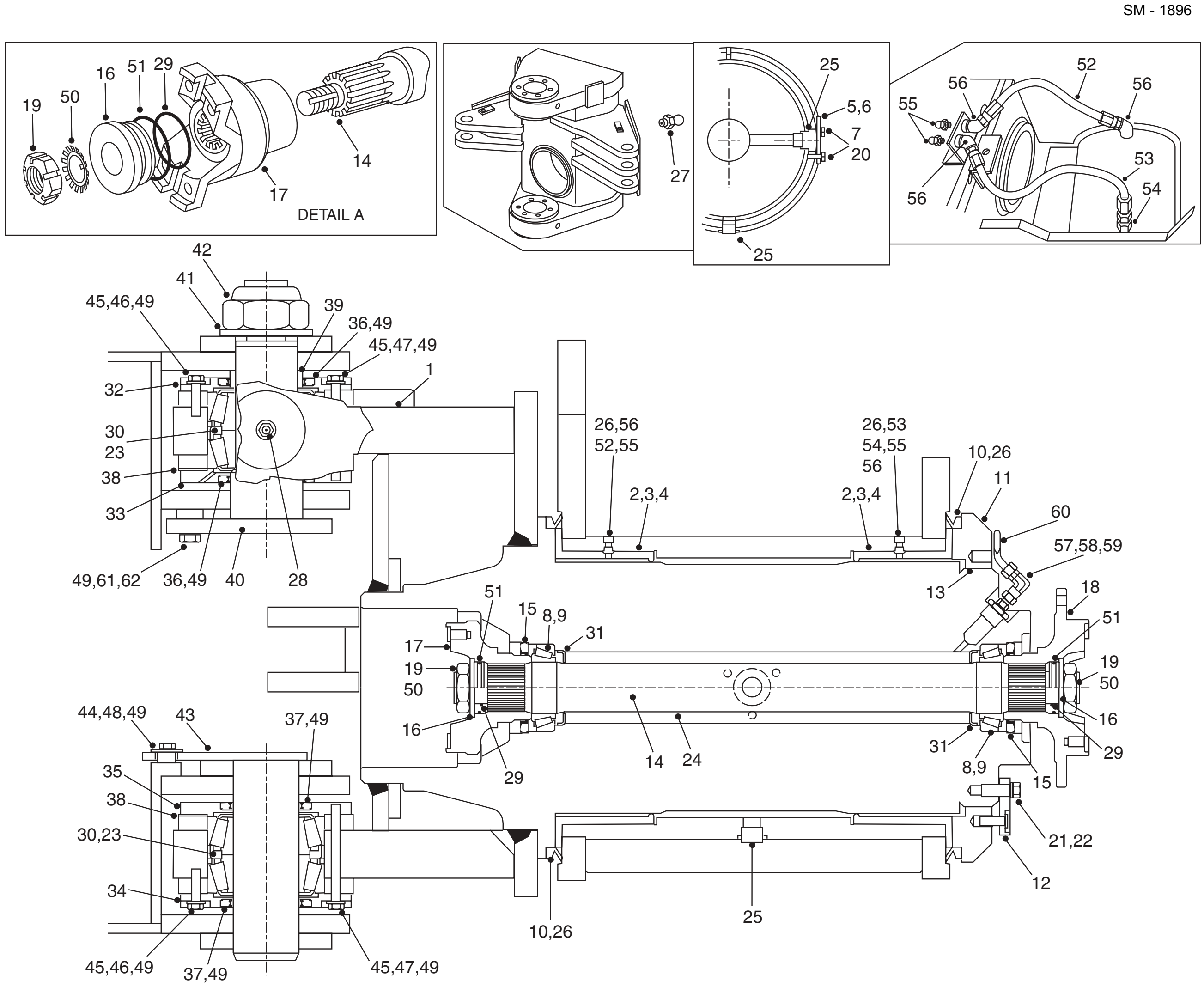

1 - Pivot Assembly
2 - Nylon Bush
3 - Loctite 648
4 - Loc Quick Primer
5 - Gasket
6 - Cover Plate
7 - Bolt
8 - Bearing Assy - Cup
9 - Bearing Assy - Cone
10 - 'V' Ring Seal
11 - Thrust Nut
12 - Locking Plate
13 - Antiseize Comp
14 - Driveshaft
15 - Seal
16 - Thrust Washer
17 - Front Yoke
18 - Brake Yoke
19 - Nut
20 - Washer
21 - Lockwasher
22 - Bolt
23 - Extreme Pressure Lithium No.2 Grease
24 - SAE 80W-90 EP Gear Oil
25 - Plug
26 - Extreme Pressure Multipurpose Grease
27 - Lube Fitting
28 - Plug
29 - 'O' Ring
30 - Bearing Assembly
31 - Retaining Ring
32 - Seal Housing
33 - Seal Housing
34 - Seal Housing
35 - Seal Housing
36 - Seal
37 - Seal
38 - Shim
39 - Spacer
40 - Upper Pin
41 - Washer
42 - Nut
43 - Lower Pin
44 - Hardened Washer
45 - Washer
46 - Bolt
47 - Bolt
48 - Bolt
49 - Loctite 243
50 - Lockwasher
51 - 'O' Ring
52 - Hose Assembly
53 - Hose Assembly
54 - Connector
55 - Lube Fitting
56 - Elbow
57 - Adaptor
58 - Connector
59 - Elbow
60 - Pipe Assembly
61 - Washer
62 - Bolt

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 bearing and associated parts can be removed, inspected and replaced or renewed by following the procedures outlined in this section.

THRU-DRIVE DRIVESHAFT

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

Note: The following procedures assume that only thru-drive components require repair.

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 blocks 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.**

Removal and Disassembly

1. Position the vehicle on a level work area and apply parking brake.

2. Raise body and install body safety prop to secure body in partially raised position.

3. Shut down engine and block all wheels securely.

4. Identify the relationship of the driveline caps to the transmission yoke and front yoke (17). Remove capscrews and remove driveline from vehicle.

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

5. Remove wheel blocks, start engine and steer vehicle into a full left-hand lock. Shut down engine and block all wheels securely.

6. Remove front nut (19), lockwasher (50) and thrust washer (16) from driveshaft (14). Reinstall nut (19) temporarily onto driveshaft (14) to protect the threads.

7. Remove and discard 'O' rings (29 & 51) from thrust washer (16).

8. Place a suitable container under the front of the pivot and pull front yoke (17) from driveshaft (14).

9. Disconnect mounting hardware securing protective guard (if fitted), from beneath the parking brake disc, to the rear frame.

10. Release the parking brake by turning the hex-head on the parking brake actuator fully anticlockwise.

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

11. Remove mounting hardware securing parking brake assembly to mounting bracket on frame, then secure parking brake assembly clear of brake disc.

12. Identify the relationship of the driveline caps to brake yoke (18). Remove capscrews, disconnect driveline and secure clear of brake yoke.

13. Withdraw driveshaft assembly (14) from housing by pulling rearwards on parking brake disc/brake yoke assembly (18). If necessary, tap front end of driveshaft (14) to ease removal, take care to avoid damaging threads. Place driveshaft (14) assembly on work bench for further disassembly.

14. Prise out and discard seal (15) from front of the housing.

15. Lift out front bearing assembly cup (8) from front of the housing.

16. If bearing replacement is required, use a suitable puller to remove front and rear bearing assembly cups (8) from the housing.

Note: If either bearing assembly cup or cone (8 or 9) need replacing, they must be replaced as a set.

17. If retaining rings (31) need replacing, use a suitable drift or puller to remove them from the housing.

18. Remove front nut (19) then temporarily install front yoke (17) fully onto front of driveshaft (14) and suitably restrain to resist rotation.

19. Remove mounting hardware securing parking brake disc to brake yoke (18) and remove brake disc.

20. Remove rear nut (19), lockwasher (50), thrust washer (16), and brake yoke (18) from driveshaft (14). Identify front and rear ends of driveshaft (14).

21. Remove and discard 'O' rings (29 & 51) from thrust washer (16).

22. Remove and discard seal (15) from driveshaft (14).

23. If bearing replacement is required, use a suitable puller or drift to remove rear bearing assembly cone (9) from driveshaft (14).

24. Reinstall nuts (19) on driveshaft (14) to protect the threads.

Inspection

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

2. Check bearing assemblies cups and cones (8 & 9) for wear or damage. Renew as necessary.

Note: If either bearing assembly cup or cone (8 or 9) need replacing, they must be replaced as a set.

3. Inspect splines of driveshaft (14) and yokes (17 & 18) for nicks, burrs or excessive wear. Replace if wear is excessive or splines are nicked. Burrs may be removed with a fine file or medium India stone.

4. Check yokes (17 & 18) for damage in region polished by oil seal lip; even slight damage in this area can cause leakage. Very slight marks may be polished out with fine emery cloth but it is essential that polishing marks are parallel to the seal lip.

5. Replace all seals and 'O' rings with new parts.

Assembly and Installation

1. If removed, use a suitable driver and install retaining rings (31) into housing, ensuring that they butt hard against abutment shoulders.

2. Using a suitable driver, install front and rear bearing assembly cups (8) into housing, ensuring that they butt hard against abutment shoulders.

3. Lightly oil both bearing assembly cones (9) with SAE 80W - 90 E. P. gear oil (24).

4. Using a suitable driver, install rear bearing assembly cone (9) on rear end of driveshaft (14). Temporarily install brake yoke (18), thrust washer (16) and nut (19) to driveshaft (14). Tighten nut (19) until the yoke (18) bottoms out on the driveshaft (14).

5. Remove nut (19), thrust washer (16) and brake yoke (18) from driveshaft (14). The distance from the end of the bearing cone (8) to the end of the spline should be approximately 57 mm.

6. Install driveshaft (14) through the housing.

7. Using a suitable driver, install front bearing assembly cone (9) on driveshaft (14).

8. Using a suitable driver, install seals (15) into ends of housing, ensuring that they butt hard against abutment shoulders.

9. Install brake yoke (18) on rear of driveshaft (14) until it butts against bearing assembly cone (9).

10. Install front yoke (17) on driveshaft (14) until it butts against bearing assembly cone (9).

11. Install 'O' rings (29 & 51) to thrust washer (16) and install assembly on front of driveshaft (14).

12. Install front nut (19) temporarily on front of driveshaft (14).

13. Install 'O' rings (29 & 51) to thrust washer (16) and install assembly on rear of driveshaft (14).

14. Install nut (19) and lockwasher (50) to rear threads of driveshaft (14). Prevent driveshaft (14) from turning by restraining brake yoke (18).

15. Tighten nut (19) and bend at least one lockwasher (50) tab into nut (19). If required back off nut (19) until the first available tab lines up with a slot in the nut (19).

16. Tighten nut (19) at front of driveshaft (14) to a torque of 250 Nm (180 lbf ft) to seat bearing cup and cone assemblies (9 & 8).

17. Chap driveshaft (14) at both ends with a hide-faced hammer. Re-torque nut (19) to 250 Nm (180 lbf ft).

18. Back off nut (19) four flats, and chap rear end of driveshaft (14) with a hide-faced hammer to remove pre-load from bearing cup and cone assemblies (9 & 8).

19. Remove nut (19) from front of driveshaft (14), install lockwasher (50) and reinstall nut (19).

20. Set up dial indicator with pointer positioned on end face of driveshaft (14). Push and pull on parking brake disc to move driveshaft (14) backwards and forwards, remembering to rotate shaft at the same time to obtain an accurate reading. Note dial indicator reading.

21. Tighten nut (19) until end play on driveshaft (14) can just be felt. Take dial indicator reading of end play. Tighten nut (19) until end play on driveshaft (14) is 0.05 - 0.15 mm (0.002 - 0.006 in).

Note: One flat on nut (19) turned is equivalent to 0.025 mm (0.001 in).

22. When correct end play is obtained, remove dial indicator and secure nut (19) by bending the first available lockwasher (50) tab into nut (19). Recheck end play.

23. Install parking brake disc on brake yoke (18) and secure with bolts and washers. Tighten bolts to a torque of 73 Nm (54 lbf ft).

24. Install parking brake assembly to mounting brackets and secure with bolts, washers and nuts. Refer to Section 170-0010, PARKING BRAKE AND MOUNTING.

25. Apply parking brake by turning the hex-head on the parking brake actuator fully clockwise.

26. Apply Loctite 638 to the threads of capscrews used to mount driveline to brake yoke (18). Align match marks and install driveline. Tighten capscrews to a torque of 153 Nm (113 lbf ft).

27. Apply Loctite 638 to the threads of capscrews used to mount driveline between transmission yoke and front yoke (17). Align match marks and install driveline. Tighten capscrews to a torque of 153 Nm (113 lbf ft).

28. Remove bolts (7), washers (20), gasket (5) and cover plate (6) from side of oscillation hub to gain access to filler/level hole plug (25) on pivot assembly (1). Remove filler/level plug (25).

29. Add SAE 80W - 90 E. P. gear oil (24) through filler/ level hole in pivot assembly (1) until the oil is level with the bottom of filler/level hole.

30. Remove plug (25) from underside of oscillation hub to drain the cavity between the oscillation hub and pivot assembly (1) of any oil that entered while filling the driveshaft bearing housing.

31. Install plug (25) into filler/level hole on pivot assembly (1). Install gasket (5) and cover plate (6) on side of oscillation hub, secure with bolts (7) and washers (20).

32. Install plug (25) into cavity drain port on underside of oscillation hub.

33. Install parking brake disc protective guard (if fitted) and secure with bolts, washers and nuts. Tighten nuts to a torque of 73 Nm (54 lbf ft).

34. Start engine, raise body, lower body safety prop and lower body.

35. Remove wheel blocks.

ARTICULATION COMPONENTS

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

Note: The following procedures assume that only components associated with articulation require repair.

Note: It is essential that the grease used for articulation components is Extreme Pressure Lithium Complex No. 2 (23), as specified in Section 300-0020, LUBRICATION SYSTEM.

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 blocks, 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.**

Disconnecting Front and Rear Frames

Note: The front and rear frames can be separated sufficiently to permit disassembly/assembly of the articulation components without disconnecting hydraulic lines or electrical wiring.

1. Position the vehicle on a level work area and apply parking brake.

2. Raise body and install body safety prop to secure body in partially raised position.

3. Shut down engine and block all wheels securely.

4. Identify the relationship of the driveline caps to the

transmission yoke and front yoke (17). Remove capscrews and remove driveline from vehicle.

5. Support tractor frame at front and rear with suitably placed stands or timbers so the frame will remain level during and after pin removal.

6. Remove bolts, washers and pins securing steering cylinders to pivot. Secure steering cylinders clear of pivot.

7. Release the parking brake by turning the hex-head on the parking brake actuator fully anticlockwise.

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

8. Attach suitable lifting equipment to pivot/rear frame assembly. Lifting equipment must prevent pivot from oscillating after separation, and, be capable of pulling pivot/rear frame assembly clear of front frame. Raise lifting equipment to support pivot/rear frame assembly.

9. Remove bolt (62), washer (61), large nut (42) and washer (41) securing upper pin (40).

10. Remove upper pin (40). If necessary tap upper pin (40) to ease removal taking care to avoid damaging the threads.

Note: It may be necessary to relieve binding between the pin and pin bores by raising or lowering the pivot/ rear frame assembly.

11. Remove bolt (48) and hardened washer (44) securing lower pin (43).

12. Remove lower pin (43). If necessary tap lower pin (43) to ease removal taking care to avoid damaging the pin.

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

13. Remove blocks from rear wheels and use lifting equipment to pull pivot/rear frame assembly clear of the front frame. After moving, block pivot/rear frame assembly and block the wheels.

14. Remove spacer (39) noting orientation to ensure correct installation.

Disassembly

1. Identify seal housings (32, 33, 34 & 35) to ensure correct location on assembly/installation.

Note: Seal housings (32, 33, 34 & 35) are not interchangeable.

2. Remove bolts (46 & 47), washers (45), seal housings (32, 33, 34 & 35) and upper and lower shims (38).

3. Prise out and discard seals (36 & 37) from the housings.

4. Remove and tag all bearing assemblies (30) with spacers to ensure correct assembly/installation.

Note: Bearing assemblies (30) and spacers are a matched set, never interchange cups, cones or spacers between sets.

Inspection

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

2. Check bearing assemblies (30) and spacers, and pins (40 & 43) for wear or damage. Renew as necessary.

Note: Bearing assemblies (30) and spacers must be renewed as a matched set.

3. Replace all seals with new parts.

Assembly

1. Apply Loctite 243 (49) sparingly to bore of seal housings (32, 33, 34 & 35).

2. Using a suitable driver, install seals (36 & 37) into seal housings (32, 33, 34 & 35) ensuring that the metal ring on inside of the seals are not disturbed, and, that they are located towards the inside of seal housing.

3. Apply Loctite 243 (49) to threads of outer seal housing bolts (46).

4. Place outer seal housings (32 & 34) in position ensuring that grease relief hole in seal housings are directly opposite bearing grease port on pivot. Secure with bolts (46) and washers (45). Tighten bolts (46) to a torque of 94 Nm (68 lbf ft).

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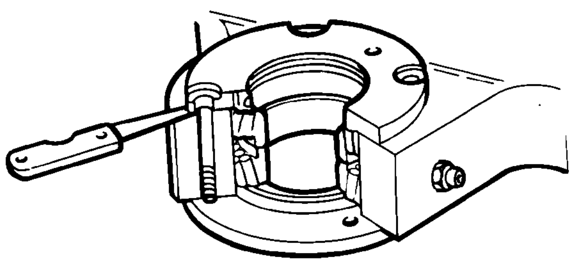

Fig. 2 - Determining Shim Thickness

Note: Bearing assemblies (30) and spacers are a matched set, never interchange cups, cones or spacers between sets.

5. Using Extreme Pressure Lithium Complex No. 2 grease (23), pack bearing assemblies (30), including end faces, and install bearings.

6. Place inner seal housings (33 & 35) temporarily in position and secure with bolts (47) and washers (45). Tighten bolts (47) to a torque of 16 Nm (12 lbf ft).

7. Using feeler gauges, as shown in Fig. 2, measure the dimension between the inner pivot faces and seal housings (33 & 35). Measure at 3 positions equally spaced around seal housings and determine average dimension, this is the size of shims (38) required.

8. Remove bolts (47), washers (45) and inner seal housings (33 & 35).

9. Install shims (38) as calculated at Step 7, reinstall inner seal housings (33 & 35) and secure with bolts (47) and washers (45). Tighten bolts (47) to a torque of 94 Nm (68 lbf ft).

Connecting Front and Rear Frames

1. Install spacer (39) in upper outer seal housing (32), as noted on removal.

2. Smear bearing and pin bores with Extreme Pressure Lithium Complex No. 2 grease (23).

3. Attach suitable lifting equipment to pivot/rear frame assembly. Lifting equipment must prevent pivot from oscillating and be capable of pulling pivot/rear frame assembly to align pivot bearing bores and front frame pin bores. Raise lifting equipment to support pivot/rear frame assembly.

4. Remove blocks from rear wheels and blocking from pivot/rear frame assembly. Using lifting equipment, pull pivot/rear frame assembly to align pivot bearing bores and front frame pin bores. Block wheels and block pivot/rear frame assembly to remain level and stationary.

5. Freeze upper and lower pins (40 & 43) to ease installation.

6. Smear lower pin (43) with Extreme Pressure Lithium Complex No. 2 grease (23) and install through front frame and bearing bores.

Note: It may be necessary to relieve binding between the pin and pin bores by raising or lowering pivot/rear frame assembly.

7. Apply Loctite 243 (49) to threads of bolt (48) and secure lower pin (43) with bolt (48) and hardened washer (44). Tighten bolt (48) to a torque of 73 Nm (54 lbf ft).

8. Smear upper pin (40) with Extreme Pressure Lithium Complex No. 2 grease (23) and install through front frame and bearing bores.

9. Apply Loctite 243 (49) to threads of bolt (62). Secure upper pin (40) with bolt (62), washer (61), large nut (42) and washer (41). Tighten nut (42) to a torque of 1 425 Nm (1 050 lbf ft).

Final Assembly

1. Apply parking brake by turning the hex-head on the parking brake actuator fully clockwise.

2. Remove lifting equipment from pivot/rear frame assembly.

3. Remove stands or timbers from front frame.

4. Apply Loctite 270 to the threads of capscrews used to mount driveline between transmission yoke and front yoke (17). Align match marks and install driveline. Tighten capscrews to a torque of 153 Nm (113 lbf ft).

5. Align steering cylinder bores and mounting pin bores on pivot, install pins and secure with bolts and washers. Tighten bolts to a torque of 73 Nm (54 lbf ft).

6. Remove plugs (28) from articulation bearing grease ports and replace with lube fittings (27).

Note: Lube fittings (27) are stored on pad on side of pivot assembly (1).

7. Fill bearing housings with Extreme Pressure Lithium Complex No. 2 grease (23), through lube fittings (27), until excess grease starts to escape from seal housings (32 & 34).

8. Remove lube fittings (27) and reinstall plugs (28). Store lube fittings (27) on pad on side of pivot assembly (1).

9. Start engine, raise body, lower body safety prop and lower body.

10. Remove wheel blocks.

OSCILLATION COMPONENTS

Numbers in parentheses refer to Fig. 1.

Note: The following procedure assumes that only components associated with oscillation require repair.

Note: It is necessary to disconnect the front and rear frames at the articulation point to service the oscillation components.

Note: It is essential that the grease used for oscillation components is Extreme Pressure Multipurpose Grease (26), as specified in Section 300-0020, LUBRICATION SYSTEM.

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 blocks, 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.**
>
> ⚠ **Hydraulic fluid pressure will remain within the braking system after engine shut down. Operate the treadle pedal continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.**

Disconnecting Front and Rear Frames

1. Position the vehicle on a level work area and apply parking brake.

2. Raise body and install body safety prop to secure body in partially raised position.

3. Shut down engine and block all wheels securely.

4. Depress and release brake pedal continuously to relieve the pressure in the braking system.

5. Carefully loosen brake lines at base of both accumulators to check that the pressure has released. Re-tighten brake lines.

6. Tag all hydraulic lines and electrical wiring between front and rear frames to ensure correct assembly/ installation. Disconnect all hydraulic lines and plug openings to prevent ingress of dirt. Disconnect electrical wiring and any other attachments which could be damaged on separation of front and rear frames.

7. Identify the relationship of the driveline caps to the transmission yoke and front yoke (17). Remove capscrews and remove driveline from the vehicle.

8. Support tractor frame at front and rear with suitably placed stands or timbers to keep the frame level during and after pin removal.

9. Remove bolts, washers and pins securing steering cylinders to pivot. Secure steering cylinders clear of pivot.

10. Release the parking brake by turning the hex-head on the parking brake actuator fully anticlockwise.

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

11. Attach suitable lifting equipment to pivot/rear frame assembly. Lifting equipment must prevent pivot from oscillating after separation, and, be capable of pulling pivot/rear assembly clear of front frame. Raise lifting equipment to support pivot/rear frame assembly.

12. Remove bolt, washer, large nut (42) and washer (41) securing upper pin (40).

13. Remove upper pin (40). If necessary tap upper pin (40) to ease removal taking care to avoid damaging the threads.

Note: It may be necessary to relieve binding between the pin and pin bores by raising or lowering the pivot/ rear frame assembly.

14. Remove bolt (48) and hardened washer (44) securing lower pin (43).

15. Remove lower pin (43). If necessary tap lower pin (43) to ease removal taking care to avoid damaging the pin.

16. Remove blocks from rear wheels and use lifting equipment to pull pivot/rear frame assembly clear of the front frame. After moving, block pivot/rear frame assembly and block the wheels.

17. Remove spacer (39) noting orientation to ensure correct installation. Cover articulation bearings to prevent ingress of dirt.

Disassembly

1. Remove protective guard (if fitted) from beneath parking brake disc by removing mounting hardware securing guard to the rear frame. Refer to Section 170-0010, PARKING BRAKE AND MOUNTING.

2. Remove mounting hardware securing parking brake assembly to mounting bracket on frame. Remove and secure parking brake assembly clear of brake disc.

3. Identify the relationship of the driveline caps to brake yoke (18). Remove capscrews, disconnect driveline and secure clear of brake yoke (18).

4. Remove mounting hardware securing parking brake disc to brake yoke (18) and remove brake disc.

5. Place a suitable container under rear brake yoke (18) to catch oil released when pulling brake yoke (18) from driveshaft (14).

6. Remove rear nut (19) and thrust washer (16) from driveshaft (14) and pull brake yoke (18) from driveshaft (14). Reinstall nut (19) on driveshaft (14) to protect the threads.

7. Remove adaptor (57), connector (58), elbow (59) and pipe assembly (60) from oscillation hub.

8. Remove bolts (22) and washers (21) securing locking plate (12). Remove locking plate (12).

9. Restrain pivot assembly (1) to prevent it oscillating, by placing a heavy bar between the steering cylinder mountings. Lock the bar in position using suitable trestles or stands. See Fig. 3.

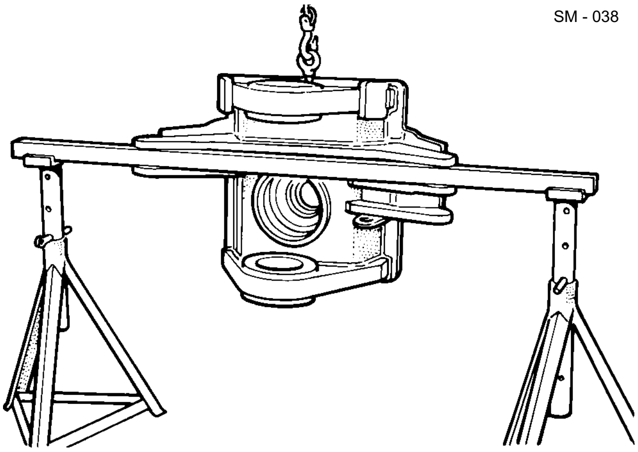

Fig. 3 - Preventing Pivot Assembly From Oscillating

10. Using a suitable tool, remove thrust nut (11). If wear area of thrust nut (11) is damaged, replace thrust nut (11).

11. Insert an M20 eyebolt into tapped pad provided on top of pivot assembly (1) and attach suitable lifting equipment.

12. Remove pivot restraining bar.

13. Using lifting equipment, carefully pull pivot assembly (1) clear of oscillation hub. Place pivot assembly (1) in a suitable work area for further disassembly.

14. Reinstall thrust nut (11) on pivot assembly (1) to protect the threads.

15. Note position of front 'V' ring (10) to aid in 'Installation'. Remove and discard 'V' ring (10).

16. Inspect nylon oscillation bushes (2) as described in 'Inspection'. If bushes are to be renewed, proceed with step 17.

17. Remove nylon oscillation bushes (2) 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

1. Clean nylon oscillation bushes with a suitable solvent and allow to dry.

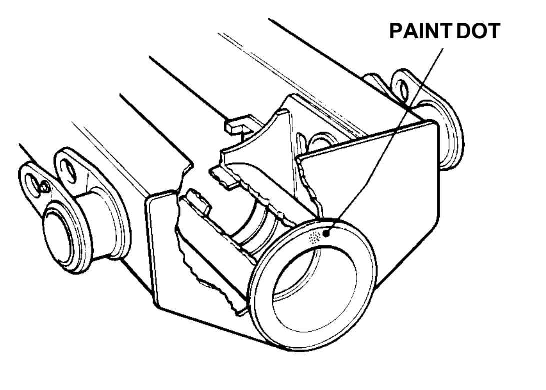

Fig. 4 - Installing Oscillation Bushes

2. Inspect nylon oscillation bushes 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.

3. Replace all seals with new parts.

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.

> ⚠ **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. Wipe bush housing clean using a suitable solvent and allow to dry.

2. Apply Loctite 648 (3) and Loc Quick Primer (4) and align new bushes (2) to housing with grease holes aligned vertically and identification 'PAINT DOT' at Top Dead Centre. Refer to Fig. 4. Drift bushes (2) into housing using hammer with soft packing for protection.

3. Install plug (25) in filler/level hole on pivot assembly (1). Install gasket (5) and cover plate (6) on side of oscillation hub and secure with bolts (7) and washers (20).

4. Install plug (25) in cavity drain port on underside of oscillation hub.

5. Install plugs (28) into oscillation bearing grease ports.

6. Lightly coat 'V' ring (10) and machined surfaces of pivot with Extreme Pressure Multipurpose Grease (26) and, install 'V' ring (10), with lip towards rear, on front of oscillation hub.

7. Using suitable lifting equipment, and taking care to prevent damaging bushes (2) or pivot threads, install pivot assembly (1) into rear frame.

8. Lightly coat 'V' ring (10) and machined surfaces of pivot with Extreme Pressure Multipurpose Grease (26) and, install 'V' ring (10), with lip towards front, on rear of oscillation hub.

9. Thread thrust nut (11) on pivot assembly (1) and tighten as follows:

a) Restrain pivot assembly (1) to prevent it oscillating, by placing a heavy bar between the steering cylinder mountings. Lock the bar in position using suitable trestles or stands. See Fig. 3.

b) Secure a suitable tool to pivot thrust nut (11) and tighten thrust nut (11) until there is no end float/ clearance at thrust face of either bush. Slacken thrust nut (11) until pin of the locking plate (12) can be inserted in the first available hole in the thrust nut (11).

c) Secure locking plate (12) with bolts (22) and lockwashers (21). Torque tighten bolts (22) to 94 Nm (69 lbf ft).

10. Install adaptor (57), connector (58), elbow (59) and pipe assembly (60) to oscillation hub.

11. Install brake yoke (18) on driveshaft (14) until it butts against bearing assembly cup and cone (8 & 9).

12. Install parking brake disc on brake yoke (18) and secure with bolts, washers and nuts. Tighten bolts to a torque of 73 Nm (54 lbf ft).

13. Install thrust washer (16) on rear of driveshaft (14).

14. Install nut (19) at rear of driveshaft (14), and tighten nut (19) to a torque of 250 Nm (180 lbf ft) to seat bearing cup and cone (8 & 9) assemblies.

15. Chap driveshaft (14) at both ends with a hide-faced hammer. Re-torque nut (19) to 250 Nm (180 lbf ft).

16. Back off nut (19) four flats, and chap rear end of driveshaft (14) with a hide-faced hammer to remove

pre-load from bearing cup and cone assemblies (8 & 9).

17. Remove nut (19) from rear of driveshaft (14), install lockwasher (50) and reinstall nut (19).

18. Set up dial indicator with pointer positioned on rear end face of driveshaft (14). Push and pull on parking brake disc to move driveshaft (14) backwards and forwards, remembering to rotate shaft at the same time to obtain an accurate reading. Note dial indicator reading.

19. Tighten nut (19) until end play on driveshaft (14) can just be felt. Take dial indicator reading of end play. Tighten nut (19) until end play on driveshaft (14) is 0.05 - 0.15 mm (0.002 - 0.006 in).

Note: One flat on nut (19) turned is equivalent to 0.025 mm (0.001 in) axial movement.

20. When correct end play is obtained, remove dial indicator and secure nut (19) by bending the first available lockwasher (50) tab into nut (19). Recheck end play.

Connecting Front and Rear Frames

1. Install spacer (39) in upper bearing assembly (30) as noted on removal.

2. Smear bearing assembly (30) and pin bores with Extreme Pressure Lithium Complex No. 2 grease (23).

3. Attach suitable lifting equipment to pivot/rear frame assembly. Lifting equipment must prevent pivot from oscillating and be capable of pulling pivot/rear frame assembly to align pivot bearing bores and front frame pin bores. Raise lifting equipment to support pivot/rear frame assembly.

4. Remove blocks from rear wheels and blocking from pivot/rear frame assembly. Using lifting equipment, pull pivot/rear frame assembly to align pivot bearing bores and front frame pin bores. Block wheels and block pivot/rear frame assembly to remain level and stationary.

5. Freeze upper and lower pins (40 & 43) to ease installation.

Note: It may be necessary to relieve binding between the pin and pin bores by raising or lowering pivot/rear frame assembly.

6. Smear lower pin (43) with Extreme Pressure Lithium Complex No. 2 grease (23) and install through front frame and bearing bores.

7. Apply Loctite 243 (49) to threads of bolt (48). Secure lower pin (43) with bolt (48) and hardened washer (44). Tighten bolt (48) to a torque of 73 Nm (54 lbf ft).

8. Smear upper pin (40) with Extreme Pressure Lithium Complex No. 2 grease (23) and install through front frame and bearing bores.

9. Apply Loctite 243 (49) to threads of bolt (62). Secure upper pin (40) with bolt (62), washer (61), washer (41) and large nut (42). Tighten nut (42) to a torque of 1 425 Nm (1 050 lbf ft).

Final Assembly

1. Install parking brake assembly to mounting brackets and secure with bolts, washers and nuts. Refer to Section 170-0010, PARKING BRAKE AND MOUNTING.

2. Apply parking brake by turning the hex-head on the parking brake actuator fully clockwise.

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

3. Remove lifting equipment from pivot/rear frame assembly.

4. Remove stands or timbers from front frame.

5. Apply Loctite 270 to threads of capscrews used to mount driveline between transmission yoke and front yoke (17). Align match marks and install driveline. Tighten capscrews to a torque of 153 Nm (113 lbf ft).

6. Align match marks and reconnect driveline to brake yoke (18). Tighten capscrews to a torque of 153 Nm (113 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.

7. Align steering cylinder bores and mounting pin bores on pivot. Install pins and secure with bolts and washers. Tighten bolts to a torque of 73 Nm (54 lbf ft).

8. Connect hydraulic lines and electrical wiring as noted on disassembly.

9. Remove bolts (7), washers (20), gasket (5) and cover plate (6) from side of oscillation hub to gain access to filler/level plug (25) on pivot assembly (1). Remove filler/level plug (25).

10. Add SAE 80W - 90 E. P. gear oil (24) through filler/level hole in pivot assembly (1) until the oil is level with the bottom of filler/level hole.

11. Remove plug (25) from underside of oscillation hub to drain the cavity between the oscillation hub and pivot assembly (1) of any oil that entered while filling the driveshaft bearing housing.

12. Install plug (25) in filler/level hole on pivot assembly (1). Install gasket (5) and cover plate (6) on side of oscillation hub, secure with bolts (7) and washers (20).

13. Install plug (25) in cavity drain port on underside of oscillation hub.

14. Remove plugs (28) from articulation bearing grease ports and replace with lube fittings (27).

Note: Lube fittings (27) are stored on pad on side of pivot assembly (1).

15. Fill bearing housings with Extreme Pressure Lithium Complex No. 2 grease (23) through lube fittings (27) until excess grease starts to escape from seal housings (32 & 34).

16. Remove lube fittings (27) and reinstall plugs (28). Store grease fittings (27) on pad on side of pivot assembly (1).

17. Add Extreme Pressure Multipurpose grease (26) to oscillation bushing lube fittings (55) on top of oscillation hub. Lube until excess grease in seen.

18. Install parking brake disc protective guard (if fitted) and secure with bolts, washers and nuts. Tighten nuts to a torque of 73 Nm (54 lbf ft).

19. Start engine to charge hydraulic systems, raise body, lower body safety prop and lower the body.

20. Bleed the braking system as described in Section 165-0010, BRAKE PARTS.

21. Remove wheel blocks.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

Every 250 hours, oscillation bushes must be lubricated. Add Extreme Pressure Multipurpose grease (26) to oscillation bushing lube fittings (55) on top of oscillation hub. Lube until excess grease in seen.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, be sure wheel blocks are properly secured and of adequate capacity to do the job safely.**

Every 250 hours, check the end float/clearance at the thrust face of the oscillation bushes. Any clearance found must be removed by adjustment of the thrust nut, as described in step 9 of 'Assembly' procedure.

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.

Every 1 000 hours (6 months), follow the procedure given below to check the oil level in the driveshaft bearing housing, and, lubricate the articulation and oscillation bearings.

Note: It is essential that the grease used for articulation components is Extreme Pressure Lithium Complex No. 2 grease (23), as specified in Section 300-0020, LUBRICATION SYSTEM.

1. Position the vehicle on a level work area and apply parking brake.

2. Raise body and install body safety prop to secure body in partially raised position.

3. Shut down engine and block all wheels securely.

4. Remove protective guard (if fitted) from beneath parking brake disc by removing nuts, washers and bolts securing guard to rear frame.

5. Remove bolts (7), washers (20), gasket (5) and cover plate (6) from side of oscillation hub to gain access to filler/level plug (25) on pivot assembly (1). Remove filler/level plug (25).

6. Add SAE 80W - 90 E. P. gear oil (24) through filler/level hole in pivot assembly (1) until the oil is level with the bottom of filler/level hole.

7. Remove plug (25) from underside of oscillation hub to drain the cavity between the oscillation hub and pivot assembly (1) of any oil that entered while filling the driveshaft bearing housing.

8. Install plug (25) into filler/level hole on pivot assembly (1). Install gasket (5) and cover plate (6) on side of oscillation hub, secure with bolts (7) and washers (20).

9. Install plug (25) into cavity drain port on underside of oscillation hub.

10. Remove plugs (28) from articulation bearing grease ports and replace with lube fittings (27).

Note: Lube fittings (27) are stored on pad on side of pivot assembly (1).

11. Fill bearing housings with Extreme Pressure Lithium Complex No. 2 grease (23) through lube fittings (27) until excess grease starts to escape from seal housings (32 & 34).

12. Remove lube fittings (27) and reinstall plugs (28). Store grease fittings (27) on pad on side of pivot assembly (1).

13. Add Extreme Pressure Multipurpose grease (26) to oscillation bushing lube fittings (55) on top of oscillation hub. Lube until excess grease in seen.

14. Install parking brake disc protective guard (if fitted) and secure with bolts, washers and nuts. Torque tighten nuts to 73 Nm (54 lbf ft).

15. Start engine, raise body, lower body safety prop and lower body.

16. Remove wheel blocks.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of the thrust nut tool and general service tools and adhesives required for procedures outlined in this section. These tools and adhesives are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS

FIG. No.	ITEM No.	ITEM NAME	TORQUE Nm	TORQUE lbf ft
1	19	Nut (to seat bearing only)	250	180
1	22	Bolt	94	69
1	42	Nut	1 425	1 050
1	46 & 47	Bolt	94	68
1	48	Bolt	73	54
-	-	Parking Brake Disc Bolts	73	54
-	-	Parking Brake Brkt Mounting Nuts	680	490
-	-	Driveline Mounting Capscrews	153	113
-	-	Protective Guard Mounting Nuts	73	54
-	-	Steering Cylinder Pin Bolts	73	54

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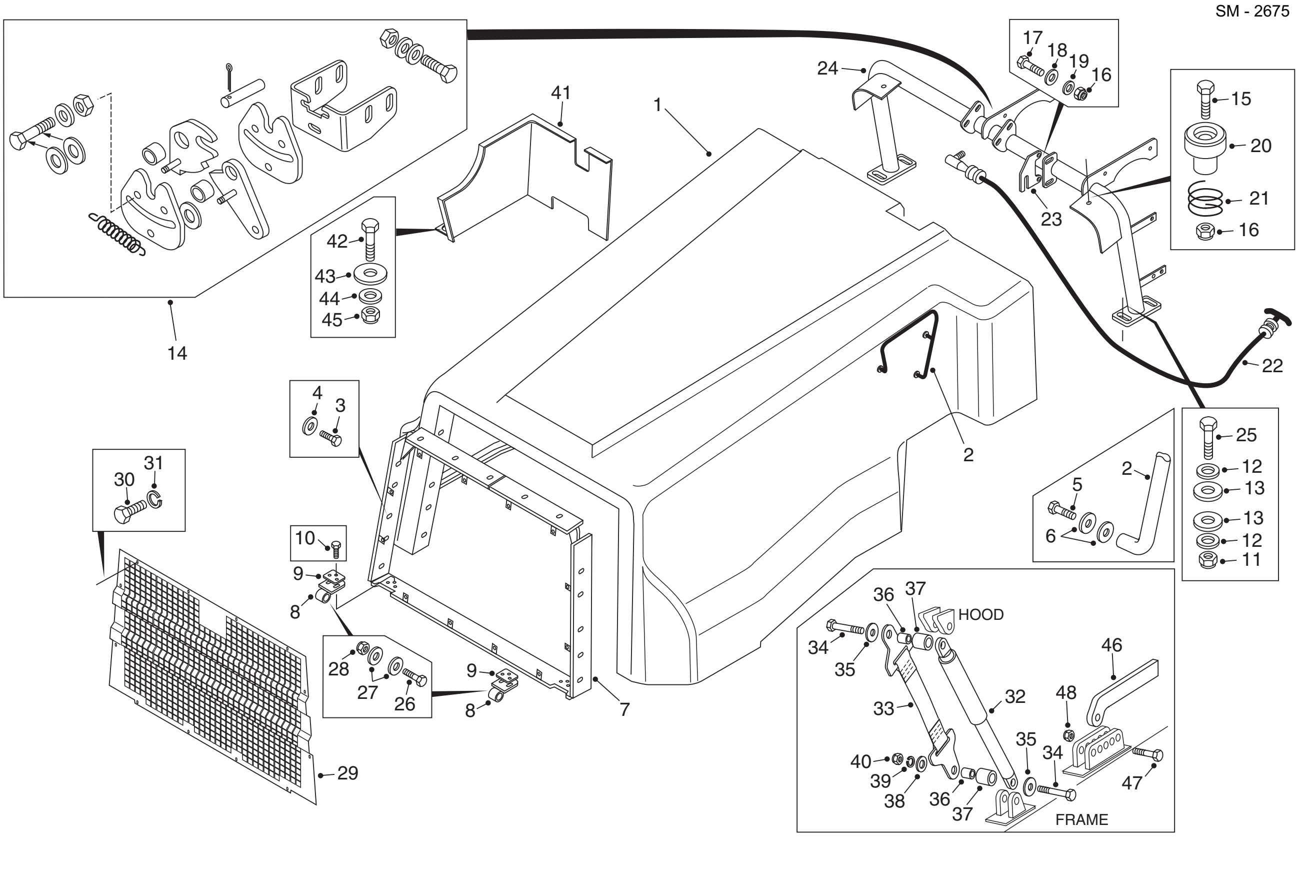


1 - Hood	13 - Washer	25 - Bolt	37 - Tube
2 - Handle - LH	14 - Hoodcatch Kit	26 - Bolt	38 - Washer
3 - Bolt	15 - Bolt	27 - Washer	39 - Lockwasher
4 - Washer	16 - Locknut	28 - Locknut	40 - Locknut
5 - Bolt	17 - Bolt	29 - Grille	41 - Hood Blanking Piece
6 - Washer	18 - Washer	30 - Bolt	42 - Bolt
7 - Grille Subframe	19 - Hardened Washer	31 - Lockwasher	43 - Washer
8 - Hinge Assembly	20 - Hood Stop	32 - Gas Strut	44 - Hardened Washer
9 - Plate	21 - Spring	33 - Hood Strap	45 - Locknut
10 - Bolt	22 - Cable Assembly	34 - Bolt	46 - Hood Safety Bar
11 - Locknut	23 - Plate	35 - Hardened Washer	47 - Bolt
12 - Washer	24 - Goalpost Assembly	36 - Tube	48 - 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 (30) and lockwashers (31) securing grille (29) to grille subframe (7). Secure grille (29) clear of hood (1).

4. Pull cable assembly (22), 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 bolts (34), hardened washers (35), tubes (36 & 37), washers (38), lockwashers (39) and nuts (40).

6. Remove hood straps (33) and gas struts (32) from hood.

7. Remove bolts (26), washers (27) and nuts (28) securing hinges (8) to frame and lift hood (1) assembly from the machine.

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

9. If required, remove mounting hardware (5 & 6) securing handle (2) to hood (1). Secure handle (2) 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 handle (2) to hood (1) using mounting hardware (5 & 6) as removed at 'Removal'.

2. If removed, secure grille subframe (7) to hood (1) with bolts (3) and washers (4).

3. Using suitable lifting equipment, lift and position hood (1) on the machine and align holes in hinges (8) with mounting holes on frame. Secure hood (1) using bolts (26), washers (27) and locknuts (28).

4. Carefully install hood straps (33) and gas struts (32) using mounting hardware (34 - 40) as removed at 'Removal'.

5. Remove lifting equipment and lower hood (1) to match with goalpost assembly (24).

6. Install grille (29) to hood (1) and secure using bolts (30) and lockwashers (31).

7. Remove wheel blocks.

GOALPOST 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 (22), handle inside cab, to release hood catch and lift up hood (1).

4. Remove mounting hardware securing washer bottle to mounting bracket on the left hand side of goalpost assembly (24). Secure washer bottle clear of goalpost assembly (24).

5. 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.

6. 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.

7. Note routing of all hoses and harnesses attached to goalpost assembly (24) and disconnect.

8. Disconnect ball joint from cam assembly in hoodcatch kit (14) and secure cable assembly (22) clear of lock mechanism.

9. Check to make certain that all necessary line and cable disconnections have been made, before lifting goalpost assembly (24).

10. Attach suitable lifting equipment to goalpost assembly (24). Remove bolts (25), washers (12), washers (13) and locknuts (11) securing goalpost assembly (24) to its mounting. Lift goalpost assembly (24) from the machine.

11. If required, remove locknuts (16), bolts (15), hood stops (20) and springs (21) from goalpost assembly (24).

12. If required, remove mounting hardware securing hood blanking piece (41) to right hand fender. Remove hood blanking piece (41) 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 hood blanking piece (41) to right hand fender with mounting hardware as removed at 'Removal'.

2. If removed, secure hood stops (20) and springs (21) to goalpost assembly (24) with bolts (15) and locknuts (16).

3. Using suitable lifting equipment, lift and position goalpost assembly (24) on the machine. Secure goalpost assembly (24) to its mounting with bolts (25), washers (12), washers (13) and locknuts (11).

4. Remove lifting equipment.

5. Connect ball joint to cam assembly in hoodcatch kit (14) and secure cable assembly (22) using clips removed during 'Removal'.

6. Install washer bottle to mounting bracket on the left hand side of goalpost assembly (24) and secure using mounting hardware as removed during 'Removal'.

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

8. Secure all hoses and harnesses to goalpost assembly (24) following routing as noted at 'Removal'.

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

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

11. Lower hood assembly and check for correct alignment between hood (1) and goalpost assembly (24) and for operation of hood catch mechanism.

12. Remove wheel blocks.

MAINTENANCE

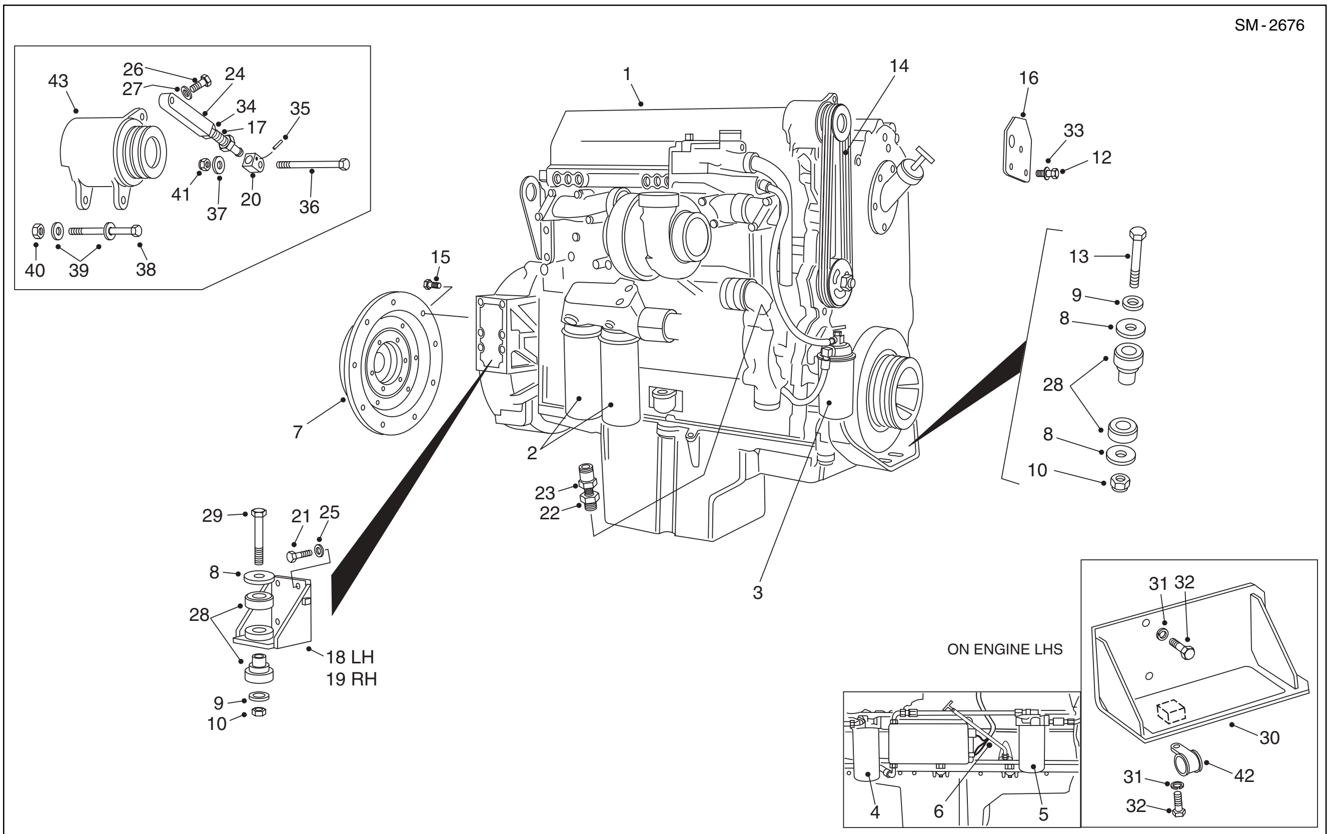
Periodically check bolts (26), washers (27) and locknuts (28) and tighten when necessary.

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.

* * * *



1 - Engine	12 - Bolt	23 - Connector	34 - Nut
2 - Oil Filter	13 - Bolt	24 - Link	35 - Pin
3 - Coolant Filter	14 - 'V' Belt	25 - Washer	36 - Bolt
4 - Primary Fuel Filter	15 - Bolt	26 - Bolt	37 - Washer
5 - Secondary Fuel Filter	16 - Plate	27 - Lockwasher	38 - Bolt
6 - Dipstick	17 - Screw Assembly	28 - Isolation Mount	39 - Washer
7 - Engine Coupling	18 - Rear LH Mount	29 - Bolt	40 - Locknut
8 - Snubbing Washer	19 - Rear RH Mount	30 - Step	41 - Locknut
9 - Washer	20 - Link	31 - Lockwasher	42 - Clip
10 - Nut	21 - Bolt	32 - Bolt	43 - Alternator
11 - Bolt	22 - Bushing	33 - Washer	

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 mounted to the tractor frame at three points by a mounting bracket at the front of engine (1) and two rear mounts (18 & 19). Rubber isolation mounts (28) through engine mounts provide sufficient flexibility to absorb varying engine vibration and torsional loads.

There are two full-flow oil filters (2) mounted on the right hand side of engine (1) in a downward position. The filters are of the throw away, spin-on type. Oil supplied by the engine oil pump passes through oil filters (2) before reaching the various moving parts of engine (1). The oil is forced by pump pressure through a passage in the filter adaptor and into the elements. Impurities are filtered out as the oil passes through the elements and out through another passage in the filter adaptor.

Engine coolant filter (3) and conditioner is a compact bypass type unit with a replaceable spin-on type element mounted on the gear case cover at the front right hand side of engine (1). Refer to Section

210-0000, COOLING SYSTEM.

There are two spin-on type fuel filters mounted on the left hand side of engine (1). Primary fuel filter (4) is in the fuel flow and acts as a strainer and secondary fuel filter (5) filters the fuel after having passed through primary fuel filter (4). The word 'Primary' or 'Secondary is cast into the top of the respective adaptor to prevent mismatching.

DETROIT DIESEL ELECTRONIC CONTROL (DDEC)

Description

Refer to Fig. 2.

> ⚠ **WARNING**
> **Before any welding is done on a machine equipped with the DDEC system, disconnect the following in this order:**
> **Battery earth cable, battery supply cable, alternator earth cables, alternator supply cables, body hydraulics joystick, transmission (Est-37) connector, ECM interface harness connector (30 pin RHS), ECM sensor harness connector (30 pin LHS) and ECM engine to transmission datalink connector (6 pin RHS). Turn off battery master switch before disconnecting any components.**
>
> **After welding connect all of the above in the reverse order.**

The engine is equipped with DDEC which controls the timing and amount of fuel injection by the electronic unit injectors (EUI). The system also monitors several engine functions using electrical sensors which send electrical signals to the electronic control module (ECM). The ECM then computes the incoming data and determines the correct fuel output and timing for optimum power, fuel economy and emissions.

The DDEC system also takes action to prevent damage to the engine and, provides the serviceman with diagnostic capabilities so that problems can be corrected quickly and easily.

1. Electronic Control Module (ECM) - Receives electronic inputs from the driver as well as from mounted sensors that provide information electronically, such as oil pressure and temperature and intake manifold pressure. This information is used to control both the quantity of fuel injected and injection timing.

2. Programmable Read Only Memory (PROM) - Located in the ECM and encoded with the operating software. Additional information is programmed into the EEPROM. This information controls the horsepower rating, torque curve, maximum engine speed and engine protection devices. The ECM processes this information and sends electronic signals to the Electronic Unit Injectors (EUI) where the precise amount of fuel is injected into the engine.

3. Electronic Unit Injectors (EUI) - The EUI is a lightweight, compact unit that injects diesel fuel directly into the combustion chamber. The amount of fuel injected and the beginning of injection timing is determined by the ECM. The ECM sends a command pulse which activates the injector solenoid.

The EUI performs four functions:

a - Creates the high fuel pressure required for efficient injection.
b - Meters and injects the exact amount of fuel required to handle the load.
c - Atomizes the fuel for mixing with the air in the combustion chamber.
d - Permits continuous fuel flow for component cooling.

Electronic unit injectors are self compensating and virtually eliminate engine tune-ups.

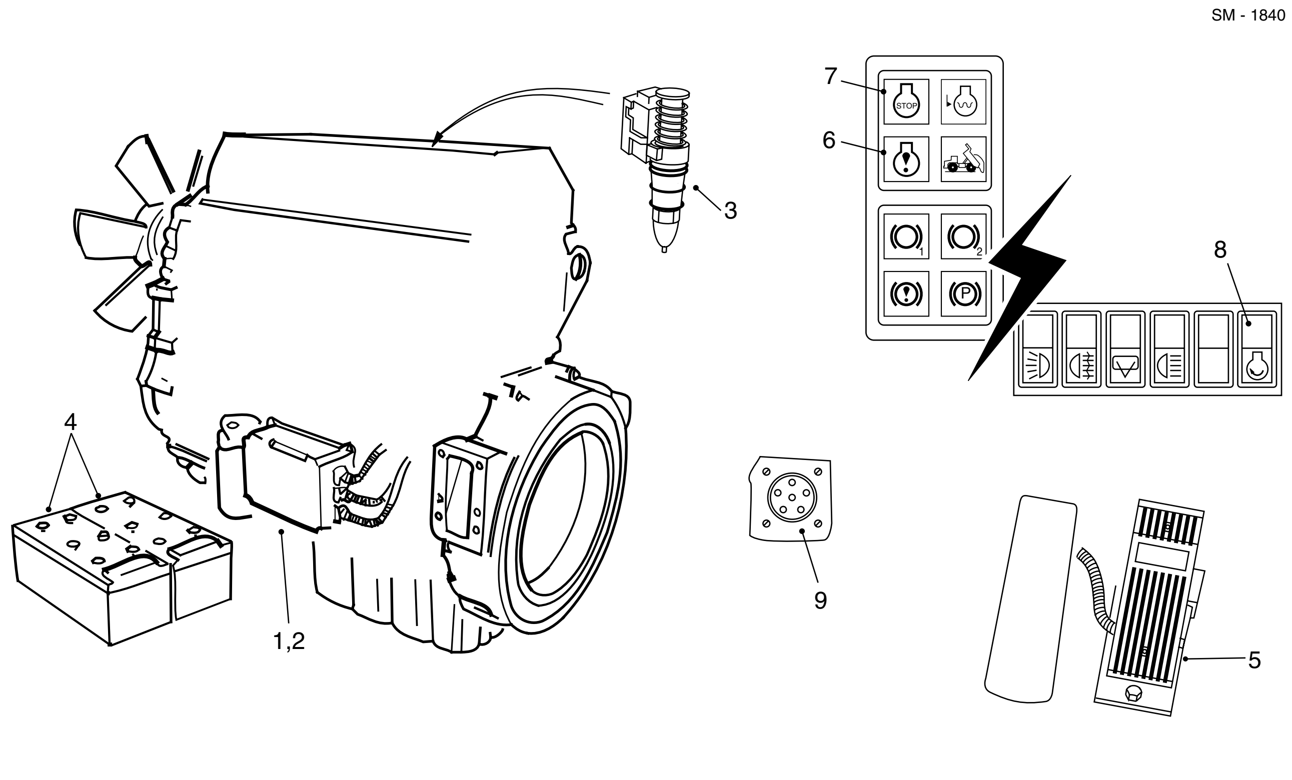
Note: Never apply 12 V directly to terminals on the injector or engine sensors as they will burn out. Before removing injectors, the fuel passages must be blown out to prevent fuel flow from entering the cylinder head.

4. Batteries - Two 12 volt maintenance free batteries supply the machine with electrical power to operate all electrical components.

5. Electronic Foot Pedal - The electronic foot pedal provides an electrical signal to the engine's fuel control system in proportion to the degree of pedal actuation.

Note: The DDEC controlled engine will override the electronic foot pedal position until the engine is warmed up to the correct operating temperature. The engine MUST be started with foot 'OFF' the electronic foot pedal.

6. Check Engine Light - When the 'Check Engine' light comes on, the computer has detected a fault in the



1 - Electronic Control Module (ECM)
2 - Programmable Read Only Memory (PROM)
3 - Electronic Unit Injectors (EUI)
4 - Batteries
5 - Electronic Foot Pedal
6 - Check Engine Light
7 - Stop Engine Light
8 - Diagnostic Request/Stop Engine Override Switch
9 - Diagnostic Test Point

Fig. 2 - DDEC Components

engine. The fault should be diagnosed and corrected at the earliest opportunity.

7. Stop Engine Light - When the 'Stop Engine' light comes on, the computer has detected a major malfunction in the engine that requires immediate attention. It is the operators responsibility to shut down the engine to avoid serious damage.

8. Diagnostic Request/Stop Engine Override Switch - Operates as a diagnostic request switch when:

a - the engine is not running and ignition is 'On'.
b - the engine is idling and not in an engine protection condition.

Pressing and releasing the switch will flash out the engine codes. Pressing the switch a second time will stop the engine codes flashing.

Note: Inactive codes are displayed on Check Engine Light and active codes are displayed on Stop Engine Light. Code 25 means no codes present.

Operates as a Stop Engine Override Switch when the engine is in a rampdown protection mode for any of the following:

Low Coolant Level
High Coolant Temperature
Low Oil Pressure
High Oil Temperature

9. Diagnostic Test Point - Plug in connector for diagnostic data reader (DDR).

Operation

Numbers in parentheses refer to Fig. 2.

The machine is equipped with the DDEC engine protection system, which records the stop engine malfunction in ECM (1). The stop engine and check engine lights illuminate when the engine protection system is initiated. The engine will immediately reduce to 70% of the available torque. Rampdown then commences over a 30 second period and reduces the engine to 40% of the available torque.

To allow for the possibility of the engine protection system being activated while the machine is operating in a critical situation, a stop engine override switch (8) is provided. If the switch is pressed and released during rampdown, the 30 second timer will reset, restoring torque to the level immediately following illumination of stop engine (7) and check engine (6) lights. The switch must be pressed and released again to obtain a subsequent override.

Note: The operator must continue to reset the automatic engine protection system by pressing and releasing stop engine override switch (8) at intervals of approximately 15 to 20 seconds.

Note: ECM (1) will record the number of times the override is activated after the fault occurs. Available Torque is the actual torque available from the engine when the fault occurred based on the actual rev/min when the fault occurred.

The engine should not be restarted after it has been shut down after activation of the engine protection system unless the problem has been diagnosed and corrected.

Conditions that will cause the Stop Engine Light to come on are; Low Coolant Level, High Coolant Temperature, Low Oil Pressure and High Oil Temperature.

Whenever check engine light (6) or stop engine light (7) comes on, the DDEC computer will determine where the problem is and will store this information in its memory. If the malfunction is intermittent, the lights will come on and go off as the computer senses the changing engine condition.

A special diagnostic data reader (DDR) is available that can be plugged into the engine computer memory to extract information related to the cause of the problem. Once the malfunction has been corrected, the DDEC system will return the engine to normal operation. The DDR can now distinguish between active codes and those stored in the historic code memory. The malfunction code recorded in ECM (1) memory will remain until it is erased by a technician.

⚠ **WARNINGS**

The operator of a DDEC-equipped vehicle must not attempt to use or read a DDR of any kind while the vehicle is operating. Doing so can result in loss of control, which may cause vehicle damage and may result in personal injury.

⚠ **When engine or electronics system diagnosis is required on a DDEC-equipped vehicle, this must be done by a person other than the operator. The operator must maintain control of the moving vehicle while the assistant performs the diagnosis.**

When the engine is not running and the ignition is on, or, the engine is idling and not in an engine protection condition, engine faults can be diagnosed by the operator. Pressing and releasing diagnostic request switch (8) will cause check engine light (6) or stop engine light (7) to flash a code number indicating the fault, e.g. flash twice - pause - flash five times - pause indicates a code 25. Code 25 indicates all systems are operating correctly. Pressing the switch a second time will stop the engine codes flashing. Refer to 'DDEC III & IV Diagnostic Codes' table for other code descriptions.

Note: Only one light will be flashing at any one time. When code flashing is initiated, the active codes (or code 25) will be flashed on stop engine light (7), then the inactive codes (or code 25) will be flashed on check engine light (6). When all of the inactive codes have been flashed, the process of flashing the codes will repeat until the conditions for code flashing are no longer satisfied.

DDECIII & IV DIAGNOSTIC CODES

DDEC Code # (Flashed)	PID	SID	FMI	DDEC Description
-	240	-	2	Fram checksum incorrect
-	251	-	10	Clock module abnormal rate
-	251	-	13	Clock module fault/failure
-	-	253	13	Incompatible calibration version
-	-	254	0	External failed RAM
-	-	254	1	Internal failed RAM
-	-	254	6	Entered boot via switches
11	187	-	4	VSG sensor voltage low
11	187	-	7	VSG switch system not responding
12	187	-	3	VSG sensor high
13	111	-	4	Coolant level sensor input voltage low
13	111	-	6	Add coolant level sensor input voltage low
14	52	-	3	Intercooler coolant temperature sensor input voltage high
14	110	-	3	Coolant temperature sensor input voltage high
14	175	-	3	Oil temperature sensor input voltage high
15	52	-	4	Intercooler coolant temperature sensor input voltage low
15	110	-	4	Coolant temperature sensor input voltage low
15	175	-	4	Oil temperature sensor input voltage low
16	111	-	3	Coolant level sensor input voltage high
16	111	-	5	Add coolant level sensor input voltage high
17	72	-	3	Throttle plate position sensor input voltage high
17	51	-	3	Throttle position sensor input voltage high
18	72	-	4	Bypass position sensor input voltage low
18	51	-	4	Throttle plate position sensor input voltage low
21	91	-	3	TPS input voltage high
22	91	-	4	TPS input voltage low
23	174	-	3	Fuel temperature sensor input voltage high
23	-	65	3	Oxygen content circuit input voltage high
24	174	-	4	Fuel temperature sensor input voltage low
24	-	65	4	Oxygen content circuit input voltage low
25	-	-	-	Reserved for 'No Codes'
26	-	25	1	Auxiliary shutdown #1 active
26	-	61	11	Auxiliary shutdown #2 active
27	171	-	3	Ambient air temperature sensor input voltage high (Release 2.00 or later only)
27	172	-	3	Air temperature sensor input voltage high
27	105	-	3	Intake manifold temperature sensor input voltage high
28	171	-	4	Ambient air temperature circuit failed low (Release 2.00 or later only)
28	172	-	4	Air temperature sensor input voltage low
28	105	-	4	Intake manifold temperature sensor input voltage low
31	-	51	3	Aux. output #3 open circuit (high side) - S3
31	-	51	4	Aux. output #3 short to ground (high side) - S3
31	-	51	7	Aux. output #3 mechanical system fail - S3
31	-	52	3	Aux. output #4 open circuit (high side) - T3
31	-	52	4	Aux. output #4 short to ground (high side) - T3
31	-	52	7	Aux. output #4 mechanical system fail - T3
32	-	238	4	SEL open circuit
32	-	238	3	SEL short to battery (+)
32	-	239	3	CEL short to battery (+)
32	-	239	4	CEL open circuit

DDEC III & IV DIAGNOSTIC CODES

DDEC Code # (Flashed)	PID	SID	FMI	DDEC Description
33	102	-	3	Turbo boost pressure sensor input voltage high
34	102	-	4	Turbo boost pressure sensor input voltage low
35	100	-	3	Oil pressure sensor input voltage high
35	19	-	3	High range oil pressure sensor input voltage high
36	100	-	4	Oil pressure sensor input voltage low
36	19	-	4	High range oil pressure sensor input voltage low
37	94	-	3	Fuel pressure sensor input voltage high
37	18	-	3	High range fuel pressure sensor input voltage high
37	95	-	3	Fuel restriction sensor input voltage high
38	94		4	Fuel pressure sensor input voltage low
38	18	-	4	High range fuel pressure sensor input voltage low
38	95	-	4	Fuel restriction sensor input voltage low
41	-	21	0	Too many SRS (missing TRS)
42	-	21	1	Too few SRS (missing SRS)
43	111	-	1	Coolant level low
44	52	-	0	Intercooler coolant temperature high
44	110	-	0	Coolant temperature high
44	172	-	0	Air inlet temperature high
44	175	-	0	Oil temperature high
44	105	-	0	Intake manifold temperature high
45	100	-	1	Oil pressure low
45	19	-	1	High range oil pressure low
46	168	-	1	ECM battery voltage low
46	-	232	1	Sensor supply voltage low
47	94	-	0	Fuel pressure high
47	102	-	0	Turbo boost pressure high
47	106	-	0	Air inlet pressure high
47	164	-	0	Injection control pressure high
47	18	-	0	High range fuel pressure high
48	18	-	1	High range fuel pressure low
48	94	-	1	Fuel pressure low
48	106	-	1	Air inlet pressure low
48	164	-	1	Injection control pressure low
52	-	254	12	A/D conversion fail
53	-	253	2	Non-voilatile checksum incorrect
53	-	253	12	EEPROM write error
53	-	253	13	Out of calibration
54	84	-	12	Vehicle speed sensor fault
55	-	231	12	J1939 data link fault
55	-	248	8	Proprietary datad link fault (Master)
55	-	248	9	Proprietary datad link fault (Receiver)
56	-	250	12	J1587 data link fault
57	-	249	12	J1922 data link fault
58	92	-	0	Torque overload
61	-	xxx	0	Injector xxx response time long
62	-	26	3	Aux. output #1 short to battery (+) - F3
62	-	26	4	Aux. output #1 open circuit - F3
62	-	40	3	Aux. output #2 short to battery (+) - A2
62	-	40	4	Aux. output #2 open circuit - A2
62	-	53	3	Aux. output #5 short to battery (+) - W3
62	-	53	4	Aux. output #5 open circuit - W3

DDEC III & IV DIAGNOSTIC CODES

DDEC Code # (Flashed)	PID	SID	FMI	DDEC Description
62	-	54	3	Aux. output #6 short to battery (+) - X3
62	-	54	4	Aux. output #6 open circuit - X3
62	-	55	3	Aux. output #7 short to battery (+) - Y3
62	-	55	4	Aux. output #7 open circuit - Y3
62	-	56	3	Aux. output #8 short to battery (+) - A1
62	-	56	4	Aux. output #8 open circuit - A1
62	-	26	7	Aux. output #1 mechanical system not responding properly - F3
62	-	40	7	Aux. output #2 mechanical system not responding properly - A2
62	-	53	7	Aux. output #5 mechanical system not responding properly - W3
62	-	54	7	Aux. output #6 mechanical system not responding properly - X3
62	-	55	7	Aux. output #7 mechanical system not responding properly - Y3
62	-	56	7	Aux. output #8 mechanical system not responding properly - A1
63	-	57	3	PWM #1 short to battery (+)
63	-	57	4	PWM #1 open circuit
63	-	58	3	PWM #2 short to battery (+)
63	-	58	4	PWM #2 open circuit
63	-	59	3	PWM #3 short to battery (+)
63	-	59	4	PWM #3 open circuit
63	-	60	3	PWM #4 short to battery (+)
63	-	60	4	PWM #4 open circuit
63	-	57	0	PWM #1 above normal range
63	-	57	1	PWM #1 below normal range
63	-	58	0	PWM #2 above normal range
63	-	58	1	PWM #2 below normal range
63	-	59	0	PWM #3 above normal range
63	-	59	1	PWM #3 below normal range
63	-	60	0	PWM #4 above normal range
63	-	60	1	PWM #4 below normal range
64	103	-	8	Turbo speed sensor input failure
64	103	-	0	Turbo overspeed
65	51	-	0	Throttle plate position above normal range
65	51	-	1	Throttle plate position below normal range
65	51	-	2	Throttle plate position erratic
65	51	-	7	Throttle plate not responding
65	107	-	3	Air filter restriction sensor voltage high
65	107	-	4	Air filter restriction sensor voltage low
66	-	76	0	Engine knock level above normal range
66	-	76	3	Engine knock level sensor input voltage high
66	-	76	4	Engine knock level sensor input voltage low
66	-	76	7	Engine knock level sensor not responding
66	-	99	3	Oil filter restriction sensor voltage high
66	-	99	4	Oil filter restriction sensor voltage low
67	109	-	3	Coolant pressure sensor input voltage high
67	109	-	4	Coolant pressure sensor input voltage low
67	106	-	3	Air inlet pressure sensor input voltage high
67	106	-	4	Air inlet pressure sensor input voltage low

DDEC III & IV DIAGNOSTIC CODES

DDEC Code # (Flashed)	PID	SID	FMI	DDEC Description
67	20	-	3	High range coolant pressure sensor input voltage high
67	20	-	4	High range coolant pressure sensor input voltage low
68	-	230	6	TPS idle validation circuit fault (short to ground)
68	-	230	5	TPS idle validation circuit fault (open circuit)
71	-	xxx	1	Injector xxx response time short
72	84	-	0	Vehicle overspeed
72	84	-	11	Vehicle overspeed (absolute)
72	-	65	0	Oxygen content too high
72	-	65	1	Oxygen content too low
73	-	151	14	ESS transmission stuck in gear
73	-	226	11	Transmission neutral switch failure (ESS Transmission)
73	-	227	2	Aux. analog input data erratic, intermittent, or incorrect (ESS transmission)
73	-	227	3	Aux. analog input #1 voltage high (ESS transmission)
73	-	77	0	Gas valve position above normal range
73	-	77	1	Gas valve position below normal range
73	-	77	3	Gas valve position input voltage high
73	-	77	4	Gas valve position input voltage low
73	-	77	7	Gas metering valve not responding
73	107	-	0	Air filter restriction high
74	99	-	0	Oil filter restriction high
74	70	-	4	Optimized idle safety loop short to ground
75	168	-	0	ECM battery voltage high
75	-	232	0	Sensor supply voltage high
76	121	-	0	Engine overspeed with engine brake
81	-	20	3	Timing actuator (dual fuel) input voltage high
81	98	-	3	Oil level sensor input voltage high
81	101	-	3	Crankcase pressure sensor input voltage high
81	164	-	3	Injection control pressure circuit voltage high
81	173	-	3	Exhaust temperature sensor input voltage high
82	-	20	4	Timing actuator (dual fuel) input voltage low
82	98	-	4	Oil level sensor input voltage low
82	101	-	4	Crankcase pressure sensor input voltage low
82	164	-	4	Injection control pressure circuit voltage low
82	173	-	4	Exhaust temperature sensor input voltage low
83	98	-	0	Oil level high
83	101	-	0	Crankcase pressure high
83	173	-	0	Exhaust temperature high
83	173	-	4	Exhaust temperature sensor input voltage low
83	73	-	0	Pump pressure high
84	98	-	1	Oil level low
84	101	-	1	Crankcase pressure low
85	190	-	0	Engine overspeed
86	73	-	3	Pump pressure sensor input voltage high
86	108	-	3	Barometric pressure sensor input voltage high
87	73	-	4	Pump pressure sensor input voltage low
87	108	-	4	Barometric pressure sensor input voltage low
88	109	-	1	Coolant pressure low
88	20	-	1	High range coolant pressure low
89	95	-	0	Fuel restriction high
89	111	-	12	Maintenance alert coolant level fault

REMOVAL

Numbers in parentheses refer to Fig. 1.

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

> ⚠ **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 can cause sparks and personal injury from burns. Turn battery master switch to the 'Off' position before removing any components. Remove battery ground cable first, and reconnect last, to avoid damaging electrical components.**

1. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine. Turn steering wheel several times to relieve any pressure in the steering circuit.

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

3. Disconnect battery cables from terminal posts (earth cable first).

4. Pull on handle to release hood catch and lift up hood.

5. Remove mounting hardware securing air cleaner assembly to right hand fender. Slacken mounting clamp at air cleaner intake pipe and draw air cleaner, complete with rubber hose, away from intake pipe. Cover open ends to prevent entry of dirt.

6. With a suitable container in position, open shut-off valve on the radiator assembly and drain the coolant.

7. Remove hood and goalpost from the vehicle. Refer to Section 100-0040, HOOD AND MOUNTING.

Note: Radiator header tank will be removed as part of the goalpost assembly.

8. Support engine sump guard with suitable blocking and remove mounting hardware securing sump guard to the frame. Remove sump guard from the frame.

9. Support guard plate under the engine at the front of the frame with suitable blocking and remove mounting hardware securing guard plate to the frame. Remove guard plate from the frame.

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

> ⚠ **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.**

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

12. Remove the radiator assembly from the vehicle. Refer to Section 210-0040, RADIATOR AND MOUNTING.

13. With a suitable container in position, remove drain cock on the transmission oil cooler flanges and drain the coolant. Remove coolant pipes from the engine water pump and engine oil cooler. Refer to Section 210-0060, TRANSMISSION OIL COOLER.

14. Remove charge air cooler pipes from engine turbocharger and engine inlet manifold.

15. Disconnect exhaust piping from the engine turbocharger.

16. Disconnect air cleaner intake pipe from engine turbocharger and remove from the engine.

17. Identify heater lines for ease of installation and with a suitable container in position, disconnect heater lines from the engine. Cap open line ends and fittings.

18. Identify fuel lines for ease of installation and with a suitable container in position, disconnect fuel lines from the engine. Cap open line ends and fittings.

19. Identify all electrical harnesses and cables for ease of installation and disconnect from the engine.

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

21. Disconnect driveline from the engine coupling and secure clear of the engine. Refer to Section

130-0010, FRONT DRIVELINES.

22. Attach suitable lifting equipment to the lifting brackets on the engine and raise lifting equipment to take up the slack.

23. Remove locknuts (10), washers (9), snubbing washers (8), bolts (13) and bolts (29) securing engine (1) to the frame through front mounting bracket and rear mounting brackets (18 & 19).

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

25. Carefully lift engine (1) clear of the frame, remove to a suitable work area and mount securely on a work stand.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Identify rear mounts (18 & 19) to aid in assembly then remove bolts (21) and washers (25) securing rear mounts to engine (1). Remove mounts (18 & 19).

2. If required, remove rubber isolation mounts (28) from rear mounts (18 & 19) and front mounting bracket on engine (1).

3. Loosen air conditioner compressor drive belt and remove compressor from engine (1). Refer to Section 260-0130, AIR CONDITIONING.

4. Loosen alternator mounting bolt (38) to allow slack in 'V' belts (14). Remove 'V' belts (14).

Note: Adjuster screw and link assembly (17, 20, 24, 34 & 35) will have been released when removing radiator assembly from the vehicle.

5. Remove bolt (26) and lockwasher (27) securing screw and link assembly (17, 20, 24, 34 & 35) to alternator (43). Support alternator (43) and remove locknut (40), washer (39) and bolt (38). Remove alternator (43) from engine (1).

6. Remove bolts (15) securing engine coupling (7) at rear of engine (1) then remove engine coupling.

7. Remove mounting hardware supporting dipstick assembly (6) to engine (1). Remove dipstick assembly (6) from engine (1).

8. If required, remove bolts (32), lockwashers (31), clip (42) and step (30) from engine (1).

9. Remove and discard filters (2, 3, 4 & 5) from engine (1), as described in 'Maintenance'. Cover engine inlet 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 isolation mounts (28) for damage and replace if required.

2. Check rear mounts (18 & 19), front mounting bracket on engine (1) and mounting brackets on the front frame for cracks and/or damage. Repair or replace as necessary.

3. Inspect engine coupling (7) for damage and repair or replace as required.

ASSEMBLY

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.

1. Remove covers from engine filter ports and install new filters (2, 3, 4 & 5) on engine (1), as described in 'Maintenance'.

2. If removed, secure step (30) and clip (42) to engine (1) with bolts (32) and lockwashers (31).

3. Install dipstick assembly (6) on engine (1) and secure with mounting hardware as removed at 'Disassembly'.

4. Install engine coupling (7) to rear of engine (1) and secure with bolts (15).

5. Position alternator (43) on engine mounting bracket and align the holes in the alternator mounting flanges with the tube in the bracket. Secure alternator (43) in position with bolt (38), washer (39) and locknut (40). Tighten bolt (38) finger tight at this stage.

6. Install adjuster screw and link assembly (17, 20, 24, 34 & 35) to alternator (43) and secure with bolt (26) and lockwasher (27). Tighten bolt (26) finger tight at this

stage.

Note: Replace all belts in a set when one is broken or replaced.

7. Install 'V' belts (14) in the grooves of alternator (43) and accessory drive pulley.

Note: Alternator belt tension adjustment is made after installation of engine (1) and the radiator assembly.

8. Install air conditioner compressor and drive belt to engine (1). Refer to Section 260-0130, AIR CONDITIONING.

Note: Position rubber isolation mounts (28) to their mounts as shown in Fig. 1.

9. If removed, install rubber isolation mounts (28) to front mounting bracket on engine (1).

10. If removed, install rubber isolation mounts (28) in rear mounts (18 & 19). Secure rear mounts (18 & 19) to engine (1) with bolts (21) and lockwashers (25) as identified at disassembly. Tighten bolts (21) to a torque of 150 Nm (110 lbf ft).

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 lifting device is properly secured and of adequate capacity to do the job safely.**

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

2. Secure engine (1) assembly to frame mounting brackets with bolts (13 & 29), snubbing washers (8) washers (9) and locknuts (10) as shown in Fig. 1. Tighten locknuts (10) to a torque of 264 Nm (195 lbf ft).

3. Connect driveline to the engine coupling and secure bracket to engine crossmember. Refer to Section 130-0010, FRONT DRIVELINES.

4. Install transmission oil cooler pipes to the engine water pump and engine oil cooler. Refer to Section 210-0060, TRANSMISSION OIL COOLER.

5. Install radiator assembly on the vehicle. Refer to Section 210-0040, RADIATOR AND MOUNTING.

Note: When installing radiator support bracket to engine (1), locate bolt (36) through link (20) then secure with snubbing washer (37) and locknut (41). Tighten locknut (41) to a torque of 165 Nm (122 lbf ft).

6. Adjust 'V' belts (14) by loosening locknut (34) and turning screw assembly (17) clockwise until the correct tension is obtained (refer to 'Drive Belt Adjustments'). When correct tension is obtained tighten locknut (34).

7. Tighten bolt (38) securing alternator (43) to engine mounting bracket and bolt (26) securing link (24) assembly to alternator (43) to a torque of 81 - 95 Nm (60 - 70 lbf ft).

8. Install air cooler pipes from engine turbocharger and engine inlet manifold to charge air cooler mounted on the radiator assembly. Refer to Section 210-0040, RADIATOR AND MOUNTING.

9. Install air cleaner intake pipe and exhaust piping to engine turbocharger.

10. Remove caps from heater lines and fittings and connect heater lines to engine (1) as identified at removal.

11. Remove caps from fuel lines and fittings and connect fuel lines to engine (1) as identified at removal.

12. Connect all electrical harnesses and cables to engine (1) (with the exception of battery connections) as identified at removal.

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

14. Install the goalpost and radiator header tank assembly on the vehicle. Refer to Section 100-0040, HOOD AND MOUNTING.

15. Ensure all cooling lines to radiator assembly, engine (1) and radiator header tank are correctly connected. Refer to Section 210-0040, RADIATOR AND MOUNTING.

16. Remove covers from air cleaner intake pipe and rubber hose on the air cleaner inlet then slide air cleaner assembly towards the hood locating the rubber hose to the inlet pipe.

17. Secure air cleaner assembly to the right hand fender and rubber hose to the inlet pipe with mounting hardware removed during removal.

18. Connect battery positive connections to battery terminals. Connect battery earth connections to battery terminals.

19. 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.

20. Ensure shut-off valve at the bottom of the radiator assembly, drain plugs in transmission oil cooler flanges and drain cocks on engine (1) water jacket are securely closed. Ensure shut off cocks at coolant filter (3) are open to allow flow through the filter.

21. Fill the cooling system with coolant. Refer to Section 210-0000, COOLING SYSTEM.

22. Fill the engine with lubricant through oil filler to the top mark on dipstick (6). Refer to Section 300-0020, LUBRICATION SYSTEM for oil specification.

23. Check all line and pipe connections for leaks prior to starting the vehicle. Tighten as required.

24. Switch the battery master switch to the 'On' position, start up the engine and check for leaks. Tighten lines, pipes and fittings and top up all systems as required.

25. Install hood assembly on the vehicle. Refer to Section 100-0040, HOOD AND MOUNTING.

Note: Check that gap between hood and cowl is correct (12 mm (0.5 in) maximum).

26. Using suitable lifting equipment position front guard plate under the engine and secure to the frame with mounting hardware removed during removal.

27. Using suitable lifting equipment position engine sump guard under the engine and secure to the frame with mounting hardware removed during removal.

28. 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.

Every 10 Hours (Daily)

Engine (1): Visually check engine for damage, loose or frayed belts and listen for any unusual noises. Check the turbocharger for leaks.

Engine (1) Oil Level: Check engine oil level and add oil if low. To allow checking before starting as well as immediately after shutting down the engine, the dipstick is provided with two types of marks:

1. Dot Marks - Before starting up after a major shut down period the oil level should be up to the top dot mark (cold level).

2. Dash Marks - Upon shutting down the engine at low idling (wait 1 to 2 minutes) the oil level should be up to, but not over, the top dash mark (hot level).

Every 250 Hours

Engine (1): Drain engine oil and refill. Refer to Section 300-0020, LUBRICATION SYSTEM for oil specification.

Engine Water Pump: Inspect water pump drain hole and clean if required.

Engine Oil Filters (2): Replace oil filters as follows:

1. Using filter wrench, remove and discard both oil filters (2) from engine (1). Inspect the sealing surface of the filter to ensure that the seal ring stayed with the filter. If not, remove it from the filter adaptor.

2. Clean the filter adaptor with a clean, lint free cloth.

3. Lightly coat new oil filter (2) seal with clean engine oil as specified in Section 300-0020, LUBRICATION SYSTEM.

4. Start a new oil filter (2) on the filter adaptor and tighten it by hand until the seal touches the adaptor filter head. Tighten an additional 2/3 of a turn after contact.

Note: Mechanical tightening of oil filters (2) is not necessary and will distort or crack the adaptor. Tighten oil filters by hand only.

5. Repeat steps 3 and 4 for second oil filter (2).

6. Start and run the engine for a short period and check for oil leaks. If any leaks are noted, have them corrected.

7. After the engine has been stopped long enough (approximately 20 minutes) for the oil from various parts of engine (1) to drain back to the crankcase, check oil level and add oil to bring it to the proper level on the dipstick. Refer to Section 300-0020, LUBRICATION SYSTEM for oil specification.

Fuel Filters (4 & 5): Replace primary fuel filter (4) and secondary fuel filter (5) as follows:

Note: There is a fuel system shut off valve on the discharge side of secondary fuel filter (5). Closing this valve will prevent loss of fuel prime at time of filter replacement.

1. Close shut off valve at secondary fuel filter (5) and, using filter wrench, remove and discard both fuel filters (4 & 5) from engine (1).

2. Fill the replacement filters and coat the gaskets slightly with clean fuel oil as specified in Section 300-0020, LUBRICATION SYSTEM.

3. Start new primary fuel filter (4) on the filter adaptor and tighten it by hand until the gasket contacts the adaptor fully with no side movement of the filter evident. Tighten an additional 1/2 of a turn.

Note: Mechanical tightening of fuel filters (4 & 5) is not recommended, and may result in seal and/or cartridge damage. Tighten fuel filters by hand only.

4. Repeat step 3 for secondary fuel filter (5).

5. Start the engine and check for leaks. If any leaks are noted, have them corrected.

Every 500 Hours

Coolant Filter (3): Check condition of coolant inhibitor as described in Section 210-0000, COOLING SYSTEM. Replace coolant filter (3) as follows:

Note: There is a shut off valve at the coolant inlet and outlet lines of coolant filter (3). Closing these valves will enable coolant filter (3) to be replaced without an excessive loss of coolant.

1. Close shut off valves at coolant filter (3) inlet and outlet lines and, using filter wrench, remove and discard coolant filter (3) from engine (1).

2. Clean the filter adaptor with a clean, lint free cloth.

3. Lightly coat new coolant filter (3) seal with clean engine oil as specified in Section 300-0020, LUBRICATION SYSTEM.

4. Start coolant filter (3) on the filter adaptor and tighten it by hand until the seal touches the adaptor filter head. Tighten an additional 2/3 of a turn after contact.

Note: Mechanical tightening of coolant filter (3) is not necessary and will distort or crack the adaptor. Tighten coolant filter by hand only.

5. Open shut off valves at coolant filter (3) inlet and outlet lines.

6. Start the engine and check for leaks. If any leaks are noted, have them corrected. Add coolant as required. Refer to Section 210-0000, COOLING SYSTEM.

Drive Belt Adjustments

Every 50 Hours: Check all drive belt tensions and adjust if required. If vehicle is equipped with air conditioning, compressor belts should be checked and adjusted as described in Section 260-0130, AIR CONDITIONING.

Every 2 000 Hours: Replace all drive belts.

Note: Replace all belts in a set when one is worn. Single belts of similar size should not be used as a substitute for a matched belt set as premature belt wear can result due to belt length variation. All belts in a matched belt set are within 0.81 mm (0.032 in) of their specified centre distances.

Using belt tension gauge, adjust the belt tension to the following values:

Alternator - 'V' Belt
Belt Tension 'New' - 556 N (125 lbf)
Belt Tension 'Used' - 445 N (100 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.

Belts should be neither too tight nor too loose. Belts that are too tight impose excess loads on the alternator bearings, shortening both belt and bearing life. A loose belt will slip and may cause damage to accessory components.

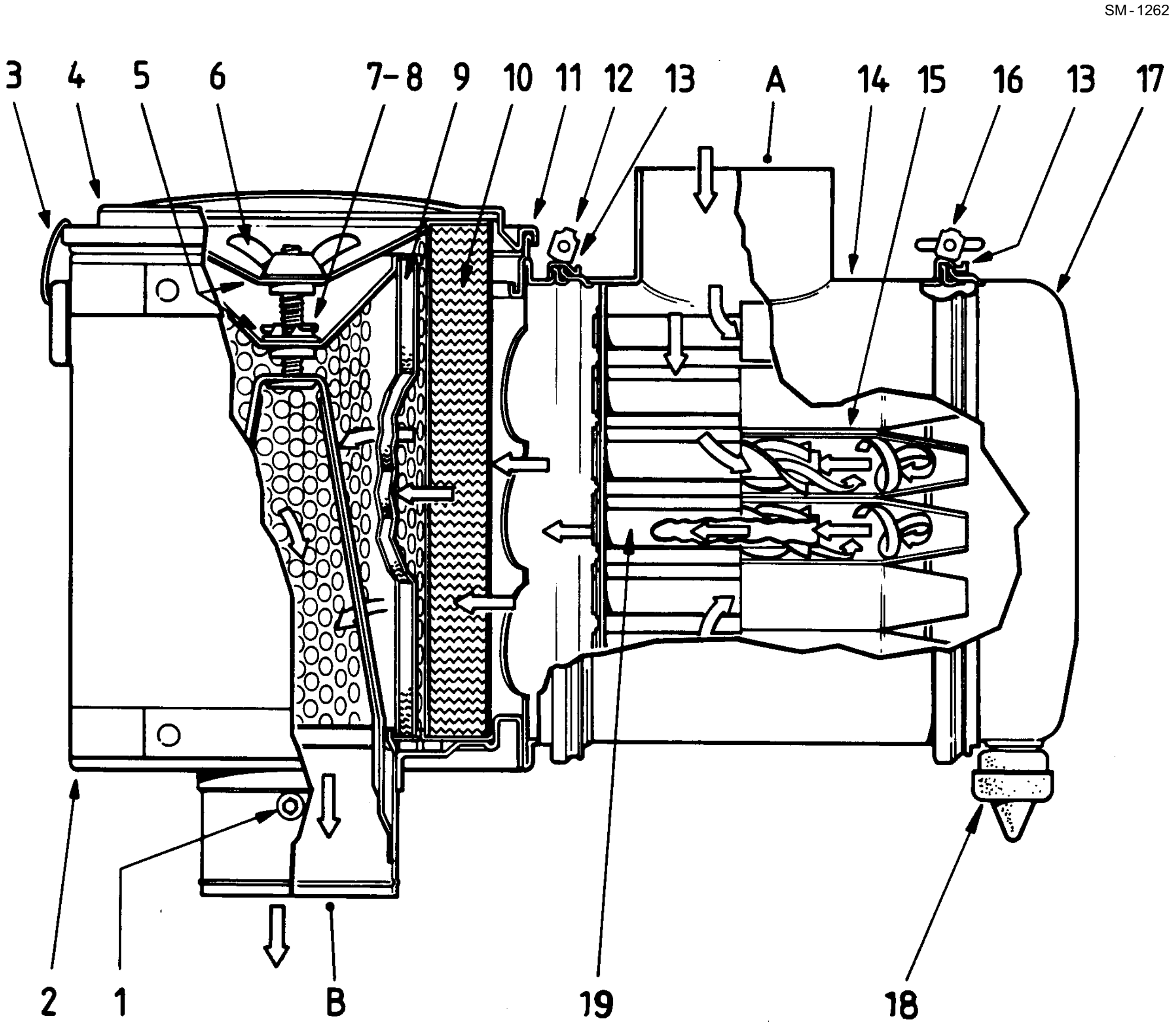
SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of service tools which should be used in conjunction with procedures outlined in the engine 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	10	Locknut	264	195
1	21	Bolt	150	110
1	26	Bolt	81 - 95	60 - 70
1	38	Bolt	81 - 95	60 - 70
1	41	Locknut	165	122

* * * *



1 - Restriction Indicator Fitting
2 - Body
3 - Latches
4 - Access Cover
5 - Gaskets
6 - Wing Nut
7 - Nut
8 - Cotter Pin
9 - Secondary (Safety) Filter Element
10 - Primary Filter Element
11 - Gasket
12 - Clamp
13 - Gasket
14 - Tube Section
15 - Funnel Shaped Tubes
16 - Clamp
17 - Dust Cup
18 - Vacuator Valve
19 - Centre Tubes
A - Air Inlet
B - Air Outlet

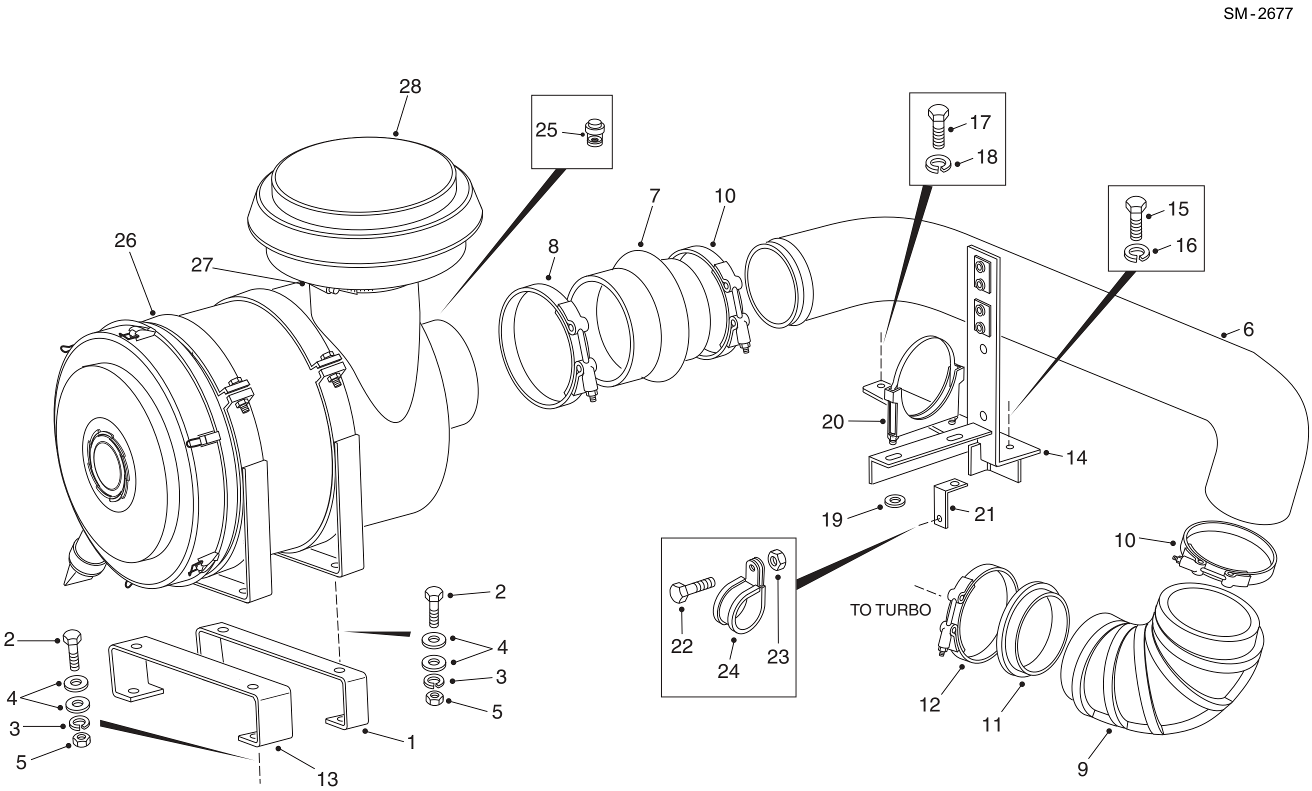
Fig. 1 - Cutaway View of Typical Air Cleaner

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1.

The dual dry element air cleaner is remote mounted on the fender of the vehicle. The air cleaner prolongs engine life by removing grit and dust 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 time.

A rubber vacuator valve (18) attached to the dust cup (17) in a downward position ejects grit, dust, and water while the engine is running. The vacuator valve minimizes the need for daily servicing. Even though the valve 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. The valve also unloads when the engine is stopped, by opening and releasing any accumulated dust or water.



1 - Bracket	8 - Clamp	15 - Bolt	22 - Bolt
2 - Bolt	9 - Elbow	16 - Lockwasher	23 - Nut
3 - Lockwasher	10 - Clamp	17 - Bolt	24 - Clamp
4 - Washer	11 - Insert	18 - Lockwasher	25 - Air Restriction Gauge
5 - Nut	12 - Clamp	19 - Washer	26 - Clamp
6 - Tube	13 - Bracket	20 - Clamp	27 - Clamp
7 - Hose	14 - Bracket	21 - Plate	28 - Cap

Fig. 2 - Exploded View of Typical Air Cleaner Mounting

Dust laden air enters pre-cleaner tube section (14) through air inlet opening (A). As the air enters this portion of the cleaner, it passes through the vanes in funnel shaped outer tubes (15). These vanes give the air a whirling motion and as the air rotates down the tubes, centrifugal force throws the heavier dust particles to the outside of the tubes and through the bottom of the funnel shaped tubes to dust cup (17).

The partially cleaned air is then drawn through centre tubes (19) and flows through primary filter element (10) and secondary (safety) filter element (9) where any remaining dust particles are removed. As the filtered air leaves the cleaner through air outlet (B), it is drawn through a ducting pipe which is securely clamped between the air cleaner and the engine air intake.

AIR CLEANER

Removal

Numbers in parentheses refer to Fig. 2.

1. Position the vehicle in a level work area, apply the parking brake, switch off the engine and turn the steering wheel in both directions several times to relieve pressure in the steering system.

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.

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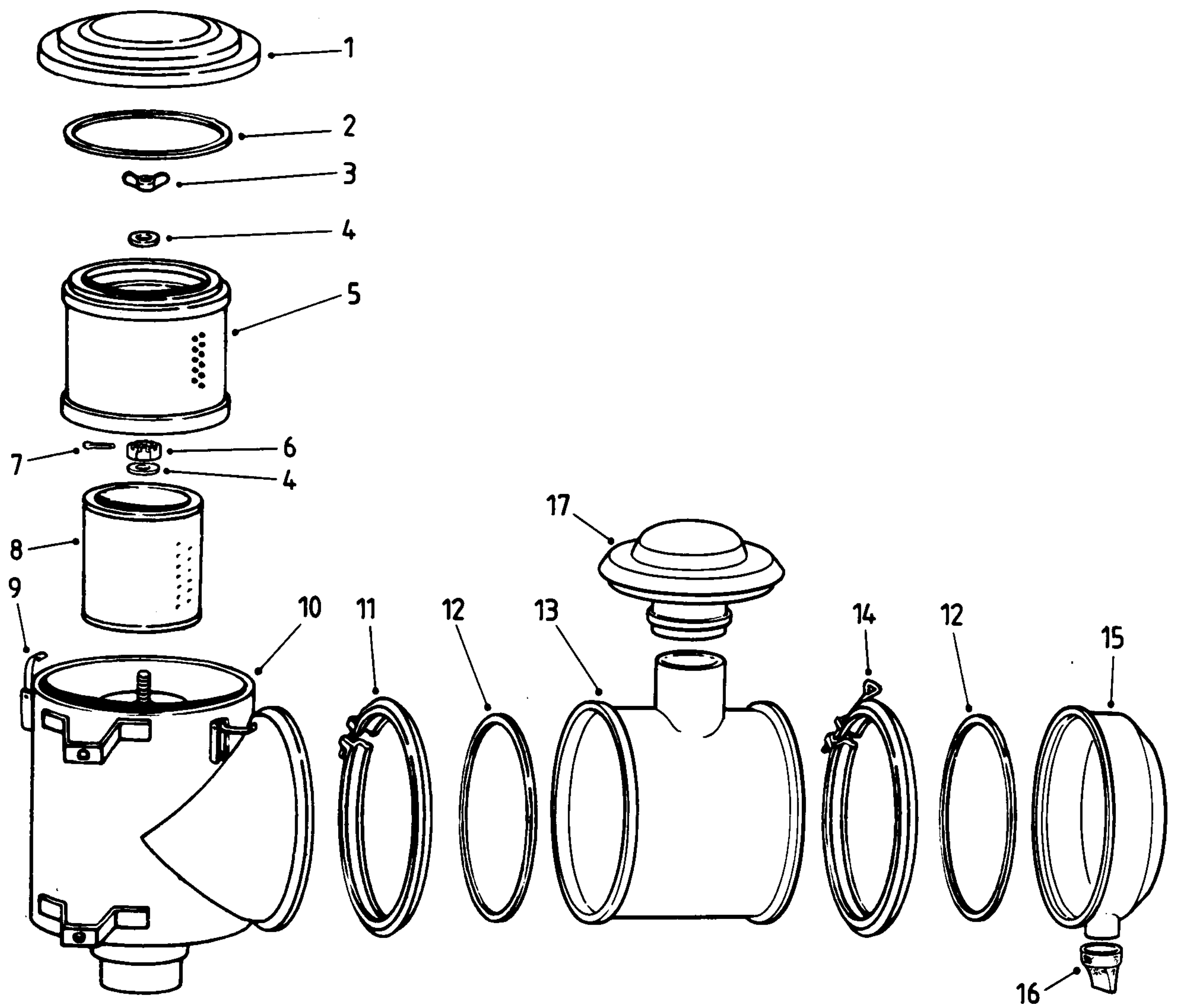

1 - Access Cover
2 - Gasket
3 - Wing Nut
4 - Gasket
5 - Primary Filter Element
6 - Nut
7 - Cotter Pin
8 - Secondary (Safety) Filter Element
9 - Latches
10 - Body
11 - Clamp
12 - Gasket
13 - Tube Section
14 - Clamp
15 - Dust Cup
16 - Vacuator Valve
17 - Inlet Cap

Fig. 3 - Exploded View of Typical Air Cleaner

4. Slacken clamps (8 & 10) and slide hose (7) clear of the air cleaner assembly.

5. Using suitable lifting equipment, support the air cleaner assembly and remove bolts (2), washers (4), lockwashers (3) and nuts (5). Remove air cleaner assembly from brackets (1 & 13).

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

7. If required, remove bolts (2), washers (4), lockwashers (3) and nuts (5) securing brackets (1 & 13) to the right hand fender. Remove brackets (1 & 13).

Disassembly

Numbers in parentheses refer to Fig. 3.

1. Remove air cleaner access cover assembly by undoing securing latches (9). Empty dust collected in access cover (1) and wipe clean.

2. Unscrew wing nut (3), remove gasket (4) and carefully withdraw primary filter element (5). Inspect gaskets (2 & 4). Replace if damaged.

3. Do not disturb secondary (safety) filter element (8). Replace access cover (1) temporarily.

4. The primary filter element (5) should be replaced after a maximum of six cleanings, or annually whichever comes first. Should the primary filter element (5) require cleaning one of the methods mentioned in the "Cleaning Primary Filter Element" section should be used.

Assembly/Installation

Numbers in parentheses refer to Fig. 2.

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. Always check air cleaner threads are clean and undamaged. Reset air restriction gauge (16).

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

a. Check air cleaner to engine tube (6) for defects and that clamps (8, 10 & 12) are securely tightened to ensure that there are no leaks in the system. Replace any worn or damaged parts.

b. Check that air cleaner mounting brackets (1 & 13) are secure and that air cleaner is mounted securely.

MAINTENANCE

Numbers in parentheses refer to Fig. 4, unless otherwise specified.

⚠ **WARNING**
Always shut down engine before servicing air cleaner.

1. Check the air restriction gauge (Fig. 4) daily. This gauge is mounted on the air cleaner outlet pipe and shows when the system air flow is being restricted, by a yellow band that gradually rises in the gauge window as air restriction increases. The yellow band is locked when maximum allowable restriction is reached.

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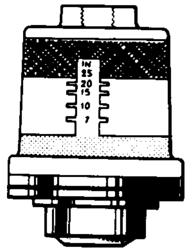


Fig. 4 - Air Restriction Gauge

2. When the yellow band locks at the top of the gauge window the primary filter element should be serviced. The air restriction gauge should be reset by pushing the button on the gauge, holding it for several seconds and then releasing it. While this device indicates the need for servicing, it does not give as precise a measurement as a water manometer or vacuum gauge connected to the tapping point on the air cleaner outlet or engine manifold.

3. The vacuator valve (16, Fig. 3) eliminates the need for frequent servicing. To function, the vacuator valve lip must point down and be kept free of debris. The valve should be closed except when the engine is idling slowly or stopped. If the vacuator valve is lost or damaged, replace it to maintain normal element service life.

CLEANING TUBE SECTION

Numbers in parentheses refer to Fig. 3.

The tube section (13) of the air cleaner should be thoroughly cleaned twice a year. Inspect lower end of tubes each time dust (15) cup is removed.

Note: Do not apply heat in any form to the air cleaner plastic tube section.

1. Loosen clamp (14) and remove dust cup (15) and gasket (12).

Note: Filter elements should always be installed when cleaning tubes as described in Step 2. This prevents dirt from entering the clean air chamber.

2. Tubes with a light dust buildup can be cleaned with compressed air or a stiff fibre brush without removing from machine. (Do not use a wire brush.)

3. If tubes require washing, remove air inlet cap (17), any attaching parts securing tube section (13) to machine and remove clamp (11), tube section (13) and gasket (12) from body (10).

4. Submerge tube section in the manufacturers recommended solution, or equivalent, and warm water, not to exceed 66° C (150° F). Soak for 30 minutes and agitate for 5 minutes. Rinse clean with clean water and allow body to dry.

Note: If plugging is severe, use a solution of 50% Oakite 202 and 50% water, or equivalent, and follow Step 4.

5. Inspect gaskets (12) and replace if damaged.

6. Position gasket (12) on body (10) and secure tube section (13) to body with clamp (11). Secure tube section (13) to machine.

7. Position gasket (12) on tube section (13) and secure dust cup (15) to tube section with clamp (14).

8. Position air inlet cap (17) on tube section (13) and secure with clamp.

Cleaning Primary Filter Element

Numbers in parentheses refer to Fig. 3.

Although a paper primary filter element (5) is used, it is possible to remove excess dirt by tapping element. The number of times one element can be reused depends on the type of dirt on it and the care exercised in cleaning. Element damage will be indicated by areas of concentrated dust on the clean side of the element. If in doubt - always fit a new element.

1. Release latches on cover assembly (1) and remove cover assembly from air cleaner body (10).

2. Remove primary element (5) from air cleaner body (10) and clean/replace. It is advised to replace the element rather than attempt to clean thoroughly.

3. Install primary element (5) in air cleaner body (10).

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

Secondary (Safety) Filter Element

Numbers in parentheses refer to Fig. 3.

The secondary (safety) filter element (8) is installed in the air cleaner body (10) and inside of the primary filter element (5). This secondary (safety) element increases the reliability of the air cleaner's protection of the engine from airborne dirt. It protects the engine from dirt admitted by a damaged primary filter element (5), or dirt that might be dropped into the air cleaner body (10) while changing the primary filter element (5). Since the secondary (safety) filter element (8) is protected from contamination by the primary filter element (5) it needs no periodic cleaning but should be replaced when it affects the total air flow restriction of the air cleaner, or on at least every third primary filter element service.

Note: Do not clean secondary (safety) filter element - replace with a new element.

Secondary (Safety) Filter Element Removal

Numbers in parentheses refer to Fig. 3.

1. Remove secondary (safety) filter element (8) by removing cotter pin (7) and then loosen nut (6). Remove nut (6) and gasket (4), then lift out element.

2. Wipe clean inside of air cleaner body (10) using a damp cloth. Check all body gaskets are properly secured and in good condition. Also check cleaner body (10) for cracks or other structural damage. Replace damaged parts immediately.

3. Check all new or properly serviced components for damage prior to installing in the cleaner body. Always check new filter element part numbers against air cleaner information label.

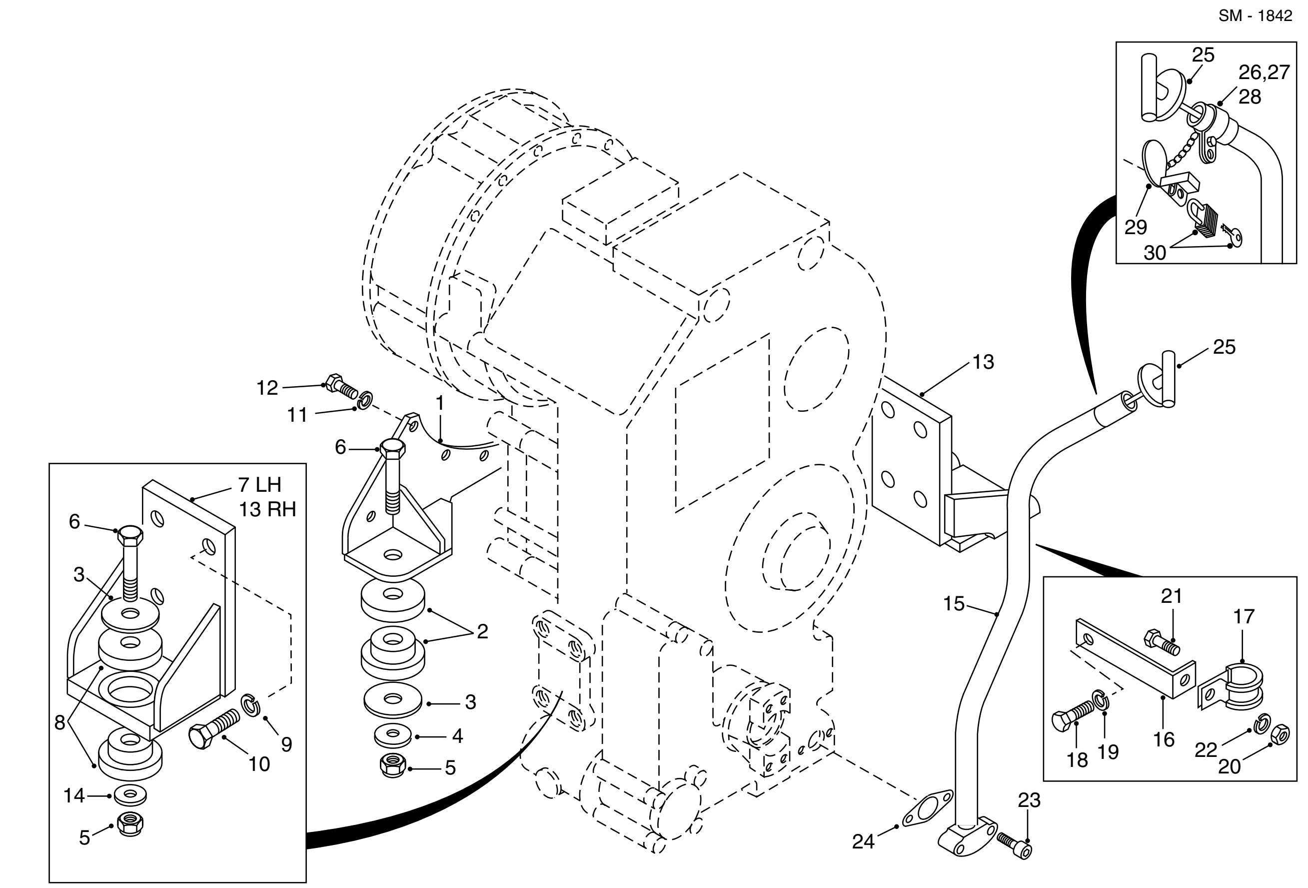
RECOMMENDATIONS

1. Under no condition should the unit be operated without both filter elements.

2. Carbon, soot and oil fumes will quickly hamper the operation of the paper filter element. Keep air cleaner inlet as far away as possible from sources of theses products, such as a parked vehicle with engine running. Also, make sure that the engine exhaust system does not leak, to prevent fouling the element with soot .

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

* * * *



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 - Clamp
27 - Bolt
28 - Locknut
29 - Latch Assembly
30 - Padlock & Key

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 6 speed gearbox with integral output transfer gearing. Automatic shifting in gear ranges 1 to 6, with kickdown feature. Lockup in all forward gears. A wear-resistant hydrodynamic retarder is integral of the transmission.

Two engine dependent power takeoffs at the rear of the transmission provide the drive for the braking system brake pump and the main hydraulic pump which supplies the steering and body hoist systems. A ground driven emergency steering pump is attached at the lower rear left hand side of the transmission.

Mounted off front bracket assembly (1) is the retarder solenoid, pressure reducing valve and centre axle differential lock solenoid (TA40 only). The transmission differential lock solenoid is located on the front frame adjacent to the right hand steering cylinder.

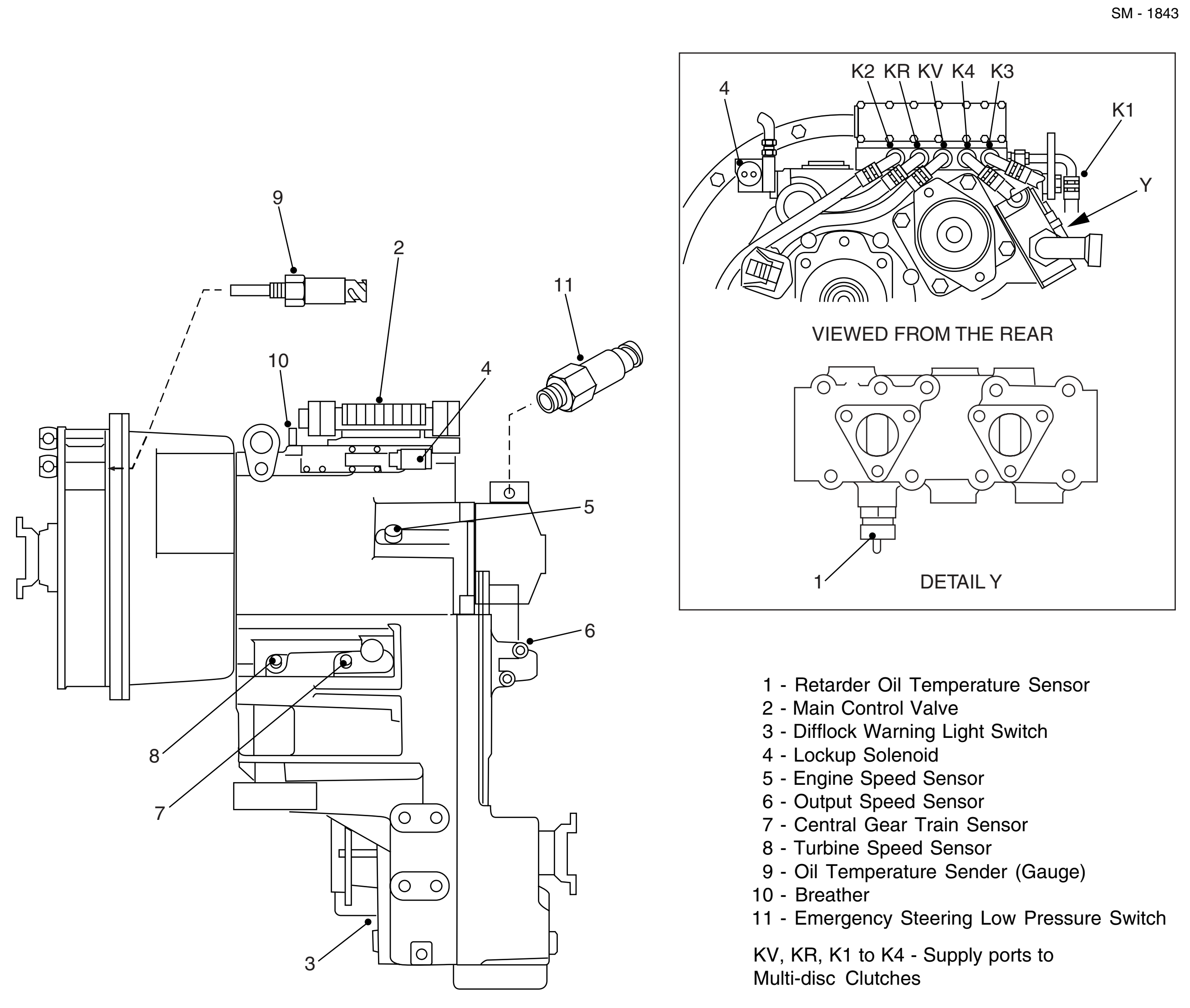


Fig. 2 - Location of Transmission Switches, Sensors and Solenoids

SWITCHES AND SENSORS

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

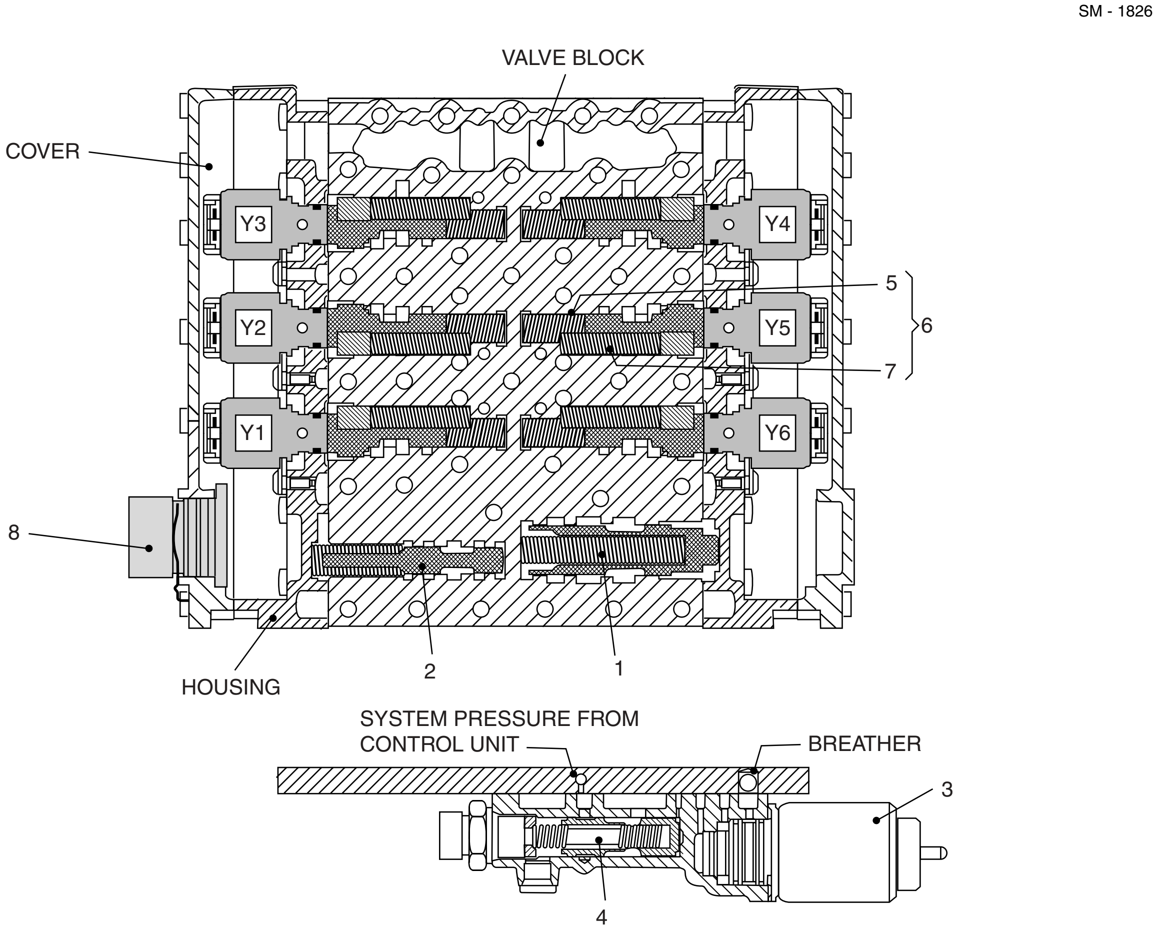
Transmission Oil Temperature

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.



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 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 hydraulic pressure to hold it 'Off', whereas, the centre axle differential lock requires pressure to hold it 'On'.

When the engine is started, hydraulic 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 hydraulic pressure is released at the transmission differential lock and applied at the centre axle differential lock (TA40 only). 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.

Retarder Control

The hydro dynamic retarder is arranged between the engine and torque converter so that a good braking effect is obtained in all speeds. The retarder is a wear resistant hydrodynamic brake with speed dependent action.

Retarder solenoid is energised on application of the retarder switch, located either on the right hand dash panel or within the treadle valve, provided that the lockup clutch is engaged and the transmission 'Stop' warning light is OUT. Energising retarder solenoid will shift retarder solenoid valve and allow oil to flow through the valve to engage the retarder.

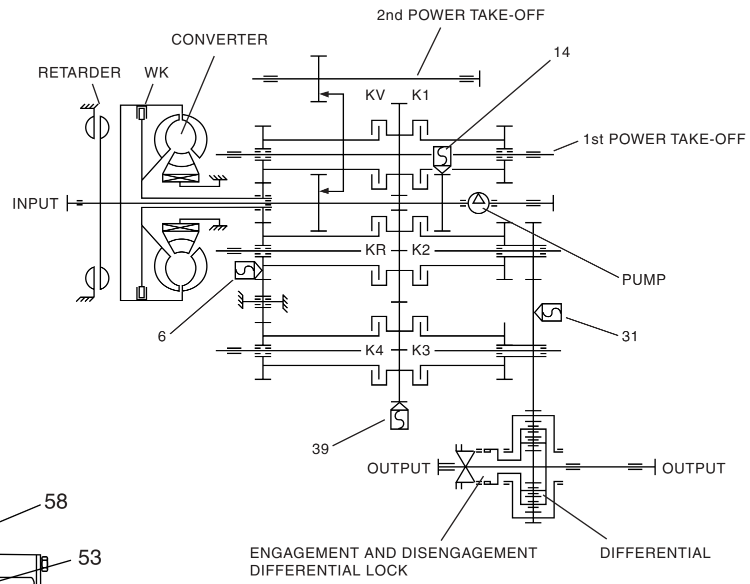
Pressing the retarder switch OFF will de-energise retarder solenoid and retarder solenoid valve will shift back to disengage the retarder.

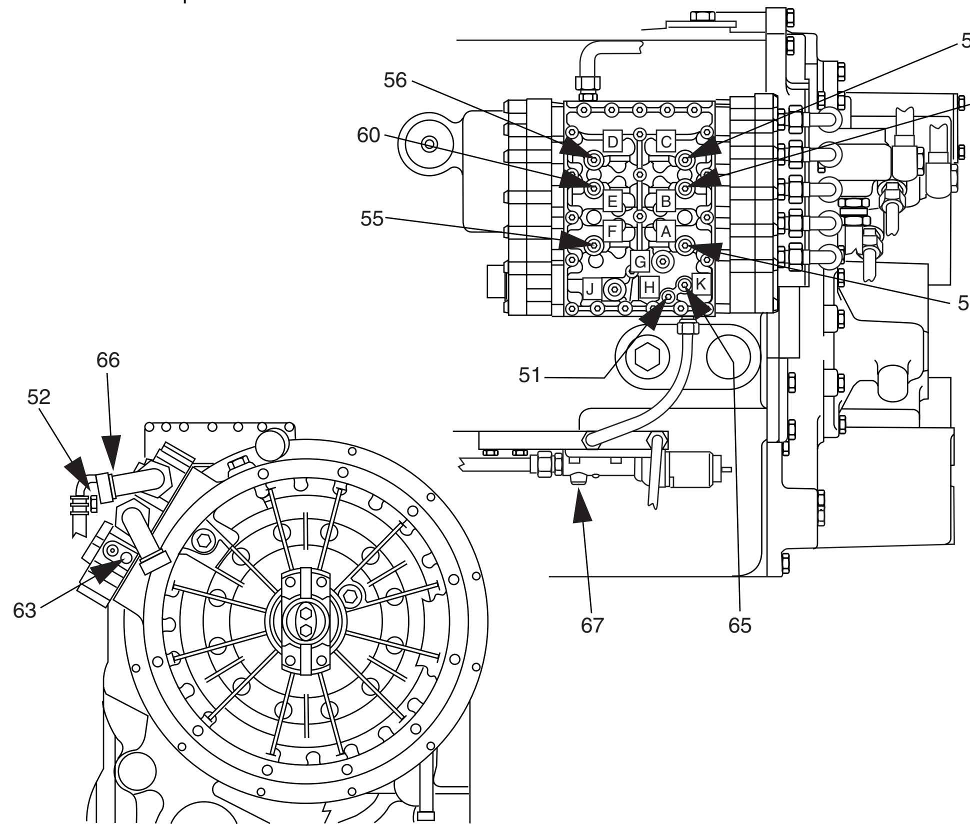
SCHEDULE OF MEASURING POINTS

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





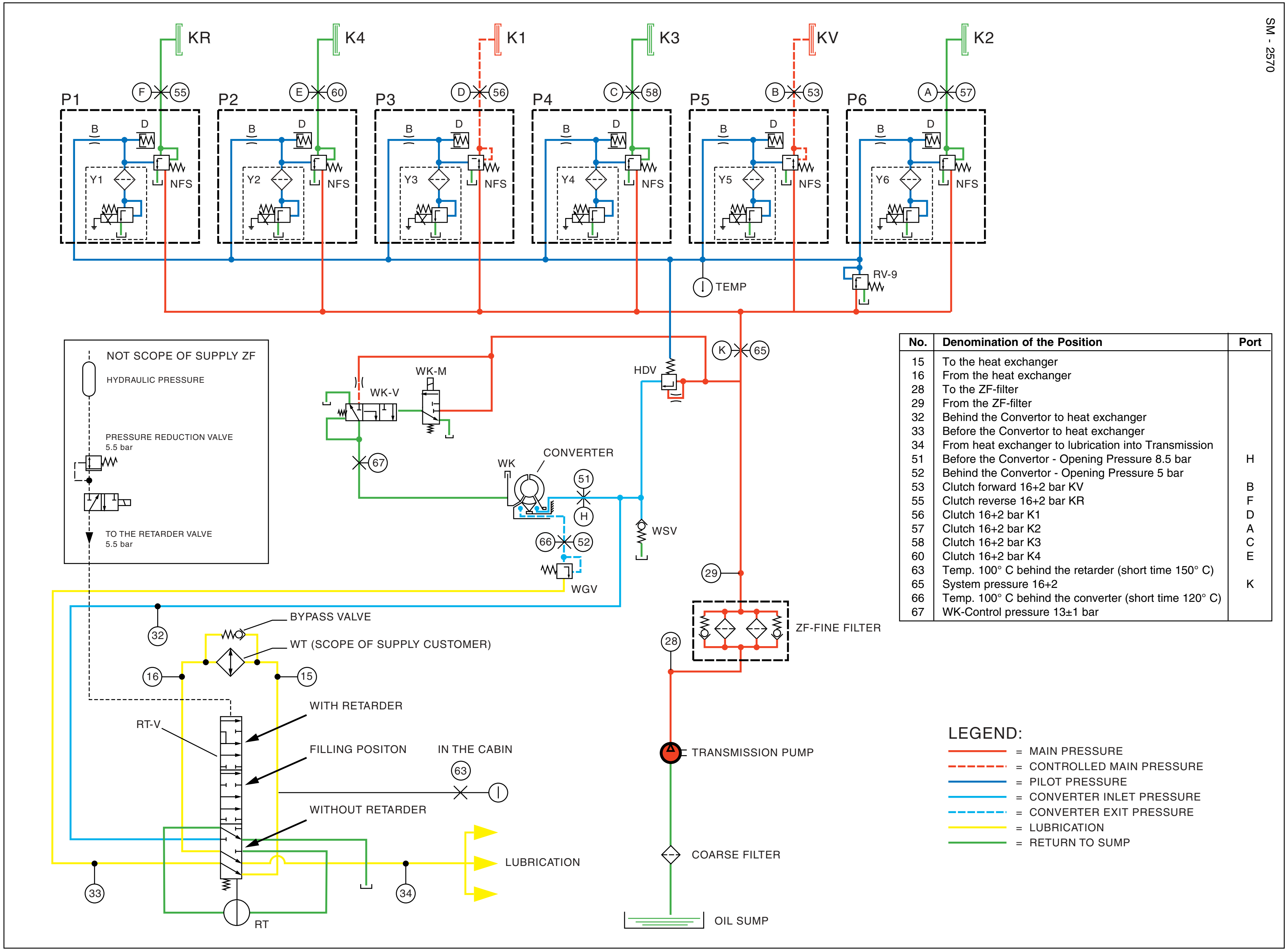
INDUCTIVE TRANSMITTERS AND SPEED SENSORS

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

SM - 1824

Fig. 4 - Typical Schedule of Measuring Points and Gear Pattern



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

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, body hydraulics joystick 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).

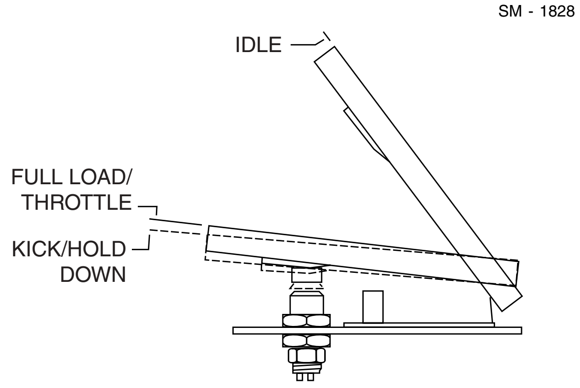
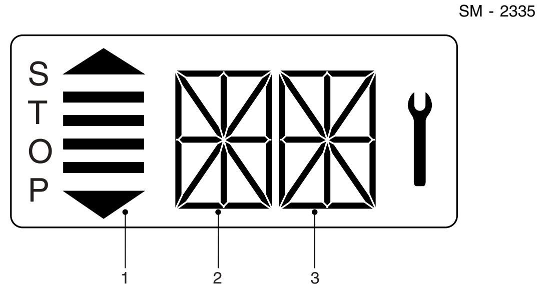


Fig. 6 - Accelerator Load Ranges and Kickdown Position



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.

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.

> **WARNINGS**
>
> **Always select the correct drive direction and gear before releasing the parking brake.**
>
> **Never allow the machine to coast with the transmission in 'NEUTRAL'.**

> **WARNINGS**
>
> **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), irrespective of engine speed.**

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	

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	

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	
13	LOGICAL ERROR AT ENGINE DERATING DEVICE TCU detected no reaction of engine while derating device active	after selecting neutral, TCU changes to	•check engine derating device	This fault is reset after power up of TCU
15	LOGICAL ERROR AT DIRECTION SELECT SIGNAL 2 SHIFT LEVER TCU detected a wrong signal combination for the direction •*cable from shift lever 2 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 if selector active OP-Mode: transmission shutdown if selector active	•check cables from TCU to shift lever 2 •check signal combinations of shift lever positions F-N-R	Fault is taken back if TCU detects a valid neutral signal for the direction at the shift lever
16	LOGICAL ERROR AT AXLE CONNECTION feedback axle connection measured by TCU and output signal axle connection don't fit •*axle can't be connected/disconnected due to mechanical problem* •*one of the cables from feedback axle connection - switch to TCU is broken*	OP-Mode: normal	•check cables from TCU to feedback axle connection switch •check signals of the feedback axle connection	

Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
17	S.C. TO GROUND AT 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* •*device has an internal defect* •*connector pin is contacted to vehicle ground*	customer specific	•check cables from TCU to device •check connectors from TCU to device •check the resistance of device	See figure 8
18	S.C. TO BATTERY VOLTAGE AT ADM4 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* •*relay has an internal defect* •*connector pin is contacted to battery voltage*	no reaction	•check cables from TCU to relay •check connectors from TCU to relay •check the resistance of relay	See figure 8
19	O.C. AT ADM4 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* •*relay has an internal defect* •*connector has no connection to TCU*	no reaction	•check cable from TCU to relay •check connectors from relay to TCU •check resistance of relay	See figure 8
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	
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	

Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
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
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

Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
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	
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	

Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
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
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

Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
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
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

Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
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
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

Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
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
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

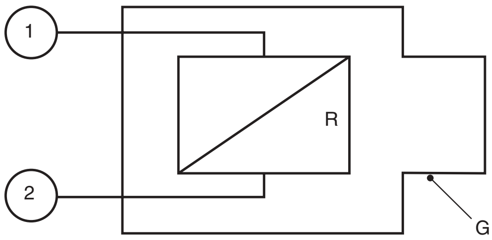
Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
A4	S.C. TO GROUND AT WARNING SIGNAL OUTPUT TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground •*cable is defective and is contacted to vehicle ground* •*warning device 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	
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	

Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
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 over the allowed threshold.	no reaction OP-Mode: normal	•cool down machine •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)	
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

Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
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
C3	OVERTEMP TORQUE CONVERTOR OUTPUT TCU measured an oil temperature at the converter output that is over the allowed threshold	no reaction OP-mode: normal	•cool down machine •check oil level •check temperature sensor	
CA	ENGINE_RETARDER CONFIG_TIMEOUT Timeout of CAN message ENGINE_RETARDER CONFIG from EEC controller •*inteference 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	
CB	ERC1 TIMEOUT Timeout of CAN-message ERC1 from EEC controller •*inteference 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	
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	

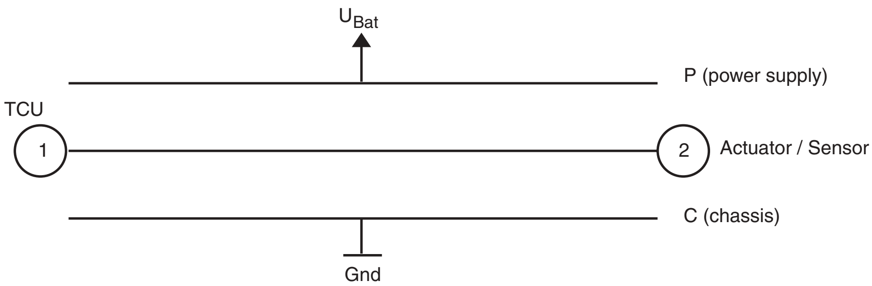
Fault Code (hex)	MEANING OF CODE possible reason for fault detection	TCU reaction	Checks	Remarks
D5	ERROR AT SWITCH 1 FOR VALVE POWER SUPPLY VPS1 TCU switched on VPS1 and measured VPS1 is off or TCU switched off VPS1 and measured VPS1 is still on •*cable or connectors are defect and are contacted to 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	

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

Retarder

The retarder is engaged when the bottom of the switch is pressed and provided that the transmission 'Stop' warning light is OUT and the transmission is in 'lockup'. To disengage retarder, press the top of the switch. On TA40 machines, the retarder switch is incorporated in the brake pedal. The first 7° of pedal travel engages the retarder, provided that the transmission 'Stop' warning light is OUT and the transmission is in 'lockup'. Further depression of pedal applies service brakes. To disengage retarder, release brake pedal. A warning light illuminates on the dash to indicate when retarder is applied.

The retarder is used to apply a continuous braking force to hold the truck to a safe steady speed when descending grades, to reduce the need for service brake applications, thus reducing service brake wear and preventing overheating. The retarder may be used anytime to slow down. If additional braking is required apply the service brakes. The retarder is not meant for bringing the vehicle to a halt, or for sudden deceleration - the service brakes should be employed for this purpose.

Before the vehicle starts down the grade, release accelerator, slow the vehicle with the service brakes, select the required gear, and apply the retarder. For maximum retardation, oil circulation and cooling, the vehicle downgrade speed (retarder applied) in the gear selected should be high enough to keep the engine operating at governed speed. Generally the gear used to ascend a grade is also correct for its descent. If the rate of descent is too slow, the transmission should be upshifted to the next highest gear. If the rate of descent is too fast, the service brakes should be applied and the transmission shifted into a lower gear which will allow a safe descent and efficient retarder operation.

Frequent use of the retarder will result in higher transmission oil temperatures. Therefore, the oil temperature gauge should be checked frequently. During normal operation the gauge should read in the green zone. However, during retarder operation the gauge can read in the yellow zone. Provided the vehicle is not in an overspeed condition, the transmission 'Stop' warning light will illuminate when the transmission oil temperature reaches 140° C (284° F). The retarder will automatically disengage when the oil temperature reaches 150° C (302° F) irrespective of engine speed. The speed must be reduced by using the service brakes so that the oil is cooled down. Reduce downgrade travel speed to avoid the oil overheating and possible damage to the transmission.

If the vehicle is approaching an overspeed condition, the transmission performs an upshift at an engine speed of 2 500 rev/min to the next highest gear to decrease the engine speed, whether in manual or automatic mode. If 6th gear is already selected, the retarder is automatically engaged at 2600 rev/min to decrease the engine speed irrespective of the accelerator position. The retarder is disengaged at 2450 rev/min. A fault code will be displayed and recorded by the TCU. If the oil temperature reaches 150° C (302° F) the retarder is disengaged and a fault code will be displayed and recorded by the TCU.

REMOVAL

Numbers in parentheses refer to Fig. 1.

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

⚠ **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 oil pressure will remain within the braking system after engine shutdown. Operate the treadle valve continuously until the pressure has dissipated before removing any brake lines or serious injury could result.**

⚠ **High electrical current can cause sparks and personal injury from burns. Turn battery master switch to the 'Off' position before disconnecting any components.**

1. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine. Operate steering right and left several times to relieve any pressure in the steering system.

2. Operate the treadle valve continuously to discharge the brake accumulators, block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

3. Disconnect the following cables and connectors in the order given, to prevent serious damage to the vehicles electrical components.

a - Battery earth cables
b - Battery supply cables
c - Alternator earth cables
d - Alternator supply cables
e - Body hydraulics joystick
f - Transmission (Est-37) connector
g - ECM interface harness connector (30 pin RHS)
h - ECM power harness connector (5 pin RHS)
i - ECM sensor harness connector (30 pin LHS)
j - ECM engine to transmission datalink connector (6 pin RHS)

4. Carefully loosen brake pipes at base of both accumulators to check that brake pressure has been discharged. Tighten brake pipes.

5. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

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.

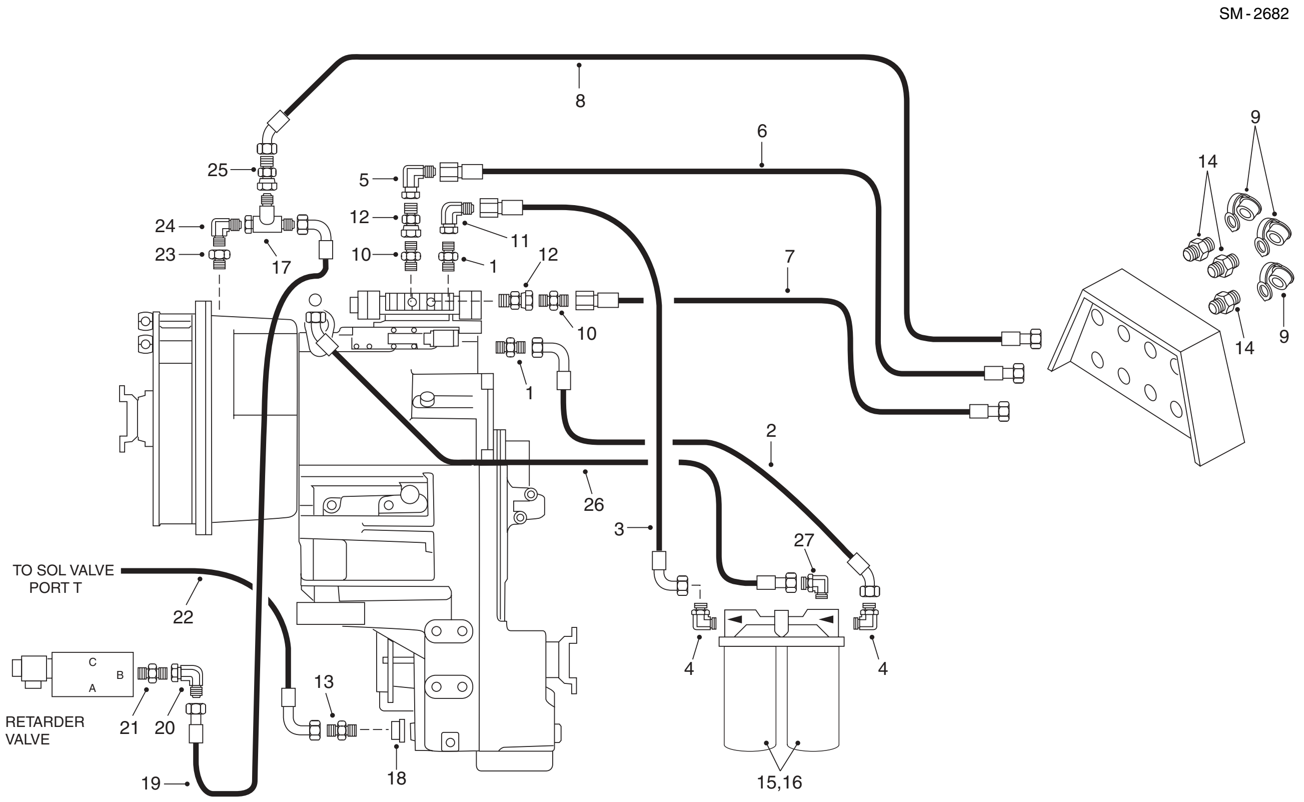
8. Disconnect all drivelines connected to the transmission and secure clear of the transmission. Refer to Section 130-0010, DRIVELINES.

9. Remove both exhaust tubes above transmission.

10. Disconnect all electrical harnesses and connections not previously disconnected on removal of the cab assembly.

11. Identify and tag all hydraulic lines at the main hydraulic, brake and emergency steering pumps. Disconnect hydraulic lines and cap lines and ports to prevent entry of dirt.

Note: The transmission can be removed from the vehicle without removing any of the pumps.



1 - Adaptor
2 - Hose Assembly
3 - Hose Assembly
4 - Elbow
5 - Elbow
6 - Hose Assembly
7 - Hose Assembly
8 - Hose Assembly
9 - Dust Cap
10 - Adaptor
11 - Elbow
12 - Adaptor
13 - Adaptor
14 - Diagnostic Nipple
15 - Oil Filter Head
16 - Filter Cartridge
17 - Tee
18 - Adaptor
19 - Hose Assembly
20 - Elbow
21 - Adaptor
22 - Hose Assembly
23 - Adaptor
24 - Elbow
25 - Adaptor
26 - Hose Assembly
27 - Elbow

Fig. 9 - Transmission Oil Lines

12. Identify, tag and disconnect hydraulic lines at transmission differential lock cylinder. Cap lines and ports to prevent entry of dirt.

13. Identify, tag and disconnect transmission oil cooler lines from the transmission retarder valve. Cap lines and ports to prevent entry of dirt.

14. Identify and tag oil filter hose assemblies (2, 3 & 26, Fig. 9) to aid installation. Disconnect hose assemblies (2, 3 & 26, Fig. 9) and cap open ends and adaptor (1, Fig. 9) and elbows (4, 11 & 27, Fig. 9) to prevent entry of dirt.

15. Identify and tag diagnostic hose assemblies (6, 7 & 8, Fig. 9) to aid in installation. Disconnect hose assemblies (6, 7 & 8, Fig. 9) and cap open ends and elbow (5, Fig. 9) and adaptors (10 & 26, Fig. 9) to prevent entry of dirt.

16. Identify, tag and disconnect all remaining lines and fixtures necessary to allow removal of the transmission from the vehicle.

17. Attach suitable lifting equipment to the lifting points on transmission and raise lifting equipment to take up the slack.

18. Remove locknut (5), hardened washer (14), bolt (6) and snubbing washer (3) securing LH bracket (7) to frame mounts.

19. Remove locknut (5), hardened washer (14), bolt (6) and snubbing washer (3) securing RH bracket (13) to frame mounts.

20. Remove locknuts (5), washers (4), snubbing washers (3) and bolts (6) securing front bracket assembly (1) to frame mounts.

21. Check to make certain that all necessary line and cable disconnections have been made before lifting the transmission.

22. 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.

23. 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. Remove mounting hardware securing main hydraulic pump to the transmission power takeoff. Refer to Section 230-0050, MAIN HYDRAULIC PUMP.

6. Remove mounting hardware securing brake pump to the transmission power takeoff. Refer to Section 250-0040, BRAKE PUMP.

7. 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.

8. 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.

9. Remove locknut (20), bolt (21), lockwasher (22) and clamp (17) securing dipstick tube (15) assembly to bracket (16). Remove screws (23), dipstick tube (15) assembly and gasket (24) from the transmission.

10. 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. 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 (21), lockwasher (22), clamp (17) and locknut (20).

2. 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.

3. 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.

4. Install main hydraulic pump to the transmission power takeoff and secure using mounting hardware removed at Disassembly. Refer to Section 230-0050, MAIN HYDRAULIC PUMP.

5. Install brake pump to the transmission power takeoff and secure using mounting hardware removed at Disassembly. Refer to Section 250-0040, BRAKE PUMP.

6. Secure LH bracket (7) and RH bracket (13) to the transmission with bolts (10) and lockwashers (9).

7. Secure front bracket assembly (1) to the transmission with bolts (12) and lockwashers (11).

8. 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 points 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 920 Nm (678 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 920 Nm (678 lbf ft).

6. Remove lifting equipment from lifting points on transmission.

7. Remove blanking cap from hose assembly (8, Fig. 9) and adaptor (26, Fig. 9) and connect hose assembly to the adaptor.

8. Remove blanking cap from hose assembly (7, Fig. 9) and adaptor (10, Fig. 9) and connect hose assembly to the adaptor.

9. Remove blanking cap from hose assembly (6, Fig. 9) and elbow (5, Fig. 9) and connect hose assembly to the elbow.

10. Remove blanking caps from hose assemblies (2, 3 & 26, Fig. 9), elbows (4, 11 & 27, Fig. 9) and adaptor (1, Fig. 9) and connect hose assemblies to the elbow and adaptors.

11. Remove blanking caps from transmission oil cooler lines and retarder ports and connect oil cooler lines. Refer to Section 210-0060, TRANSMISSION OIL COOLER.

12. Remove blanking caps and connect lines to retarder solenoid, differential lock solenoid and pressure reducing valve mounted on front bracket assembly (1), as identified at removal.

13. Remove blanking caps and connect hydraulic lines to the main hydraulic, brake and steering pumps, as identified at removal.

14. Connect all electrical cables, harnesses and connections to the transmission, as identified at removal.

15. Install both exhaust tubes above transmission.

16. Connect all drivelines to the transmission and secure with mounting hardware removed during removal. Refer to Section 130-0010, DRIVELINES.

17. Prior to installing the cab, ensure that all connections to the transmission, other than cab connections, are connected securely and properly clipped.

18. Install the cab assembly on the front frame. Refer to Section 260-0010, CAB AND MOUNTING.

19. Connect transmission harness at the cab floor and earth strap between LH side of the transmission and the frame.

20. Connect main frame harness and electrical connections at front left hand of the cab. Secure cover plate with mounting hardware removed during removal.

21. 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.

22. Fill transmission with engine oil specified in Section 300-0020, LUBRICATION SYSTEM. Check the oil level as described under 'Oil Level Check'.

23. Connect the following cables and connectors in the order given to prevent serious damage to the engines electrical components.

a - ECM engine to transmission datalink connector (6 pin RHS)
b - ECM sensor harness connector (30 pin LHS)
c - ECM power harness connector (5 pin RHS)
d - ECM interface harness connector (30 pin RHS)
e - Transmission (Est-37) connector
f - Body hydraulics joystick
g - Alternator supply cables
h - Alternator earth cables
i - Battery supply cables
j - Battery earth cables

24. 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. Allow transmission to warm up and recheck all connections for leaks.

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

26. 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 - Engine Off
This check is made only to determine if the transmission contains sufficient oil for safe starting. Oil level should show at least 6" (152 mm) above the hot oil maximum (MAX 80° C) mark on the dipstick. Add oil if low.

Cold Oil Level Check - Engine Running
This cold check is valid only when transmission oil temperature is below 40° C (104° F).

1. Position the vehicle on a level work area, apply the parking brake and block all road wheels securely.

2. With parking brake applied, gear selector in neutral and engine idling, check the oil level on dipstick. Oil level should be up to the 'COLD MIN' mark on the dipstick. Add oil if low.

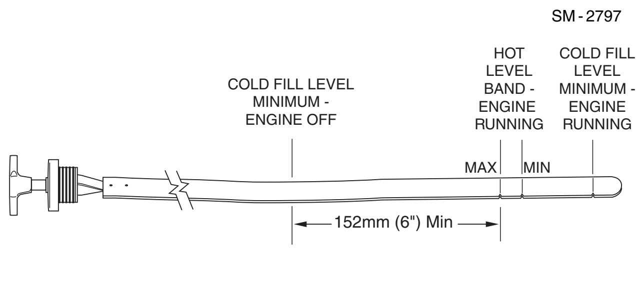


Fig. 10 - Transmission Dipstick Markings

Hot Oil Level Check - Engine Running
This hot check is valid for normal operating oil temperature of 80° C (176° F).

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.

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. Oil level should be between the 'MAX 80° C' upper mark and the 'MIN 80° C' lower mark on the dipstick. Add oil if low.

Oil and Filter Change

After the first 500 hours of operating a new or rebuilt transmission, the transmission oil and filter cartridges (16, Fig. 9) 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.

AEB Starter

The AEB Starter is an electronic tool used to calibrate the transmission to ensure optimum shift comfort. It is recommended to run the AEB Starter after the first 500 hours of transmission operation. The AEB Starter should also be run if shift quality deteriorates, or whenever the transmission, electronic control unit (ECU) or shift lever are replaced. The procedure for running the AEB Starter is detailed in the table on the following page. Refer to table on page 10 for typical codes displayed during AEB mode.

Note: Connect the AEB Starter to plug X25 located below the right hand dash panel, adjacent to the ECU.

TROUBLESHOOTING

Numbers in parentheses refer to Fig. 2, unless otherwise specified. Refer to Fig. 11 for plug identification.

Transmission Sensor Checks

The engine (5), turbine (8), central gear train (7) and output (6) speed sensors can be checked by measuring their resistance at plug X8 (located below the dash panel).

1. Engine speed sensor (5). Check across pins 1 & 2. Resistance should be 945 - 1 155 ohms at a temperature of 20° C (68° F).

2. Turbine speed sensor (8). Check across pins 3 & 4. Resistance should be 945 - 1 155 ohms at a temperature of 20° C (68° F).

3. Central gear train speed sensor (7). Check across pins 5 & 6. Resistance should be 945 - 1 155 ohms at a temperature of 20° C (68° F).

4. Output speed sensor (6). Check across pins 21 & 22. Resistance should be 5 mega ohms.

The installation of the speed sensors can also be checked by measuring the gap between the sensor and the gear tooth:

Engine speed sensor (5) and turbine speed sensor (8) - gap should be 0.5 - 0.8 mm.

Central gear train speed sensor (7) - gap should be 0.3 +/- 0.1 mm.

Output speed sensor (6) - gap should be 1.0 - 1.5 mm.

Lock-Up Solenoid

The solenoid can be checked at plug X9, pins 7 & 8 (located below the dash panel).

Resistance: 60 - 80 ohms
Current: 0.25 - 0.35 A
Voltage: 24 V

Pressure can also be checked (see Fig. 4).

Temperature Sensors

The sump temperature sensor, located in the main control valve (2) can be checked at plug X8, pins 14 & 15. Resistance should be 1 000 - 1 500 ohms.

The retarder oil temperature sensor (1) can be checked at plug X9, pins 15 & 16. Resistance should be 800 - 1 500 ohms.

Shift Controller

To troubleshoot the shift controller, continuity checks can be easily done by removing plug X2, selecting position and measuring across following pins:

Neutral	-	Pins 2 & 5
Forward	-	Pins 2 & 4
Reverse	-	Pins 2 & 6
Up	-	Pins 2 & 7
Down	-	Pins 2 & 8
Button	-	Pins 2 & 10

Transmission To Engine CAN-Bus

The communication link between the transmission and the engine can be electrically checked by measuring resistance and voltage. Refer to tables below.

Solenoid Coil Ratings

The following data should be referenced when checking solenoids:

1. Diff-lock solenoid(s). Solenoid(s) can be checked at plug X9, pins 11 & 12.

Resistance: 41 ohms
Current: 0.6 A

Measuring CAN-Bus Resistance At Plug X4 (Ignition OFF)

Measurement between	Specified Value (ohms)	Actual Value (ohms)	Possible Cause
CAN H (X4 pin 1) and CAN L (X4 pin 2)	60	0	Short circuit from CAN H to CAN L
	60	120	Connection to one end of resistor is damaged or cut off
	60	Infinity	End resistors damaged or cut off

Measuring CAN-Bus Voltage At Plug X4 (Ignition ON)

Measurement between	Specified Value (Volts)	Actual Value (volts)	Possible Cause
CAN H (X4 pin 1) and Ground	2.4 - 2.9	24	Short circuit from CAN H to battery
		0	Short circuit from CAN H to ground
		0 - 2.3 3.0 - 24	Intermittent short circuit from CAN H to another component
CAN L (X4 pin 2) and Ground	2.2 - 2.7	24	Short circuit from CAN L to battery
		0	Short circuit from CAN L to ground
		0 - 2.1 2.8 - 24	Intermittent short circuit from CAN L to another component

AEB Starter Procedure			
	ACTION	**DISPLAY MESSAGE**	**REMARK**
1	warm up transmission	normal operating messages	
2	turn off ignition	nothing	
3	plug in AEB - Starter		
4	• move shift lever to N position • engage parkbrake		
5	start engine	'PL'	TCU must recognise PL for at least 2 seconds before you can press the button
6	set engine speed to idle	'PL' if start conditions are OK	
7	press button of the AEB-Starter	'ST' if start conditions are OK	The button must not be released before TCU has started the AEB or quit with an error code (see display table)
8	hold button until AEB has started	'K1' (Information about the AEB state)	TCU has started the AEB, and goes on adjusting K1, K2, …, KR. (Button may be released)
9	wait until AEB has finished	'OK' (AEB has been successful)	
10	turn off ignition and unplug AEB-Starter	nothing	

2. Retarder solenoid (on bracket at front of transmission). The solenoid can be checked at plug X9, pins 9 & 10.
Resistance: 30 ohms
Current: 0.8 A

Differential Pressure Switch

When oil is at operating temperature, the switch can be checked at plug X9, pins 17 & 18. With the harness connected to the switch, resistance should be 500 ohms.

Pressure Checks

Refer to Fig. 4 for measurement points and pressures.

The system pressure, convertor pressure and retarder pressure can be measured at the diagnostic test points located at the rear of the tractor frame. If other pressures are to be measured, then diagnostic connectors on main control valve (2) should be moved to required point, so pressure can be read from diagnostic test point.

SERVICE TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part number of AEB Starter and other 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				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	6, Front Mounts	Bolt	920	678
1	6, Rear Mounts	Bolt	920	678

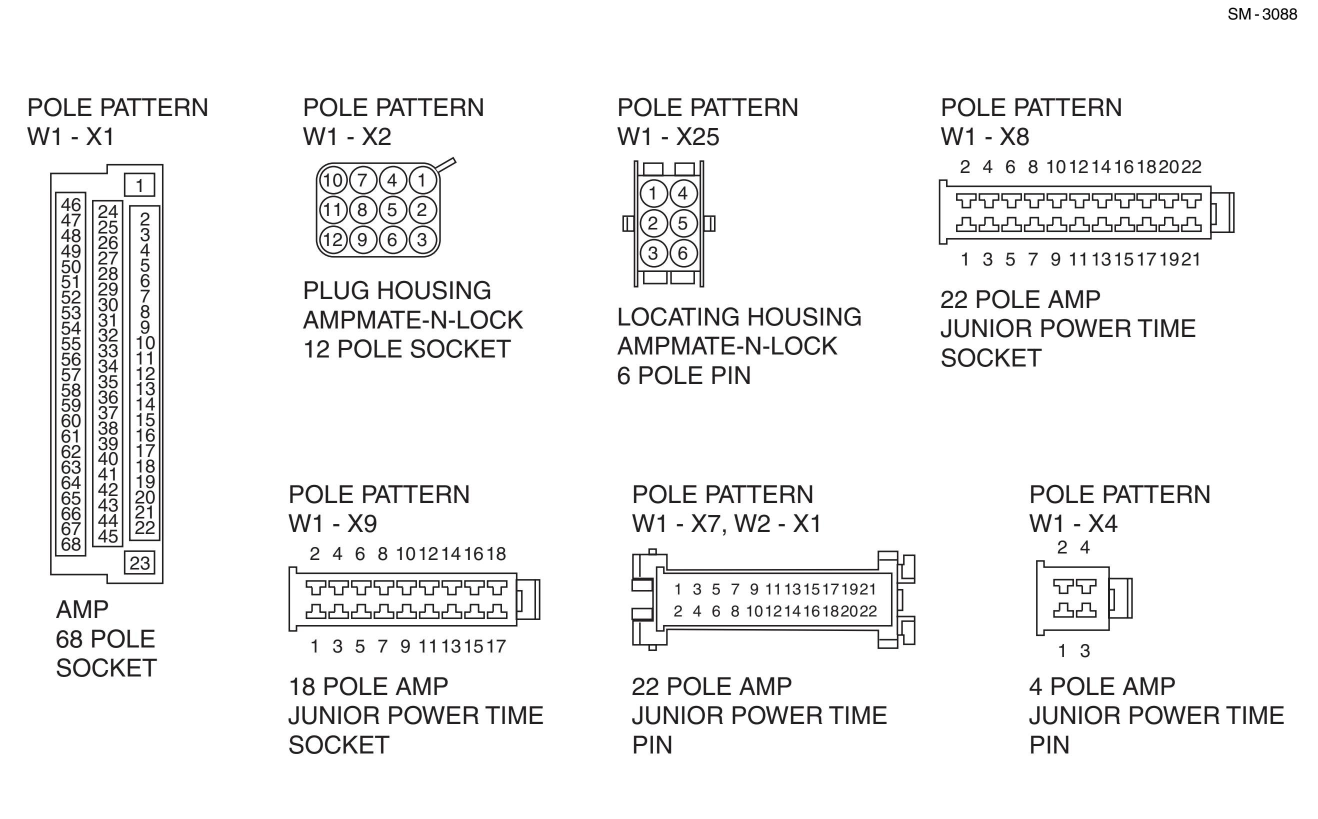
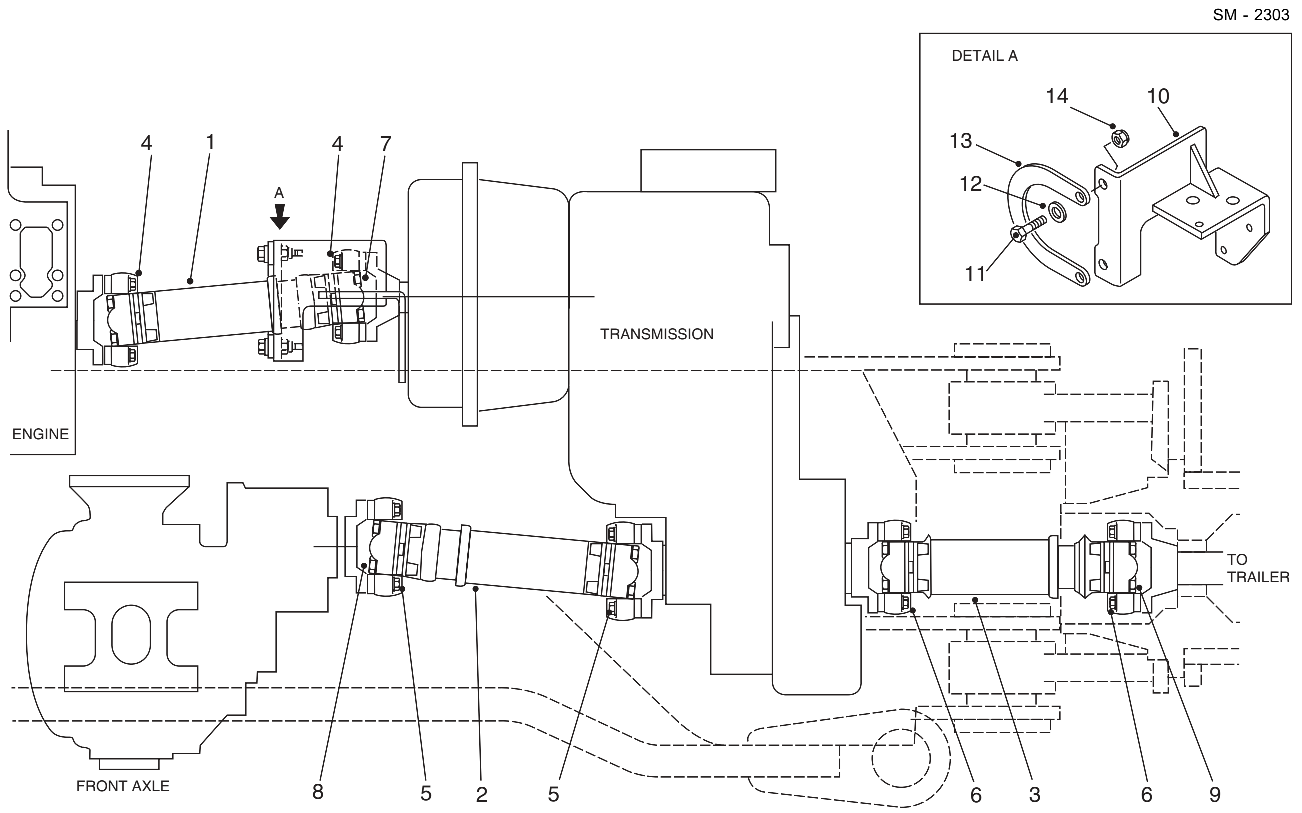


Fig. 11 - Plug Identification

*   *   *   *



1 - Driveline Assembly
2 - Driveline Assembly
3 - Driveline Assembly
4 - Capscrew
5 - Capscrew
6 - Capscrew
7 - Screw
8 - Screw
9 - Screw
10 - Bracket
11 - Bolt
12 - Washer
13 - Bracket
14 - Locknut

Fig. 1 - Front Drivelines and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

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 (2) is connected between the front axle drive flange and transmission final drive.

Driveline assembly (3) connects the rear final drive of the transmission to the articulation and oscillation pivot.

REMOVAL

Numbers in parentheses refer to Fig. 1.

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.

> ⚠ **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.**
>
> ⚠ **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. Depress the brake pedal continuously to relieve any pressure in the braking circuit. Turn the steering wheel several times to relieve any pressure in the steering circuit.

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

3. Remove mounting hardware securing insulation quilts under the fenders to allow access to driveline assembly (1). Remove insulation quilts.

Note: Access to driveline assembly (1) can be obtained from underneath the vehicle.

4. Remove mounting hardware securing guard bracket (13) over driveline assembly (1) and at the transmission. Remove guard bracket (13).

5. Match mark universal joints and their mating surfaces to ensure correct mating alignment when installing driveline assembly (1).

6. Support driveline (1) with suitable lifting equipment and remove capscrews (4) securing universal joints to their mating components and remove driveline assembly (1). If necessary tap driveline assembly (1) from its mating components with a soft faced hammer.

Note: Access to driveline assemblies (2 & 3) can be obtained from underneath the vehicle.

7. Match mark universal joints and their mating surfaces to ensure correct mating alignment when installing driveline assemblies (2 & 3).

8. Support driveline (2) with suitable lifting equipment and remove capscrews (5) securing universal joints to their mating components and remove driveline assembly (2). If necessary tap driveline assembly (2) from its mating components with a soft faced hammer.

9. Support driveline (3) with suitable lifting equipment and remove capscrews (6) securing universal joints to their mating components and remove driveline assembly (3). If necessary tap driveline assembly (3) from its mating components with a soft faced hammer.

DISASSEMBLY

Universal Joint

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 screws (7) and universal joint from driveline assembly (1).

3. Place the shaft end of driveline assembly (1) in a soft jawed vice.

4. Remove screws (7) and universal joint from driveline assembly (1).

5. Repeat steps 1 to 4 for drivelines (2 & 3).

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 universal joints mate against for parallelism. Refer to Fig. 2.

4. Check condition of mounting capscrews and replace if required.

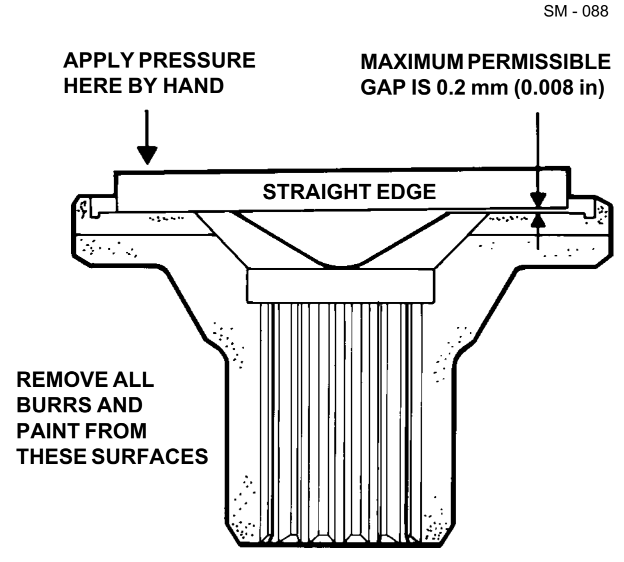


Fig. 2 - Checking Parallelism

ASSEMBLY

Universal Joint

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. Install universal joint to yoke end of driveline assembly (1) and secure with screws (7).

3. Place the shaft end of driveline assembly (1) in a soft jawed vice.

4. Install universal joint to shaft end of driveline assembly (1) and secure with screws (7).

5. Repeat steps 1 to 4 for drivelines (2 & 3).

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.

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.

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.

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 (3) on the vehicle as shown in Fig. 1 and align match marks on universal joints with those on their mating surfaces.

2. Apply Loctite 648 to the threads of capscrews (6). Secure universal joints to their mating surfaces with capscrews (6). Tighten capscrews (6) to a torque of 154 Nm (113 lbf ft).

3. Position driveline assembly (2) on the vehicle as shown in Fig. 1 and align match marks on universal joints with those on their mating surfaces.

4. Apply Loctite 648 to the threads of capscrews (5). Secure universal joints to their mating surfaces with capscrews (5). Tighten capscrews (5) to a torque of 154 Nm (113 lbf ft).

5. Position driveline assembly (1) on the vehicle as shown in Fig. 1 and align match marks on universal joints with those on their mating surfaces.

6. Apply Loctite 648 to the threads of capscrews (4). Secure universal joints to their mating surfaces with capscrews (4). Tighten capscrews (4) to a torque of 154 Nm (113 lbf ft).

7. Secure guard bracket (13) evenly over driveline assembly (1) and onto bracket at transmission with mounting hardware removed during removal.

8. Secure insulation quilts under fenders and on to mounting brackets with hardware removed during removal.

9. Ensure the parking brake is applied and remove wheel chocks from all road wheels.

MAINTENANCE

Universal Joints

Every 500 Hours: Check the universal joints for wear and replace if required.

Every 2 000 Hours: Check drivelines for leaks and damage, 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.

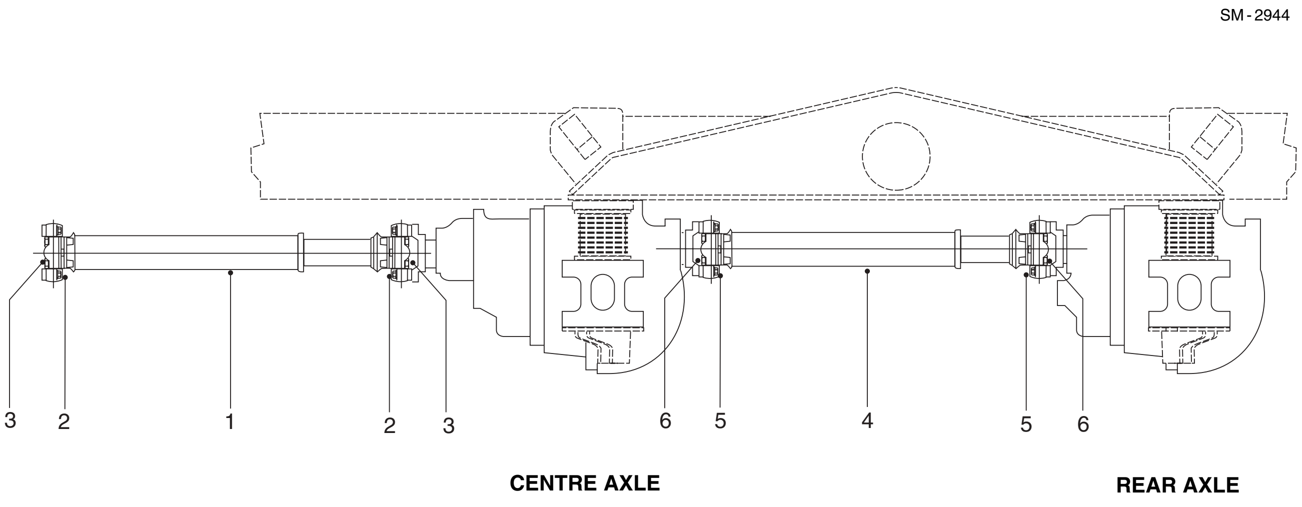
SPECIAL TOOLS

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.

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	4	Capscrew	154	113
1	5	Capscrew	154	113
1	6	Capscrew	154	113

* * * *



1 - Driveline Assembly
2 - Capscrew
3 - Screw
4 - Driveline Assembly
5 - Capscrew
6 - Screw

Fig. 1 - Rear Drivelines and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

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 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 (1) is connected between the articulation and oscillation pivot and the centre axle.

Driveline assembly (4) 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.

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..

⚠ Disconnecting or removing any of the rear drivelines will make the parking brake ineffective.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Depress the brake pedal continuously to relieve any pressure in the braking circuit. Turn the steering wheel several times to relieve any pressure in the steering circuit.

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

Note: Access to driveline assemblies (1 & 4) can be obtained from underneath the vehicle.

3. Match mark universal joints and their mating surfaces to ensure correct mating alignment when installing driveline assembly (1).

4. Remove capscrews (2) securing universal joints to their mating components and remove driveline assembly (1). If necessary tap driveline assembly (1) from its mating components with a soft faced hammer.

5. Match mark universal joints and their mating surfaces to ensure correct mating alignment when installing driveline assembly (4).

6. Remove capscrews (5) securing universal joints to their mating components and remove driveline assembly (4). If necessary tap driveline assembly (4) from its mating components with a soft faced hammer.

DISASSEMBLY

Universal Joint

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 screws (3) and universal joint from driveline assembly (1).

3. Place the shaft end of driveline assembly (1) in a soft jawed vice.

4. Remove screws (3) and universal joint from driveline assembly (1).

5. Repeat steps 1 to 4 for driveline (4).

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 universal joints mate against for parallelism. Refer to Fig. 2.

4. Check condition of mounting capscrews and replace if required.

ASSEMBLY

Universal Joint

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. Install universal joint to yoke end of driveline assembly (1) and secure with screws (3).

3. Place the shaft end of driveline assembly (1) in a soft jawed vice.

4. Install universal joint to shaft end of driveline assembly (1) and secure with screws (3).

5. Repeat steps 1 to 4 for driveline (4).

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

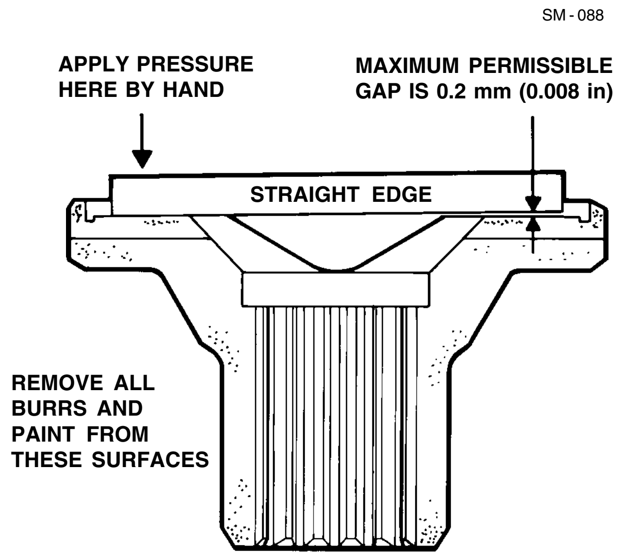


Fig. 2 - Checking Parallelism

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.

⚠ **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..**

⚠ **Disconnecting or removing any of the rear drivelines will make the parking brake ineffective.**

1. Position driveline assembly (1) on the vehicle as shown in Fig. 1 and align match marks on universal joints with those on their mating surfaces.

2. Apply Loctite 648 to the threads of capscrews (2). Secure universal joints to their mating surfaces with capscrews (2). Tighten capscrews (2) to a torque of 154 Nm (113 lbf ft).

3. Position driveline assembly (4) on the vehicle as shown in Fig. 1 and align match marks on universal joints with those on their mating surfaces.

4. Apply Loctite 648 to the threads of capscrews (5). Secure universal joints to their mating surfaces with capscrews (5). Tighten capscrews (5) to a torque of 154 Nm (113 lbf ft).

5. Ensure the parking brake is applied and remove wheel blocks from all road wheels.

MAINTENANCE

Universal Joints

Every 500 Hours: Check the universal joints for wear and replace if required.

Every 2 000 Hours: Check drivelines for leaks and damage, 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.

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.

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	2	Capscrew	154	113
1	5	Capscrew	154	113

* * * *

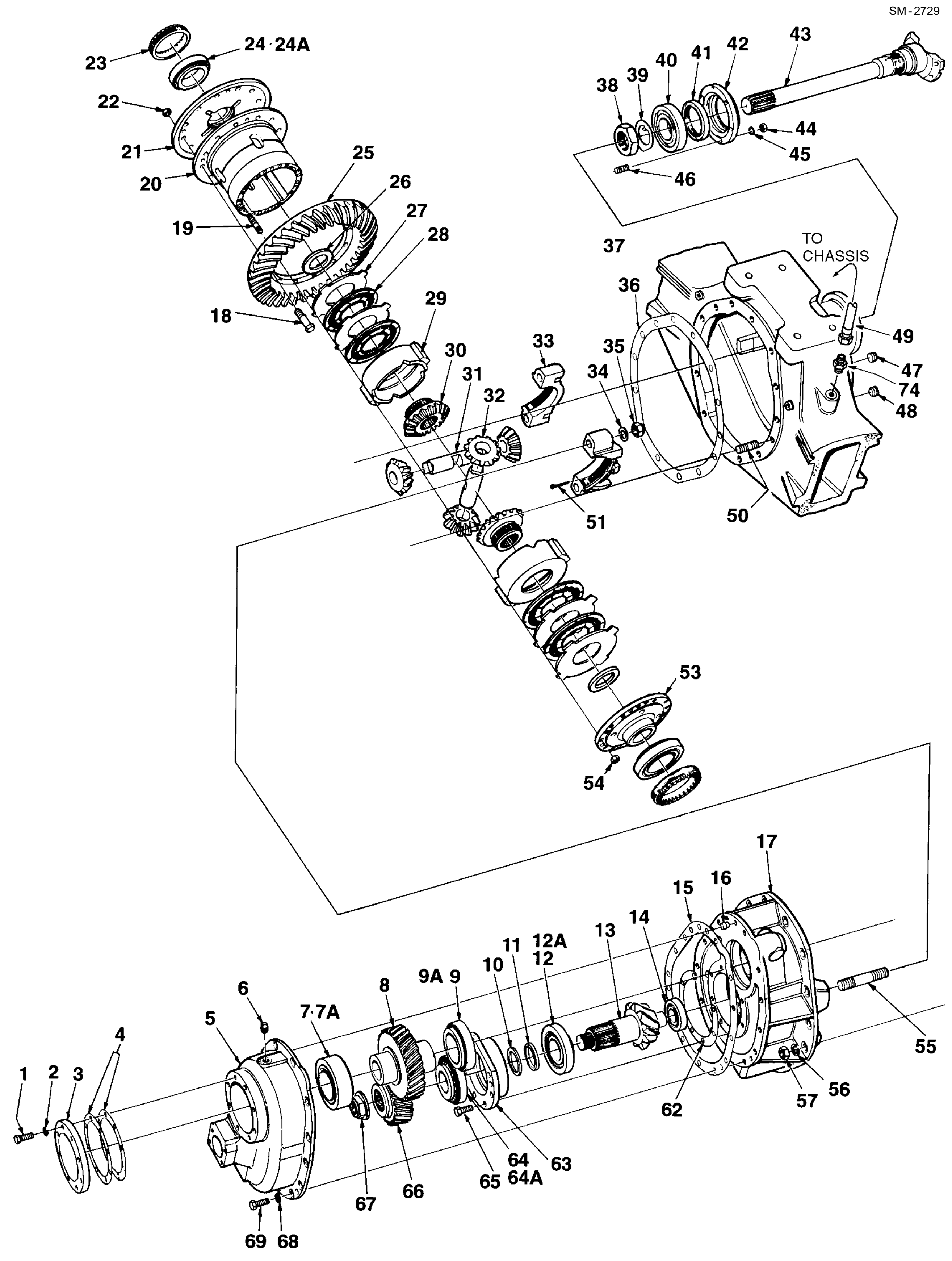


Fig. 1 - POWR LOK Differential Drive Head

LEGEND FOR FIG. 1

1 - Setscrew	16 - Dowel	33 - Strap	51 - Split Pin
2 - Spring Washer	17 - Gear Casing	34 - Washer	53 - End Flange
3 - Bearing Retainer	18 - Bolt	35 - Nut	54 - Nut
4 - Shim	19 - Stud	36 - Gasket	55 - Stud
5 - Helical Gear Housing	20 - Differential Housing Body	37 - Axle Casing	56 - Spring Washer
6 - Plug	21 - End Flange	38 - Shaft Nut	57 - Nut
7 - Outer Bearing Cup	22 - Nut	39 - Lockplate	62 - Shim
7A - Outer Bearing Cone	23 - Adjusting Nut	40 - Shaft Bearing	63 - Bearing Housing
8 - Helical Pinion	24 - Bearing Cup	41 - Oil Seal	64 - Bearing Cup
9 - Inner Bearing Cup	24A - Bearing Cone	42 - End Cap	64A - Bearing Cone
9A - Inner Bearing Cone	25 - Crownwheel	43 - Differential Shaft	65 - Setscrew
10 - Outer Spacer	26 - Thrust Washer	44 - Nut	66 - Helical Gear
11 - Inner Spacer	27 - Clutch Plate	45 - Spring Washer	67 - End Nut
12 - Inner Bearing Cup	28 - Friction Plate	46 - Stud	68 - Washer
12A - Inner Bearing Cone	29 - Cage Half	47 - Oil Filler/Level Plug	69 - Bolt
13 - Pinion	30 - Wheel	48 - Drain Plug	
14 - Nose Bearing	31 - Trunnion	49 - Breather Tube	
15 - Gasket	32 - Pinion	50 - Stud	

DESCRIPTION

The axle employs a helical gear housing assembly containing a helical pinion running in taper roller bearings. A drive wheel transfers the input torque through the hypoid form pinion and crownwheel to a POWR LOK differential. The pinion is supported by three roller bearings, the outer and centre bearings being pre-loaded taper roller bearings whilst the nose bearing is of the plain roller type.

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.

Draining the Oil

1. Position the vehicle (preferably after a short run to warm the oil) on a level, solid concrete floor, apply the parking brake and switch off the engine.

2. Block appropriate road wheels and turn the battery master switch to the 'Off' position.

3. Whilst road wheels are still on the ground, loosen wheel nuts of each wheel.

4. Jack up chassis until the tyres are clear of ground and support with suitably placed stands or timbers.

5. Remove wheel nuts then pull off road wheels.

6. Disconnect differential shaft flange (43) from driveline.

7. Remove front axle from vehicle and place on a suitable axle stand. Refer to Section 180-0020, FRONT SUSPENSION.

Note: As there is no oil sealing between the drive head and the hubs, the oil must be drained from all three units before overhaul.

8. Place suitable containers under the drive head and both hubs.

9. Rotate hubs to bring bolts (6, Fig. 2) to their lowest point. Unscrew and remove filler/level plugs (7, Fig. 2). Remove bolts (6, Fig. 2) and washers (5, Fig. 2) to drain the oil from the hubs.

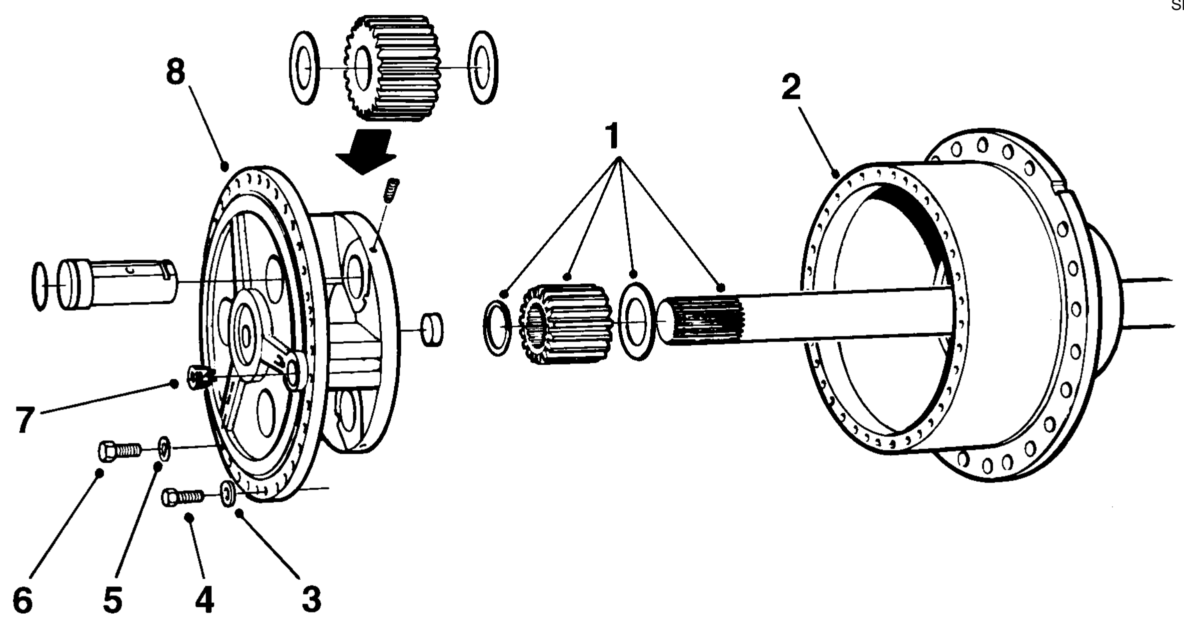
10. Unscrew and remove oil filler/level plug (47) and drain plug (48) to drain oil from drive head.

Driveshafts and Driveline

1. Remove bolts (4, Fig. 2) and washers (3, Fig. 2).

2. Using suitable lifting equipment, pull off planet carrier assembly (8, Fig. 2) and place on bench, small diameter down.

SM - 033



1 - Driveshaft Assembly
2 - Hub
3 - Washer
4 - Bolt
5 - Washer
6 - Bolt
7 - Oil Filler/Level Plug
8 - Planet Carrier

Fig. 2 - Part View of Hub Reduction Unit

3. Pull out driveshaft assembly (1, Fig. 2) from hub to disengage the shaft splines from wheel (30).

4. Cover open end of hub unit to prevent entry of dirt.

5. Repeat steps 1 through 4 for other hub end.

6. Identify the relationship of the driveline flange to both the differential shaft (43) and the transmission flange. Remove the driveline from the machine. Refer to Section 130-0010, FRONT DRIVELINES.

Drive Head Unit from Axle Casing

1. Remove nuts (44) and washers (45) from rear end cap (42).

2. Withdraw differential shaft (43) complete with end cap (42), oil seal (41), shaft bearing (40), lockplate (39) and shaft nut (38).

3. Remove all gasket material from bearing recess in axle casing (37).

4. Support the weight of the drive head with suitable lifting equipment.

5. Remove nuts (57) and spring washers (56).

6. Insert two 5/8 in UNF bolts into extractor holes provided in gear casing flange and tighten to separate gear casing (17) and helical gear housing (5) from axle casing (37).

7. Carefully remove gear casing (17) assembly clear of axle casing (37) and place on a suitable build stool.

8. Remove all traces of gasket material from axle casing (37) and gear casing (17) flanges.

Helical Gear Housing from Gear Casing

1. Attach suitable lifting equipment to helical gear housing (5).

2. Remove bolts (69) and washers (68).

3. Insert two 1/2 in UNF bolts into extractor holes provided in helical gear housing flange and with container ready to catch the oil, tighten bolts to separate helical gear housing (5) from gear casing (17).

4. Carefully lift helical gear housing from gear casing and place on work bench, bearing retainer (3) uppermost.

5. Remove all traces of joint material from gear casing flange and remove lifting equipment.

DISASSEMBLY

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.

⚠ WARNING
When necessary to drive out components during disassembly, be sure to use a soft drift to prevent property damage and personal injury.

Helical Gear Housing Disassembly

1. Remove setscrews (1) and spring washers (2).

2. Lift off bearing retainer (3) and shims (4).

3. Lift helical gear housing (5) from helical pinion (8).

4. If bearing replacement is required, use suitable puller to remove outer bearing cone (7A) and inner bearing cone (9A) from helical pinion (8).

5. Inspect helical pinion (8) for wear or damage and replace if necessary.

6. If replacing inner or outer bearing cones (9A & 7A), drift out the mating cup from gear casing (17) or helical gear housing (5).

Note: If either bearing cup or cone need replacing, they must be replaced as a set.

7. Remove any gasket material from bottom gasket face of helical gear housing (5).

Differential Unit Disassembly

1. Match mark straps (33) as shown in Fig. 3 to ensure correct rebuild position then remove nuts (35) and washers (34).

2. Lift off two straps (33), adjusting nuts (23) and split pins (51).

3. Lift complete differential and crownwheel assembly from gear casing (17). Place assembly on bench with crownwheel (25) teeth uppermost.

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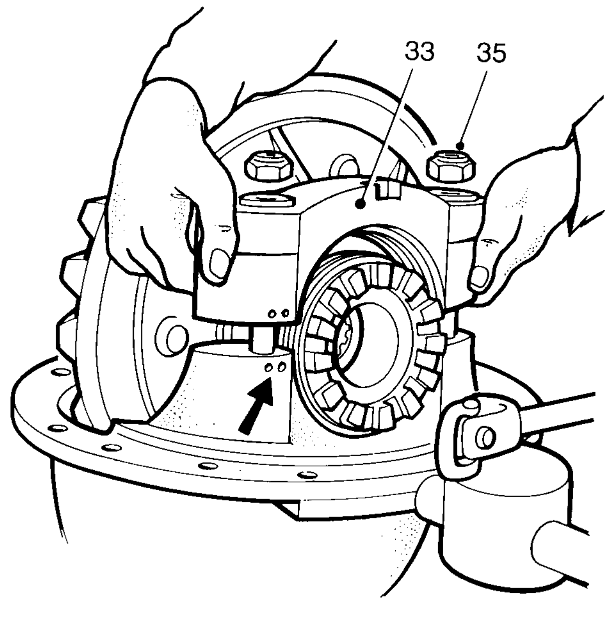

Fig. 3 - Match Marking Gear Casing Straps

SM - 1205

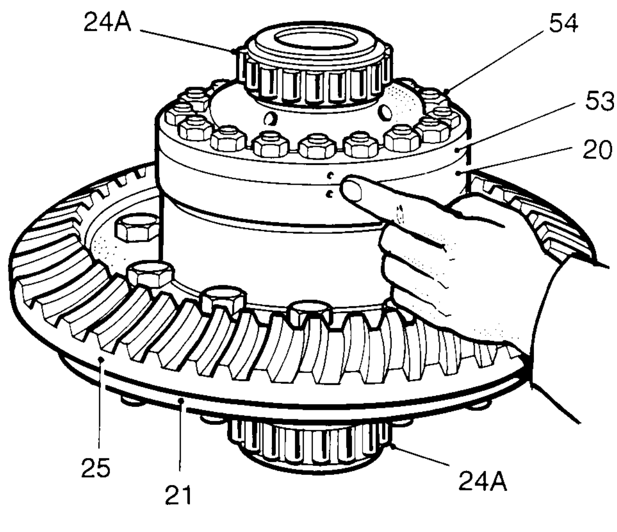

Fig. 4 - Matching Marks on Diff Housing

4. Check end flanges (21 & 53) and differential housing body (20) for identification and matching marks (See Fig. 4). If unmarked, centre punch the parts to ensure correct mating on assembly.

5. Remove nuts (54) from studs (19) which fasten upper end flange (53) to differential housing body (20).

6. Lift off end flange (53) and thrust washer (26).

Note: Shims may have been fitted between end flange (53) and differential housing body (20). These must be replaced on assembly to maintain an operating clearance within the differential assembly. The components contained in the differential unit have been carefully measured and selected to ensure correct operation. DO NOT fit the components in a different sequence to that of the original assembly or attempt to change/introduce shimming. This will result in failure of the POWR LOK system.

7. Remove first clutch plate (27) and friction plate (28) followed by second pair of plates. Set aside plates so that they can be reinstalled in their original position.

8. Slide out cage half (29) from differential housing body (20).

9. From remaining cage half, lift out wheel (30), pinions (32) and trunnions (31).

10. Remove second wheel (30) and cage half (29) followed by two pairs of clutch plates (27 & 28) and second thrust washer (26).

11. Unscrew and remove nuts (22) and bolts (18).

12. Separate end flange (21) from differential housing body (20).

13. Using hide faced mallet, remove crownwheel (25) from its register on differential housing body (20).

14. Inspect all parts of differential assembly. If there is any wear or damage install new differential unit complete. Renew crownwheel (25) and pinion (13) as a matched pair.

Bevel Pinion Disassembly

1. Remove setscrews (65) then, using hide faced mallet, knock out complete pinion assembly from gear casing (17) taking care not to lose any of the pinion setting shims (62).

Note: If the original pinion and crownwheel are to be reinstalled, retain the shim pack as a unit for reuse.

2. Secure pinion assembly in a vice fitted with soft jaws then remove end nut (67).

3. Pull off helical gear (66), using suitable extraction equipment.

4. Tap pinion (13) along with spacers (10 & 11), inner bearing cone (12A) and pinion nose bearing (14) out of bearing housing (63). Remove spacers (10 & 11) from bevel pinion and retain for reuse if original pinion bearings are to be reinstalled.

5. Remove inner bearing cone (12A) and nose bearing (14) from pinion (13) if required.

6. Lift out outer bearing cone (64A) from bearing housing (63). Bearing cups (64 & 12) can now be drifted out of bearing housing (63) for replacement if required.

Note: If either bearing cup or cone need replacing, they must be replaced as a set.

Differential Shaft Disassembly

1. Straighten tab on lockplate (39). Remove left hand threaded shaft nut (38), lockplate (39) and shaft bearing (40) using suitable extraction equipment.

2. Pull off rear end cap (42).

3. Using suitable drift, remove and discard oil seal (41) from rear end cap (42).

4. Remove all joint material from bearing recess in rear end cap (42).

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

Note: Prior to assembly, lightly oil bearings in clean gear oil as specified in Section 300-0020, LUBRICATION SYSTEM.

⚠ **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.

⚠ **When necessary to drive on components during assembly, be sure to use a soft drift to prevent property damage and personal injury.**

Bevel Pinion

1. If new nose bearing (14) is to be fitted, apply a light coating of Loctite 641 to bore of nose bearing then press onto pinion (13) hard against its abutment shoulder. To retain bearing, lightly peen over end of pinion shaft in three places as shown in Fig. 5.

2. Press inner bearing cone (12A) onto pinion (13). If original pinion (13) and bearings (12 & 64) are being refitted, install original spacers (10 & 11) onto pinion.

Note: If new parts are being fitted, install the largest available spacers (10 & 11). This is to ensure that the bearing cannot be over pre-loaded, preventing bearing damage.

3. Press inner and outer bearing cups (12 & 64) into bearing housing (63), hard against abutment shoulders.

4. Insert pinion assembly into bearing housing (63) and secure with outer bearing cone (64A).

5. To obtain correct position of pinion relative to crownwheel, shim (62) thickness is worked out using formula 8.636 mm + A mm + B mm + C mm (0.34 in + 0.00A in + 0.00B in + 0.00C in) where as:-

8.636 mm (0.034 in) shims selected as nominal.

'A' - Select shim thickness equivalent to figure stamped on end face of pinion (13).

'B' - Select shim thickness equivalent to figure stamped on gear casing (17).

'C' - Variation in bearing height from 44.653 mm (1.758 in) ref. dimension.

6. Place shim pack on inner face of bearing housing (63) then install assembly into gear casing (17). Secure assembly in position by installing setscrews (65) and evenly tighten to a torque of 98 - 109 Nm (72 - 80 lbf ft).

7. Install helical gear (66) and end nut (67) onto pinion (13).

8. Lock helical gear with suitable tool and tighten end nut (67) to a torque of 1 085 - 1 220 Nm (800 - 900 lbf ft) (See Fig. 6).

Setting Pinion Bearing Pre-Load

1. Shock load spiral bevel pinion bearings.

2. Secure length of cord to helical gear (66) and attach free end to spring balance.

3. Wrap cord around OD of helical gear (66) and pull on spring balance to rotate pinion (13) (See Fig. 7). Note the force required to maintain rotation, ignoring initial starting force.

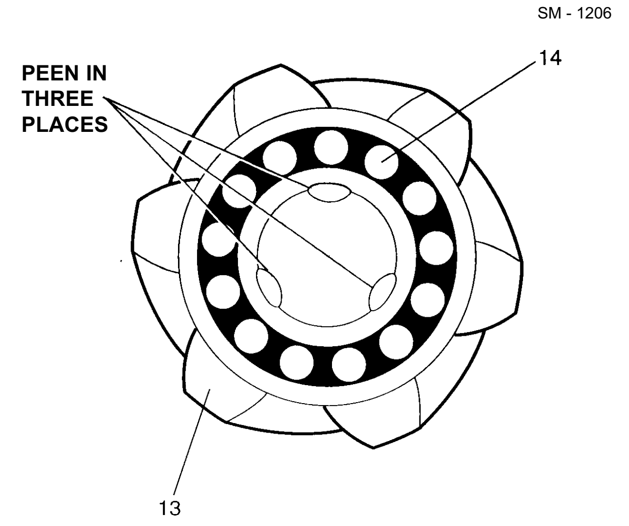

Fig. 5 - Peening Pinion Nose Bearing

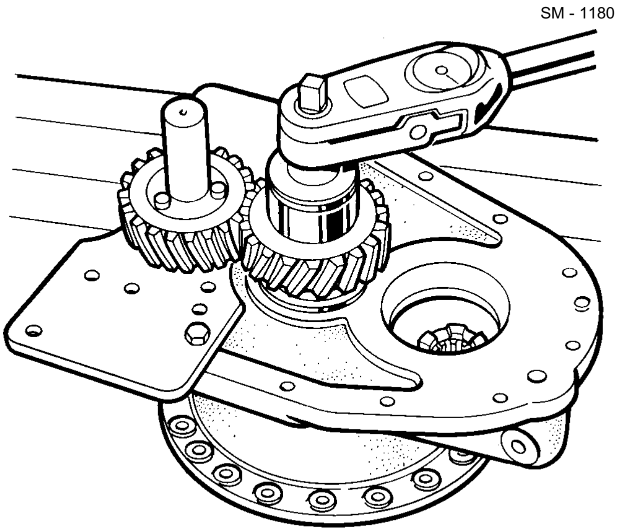

Fig. 6 - Tightening Helical Gear Nut

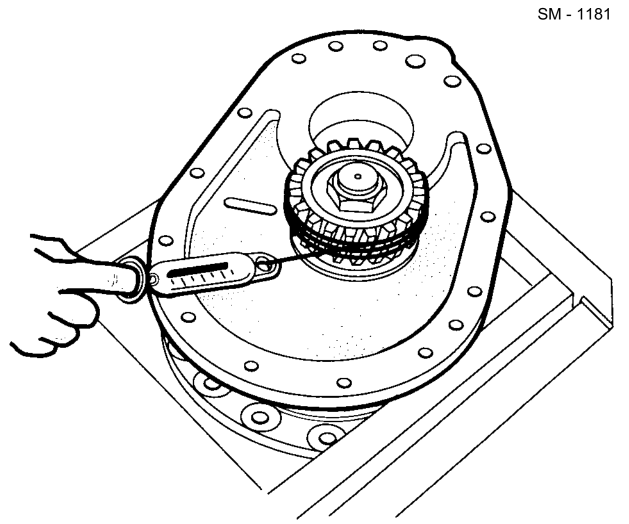

Fig. 7 - Measuring Force for Bearing Rotation

Note: The force required to maintain rotation should be related in the following manner to determine pre-load.

T = F x R, where:

T = Torque
F = Force to maintain rotation
R = Radius of secured cord

Pre-load obtained should be between limits of 1.7 - 2.8 Nm (15 - 25 lbf in).

If torque reading is less than 1.7 Nm (15 lbf in) then a smaller outer spacer needs to be fitted.

If torque obtained is greater than 2.8 Nm (25 lbf in) then a larger outer spacer needs to be fitted.

Note: If largest available combination of spacers (10 & 11) is already fitted, then a defect must be present in one or more parts of the assembly and needs to be found and remedied before continuing differential build.

4. When correct pre-load has been achieved, remove helical gear (66) and end nut (67).

5. Apply Loctite 638 by brush to pinion (13) splines and threads and also end nut (67) clamping face.

6. Install helical gear (66) and end nut (67). Lock helical gear (66) using suitable tool.

7. Tighten end nut (67) to a torque of 1 085 - 1 220 Nm (800 - 900 lbf ft) (See Fig. 6).

8. Lock end nut (67) in position by peening raised collar of nut into slot cut in end face of pinion (13).

Differential Unit

1. If crownwheel (25) has been separated from differential housing body (20) refit as follows:

a. Heat crownwheel (25) to a temperature of approximately 150° C (300° F). This is necessary to ensure that crownwheel fits onto register on differential housing body (20).

b. Place crownwheel (25) into position on differential housing body (20), ensuring that bolt holes and matching marks line up.

c. Install two bolts (18) diagonally opposite, through crownwheel and differential housing body (20) then allow assembly to cool fully.

d. Install end flange (21) aligning matching marks and grooves in end face with those in differential housing body. Install remaining bolts (18) and nuts (22) then tighten to a torque of 155 - 171 Nm (114 - 126 lbf ft).

2. Place assembly on bench with end flange (21) downwards. Check tightness of studs (19) and if necessary tighten to a torque of 19 - 22 Nm (14 - 16 lbf ft).

3. Soak friction plates (28) in gear oil for at least 30 minutes prior to installing to ensure complete impregnation. Lightly oil differential components before assembly.

4. Install first thrust washer (26) into bore of end flange (21).

5. Slide steel clutch plate (27) then friction plate (28) into differential housing body (20), making sure that they are free to move vertically in grooves.

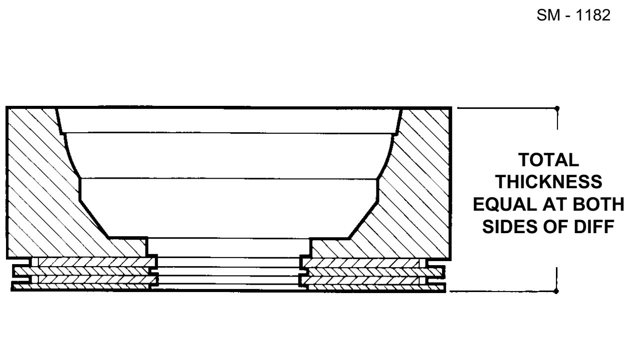

Fig. 8 - Measuring Thickness of Clutch Plates and Diff Cage Half

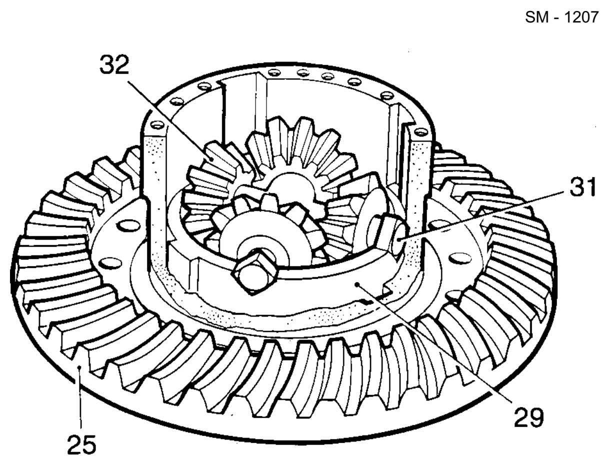

Fig. 9 - Pinion/Diff Wheel Arrangement

6. Similarly, install second pair of clutch plates followed by mating cage half (29).

Note: The clutch plates and cage half must be assembled as the original matched set to ensure correct operation of POWR LOK system. If unsure as to which parts complete a set, measure total thickness of clutch plates and cage half for both sides of differential unit. Each total thickness figure must be the same (See Fig. 8).

7. Install wheel (30) into cage half (29) engaging splines with both friction plates (28) and end face hard against thrust washer (26).

8. Assemble pinions (32) onto trunnion (31) and lay assembly in place in cage half (29), in mesh with wheel (30) as shown in Fig. 9.

9. Add remaining wheel (30) and cage half (29).

10. Stack alternate friction and steel clutch plates (28 & 27) then check that cage half (29) and clutch plates will slide in differential housing body (20) by raising and lowering wheel (30).

11. If originally fitted, place shims on end face of differential housing body (20). Install second thrust washer (26) onto wheel (30) then carefully offer end flange (53) to the assembly, lining up matching marks (See Fig. 10).

12. Secure assembly with nuts (54) then tighten nuts to a torque of 61 - 66 Nm (45 - 49 lbf ft).

13. To check assembly of differential unit, insert a driveshaft to engage with each wheel (30). Hold one driveshaft to lock wheel; the other must turn freely.

14. Press a bearing cone (24A) onto each end flange (21 & 53) until hard against shoulder.

Initial Preparation Before Installing Assembled Differential Unit

Note: Secure the crownwheel and gear casing assembly in a suitable build stool.

Check fit of adjusting nuts (23) as follows:

1. Clean and deburr gear casing (17) legs and straps (33).

2. Install bearing cups (24) into half bores of gear casing (17) legs.

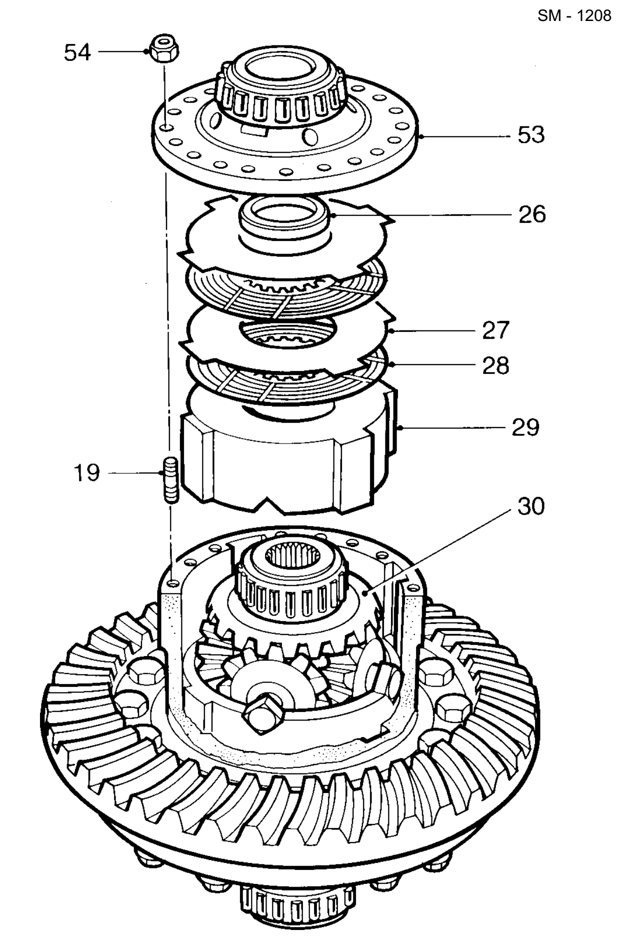

Fig. 10 - Differential Assembly

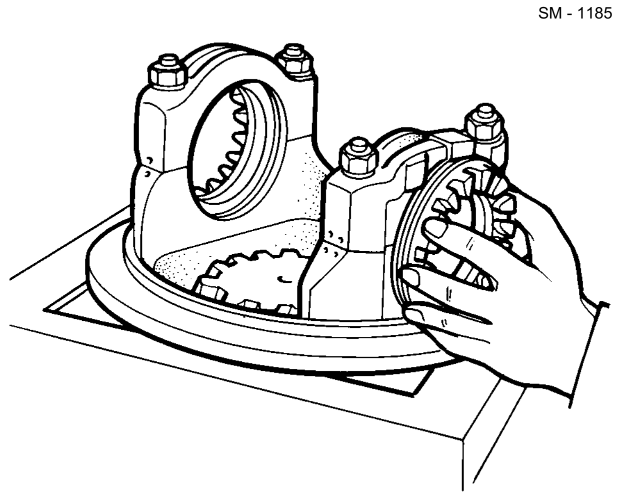

Fig. 11 - Checking Freedom of Diff Bearing Adjusting Nut

3. Check studs (55), and replace as necessary. Tighten to a torque of 129 - 142 Nm (95 - 105 lbf ft).

4. Carefully install two straps (33) and adjusting nuts (23) to locate on bearing cups (24). Check the

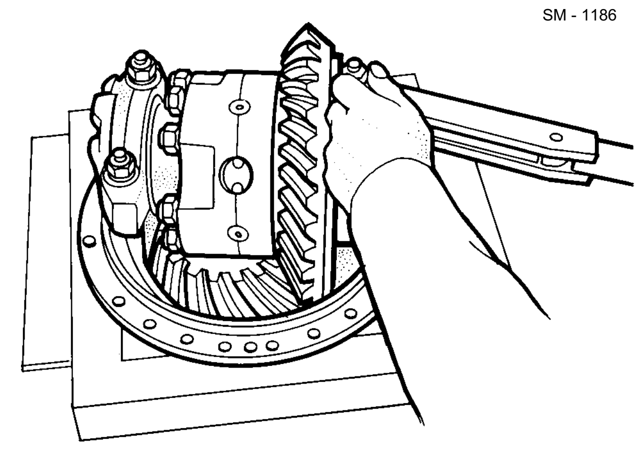

Fig. 12 - Tightening Gear Casing Straps

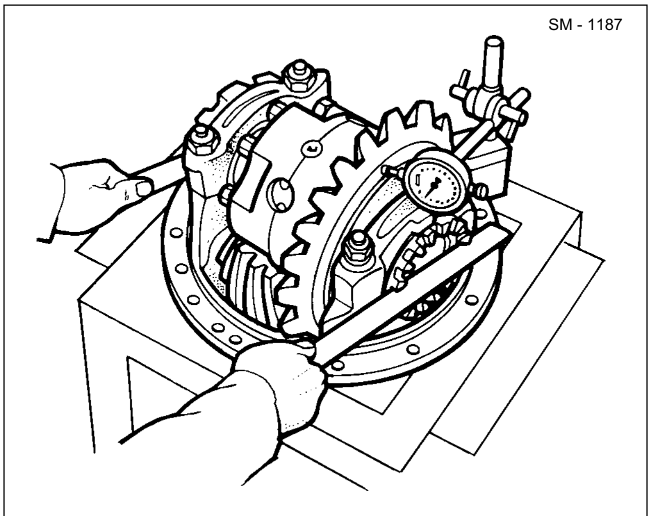

Fig. 13 - Setting Dial Indicator on Crownwheel Backface

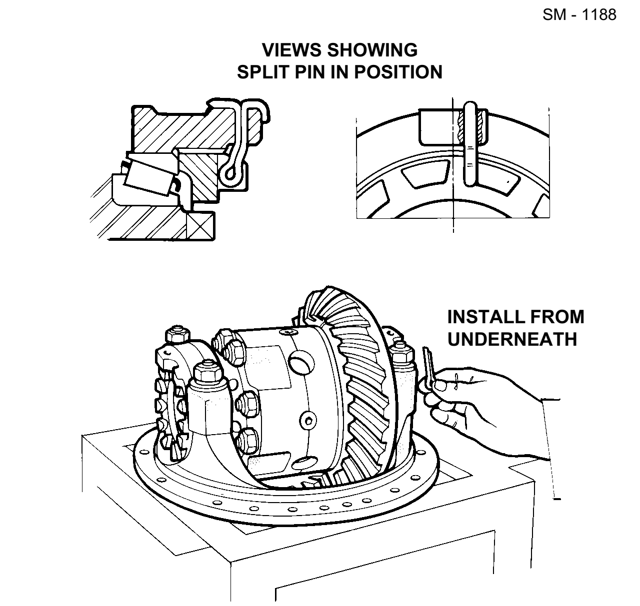

Fig. 14 - Installing Adjusting Nut Split Pins

alignment of matching marks on gear casing (17) legs and straps (33) to ensure that straps are not transposed. Bearing cups (24) should seat snugly in bores and adjusting nuts (23) should be free to turn with hand pressure only, if not, it may be because of cross threading. Remove and deburr. On no account use additional pressure i.e. hammer.

5. Install washers (34) and temporarily install plain nuts onto studs (55). Tighten nuts to a torque of 502 - 542 Nm (370 - 400 lbf ft).

6. Check freedom of bearing adjusting nuts (23) by unscrewing and refitting, to assist this operation tap straps (33) lightly on top with a 1 kg (2 lb) hammer (See Fig. 11).

7. Having checked fit of adjusting nuts (23), remove straps (33), bearing cups (24) and adjusting nuts (23).

Installing Crownwheel and Differential Assembly into Gear Casing

1. Hold bearing cups (24) in position on bearing cones (24A) and place crownwheel (25) and differential assembly in position in gear casing (17).

2. Install two adjusting nuts (23) onto half threads of gear casing (17) legs. Re-check freedom of adjusting nuts on threads.

3. Install two straps (33) onto studs (55) to locate on bearing cups (24) and adjusting nuts (23).

Note: Ensure matching marks coincide to prevent misalignment of straps (33).

4. Turn adjusting nuts (23) hand tight against bearings (24 & 24A).

5. Install washers (34) and nuts (35). Tighten nuts to a torque of 502 - 542 Nm (370 - 400 lbf ft) (See Fig. 12).

Setting 'No End Float' Condition

1. Set up dial indicator on back face of crownwheel (25) as shown in Fig. 13 and screw in each adjusting nut (23) just sufficiently to ensure that no crownwheel axial movement is registered on dial indicator.

2. Tap straps (33) and rotate crownwheel, then re-check that no axial movement is present.

3. Turn each adjusting nut (23) until nut slots line up with one of the two split pin holes in straps (33). Install two split pins (51) as shown in Fig. 14.

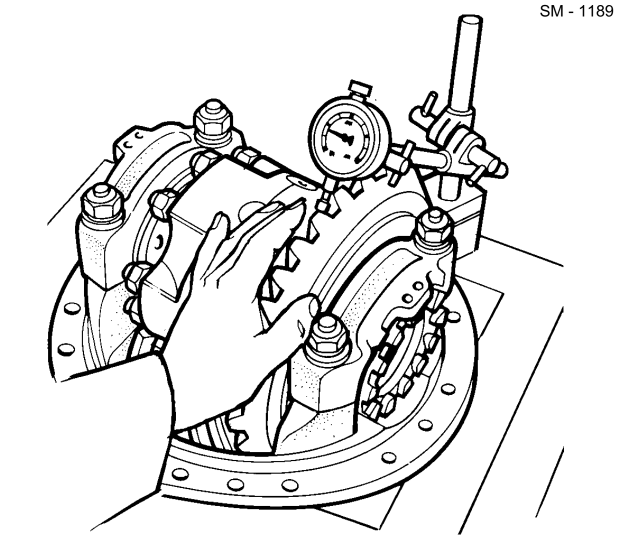

Fig. 15 - Setting Dial Indicator onto Crownwheel Tooth

4. Set up dial indicator on crownwheel (25) and check for no end float condition.

Setting Crownwheel and Pinion Backlash

1. Move dial indicator onto crownwheel (25) tooth as shown in Fig. 15. Hold pinion (13) still and rock crownwheel (25) backwards and forwards, to check free play between gears (backlash), and note variation of indicator reading.

2. Repeat the above steps three more times so that four readings are taken at positions equally spaced around crownwheel (25).

Note: The variations of readings on dial indicator must be within limits of 0.203 - 0.330 mm (0.008 - 0.013 in). If difference in backlash of more than half backlash tolerance exists between tooth mesh positions, then assembly should be further examined for cause and rectified.

Checking Crownwheel and Pinion Mesh

1. Apply a thin coating of engineers marking compound to several consecutive crownwheel teeth.

2. Turn crownwheel for few revolutions in both directions to make positive tooth contact impression on crownwheel and pinion teeth.

3. Inspect deposit of marking compound on crownwheel and pinion teeth and compare them with Fig. 16.

In all cases, action, (if any) to be taken is shown below:

Fig. A - Indicates correct mesh. No further action required.

Fig. B - Indicates pinion and crownwheel are too far out of mesh. To remedy, move pinion inwards towards crownwheel. To maintain backlash, move crownwheel away from pinion in direction of arrow B.

Fig. C - Indicates pinion and crownwheel too far into mesh. To remedy, move pinion outwards away from crownwheel. To maintain backlash, move crownwheel towards pinion in direction of arrow B.

If any action is required, adjust pinion position by altering the thickness of shims (62) i.e. add shims to move pinion away from crownwheel and remove shims to move pinion towards crownwheel.

Helical Pinion/Helical Housing Assembly

1. Press inner bearing cup (9) into gear casing (17).

2. Press helical bearing cones (9A & 7A) onto helical pinion (8).

3. Place helical pinion (8) in position on gear casing (17).

4. Install dowels (16) into their relevant holes in gear casing (17).

5. Apply a thin coating of Red Hermatite to helical housing clamping face on gear casing (17) and install gasket (15) in position.

6. Install helical gear housing (5) onto gear casing (17) ensuring correct location with dowels (16).

7. Install bolts (69) and washers (68) and tighten bolts to a torque of 98 - 109 Nm (72 - 80 lbf ft).

8. Install outer bearing cup (7) onto its bearing cone (7A) already on helical pinion (8).

9. Install bearing retainer (3) on helical gear housing (5) and secure with two opposite setscrews (1). Hand tighten setscrews (1) at this point.

10. Shock load helical pinion bearings with hide faced hammer.

11. Using feeler gauges, measure gap between joint faces of bearing retainer (3) and helical gear housing

TYPICAL PREFERRED TOOTH CONTACT
(Pinion member left hand in all cases shown)

SM - 1190

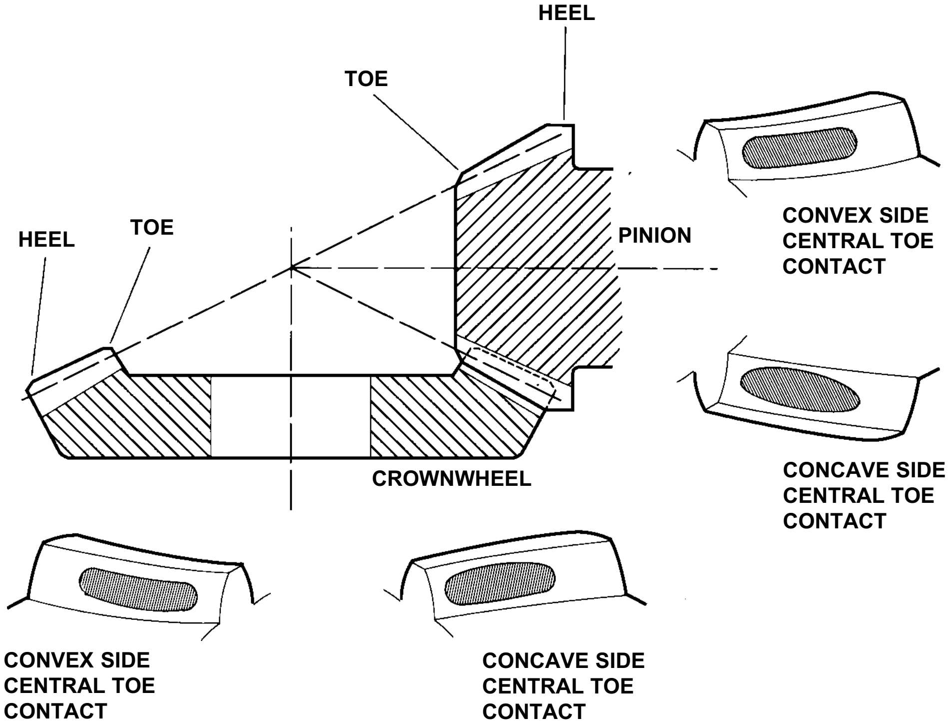

Fig. A - Correct Mesh

SM - 1191

PROFILE ERROR
To correct; move pinion towards crownwheel in direction of arrow A.

To maintain backlash; move crownwheel away from pinion in direction of arrow B.

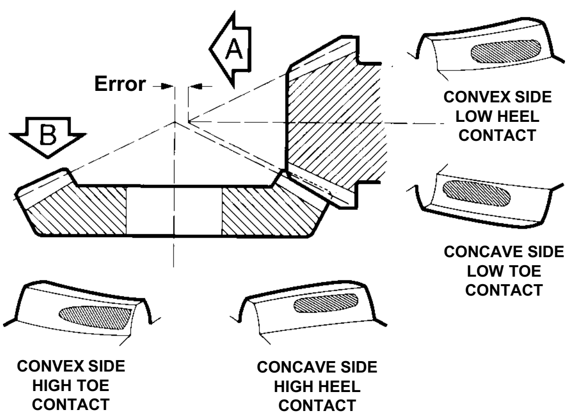

Fig. B - Pinion and Crownwheel too far out of Mesh

SM - 1192

PROFILE ERROR
To correct; move pinion away from crownwheel in direction of arrow A.

To maintain backlash; move crownwheel towards pinion in direction of arrow B.

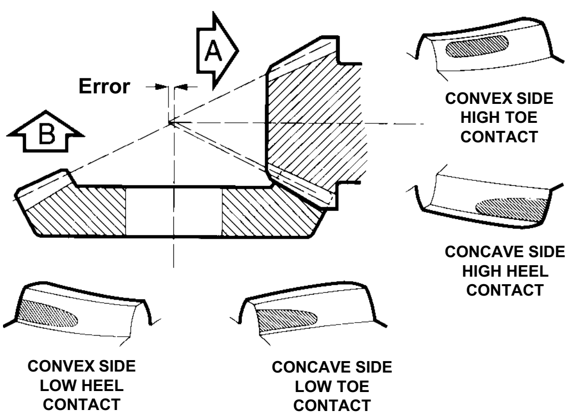

Fig. C - Pinion and Crownwheel too far into Mesh

Fig. 16 - Gleason Gears

(5). Add 0.076 mm (0.003 in) to measured gap to obtain correct shim (4) pack thickness, providing end play for helical pinion bearings.

12. Remove setscrews (1) and bearing retainer (3).

13. Place selected shim (4) pack on helical gear housing (5) and install bearing retainer (3), spring washers (2) and setscrews (1). Evenly tighten setscrews to a torque of 60 - 65 Nm (44 - 48 lbf ft).

14. Place completed assembly in clean storage place until required for installing into axle.

Note: If the period before lifting the assembled unit into the axle is likely to be more than 4 hours, thoroughly oil all gears and bearings. If it is to be more than 12 hours, the oil should be of a protective type, with anti-rust additive such as Shell 'Ensis 40' and the unit should be stored in a dust proof and damp proof container.

INSTALLATION

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.**

Drive Head Unit into Axle Casing

1. Check studs (50) and replace as necessary. Tighten studs (50) to a torque of 90 - 100 Nm (66 - 74 lbf ft).

2. Apply a thin coating of Red Hermatite to axle casing (37) gasket face and install gasket (36).

3. Using suitable lifting equipment, offer drive head unit to axle casing (37) ensuring that drive head is in correct position, with matching marks lined up.

4. Install spring washers (56) and nuts (57) then tighten nuts to a torque of 230 - 258 Nm (170 - 190 lbf ft).

Differential Shaft

1. Fit oil seal (41) into rear end cap (42) noting the following:

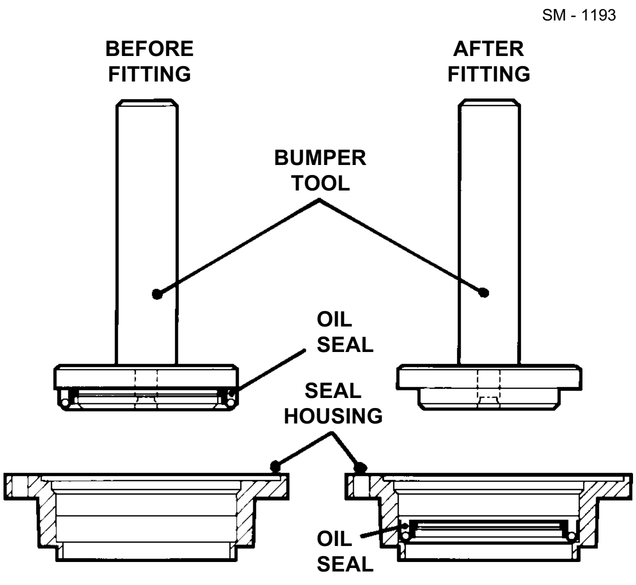

Fig. 17 - Method of Fitting Oil Seal

a. Seal must be fitted using oil seal bumper tool (See Special Tools), which bears on the seal close to its outside diameter where the casing is strongest. Failure to use the oil seal bumper tool will result in distortion of seal casing, uneven wear of lip and leakage. Fig. 17 illustrates typical example where the seal is fitted into the seal retainer.

b. Seal must remain square to the bore during fitting. If seal cocks over and one side enters the bore first, it will almost certainly result in distortion of the casing which will not be corrected by straightening up the seal further down the bore. Where possible the seal should be fitted under a press, which reduces the likelihood of this problem.

c. Seal must be truly square after fitting, a cocked seal will act as an oil pump.

d. When replacing a seal, always check differential shaft (43) surface for damage in region polished by oil seal lip; even slight damage in this area can cause leakage. Very slight marks may be polished out with fine emery cloth but it is essential that polishing marks are parallel to the seal lip. Where there is more serious damage, it is permissible to fit two seals back to back if there is room in the retainer, i.e. outer seal with spring facing inwards. The outer seal acts as a spacer and ensures that inner seal is fitted square and that it runs on a different part of coupling surface.

e. Pack the seal with high temperature grease before fitting.

f. The oil seal lip or journal of coupling should be smeared with clean gear oil prior to assembly. If seal is fitted dry, it can burn out in a matter of minutes, before oil reaches it.

2. Install end cap (42) assembly onto differential shaft (43).

3. Apply a small bead of Hylomar sealant around corner of bearing recess in end cap (42) and axle casing (37).

4. Install shaft bearing (40), lockplate (39) and left hand threaded shaft nut (38) onto differential shaft (43). Tighten shaft nut (38) so that shaft bearing (40) is hard against abutment shoulder on differential shaft (43), then bend over lockplate tab to fasten shaft nut (38) in position.

5. Check security of rear end cap studs (46) in axle casing (37) and tighten to a torque of 26 - 28 Nm (19 - 21 lbf ft) if necessary.

6. Install differential shaft (43) into axle casing (37) carefully engaging shaft splines with helical pinion (8) bore splines. When differential shaft is correctly located, drive it home using hide faced hammer.

7. Install spring washers (45) and nuts (44) evenly tightening to a torque of 38 - 43 Nm (28 - 32 lbf ft).

Note: Check that there is a gap of 0.2 mm (0.008 in) maximum between joint faces of end cap (42) and axle casing (37). There must be NO PRE-LOADING of shaft bearing (40).

Final Assembly

1. Carefully feed driveshaft assembly (1, Fig. 2) back into axle casing to locate driveshaft splines in wheel (30).

2. Coat hub mating face of planet carrier (8, Fig. 2) with Loctite 275 then offer planet carrier unit to hub (2, Fig. 2) using suitable lifting gear if required. Ensure planet gear teeth mesh with sun gear.

3. Install bolts (4, Fig. 2) and washers (3, Fig. 2) then tighten to a torque of 149 -164 Nm (109 - 121 lbf ft).

4. Install bolt (6, Fig. 2) and washer (5, Fig. 2) then tighten to a torque of 237 - 244 Nm (175 - 180 lbf ft).

5. Rotate both hubs until bottom of oil filler/level plug holes are approximately 13 mm (0.5 in) above axle centre line (level with oil filler/level hole).

6. Install differential drain plug (48) and tighten.

7. Add gear oil of the type specified in Section 300-0020, LUBRICATION SYSTEM, through oil filler/level hole until the oil is level with bottom of filler/level hole.

8. Check oil level to bottom of filler/level hole in both hubs and top up as necessary. Leave oil to settle for 15 minutes then check oil level again in both hubs and drive head. Always check final oil level at drive head.

9. Install then tighten filler/level plugs in drive head and both hubs.

10. Install front axle onto vehicle. Refer to Section 180-0020, FRONT SUSPENSION.

11. Install driveline between differential shaft (43) flange and transmission flange. Tighten driveline capscrews to a torque of 154 Nm (113 lbf ft). Refer to Section 130-0010, FRONT DRIVELINES.

12. Install breather tube (49) in adaptor (74).

13. Clean interfaces between road wheels, hub and wheel nuts.

14. Re-fit road wheels, securing with wheel nuts. Remove stands or timber supports and lower vehicle to ground. Fully tighten wheel nuts to a torque of 365 - 400 lbf ft (495 - 542 Nm).

15. Remove wheel blocks.

MAINTENANCE

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.**

General

At first service, then every 1 000 hours (6 months), check the following and repair or replace where necessary:

a - Input flange for wear/damage.
b - Pinion oil seals for leaks.
c - Breather for signs of leakage or dirt ingress.

d - Leaks around joints.
e - General condition and tightness of nuts and bolts.
f - General condition of axle casing.

Oil Change Period

Note: For recommended oils, refer to Section 300-0020, LUBRICATION SYSTEM.

With new or rebuilt units, drain (preferable after a short run to warm the oil) and refill after 100 hours of operating, then at intervals of 2 000 hours (12 months).

Oil Level

Check oil levels every 250 hours (monthly), following the procedure below:

1. Drive vehicle onto a level, solid concrete floor, apply the parking brake and switch off the engine.

2. Block appropriate road wheels and turn the battery master switch to the 'Off' position.

3. Unscrew oil filler/level plug (47) and check that oil level is to bottom of plug hole. Add oil if necessary.

Note: As there is no oil sealing between drive head and the hubs, the hub oil levels should be same as the drive head. i.e. 13 mm (0.5 in) above the axle centre line. After filling, allow oil to settle for at least 15 minutes, then re-check oil level at all points. Add oil as necessary until levels remain constant after settling period. Always check final oil level at drive head.

4. Raise axle until both road wheels are just off the ground then support with suitable stands or timbers.

5. Rotate each hub so that bottom of oil filler/level plugs (7, Fig. 2) are approximately 13 mm (0.5 in) above axle centre line (level with oil filler/level plug).

6. Unscrew plugs and check that oil level is to bottom of plug holes. If not, add oil to each hub through plug holes then re-check oil level in drive head.

7. When level is correct, refit and tighten all filler/level plugs to the specified torques, lower vehicle to ground and remove wheel blocks.

SPECIAL TOOLS

Refer to Section 300-0020, SERVICE TOOLS, for part numbers of oil seal bumper tool (Fig. 17) and general service tools and adhesives required. These tools and adhesives are available from your dealer.

FAULT DIAGNOSIS

Very often, noises and vibrations originating in other parts of the vehicle are mistakenly believed to emanate from the drive head, with the result that time and effort is wasted on an unnecessary dismantling operation. Therefore, before fixing suspicion on the drive head, investigate all other possible sources of trouble first. Where the drive head is definitely suspect however, draining the housing and examining the oil for metal particles, will aid diagnosis and help to pinpoint any malfunction. Refer to 'Diagnosis Chart'.

DIAGNOSIS CHART

CONDITION	REASON	REMEDY
Vibration	Broken gear teeth, worn bearings	Replace gear or bearings
Continued noise	Worn gears or bearings	Replace gears or bearings
Overheating	Loss of lubricant	Replace faulty joint or seal and refill
	Crownwheel adjustment too tight	Readjust
	Seized bearings	Replace bearings
Noise on turns	Worn diff side gears and pinions	Replace diff side gears and pinions
	Worn or damaged trunnions	Replace trunnions
	Loss of lubricant	Replace faulty joint or seal and refill
	Loose nuts on differential casings	Tighten nuts to specified torque
Loss of drive	Worn driveshaft splines	Replace driveshaft
	Broken driveshaft	Replace driveshaft

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	1	Setscrew	60 - 65	44 - 48
1	18	Bolt	155 - 171	114 - 126
1	19	Stud	19 - 22	14 - 16
1	22	Nut	155 - 171	114 - 126
1	35	Nut	502 - 542	370 - 400
1	44	Nut	38 - 43	28 - 32
1	46	Stud	26 - 28	19 - 21
1	50	Stud	90 - 100	66 - 74
1	54	Nut	61 - 66	45 - 49
1	55	Stud	129 - 142	95 - 105
1	57	Nut	230 - 258	170 - 190
1	65	Setscrew	98 - 109	72 - 80
1	67	End Nut	1 085 - 1 220	800 - 900
1	69	Bolt	98 - 109	72 - 80
2	4	Bolt	149 - 164	109 - 121
2	6	Bolt	237 - 244	175 - 180
-	-	Driveline Capscrews	154	113

* * * *

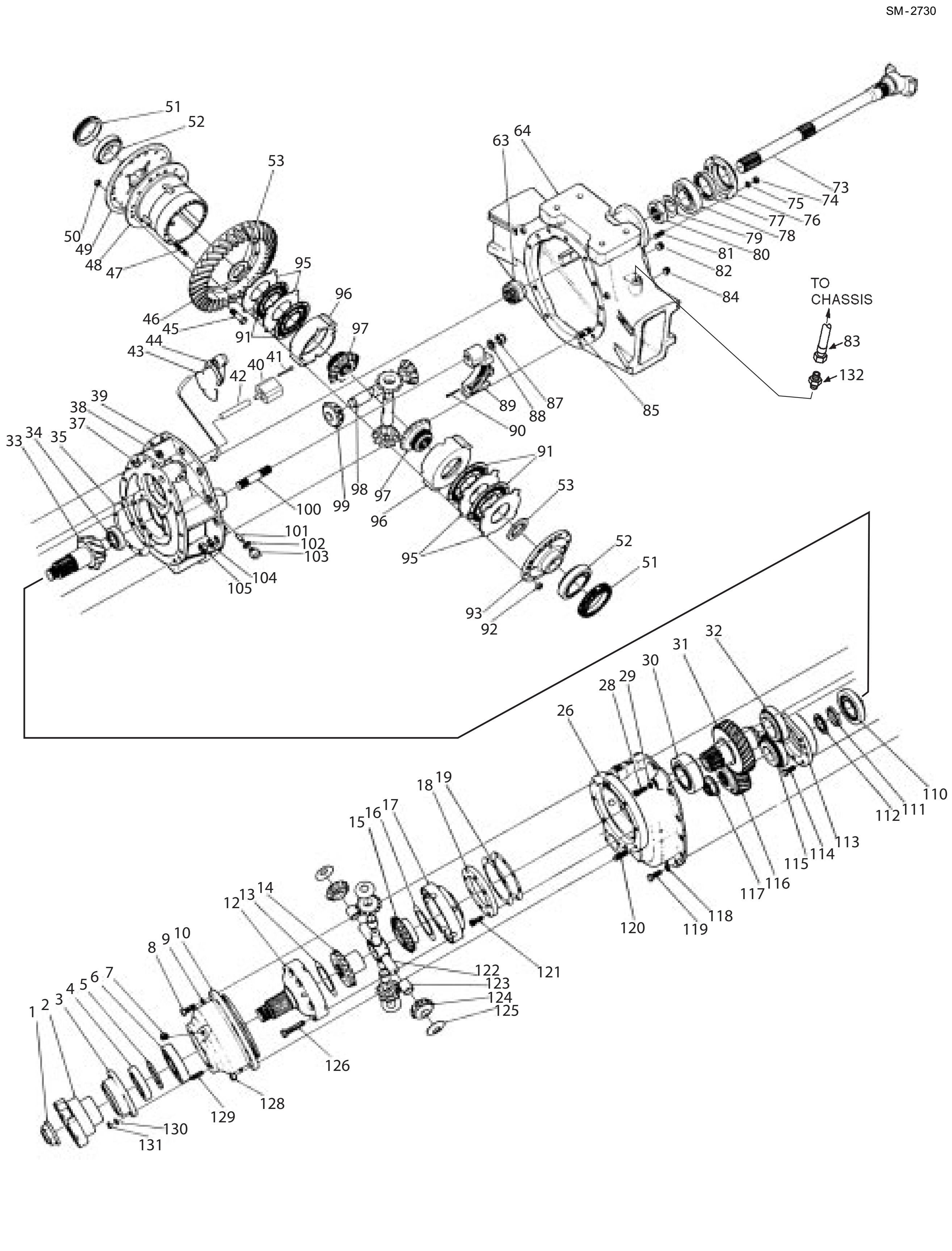

Fig. 1 - Differential Drive Head (Centre Axle)

LEGEND FOR FIG. 1

1 - Flange Nut
2 - Coupling Flange
3 - Front End Cap
4 - Oil Seal
5 - Washer
6 - Bearing
7 - Filler Plug
8 - Setscrew
9 - Spring Washer
10 - 3rd Differential Housing
12 - Cage Half - Shaft
13 - Thrust Washer
14 - Wheel (Outer)
15 - Wheel (Inner)
16 - Thrust Washer
17 - Cage Half
18 - Retainer Plate
19 - Shims
26 - Helical Gear Housing
28 - Setscrew
29 - Locknut
30 - Bearing Cup
30A - Bearing Cone
31 - Helical Pinion
32 - Bearing Cup
32A - Bearing Cone
33 - Spiral Bevel Pinion
34 - Nose Bearing
35 - Shim
37 - Dowel
38 - Plug
39 - Gear Casing
40 - Air Cylinder
41 - Capscrew
42 - Operating Shaft
43 - Retaining Spring
44 - Operating Fork
45 - Bolt
46 - Crownwheel
47 - Stud
48 - Differential Housing Body
49 - End Flange
50 - Nut
51 - Adjusting Nut
52 - Bearing Cup
52A - Bearing Cone
53 - Thrust Washer
63 - Clutch Dog
64 - Axle Casing
73 - 3rd Differential Shaft
74 - Nut
75 - Spring Washer
76 - Rear End Cap
77 - Oil Seal
78 - Bearing
79 - Lockplate
80 - Shaft Nut
81 - Stud
82 - Oil Filler/Level Plug
83 - Breather Tube
84 - Drain Plug
85 - Stud
87 - Nut
88 - Washer
89 - Strap
90 - Split Pin
91 - Friction Plate
92 - Nut
93 - End Flange
95 - Clutch Plate
96 - Cage Half
97 - Wheel
98 - Trunnion
99 - Pinion
100 - Stud
101 - Lockpin
102 - Washer
103 - Difflock Switch
104 - Spring Washer
105 - Nut
110 - Bearing Cup
110A - Bearing Cone
111 - Spacer - Wide
112 - Spacer - Narrow
113 - Bearing Housing
114 - Setscrew
115 - Bearing Cup
115A - Bearing Cone
116 - Helical Gear
117 - End Nut
118 - Washer
119 - Bolt
120 - Stud
121 - Capscrew
122 - Trunnion
123 - Bush
124 - Pinion
125 - Thrust Washer
126 - Bolt
128 - Nut
129 - Stud
130 - Spring Washer
131 - Nut
132 - Adaptor

DESCRIPTION

Drive is transmitted through a lockable bevel type inter-axle differential to single drop helical gears which drive a spiral bevel pinion mounted on a roller nose bearing and spaced taper roller bearings.

The crownwheel is of heavy section, also running on taper roller bearings.

The main differential is a POWR LOK torque bias unit which maintains traction at both wheels. The design ensures that both the engagement and disengagement action of the POWR LOK unit does not produce any shock torsional loads in the driveshafts.

REMOVAL

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.

Draining the Oil

1. Position the vehicle (preferably after a short run to warm the oil) on a level, solid concrete floor, apply the parking brake and switch off the engine.

2. Block appropriate road wheels and turn the battery master switch to the 'Off' position.

3. Whilst road wheels are still on the ground, loosen wheel nuts of each wheel.

4. Jack up chassis until the tyres are clear of ground and support with suitably placed stands or timbers.

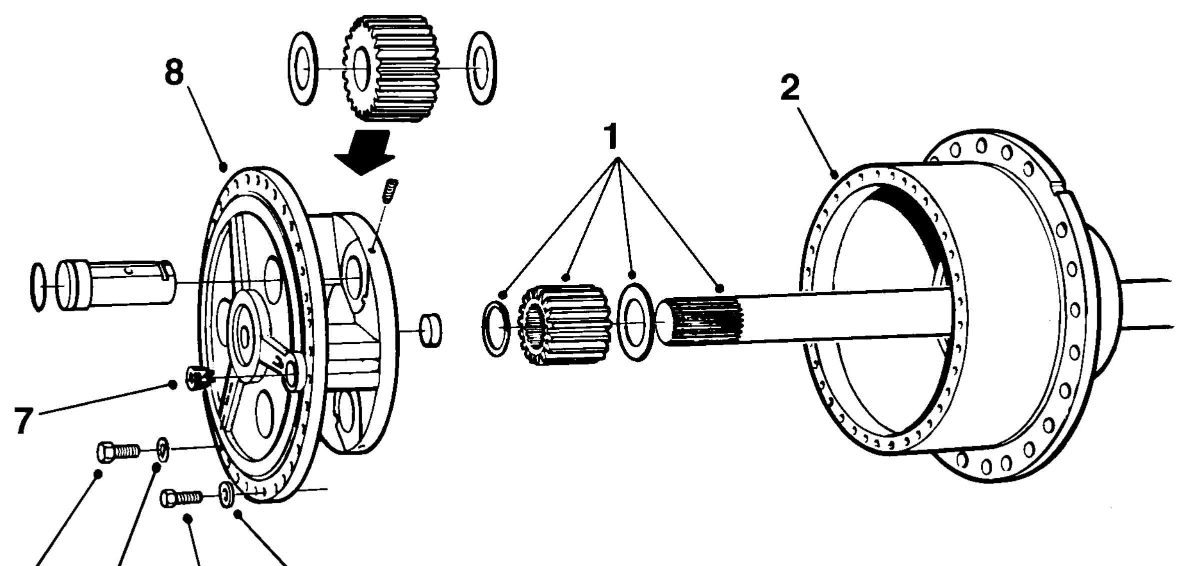

Fig. 2 - Part View of Hub Reduction Unit

5. Remove wheel nuts then pull off road wheels.

6. Identify the relationship of both driveline flanges to coupling flange (2) and 3rd differential shaft (73). Disconnect drivelines and secure clear of drive head. Drivelines may be removed if convenient to do so. Refer to Section 130-0020, REAR DRIVELINES.

7. Loosen coupling flange nut (1) but **do not** remove.

8. Disconnect breather tube (83) from adaptor (132).

9. Remove centre axle from vehicle and place on a suitable axle stand. Refer to Section 180-0040, REAR SUSPENSION.

Note: As there is no oil sealing between the drive head and the hubs, the oil must be drained from all three units before overhaul.

10. Place suitable containers under the drive head and both hubs.

11. Rotate hubs to bring bolts (6, Fig. 2) to their lowest point. Unscrew and remove filler/level plugs (7, Fig. 2). Remove bolts (6, Fig. 2) and washers (5, Fig. 2) to drain the oil from the hubs.

12. Unscrew and remove oil filler/level plug (82) and drain plug (84) to drain oil from drive head.

Driveshafts

1. Remove bolts (4, Fig. 2) and washers (3, Fig. 2).

2. Using suitable lifting equipment, pull off planet carrier assembly (8, Fig. 2) and place on bench, small diameter down.

3. Pull out driveshaft assembly (1, Fig. 2) from hub to disengage the shaft splines from wheel (97).

4. Cover open end of hub unit to prevent entry of dirt.

5. Repeat steps 1 through 4 for other hub end.

Drive Head Unit from Axle Casing

1. Remove nuts (74) and spring washers (75) from studs (81).

2. Withdraw 3rd differential shaft (73) along with rear end cap (76), oil seal (77), bearing (78), lockplate (79), and shaft nut (80).

3. Fit 'U' bolts to coupling flange (2) and using suitable lifting equipment, rotate axle so that 3rd differential housing is uppermost. Leave lifting equipment in place.

4. Remove nuts (105) and spring washers (104).

5. Insert two 5/8 in UNF bolts into two extractor holes provided in gear casing flange and tighten to separate gear casing (39) from axle casing (64).

6. Carefully remove gear casing (39) assembly clear of axle casing (64) and place on a suitable build stool.

7. Remove all traces of gasket material and sealant from axle casing (64) and gear casing (39) flanges.

Helical Gear Housing and 3rd Differential Housing from Gear Casing

1. Remove bolts (119) and washers (118).

2. Insert two 1/2 in UNF bolts into two extractor holes provided in helical gear housing flange and with container ready to catch the oil, tighten bolts to separate helical gear housing (26) from gear casing (39).

3. Carefully lift helical gear housing and 3rd differential housing assembly from gear casing and place on work bench, coupling flange (2) uppermost.

4. Remove all traces of gasket material from helical gear casing and gear casing flanges.

3rd Differential Housing from Helical Gear Housing

1. Remove setscrews (8), washers (9) and nuts (128).

2. With suitable container ready to catch the oil, lift 3rd differential housing (10) from helical gear housing (26) and place on work bench, coupling flange (2) uppermost.

3. Remove all traces of gasket material from helical gear housing (26) and 3rd differential housing (10) flanges. Remove lifting equipment and 'U' bolts from coupling flange.

DISASSEMBLY

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.

⚠ **When necessary to drive out components during disassembly, be sure to use a soft drift to prevent property damage and personal injury.**

3rd Differential Unit

1. Remove flange nut (1) and pull coupling flange (2) from cage half (12) shaft splines using a suitable extractor.

2. Unscrew and remove nuts (131) and spring washers (130).

3. Lift off front end cap (3). Using a suitable drift, remove and discard oil seal (4). Remove all traces of gasket material from bearing mounting face in front end cap (3).

4. Remove washer (5) from cage half (12) shaft splines.

5. Withdraw 3rd differential assembly from 3rd differential housing (10) by pressing cage half (12) from bearing (6).

6. Press bearing (6) from 3rd differential housing (10) and remove all traces of gasket material.

7. Mark two halves of cage half (12 & 17) to ensure correct rebuild position then remove bolts (126).

8. With cage half (17) on work bench, lift off cage half (12).

9. Remove thrust washer (13), outer wheel (14), trunnion and pinion assembly (122, 123, 124 & 125), inner wheel (15) and thrust washer (16) from cage half (17).

10. Separate thrust washers (125), pinions (124) and bushes (123) from trunnion (122).

Note: Mark parts of 3rd differential assembly to ensure correct rebuild position.

Helical Gear Housing

1. Remove cap screws (121) and lift off retainer plate (18) and shims (19).

2. Lift helical gear housing (26) from helical pinion (31).

3. If bearing replacement is required, use suitable puller to remove outer bearing cone (30A) and inner bearing cone (32A) from helical pinion (31).

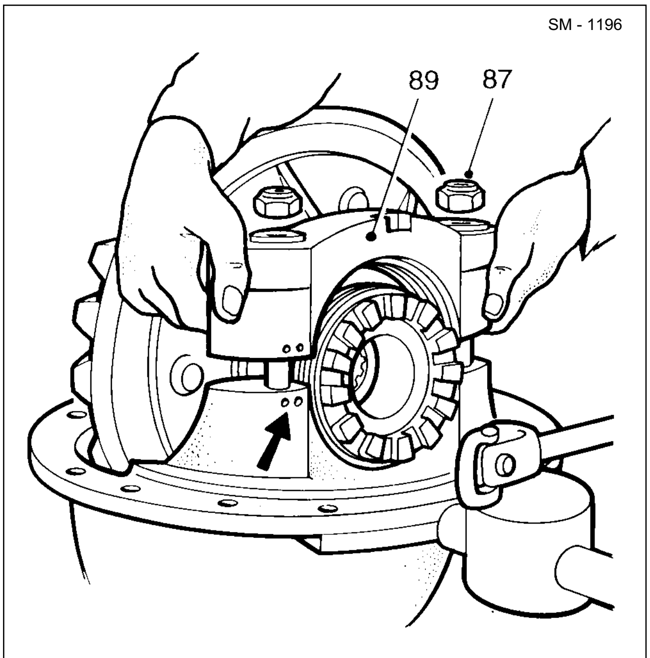

Fig. 3 - Match Marking Gear Casing Straps

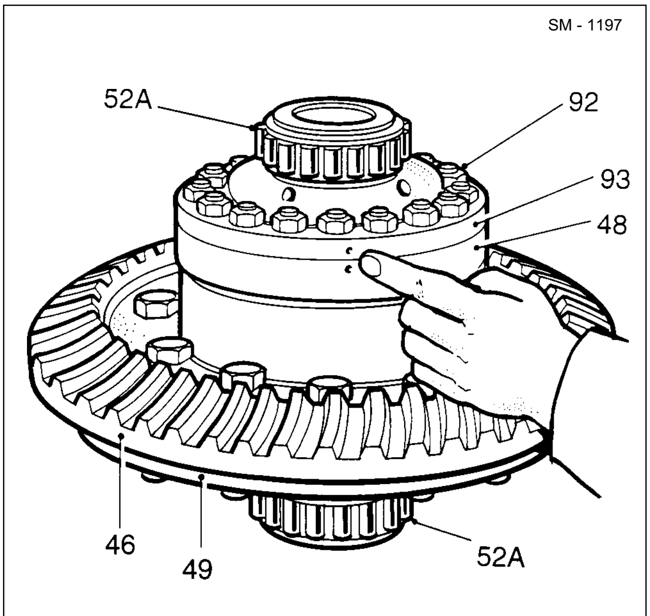

Fig. 4 - Matching Marks on Diff Housing

4. Inspect helical pinion (31) for wear or damage and renew if necessary.

5. If renewing inner or outer bearing cones (32A & 30A), drift out the mating cup from gear casing (39) or helical gear housing (26).

Note: If either bearing cup or cone needs replacing, they must be replaced as a set.

6. Remove any joint material from the bottom gasket face of helical gear housing (26).

Differential Unit

1. Match mark straps (89) as shown in Fig. 3 to ensure correct rebuild position then remove nuts (87) and washers (88).

2. Lift off both straps (89), adjusting nuts (51) and split pins (90).

3. Lift complete differential and crownwheel assembly from gear casing (39). Place assembly on bench with crownwheel (46) teeth uppermost.

4. Check end flanges (49 & 93) and differential housing body (48) for identification and matching marks (See Fig. 4). If unmarked, centre punch parts to ensure correct mating on assembly.

5. Remove nuts (92) from studs (47) which fasten upper end flange (93) to differential housing body (48).

6. Lift off end flange (93) and thrust washer (53).

Note: Shims may have been fitted between end flange (93) and differential housing body (48). These must be replaced on assembly to maintain an operating clearance within the differential assembly. The components contained in the differential unit have been carefully measured and selected to ensure correct operation. DO NOT fit the components in a different sequence to that of the original assembly or attempt to change/introduce shimming. This will result in failure of the POWR LOK system.

7. Remove first clutch plate (95) and friction plate (91) followed by second pair of plates. Set aside plates so that they can be reinstalled in their original position.

8. Slide out cage half (96) from differential housing body (48).

9. From remaining cage half (96), lift out wheel (97), pinions (99) and two piece trunnions (98).

10. Remove second wheel (97) and cage half (96) followed by two pairs of clutch plates (91 & 95) and second thrust washer (53).

11. Unscrew and remove nuts (50) and bolts (45).

12. Separate end flange (49) from differential housing body (48).

13. Using hide faced mallet, remove crownwheel (46) from its register on differential housing body (48).

14. Inspect all parts of differential assembly. If there is any wear or damage install new differential unit complete. Renew crownwheel (46) and spiral bevel pinion (33) as a matched pair.

Differential Lock Mechanism and 3rd Differential Driveshaft

1. Unscrew and remove plug (38) from gear casing (39).

2. Remove diff lock switch (103) and washer (102) from gear casing (39).

3. Using a suitable drift, drive out lockpin (101) from operating fork (44) and shaft (42).

4. Withdraw shaft (42) and operating fork (44) assembly from gear casing (39).

5. Remove capscrew (41) and air cylinder (40) from shaft (42).

6. Remove retaining spring (43) and separate operating fork (44) from clutch dog (63).

7. Straighten tab on 3rd diff shaft nut lockplate (79) and unscrew left hand threaded shaft nut (80). Remove shaft nut (80), lockplate (79) and bearing (78) from diff shaft (73).

8. Pull rear end cap (76) from diff shaft (73). Remove and discard oil seal (77) using a suitable drift.

Bevel Pinion Assembly

1. Remove pinion bearing housing setscrews (114) then, using hide faced mallet, knock out complete pinion assembly from gear casing (39) taking care not to lose any of the pinion setting shims (35).

Note: If the original pinion and crownwheel are to be reinstalled, retain the shim pack as a unit for reuse.

2. Secure pinion assembly in vice fitted with soft jaws then remove end nut (117).

3. Pull off helical gear (116), using suitable extraction equipment.

4. Tap spiral bevel pinion (33) along with spacers (111 & 112), inner bearing cone (110) and nose bearing (34) out of bearing housing (113). Remove spacers (111 & 112) from spiral bevel pinion (33) and retain for reuse if original pinion bearings are to be reinstalled.

5. Remove inner bearing cone (110) and nose bearing (34) from pinion (33) if required.

6. Lift out outer bearing cone (115) from bearing housing (113). Drift out pinion bearing cups (110 & 115) of bearing housing (113) for renewal if required.

Note: If either bearing cup or cone needs replacing both a new cup and cone MUST be fitted.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

Note: Prior to assembly, lightly oil bearings with clean gear oil as specified in Section 300-0020, LUBRICATION SYSTEM.

> ⚠ **WARNINGS**
> **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.**
>
> ⚠ **When necessary to drive on components during assembly, be sure to use a soft drift to prevent property damage and personal injury.**

Bevel Pinion

1. If new nose bearing (34) is to be fitted, apply a light coating of Loctite 641 to bore of nose bearing then press onto pinion (33) hard against its abutment shoulder. To retain bearing, lightly peen over end of pinion shaft in three places as shown in Fig. 5.

2. Press inner bearing cone (110A) onto pinion (33). If original pinion (33) and bearings (110 & 115) are being refitted, install original spacers (111 & 112) onto the pinion.

Note: If new parts are being fitted, install the largest available spacers (111 & 112). This is to ensure that the bearing cannot be over pre-loaded, preventing bearing damage.

3. Press inner and outer bearing cups (110 & 115) into bearing housing (113), hard against abutment shoulders.

4. Insert pinion assembly into bearing housing (113) and secure with outer bearing cone (115A).

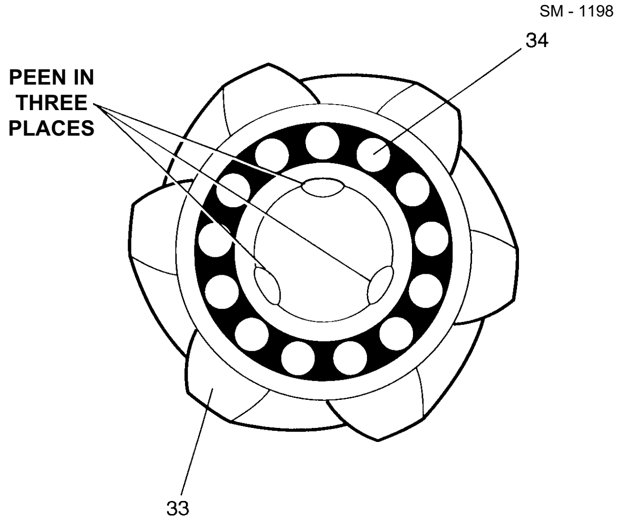

Fig. 5 - Peening Pinion Nose Bearing

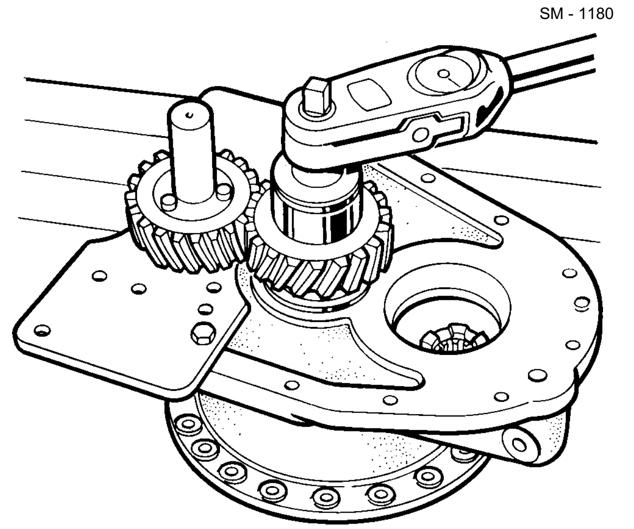

Fig. 6 - Tightening Helical Gear Nut

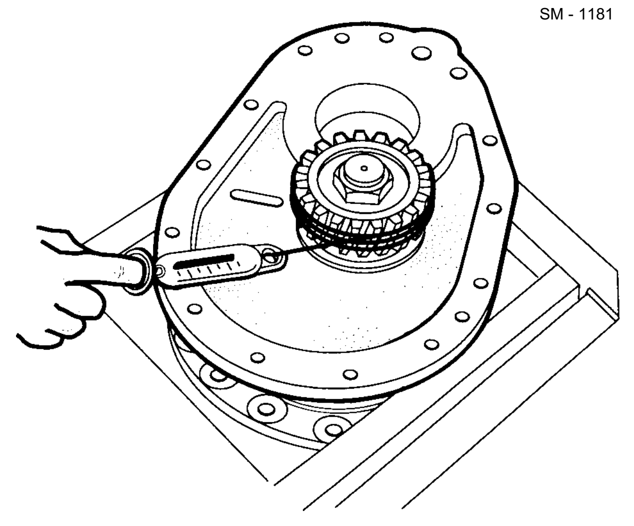

Fig. 7 - Measuring Force for Bearing Rotation

5. To obtain correct position of pinion relative to crownwheel, shim (35) thickness is worked out using formula 8.636 mm + A mm + B mm + C mm (0.34 + 0.00A in + 0.00B in + 0.00C in) where as:

8.636 mm (0.034 in) shims selected as nominal.

'A' - Select shim thickness equivalent to figure stamped on end face of spiral bevel pinion (33).

'B' - Select shim thickness equivalent to figure stamped on gear casing (39).

'C' - Variation in bearing height from 44.653 mm (1.758 in) ref. dimension.

6. Place shim pack on inner face of bearing housing (113) then install assembly into gear casing (39). Secure assembly in position by installing setscrews (114) and evenly tighten to a torque of 98 - 109 Nm (72 - 80 lbf ft).

7. Fit helical gear (116) and end nut (117) onto spiral bevel pinion (33).

8. Lock helical gear with suitable tool and tighten end nut (117) to a torque of 1 085 - 1 220 Nm (800 - 900 lbf ft) (See Fig. 6).

Setting Pinion Bearing Pre-load

1. Shock load spiral bevel pinion bearings.

2. Secure length of cord to helical gear (116) and attach free end to spring balance.

3. Wrap cord around OD of helical gear (116) and pull on spring balance to rotate spiral bevel pinion (33) (See Fig. 7). Note the force required to maintain rotation, ignoring initial starting force.

Note: The force required to maintain rotation should be related in the following manner to determine pre-load.

T = F x R, where:

T = Torque
F = Force to maintain rotation
R = Radius of secured cord

Pre-load obtained should be between limits of 1.7 - 2.8 Nm (15 - 25 lbf in)

If torque reading is less than 1.7 Nm (15 lbf in) then a smaller outer spacer needs to be fitted.

If torque obtained is greater than 2.8 Nm (25 lbf in) then a larger outer spacer needs to be fitted.

Note: If largest available combination of spacers (111 & 112) is already fitted, then a defect must be present in one or more parts of the assembly and needs to be found and remedied before continuing differential build.

4. When correct pre-load has been achieved, remove end nut (117) and helical gear (116).

5. Apply Loctite 638 by brush to spiral bevel pinion (33) splines and thread and also end nut (117) clamping face.

6. Install helical gear (116) and end nut (117). Lock helical gear (116) using suitable tool.

7. Tighten end nut (117) to a torque of 1085 - 1220 Nm (800 - 900 lbf ft).

8. Lock end nut (117) in position by peening raised collar of nut into slot cut in end face of spiral bevel pinion (33).

Differential Lock Mechanism and 3rd Differential Driveshaft

1. Using capscrews (41), install air cylinder (40) to operating shaft (42).

2. Fit clutch dog (63) to operating fork (44) using retaining spring (43).

3. Hold operating fork assembly in position in gear casing (39) with clutch dog engagement teeth facing forward. Install operating shaft (42) through gear casing (39), operating fork (44) and into the hole in the front of gear casing.

4. Insert lockpin (101) into operating fork (44) and shaft (42) through diff lock switch hole in gear casing. Install washer (102), diff lock switch (103) and plug (38) into gear casing (39).

Note: Setscrew (28) must be set in the correct position after the third diff driveshaft is installed. See "Setting 3rd Diff Lock Mechanism".

Differential Unit

1. If crownwheel (46) has been separated from differential housing body (48) refit as follows:

a. Heat crownwheel (46) to a temperature of approximately 150° C (300° F). This is necessary to ensure that crownwheel fits onto register on differential housing body (48).

b. Place crownwheel (46) into position on differential housing body (48), ensuring that bolt holes and matching marks line up.

c. Install two bolts (45) diagonally opposite, through crownwheel (46) and differential housing body (48) then allow assembly to cool fully.

d. Install end flange (49) aligning matching marks and grooves in end face with those in differential housing body (48). Install remaining bolts (45) and nuts (50) then tighten to a torque of 155 - 171 Nm (114 - 126 lbf ft).

2. Place assembly on bench with end flange (49) downwards. Check tightness of studs (47) and if necessary tighten studs (47) to a torque of 19 - 22 Nm (14 - 16 lbf ft).

3. Soak friction plates (91) in gear oil for at least 30 minutes prior to installing to ensure complete impregnation. Lightly oil differential components before assembly.

4. Install first thrust washer (53) into bore of end flange (49).

5. Slide steel clutch plate (95) then friction plate (91) into differential housing body (48), making sure that they are free to move vertically in grooves.

6. Similarly, install second pair of clutch plates followed by mating cage half (96).

Note: The clutch plates and cage half must be assembled as the original matched set to ensure correct operation of POWR LOK system. If unsure as to which parts complete a set, measure total thickness of clutch plates and cage half for both sides of differential unit. Each total thickness figure must be the same (See Fig. 8).

7. Install wheel (97) into cage half (96) engaging splines with both friction plates (91) and end face hard against thrust washer (53).

8. Assemble pinions (99) onto trunnion (98) and lay assembly in place in cage half (96), in mesh with wheel (97) as shown in Fig. 9.

9. Add remaining wheel (97) and cage half (96).

10. Stack alternate friction and steel clutch plates

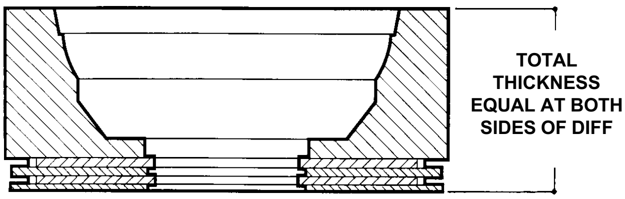

Fig. 8 - Measuring Thickness of Clutch Plates and Diff Cage Half

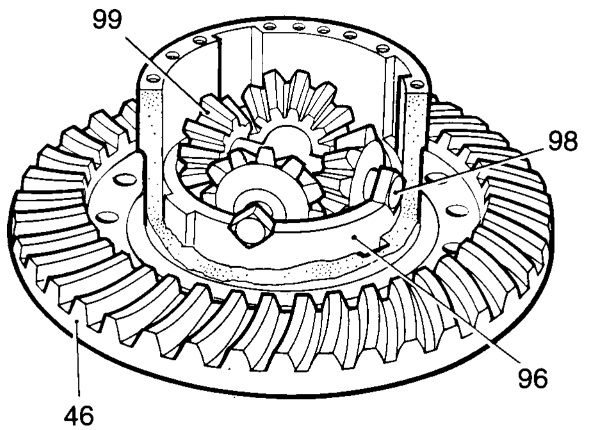

Fig. 9 - Pinion/Diff Wheel Arrangement

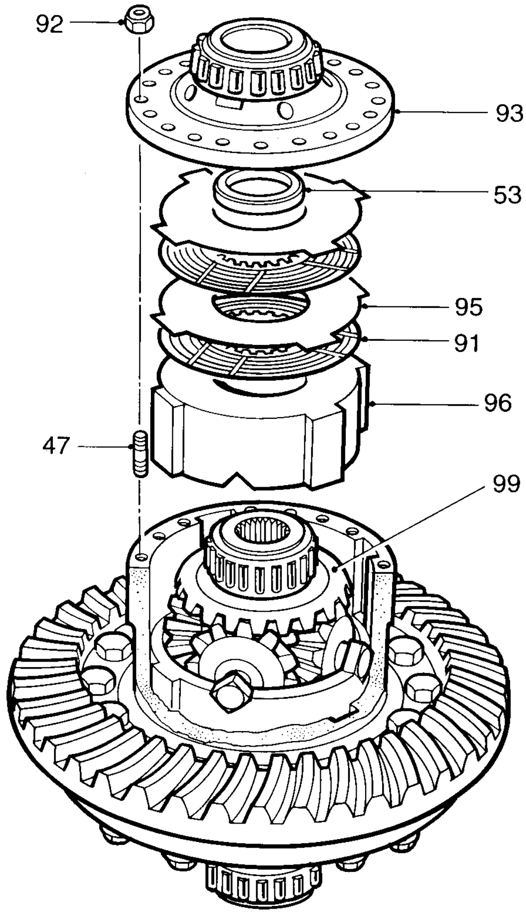

Fig. 10 - Differential Assembly

(91 & 95) then check that cage half (96) and clutch plates will slide in differential housing body (48) by raising and lowering wheel (97).

11. If originally fitted, place shims on end face of differential housing body (48). Install second thrust washer (53) onto wheel (97) then carefully offer end flange (93) to the assembly, lining up matching marks (See Fig. 10).

12. Secure assembly with nuts (92) then tighten to a torque of 61 - 66 Nm (45 - 49 lbf ft).

13. To check assembly of differential unit, insert a half shaft to engage with each wheel (97). Hold one half shaft to lock wheel; the other must turn freely.

14. Press bearing cone (52A) onto each end flange (49 & 93) until hard against shoulder.

Initial Preparation Before Installing Assembled Differential Unit

Note: Secure the crownwheel and gear casing assembly in a suitable diff build stool.

Check fit of adjusting nuts (51) as follows:

1. Clean and deburr gear casing (39) legs and straps (89).

2. Install bearing cups (52) into half bores of gear casing (39) legs.

3. Check studs (100), and replace as necessary. Tighten to a torque of 129 - 142 Nm (95 - 105 lbf ft).

4. Carefully install two straps (89) and adjusting nuts (51) to locate on bearing cups (52). Check alignment of matching marks on gear casing (39) legs and straps (89) to ensure that straps are not transposed. Bearing cups (52) should seat snugly in bores and adjusting nuts (51) should be free to turn with hand pressure

only, if not, it may be because of cross threading. Remove and deburr. On no account use additional pressure i.e. hammer.

5. Install washers (88) and temporarily install plain nuts onto studs (100). Tighten nuts to a torque of 502 - 542 Nm (370 - 400 lbf ft.).

6. Check freedom of adjusting nuts (51) by unscrewing and refitting, to assist this operation tap straps (89) lightly on top with 1 kg (2 lb) hammer (See Fig. 11).

7. Having checked fit of adjusting nuts (51), remove straps (89), bearing cups (52) and adjusting nuts (51).

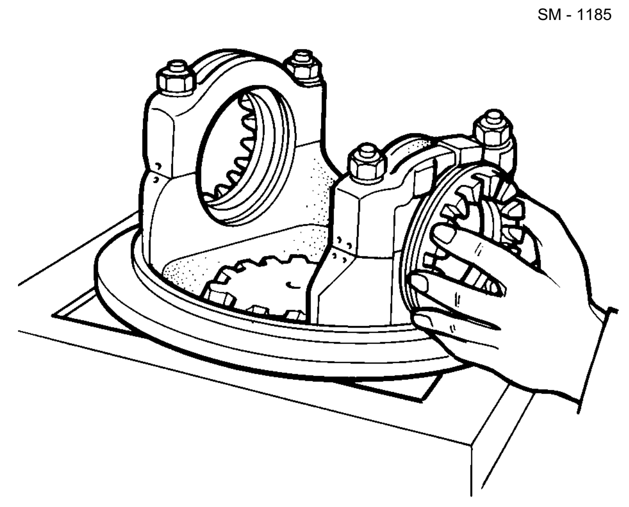

Fig. 11 - Checking Freedom of Bearing Adjusting Nut

Installing Crownwheel and Differential Assembly into Gear Casing

1. Hold bearing cups (52) in position on bearing cones (52A) and place crownwheel (46) and differential assembly in position in gear casing (39).

2. Install adjusting nuts (51) onto half threads of gear casing (39) legs. Re-check freedom of adjusting nuts on threads.

3. Install two straps (89) onto studs (100) to locate on bearing cups (52) and adjusting nuts (51).

Note: Ensure matching marks coincide to prevent misalignment of straps (89).

4. Turn adjusting nuts (51) hand tight against bearings (52 & 52A).

5. Install washers (88) and nuts (87). Tighten nuts to a torque of 502 - 542 Nm (370 - 400 lbf ft) (See Fig. 12).

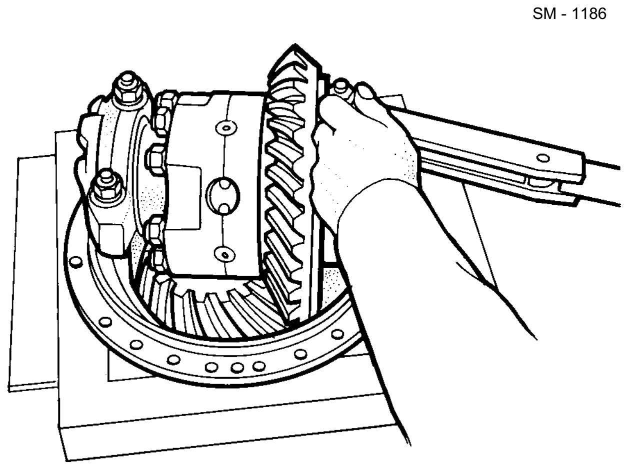

Fig. 12 - Tightening Gear Casing Straps

Setting 'No End Float' Condition

1. Set up dial indicator on back face of crownwheel (46) as shown in Fig. 13 and screw in each adjusting nut (51) just sufficiently to ensure that no crownwheel axial movement is registered on dial indicator.

2. Tap straps (89) and rotate crownwheel (46), then re-check that no axial movement is present.

3. Turn each adjusting nut (51) until nut slots line up with one of the two split pin holes in straps (89). Install two split pins (90) as shown in Fig. 14.

4. Set up dial indicator on crownwheel (46) and check for 'No End Float' condition.

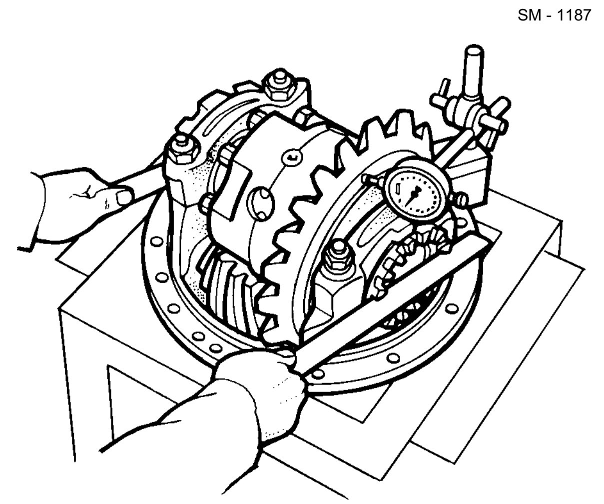

Fig. 13 - Setting Dial Indicator on Crownwheel Backface

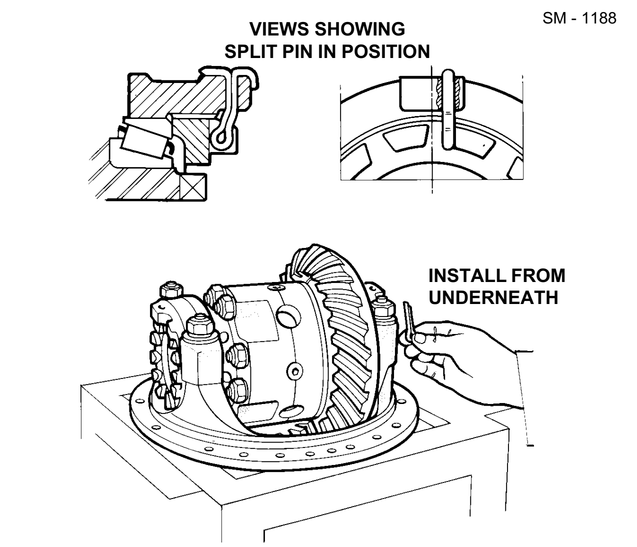

Fig. 14 - Installing Adjusting Nut Split Pins

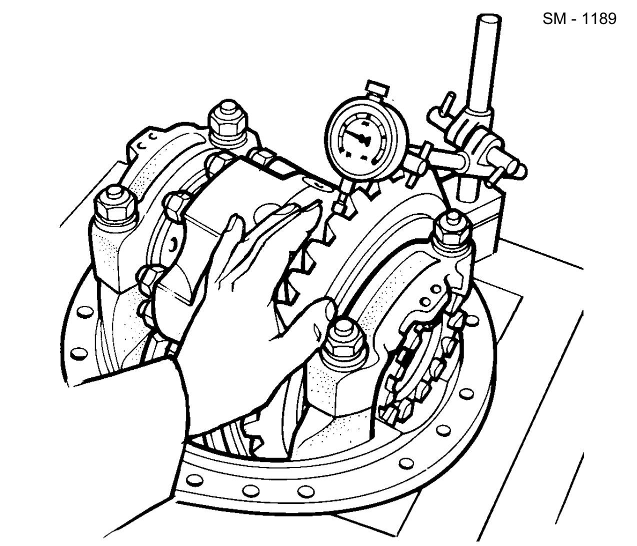

Fig. 15 - Setting Dial Indicator onto Crownwheel Tooth

Setting Crownwheel and Pinion Backlash

1. Move dial indicator onto crownwheel (46) tooth as shown in Fig. 15. Hold spiral bevel pinion (33) still and rock crownwheel (46) backwards and forwards, to check free play between gears (backlash), and note variation of indicator reading.

2. Repeat the above steps three more times so that four readings are taken at positions equally spaced around crownwheel (46).

Note: The variations of readings on dial indicator must be within limits of 0.203 - 0.330 mm (0.008 - 0.013 in). If difference in backlash of more than half backlash tolerance exists between tooth mesh positions, then assembly should be further examined for cause and rectified.

Checking Crownwheel and Pinion Mesh

1. Apply thin coating of engineers marking compound to several consecutive crownwheel teeth.

2. Turn crownwheel for few revolutions in both directions to make positive tooth contact impression on crownwheel and pinion teeth.

3. Inspect deposit of marking compound on crownwheel and pinion teeth and compare them with Fig. 16.

In all cases, action, (if any) to be taken is shown below:

Fig. A - Indicates correct mesh. No further action required.

Fig. B - Indicates pinion and crownwheel are too far out of mesh. To remedy, move pinion inwards towards crownwheel. To maintain backlash, move crownwheel away from pinion in direction of arrow B.

Fig. C - Indicates pinion and crownwheel too far into mesh. To remedy, move pinion outwards away from crownwheel. To maintain backlash, move crownwheel towards pinion in direction of arrow B.

If any action is required, adjust pinion position by altering the thickness of pinion setting shims (35) i.e. add shims to move pinion away from crownwheel and remove shims to move pinion towards crownwheel.

Helical Pinion/Helical Housing Assembly

1. Press inner bearing cup (32) into gear casing (39).

2. Press bearing cones (30A & 32A) onto helical pinion (31).

3. Place helical pinion (31) in position on gear casing (39).

4. Install dowels (37) into their relevant holes in gear casing (39).

5. Apply a thin coating of Red Hermatite to helical housing clamping face on gear casing (39) and install gasket (36) in position.

6. Install helical gear housing (26) onto gear casing (39) ensuring correct location with dowels (37).

7. Install bolts (119) and washers (118) and tighten to 98 - 108 Nm (72 - 80 lbf ft).

8. Install outer bearing cup (30) onto its bearing cone

TYPICAL PREFERRED TOOTH CONTACT
(Pinion member left hand in all cases shown)

SM - 1190

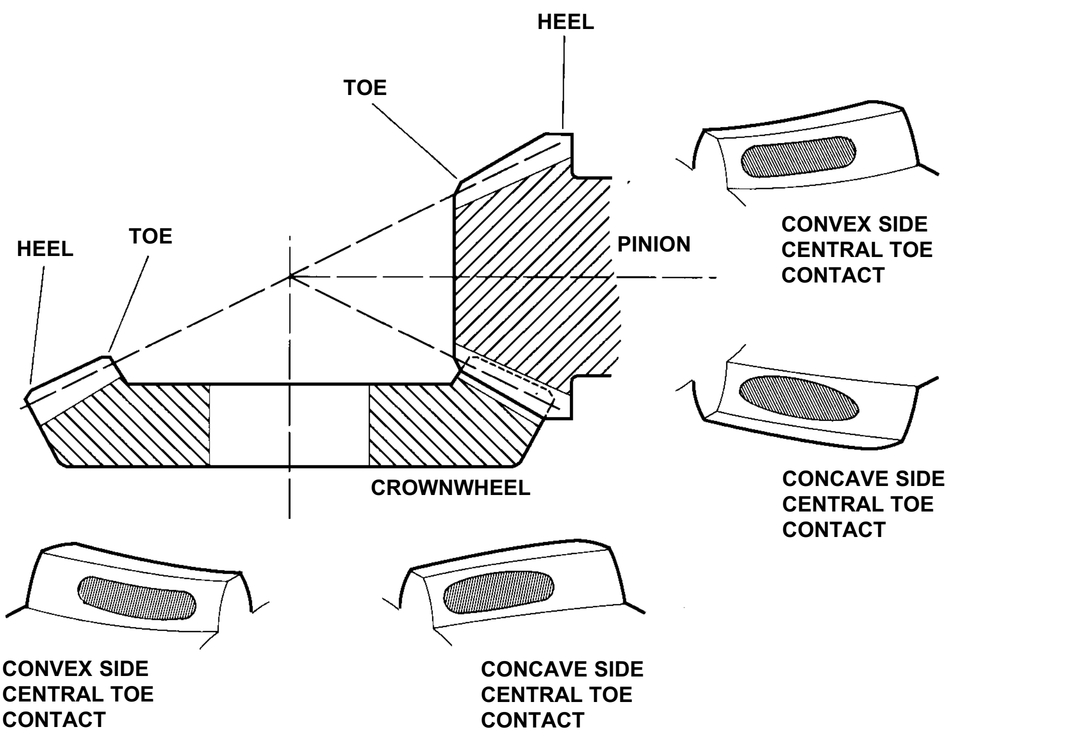

Fig. A - Correct Mesh

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PROFILE ERROR
To correct; move pinion towards crownwheel in direction of arrow A.

To maintain backlash; move crownwheel away from pinion in direction of arrow B.

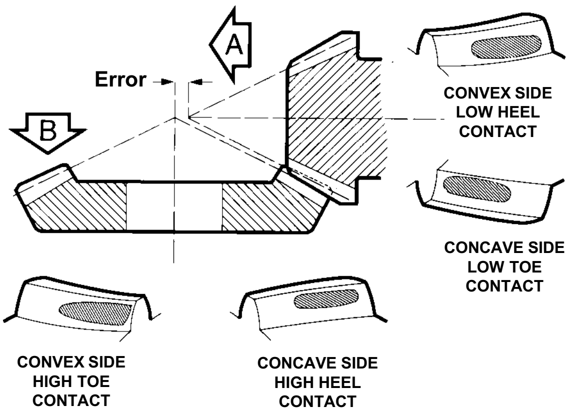

Fig. B - Pinion and Crownwheel too far out of Mesh

SM - 1192

PROFILE ERROR
To correct; move pinion away from crownwheel in direction of arrow A.

To maintain backlash; move crownwheel towards pinion in direction of arrow B.

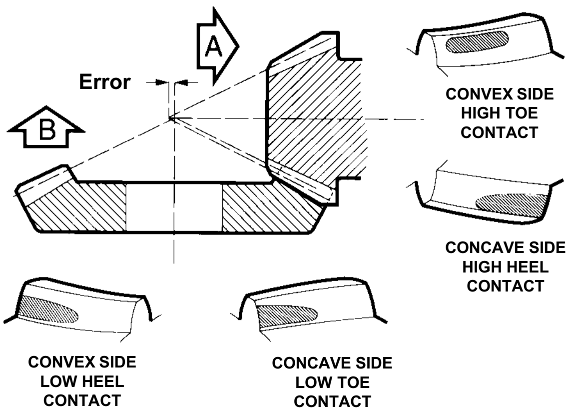

Fig. C - Pinion and Crownwheel too far into Mesh

Fig. 16 - Gleason Gears

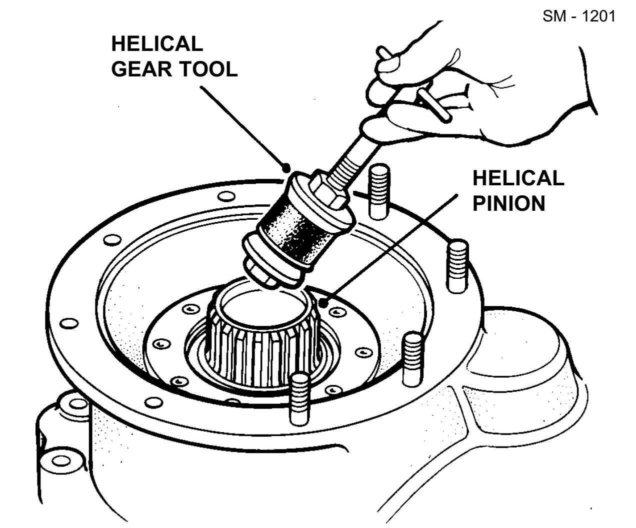

Fig. 17 - Installing Helical Gear Tool

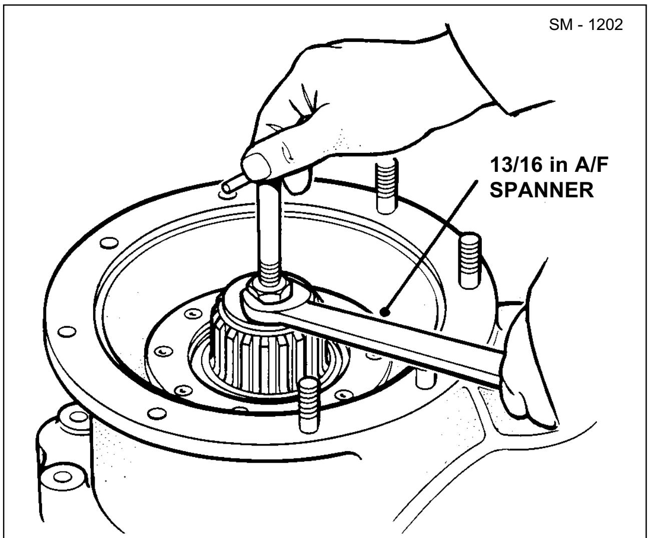

Fig. 18 - Securing Tool No. 15269088

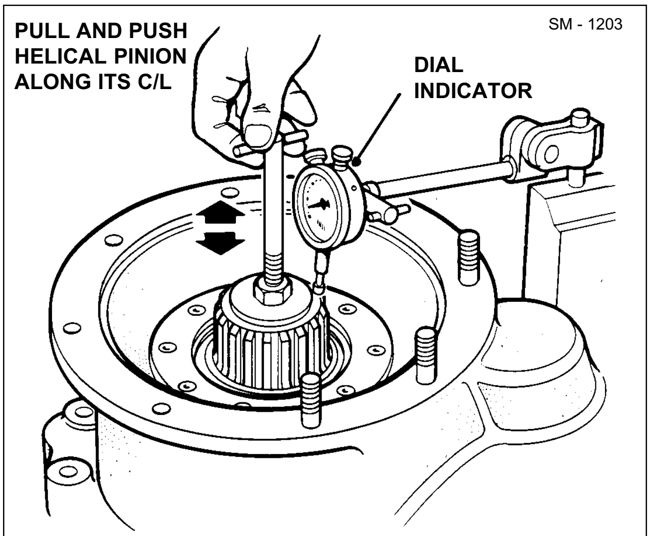

Fig. 19 - Measuring Helical Pinion Movement

(30A) already on helical pinion (31).

9. Select shim pack (19) of 0.762 mm (0.030 in) thickness and position in helical gear housing (26).

10. Place retainer plate (18) on shims and install eight standard type capscrews. Tighten capscrews to a torque of 64 - 72 Nm (47 - 53 lbf ft).

11. Shock load helical pinion bearings using a hide faced mallet.

12. Install helical gear tool (See Special Tools) into helical pinion (31) bore (See Fig. 17).

13. Tighten locknut on pinion tool clockwise to secure tool in pinion bore. (See Fig. 18).

14. Mount dial indicator on helical gear housing (26), with pointer positioned on end face of helical pinion (31). Pull helical pinion up and down using adjusting tool and note dial indicator movement (see Fig. 19).

Correct end float is between 0.051 - 0.102 mm (0.002 - 0.004 in).

To increase end float, add shims.

To decrease end float, subtract shims.

Add or subtract shims as required until correct end float is obtained.

15. Remove dial indicator and adjusting tool.

16. Remove standard capscrews installed at Step 10.

17. Fit new 'Eslok' capscrews (121) and evenly tighten to a torque of 63 - 72 Nm (47 - 53 lbf ft) whilst rotating helical pinion (31).

3rd Differential Unit Assembly

Note: Before assembly, check that the two cage halves (12 & 17) are a matched set. If one half is replaced, they must be replaced as a pair.

1. Place inner cage half (17) on work bench with open end uppermost and install thrust washer (16) and wheel (15).

2. Install bushes (123), pinions (124) and thrust washers (125) on trunnion (122).

3. Place trunnion assembly in position on wheel (15).

4. Install outer wheel (14) and thrust washer (13).

5. Place outer cage half (12) onto assembly and secure with bolts (126). Evenly tighten bolts to a torque of 98 - 108 Nm (72 - 80 lbf ft), then fasten in pairs with lockwire.

6. Rotate inner wheel (15) inside cage assembly to ensure all parts move freely.

7. Check security of studs (120) in helical gear housing (26) and tighten to a torque of 33 - 35 Nm (24 - 26 lbf ft) if necessary.

8. Apply a thin coating of Red Hermatite to helical gear housing (26) face and install new gasket (20).

9. Install 3rd differential assembly onto spline of helical pinion shaft (31).

10. Apply a small bead of Hylomar sealant to the corner of the bearing recess in 3rd differential housing (10). Press outer bearing (6) into housing (10).

11. Install new 'O' ring (11) onto the spigot on 3rd differential housing (10) then install housing onto helical gear housing (26).

12. Install setscrews (8), spring washers (9), nuts (128) and spring washers (127). Evenly tighten nuts (128) and setscrews (8) to a torque of 98 - 108 Nm (72 - 80 lbf ft).

13. Check security of studs (129) in 3rd differential housing (10) and tighten to a torque of 26 - 28 Nm (19 - 21 lbf ft) if necessary.

14. Fit new oil seal (4) into front end cap (3) noting the following:

a. Seal must be fitted using oil seal bumper tool (See Special Tools), which bears on the seal close to its outside diameter where the casing is strongest. Failure to use tool will result in distortion of seal casing, uneven wear of lip and leakage. Fig. 20 illustrates a typical example where the seal is fitted into the seal retainer using oil seal bumper tool.

b. Seal must remain square to the bore during fitting. If seal cocks over and one side enters the bore first, it will almost certainly result in distortion of the casing which will not be corrected by straightening up the seal further down the bore. Where possible the seal should be fitted under a press, which reduces the likelihood of this problem.

c. Seal must be truly square after fitting, a cocked seal will act as an oil pump.

d. When replacing a seal, always check coupling flange (2) surface for damage in region polished by oil seal lip; even slight damage in this area can cause leakage. Very slight marks may be polished out with fine emery cloth but it is essential that polishing marks are parallel to the seal lip. Where there is more serious damage, it is permissible to fit two seals back to back if there is room in the retainer, i.e. outer seal with spring facing inwards. The outer seal acts as a spacer and ensures that inner seal is fitted square and that it runs on a different part of coupling surface.

e. Pack the seal with high temperature grease before fitting.

f. The oil seal lip or journal of coupling should be smeared with clean gear oil prior to assembly. If seal is fitted dry, it can burn out in a matter of minutes, before oil reaches it.

15. Apply a small bead of Hylomar sealant to the corner of bearing recess in front of end cap (3).

16. Install washer (5) onto outer cage half (12) shaft splines.

17. Apply Loctite 275 by brush to outer cage half (12) shaft splines and threads.

18. Place front end cap (3) onto 3rd differential housing

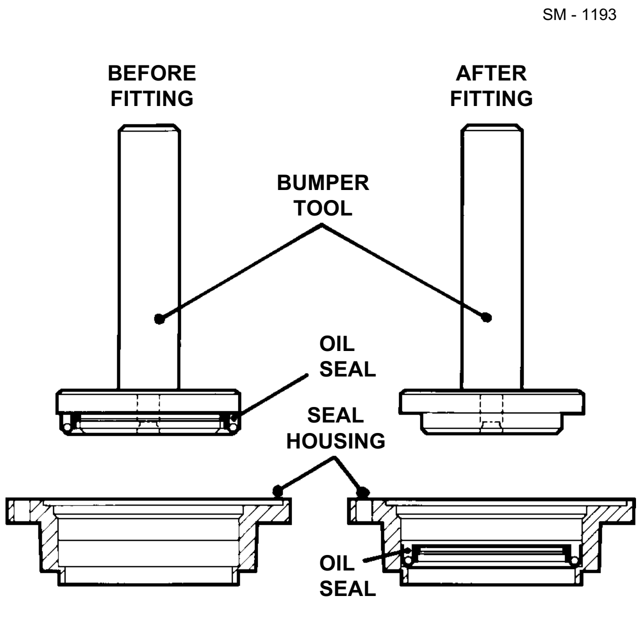

Fig. 20 - Method of Fitting Oil Seal

(10) and secure with nuts (131) and washers (130). Evenly tighten nuts to a torque of 38 - 43 Nm (28 - 32 lbf ft).

Note: Check for a gap of 0.2 mm (0.008 in) maximum between front end cap (3) and 3rd differential housing (10). Bearing (6) must not be pre-loaded.

19. Install coupling flange (2) and flange nut (1). Tighten flange nut (1) to a torque of 1 085 - 1 220 Nm (800 - 900 lbf ft).

20. Lock flange nut (1) in position by peening raised collar of flange nut into slot in end face of outer cage half (12).

Place completed assembly in clean storage place until required for lifting into axle.

Note: If the period before lifting the assembled unit into the axle is likely to be more than 4 hours, thoroughly oil all gears and bearings. If it is to be more than 12 hours, the oil should be of a protective type, with anti-rust additive such as Shell 'Ensis 40' and the unit should be stored in a dust proof and damp proof container.

INSTALLATION

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.**

Drive Head Unit and Differential Shaft into Axle Casing

1. Check studs (85) and renew as necessary. Tighten to a torque of 89 -100 Nm (66 - 74 lbf ft).

2. Apply a thin coating of Red Hermatite to axle casing (64) face and install new gasket (86).

3. Using suitable lifting equipment, offer drive head unit to axle casing (64) ensuring that drive head is in correct position, with matching marks lined up.

4. Install spring washers (104) and nuts (105) then tighten to a torque of 230 - 258 Nm (170 - 190 lbf ft).

5. Check security of studs (81) in axle casing (64) and tighten to a torque of 26 - 28 Nm (19 - 21 lbf ft) if necessary.

6. Install new oil seal (77) into rear end cap (76). Check 3rd differential shaft (73) for damage in region polished by oil seal lip.

7. Apply a small bead of Hylomar sealant to the corner of the bearing recess in rear end cap (76) and axle casing (64).

8. Install rear end cap (76) against 3rd differential shaft (73) coupling.

9. Install bearing (78) hard against shoulder on 3rd differential shaft (73). Secure with lockplate (79) and shaft nut (80) then bend over lock tabs.

10. Insert 3rd differential shaft (73) into axle casing and ease into position through clutch dog (63), helical pinion (31) and inner wheel (15). When 3rd differential shaft (73) is correctly located, drive it fully home.

11. Install spring washer (75) and nuts (74). Evenly tighten nuts to a torque of 38 - 43 Nm (28 - 32 lbf ft).

Note: Check for a gap of 0.2 mm (0.008 in) maximum between rear end cap (76) and axle casing (64). Bearing (78) must not be pre-loaded.

Setting 3rd Diff Lock Mechanism

1. Loosen locknut (29) then screw out stop screw (28) from helical gear housing (26). See Fig. 21.

2. Apply pressure to engage diff lock. To check that lock is engaged, hold front coupling flange (2) stationary, and try to turn differential shaft (73) at rear flange. If lock is engaged, both flanges will rotate together.

3. With operating shaft (42) fully forward, apply Hylomar to stop screw threads (28) and screw in until it just touches end of operating shaft (42). Release pressure on operating cylinder (40) and tighten stop screw a further half a turn and tighten locknut (29) to 13 - 15 lbf ft (18 - 20 Nm). This will allow approximately 0.020 inch (0.51 mm) clearance for clutch dog faces (63) when fully engaged.

4. Engage then disengage operating cylinder (40) five times using air pressure and observe that cylinder moves smoothly in both directions.

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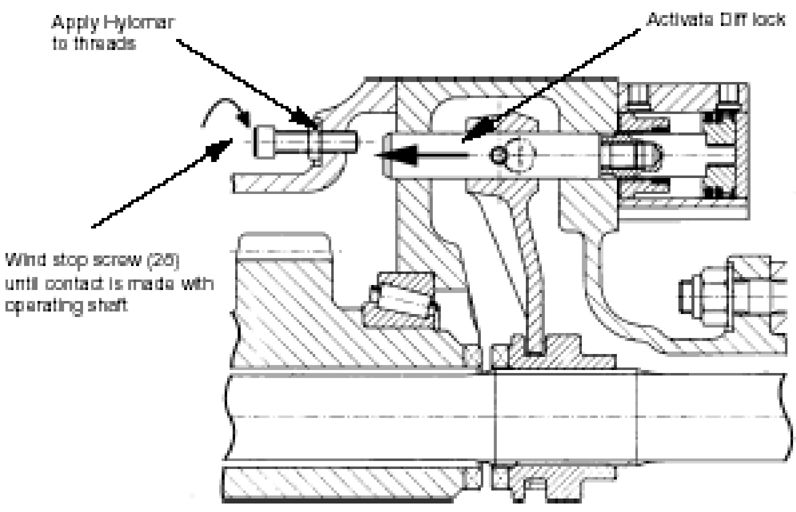

Fig. 21 - Setting 3rd Diff Lock Mechanism

Final Assembly

1. Carefully feed driveshaft assembly (1, Fig. 2) back into axle casing (64) to locate driveshaft splines in wheel (97).

2. Coat hub mating face of planet carrier (8, Fig. 2) with Loctite 515 then offer planet carrier unit to hub (2, Fig. 2) using suitable lifting gear if required. Ensure planet gear teeth mesh with sun gear.

3. Install bolts (4, Fig. 2) and washers (3, Fig. 2) then tighten to a torque of 142 -149 Nm (105 - 110 lbf ft).

4. Install bolt (6, Fig. 2) and washer (5, Fig. 2) then tighten to a torque of 237 - 244 Nm (175 - 180 lbf ft).

5. Rotate both hubs until bottom of oil filler/level plug holes are approximately 13 mm (0.5 in) above axle centre line (level with diff filler/level hole).

6. Install differential drain plug (84) and tighten.

Note: To provide immediate lubrication of the 3rd differential unit, add 1 litre (1 3/4 pints) of oil through the differential housing filler hole then install and tighten filler plug (7).

7. Add gear oil of the type specified in Section 300-0020, LUBRICATION SYSTEM, through diff filler/ level hole until the oil is level with bottom of filler/level hole.

8. Check oil level to bottom of filler/level hole in both hubs and top up as necessary. Leave oil to settle for 15 minutes then check oil level again in both hubs and drive head.

9. Install then tighten filler/level plugs in drive head and both hubs.

10. Reconnect drivelines to coupling flange (2) and 3rd differential shaft (73). Tighten driveline capscrews to a torque of 153 Nm (113 lbf ft).

11. Install breather tube (83) in adaptor (132).

12. Clean interfaces between road wheels, hub and wheel nuts.

13. Re-fit road wheels, securing with wheel nuts. Remove stands or timber supports and lower vehicle to ground. Fully tighten wheel nuts to a torque of 540 Nm (400 lbf ft). Remove wheel blocks.

Note: Wheel nuts should be checked and re-tightened if necessary, after a short period of vehicle service.

MAINTENANCE

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.**

General

At first service, then every 1 000 hours (6 months), check the following and repair or replace where necessary:

a - Input flange for wear/damage.
b - Pinion oil seals for leaks.
c - Breather for signs of leakage or dirt ingress.
d - Leaks around joints.
e - General condition and tightness of nuts and bolts.
f - General condition of axle casing.

Oil Change Period

Note: For recommended oils, refer to Section 300-0020, LUBRICATION SYSTEM.

With new or rebuilt units, drain (preferable after a short run to warm the oil) and refill after 100 hours of operating, then at intervals of 2 000 hours (12 months).

Oil Level

Check oil levels every 250 hours (monthly), following the procedure below:

1. Drive vehicle onto a level, solid concrete floor, apply the parking brake and switch off the engine.

2. Block appropriate road wheels and turn the battery master switch to the 'Off' position.

3. Unscrew oil filler/level plug (84) and check that oil level is to bottom of plug hole. Add oil if necessary.

Note: As there is no oil sealing between drive head and the hubs, the hub oil levels should be same as the drive head. i.e. 13 mm (0.5 in) above the axle centre line. After filling, allow oil to settle for at least 15 minutes, then re-check oil level at all points. Add oil as necessary until levels remain constant after settling period.

4. Raise axle until both road wheels are just off the ground then support with suitable stands or timbers.

5. Rotate each hub so that bottom of oil filler/level plugs (7, Fig. 2) are approximately 13 mm (0.5 in) above axle centre line (level with diff filler/level plug).

6. Unscrew plugs and check that oil level is to bottom of plug holes. If not, add oil to each hub through plug holes then re-check oil level in drive head.

7. When level is correct, refit and tighten all filler/level plugs to the specified torques, lower vehicle to ground and remove wheel blocks.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of helical gear tool (Figs. 17 and 18), oil seal bumper tool (Fig. 20) and general service tools and adhesives required. These tools and adhesives are available from your dealer.

FAULT DIAGNOSIS

Very often, noises and vibrations originating in other parts of the vehicle are mistakenly believed to emanate from the drive head, with the result that time and effort is wasted on an unnecessary dismantling operation. Therefore, before fixing suspicion on the drive head, investigate all other possible sources of trouble first. Where the drive head is definitely suspect however, draining the housing and examining the oil for metal particles, will aid diagnosis and help to pinpoint any malfunction. Refer to 'Diagnosis Chart'.

DIAGNOSIS CHART		
CONDITION	REASON	REMEDY
Vibration	Broken gear teeth, worn bearings	Replace gear or bearings
Continued noise	Worn gears or bearings	Replace gears or bearings
Overheating	Loss of lubricant	Replace faulty joint or seal and refill
	Crownwheel adjustment too tight	Readjust
	Seized bearings	Replace bearings
Noise on turns	Worn diff side gears and pinions	Replace diff side gears and pinions
	Worn or damaged trunnions	Replace trunnions
	Loss of lubricant	Replace faulty joint or seal and refill
	Loose nuts on differential casings	Tighten nuts to specified torque
Loss of drive	Worn driveshaft splines	Replace driveshaft
	Broken driveshaft	Replace driveshaft

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	1	Flange Nut	1 085 - 1 220	800 - 900
1	8	Setscrew	98 - 108	72 - 80
1	42	3rd Diff Operating Shaft	51 - 57	38 - 42
1	45	Bolt	155 - 171	114 - 126
1	47	Stud	19 - 22	14 - 16
1	50	Nut	155 - 171	114 - 126
1	74	Nut	38 - 43	28 - 32
1	81	Stud	26 - 28	19 - 21
1	85	Stud	89 - 100	66 - 74
1	87	Nut	502 - 542	370 - 400
1	92	Nut	61 - 66	45 - 49
1	100	Stud	129 - 142	95 - 105
1	105	Nut	230 - 258	170 - 190
1	41	Operating Cylinder Capscrews	18 - 20	13 - 15
1	114	Setscrew	98 - 109	72 - 80
1	117	End Nut	1 085 - 1 220	800 - 900
1	119	Bolt	98 - 109	72 - 80
1	120	Stud	33 - 35	24 - 26
1	121	Capscrew	63 - 72	47 - 53
1	126	Bolt	98 - 108	72 - 80
1	128	Nut	98 - 108	72 - 80
1	129	Stud	26 - 28	19 - 21
1	131	Nut	38 - 43	28 - 32
2	4	Bolt	142 - 149	105 - 110
2	6	Bolt	237 - 244	175 - 180
-	-	Driveline Capscrews	153	113

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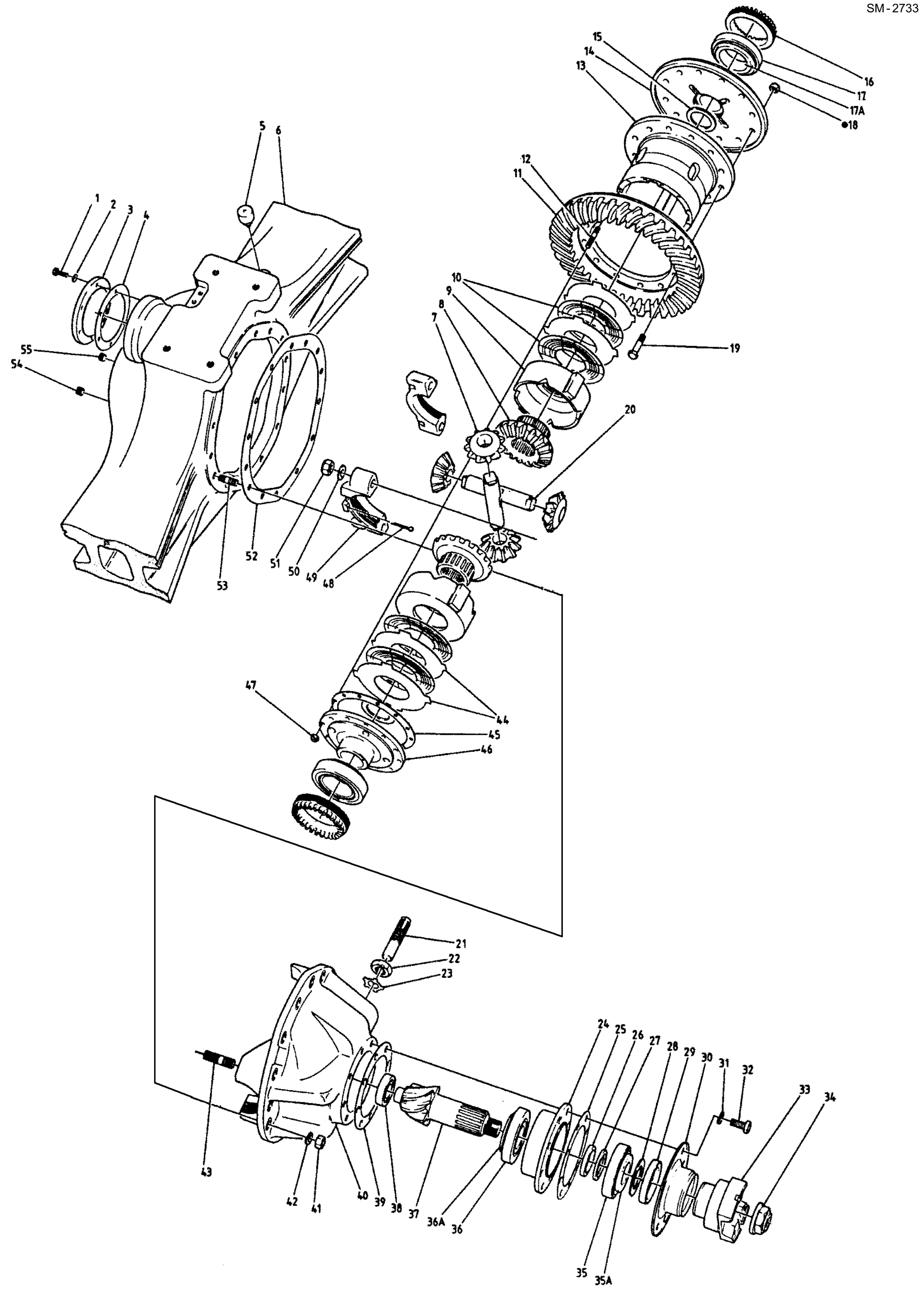


Fig. 1 - POWR LOK Differential Drive Head

LEGEND FOR FIG. 1

1 - Bolt
2 - Spring Washer
3 - End Cap
4 - Not fitted
5 - Not fitted
6 - Axle Casing
7 - Diff Pinion
8 - Diff Wheel
9 - Diff Cage Assy
10 - Friction Plate (Sintered)
11 - Crownwheel
12 - See item 13
13 - Diff Housing Assy comprising items 12-14,46,47
14 - See item 13
15 - Diff Wheel Thrust Washer
16 - Diff Bearing Adjusting Nut
17 - Diff Bearing Cup
17A - Diff Bearing Cone
18 - Nut
19 - Bolt
20 - Diff Trunnion
21 - Not fitted
22 - Not fitted
23 - Not fitted
24 - Pinion Bearing Housing
25 - Not fitted
26 - Spacer
27 - Spacer
28 - Washer Spacer
29 - Oil Seal
30 - End Cap
31 - Spring Washer
32 - Setscrew
33 - Coupling Flange
34 - Coupling Flange Nut
35 - Pinion Bearing Cup
35A - Pinion Bearing Cone
36 - Pinion Bearing Cup
36A - Pinion Bearing Cone
37 - Pinion
38 - Pinion Nose Bearing
39 - Shim
40 - Gear Casing
41 - Axle Casing Nut
42 - Spring Washer
43 - Stud
44 - Clutch Plate
45 - Not fitted
46 - See item 13
47 - See item 13
48 - Adjusting Nut Split Pin
49 - Gear Casing Strap
50 - Washer
51 - Nut
52 - Not fitted
53 - Axle Casing Stud
54 - Drain Plug
55 - Oil Plug (Filler)

DESCRIPTION

The axle employs a differential drive unit, consisting of a single reduction spiral bevel crownwheel and pinion. The pinion is supported by three roller bearings, the outer and centre bearings being pre-loaded taper roller bearings whilst the nose bearing is of the plain roller type. The differential is a POWR LOK torque bias unit which maintains traction at both wheels. The design also ensures that both the engagement and disengagement action of the POWR LOK unit does not produce any shock torsional loads in the drive shafts.

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.

Draining the Oil

1. Position the vehicle (preferably after a short run to warm the oil) on a level, solid concrete floor, apply the parking brake and switch off the engine.

2. Block appropriate road wheels and turn the battery master switch to the 'Off' position.

3. Whilst road wheels are still on the ground, loosen the wheel nuts of each wheel.

4. Jack up chassis until the tyres are clear of ground and support with suitably placed stands or timbers.

5. Remove the wheel nuts then pull off road wheels.

6. Identify the relationship of the driveline flange to the coupling flange (33). Disconnect driveline and secure clear of drive head. Driveline may be removed if convenient to do so. Refer to Section 130-0020, REAR DRIVELINES.

7. Loosen coupling flange nut (34) but do not remove.

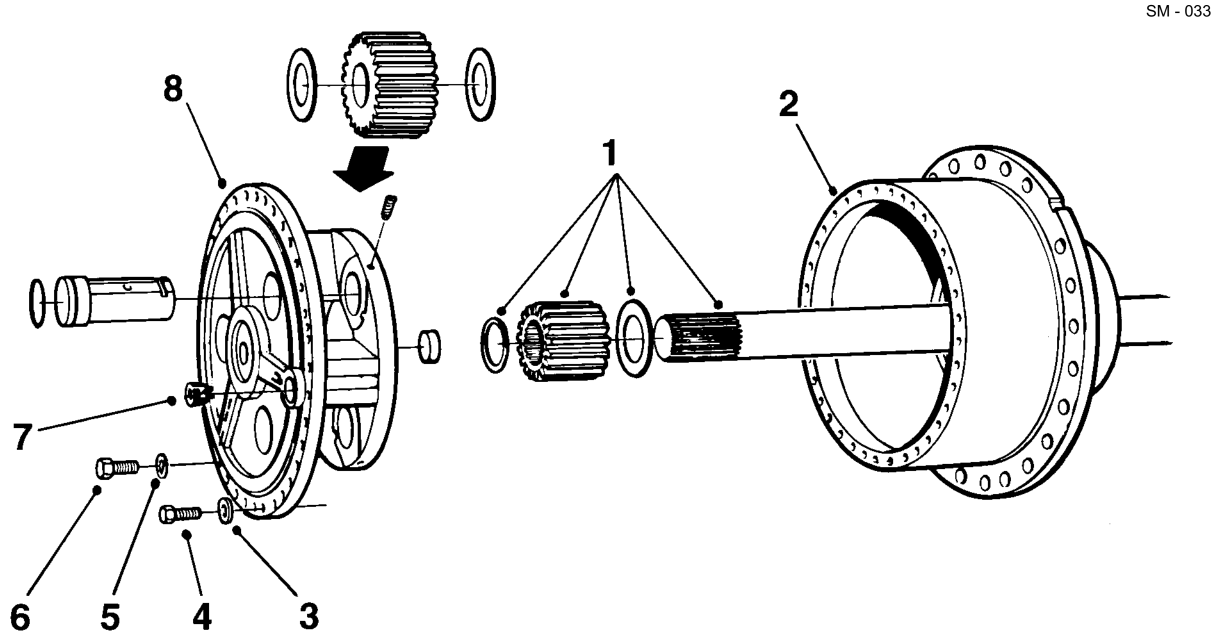
8. Disconnect breather tube from adaptor.

9. Remove rear axle from vehicle and place on a suitable axle stand. Refer to Section 180-0040, REAR SUSPENSION.

Note: As there is no oil sealing between the drive head and the hubs, the oil must be drained from all three units before overhaul.

10. Place suitable containers under the drive head and both hubs.

11. Rotate hubs to bring bolts (6, Fig. 2) to their lowest point. Unscrew and remove filler/level plugs (7, Fig. 2). Remove bolts (6, Fig. 2) and washers (5, Fig. 2) to drain the oil from the hubs.



1 - Driveshaft Assembly
2 - Hub
3 - Washer
4 - Bolt
5 - Washer
6 - Bolt
7 - Oil Filler/Level Plug
8 - Planet Carrier

Fig. 2 - Part View of Hub Reduction Unit

12. Unscrew and remove oil filler/level plug (55) and drain plug (54) to drain oil from drive head.

Driveshafts

1. Remove bolts (4, Fig. 2) and washers (3, Fig. 2).

2. Using suitable lifting equipment, pull off planet carrier assembly (8, Fig. 2) and place on bench, small diameter down.

3. Pull out driveshaft assembly (1, Fig. 2) from hub to disengage the shaft splines from wheel (8).

4. Cover open end of hub unit to prevent entry of dirt.

5. Repeat steps 1 through 4 for other hub end.

Drive Head Unit from Axle Casing

1. If gear casing (40) is not in vertical position, fit two 'U' bolts to coupling flange (33) and using lifting gear, rotate the axle. Leave lifting gear in position.

2. Remove nuts (41) and spring washers (42).

3. Carefully remove gear casing (40) assembly clear of axle casing (6) and place on a suitable build stool.

4. Remove all traces of gasket material from axle casing (6) and gear casing (40) flanges.

5. Remove lifting gear and 'U' bolts from coupling flange (33).

DISASSEMBLY

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.

⚠ **When necessary to drive out components during disassembly, be sure to use a soft drift to prevent property damage and personal injury.**

Differential Unit

1. Straighten lockplate tabs (23) then loosen crownwheel thrust screw locknut (22) and remove thrust screw (21), locknut and washer from gear casing (40).

2. Match mark straps (49) as shown in Fig. 3 to ensure correct rebuild position then remove nuts (51) and washers (50).

3. Lift off two straps (49) and diff bearing adjusting nuts (16).

4. Remove and discard bearing adjusting nut split pins (48) from diff straps (49).

5. Lift complete differential and crownwheel assembly from gear casing (40). Place assembly on bench with crownwheel (11) teeth uppermost.

6. Check end flanges (14 & 46) and differential housing body (13) for identification and matching marks (See Fig. 4). If unmarked, centre punch the parts to ensure correct mating on assembly.

7. Remove nuts (47) from studs (12) which fasten upper end flange (46) to differential housing body (13).

8. Lift off end flange (46) and thrust washer (15).

Note: Shims (45) may have been fitted between end flange (46) and differential housing body (13). These must be replaced on assembly to maintain an operating clearance within the differential assembly. The components contained in the differential unit have been carefully measured and selected to ensure correct operation. DO NOT fit the components in a different sequence to that of the original assembly or attempt to change/introduce shimming. This will result in failure of the POWR LOK system.

9. Remove first clutch plate (44) and friction plate (10) followed by second pair of plates. Set aside plates so that they can be reinstalled in their original position.

10. Slide out cage half (9) from differential housing body (13).

11. From remaining cage half, lift out wheel (8), pinions (7) and trunnions (20).

12. Remove second wheel (8) and cage half (9) followed by two pairs of clutch plates (10 & 44) and second thrust washer (15).

13. Unscrew and remove nuts (18) and bolts (19).

14. Separate end flange (14) from differential housing body (13).

15. Using hide faced mallet, remove crownwheel (11) from its register on differential housing body (13).

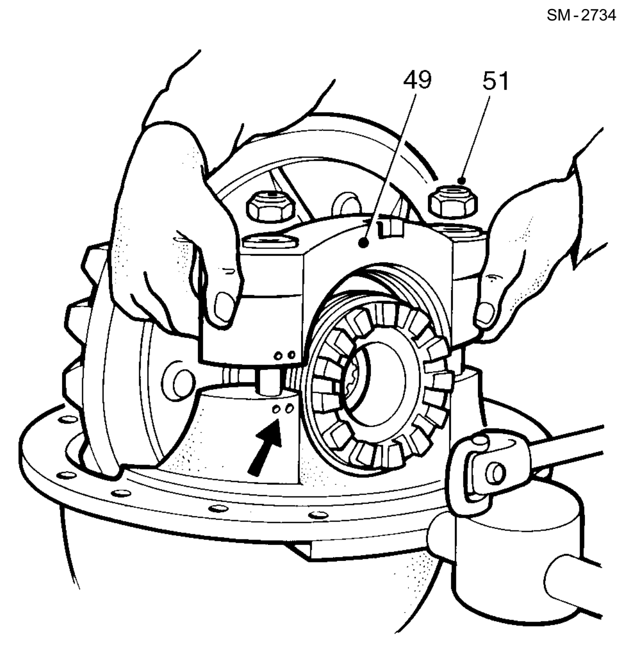


Fig. 3 - Match Marking Gear Casing Straps

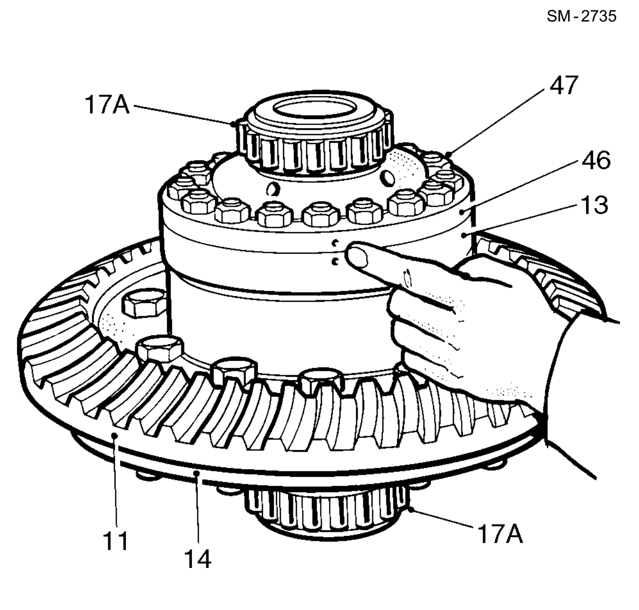


Fig. 4 - Matching Marks on Diff Housing

16. Inspect all parts of differential assembly. If there is any wear or damage install new differential unit complete. Renew crownwheel (11) and pinion (37) as a matched pair.

Bevel Pinion Assembly

1. Remove setscrews (32) then, using hide faced mallet, knock out complete pinion assembly from gear casing (40) taking care not to lose any of the pinion

setting shims (39).

Note: If the original pinion and crownwheel are to be reinstalled, retain the shim pack as a unit for reuse.

2. Remove all traces of sealant from the outer shims (39), pinion bearing housing (24) and gear casing (40).

3. Secure pinion assembly in a vice fitted with soft jaws then remove pinion nut (34).

4. Pull off coupling flange (33), using suitable extraction equipment.

5. Lift off pinion end cap (30) complete with pinion oil seal (29), followed by coupling flange washer (28).

6. Tap pinion (37) along with inner bearing cone (36A), pinion spacers (26 & 27) and pinion nose bearing (38) out of bearing housing (24). Remove spacers, inner bearing cone and nose bearing from pinion if required.

7. Lift out outer bearing cone (35A) from bearing housing (24). Bearing cups (35 & 36) can now be drifted out of bearing housing (24) for replacement if required.

Note: If either bearing cup or cone need replacing, they must be replaced as a set.

8. Prise out and discard pinion oil seal (29) from pinion end cap (30).

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

Note: Prior to assembly, lightly oil bearings in clean gear oil as specified in Section 300-0020, LUBRICATION SYSTEM.

⚠ **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.

⚠ **When necessary to drive on components during assembly, be sure to use a soft drift to prevent property damage and personal injury.**

Bevel Pinion

1. If new nose bearing (38) is to be fitted, apply a light coating of Loctite 641 to bore of nose bearing then press onto pinion (37) hard against its abutment shoulder. To retain bearing, lightly peen over end of pinion shaft in three places as shown in Fig. 5.

2. Press inner and outer pinion cups (35 & 36) into pinion bearing housing (24) until they register hard and square against abutment shoulders.

3. Press inner pinion bearing cone (36A) onto pinion shaft (37). Lightly oil bearing cone with clean gear oil.

4. Fit inner bearing spacer (26) followed by outer spacer (27) onto pinion shaft (37) then feed assembly into housing (24).

Note: If new parts are being fitted, install the largest available spacers. This is to ensure that the bearing cannot be over pre-loaded, preventing bearing damage.

5. Press outer pinion bearing cone (35A) into position on pinion (37) then lightly oil with clean gear oil.

Setting Pinion Bearing Pre-Load

1. Fit coupling flange washer (28) onto pinion (37) followed by coupling flange (33) and pinion nut (34). Do not install end cap (30) at this stage. Secure assembly in vice then tighten pinion nut as shown in Fig. 6 to a torque of 800 - 900 lbf ft (1085 - 1220 Nm).
Check and if necessary adjust pinion bearings pre-load as follows (see Fig. 7).

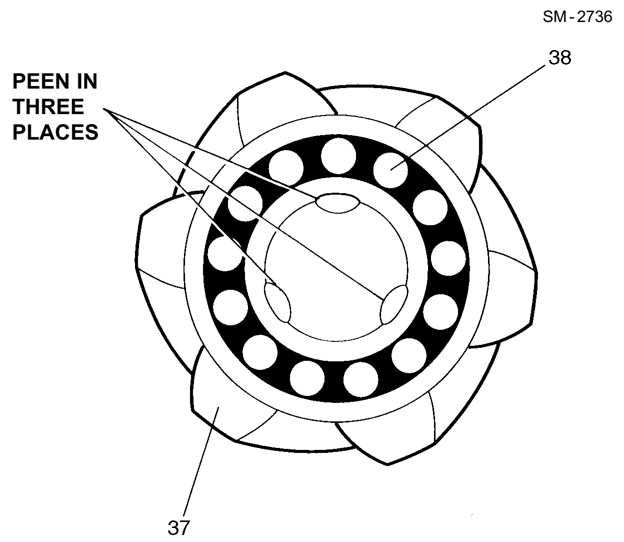


Fig. 5 - Peening Pinion Nose Bearing

2. Secure assembly in vice, hold on coupling flange (33).

3. Secure length of cord around pinion bearing cage (24) and attach free end to spring balance.

4. Pull tangentially on spring balance to rotate pinion bearing cage. Note the force required to maintain rotation, ignoring initial starting force.

5. The correct spring balance reading should be between 3.5 - 6 lbs pull (1.5 - 2.75 kg) giving a rolling torque of 15 - 25 lbf in (1.7 - 2.8 Nm).

If torque reading is less than 1.7 Nm (15 lbf in) then a smaller outer spacer needs to be fitted.

If torque obtained is greater than 2.8 Nm (25 lbf in) then a larger outer spacer needs to be fitted.

Note: If largest available combination of spacers (26 & 27) is already fitted, then a defect must be present in one or more parts of the assembly and needs to be found and remedied before continuing differential build.

6. When correct pre-load has been achieved, remove coupling flange nut (34) and pull off coupling flange (33).

7. Fit a new oil seal (29) into pinion end cap (30) with spring loaded lip facing inboard when fitted on axle, taking care not to damage the seal.

8. Pack cavity between seal lips with Duckhams Keenomax L2 or equivalent grease.

9. Apply Red Hermetite or similar sealant to both faces of pinion end cap joint (25) then assemble onto bearing housing flange (24) along with pinion end cap assembly (29 & 30).

Note: For assemblies where no joint is fitted, clean mating faces with Loctite Superclean Safety Slovent 706 or similar chlorinated solvent then apply a continuous bead of Loctite Gasket Eliminator 515 to one of mating faces prior to assembly.

10. Secure end cap centrally in position about pinion (37) with washers and setscrews (31 & 32). Tighten setscrews to 180 - 200 lbf ft (244 - 271 Nm).

11. Refit coupling flange (33) and nut (34). Torque tighten nut (34) to 800 - 900 lbf ft (1085 - 1220 Nm).

12. Lock nut (34) in position by peening a portion of nut locking ring into slot in pinion shank (37).

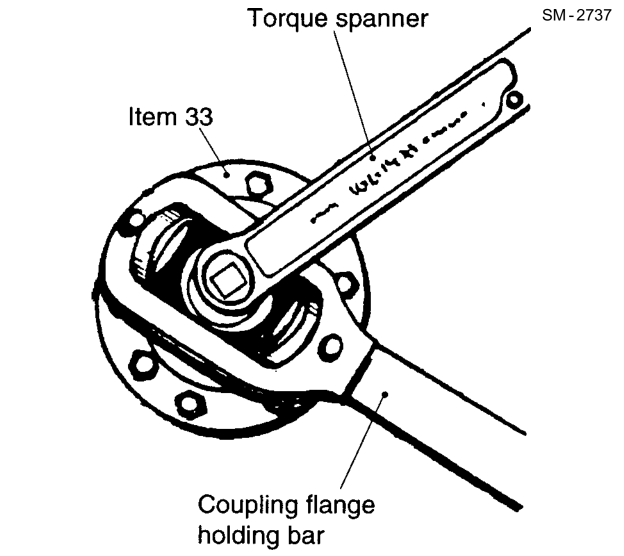


Fig. 6 - Tightening Pinion Nut

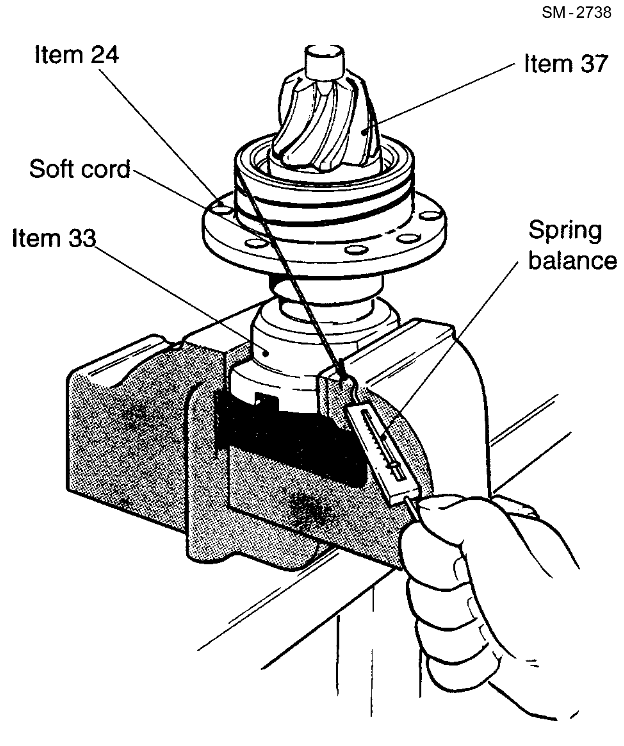


Fig. 7 - Method Of Setting Bearing Pre-load

Setting Pinion Depth

1. If original crownwheel and pinion (11 & 37) are being refitted, place the already assembled pinion unit (24 to 38) into bevel casing (40), having fitted original shims (39) between pinion bearing housing (24) and bevel casing (40). See Fig. 8.

2. Fit pinion bearing housing setscrews and washers (32 & 31) to secure pinion bearing housing (24) to bevel casing (40) then tighten to 180 - 200 lbf ft (244 - 271

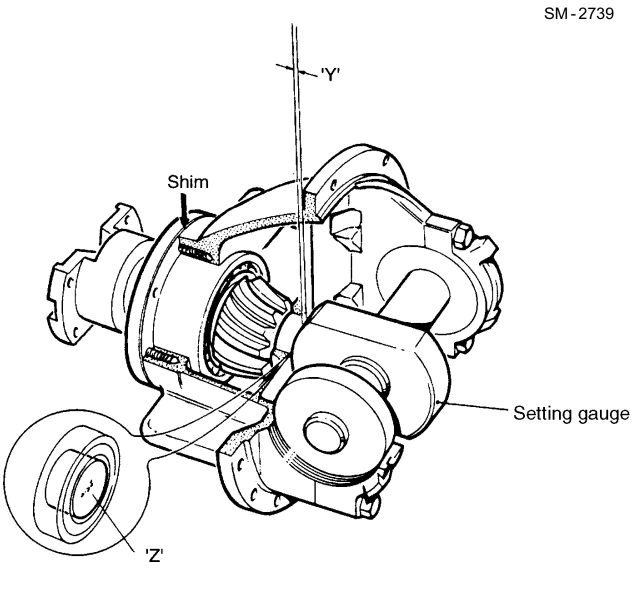


Fig. 8 - Method Of Setting Pinion Depth

Nm).

3. If a new crownwheel and pinion (11 & 37) are to be fitted, proceed as follows:

a) Insert shims (39) of 0.025" (0.6 mm) nominal thickness between pinion bearing housing (24) and bevel casing (40).

b) Fit pinion bearing housing setscrews and washers (32 & 31) to secure pinion bearing housing (24) to bevel casing (40) then tighten to 180 - 200 lbf ft (244 - 271 Nm).

c) Assemble setting gauge into bevel casing (40) as shown in Fig. 8 and secure with bevel straps (49).

d) Using feeler gauges, measure gap 'Y' between setting gauge and pinion nose. The gap should measure 0.025" (0.6 mm) plus figure 'Z' which is etched on pinion nose. Adjust shim pack thickness as required to give correct measurement.

Differential Unit

1. If crownwheel (11) has been separated from differential housing body (13) refit as follows:

a. Heat crownwheel to a temperature of approximately 150° C (300° F). This is necessary to ensure that crownwheel fits onto register on differential housing body (13).

b. Place crownwheel (11) into position on differential housing body (13), ensuring that bolt holes and matching marks line up.

c. Install two bolts (19) diagonally opposite, through crownwheel and differential housing body (13) then allow assembly to cool fully.

d. Install end flange (14) aligning matching marks and grooves in end face with those in differential housing body. Install remaining bolts (19) and nuts (18) then tighten to a torque of 155 - 171 Nm (114 - 126 lbf ft).

2. Place assembly on bench with end flange (14) downwards. Check tightness of studs (12) and if necessary tighten to a torque of 19 - 22 Nm (14 - 16 lbf ft).

3. Soak friction plates (10) in gear oil prior to installing and lightly oil differential components before assembly.

4. Install first thrust washer (15) into bore of end flange (14).

5. Slide steel clutch plate (44) then friction plate (10)

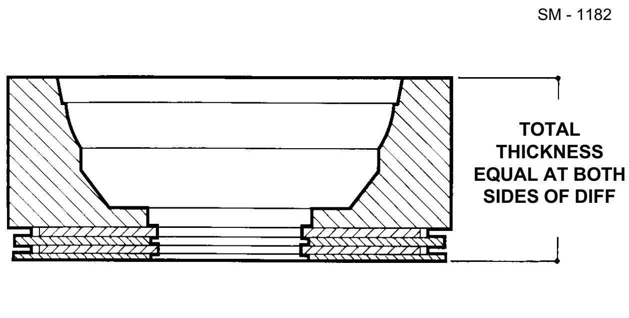


Fig. 9 - Measuring Thickness of Clutch Plates and Diff Cage Half

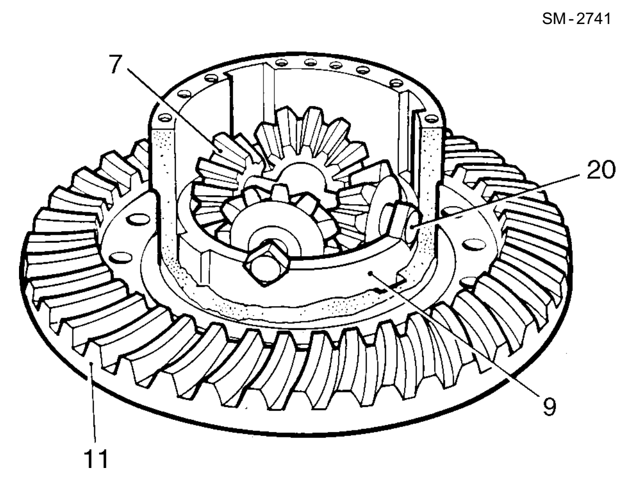


Fig. 10 - Pinion/Diff Wheel Arrangement

into differential housing body (13), making sure that they are free to move vertically in grooves.

6. Similarly, install second pair of clutch plates followed by mating cage half (9).

Note: The clutch plates and diff cage half must be assembled as the original matched set to ensure correct operation of POWR LOK system. If unsure as to which parts complete a set, measure total thickness of clutch plates and diff cage half for both sides of differential unit. Each total thickness figure must be the same (See Fig. 9).

7. Install wheel (8) into cage half (9) engaging splines with both friction plates (10) and end face hard against thrust washer (15).

8. Assemble pinions (7) onto trunnion (20) and lay assembly in place in cage half (9), in mesh with wheel (8) as shown in Fig. 10.

9. Add remaining wheel (8) and cage half (9).

10. Stack alternate friction and steel clutch plates (10 & 44) then check that diff cage half (9) and clutch plates will slide in differential housing body (13) by raising and lowering diff wheel (8).

11. If originally fitted, place shims on end face of differential housing body (13). Install second thrust washer (15) onto wheel (8) then carefully offer end flange (46) to the assembly, lining up matching marks (See Fig. 11).

12. Secure assembly with nuts (47) then tighten nuts to a torque of 61 - 66 Nm (45 - 49 lbf ft).

13. To check assembly of differential unit, insert a driveshaft to engage with each wheel (8). Hold one driveshaft to lock wheel; the other must turn freely.

14. Press a bearing cone (17A) onto each end flange (14 & 46) until hard against shoulder.

Initial Preparation Before Installing Assembled Differential Unit

Note: Secure the crownwheel and gear casing assembly in a suitable diff build stool.

Check fit of adjusting nuts (16) as follows:

1. Clean and deburr gear casing (40) legs and straps (49).

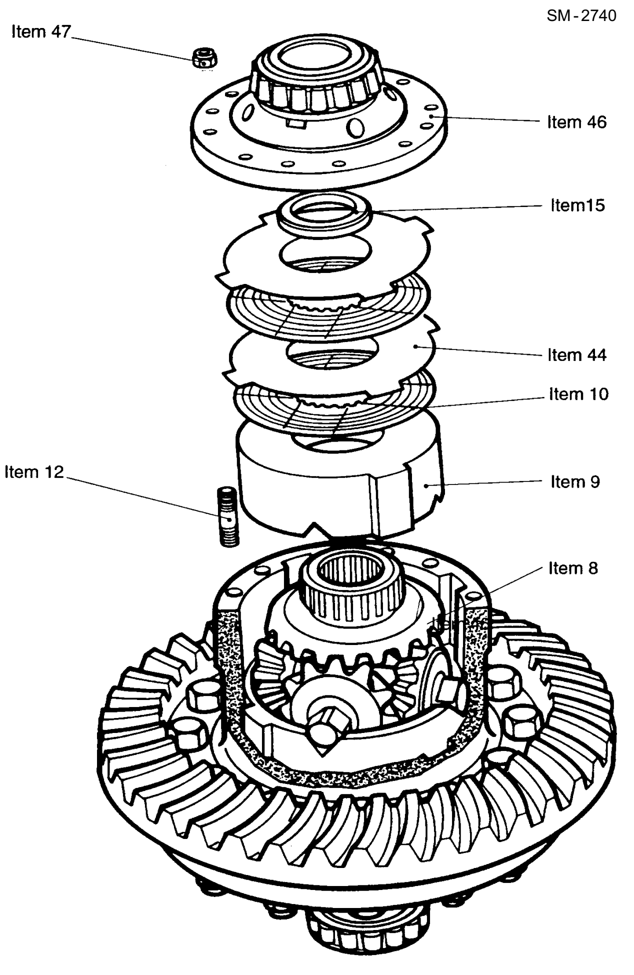


Fig. 11 - Differential Assembly

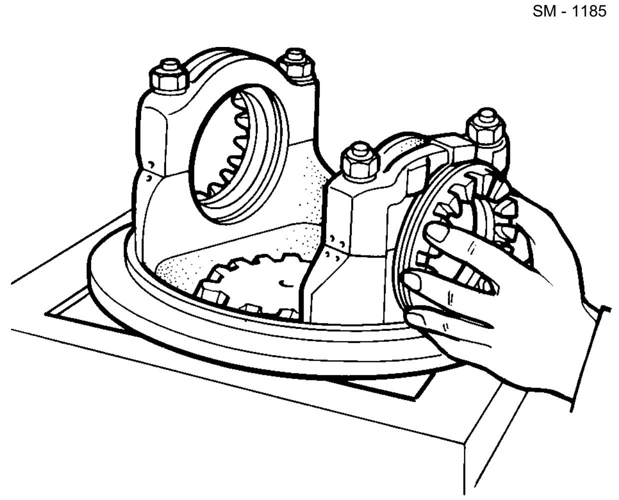


Fig. 12 - Checking Freedom of Diff Bearing Adjusting Nut

2. Install bearing cups (17) into half bores of gear casing (40) legs followed by diff bearing adjusting nuts (16).

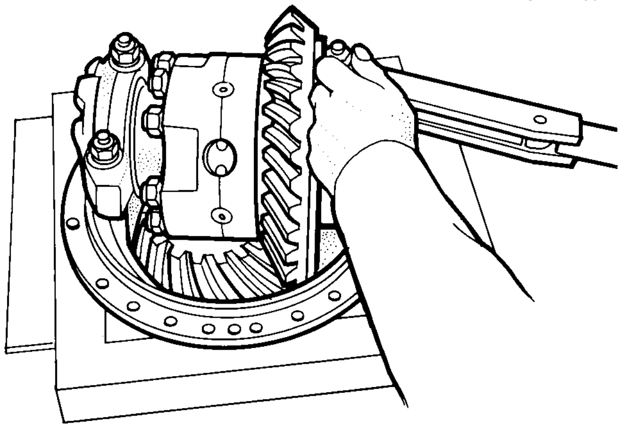


Fig. 13 - Tightening Gear Casing Straps

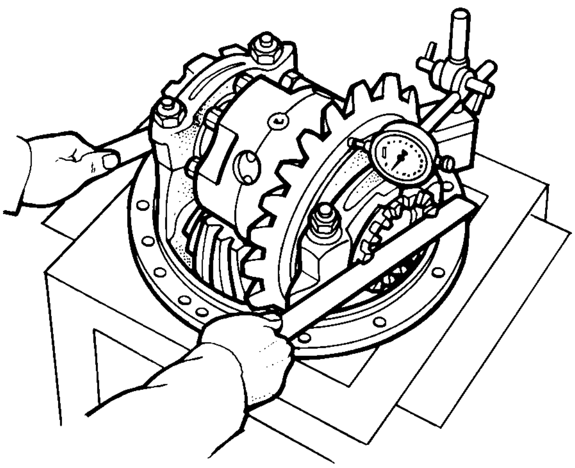


Fig. 14 - Setting Dial Indicator on Crownwheel Backface

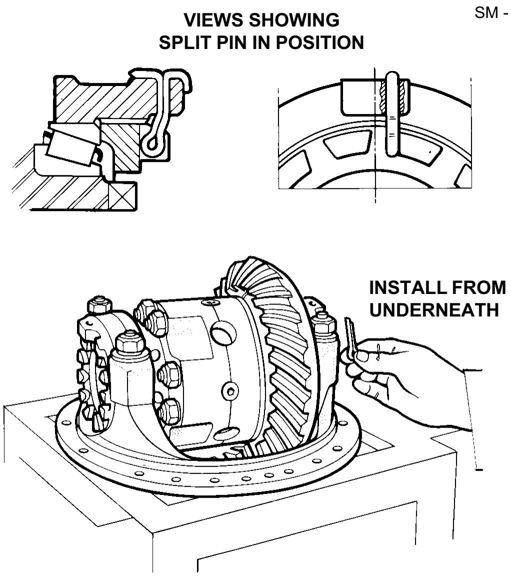


Fig. 15 - Installing Split Pins

4. Carefully install two straps and secure with strap nuts (51) and washers (50). Check the alignment of matching marks on gear casing (40) legs and straps (49) to ensure that straps are not transposed.

5. Bearing cups (17) should seat snugly in bores and adjusting nuts (16) should be free to turn with hand pressure only, if not, it may be because of cross threading. Remove and deburr. On no account use additional pressure i.e. hammer.

6. Tighten strap nuts (51) to a torque of 502 - 542 Nm (370 - 400 lbf ft).

7. Check freedom of diff bearing adjusting nuts (16) by unscrewing and refitting, to assist this operation tap straps (49) lightly on top with a 1 kg (2 lb) hammer (See Fig. 12).

8. Having checked fit of adjusting nuts (16), remove nuts and washers (51 & 50) then lift off straps (49), bearing cups (17) and adjusting nuts (16).

Installing Crownwheel and Differential Assembly into Gear Casing

1. Hold bearing cups (17) in position on bearing cones (17A) and place crownwheel (11) and differential assembly in position in gear casing (40) ensuring correct meshing of crownwheel and pinion teeth.

2. Install two adjusting nuts (16) onto half threads of gear casing (40) legs. Re-check freedom of adjusting nuts on threads.

3. Install two straps (49) followed by nuts (51) and

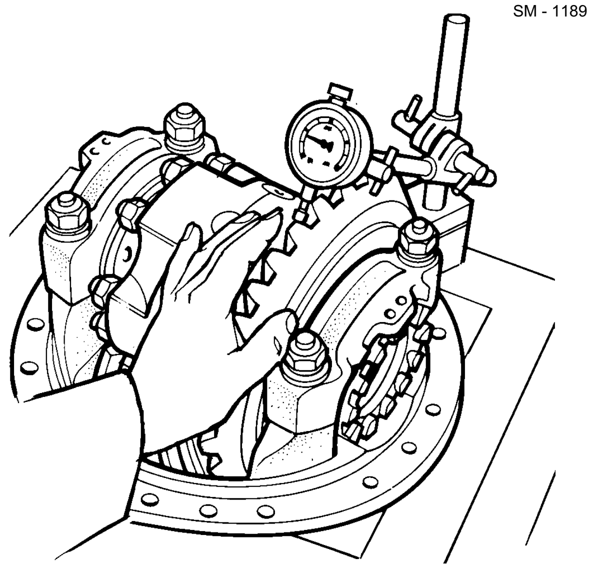


Fig. 16 - Setting Dial Indicator onto Crownwheel Tooth

washers (50).

Note: Ensure matching marks coincide to prevent misalignment of straps (49).

4. Turn adjusting nuts (16) hand tight against bearings (17 & 17A).

5. Tighten nuts (51) to a torque of 502 - 542 Nm (370 - 400 lbf ft) (See Fig. 13).

Setting 'No End Float' Condition

1. Set up dial indicator on back face of crownwheel (11) as shown in Fig. 14 and screw in each adjusting nut (16) just sufficiently to ensure that no crownwheel axial movement is registered on dial indicator.

2. Tap straps (49) and rotate crownwheel, then re-check that no axial movement is present.

Setting Crownwheel and Pinion Backlash

1. Move dial indicator onto crownwheel (11) tooth as shown in Fig. 16. Hold pinion (37) still and rock crownwheel (11) backwards and forwards, to check free play between gears (backlash), and note variation of indicator reading.

2. Repeat the above steps three more times so that four readings are taken at positions equally spaced around crownwheel (11).

Note: The variations of readings on dial indicator must be within limits of 0.203 - 0.330 mm (0.008 - 0.013 in). If difference in backlash of more than half backlash tolerance exists between tooth mesh positions, then assembly should be further examined for cause and rectified.

Checking Crownwheel and Pinion Mesh

1. Apply a thin coating of engineers marking compound to several consecutive crownwheel teeth.

2. Turn crownwheel for few revolutions in both directions to make positive tooth contact impression on crownwheel and pinion teeth.

3. Inspect deposit of marking compound on crownwheel and pinion teeth and compare them with Fig. 17.

In all cases, action, (if any) to be taken is shown below:

Fig. A - Indicates correct mesh. No further action required.

Fig. B - Indicates pinion and crownwheel are too far out of mesh. To remedy, move pinion inwards towards crownwheel. To maintain backlash, move crownwheel away from pinion in direction of arrow B.

Fig. C - Indicates pinion and crownwheel too far into mesh. To remedy, move pinion outwards away from crownwheel. To maintain backlash, move crownwheel towards pinion in direction of arrow B.

If any action is required, adjust pinion position by altering the thickness of shims (39) i.e. add shims to move pinion away from crownwheel and remove shims to move pinion towards crownwheel.

4. When settings are correct, remove pinion bearing housing setscrews with washers (32 & 31) then pull off pinion assembly and lift off shims (39).

5. Thoroughly clean shims (39), also mating face of pinion housing and gear casing (24 & 40) using Loctite Superclean Safety Solvent 706 or other suitable chlorinated solvent.

6. Apply a thin film of Loctite 515 gasket eliminator to one side of each shim (39) then fit, Loctite side first, onto housing (24).

7. Similarly coat gear casing mating face (40) with Loctite 515 gasket eliminator and re-fit pinion assembly to gear casing, tapping into place with a hide faced hammer.

8. Secure in position with washer (31) and setscrews (32). Tighten setscrews progressively using diagonal selection, until tightened to correct torque 244 - 271 Nm (180 - 200 lbf ft).

Final Assembly of Differential

1. When gears are set correctly, fit new split pins (48) as shown in Fig. 15.

2. Fit thrust screw (21) into gear casing (40). Tighten firmly against back face of crownwheel (11). Adjust thrust screw (21) to provide 0.254 - 0.381 mm (0.010 - 0.015 in) clearance by loosening back 1/8th of a turn then fit lockwasher and locknut (23 & 22).

3. Tighten locknut (22) then secure in position by bending lockwasher tabs (23) over locknut flat (22), also into groove in lockscrew shank.

TYPICAL PREFERRED TOOTH CONTACT
(Pinion member left hand in all cases shown)

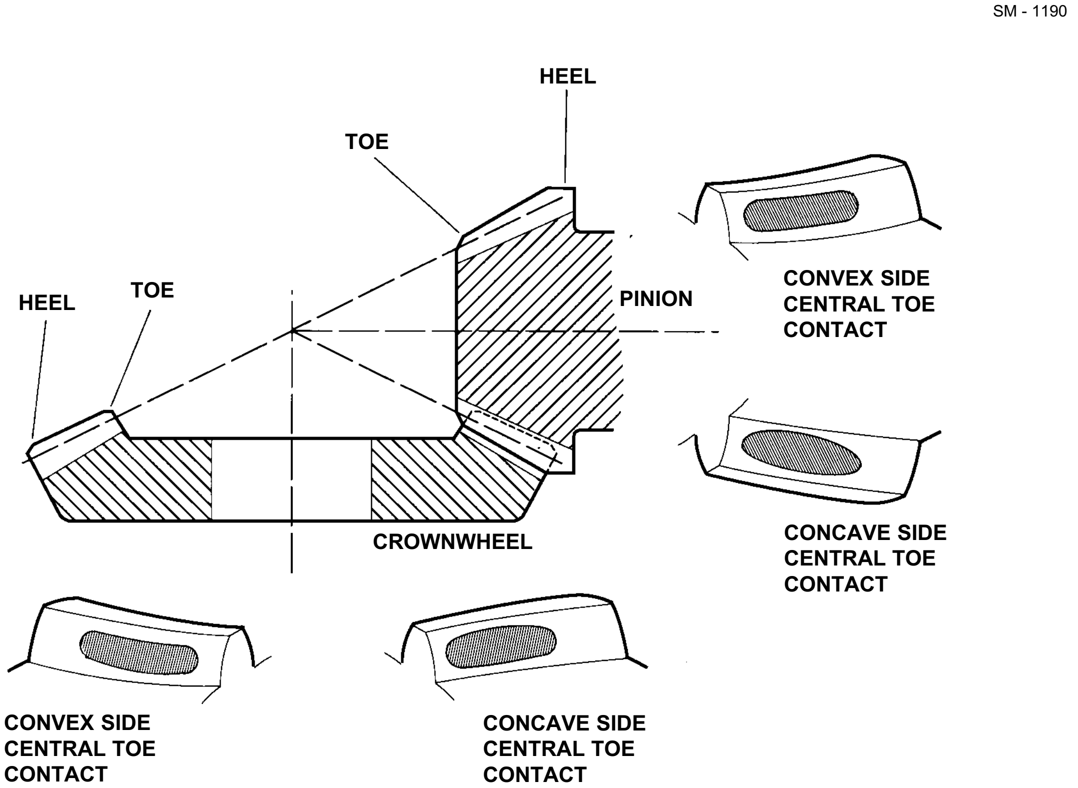


Fig. A - Correct Mesh

SM - 1191

PROFILE ERROR
To correct; move pinion towards crownwheel in direction of arrow A.

To maintain backlash; move crownwheel away from pinion in direction of arrow B.

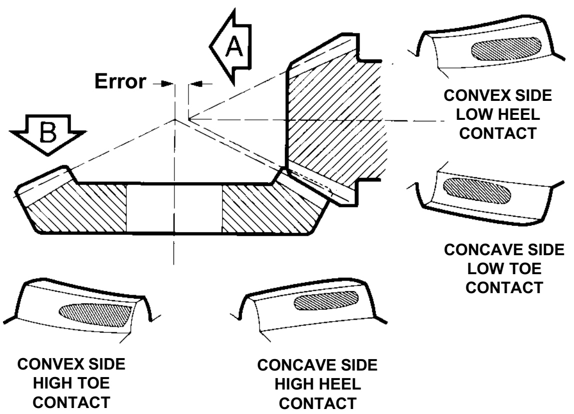


Fig. B - Pinion and Crownwheel too far out of Mesh

SM - 1192

PROFILE ERROR
To correct; move pinion away from crownwheel in direction of arrow A.

To maintain backlash; move crownwheel towards pinion in direction of arrow B.

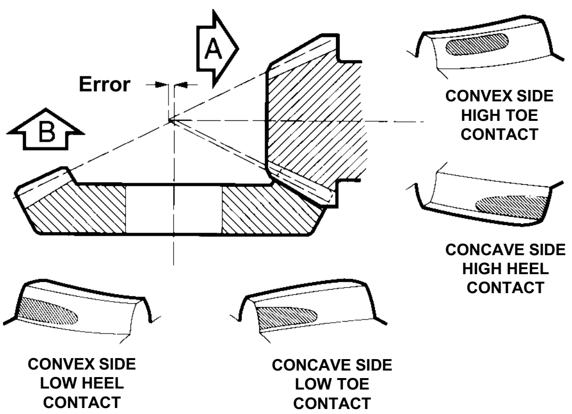


Fig. C - Pinion and Crownwheel too far into Mesh

Fig. 17 - Gleason Gears

INSTALLATION

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.**

Drive Head Unit into Axle Casing

1. Clean mating faces of drive head and axle casing with Loctite 7070 cleaner or similar chlorinated solvent then apply a continuous bead of Loctite Gasket Eliminator 515 to one of mating faces prior to assembly.

2. Using suitable lifting equipment, offer drive head unit to axle casing (6) ensuring that drive head is in correct position, with matching marks lined up.

3. Fit axle casing nuts (41) and washers (42) then tighten nuts to a torque of 230 - 258 Nm (170 - 190 lbf ft).

Final Assembly

1. Carefully feed driveshaft assembly (1, Fig. 2) back into axle casing to locate driveshaft splines in wheel (8).

2. Coat hub mating face of planet carrier (8, Fig. 2) with Loctite 275 then offer planet carrier unit to hub (2, Fig. 2) using suitable lifting gear if required. Ensure planet gear teeth mesh with sun gear.

3. Install bolts (4, Fig. 2) and washers (3, Fig. 2) then tighten to a torque of 142 -149 Nm (105 - 110 lbf ft).

4. Install bolt (6, Fig. 2) and washer (5, Fig. 2) then tighten to a torque of 237 - 244 Nm (175 - 180 lbf ft).

5. Rotate both hubs until bottom of oil filler/level plug holes are approximately 13 mm (0.5 in) above axle centre line (level with diff filler/level hole).

6. Add gear oil of the type specified in Section 300-0020, LUBRICATION SYSTEM, through diff filler/ level hole until the oil is level with bottom of filler/level hole.

7. Check oil level to bottom of filler/level hole in both hubs and top up as necessary. Leave oil to settle for 15 minutes then check oil level again in both hubs and drive head.

8. Install then tighten filler/level plugs in drive head and both hubs.

9. Install rear axle onto vehicle. Refer to Section 180-0040, REAR SUSPENSION.

10. Line-up match marks and reconnect driveline to coupling flange (33). Coat threads of driveline capscrews at transmission with Loctite 270. Tighten capscrews to a torque of 153 Nm (113 lbf ft). Refer to Section 130-0020, REAR DRIVELINES.

11. Install breather tube in adaptor.

12. Clean interfaces between road wheels, hub and wheel nuts.

13. Re-fit road wheels, securing with wheel nuts. Remove stands or timber supports and lower vehicle to ground. Fully tighten wheel nuts to a torque of 400 lbf ft (540 Nm).

14. Remove wheel blocks.

MAINTENANCE

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.**

General

At first service, then every 1 000 hours (6 months), check the following and repair or replace where necessary:

a - Coupling flange for wear/damage.
b - Pinion oil seals for leaks.
c - Breather tube for signs of leakage.
d - Leaks around joints.
e - General condition and tightness of nuts and bolts.
f - General condition of axle casing.

Oil Change Period

Note: For recommended oils, refer to Section

300-0020, LUBRICATION SYSTEM.

With new or rebuilt units, drain (preferable after a short run to warm the oil) and refill after 100 hours of operating, then at intervals of 2 000 hours (12 months).

Oil Level

Check oil levels every 250 hours (monthly), following the procedure below:

1. Drive vehicle onto a level, solid concrete floor, apply the parking brake and switch off the engine.

2. Block appropriate road wheels and turn the battery master switch to the 'Off' position.

3. Unscrew oil filler/level plug and check that oil level is to bottom of plug hole. Add oil if necessary.

Note: As there is no oil sealing between drive head and the hubs, the hub oil levels should be same as the drive head. i.e. 13 mm (0.5 in) above the axle centre line. After filling, allow oil to settle for at least 15 minutes, then re-check oil level at all points. Add oil as necessary until levels remain constant after settling period.

4. Raise axle until both road wheels are just off the ground then support with suitable stands or timbers.

5. Rotate each hub so that bottom of oil filler/level plugs (7, Fig. 2) are approximately 13 mm (0.5 in) above axle centre line (level with diff filler/level plug).

6. Unscrew plugs and check that oil level is to bottom of plug holes. If not, add oil to each hub through plug holes then re-check oil level in drive head.

7. When level is correct, refit and tighten all filler/level plugs to the specified torques, lower vehicle to ground and remove wheel blocks.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of the oil seal bumper tool and general service tools and adhesives required. These tools and adhesives are available from your dealer.

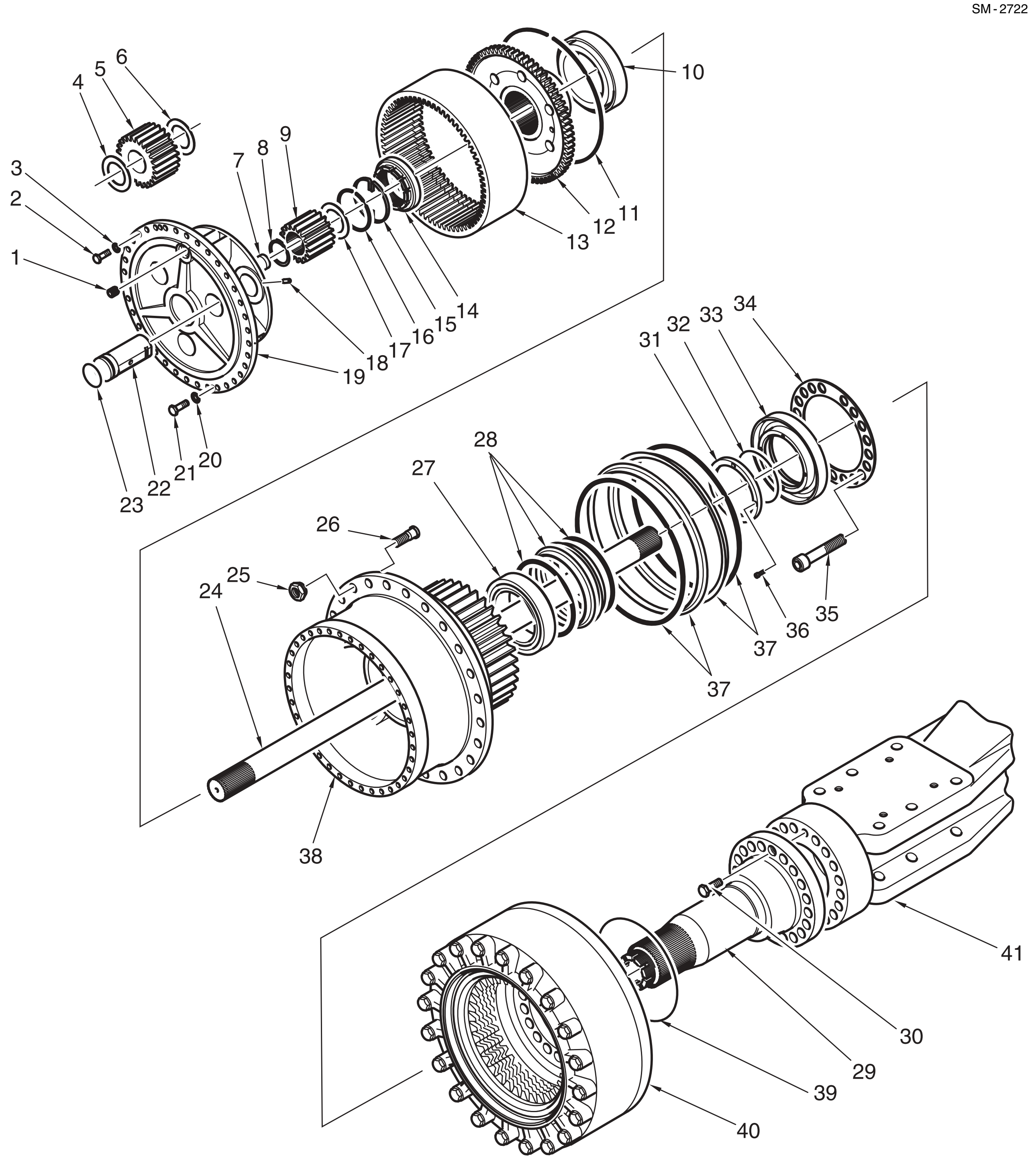
FAULT DIAGNOSIS

Very often, noises and vibrations originating in other parts of the vehicle are mistakenly believed to emanate from the drive head, with the result that time and effort is wasted on an unnecessary dismantling operation. Therefore, before fixing suspicion on the drive head, investigate all other possible sources of trouble first. Where the drive head is definitely suspect however, draining the housing and examining the oil for metal particles, will aid diagnosis and help to pinpoint any malfunction. Refer to 'Diagnosis Chart' below.

DIAGNOSIS CHART		
CONDITION	REASON	REMEDY
Vibration	Broken gear teeth, worn bearings	Replace gear or bearings
Continued noise	Worn gears or bearings	Replace gears or bearings
Overheating	Loss of lubricant	Replace faulty joint or seal and refill
	Crownwheel adjustment too tight	Readjust
	Seized bearings	Replace bearings
Noise on turns	Worn diff side gears and pinions	Replace diff side gears and pinions
	Worn or damaged trunnions	Replace trunnions
	Loss of lubricant	Replace faulty joint or seal and refill
	Loose nuts on differential casings	Tighten nuts to specified torque
Loss of drive	Worn driveshaft splines	Replace driveshaft
	Broken driveshaft	Replace driveshaft

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	1	Bolt	34 - 41	25 - 30
1	18	Crownwheel Nuts	155 - 171	114 - 126
1	32	Setscrew	244 - 271	180 - 200
1	34	Coupling Flange Nut	1085 - 1220	800 - 900
1	41	Axle Casing Nut	230 - 258	170 - 190
1	47	Diff Housing Nut	61 - 66	45 - 49
1	51	Diff Strap Nut	502 - 542	370 - 400

* * * *



1 - Plug
2 - Bolt
3 - Washer
4 - Washer
5 - Planet Gear
6 - Washer
7 - Thrust Button
8 - Circlip
9 - Sun Gear
10 - Bearing Assembly
11 - Retainer
12 - Hub Ring Gear
13 - Planetary Ring Gear
14 - Hub Nut
15 - Lock Ring
16 - Spring Ring
17 - Thrust Washer
18 - Screw
19 - Planet Carrier
20 - Washer
21 - Bolt
22 - Pin
23 - 'O' Ring
24 - Driveshaft
25 - Wheel Nut
26 - Stud
27 - Bearing Assembly
28 - Hub/Stub Face Seal
29 - Axle Stub
30 - Capscrew
31 - Oil Seal Spacer
32 - 'O' Ring
33 - Oil Seal Housing
34 - Ring
35 - Capscrew
36 - Capscrew
37 - Seal
38 - Hub
39 - 'O' Ring
40 - Brake Assembly
41 - Axle Housing

Fig. 1 - Hub Reduction Unit

DESCRIPTION

Numbers in parentheses refer to Fig. 1**.**

The hub gears are driven by a floating sun gear (9) which is splined to driveshaft (24). Sun gear (9) mates with three planet gears (5) mounted in planet carrier (19) which is bolted to hub (38). The ring gear unit (12 & 13) is of the two piece variety and is splined to axle stub (29), it also serves to support outer bearing (10). The brake assembly (40) consists of enclosed oil cooled, friction plates splined to hub rotor and fixed housing. Brake assembly (40) is mounted on the back of hub (38). Hub (38) is fully floating, running on taper roller bearings (10 & 27) which are secured and adjusted by a special hub nut (14) with lock ring (15) and spring ring (16) arrangement. The whole unit is carried on demountable axle stub (29) bolted to axle housing (41).

REMOVAL AND DISASSEMBLY

Numbers in parentheses refer to Figs. 1 - 7**.**

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.**
>
> ⚠ **When necessary to drive out components during disassembly, be sure to use a soft drift to prevent property damage and personal injury from flying chips.**

Draining the Oil

1. Before attempting to remove the road wheels, position the vehicle (preferably after a short run to warm the oil) on a level, solid concrete floor, apply the parking brake and switch off the engine.

> ⚠ **WARNING**
> **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.**

2. Block all road wheels and turn the battery master switch to the 'Off' position.

3. Whilst road wheels are still on the ground, loosen wheel nuts (25) of each wheel.

4. Jack up axle and support with suitably placed stands or timbers.

5. Support tyre and rim assembly with sling and attach lifting device.

6. Remove wheel nuts (25) and, using lifting device, remove tyre and rim assembly from wheel and lift clear of machine.

Note: As there is no oil sealing between the drive head and the hubs, the oil must be drained from all three units before overhaul.

7. Place suitable containers under drive head and hubs (38).

8. Unscrew differential oil filler/level plug and drain bolt to drain oil from the drive head. Refer to Sections 140-0060, 150-0020 or 160-0020, DIFFERENTIAL DRIVE HEAD.

9. Rotate hubs (38) to bring bolts (21) to their lowest point.

10. Unscrew and remove oil filler/level plugs (1).

11. Unscrew and remove bolts (21) and washers (20) to drain oil from hubs (38).

12. When oil is completely drained, remove drip tray, and support hub (38) adequately with solid timber blocks.

13. Replace bolts (21), washers (20) and oil filler/level plugs (1).

14. Replace differential drain bolt and oil filler/level plug.

15. Remove brake cooling and actuation lines from brake assembly (40). Refer to Section 165-0010, BRAKE PARTS. Cap open lines to prevent ingress of dirt.

16. Remove drain plug from brake assembly (40) and allow oil to drain into a suitable container. Refer to Section 165-0010, BRAKE PARTS.

Disassembly of Planet Carrier Unit

1. Unscrew and remove planet carrier bolts (2) and washers (1).

2. Using suitable lifting equipment to aid this operation, carefully remove planet carrier (19) assembly from axle. Place on bench and support in upright position with timber blocks to prevent assembly from rolling.

3. Carefully remove one planet pin (22) from planet carrier (19) by first removing grub screw (18) then press planet pin (22) forward and out from planet carrier (19).

4. Carefully remove one planet gear (5), together with planet pin (22) and gear washers (4 & 6).

5. Repeat steps 3 and 4 for the other two planet gear (5) assemblies.

6. Remove and discard ‘O’ rings (23) from planet pins (22).

7. Remove thrust button (7) from planet carrier (19).

Disassembly of Ring Gear Unit

1. Pull out driveshaft (24) and sun gear (9) assembly from axle stub (29), then place on bench.

2. Remove external circlip (8) from groove in end of driveshaft (24) and pull off sun gear (9) together with thrust washer (17) .

3. Remove spring ring (16) and lock ring (15) followed by hub nut (14).

4. With suitable lifting equipment, remove planet ring gear (13), hub ring gear (12) and retainer (11) as an assembly. Outer bearing (10) will come away with hub ring gear (12).

5. Place assembly on bench with outer bearing (10) uppermost. Carefully prise out ring gear retainer (11) using a thin bladed screwdriver.

6. Lift hub ring gear (12) from planet ring gear (13). Inspect outer bearing (10) cone for wear or damage and pull from hub ring gear (12) if replacement is required.

7. Check planet ring gear (13) and ring gear retainer (11) for damage and replace as necessary.

Disassembly of Hub Unit

1. Lock brake plates into the "ON" position by winding the slack adjusters fully home. Refer to Section 165-0010, BRAKE PARTS.

2. Using suitable lifting/support equipment, carefully withdraw hub (38) from axle stub (29) complete with outer bearing (10) cup, inner bearing (27) cup and oil seals (37). Place hub (38) assembly on clean floor and block both sides with wooden blocks.

3. Remove and discard oil seals (37) from hub (38) bore.

4. Check outer bearing (10) cup and inner bearing (27) cup for wear or damage. If necessary, remove cups from hub (38) using a soft metal drift.

Note: If either bearing cup or cone need replacing, they must be replaced as a set.

5. Release brake plates by winding out the slack adjuster to allow later disassembly.

6. Inspect wheel studs (26) and replace any that are damaged.

7. Insert a bearing puller behind oil seal housing (33) and pull it together with bearing assembly (27) cone, oil seal spacer (31), 'O' ring (32), oil seal housing (33) and capscrews (36) from axle stub (29).

8. Remove 3 off capscrews (36) from oil seal spacer (31) and discard 'O' ring (32).

Removal of Complete Brake Assembly

1. Attach suitable lifting equipment to brake unit and support weight. Loosen and remove capscrews (35) and ring (34) from axle stub (29)/brake assembly (40).

2. With brake assembly (40) supported, remove brake assembly (40) from axle stub (29).

3. Place brake assembly (40) on a clean work surface for disassembly.

4. Remove and discard 'O' ring (39) and oil seals (37) from brake assembly.

Removal of Axle Stub

1. Fully support weight of axle stub (29) with suitable lifting equipment.

2. Loosen and remove axle stub retaining capscrew (30).

3. Carefully remove axle stub (29) and place on a clean

work surface for inspection.

4. Clean any residual sealant from faces of axle stub (29) and axle housing (41).

ASSEMBLY AND INSTALLATION

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

Note: Prior to assembly, lightly lubricate all parts in clean gear oil as specified in Section 300-0020, LUBRICATION SYSTEM, except where other instructions are given. Pack taper bearings with grease (Shell Retinax LX or equivalent).

⚠ **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.

⚠ **When necessary to drive on components during assembly, be sure to use a soft drift to prevent property damage and personal injury from flying chips.**

Hub Unit - Sub Assembly

1. Place hub (38), small diameter face downward on clean floor.

2. Position outer bearing (10) cup into hub (38).

3. With suitable lifting equipment, turn hub (38) completely over so that small diameter face is up.

4. Similarly fit inner bearing (27) cup into hub (38) bore followed by inner bearing (27) cone.

5. Ensure that oil seal mounting diameter in hub (38) is free from dirt and that all edges in seal mating bore are radiused.

6. Assemble two parts of hub/stub face seal (28), i.e. 'O' ring and metal ring, then fit service tool 15500013 in place on seal assembly (28), clamping on metal ring.

7. Fit seal (28) into its bore in hub (38) using even pressure on service tool 15500013, thus ensuring that seal is fitted parallel in bore.

Note: To aid in assembly, moisten bore and 'O' ring with a weak spirit/water mixture.

8. Similarly with hub (38), outer face down on bench, fit seal assembly (37). Ensure that oil seal mounting diameter in hub (38) is free from dirt and that all edges in seal mating bore are radiused.

9. Assemble two parts of oil seal (37), i.e. 'O' ring and metal ring, then fit service tool 15500012 in place on seal (37) assembly, clamping on metal ring.

10. Fit seal (37) into its bore in hub (38) using even pressure on service tool 15500012, thus ensuring that seal is fitted parallel in bore.

Note: To aid in assembly, moisten bore and 'O' ring with a weak spirit/water mixture.

Ring Gear Unit - Sub Assembly

1. Place hub ring gear (12) on bench, large diameter face down. Slide outer bearing (10) cone onto hub ring gear (12), tapping into position with mild steel drift and hammer.

2. Put planet ring gear (13) on bench, retainer (11) upward.

3. Using suitable lifting gear, position hub ring gear (12) over centre of planet ring gear (13). Lower hub ring gear (12) into open top of planet ring gear (13).

4. Insert retainer (11) into groove in planet ring gear (13) to retain hub ring gear (12). Ensure it is seated correctly in groove.

Planet Carrier Unit - Sub Assembly

1. Place planet carrier (19) on bench, large diameter face uppermost, so that planet gear (5) access hole faces forward.

2. Insert washer (6) into planet carrier (19), ensuring lock tab is located in slot cut in planet carrier (19).

3. Smear clean grease into bore of one planet gear (5).

4. Carefully position planet gear (5) on top of previously located washer (6).

5. Fit other washer (4) onto top of planet gear (5) locating lock tab on washer into slot cut in planet carrier (19).

6. Lightly oil 'O' ring (23) and 'O' ring groove in planet pin (22) with clean gear oil then fit 'O' ring into groove.

7. Carefully insert planet pin (22), 'O' ring uppermost,

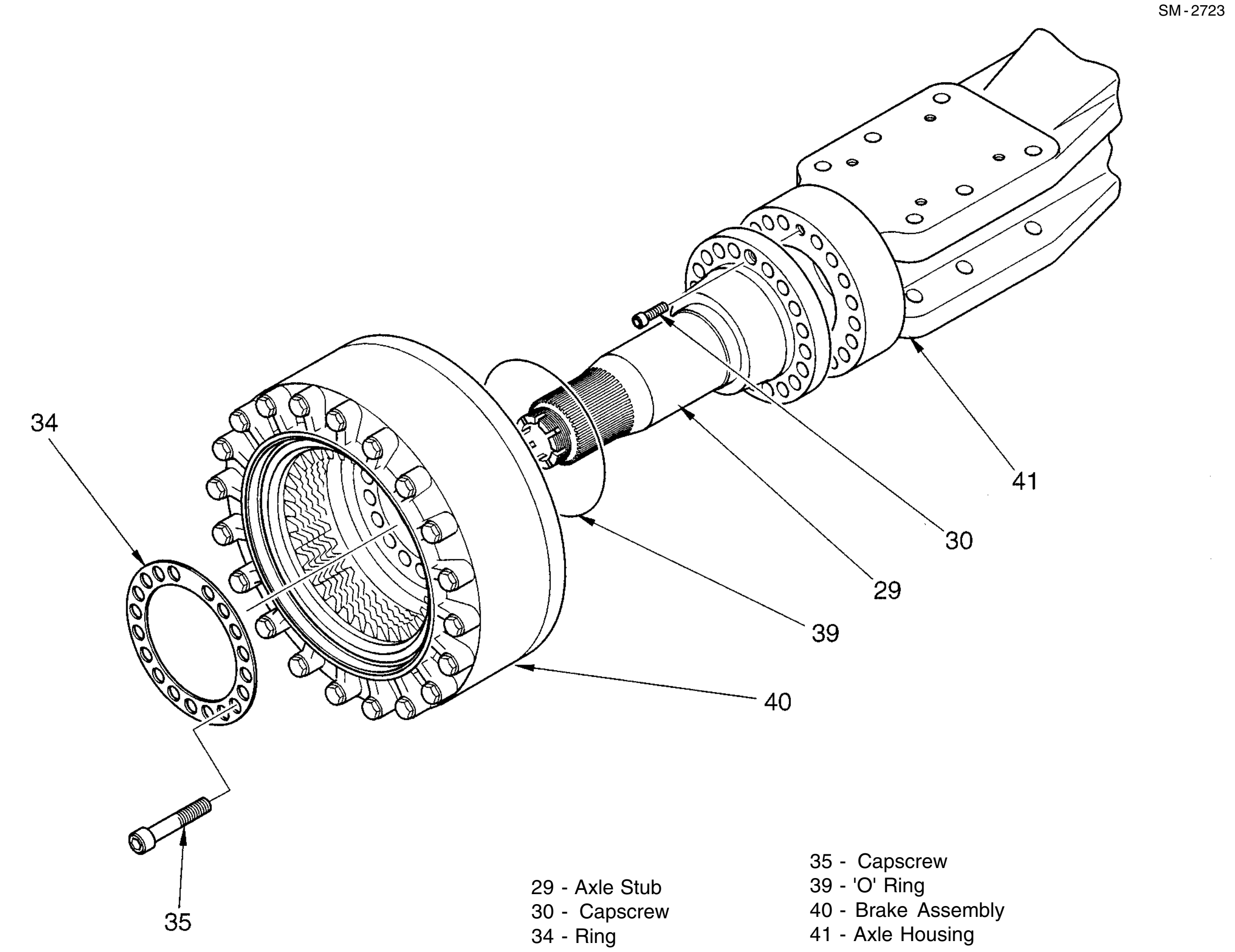


Fig. 2 - Brake Assembly/Axle Stub Installation

into planet carrier (19) and through first washer (4), planet gear (5) and second washer (6) making sure to line up flat on planet pin (22) with hole in planet carrier (19) for grub screw (18).

8. Clean grub screw (18) threads with suitable solvent then apply Loctite 275. Fit grub screw (18) into hole in planet carrier (19) and tighten to a torque of 30 - 36 Nm (22 - 27 lbf ft) to secure planet pin (22) assembly.

9. Repeat steps 2 through 8 for the other two planet gear (5) assemblies.

10. Peen over grub screw (18) in four places to lock in position.

11. Coat thrust button (7) bore in planet carrier (19) with Loctite 275 then fit thrust button (7).

Installation of Axle Stub

1. Clean mating faces of axle stub (29) and axle housing (41).

2. Apply a coating of Loctite 515 to mating faces using a roller.

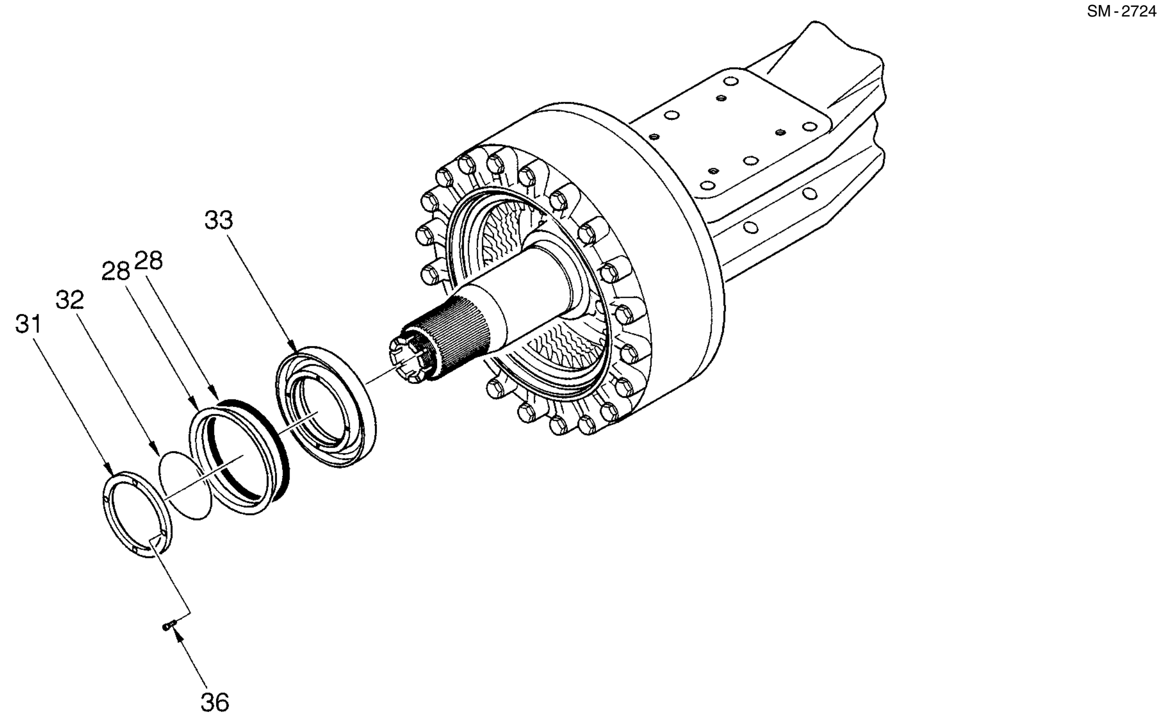
3. Using suitable lifting equipment, offer axle stub (29) up to axle housing (41), ensuring small counterbored hole for retaining capscrew (30) is in line with its tapped hole in axle housing (41).

4. Tap axle stub (29) into position using a hide faced mallet and insert retaining capscrew (30) into axle stub (29)/axle housing (41). Tighten capscrew (30) to 372 - 412 lbf ft (505 - 559 Nm).

Note: The use of two short bolts (similar to item 35) may help in drawing on the axle stub.

Installation of Brake Assembly

1. Clean 'O' ring groove in brake assembly (40) and insert a new 'O' ring (39). Smear new 'O' ring with clean



28 - Hub/Stub Face Seal
31 - Oil Seal Spacer
32 - 'O' Ring
33 - Oil Seal Housing
36 - Capscrew

Fig. 3 - Oil Seal Housing Installation

grease to aid in reassembly.

2. Using suitable lifting equipment, offer brake assembly (40) up to axle stub and housing (29 & 41) and seat on register.

3. Insert a brake retaining capscrew (35) through the brake retaining ring (34) and then offer ring (34) and capscrew (35) up to and through the brake assembly (40) and into the axle stub and housing (29 & 41).

4. Insert remainder of capscrews (35) and tighten all to 750 - 830 lbf ft (1017 - 1135 Nm) using a diagonal pattern.

5. Install remaining oil seal (37) in brake assembly (40). Ensure that oil seal mounting diameter in brake assembly (40) is free from dirt and that all edges in seal mating bore are radiused.

6. Assemble two parts of oil seal (37), i.e. 'O' ring and metal ring, then fit service tool 15500012 in place on seal (37) assembly, clamping on metal ring.

7. Fit seal (37) into its bore in brake assembly (40) using even pressure on service tool 15500012, thus ensuring that seal is fitted parallel in bore.

Note: To aid in assembly, moisten bore and 'O' ring with a weak spirit/water mixture.

Installation of Oil Seal Housing

1. Offer oil seal housing (33) up to axle stub (29) and slide into position until it abuts the back face of the stub (29).

2. Fit new 'O' ring (32) into recess in oil seal housing (33).

3. Slide bearing spacer (31) into position and secure with capscrews (36). Tighten capscrews (36) to 13 - 15 lbf ft (18 - 20 Nm).

4. Fit hub/stub face seal (28) into oil seal housing (33). Ensure that oil seal mounting diameter in housing (33) is free from dirt and that edges in seal mating bore are radiused.

5. Assemble two parts of hub/stub face seal (28), i.e. 'O' ring and metal ring, then fit service tool 15500013 in place on seal assembly (28), clamping on metal ring.

6. Fit seal (28) into its bore in hub (38) using even pressure on service tool 15500013, thus ensuring that seal is fitted parallel in bore.

Note: To aid in assembly, moisten bore and 'O' ring with a weak spirit/water mixture.

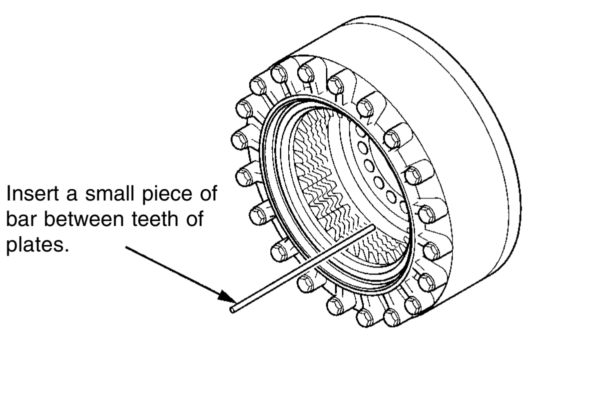


Fig. 4 - Aligning Plates

Installation of Hub Assembly

1. Prior to fitting hub assembly (38) to axle, it is important to align and centralise the brake friction plates. This can be done by first inserting a small piece of bar between the teeth of the plates to bring them into line (see Fig. 4).

Note: Ensure the large 'oil flow' gaps in the friction plates are grouped together.

2. Remove bar, and insert plate centralising tool 15500014 (see Fig. 5).

3. Lock brake plates into the "ON" position by winding the slack adjusters fully home. Refer to Section 165-0010, BRAKE PARTS.

4. Remove plate centralising tool from brake.

5. With brake plates locked in a centralised position, fit hub guide sleeve tool 15500016 onto axle stub (29) (see Fig. 6).

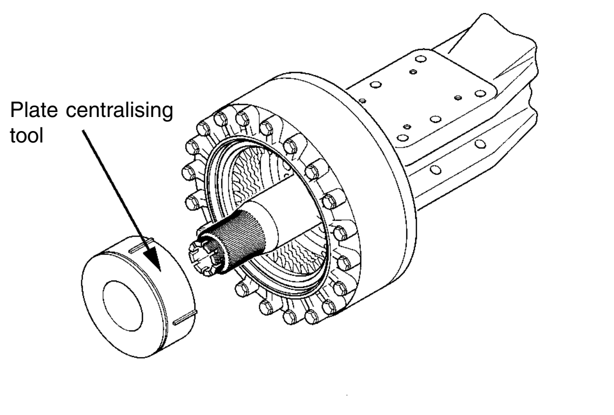


Fig. 5 - Plate Centralising Tool

6. Using suitable lifting equipment, lift hub assembly (38) and slide into position on axle. Take care when inserting hub splines into brake assembly (40) so as not to damage plates.

7. Carefully feed hub (38) onto axle stub (29) as far as it will go by sliding it gently forwards.

Note: Do not bump the hub (38) onto the stub (29) by pulling back and forth along axle stub (29). This can cause the face seals (37) to come out of position.

8. With hub (38) still supported, and a second person holding the hub in position, carefully remove hub guide sleeve tool from axle stub (29).

9. Screw ring gear alignment tool 15500015 onto axle stub threads, and slide ring gear unit (10 - 13) into position on axle stub (29).

10. Remove ring gear alignment tool and fit hub nut (14). Tighten hub nut (14) slowly to 375 lbf ft (508 Nm).

Note: This serves to gently draw the hub fully home into position.

11. Remove hub lifting equipment and rotate hub (38) unit through several revolutions to seat bearings (10 & 27).

12. Re-check hub nut (14) torque. Check alignment of slots in hub nut (14) with slots in axle stub (29).

13. If slots are aligned, fit hub lock ring (15) and spring ring (16). If slots are not aligned, tighten hub nut (14) gradually until the slots do align. DO NOT SLACKEN HUB NUT (14) TO ALIGN SLOTS.

Installation of Driveshaft

1. Once hub assembly has been refitted, fit sun gear (9) and sun gear washer (17) onto driveshaft (24).

2. Retain sun gear (9) and sun gear washer (17) with circlip (8) and slide driveshaft (24) through hole in end of axle stub (29) until driveshaft (24) splines engage with splines in drivehead.

Note: Fitting of sun gear (9) to driveshaft (24) before insertion into axle stub (29) provides a better grip for insertion of splines.

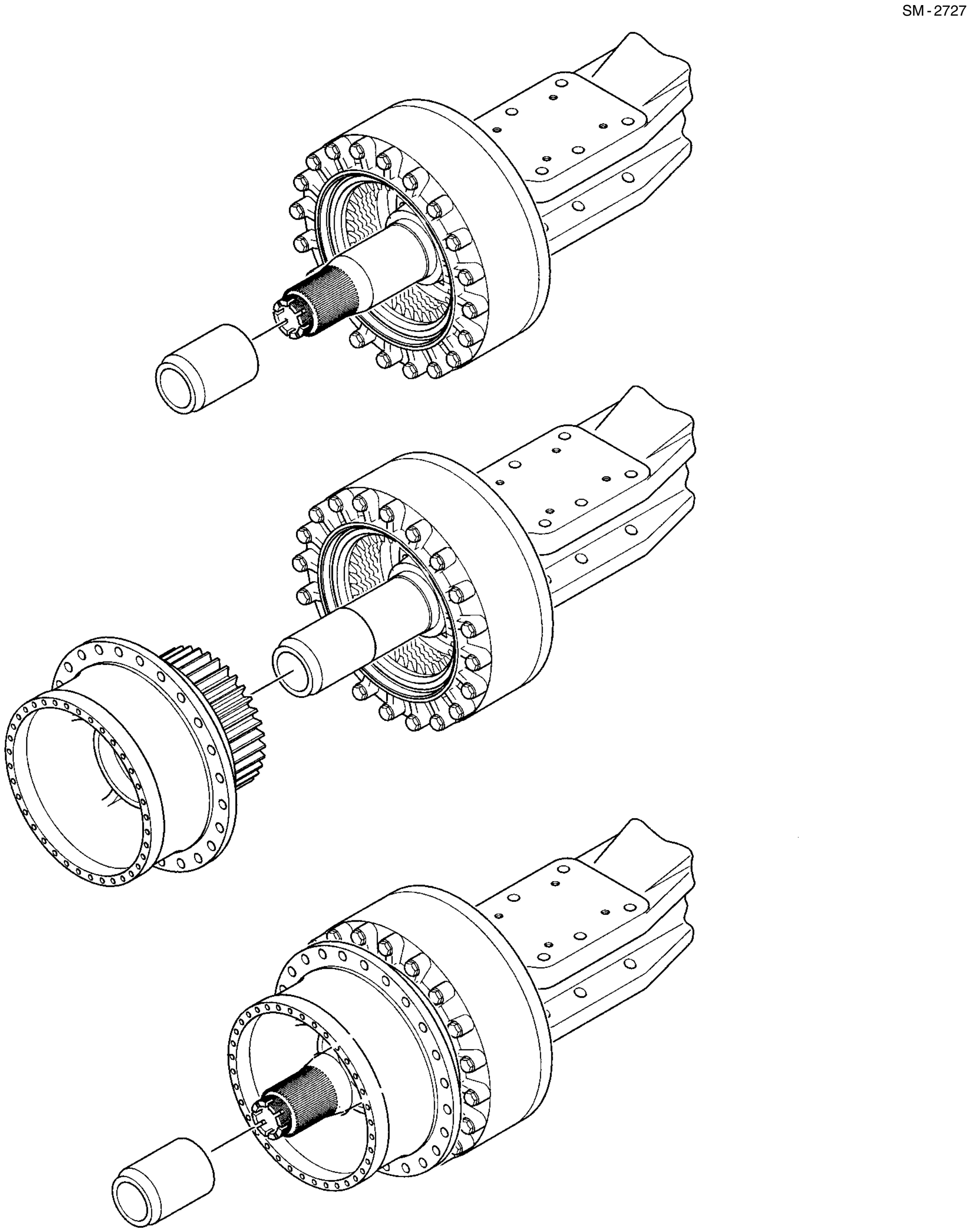


Fig. 6 - Hub Assembly Installation

Installation of Planet Carrier Unit

1. Clean mating faces of hub (38) and planet carrier (19) with a suitable cleaning agent. Coat hub mating face of planet carrier (19) with Loctite 515 and offer planet carrier (19) unit to hub (38), using suitable lifting equipment. Ensure that planet gear (5) teeth mesh with sun gear (9).

2. Fit planet carrier bolts (2) and hardened washers (3) then torque tighten to 109 - 121 lbf ft (149 - 164 Nm).

3. Fit drain bolt (21) and washer (20) and torque tighten to 175 - 180 lbf ft (237 - 244 Nm).

4. Rotate both hubs (38) until bottom of oil filler/level plug holes are approximately 13mm above axle centre line (level with differential filler plug).

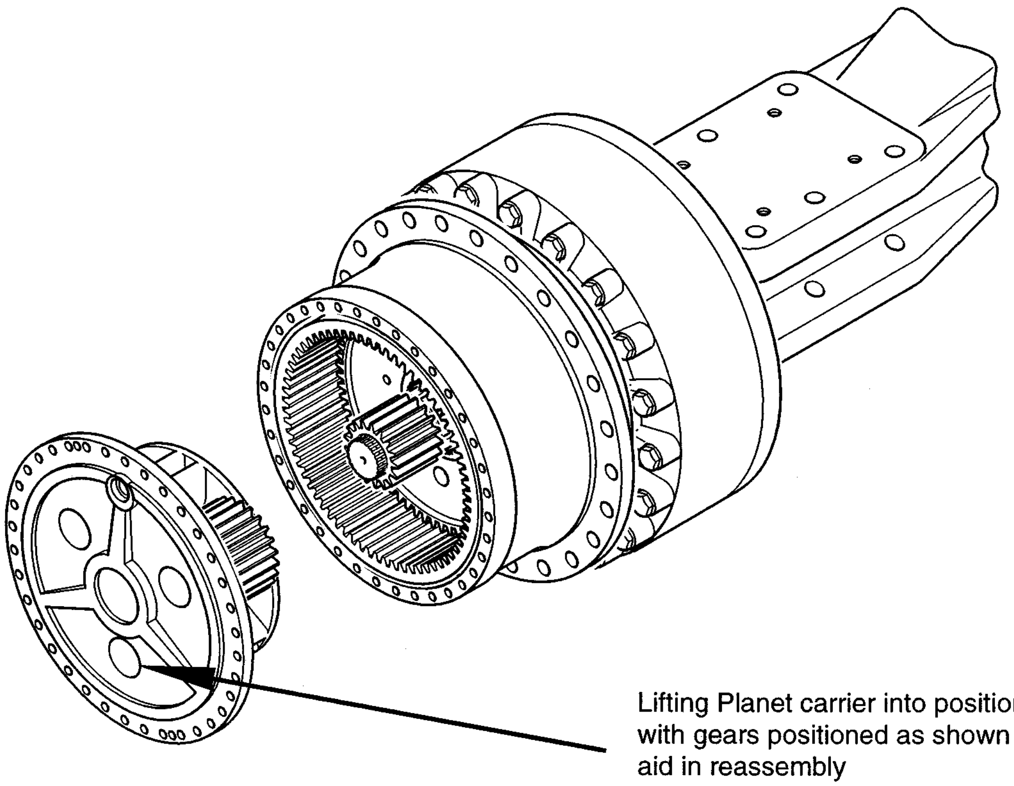


Fig. 7 - Planet Carrier Installation

5. Add gear oil of the type specified in Section 300-0020, LUBRICATION SYSTEM, through the differential oil filler/level hole until level with bottom of hole.

6. Check oil level to bottom of filler/level hole in both hubs (38) and top up as necessary. Leave oil to settle for 15 minutes then check oil level again in both hubs (38) and differential.

7. Re-fit then tighten filler/level plugs (1) in both hubs (38) and differential.

8. Clean interfaces between road wheels, hub (38) and wheel nuts (25).

9. Re-fit road wheels, securing with wheel nuts (25). Remove timber supports and lower vehicle to ground. Fully tighten wheel nuts (25) to a torque of 365 - 400 lbf ft (495 - 542 Nm).

MAINTENANCE

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.

General

At first service then every 1 000 hours (6 months), check the following and repair or replace where necessary:

a - General condition of nuts, bolts and axle housing.
b - Gaskets and oil seals for signs of leakage.

Wheel nuts (25) should be checked and re-tightened if necessary, after first 10 hours of operation. Check torque every 50 hours (weekly) thereafter.

Oil Change Period

Note: For recommended oils, refer to Section

300-0020, LUBRICATION SYSTEM.

With new or rebuilt units, drain (preferably after a short run to warm the oil) and refill after 100 hours of operating, then at intervals of 2 000 hours (12 months).

Note: When refilling centre axle, ensure that 3rd differential unit is primed with 1 litre (1.75 pints) of oil before filling drive head.

Oil Level Check

Check oil levels every 250 hours (monthly), following the procedure below:

1. Drive vehicle onto a level, solid concrete floor, apply the parking brake and switch off the engine.

2. Block appropriate road wheels and turn the battery master switch to the 'Off' position.

3. Unscrew differential oil filler/level plug (refer to Sections 140-0060, 150-0020 or 160-0020, DIFFERENTIAL DRIVE HEAD) and check that oil level is to bottom of plug hole. Add oil if necessary.

Note: As there is no oil sealing between the drive head and hubs (38), the hub oil levels should be the same as the drive head i.e. 13 mm (0.5 in) above the axle centre line. After filling, allow oil to settle for at least 15 minutes, then re-check oil level at all points. Add oil as necessary until levels remain constant after settling period.

4. Raise axle until both road wheels are just off the ground then support with suitable stands or timbers.

5. Rotate each hub (38) so that bottom of oil filler/level plugs (1) are approximately 13 mm (0.5 in) above axle centre line (level with differential oil filler/level plug).

6. Unscrew plugs (1) and check that oil level is to bottom of plug holes. If not, add oil to each hub (38) through plug holes then re-check oil level in differential.

7. When level is correct, refit and tighten all oil filler/level plugs, lower vehicle to ground and remove wheel blocks.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of the face seal insertion tools, plate centralising tool, ring gear alignment tool, hub guide sleeve and general service tools and adhesives required. These tools and adhesives are available from your dealer.

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.**

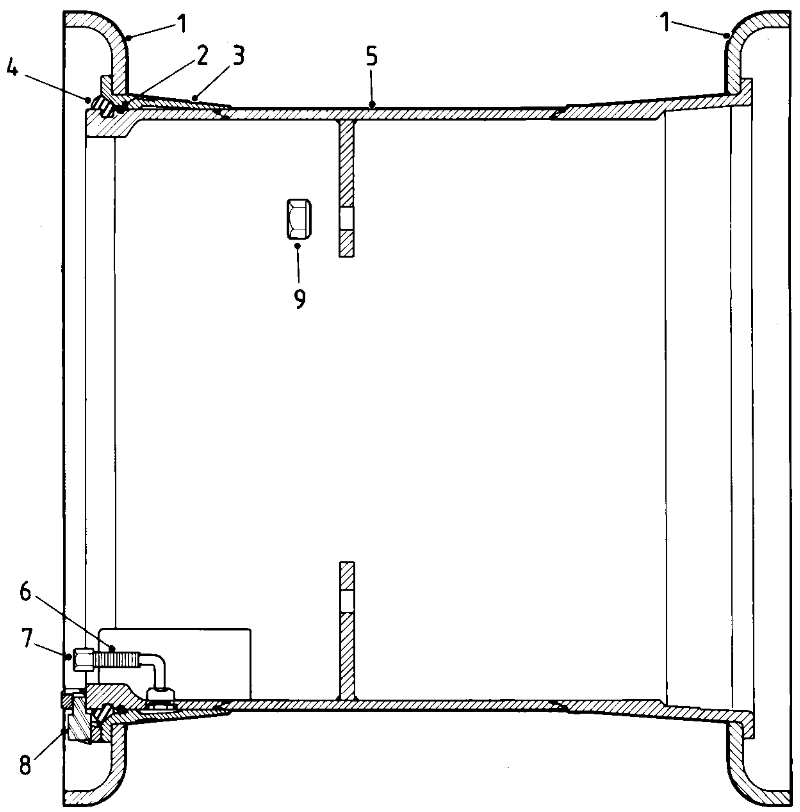
True axle noises may be located by lifting or jacking the machine up until all tyres are clear of the floor or ground. Securely block the machine in this position. Run power train at moderate speed. Be certain all tyres are off the ground to prevent damage to the differential and make sure that there is no brake drag.

AXLE DIAGNOSIS CHART		TABLE643
CONDITION	REASON	REMEDY
Noises	Insufficient or incorrect lubricant	Check level, fill with proper type and grade of lubricant
	Hub bearings scored or rough	Replace bearings
	Gear teeth in planetary chipped	Replace gear
Loss of lubricant	Lubricant level too high	Correct oil level
	Lubricant foams excessively	Drain and fill with correct type and grade of lubricant
	Worn or broken oil seal	Replace oil seal
	Restricted breather vent	Clean vent
	Loose nuts or bolts	Tighten nuts or bolts
Gain of lubricant	Restricted breather vent	Clean vent
	Incorrect lubricant	Drain and fill with correct type and grade of lubricant

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	14	Hub Nut	508	375
1	25	Wheel Nuts	495 - 542	365 - 400
1	35	Brake Mtg Bolts	1017 - 1135	750 - 830
1	30	Axle Stub Mtg Bolt	505 - 559	372 - 412
1	2	Planet Carrier Bolts	149 - 164	109 - 121
1	21	Hub Drain Bolt	237 - 244	175 - 180
1	36	Bearing Spacer Screws	18 - 20	13 - 15
1	18	Planet Pin Grubscrew	30 - 37	22 - 27

* * * *

SM - 1176



1 - Flanges
2 - 'O' Ring
3 - Bead Seat Band
4 - Lock Ring
5 - Wheel Rim
6 - Valve Assembly
7 - Cap
8 - Driver
9 - Wheel Nut

Fig. 1 - Cutaway View of Wheel Rim

DESCRIPTION AND OPERATION

The wheel assembly is 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, dismounting tyre from rim and the use of hand and special tools, are described in this section.

The rim assembly consists of the following components which are illustrated in Fig. 1: wheel 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.

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. Turn the steering wheel in both directions several times to relieve pressure in the steering system.

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 (9) 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 (9) securing wheel rim (5).

8. With lifting device, remove tyre and rim assembly from wheel and lift clear of machine.

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.

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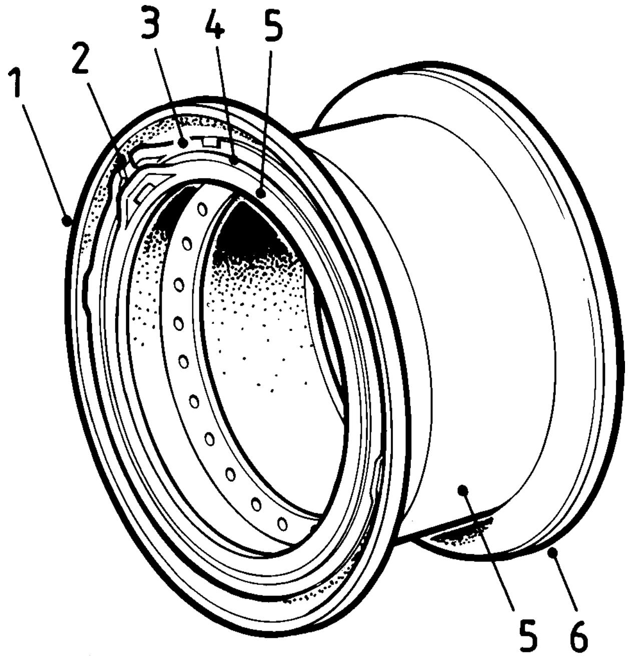


1 - Outer Flange
2 - Driver
3 - Bead Seat Band
4 - Lock Ring
5 - Wheel Rim
6 - Inner Flange

Fig. 2 - Typical Rim Assembly

SM - 205

Fig. 3 - Pry Bar

SM - 206

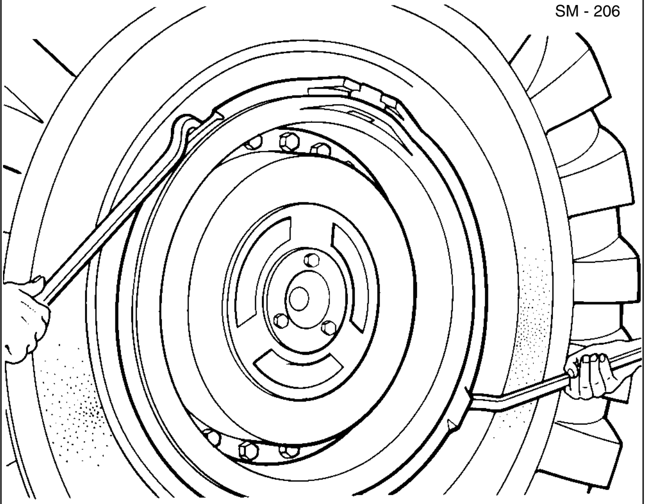


Fig. 4 - Breaking Typical Tyre Bead

> ⚠ **WARNING**
> **When lifting tyre from rim, be sure the equipment is of sufficient capacity and properly secured to do the job safely.**

1. Remove valve cap and valve core and leave valve open to prevent trapping of air in tyre. Tape valve threads for protection.

2. 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 bar toward tyre to break bead.

6. A second bar may be inserted in space between bead seat band (3) and outer flange (1). Twist second bar to maintain space gained by the first bar.

7. Move the first bar around the rim, twisting and following with the second 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 groove of wheel rim (5), between ends of lock ring (4), and prying up with bar. Using two bars, as in Step 7, work completely around wheel rim (5).

9. Pry lock ring (4) out in same manner by starting at prying notch in rim assembly and work all the way around rim with two pry bars.

10. Remove and discard 'O' ring (2, Fig. 1).

11. Remove lock ring (4), 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 tyre and rim assembly are on the machine, the following procedure may be used for breaking the inner bead.

13. Place jack between inner flange (6) and machine frame. Extend jack until tyre bead is broken. Continue around 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 machine, and no tyre lifting equipment is available, 'walk' tyre off 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 tyre is off 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. 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 rim, be sure the equipment is of sufficient capacity and properly secured to do the job safely.**

1. For off-machine installation, lay rim on blocks or mounting stand with 'O' ring groove up. Rim should be off floor enough to allow tyre to rest on rim and not on 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).

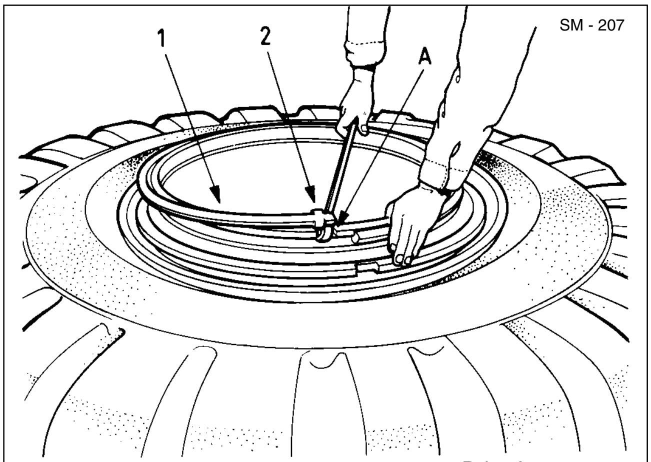
3. Lubricate tyre beads and 'O' ring, with a thin solution of vegetable base soap and water.

4. Using suitable lifting equipment, lower tyre onto rim. Seat tyre firmly against inner flange (6).

5. Install outer flange (1) on 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. 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 lug. Use bar for installing lock ring, as illustrated in Fig. 5.



1 - Lock Ring 2 - Drive Lug

Fig. 5 - Installing Typical Lock Ring

8. 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 adjacent to 'O' ring, 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.

9. Install driver (2). Make sure all rim components are correctly assembled.

10. 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.

11. Refer to 'Tyre Inflation' in this section for the proper procedure for inflating the tyre.

MOUNTING TYRE AND RIM ASSEMBLY ON MACHINE

Numbers in parentheses refer to Fig. 1.

> **⚠ WARNING**
> **When jacking, lifting, or blocking the machine, be sure the equipment is of sufficient capacity to do the job safely.**

1. Support tyre and rim assembly with a chain, or rope sling. Attach sling to overhead lifting device. Slide assembly on to wheel of machine, with lock ring (4) and bead seat band (3) facing outward.

2. Install wheel nuts (9) on wheel studs. Gradually tighten nuts opposite each other until all nuts are snug. Torque tighten wheel nuts (9) to 540 Nm (400 lbf ft). Torque tighten wheel nuts (9) again, after 10 hours of machine 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.

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.

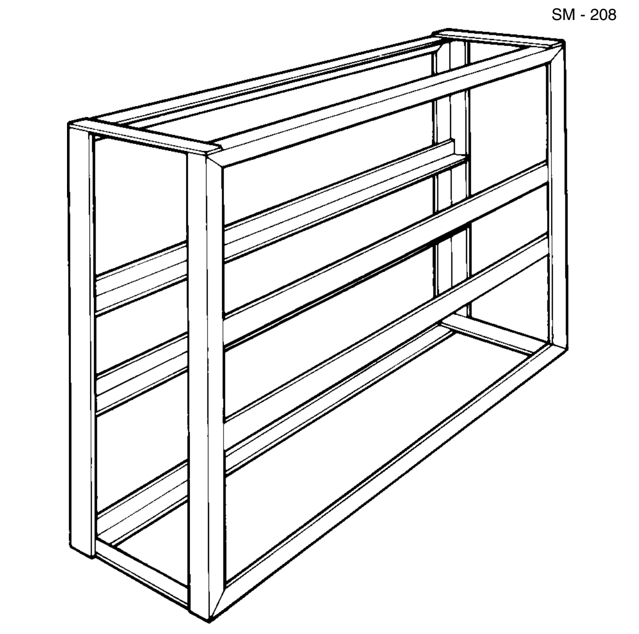


Fig. 6 - Typical Safety Cage

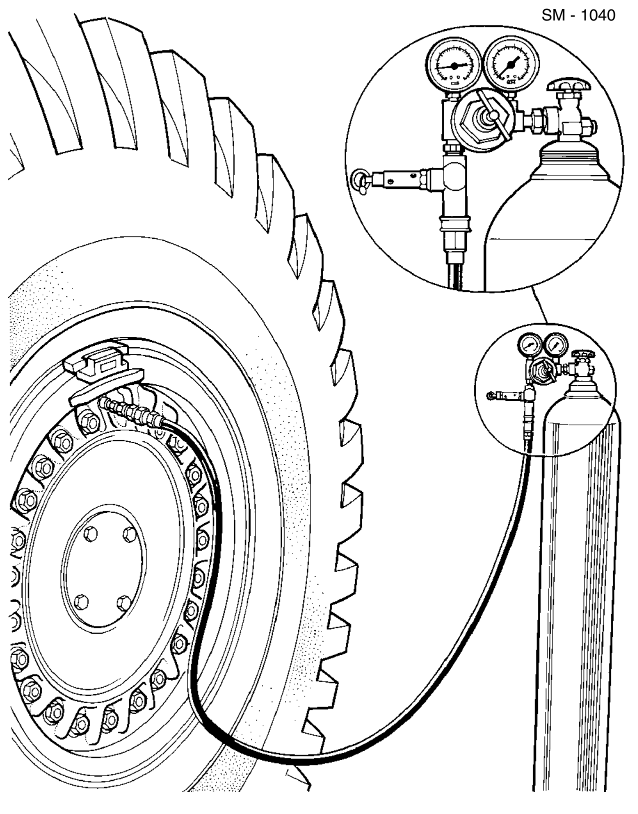


Fig. 7 - Nitrogen Tyre Inflation Kit

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/in^2), 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.

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/in^2) 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/in^2) 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/in^2), 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/in^2), 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

⚠ **WARNINGS**
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. 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.**

⚠ WARNINGS
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.

⚠ 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.

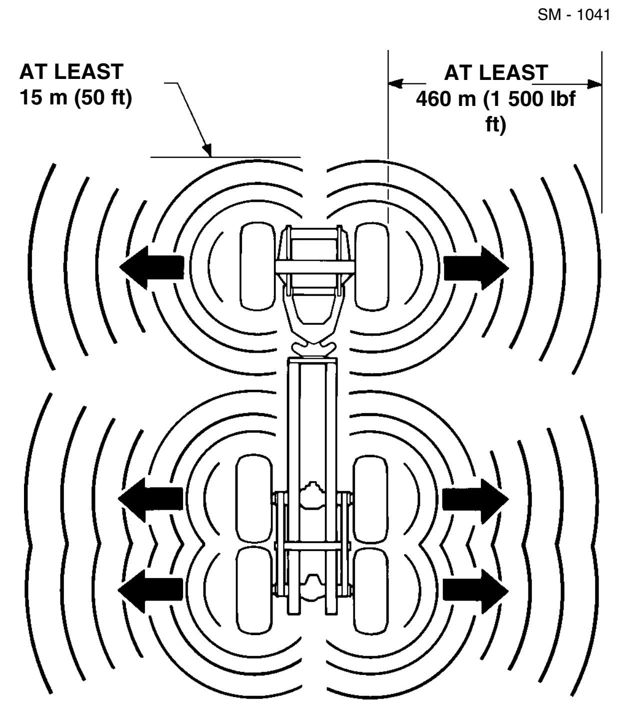


Fig. 8 - APPROACH AREA.
Do Not Approach Tyre in Shaded Area

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.

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 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 sheets, 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 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 540 Nm (400 lbf ft).

Check tyres regularly and replace or repair if required.

SERVICE TOOLS

Refer to Section 300-0070, SERVICE TOOLS for part numbers of the nitrogen tyre inflation kit shown in Fig. 7 and general service tools required.

TYRE INFLATION PRESSURES (BRIDGESTONE)

		FRONT		CENTRE AND REAR	
MODEL	TYRE SIZE	bar	lbf/in^2	bar	lbf/in^2
TA40	29.5 R 25**	3.5	51	4.25	62

TYRE INFLATION PRESSURES (MICHELIN)

		FRONT		CENTRE AND REAR	
MODEL	TYRE SIZE	bar	lbf/in^2	bar	lbf/in^2
TA40	29.5 R 25**	3.0	44	3.65	53

TYRE INFLATION PRESSURES (CONTINENTAL)

		FRONT		CENTRE AND REAR	
MODEL	TYRE SIZE	bar	lbf/in^2	bar	lbf/in^2
TA40	29.5 R 25**	3.0	51	4.25	62

SPECIAL TORQUE SPECIFICATIONS TABLE636

			TORQUE	
FIG. NO.	ITEM N0.	ITEM NAME	Nm	lbf ft
1	9	Wheel Nut	540	400

TUBELESS TYRE LEAK DIAGNOSIS	TABLE499
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.

* * * *

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1.

The service brakes are of the enclosed, forced oil-cooled multiple disc type. The service brakes are actuated by hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. **DO NOT use BRAKE FLUID (J 1703).** Multiple discs within the brake assemblies are cooled by brake cooling oil as specified in Section 300-0020, LUBRICATION SYSTEM.

The brake assembly is bolted to the stub axle and houses a sandwich of friction discs splined to a hub rotor. There are six friction discs (26) in each of the front axle brake assemblies, four in the centre and rear axle brake assemblies.

When the treadle valve is actuated, hydraulic oil enters the brake assembly and forces the piston (21) against the rotating friction discs (26) which react with stationary stator plates (27). The stator plates (27) are retained by scalloped tangs at the outside diameter, which in turn transfers the reaction torque to the rigid outside housing (31), slowing or stopping wheel rotation.

In an emergency situation, application of the park/emergency valve will actuate the service brakes and the parking brake to bring the machine to a halt. In this condition, a restriction in the 'Px' line from the brake manifold valve will slow oil flow from the parking brake allowing the service brakes to actuate momentarily ahead of the parking brake.

When the treadle valve or park/emergency brake is released, hydraulic pressure against piston (21) is relieved and retractor springs (28) forces the piston (21) to return to its original position, thus, relieving the pressure against the brake disc pack.

INSPECTION

Disc Assembly Wear Measurement Procedure

Note: This measurement should be made prior to removal and disassembly of the brake assembly to determine the amount of wear on the brake discs.

Numbers in parentheses refer to Fig. 1.

1. Position the vehicle in a level work area, block all raod wheels and apply the parking brake. With the engine running this will apply the service brakes.

2. Carefully remove wear indicator cap (7) from brake housing (31).

3. Press in wear indicator pin (9) until it contacts the discs.

4. The friction discs (26) should be replaced when the end of the indicator pin (9) is flush with the counterbore in the brake housing (31).

5. Repeat steps 2 to 4 for the remaining five brake assemblies.

REMOVAL

Numbers in parentheses refer to Fig. 24, unless otherwise stated.

⚠ **WARNINGS**
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.

⚠ **Hydraulic fluid will remain within the braking system after engine shutdown. Operate the treadle valve continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.**

⚠ **Use extreme caution to prevent personal injury when removing wheels. The exact procedure must be followed as described in Section 160-0050, WHEEL, RIM AND TYRE.**

Note: Before removing and disassembling brake assemblies, check the wear of the friction discs. Refer to 'Disc Assembly Wear Measurement Procedure', under 'Inspection' in this section, for the maximum allowable wear limits.

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

2. Turn the steering wheel in both directions several times to relieve any pressure in the steering circuit. Operate the treadle valve continuously to relieve any pressure in the braking system. Block all road wheels.

3. Remove drain plug and drain cooling oil from brake packs into a clean container. Reinstall plug.

4. Drain oil from hubs and differentials. Refer to

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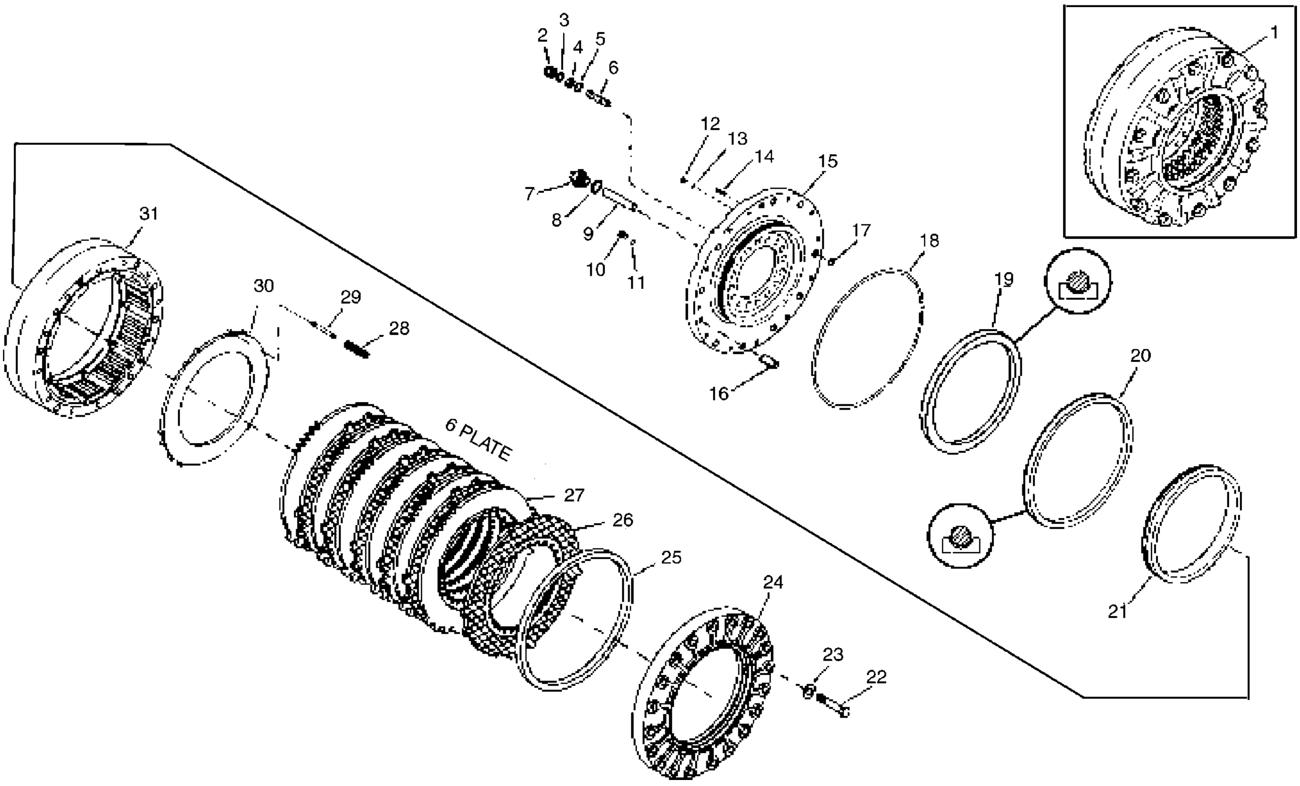


1 - Brake Assy (6 Plate)
2 - Slack Adjuster Nut
3 - Slack Adjuster Seal
4 - Slack Adjuster Jam Nut
5 - Slack Adjuster Seal
6 - Slack Adjuster Screw
7 - Wear Indicator Cap
8 - 'O' Ring
9 - Wear Indicator Pin
10 - Drain Plug
11 - 'O' Ring
12 - Plug
13 - 'O' Ring
14 - Bleeder Screw
15 - Brake Inner Cover
16 - Dowel Pin
17 - 'O' Ring
18 - 'O' Ring
19 - Piston Inner Seal
20 - Piston Outer Seal
21 - Brake Piston
22 - Capscrew
23 - Washer
24 - Brake Outer Cover
25 - 'O' Ring
26 - Friction Disc
27 - Reaction Disc
28 - Retractor Spring
29 - Guide Pin
30 - Piston Pressure Plate
31 - Brake Housing

Fig. 1 - Brake Pack Explosion

Section 160-0030, AXLE GROUP (HUB) and Section 160-0020, DIFFERENTIAL DRIVE HEAD.

5. Refer to Section 160-0030, AXLE GROUP (HUB) for disassembly instructions.

6. Attach suitable lifting equipment to brake assembly (40) and support weight. Loosen and remove capscrews (35) and ring (34) securing brake assembly (40) to axle stub (29).

7. With brake assembly (40) supported, remove brake assembly (40) from axle stub (29).

8. Place brake assembly (40) on a clean work surface for disassembly.

9. Remove and discard 'O' ring (39) and oil seals (37) from brake assembly.

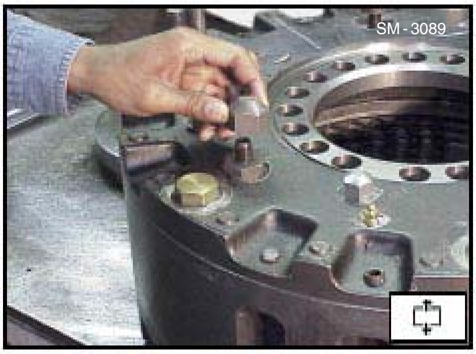


Fig. 2 - Removing Caps

Fig. 3 - Removing Adjusters

Fig. 4 - Removing Jam Nuts

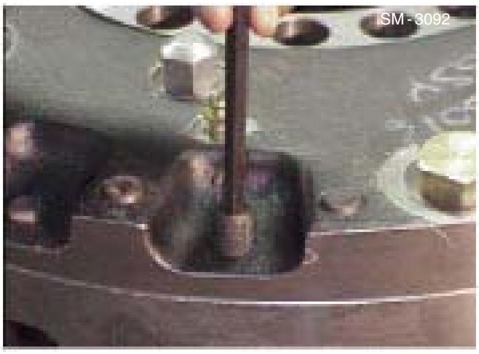


Fig. 5 - Removing Plugs

DISASSEMBLY

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

> ⚠ **WARNINGS**
> **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.**

1. Remove caps (7) from adjusting screws (6) as shown in Fig. 2.

2. Loosen the jam nuts (4) and remove the adjuster screws (6).

3. Remove the jam nuts (4) from the adjuster screws (6), and remove the seals from the jam nuts (4) and nuts (2).

4. Remove the puller screw plugs (12) and bleeder screw (14).

5. Remove the wear indicator cap (7) only at this stage. Remove the plugs and fittings for the cooling lines and the actuation lines from the brake inner cover (15). Note locations of plugs and fittings to aid in Assembly.

Fig. 6 - Removing Fittings

6. Remove the capscrews (22) and washers (23) from brake outer cover (24).

Fig. 7 - Removing Capscrews

7. Remove the brake cover (24), the retractor springs (28) and 'O' ring (25). Remove the friction discs (26), reaction discs (27) and piston pressure plate (30) from the housing (31) as shown in Fig. 8.
Remove the spring guide pins (29) from the piston pressure plate (30).

Fig. 8 - Removing Discs

8. Remove brake piston (21) from housing (31). It may be necessary to use puller holes as shown in Fig. 9.

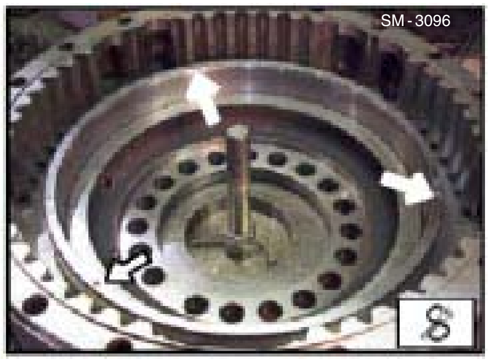


Fig. 9 - Puller Hole Locations

Fig. 10 - Removing Outer Seal

9. Before separating the brake housing (31) and the brake inner cover (15), ensure that the serial numbers are stamped on both components. If no numbers are found, match mark components to aid in reassembly. Using suitable lifting equipment, lift the brake housing (31) clear of cover (15).

10. Remove piston outer seal (20) from brake housing (31) as shown in Fig. 10.

Fig. 11 - Removing Inner Seal

11. Carefully remove piston inner seal (19) from brake inner cover (15) as shown in Fig. 11. Remove 'O' rings (17 & 18) from brake inner cover (15), along with wear indicator pin (9) and 'O' ring (8).

Fig. 12 - Installing Wear Indicator Pin

ASSEMBLY

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

> ⚠ **WARNINGS**
> **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.**

1. Install 'O' ring (8) on wear indicator pin (9) and lubricate. Insert pin (9) in brake inner cover (15) as shown in Fig. 12.

2. Gently tap pin (9) into cover (15) until it is at the correct depth as shown in Fig. 13.

Fig. 13 - Pin at Proper Depth

3. Install the brake cover 'O' ring (18) and the three 'O' rings (17) on the brake cover (arrowed on Fig. 14). Install the piston inner seal (19) 'O' ring.

Fig. 14 - Installing 'O' Rings

4. Install the piston inner seal (19) over the inner seal 'O' ring. Use a screwdriver with no nicks or burrs to help install the seal (19), being careful not to overstretch the seal. Lubricate the seal with recommended lubricant.

5. If installing a new brake housing (31) or if dowel pins (16) have been removed, install three new dowel pins (16) in brake housing (31).

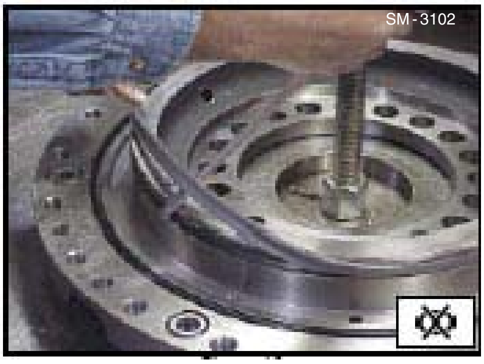


Fig. 15 - Installing Inner Seal

6. Install the piston outer 'O' ring and seal (20) in brake housing (31) as shown in Fig. 16.

7. Using suitable lifting equipment, place the brake housing (31) on brake inner cover (15), lining up serial numbers or match marks.

Fig. 16 - Installing Outer Seal

8. As shown in Fig. 17 insert three capscrews (22), fitted with non-marking spacers, in brake housing and tighten until housing (31) is seated against brake inner cover (15).

9. Lubricate piston seals (19 & 20) and carefully install piston (21) in brake housing (31) with holes in piston (21) facing up. Press the piston (21) home using three G-clamps and wooden blocks.

Fig. 17 - Installing Three Capscrews

Fig. 18 - Installing Reaction Disc

10. Coat threads of guide pins (29) with Loctite 262 and install in piston pressure plate (30).

11. Place piston pressure plate (30) in brake housing (31), with pins (29) facing upwards.

12. Install reaction disc (27) over pressure plate (30) in brake housing (31) as shown in Fig. 18.

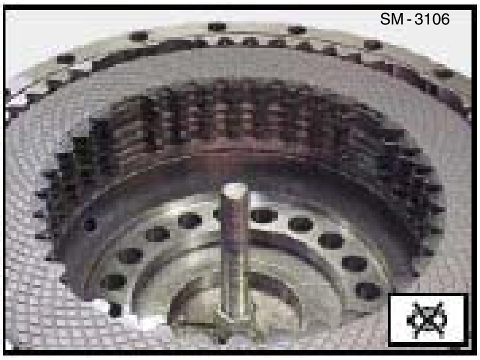


Fig. 19 - Discs Installed

13. Next install friction disc (26) on top of reaction disc (27). Thereafter, alternately install reaction disc (27) and friction disc (26) until the proper number of friction discs have been installed (six in front axle brake assemblies, four in centre and rear axle brake assemblies). **Note:** It is important to keep teeth aligned.

14. Install 'O' ring (25) in housing (31) and retractor springs (28) over guide pins (29).

Fig. 20 - Tightening Capscrews

Fig. 21 - Installing Slack Adjusters

15. Place brake outer cover (24) on housing (31) and secure with capscrews (22) and washers (23). Coat threads of capscrews with Loctite 262.

16. In a crossing pattern run down capscrews (22) and torque to 300 - 350 lbf ft (410 - 450 Nm) as shown in Fig. 20.

17. Using suitable lifting equipment, flip over brake assembly and install plugs and fittings as noted during Disassembly.

18. Install wear indicator cap (7) and tighten to 20 - 25 lbf ft (27 - 34 Nm).

19. Install bleeder screw (14) and tighten to 10 - 12 lbf ft (14 - 16 Nm).

20. Install puller screw plugs (12) and tighten to 20 - 25 lbf ft (27 - 34 Nm).

21. Install new seals (3 & 5) in nuts (2 & 4) and lubricate seals. Assemble lubricated slack adjuster screws (6) and jam nuts (4).

22. Install assembled slack adjusters in brake assembly as shown in Fig. 21.

23. Install pressure gauge assembly to brake actuation port as shown in Fig. 22.

WARNINGS
To prevent personal injury and property damage, be sure threads are sealed properly and all gauge assembly components can safely handle at least 2000 lbf/in^2 (138 bar).

24. Apply 100 lbf/in^2 (7 bar) air pressure to gauge. Back off jam nuts (4) and tighten adjuster screws (6) until they contact piston (21).

25. Tighten adjuster screws (6) to 10 lbf ft (13.5 Nm), then back off screws 1.75 turns.

26. Tighten jam nuts (4) to 50 - 75 lbf ft (68 - 102 Nm) as shown in Fig. 23.

27. Install slack adjuster nuts (2) and tighten to 50 - 75 lbf ft (68 - 102 Nm). Carefully release air pressure.

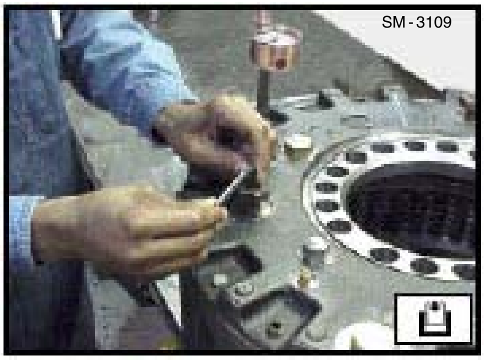


Fig. 22 - Tightening Slack Adjusters

Fig. 23 - Tightening Jam Nuts

HYDRAULIC PRESSURE TEST

WARNINGS
To prevent personal injury and property damage, be sure threads are sealed properly and all gauge assembly components can safely handle at least 2000 lbf/in^2 (138 bar).

1. Remove brake pack from truck and place on a workbench.

2. Using a suitable hydraulic test circuit and pressure gauge assembly, apply 2000 lbf/in^2 (138 bar) of hydraulic pressure to the brake actuation port.

3. Shut off pressure at gauge.

4. After stabilizing for 30 seconds, pressure should remain constant for a minimum of 30 seconds.

5. Repeat this test twice. Carefully release hydraulic pressure.

6. If brake will not maintain pressure, disassemble to determine cause.

INSTALLATION

Numbers in parentheses refer to Fig. 24, unless otherwise stated.

1. Clean 'O' ring groove in brake assembly (40) and insert a new 'O' ring (39). Smear new 'O' ring with clean grease to aid in reassembly.

2. Using suitable lifting equipment, offer brake assembly (40) up to axle stub and housing (29 & 41) and seat on register.

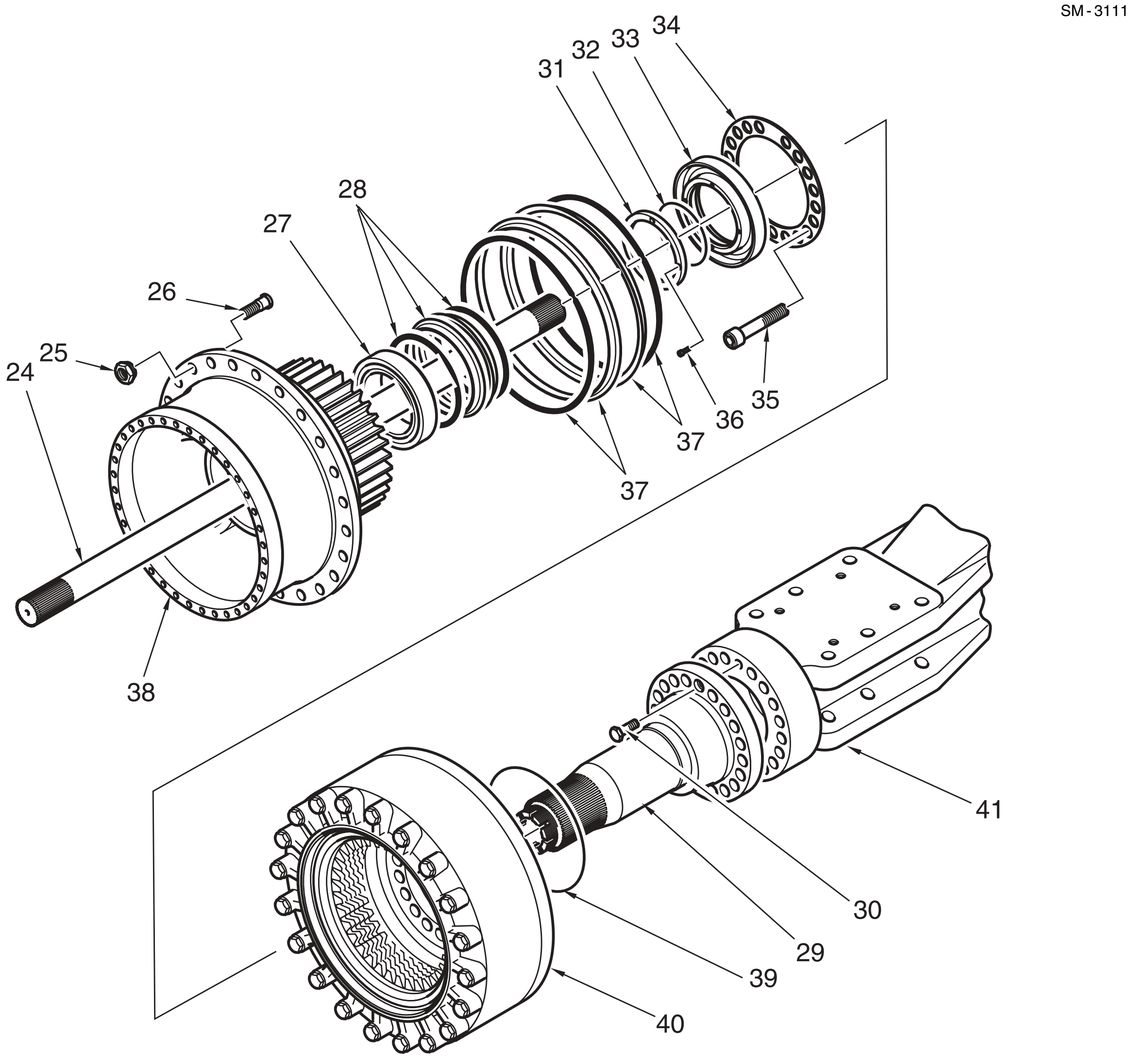
3. Insert a brake retaining capscrew (35) through the brake retaining ring (34) and then offer ring (34) and capscrew (35) up to and through the brake assembly (40) and into the axle stub and housing (29 & 41).

4. Insert remainder of capscrews (35) and tighten all to 750 - 830 lbf ft (1017 - 1135 Nm) using a diagonal pattern.

5. Install remaining oil seal (37) in brake assembly (40). Ensure that oil seal mounting diameter in brake assembly (40) is free from dirt and that all edges in seal mating bore are radiused.

6. Assemble two parts of oil seal (37), i.e. 'O' ring and metal ring, then fit service tool 15500012 in place on seal (37) assembly, clamping on metal ring.

7. Fit seal (37) into its bore in brake assembly (40) using even pressure on service tool 15500012, thus ensuring that seal is fitted parallel in bore.



24 - Driveshaft	30 - Capscrew	36 - Capscrew
25 - Wheel Nut	31 - Oil Seal Spacer	37 - Seal
26 - Stud	32 - 'O' Ring	38 - Hub
27 - Bearing Assembly	33 - Oil Seal Housing	39 - 'O' Ring
28 - Hub/Stub Face Seal	34 - Ring	40 - Brake Assembly
29 - Axle Stub	35 - Capscrew	41 - Axle Housing

Fig. 24 - Brake Assembly/Axle Stub Installation

Note: To aid in assembly, moisten bore and 'O' ring with a weak spirit/water mixture.

MAINTENANCE

> **⚠ 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.**

General

Every 1 000 hours (6 months), check the disc wear at each brake assembly, as described in 'Inspection'.

Oil Change Period

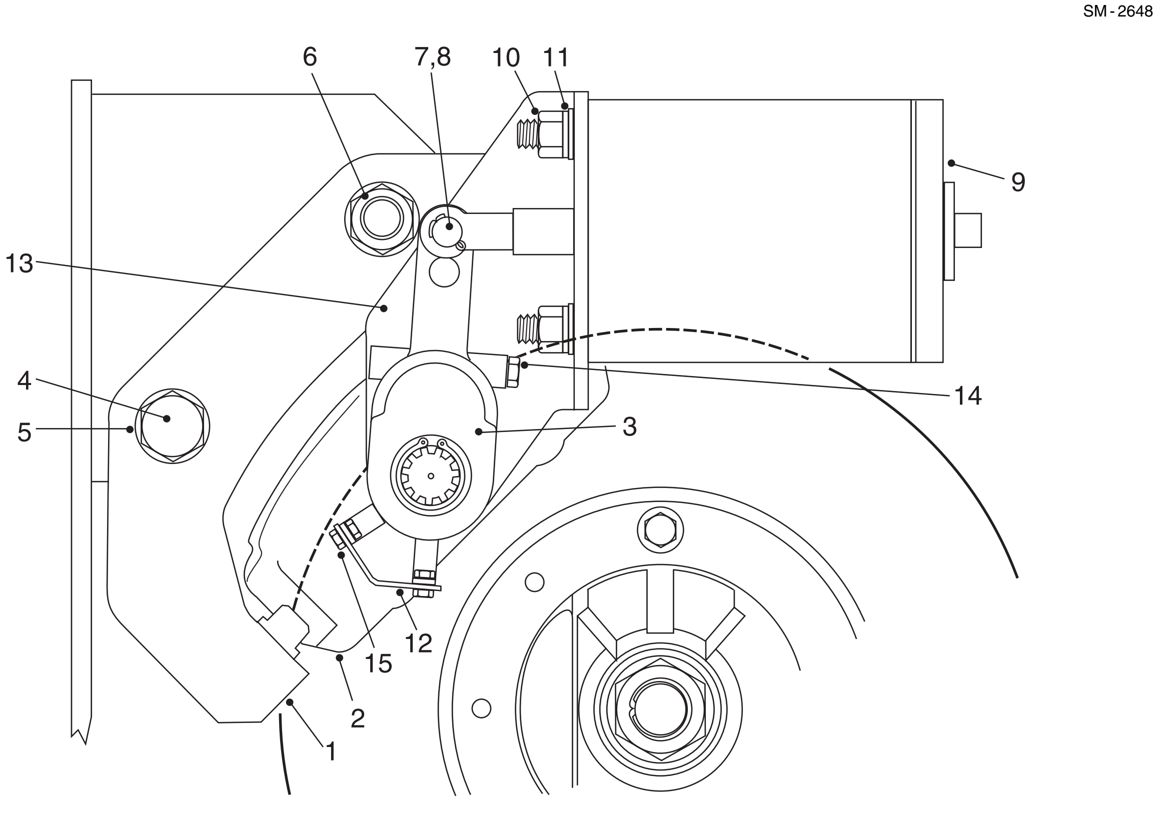
Note: For recommended oils, refer to Section 300-0020, LUBRICATION SYSTEM.

Drain (preferably after a short run to warm the oil) oil from brake coolant tank every 1 000 hours. Refer to Section 250-0025, BRAKE COOLANT TANK. Remove drain plugs and drain brake cooling oil from each brake assembly every 1 000 hours of operating. Refill brake coolant tank as described in Section 250-0025, BRAKE COOLANT TANK.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for details of service tools and adhesives required. These tools and adhesives are available from your dealer.

* * * *



1 - Bracket Assembly
2 - Calliper Head Assembly
3 - Slack Adjuster
4 - Bolt
5 - Washer
6 - Nut
7 - Clevis Pin
8 - Cotter Pin
9 - Actuator
10 - Nut
11 - Washer
12 - Control strap
13 - Cap assembly
14 - Slack adjuster screw
15 - Bolt

Fig. 1 - Parking Brake Mounting

WARNINGS
Use only hydraulic oils meeting specifications outlined in Section 300-0020, LUBRICATION SYSTEM. Do Not use Brake Fluid (J1703). Use of improper fluids is destructive to rubber components of brakes resulting in loss of braking and possible catastrophic failure.

Exercise extreme caution while working on the braking system. Braking system actuating pressure is 138 ± 6.9 bar (2 000 ± 100 lbf/in²).

DESCRIPTION AND OPERATION

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

The parking brake consists of a sliding calliper acting on a brake disc on a rear drive line. The parking brake is of 'Inverted Design' i.e. requiring pressure to hold the parking brake off.

Operation is by a spring applied/hydraulically released actuator (9). Actuator (9) is connected through slack adjuster (3) to the power screw shaft (19, Fig. 2) that is screwed into piston (6, Fig. 2) in calliper head assembly (2). Calliper head assembly (2) slides on anchor plate guides in bracket assembly (1) bolted to the frame. Slack adjuster (3) automatically maintains brake clearance after each application through the control strap (12). Control strap (12) connects the slack adjuster (3) to the cap assembly (13).

A push control on the dash panel activates the solenoid on the brake manifold valve, controlling oil pressure from the rear brake circuit accumulator to actuator (9). Application of the push control releases oil from actuator (9) allowing internal springs in the actuator to apply the parking brake. Pulling out the push control directs oil pressure from the rear brake circuit accumulator to actuator (9), compressing internal springs, to release the parking brake.

Note: The parking brake is automatically applied when the ignition is switched off.

REMOVAL

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.

Hydraulic fluid pressure will remain within the braking system after engine shut down. Operate the treadle pedal continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.

1. Position the vehicle on a level surface, apply the parking brake, block all road wheels and place the steering lock bar in the 'Locked' position.

2. Raise the body and install body safety prop to secure in partially raised position.

3. Pull out push control to release the parking brake.

4. Release spring tension on slack adjuster clevis pin (7) by unscrewing tensioning bolt on slack adjuster (3) until clevis pin (7) feels loose. Remove cotter pin (8) and clevis pin (7) from actuator (9).

5. Switch off the engine and place the battery master switch in the 'Off' position.

6. Disconnect and plug hydraulic line from actuator (9). Cap actuator (9) to prevent ingress of dirt.

7. Remove nuts (10) and washers (11) securing actuator (9) to cap assembly (13). Remove actuator (9) from cap assembly (13).

8. Support calliper head assembly (2) and remove bolts (4), washers (5) and nuts (6) securing bracket assembly (1) to mounting bracket on the frame.

9. Remove bracket assembly (1) and calliper head assembly (2) from the vehicle.

10. Slide calliper head assembly (2) from bracket assembly (1) and set aside for disassembly.

Note: Service of actuator (9) is covered in Section 170-0030, ACTUATOR.

DISASSEMBLY

Numbers in parentheses refer to Fig. 2.

1. Remove calliper head assembly as described under removal.

2. Remove snap ring (14) from power screw shaft (19).

3. Slide slack adjuster (15) from power screw shaft (19).

4. Remove and discard washer (16), wave spring washer (17) and packing (18) from power screw shaft (19).

5. Remove bolts (2) and washers (3) securing cap assembly (22) to calliper (7).

6. Remove as a unit, power screw shaft (19), piston (6) and cap assembly (20 through 23) from calliper (7).

7. Slide power screw shaft (19) and piston (6) from cap assembly (22).

8. Unscrew piston (6) from power screw shaft (19).

9. Remove and discard thrust bearing (20) from power screw shaft (19) and gasket (21) from cap assembly (22).

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 (23) in cap assembly (22) for wear. Journal bearing (23) ID should not exceed 38.35 mm (1.51 in). Replace if necessary.

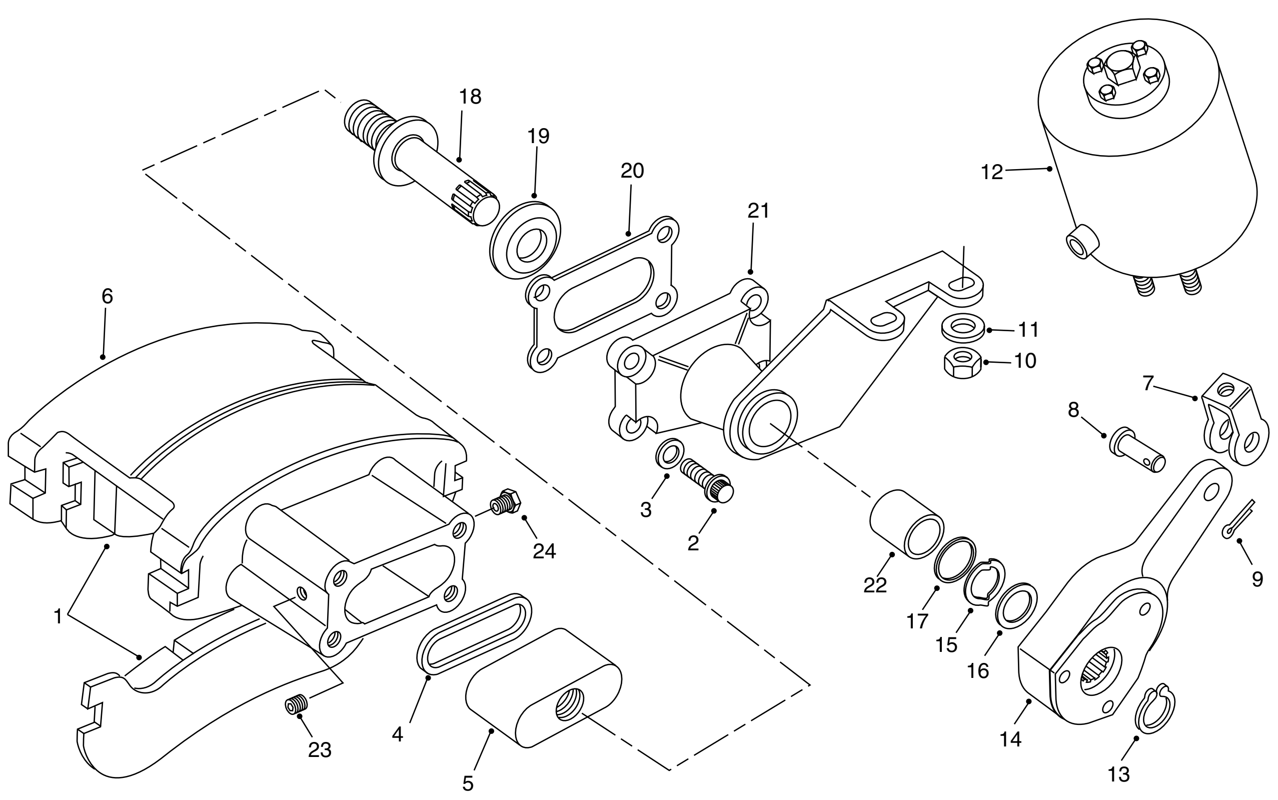
2. Replace cap assembly (22) if excessively worn.

3. Inspect all brake parts for cracks, excessive wear or scoring. Replace brake parts as required.

ASSEMBLY

Numbers in parentheses refer to Fig. 2.

1. Install new piston seal (5) into seal groove in calliper (7).



1 - Brake Pad	7 - Clevis	13 - Snap Ring	19 - Thrust Bearing
2 - Bolt	8 - Clevis Pin	14 - Slack Adjuster	20 - Gasket
3 - Washer	9 - Cotter Pin	15 - Wave Spring Washer	21 - Cap Assembly
4 - Piston Seal	10 - Nut	16 - Washer	22 - Journal Bearing
5 - Piston	11 - Washer	17 - Packing	23 - Plug
6 - Calliper	12 - Actuator	18 - Power Screw Shaft	24 - Pressure Relief Fitting

Fig. 2 - Exploded View of Parking Brake Assembly

2. Apply grease (Lubriplate Aero or equivalent) to flat face of new thrust bearing (20).

3. Install and seat new thrust bearing (20) over splined end of power screw shaft (19) with greased side of thrust bearing (20) against thrust collar of power screw shaft (19).

Note: Ensure correct installation of thrust bearing (20) by verifying that installation was made over the larger diameter end of power screw shaft (19), and, that thrust bearing (20) ID lip is towards splined end of power screw shaft (19).

4. Lubricate threads of power screw shaft (19) with grease (Lubriplate Aero or equivalent) and screw power screw shaft (19) into piston (6).

5. Coat outside of piston (6) with grease (Lubriplate Aero or equivalent) then slide assembled power screw shaft (19) and piston (6) into cap assembly (22), shaft end first.

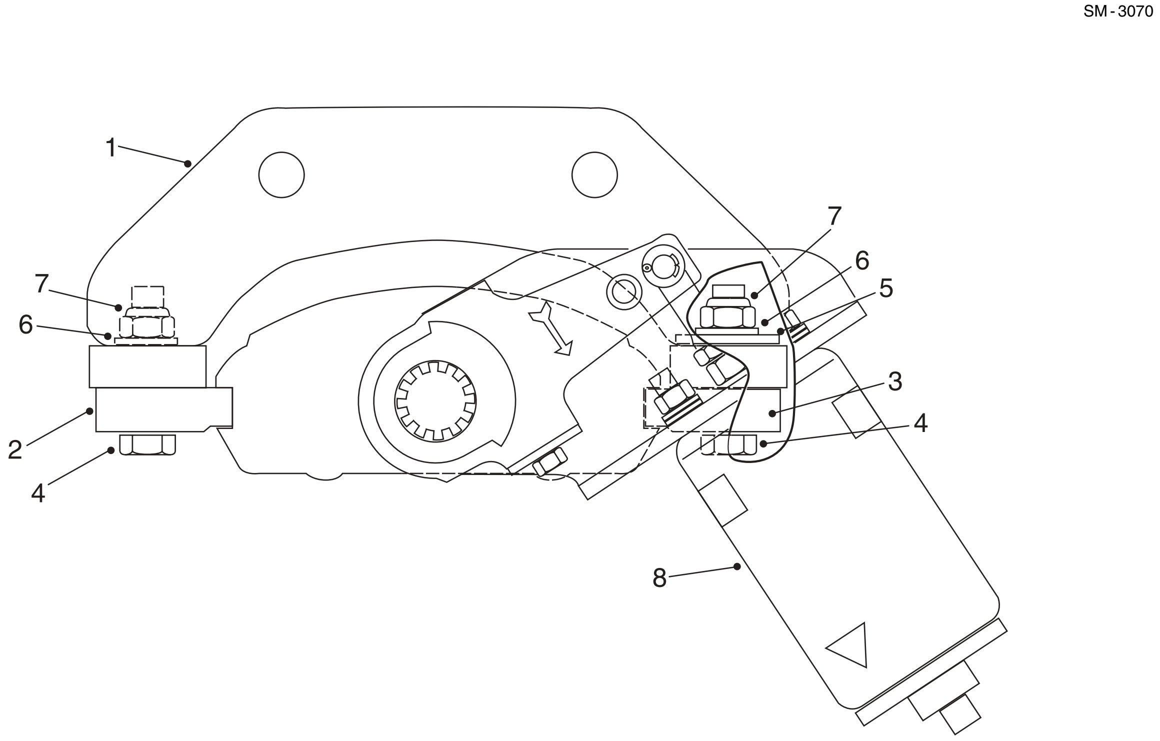
6. Line up gasket (21) and bolt cap assembly (22), with assembled power screw shaft (19) and piston (6), to calliper (7) using bolts (2) and washers (3). Tighten bolts (2) to a torque of 170 - 183 Nm (125 - 135 lbf ft).

Note: Care should be taken not to push piston seal (5) out of seal groove in calliper (7) when assembling cap assembly (22), with piston (6) and power screw shaft (19), to calliper (7).

7. Install new packing (18), wave spring washer (17) and washer (16) over power screw shaft (19), in the order shown in Fig. 2.

8. Mount actuator (13) on cap assembly (22) with nuts (11) and washers (12). Tighten nuts (11) finger tight only at this stage.

9. Apply coat of grease (Lubriplate Aero or equivalent)



1 - Bracket Assembly
2 - Torque Plate Side A
3 - Torque Plate Side B
4 - Bolt
5 - Clamp Plate
6 - Hardened Washer
7 - Nut
8 - Park Brake Assembly

Fig. 3 - Assembling Parking Brake Mounting

to mounting spline of slack adjuster (15).

10. With adjusting screw facing towards actuator (13) slide slack adjuster (15) on power screw shaft (19) aligning slack adjuster (15) arm with clevis (10).

11. Install snap ring (14) on power screw shaft (19).

12. Remove nuts (11) and washers (12) securing actuator (13) to cap assembly (22). Remove actuator (13) from cap assembly (22) to aid in installation.

INSTALLATION

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. Assemble bracket assembly (1, Fig. 3) and torque plate side A (2, Fig. 3) and secure with bolts (4, Fig. 3), hardened washers (6, Fig. 3) and nuts (7, Fig. 3).

2. Install park brake assembly (8, Fig. 3) and push park brake assembly (8, Fig. 3) hard against torque plate side A (2, Fig. 3). Slide torque plate side B (3, Fig. 3) into the slots of park brake assembly (8, Fig. 3).

3. Secure torque plate side B (3, Fig. 3) by installing bolts (4, Fig. 3), clamp plate (5, Fig. 3), hardened washers (6, Fig. 3) and nuts (7, Fig. 3).

4. Install a feeler gauge of 0.635 mm (0.025") between park brake assembly (8, Fig. 3) and torque plate side B (3, Fig. 3) to obtain clearance as shown in Fig. 3.

5. Tighten all four bolts to 680 Nm (490 lbf ft) and recheck clearance is within tolerance 0.51 - 0.76 mm (0.020 - 0.030").

6. Attach suitable lifting device and position bracket assembly (1) and calliper head assembly (2) over brake disc. Secure bracket assembly (1) to mounting bracket on the frame with bolts (4), washers (5) and nuts (6). Tighten nuts (6) to a torque of 745 Nm (550 lbf ft).

7. Remount actuator (9) on cap assembly (22, Fig. 2) and install washers (11) and nuts (10). Tighten nuts (10) finger tight only at this stage.

> ⚠ **WARNING**
> **Do not pressurize actuator until the following instruction has been carried out. Pressurizing the actuator beforehand can result in serious brake damage.**

8. Turn adjustment screw (14) on the slack adjuster (3) in a clockwise direction until the brake pads in calliper head assembly (2) are tight against the brake disc.

9. Connect hydraulic line to actuator (9). Place the battery master switch in the 'On' position, start the engine and pull out parking brake control knob to extend the actuator.

10. Connect slack adjuster (3) to actuator (9) by inserting clevis pin (7) through clevis (10, Fig. 2) on actuator (9). Secure clevis pin (7) with cotter pin (8).

11. Align actuator (9) to slack adjuster (3) and torque nuts (10) to 115 - 136 Nm (85 - 100 lbf ft).

12. Loosen bolt (15) at the control arm of slack adjuster (3) and control strap (12).

13. Position control arm of slack adjuster (3) in fully released position (forcing it in a direction away from actuator (9)) by turning adjustment screw (14) on the slack adjuster (3), until it comes to a positive stop inside the control strap (12).

14. Tighten bolt (15) at the control arm of slack adjuster (3) and control strap (12).

Note: Failure to position the slack adjuster against the internal stop may result in brake drag.

15. Use 1.5mm feeler gauge between brake pads in calliper head assembly (2) and brake disc. Turn the adjustment screw (14) on the slack adjuster (3) until the 1.5 mm total clearance is obtained.

16. Remove feeler gauge and apply brake several times. The automatic slack adjuster will adjust the brake pad clearance with each application, which can be seen by the rotation of the adjustment screw (14).

17. When the adjustment screw (14) stops rotating, the specified clearance of 0.7 - 1.0 mm has been obtained and the brake is ready for normal operation.

18. Remove wheel blocks and place the steering lock bar in the 'Stowed' position.

MAINTENANCE

Every 250 hours

Check wear on brake pads and disc. Replace brake pads when lining thickness is 3.0 mm (0.125 in) or less.

Brake Pad Replacement

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.

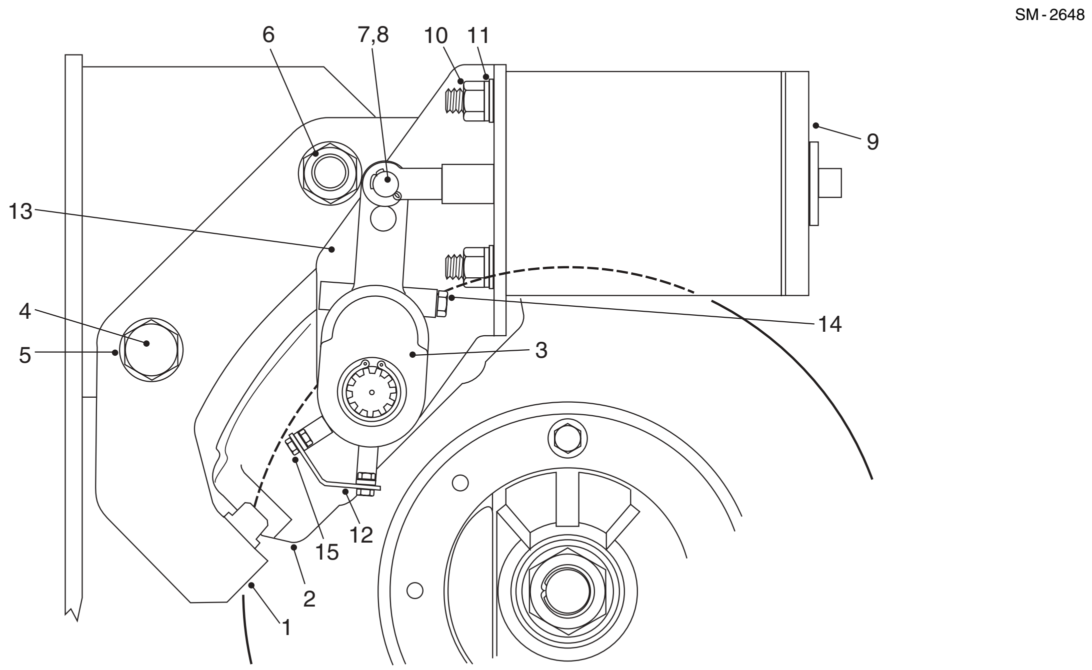
SPECIAL TOOLS

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	TORQUE lbf ft
1	6	Nut	745	550
1	10	Nut	115 - 136	85 - 100
2	2	Bolt	170 - 183	125 - 135
3	4	Bolt	680	490

* * * *



1 - Bracket Assembly
2 - Calliper Head Assembly
3 - Slack Adjuster
4 - Bolt
5 - Washer
6 - Nut
7 - Clevis Pin
8 - Cotter Pin
9 - Actuator
10 - Nut
11 - Washer
12 - Control strap
13 - Cap assembly
14 - Slack adjuster screw
15 - Bolt

Fig. 1 - Actuator Mounting

DESCRIPTION AND OPERATION

⚠ WARNING
Use only hydraulic oils meeting specifications outlined in Section 300-0020, LUBRICATION SYSTEM. Do Not use Brake Fluid (J 1703). Use of improper fluids is destructive to rubber components of brakes resulting in loss of braking and possible catastrophic failure.

The actuator is a spring on/fluid off type which operates the parking brake. It is connected, through a slack adjuster to the power screw shaft, screwed into a piston in the brake calliper head assembly.

A push control on the dash panel, in the operators compartment, activates the solenoid on the brake manifold valve, controlling oil pressure from the rear brake circuit accumulator to the actuator. Application of the push control releases oil from the actuator allowing internal springs in the actuator to apply the parking brake. Pulling out the push control directs oil pressure from the front brake circuit accumulator to the actuator, compressing internal springs, to release the parking brake.

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 braking system after engine shut down. Operate the treadle pedal continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.

1. Position the vehicle on a level surface, raise the body and install safety prop to secure body in the partially raised position.

2. Block all road wheels and place the steering lock bar in the 'Locked' position.

3. Pull out push control to release the parking brake.

4. Release spring tension on clevis pin (7) by unscrewing tensioning bolt on slack adjuster (3) until clevis pin (7) feels loose. Remove cotter pin (8) and clevis pin (7) from actuator (9).

Note: On engine shutdown the parking brake will automatically apply. Ensure there is sufficient clearance for actuator rod travel.

5. Switch off the engine and place the battery master switch in the 'Off' position.

6. Disconnect and plug hydraulic line from actuator (9). Cap actuator (9) and hydraulic line to prevent entry of dirt.

7. Remove nuts (10) and washers (11) securing actuator (9) to cap assembly (13). Remove actuator (9) from cap assembly (13) and set aside for disassembly.

REPLACEMENT OF SEALING RINGS

Numbers in parentheses refer to Fig. 2.

Note: Before and during assembly and disassembly of the brake actuator precautions should be taken to avoid damaging plunger (12) assembly.

Disassembly

1. Turn bolt (34) until it is approximately 25 mm (1 in) out of cap (31).

2. Remove bolts (30) from the periphery of actuator housing (1).

3. Press cap (31) approximately 10 mm (0.4 in) into actuator housing (1). If necessary use a rubber hammer.

4. Remove retaining ring (39) from the boss of actuator housing (1).

5. Press plunger (12) fully in. Cap (31) with springs (37 & 38) will be pressed out of actuator housing (1).

> ⚠ **WARNING**
> **Springs (37 & 38) have been assembled under pressure. Bolts (24 & 34) should not be turned in this situation.**

6. Turn joining nipple (21) and remove from actuator housing (1). Remove and discard U-sit ring (19) and grommet (20).

7. Remove four bolts (6) and lockwashers (5) from the front cap.

8. Remove the hydraulic unit, with plungers (12 & 23) and base (22), from actuator housing (1).

9. Press plungers (12 & 23) out of base (22).

10. Remove and discard wiper (13), U-cups (15 & 28) and 'O' ring (16) from hydraulic unit.

11. Carefully press plunger (12) assembly out of plunger (23). Remove and discard 'O' ring (17) from plunger (23).

Note: Remove 'O' rings carefully from 'O' ring grooves in order to avoid damaging the grooves.

Assembly

1. Install new 'O' ring (17) in plunger (23) and carefully press plunger (12) assembly into plunger (23).

2. Install new wiper (13), U-cups (15 & 28) and 'O' ring (16) in/on hydraulic unit, as shown in Fig. 2.

Note: U-cups (15 & 28) close, but only in one direction. These should be assembled with the groove side in the correct direction, as shown in Fig. 2.

3. Lightly grease plunger assembly (12 & 23) and install in base (22). Install 'O' ring gland (14) in base (22).

4. Install the hydraulic unit with Tectyl 280 rust preventive or equivalent, against the front cap in actuator housing (1). Secure hydraulic unit to the front cap with four bolts (6) and lockwashers (5). Tighten bolts (6) to a torque of 25 Nm (18 lbf ft).

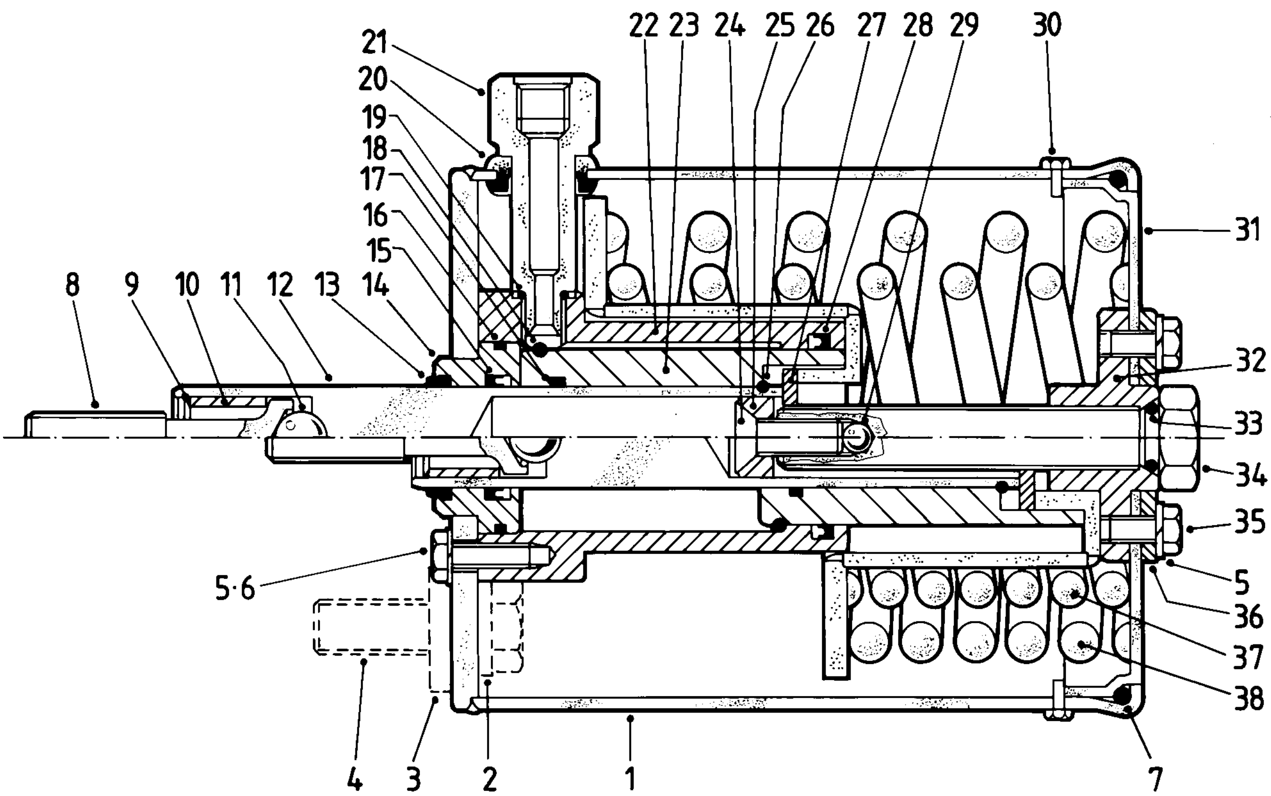
5. Grease new grommet (20) and install in actuator housing (1).

6. Install new U-sit ring (19) on joining nipple (21). Smear the threads of joining nipple (21) with Loctite 270 and install through grommet (20). Tighten joining nipple (21) to a torque of 95 Nm (70 lbf ft).

7. Install rear cap (31) assembly, complete with springs (37 & 38), in actuator housing (1).

8. Press rear cap (31) assembly approximately 10 mm (0.4 in) under the rim of actuator housing (1).

9. Smear groove in actuator housing (1) and retaining ring (7) with Tectyl 280 or equivalent, and install retaining ring (7) in the groove.



1 - Actuator Housing
2 - Lockwasher
3 - Nut
4 - Bolt
5 - Lockwasher
6 - Bolt
7 - Retaining Ring
8 - Rod-End
9 - Seeger Circlip

10 - Tube
11 - Ball
12 - Plunger
13 - Wiper
14 - Gland
15 - U-Cup
16 - 'O' Ring
17 - 'O' Ring
18 - Retaining Ring

19 - U-Sit Ring
20 - Grommet
21 - Joining Nipple
22 - Base
23 - Plunger
24 - Bolt
25 - Bearing
26 - Retaining Ring
27 - Washer
28 - U-Cup

29 - Ball
30 - Bolt
31 - Cap
32 - Nut
33 - 'O' Ring
34 - Bolt
35 - Bolt
36 - Plate
37 - Spring
38 - Spring

Fig. 2 - Sectional View of Parking Brake Actuator
Upper Section No Oil Pressure Applied - Lower Section Oil Pressure Applied

10. Screw release bolt (34) fully in, so that springs (37 & 38) press rear cap (31) against retaining ring (7). Check if retaining ring (7) is flush in the groove.

11. Apply Loctite 221 on bolts (30) and install bolts in actuator housing (1). Tighten bolts (30) to a torque of 3 Nm (26 lbf in). The actuator is now ready for use.

REPLACEMENT OF SPRINGS

Numbers in parentheses refer to Fig. 2.

Note: Before and during assembly or disassembly precautions should be taken to avoid damaging plunger (12) assembly.

Disassembly

1. Remove bolts (30) from the periphery of actuator housing (1).

2. Remove bolts (35) from rear cap (31).

3. Press release bolt (34) complete with nut (32) in and remove plate (36).

4. Place the complete actuator under a press with the flat plunger side (front side) face down.

> ⚠ **WARNING**
> **Springs (37 & 38) have been assembled under pressure, therefore pressing should be carried out with the utmost precaution.**

5. Press rear cap (31) in approximately 10 mm (0.4 in) by using a solid plate of approximately 130 mm (5 in) diameter.

6. Remove retaining ring (7) from groove in actuator housing (1).

7. Release the pressure slowly allowing rear cap (31) to be pushed completely out of actuator housing (1) until springs (37 & 38) are totally released.

8. Remove rear cap (31) and take out springs (37 & 38).

Assembly

Numbers in parentheses refer to Fig. 2.

1. Place new springs (37 & 38) in actuator housing (1).

2. Place rear cap (31) on springs (37 & 38).

3. By using a press and a solid plate of approximately 130 mm (5 in) diameter, press rear cap (31) approximately 10 mm (0.4 in) under the top rim of actuator housing (1).

4. Smear groove in actuator housing (1) and retaining ring (7) with Tectyl 280 or equivalent. Fit retaining ring (7) in groove in actuator housing (1).

5. Release the pressure on rear cap (31) very slowly.

6. Check if retaining ring is correctly in the groove.

7. By using an M8 threaded rod, with a minimum length of 130 mm (5 in) and pushing this through bolt holes in rear cap (31), nut (32) can be pulled into place.

8. Install plate (36) with Tectyl 280 or equivalent, around bolt (35) hole and inside rim of actuator housing (1).

9. Install bolts (35) with lockwashers (5) and tighten bolts (35) to a torque of 25 Nm (18 lbf ft).

10. Apply Loctite 221 on bolts (30) and install bolts in actuator housing (1). Tighten bolts (30) to a torque of 3 Nm (26 lbf in). The actuator is now ready for use.

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. Remount actuator (9) on cap assembly (13) and install washers (11) and nuts (10). Tighten nuts (10) finger tight only at this stage.

> ⚠ **WARNING**
> **Do not pressurize actuator until the following instruction has been carried out. Pressurizing the actuator beforehand can result in serious brake damage.**

2. Turn adjustment screw (14) on the slack adjuster (3) in a clockwise direction until the brake pads in calliper head assembly (2) are tight against the brake disc.

3. Connect hydraulic line to actuator (9). Place the battery master switch in the 'On' position, start the engine and pull out parking brake control knob to extend the actuator.

4. Connect slack adjuster (3) to actuator (9) by inserting clevis pin (7) through clevis on actuator (9). Secure clevis pin (7) with cotter pin (8).

5. Align actuator (9) to slack adjuster (3) and torque nuts (10) to 115 - 136 Nm (85 - 100 lb ft).

6. Loosen bolt (15) at the control arm of slack adjuster (3) and control strap (12).

7. Position control arm of slack adjuster (3) in fully released position (forcing it in a direction away from actuator (9)) by turning adjustment screw (14) on the slack adjuster (3), until it comes to a positive stop inside the control strap (12).

8. Tighten bolt (15) at the control arm of slack adjuster (3) and control strap (12).

Note: Failure to position the slack adjuster against the internal stop may result in brake drag.

9. Use 1.5mm feeler gauge between brake pads in calliper head assembly (2) and brake disc. Turn the

adjustment screw (14) on the slack adjuster (3) until the 1.5 mm total clearance is obtained.

10. Remove feeler gauge and apply brake several times. The automatic slack adjuster will adjust the brake pad clearance with each application, which can be seen by the rotation of the adjustment screw (14).

11. When the adjustment screw (14) stops rotating, the specified clearance of 0.7 - 1.0 mm has been obtained and the brake is ready for normal operation.

12. Remove wheel blocks and place the steering lock bar in the 'Stowed' position.

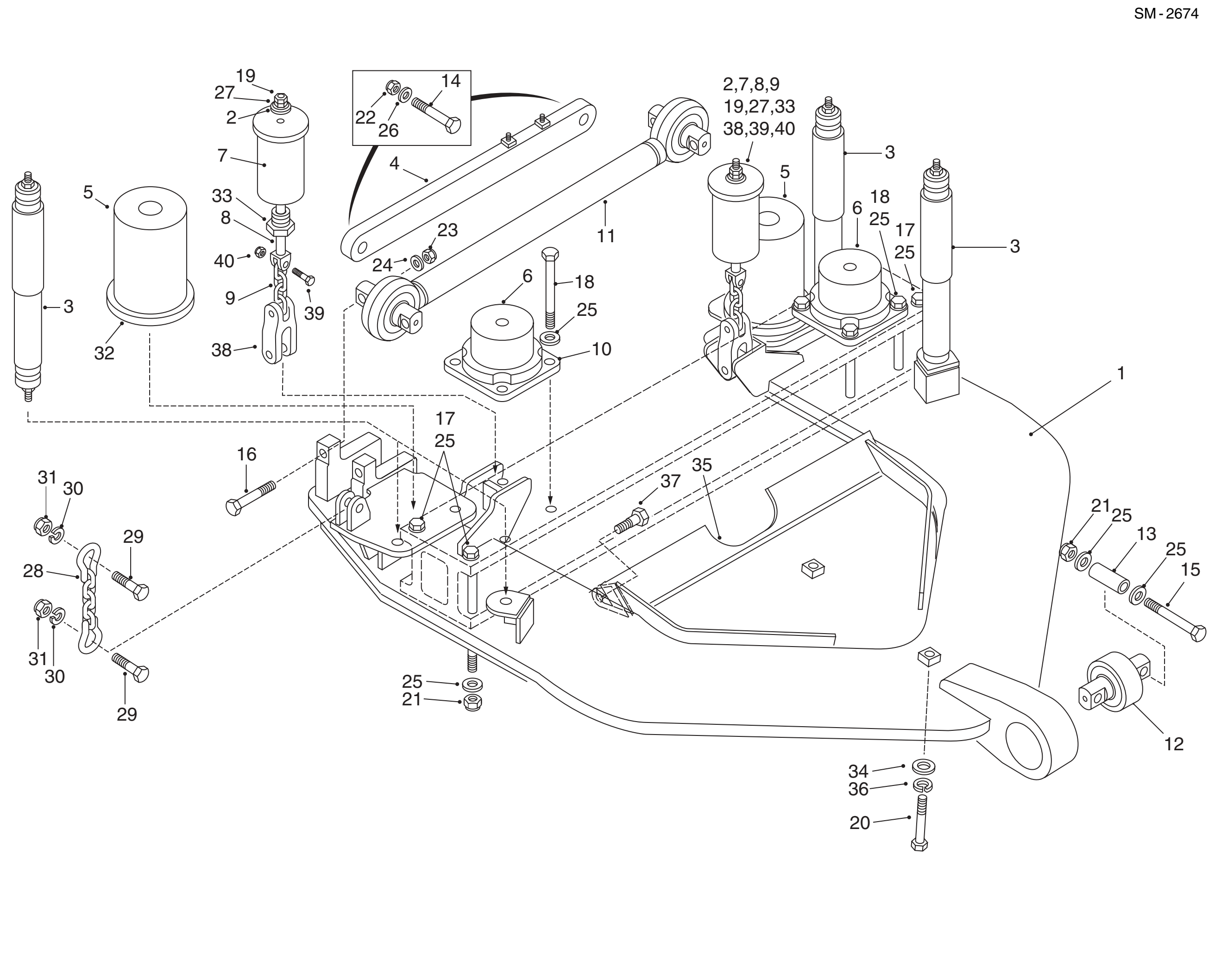
SPECIAL TOOLS

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 and adhesives required. These tools and adhesives are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE Nm	TORQUE lbf ft
1	10	Nut	115 - 136	85 - 100
2	6 & 35	Bolt	25	18
2	21	Joining Nipple	95	70
2	30	Bolt	3	-

* * * *



1 - Suspension Frame	11 - Panhard Rod	21 - Locknut	31 - Nut
2 - Snubbing Washer	12 - Bearing	22 - Locknut	32 - Plate
3 - Shock Absorber	13 - Bush	23 - Locknut	33 - Suspension Bush
4 - Link	14 - Bolt	24 - Hardened Washer	34 - Washer
5 - Rubber Mount	15 - Bolt	25 - Hardened Washer	35 - Guard
6 - Rubber Mount	16 - Bolt	26 - Washer	36 - Lockwasher
7 - Rubber Mount	17 - Bolt	27 - Washer	37 - Bolt
8 - Bolt	18 - Bolt	28 - Chain & Shackle	38 - Shackle
9 - Chain	19 - Nut	29 - Bolt	39 - Bolt
10 - Pin Assembly	20 - Bolt	30 - Lockwasher	40 - Locknut

Fig. 1 - Exploded View of Front Suspension

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The front axle assembly is mounted on the leading arms of suspension frame (1). The complete unit is pivoted at the rear through a spherilastic type bearing (12) connecting the rear of suspension frame (1) to the tractor frame, forward of the lower articulation pivot point. Side thrust is taken up by panhard rod (11) connected at one end on the underside of the chassis and the other end to the suspension frame (1). A link (4) is provided as a tie bar connected to the upper part of the suspension assembly.

Suspension is provided by two heavy duty rubber suspension mounts (5) mounted on top of suspension frame (1) and connected to the tractor frame. In addition, there are two smaller heavy duty rubber suspension mounts (6) mounted between the axle beam and chassis beam. Apart from rubber mounts

(5 & 6) there are four heavy duty double acting shock absorbers (3) (two off each side) to smooth out the ride. Two chain and shackle assemblies (28) and rubber rebound mounts (7) provide extra retention on rebound.

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, ensure the body is fully lowered, apply the parking brake and switch off the engine. Turn steering wheel several times to relieve any pressure in the steering system.

2. Block rear road wheels, place the steering lock bar in the 'Locked' position and place 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 machine until both front tyres are off the ground. Support the vehicle with suitable stands and blocking at the tractor frame and articulation pivot area.

5. Support one tyre and rim assembly with suitable lifting equipment and remove wheel nuts securing the rim to the axle. Remove tyre and rim assembly.

6. Repeat step 5 for the opposite tyre and rim assembly.

7. Support guard (35) and remove bolts (20 & 37), washer (34) and lockwasher (36) securing guard (35) to suspension frame (1). Remove guard (35).

8. Disconnect hydraulic brake line at tee on front axle assembly. Disconnect differential breather line. Cap lines and fittings to prevent ingress of dirt.

9. Remove nuts (31), lockwashers (30) and bolts (29) securing chain and shackle assemblies (28) to suspension frame (1) and tractor frame assembly.

10. Support driveline and remove bolts securing driveline to front axle. Refer to Section 130-0010, FRONT DRIVELINES.

11. Remove thread cap and mounting hardware securing shock absorbers (3) to suspension frame (1).

12. Support rebound mounts (7) and remove nuts (19), washers (27) and shackles (38) securing rebound mounts (7) to suspension frame (1). Remove bolts (39) and locknuts (40) securing chains (9) to bolts (8).

13. Remove rebound mounts (7), bolts (8) and snubbing washers (2) from suspension frame (1).

14. Support panhard rod (11) and remove locknuts (23), hardened washers (24) and bolts (16) securing panhard rod (11) assembly to suspension frame (1).

15. Support link (4) and remove locknuts (22), washers (26) and bolts (14) securing link (4) to suspension frame (1).

16. Position two jacks under the leading arms of suspension frame (1) and remove bolts (18) and hardened washers (25) securing rubber mounts (5 & 6) to the tractor frame. Lower jacks until rubber mounts are free of compression.

17. Position a suitable trolley under suspension frame (1) and, using suitable equipment, support the rear end of suspension frame (1).

18. Remove locknuts (21), hardened washers (25), bolts (15) and bushes (13) securing bearing (12) to the tractor frame.

19. Carefully lower suspension frame (1) assembly onto the trolley and remove from under the vehicle.

20. Remove cap from shock absorber (3) mounting nuts and remove nuts and washers securing shock absorbers (3) to the tractor frame assembly. Remove shock absorbers (3).

21. Support panhard rod (11) assembly and remove locknuts (23), hardened washers (24) and bolts (16). Remove panhard rod (11) assembly from the tractor frame 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. Remove locknuts (21), hardened washers (25) and bolts (17) securing front axle assembly on suspension frame (1). Using suitable lifting equipment, remove front axle assembly from suspension frame (1).

2. Remove bolts (18) and washers (25) securing pin assemblies (10) and suspension mounts (6) to suspension frame (1).

3. Remove suspension mounts (5) and locator plate (32) assemblies from suspension frame (1).

4. If required, press spherilastic bearing (12) from suspension frame (1).

ASSEMBLY

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 lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Using suitable lifting equipment, position front axle assembly on suspension frame (1) and secure with bolts (17), hardened washers (25) and locknuts (21). Tighten locknuts (21) to a torque of 869 Nm (627 lbf ft).

2. If bearing (12) was removed during disassembly, install a new spherilastic bearing as follows:

a. Enter spherilastic bearing (12) into bore in suspension frame (1), ensure flats on shaft are perpendicular to the main suspension plate.

b. Mark a slot on bearing (12) and face of suspension frame (1) adjacent to slot on bearing and remove bearing (12). Apply Loctite to bearing surface.

c. Using press tool and power press (See Special Tools), install bearing (12) in suspension frame (1), ensuring that bearing (12) does not twist during pressing operation.

d. Re-check angle of shaft with level gauge.

3. Install suspension mounts (5) and plate (32) assemblies on locating bosses on suspension frame (1).

4. Install suspension mounts (6) and pin assemblies (10) to axle mounts and secure using bolts (18) and washers (25).

INSTALLATION

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. Position suspension frame (1) assembly and trolley under the front frame with bearing (12) to the rear.

2. Using suitable lifting equipment, lift suspension frame (1) assembly and locate bearing (12) to its mounting bracket. Install bushes (13) through bearing (12) and secure with bolts (15), hardened washers (25) and locknuts (21). Tighten locknuts (21) to a torque of 869 Nm (627 lbf ft).

3. Apply a small bead of Hylosil Sealant around the top edge of rubber mounts (5 & 6). Mount two hydraulic jacks (See Special Tools) between outside shock absorber mountings.

4. Align holes in rubber mounts (5) and locator plate (32) assemblies with mounting pins on suspension frame (1). Install rubber mounts (6) and pin assemblies (10) and secure with bolts (18) and hardened washers (25). Using a hydraulic pump to operate hydraulic jacks, compress rubber mounts.

5. Connect chain and shackle assemblies (28) between suspension frame (1) and tractor frame and secure with bolts (29), lockwashers (30) and locknuts (31).

6. Install link (4) to mounting on tractor frame and secure with bolts (14), hardened washers (26) and locknuts (22). Tighten bolts (14) to a torque of 1136 Nm (820 lbf ft).

7. While rubber mounts are still compressed, install panhard rod (11) to mounting on tractor frame and suspension frame (1) and secure with bolts (16), hardened washers (24) and locknuts (23). Tighten bolts (16) to a torque of 535 Nm (386 lbf ft).

8. Release pressure from hydraulic jacks and remove from shock absorber mountings.

9. Install shock absorbers (3) to the tractor frame and secure with locknuts and washers. Tighten upper locknuts to a torque of 103 Nm (74 lbf ft).

10. Align bottom of shock absorbers (3) with mounting brackets on suspension frame (1) and secure with washers and locknuts. Tighten lower locknuts to a torque of 215 Nm (155 lbf ft). Install thread caps.

11. Remove caps and connect hydraulic brake line to tee on front axle assembly. Connect differential breather line.

12. Remove trolley from underneath tractor frame.

13. Position rebound mounts (7) on upper surface of mounting plate on chassis. Install shackles (38), chains (9) and sealant to bolts (8).

14. Insert bolts (8) through suspension bushes (33) and rebound mounts (7). Secure chains (9) to bolts (8) with bolts (39) and nuts (40).

15. Position snubbing washers (2), washers (27) and nuts (19). Adjust nuts (19) until all parts are seated.

Note: No compression on mounts (7) and no slack in assembly.

16. After parts are seated, compress rebound mount (7) to suit working conditions. See 'Adjustments'.

17. Position guard (35) on suspension frame (1), using suitable lifting equipment and secure with bolts (37 & 38), washer (34) and lockwasher (36).

18. Using suitable lifting equipment, position one tyre and rim assembly on a front wheel and secure with wheel nuts. Tighten locknuts to a torque of 540 Nm (400 lbf ft).

19. Using suitable lifting equipment, position opposite tyre and rim assembly on the opposite front wheel and secure with wheel nuts.

20. Using suitable lifting equipment, raise tractor frame sufficiently to remove stands and blocking from the tractor frame and articulation pivot. Lower vehicle to the ground and remove lifting equipment. Tighten all wheel nuts to a torque of 540 Nm (400 lbf ft).

21. Remove wheel blocks from rear road wheels and place the steering lock bar in the 'Stowed' position.

22. Bleed all air from hydraulic brake lines. Refer to Section 165-0010, BRAKE PARTS.

ADJUSTMENTS

Numbers in parentheses refer to Fig. 2.

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

To improve ride comfort, the front suspension can be adjusted to suit working conditions, by altering the height of the rubber rebound mounts (7). The rebound mounts (7) are factory set at a height of 185 mm. For a harder ride, the rubber mounts (7) should be compressed to 140 - 185 mm. For a softer ride, the rubber mounts (7) should be set to 185 - 200 mm.

1. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine. Turn steering wheel several times to relieve any pressure in the steering system.

2. Following instructions at 'Removal' adjust inner nuts (19) to give desired compression of rubber mounts (7).

3. Apply Loctite Activator 'T' and Loctite 638 to threads above inner nuts (19). Tighten down outer nuts (19) against inner nuts (19), making sure that inner nuts (19) do not move.

4. Complete installation of front suspension. Refer to 'Installation'.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of hydraulic jack, power press, press tool and general service tools and sealants required. These tools and sealants are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE Nm	TORQUE lbf ft
1	14	Bolt	1136	820
1	16	Bolt	535	386
1	21	Locknut	869	627
1	3	Shock Absorber Nut (Upper)	103	74
1	3	Shock Absorber Nut (Lower)	215	155
-	-	Wheel Nut	540	400

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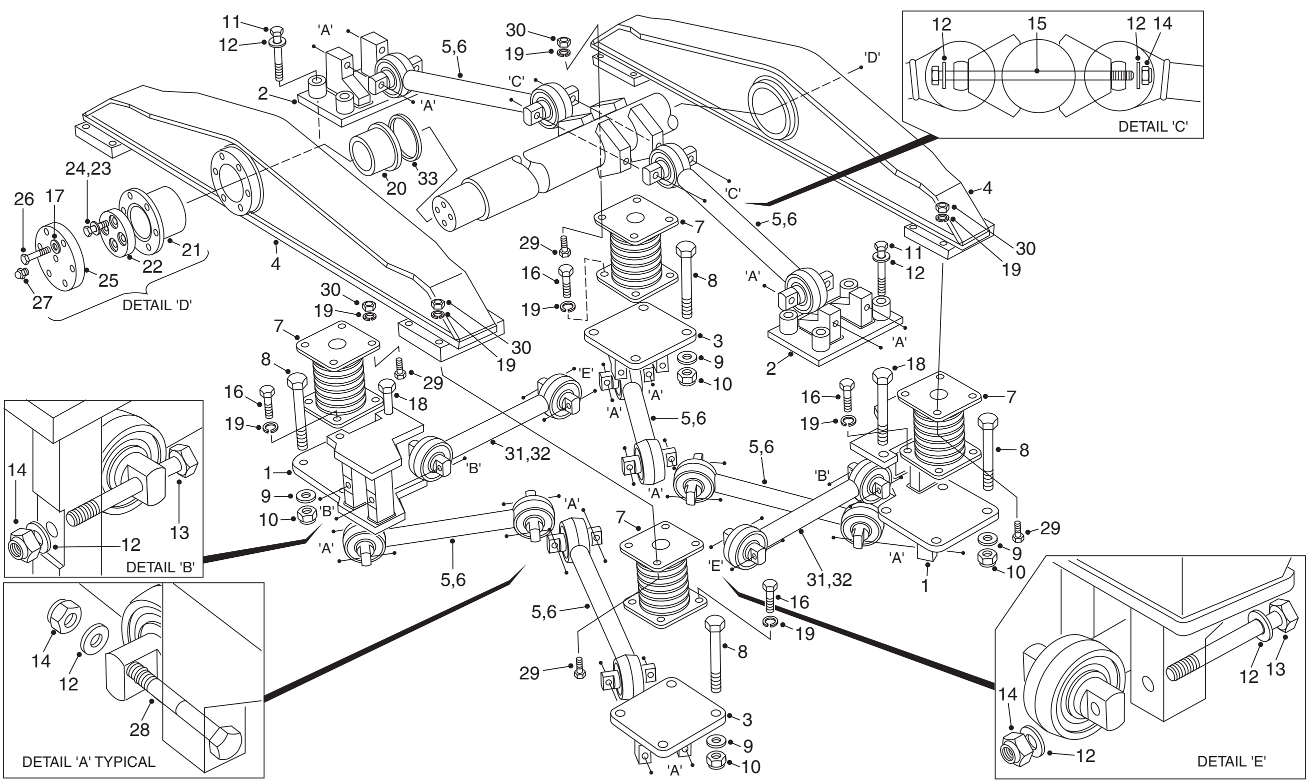


1 - Bracket
2 - Bracket
3 - Bracket
4 - Equalizer Beam
5 - Control Link
6 - Bushing
7 - Interleaf Mount
8 - Bolt
9 - Hardened Washer
10 - Locknut
11 - Bolt
12 - Hardened Washer
13 - Bolt
14 - Locknut
15 - Bolt
16 - Bolt
17 - Washer
18 - Bolt
19 - Lockwasher
20 - Wear Ring
21 - Bushing
22 - Retaining Plate
23 - Washer
24 - Bolt
25 - Cover Plate
26 - Bolt
27 - Lube Fitting
28 - Bolt
29 - Bolt
30 - Locknut
31 - Control Link
32 - Bushing
33 - 'V' Ring Seal

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 leading or trailing control links (5) which provide longitudinal restraint. Lateral restraint is by transverse control links (31).

Loads acting on the centre and rear axles are balanced by centrally pivoting equalizer beams (4) with rubber cushioning interleaf mounts (7) between axles and beam ends. Interleaf mounts (7) are rubber/steel laminated compression units with chain link ties.

The rear suspension system is effectively maintenance free due to the use of rubber bushings (6 & 32) being used in control links (5 & 31). Lubrication of bushings (21) in equalizer beams (4) is through lube fittings (27).

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. Position the vehicle in a level work area, raise the body and install body safety prop to secure body in

partially raised position

2. Apply the parking brake and switch off the engine. Turn steering wheel several times to relieve any pressure in the steering system.

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

4. Using suitable blocking equipment, block equalizer beams 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 machine until the rear wheels are off the ground. Support the vehicle with suitable stands and blocking at the trailer frame, articulation pivot area and centre and rear axle assemblies.

7. Support one tyre and rim assembly with suitable lifting equipment and remove wheel nuts securing the rim to the axle. Remove tyre and rim assembly.

8. Repeat step 7 for the remaining rear tyre and rim assemblies.

9. Disconnect hydraulic brake lines from tee at both the centre axle and rear axle assemblies. Cap lines and fittings to prevent ingress of dirt.

10. Remove blocking equipment from equalizer beams (4).

11. Remove locknuts (30), lockwashers (19) and bolts (29) securing interleaf mounts (7) to equalizer beams (4).

12. Remove bolts (16) and lockwashers (19) securing interleaf mounts (7) to brackets (1 & 3) mounted on the centre and rear axles. Remove interleaf mounts (7).

13. Remove bolts (26) and washers (17) securing cover (25) to equalizer beam (4). Remove cover (25).

14. Remove bolts (24) and washers (23) securing retaining plate (22) to shaft on frame. Remove retaining plate (22).

15. Using suitable lifting equipment, support equalizer beam (4) and withdraw from shaft on frame. If required remove bushing (21) from equalizer beam (4).

16. Remove wear ring (20) and 'V' ring seal (33) from shaft on frame.

17. Repeat steps 13 through 16 to remove the opposite equalizer beam (4).

18. Remove locknuts (14), hardened washers (12) and bolts (15 & 28) securing control links (5) between the rear and centre axle brackets (1, 2 & 3) and frame mounting brackets. Remove control links (5).

19. Remove locknuts (14), hardened washers (12) and bolts (13 & 28) securing control link (31) between mounting bracket (1) on the centre axle and LH frame mounting bracket. Remove control link (31).

20. Remove locknuts (14), hardened washers (12) and bolts (13 & 28) securing control link (31) between mounting bracket (1) on the rear axle and RH frame mounting bracket. Remove control link (31).

21. Remove locknuts (10), hardened washers (9) and bolts (8) securing mounting bracket (3) on the rear axle. Remove mounting bracket (3).

22. Remove locknuts (10), hardened washers (9) and bolts (8 & 18) securing mounting bracket (1) on the rear axle. Remove mounting bracket (1).

23. Remove bolts (11) and hardened washers (12) securing mounting bracket (2) on the rear axle. Remove mounting bracket (2).

24. Remove locknuts (10), hardened washers (9) and bolts (8) securing mounting bracket (3) on the centre axle. Remove mounting bracket (3).

25. Remove locknuts (10), hardened washers (9) and bolts (8 & 18) securing mounting bracket (1) on the centre axle. Remove mounting bracket (1).

26. Remove bolts (11) and hardened washers (12) securing mounting bracket (2) on the centre axle. Remove mounting bracket (2).

INSTALLATION

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. Install bracket (2) on rear axle with holes on control link (5) mounting lugs to the rear. Apply Loctite 243 to bolts (11) and secure bracket (2) to rear axle with bolts (11) and hardened washers (12). Tighten bolts (11) to a torque of 457 Nm (337 lbf ft).

2. Install RH bracket (1) on rear axle with control link (5) mounting brackets to underside and bracket extension to the front. Secure bracket (1) to rear axle with bolts (8 & 18), hardened washers (9) and locknuts (10). Install bolts from the top with hardened washers and locknuts at the bottom. Tighten bolts (8 & 18) to a torque of 790 Nm (583 lbf ft).

3. Install LH bracket (3) on rear axle with control link (5) mounting brackets to underside and pointing inwards towards the rear. Secure bracket (3) to rear axle with bolts (8), hardened washers (9) and locknuts (10). Install bolts from the top with hardened washers and locknuts at the bottom. Tighten bolts (8) to a torque of 790 Nm (583 lbf ft).

4. Install interleaf mountings (7) on the rear axle. Apply Loctite 243 to bolts (16) and secure interleaf mounts (7) on the rear axle with bolts (16) and lockwashers (19). Tighten bolts (16) to a torque of 169 Nm (125 lbf ft).

5. Install bracket (2) on centre axle with holes on control link (5) mounting lugs to the front. Apply Loctite 243 to bolts (11) and secure bracket (2) to centre axle with bolts (11) and hardened washers (12). Tighten bolts (11) to a torque of 457 Nm (337 lbf ft).

6. Install LH bracket (1) on centre axle with control link (5) mounting brackets to underside and bracket extension to the rear. Secure bracket (1) to centre axle with bolts (8 & 18), hardened washers (9) and locknuts (10). Install bolts from the top with hardened washers and locknuts at the bottom. Tighten bolts (8 & 18) to a torque of 790 Nm (583 lbf ft).

7. Install RH bracket (3) on centre axle with control link (5) mounting brackets to underside and pointing inwards towards the rear. Secure bracket (3) to centre axle with bolts (8), hardened washers (9) and locknuts (10). Install bolts from the top with hardened washers and locknuts at the bottom. Tighten bolts (8) to a torque of 790 Nm (583 lbf ft).

8. Install interleaf mountings (7) on the centre axle. Apply Loctite 243 to bolts (16) and secure interleaf mounts (7) on the centre axle with bolts (16) and lockwashers (19). Tighten bolts (16) to a torque of 169 Nm (125 lbf ft).

9. Install control links (5) between rear and centre axle mounting brackets (1 & 3) and frame mounting brackets and secure with bolts (28), hardened washers (12) and locknuts (14). Install bolts (28) with bolt heads to the brackets. Tighten bolts (28) to a torque of 531 Nm (392 lbf ft).

Note: Ensure that there is at least 2/3 mounting surface area contact. Check contact area using a 0.05 mm (0.002 in) feeler gauge.

10. Install control links (5) between rear and centre axle mounting brackets (2) and frame mounting brackets and secure with bolts (15), hardened washers (12) and locknuts (14). Tighten bolts (15) to a torque of 531 Nm (392 lbf ft).

Note: Ensure that there is at least 2/3 mounting surface area contact. Check contact area using a 0.05 mm (0.002 in) feeler gauge.

11. Install control link (31) between mounting bracket (1) on centre axle and LH frame mounting bracket and secure with bolts (13 & 28), hardened washers (12) and locknuts (14). Tighten bolts (13 & 28) to a torque of 531 Nm (392 lbf ft).

Note: Ensure that there is at least 2/3 mounting surface area contact. Check contact area using a 0.05 mm (0.002 in) feeler gauge.

12. Install control link (31) between mounting bracket (1) on rear axle and RH frame mounting bracket and secure with bolts (13 & 28), hardened washers (12) and locknuts (14). Tighten bolts (13 & 28) to a torque of 531 Nm (392 lbf ft).

Note: Ensure that there is at least 2/3 mounting surface area contact. Check contact area using a 0.05 mm (0.002 in) feeler gauge.

13. Using a suitable solvent, clean equalizer beam (4) shaft on the frame. Install new 'V' ring seal (33) and new wear rings (20) on the shaft with flanges to the inside. Ensure mounting holes on the ends of the shaft are clean.

14. Using a suitable solvent, clean the bores of equalizer beams (4). Install new bushings (21) in equalizer beams (4) aligning holes in bushings with holes in equalizer beams.

15. Using suitable lifting equipment, install equalizer beam (4) on frame shaft. Apply Loctite 243 to bolts (24) and secure equalizer beam (4) to shaft with bolts (24), washers (23) and retaining plate (22). Tighten bolts (24) to a torque of 169 Nm (125 lbf ft).

16. Apply Loctite 243 to bolts (26). Install cover plate (25) to equalizer beam (4) and secure with bolts (26) and washers (17). Tighten bolts (26) to a torque of 73 Nm (54 lbf ft).

17. Apply Loctite 243 to lube fitting (27) and install in cover plate (25). Lubricate with grease specified in Section 300-0020, LUBRICATION SYSTEM, until excess lube is seen.

18. Repeat steps 15 through 17 to install opposite equalizer beam (4).

19. Connect interleaf mounts (7) to equalizer beams (4) with bolts (29), lockwashers (19) and locknuts (30). Tighten bolts (29) to a torque of 169 Nm (125 lbf ft).

20. Remove caps and connect hydraulic brake lines to tees on centre axle and rear axle assemblies.

21. Using suitable blocking equipment, block equalizer beams (4) to prevent movement when installing rear wheels.

22. Using suitable lifting equipment, position one tyre and rim assembly on one rear wheel and secure with wheel nuts.

23. Repeat step 22 for remaining rear wheels.

24. Using suitable lifting equipment, raise trailer frame sufficiently to remove stands and blocking from the axles, articulation pivot and trailer frame. Lower vehicle to the ground and remove lifting equipment. Tighten all wheel nuts to torque specified in Section 160-0050, WHEEL RIM AND TYRE.

25. Remove wheel blocks from front road wheels and place the steering lock bar in the 'Stowed' position.

26. Bleed all air from hydraulic brake lines. Refer to Section 165-0010, BRAKE PARTS.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

Every 250 Hours: Lubricate equalizer beam bushings (21) through lube fittings (27) with grease specified in Section 300-0020, LUBRICATION SYSTEM, until excess lube is seen.

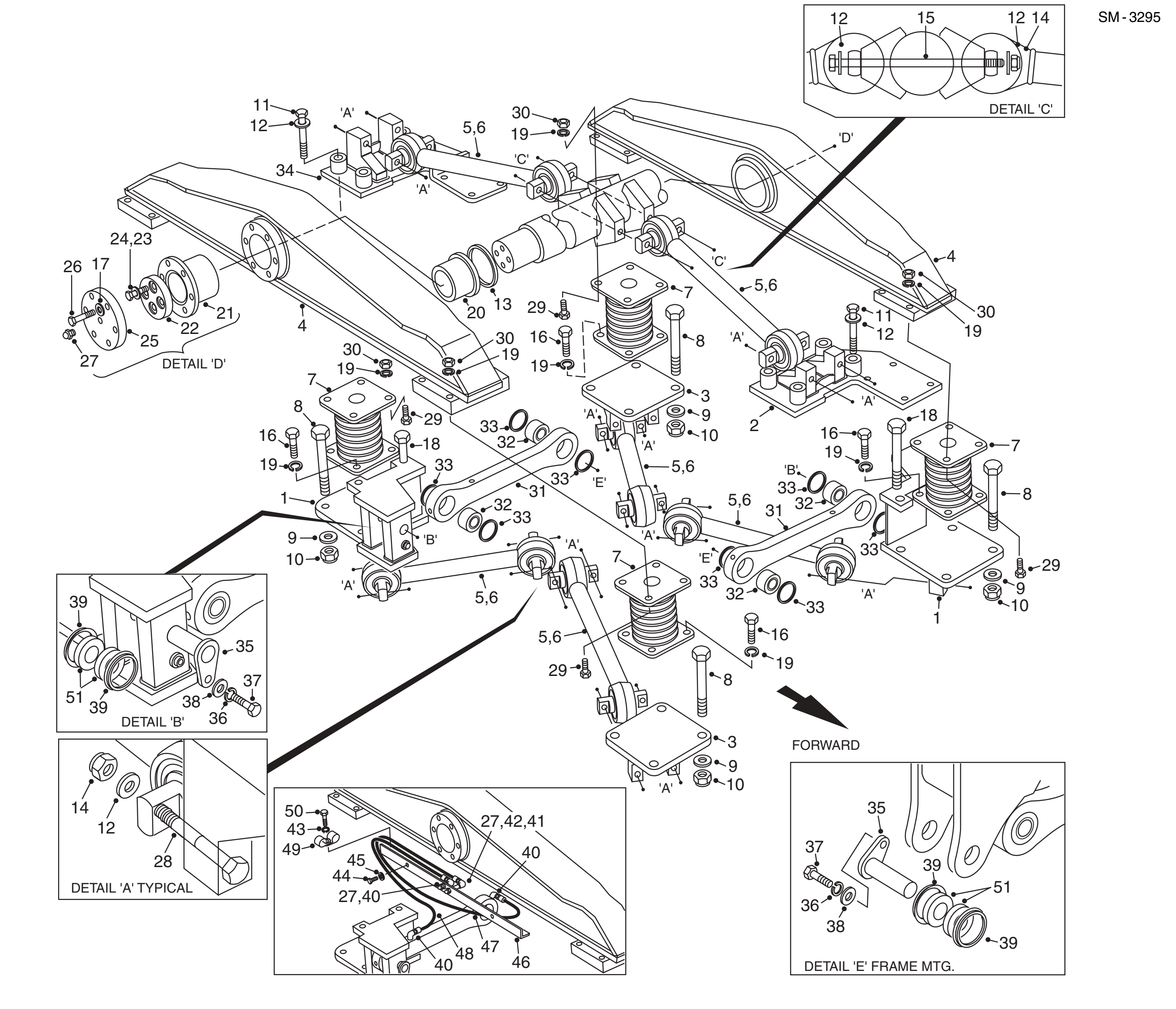
SPECIAL TOOLS

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.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE Nm	TORQUE lbf ft
1	8 & 18	Bolt	790	583
1	11	Bolt	457	337
1	15 & 28	Bolt	531	392
1	16, 24 & 29	Bolt	169	125
1	26	Bolt	73	54

* * * *



1 - Bracket assembly	12 - Hardened Washer	22 - Retaining Plate	32 - Spherical Bearing	42 - Elbow
2 - Bracket assembly	13 - V-Ring Seal	23 - Washer	33 - Retainer	43 - Lockwasher
3 - Bracket assembly	14 - Locknut	24 - Bolt	34 - Bracket Assembly	44 - Bolt
4 - Equalizer Beam	15 - Bolt	25 - Cover Plate	35 - Pin	45 - Washer
5 - Control Link	16 - Bolt	26 - Bolt	36 - Lockwasher	46 - Manifold Bracket
6 - Bushing	17 - Washer	27 - Lube Fitting	37 - Bolt	47 - Grease Line
7 - Interleaf Mount	18 - Bolt	28 - Bolt	38 - Washer	48 - Grease Line
8 - Bolt	19 - Lockwasher	29 - Bolt	39 - V-Ring Seal	49 - P-Clip
9 - Hardened Washer	20 - Wear Ring	30 - Locknut	40 - elbow	50 - Bolt
10 - Locknut	21 - Bushing	31 - Panhard Rod	41 - Nipple	51 - Spacer
11 - Bolt				

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 leading or trailing control links (5) which provide longitudinal restraint. Lateral restraint is by transverse panhard rods (31).

Loads acting on the centre and rear axles are balanced by centrally pivoting equalizer beams (4) with rubber cushioning interleaf mounts (7) between axles and beam ends. Interleaf mounts (7) are rubber/steel laminated compression units with chain link ties.

Lubrication of spherical bearings (32) in panhard rods (31) is through lube fittings (27). Lubrication of bushings (21) in equalizer beams (4) is through lube fittings (27).

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. Position the vehicle in a level work area, raise the body and install body safety prop to secure body in partially raised position

2. Apply the parking brake and switch off the engine. Turn steering wheel several times to relieve any pressure in the steering system.

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

4. Using suitable blocking equipment, block equalizer beams 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 machine until the rear wheels are off the ground. Support the vehicle with suitable stands and blocking at the trailer frame, articulation pivot area and centre and rear axle assemblies.

7. Support one tyre and rim assembly with suitable lifting equipment and remove wheel nuts securing the rim to the axle. Remove tyre and rim assembly.

8. Repeat step 7 for the remaining rear tyre and rim assemblies.

9. Disconnect hydraulic brake lines from tee at both the centre axle and rear axle assemblies. Cap lines and fittings to prevent ingress of dirt.

10. Remove blocking equipment from equalizer beams (4).

11. Disconnect grease lines (47 & 48) from elbows (40), on both panhard rods (31). Cap lines and fittings. If necessary remove elbows (40) from panhard rods (31).

12. Remove bolts (44) and washers (45) securing manifold brackets (46) to equaliser beams (4). Remove manifold brackets (46).

13. Remove locknuts (30), lockwashers (19) and bolts (29) securing interleaf mounts (7) to equalizer beams (4).

14. Remove bolts (16) and lockwashers (19) securing interleaf mounts (7) to brackets (1 & 3) mounted on the centre and rear axles. Remove interleaf mounts (7).

15. Remove bolts (26) and washers (17) securing cover (25) to equalizer beam (4). Remove cover (25).

16. Remove bolts (24) and washers (23) securing retaining plate (22) to shaft on frame. Remove retaining plate (22).

17. Using suitable lifting equipment, support equalizer beam (4) and withdraw from shaft on frame. If required remove bushing (21) from equalizer beam (4).

18. Remove wear ring (20) and 'V' ring seal (13) from shaft on frame.

19. Repeat steps 13 through 16 to remove the opposite equalizer beam (4).

20. Remove locknuts (14), hardened washers (12) and bolts (15 & 28) securing control links (5) between the rear and centre axle brackets (1, 2 , 3 & 34) and frame mounting brackets. Remove control links (5).

21. Refer to detail 'B' & 'E'. Remove bolts (37), lockwashers (36) and washers (38) securing pins (35) through mounting brackets (1) on both centre axle/ LH frame mounting bracket and the rear axle / RH frame mounting brackets.

22. Remove both panhard rods (31), v-ring seals (39) and spacers (51). If necessary remove retainers (33) and spherical bearings (32) from panhard rods (21).

23. Remove locknuts (10), hardened washers (9) and bolts (8) securing mounting bracket (3) on the rear axle. Remove mounting bracket (3).

24. Remove locknuts (10), hardened washers (9) and bolts (8 & 18) securing mounting bracket (1) on the rear axle. Remove mounting bracket (1).

25. Remove bolts (11) and hardened washers (12) securing mounting bracket (2) on the rear axle. Remove mounting bracket (2).

26. Remove locknuts (10), hardened washers (9) and bolts (8) securing mounting bracket (3) on the centre axle. Remove mounting bracket (3).

27. Remove locknuts (10), hardened washers (9) and bolts (8 & 18) securing mounting bracket (1) on the centre axle. Remove mounting bracket (1).

28. Remove bolts (11) and hardened washers (12) securing mounting bracket (34) on the centre axle.

INSTALLATION

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. Install bracket (2) on rear axle with holes on control link (5) mounting lugs to the rear. Apply Loctite 243 to bolts (11) and secure bracket (2) to rear axle with bolts (11) and hardened washers (12). Tighten bolts (11) to a torque of 457 Nm (337 lbf ft).

2. Install RH bracket (1) on rear axle with control link (5) mounting brackets to underside and bracket extension to the front. Secure bracket (1) to rear axle with bolts (8 & 18), hardened washers (9) and locknuts (10). Install bolts from the top with hardened washers and locknuts at the bottom. Tighten bolts (8 & 18) to a torque of 790 Nm (583 lbf ft).

3. Install LH bracket (3) on rear axle with control link (5) mounting brackets to underside and pointing inwards towards the rear. Secure bracket (3) to rear axle with bolts (8), hardened washers (9) and locknuts (10). Install bolts from the top with hardened washers and locknuts at the bottom. Tighten bolts (8) to a torque of 790 Nm (583 lbf ft).

4. Install interleaf mountings (7) on the rear axle. Apply Loctite 243 to bolts (16) and secure interleaf mounts (7) on the rear axle with bolts (16) and lockwashers (19). Tighten bolts (16) to a torque of 169 Nm (125 lbf ft).

5. Install bracket (2) on centre axle with holes on control link (5) mounting lugs to the front. Apply Loctite 243 to bolts (11) and secure bracket (2) to centre axle with bolts (11) and hardened washers (12). Tighten bolts (11) to a torque of 457 Nm (337 lbf ft).

6. Install LH bracket (1) on centre axle with control link (5) mounting brackets to underside and bracket extension to the rear. Secure bracket (1) to centre axle with bolts (8 & 18), hardened washers (9) and locknuts (10). Install bolts from the top with hardened washers and locknuts at the bottom. Tighten bolts (8 & 18) to a torque of 790 Nm (583 lbf ft).

7. Install RH bracket (3) on centre axle with control link (5) mounting brackets to underside and pointing inwards towards the rear. Secure bracket (3) to centre axle with bolts (8), hardened washers (9) and locknuts (10). Install bolts from the top with hardened washers and locknuts at the bottom. Tighten bolts (8) to a torque of 790 Nm (583 lbf ft).

8. Install interleaf mountings (7) on the centre axle. Apply Loctite 243 to bolts (16) and secure interleaf mounts (7) on the centre axle with bolts (16) and lockwashers (19). Tighten bolts (16) to a torque of 169 Nm (125 lbf ft).

9. Install control links (5) between rear and centre axle mounting brackets (1 & 3) and frame mounting brackets and secure with bolts (28), hardened washers (12) and locknuts (14). Install bolts (28) with bolt heads to the brackets. Tighten bolts (28) to a torque of 531 Nm (392 lbf ft).

Note: Ensure that there is at least 2/3 mounting surface area contact. Check contact area using a 0.05 mm (0.002 in) feeler gauge.

10. Install control links (5) between rear and centre axle mounting brackets (2) and frame mounting brackets and secure with bolts (15), hardened washers (12) and locknuts (14). Tighten bolts (15) to a torque of 531 Nm (392 lbf ft).

Note: Ensure that there is at least 2/3 mounting surface area contact. Check contact area using a 0.05 mm (0.002 in) feeler gauge.

11. Install panhard rod (31) between mounting bracket (1) on centre axle and LH frame mounting bracket. Locate spacers (51), v-ring seals (39) and panhard rod (31) ends in place. Insert pins (35) into bores and secure pins (35) in place with washers (38), lockwashers (36) and bolts (37).

Note: Ensure that there is at least 2/3 mounting surface area contact. Check contact area using a 0.05 mm (0.002 in) feeler gauge.

12. Install panhard rod (31) between mounting bracket (1) on rear axle and RH frame mounting bracket. Locate spacers (51), v-ring seals (39) and panhard rod (31) ends in place. Insert pins (35) into bores and

secure pins (35) in place with washers (38), lockwashers (36) and bolts (37).

Note: Ensure that there is at least 2/3 mounting surface area contact. Check contact area using a 0.05 mm (0.002 in) feeler gauge.

13. Using a suitable solvent, clean equalizer beam (4) shaft on the frame. Install new 'V' ring seal (13) and new wear rings (20) on the shaft with flanges to the inside. Ensure mounting holes on the ends of the shaft are clean.

14. Using a suitable solvent, clean the bores of equalizer beams (4). Install new bushings (21) in equalizer beams (4) aligning holes in bushings with holes in equalizer beams.

15. Using suitable lifting equipment, install equalizer beam (4) on frame shaft. Apply Loctite 243 to bolts (24) and secure equalizer beam (4) to shaft with bolts (24), washers (23) and retaining plate (22). Tighten bolts (24) to a torque of 169 Nm (125 lbf ft).

16. Apply Loctite 243 to bolts (26). Install cover plate (25) to equalizer beam (4) and secure with bolts (26) and washers (17). Tighten bolts (26) to a torque of 73 Nm (54 lbf ft).

17. Apply Loctite 243 to lube fitting (27) and install in cover plate (25). Lubricate with grease specified in Section 300-0020, LUBRICATION SYSTEM, until excess lube is seen.

18. Repeat steps 15 through 17 to install opposite equalizer beam (4).

19. Connect interleaf mounts (7) to equalizer beams (4) with bolts (29), lockwashers (19) and locknuts (30). Tighten bolts (29) to a torque of 169 Nm (125 lbf ft).

20. Remove caps and connect hydraulic brake lines to tees on centre axle and rear axle assemblies.

21. Using suitable blocking equipment, block equalizer beams (4) to prevent movement when installing rear wheels.

22. Secure manifold brackets (46) to equaliser beams (4), using bolts (44) and washers (45). Fit elbows (40 & 41) to panhard rods (31) and nipples (42).

23. Route grease lines (47 & 48); securing to manifold brackets (46), using clips (49), lockwashers (43) and bolts (50). Connect grease lines (47 & 48) to their respective elbows (40 & 42).

24. Using suitable lifting equipment, position one tyre and rim assembly on one rear wheel and secure with wheel nuts.

25. Repeat step 24 for remaining rear wheels.

26. Using suitable lifting equipment, raise trailer frame sufficiently to remove stands and blocking from the axles, articulation pivot and trailer frame. Lower vehicle to the ground and remove lifting equipment. Tighten all wheel nuts to torque specified in Section 160-0050, WHEEL RIM AND TYRE.

27. Remove wheel blocks from front road wheels and place the steering lock bar in the 'Stowed' position.

28. Bleed all air from hydraulic brake lines. Refer to Section 165-0010, BRAKE PARTS.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

Every 250 Hours: Lubricate equalizer beam bushings (21) through lube fittings (27) with grease specified in Section 300-0020, LUBRICATION SYSTEM, until excess lube is seen.

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.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE Nm	TORQUE lbf ft
1	8 & 18	Bolt	790	583
1	11	Bolt	457	337
1	15 & 28	Bolt	531	392
1	16, 24 & 29	Bolt	169	125
1	26	Bolt	73	54

* * * *

COMPONENT DESIGNATIONS

A4 - Radio/cassette
A5 - Radio/cassette speaker

B2 - Coolant temperature sender
B7 - Coolant Level sender
B13 - Rot'nl speed sensor
B15 - Air temperature sender
B19 - Throttle position sender
B20 - Engine oil temp sender
B21 - Trans oil temp sender
B22 - Engine oil press sender
B24 - Turbo boost sender
B25 - Fuel pressure sender
B26 - Fuel temperature sender
B27 - Synchro reference sender
B28 - Timing reference sender
B32 - Trans oil retard temp sender
B33 - Air cond temp sender

E3 - Interior light
E5 - Reverse light
E7 - Inst panel lights
E11 - Side marker light, L
E12 - Taillight, L
E13 - Side marker light, R
E14 - Taillight, R
E15 - High/low beam headlamp, L
E16 - High/low beam headlamp, R
E19 - Rear fog lamp (Option)
E21 - Rotating Beacon (Option)
E23 - Work light (Option)
E26 - High beam headlamp, L
E27 - High beam headlamp, R
E35 - Heated mirror

G1 - Generator
G2 - Battery

H2 - Warning light
H5 - Dir indicator w/l
H6 - Dir indicator, F, L
H7 - Dir indicator, B, L
H8 - Dir indicator, F, R
H9 - Dir indicator, B, R
H10 - Brake light, L
H11 - Brake light, R
H12 - High beam w/l
H23 - Engine check w/l
H24 - Engine stop w/l
H27 - Trans stop w/l

K1 - Starter relay
K4 - Dir ind flasher unit
K5 - Air cond compressor clutch
K14 - Start interlock relay
K15 - Headlamp relay
K17 - Reverse relay
K21 - Trans shift clutch
K22 - Lock-up clutch
K23 - Ignition relay
K32 - Eng comp brake relay on
K33 - Radiator fan relay
K34 - Horn relay
K35 - Body up relay
K36 - Body float relay
K37 - Body hyd system relay 12V
K40 - Radiator solenoid valve
K43 - Radio/cassette relay
K45 - Brake pump compensator
K57 - Sound power relay No. 1
K58 - Sound power relay No. 2

L3 - Reverse alarm
L4 - Buzzer
L5 - Electric horn

M1 - Starter motor
M3 - Heater 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
P8 - Trans. Oil Temp. gauge

R7 - Cigar Lighter

S1 - Battery master switch
S2 - Starter keyswitch
S4 - W/L test switch
S7 - Emergency/park brake sw
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
S29 - Retarder request switch
S31 - Park brake w/l switch
S37 - Axle difflock switch
S40 - Gear shift selector
S41 - Auxillary lights switch
S43 - Air cond pressure sw
S48 - Accumulator press sw, F
S49 - Accumulator press sw, B
S55 - Brake diff press switch
S57 - Steering press switch
S60 - Difflock request switch
S67 - Lock-up press switch
S68 - Diagnostic request & engine override switch
S71 - Air cond rheostat switch
S74 - Kickdown switch
S77 - Trans difflock switch
S79 - Heated mirror switch
S80 - Engine compression brake deacceleration mode switch
S81 - Retarder/engine compression brake selection switch
S82 - Eng comp brake on/off switch
S90 - Trans. filter restriction switch

X1 - Handlamp socket

Y3 - Retarder valve
Y4 - Brake diverter valve
Y7 - Difflock valve transmission
Y7 - Difflock valve middle axle
Y20 - Fuel injector
Y26 - Body raise solenoid
Y27 - Body lower solenoid
Y29 - Engine comp brake solenoid

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

TERMINAL DESIGNATIONS IN ACCORDANCE WITH DIN 72 552
L - LEFT R - RIGHT F - FRONT B - BACK

DIODE RESISTOR FUSE PLUG

TRAILER CONNECTION

DDEC IV COMPONENT AND CABLE DESIGNATIONS

STANDARD (DDEC) CABLES

109 - Timing reference sender ground
110 - Timing reference sender supply
111 - Sync reference sender supply
112 - Sync reference sender ground
115 - ECM supply to coolant level sender
120 - Oil temperature sender supply
132 - Air temperature sender supply
133 - Coolant temperature sender supply
150 - ECM to master switch ground
151 - ECM to master switch ground
240 - 24 Volt battery post to ECM via 15A fuse
241 - 24 Volt battery post to ECM via 15A fuse
416 - Engine sender supplys (5VDC)
417 - Throttle position sender signal
419 - Check engine light ground to ECM
432 - Turbo boost sender signal
439 - Ignition sensed supplys
440 - 24 Volt battery post to ignition relay
452 - Engine sender returns
472 - Fuel temperature sender supply
509 - Stop engine light ground to ECM
528 - Diagnostic/stop engine override switch
530 - Oil pressure sender signal
531 - Digital input transmission lockup
561 - Engine compression brake low solenoid
562 - Engine compression brake medium solenoids
583 - Digital input engine compression brake low
611 - Injector 1 power drive
612 - Injector 5 power drive
613 - Injector 3 power drive
614 - Injector 6 power drive
615 - Injector 2 power drive
616 - Injector 4 power drive
619 - Injectors 1, 2, 3 returns
620 - Injectors 4, 5, 6 returns
900 - Data link diagnostics supply
901 - Data links diagnostics return
905 - Fuel pressure sender signal
911 - PWM radiator fan ground
916 - Throttle sender supply (5VDC)
925 - CAN H / J1939 (+) control link data
926 - CAN L / J1939 (-) control link data
927 - CAN SHLD / J1939 shield
952 - Throttle return
953 - Master switch grounds
979 - Digital input engine compression brake medium

NOTES:

1. DDEC IV WIRE NUMBERS ARE IN ( ).
2. WIRES MARKED * ARE SUPPLIED WITH ENGINE.
3. SOME DDEC III & IV HARNESSES ARE SHIELDED FROM ELECTRO MAGNETIC INDUCTION WHERE THEY RUN CLOSE TO OTHER VEHICLE SYSTEMS.

TERMINAL DESIGNATIONS IN ACCORDANCE WITH DIN 72 552

L - LEFT   R - RIGHT   F - FRONT   B - BACK

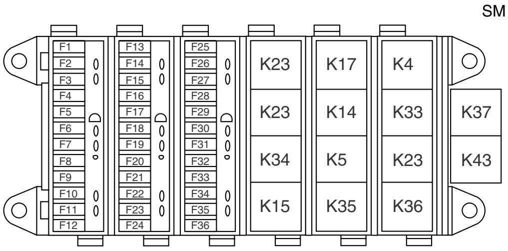
DIODE   FUSE   CABLES TWISTED 30 TURNS / metre   TRAILER CONNECTION

INDICATOR LIGHT   RESISTOR   SCREENED CABLES

FUSES

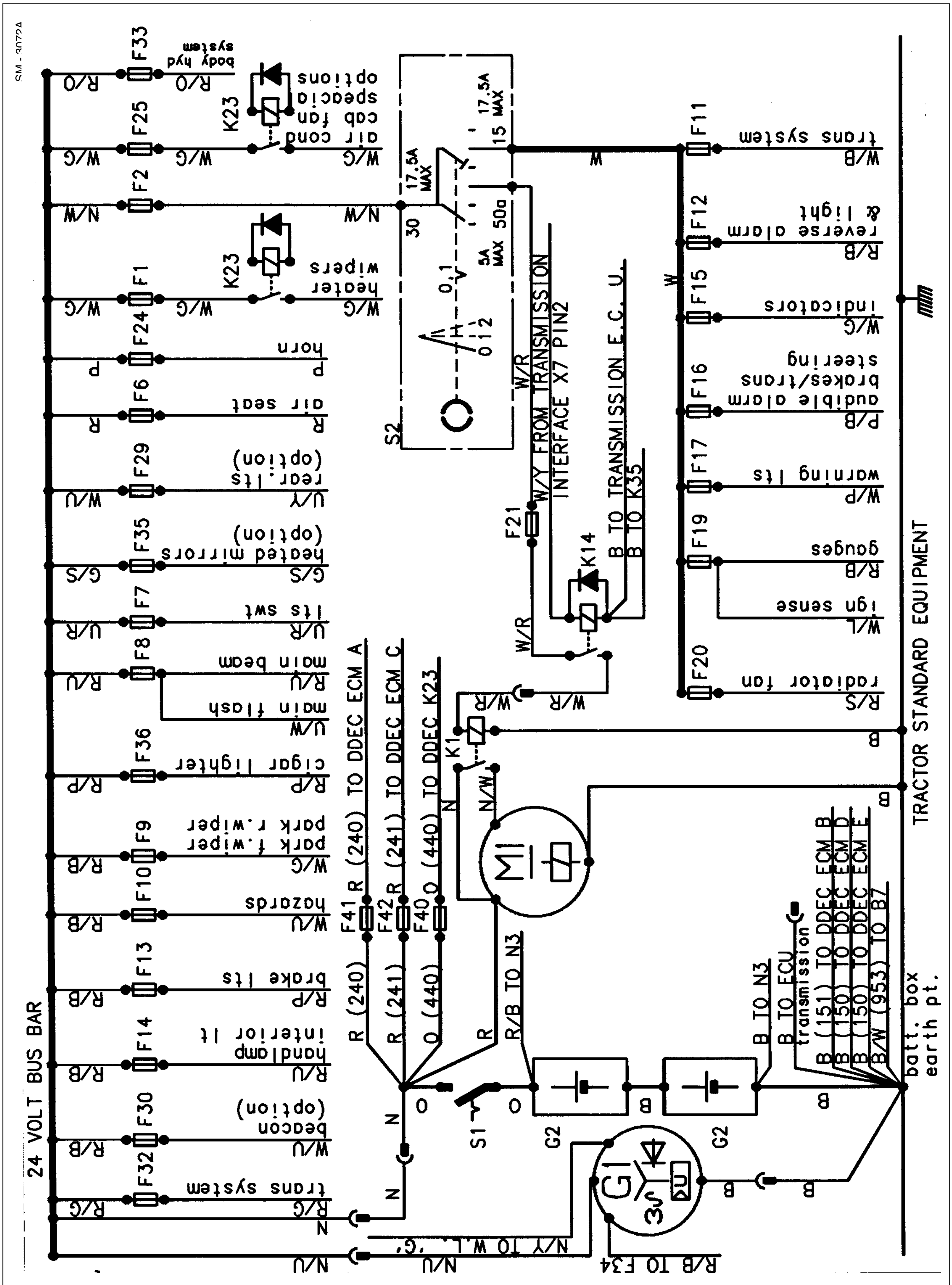
Location	Fuse No.	Circuit	Current Rating
Fuse Box - Column A	1	Ignition Sensed Relay Contacts (Heater)	30A
	2	Keyswitch	15A
	3	Cab Fan Ventilator Blower	15A
	4	Rear Wash/Wipe	10A
	5	Horn Relay Coil, Front Wash/Wipe	10A
	6	Air Seat Compressor	10A
	7	Lights Switch	10A
	8	Main Beam	10A
	9	Wiper Park Front 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	Spare	-
	19	Gauges/Ignition Sensed Relay Coils	3A
	20	Radiator Fan	3A
	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 Conditioning Compressor	15A
	27	Spare	-
	28	Ignition Auxilary Supply Option	10A
	29	Work 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	Cigar Lighter	10A
Radio Harness	38	Radio/Cassette Supply (Glass Fuse)	7A
	39	Radio/Cassette Supply (Glass Fuse)	1A
Battery Box	40	DDEC IV ECM Ignition Sensed Supply	5A
	41	DDEC IV ECM Battery Supply	15A
	42	DDEC IV ECM Battery Supply	15A
Bus Bar	47	Sound Power Legislation Relay No. 1 Supply	3A

SM - 2571

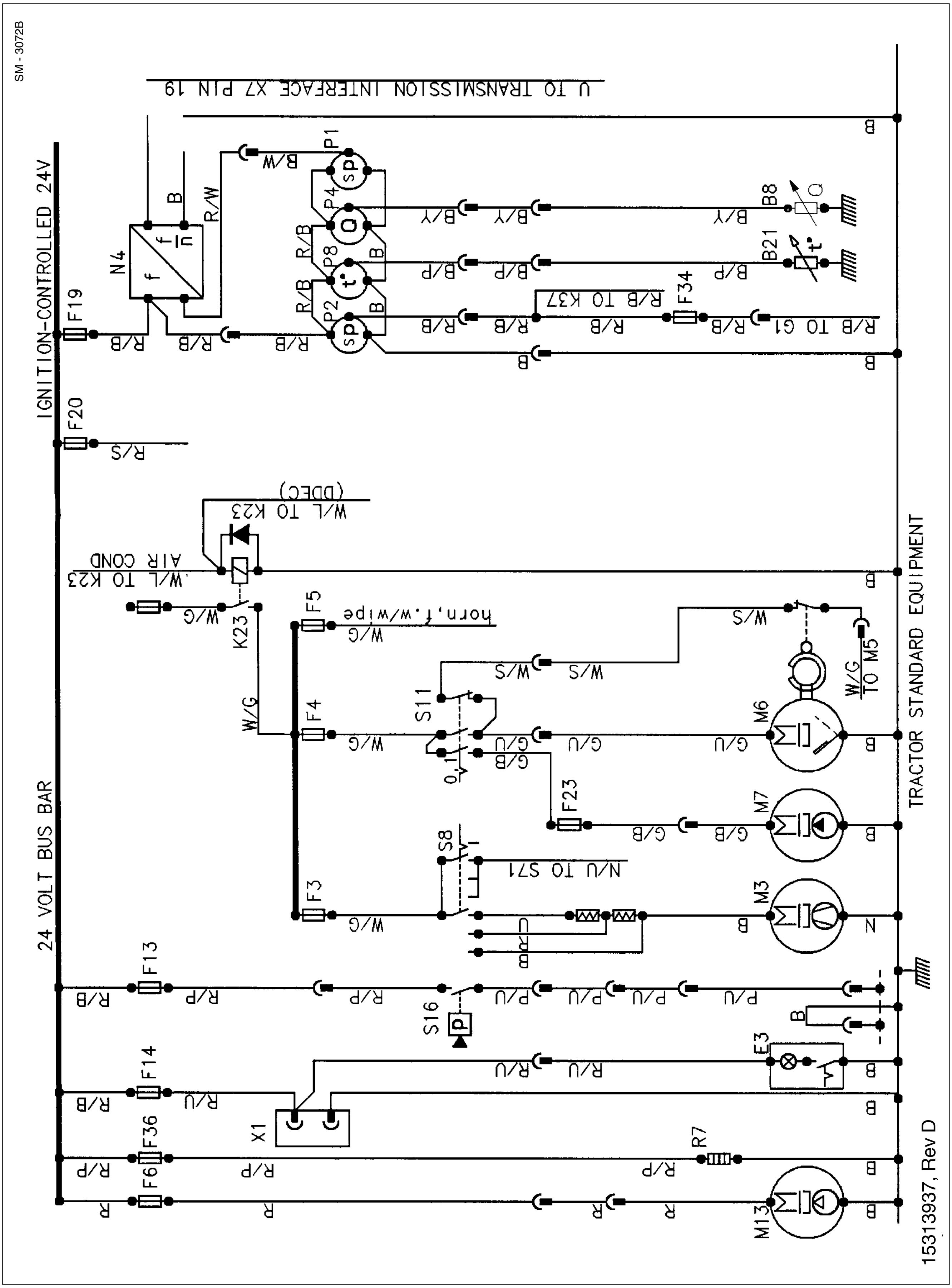


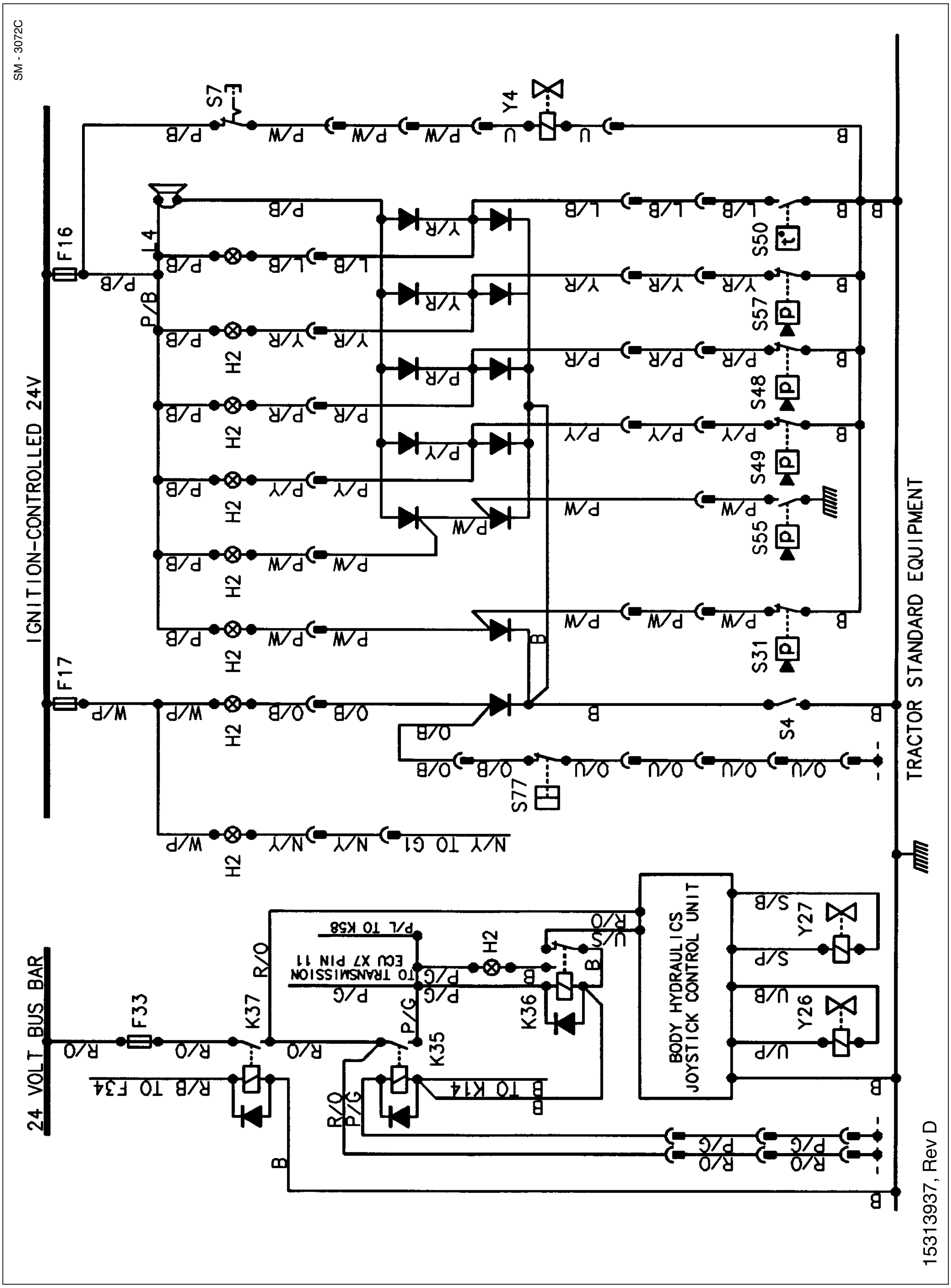
RELAYS

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

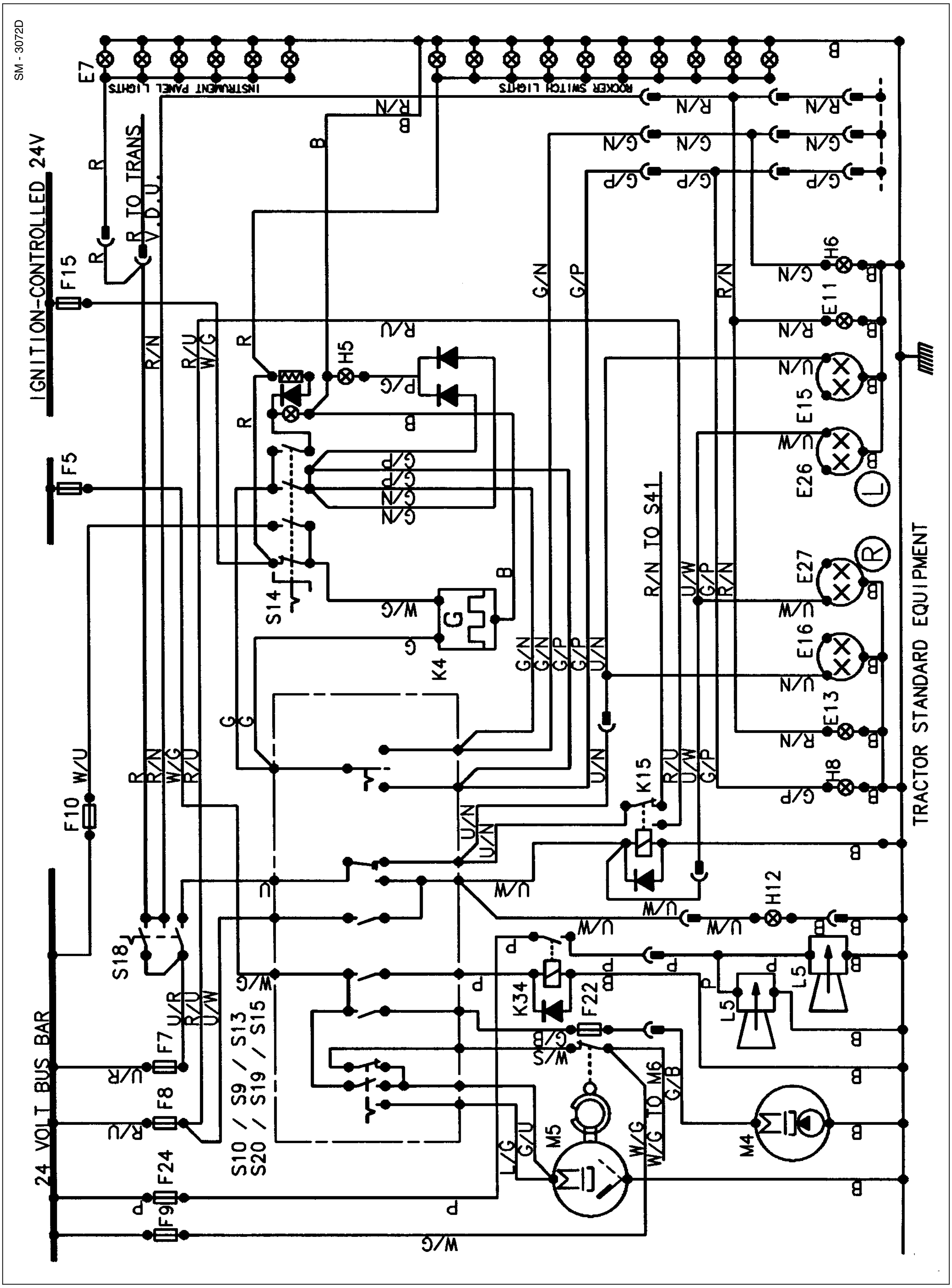


24 VOLT BUS BAR
TRACTOR STANDARD EQUIPMENT
trans system
reverse alarm & light
indicators
audible alarm brakes/trans steering
warning lts
gauges
ign sense
radiator fan
body hyd system
air cond cab fan special options
heater wipers
horn
air seat
rear. lts (option)
heated mirrors (option)
lts swt
main beam
main flash
cigar lighter
park f.wiper
park r.wiper
hazards
brake lts
interior lt handlamp
beacon (option)
W/Y FROM TRANSMISSION INTERFACE X7 PIN2
B TO TRANSMISSION E.C.U.
B TO K35
R (240) TO DDEC ECM A
R (241) TO DDEC ECM C
O (440) TO DDEC K23
R/B TO N3
B TO N3
B TO ECU transmission
B (151) TO DDEC ECM B
B (150) TO DDEC ECM D
B (150) TO DDEC ECM E
B/W (953) TO B7
batt. box earth pt.
N/Y TO W.L. 'G'
R/B TO F34

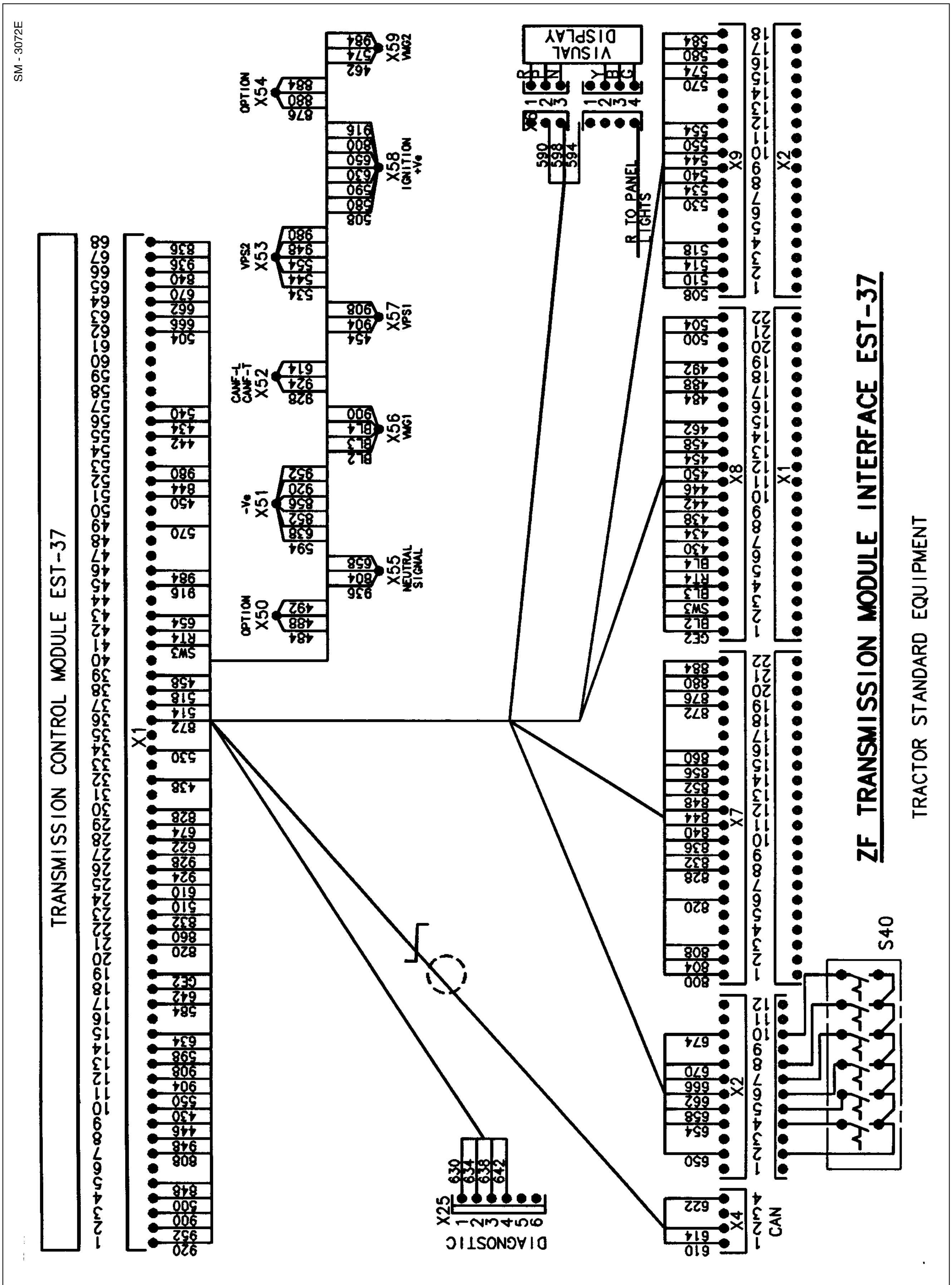

SM - 3072B
U TO TRANSMISSION INTERFACE X7 PIN 19
IGNITION-CONTROLLED 24V
24 VOLT BUS BAR
TRACTOR STANDARD EQUIPMENT
W/L TO K23 (DDEC)
W/L TO K23 AIR COND
R/B TO K37
R/B TO G1
N/U TO S71
W/G TO M5
horn, f.w/wipe
F19
F20
F5
F4
F3
F13
F14
F36
F6
F34
F23
N4
K23
S11
S8
S16
X1
R7
M13
M3
M7
M6
E3
B8
B21
P1
P2
P4
P8
15313937, Rev D



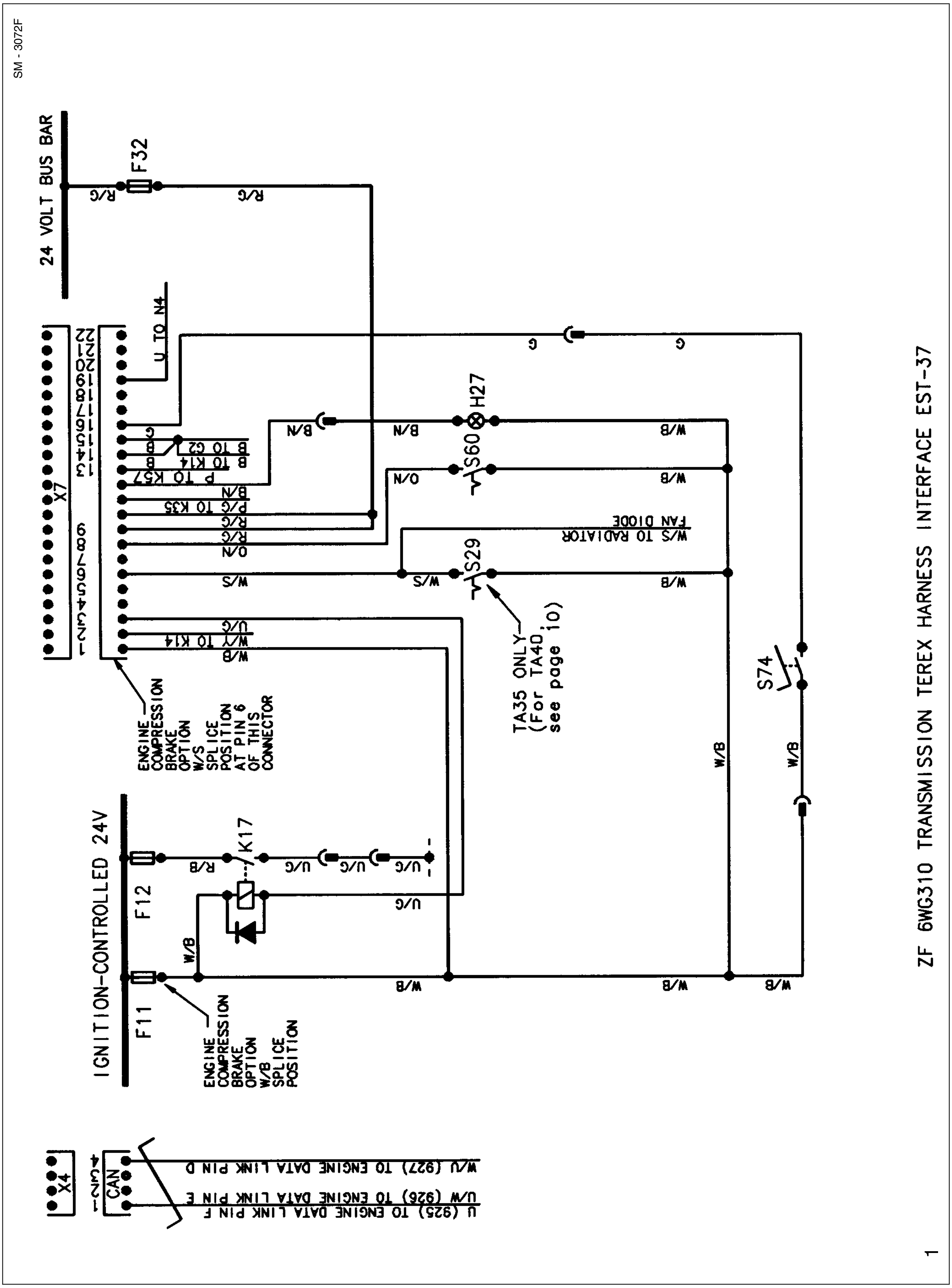
SM - 3072C
IGNITION-CONTROLLED 24V
F16
F17
S7
Y4
L4
H2
S50
S57
S48
S49
S55
S31
S4
S77
N/Y TO G1
TRACTOR STANDARD EQUIPMENT
24 VOLT BUS BAR
F33
K37
K35
K36
R/B TO F34
B TO K14
P/L TO K58
P/G TO TRANSMISSION ECU X7 PIN 11
BODY HYDRAULICS JOYSTICK CONTROL UNIT
Y27
Y26
15313937, Rev D

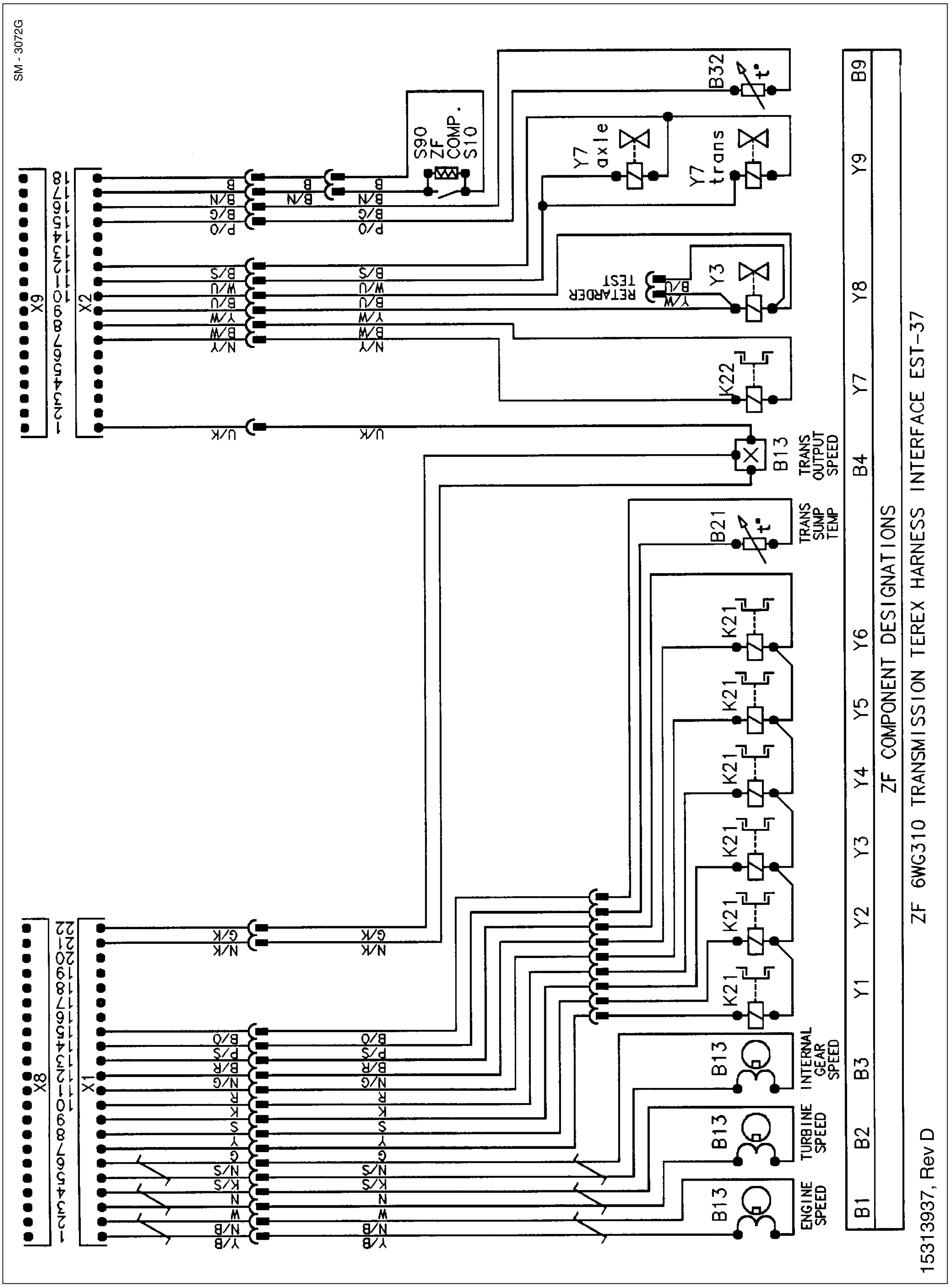


SM - 3072D
E7
INSTRUMENT PANEL LIGHTS
ROCKER SWITCH LIGHTS
IGNITION-CONTROLLED 24V
R TO TRANS
V.D.U.
F15
F5
F10
S18
F7
F8
F24
F9
24 VOLT BUS BAR
S14
K4
H5
S10 / S9 / S13 / S15
S20 / S19
R/N TO S41
K15
K34
F22
M5
W/G TO M6
M4
L5
H12
H6
E11
E15
E26
E27
E16
E13
H8
TRACTOR STANDARD EQUIPMENT

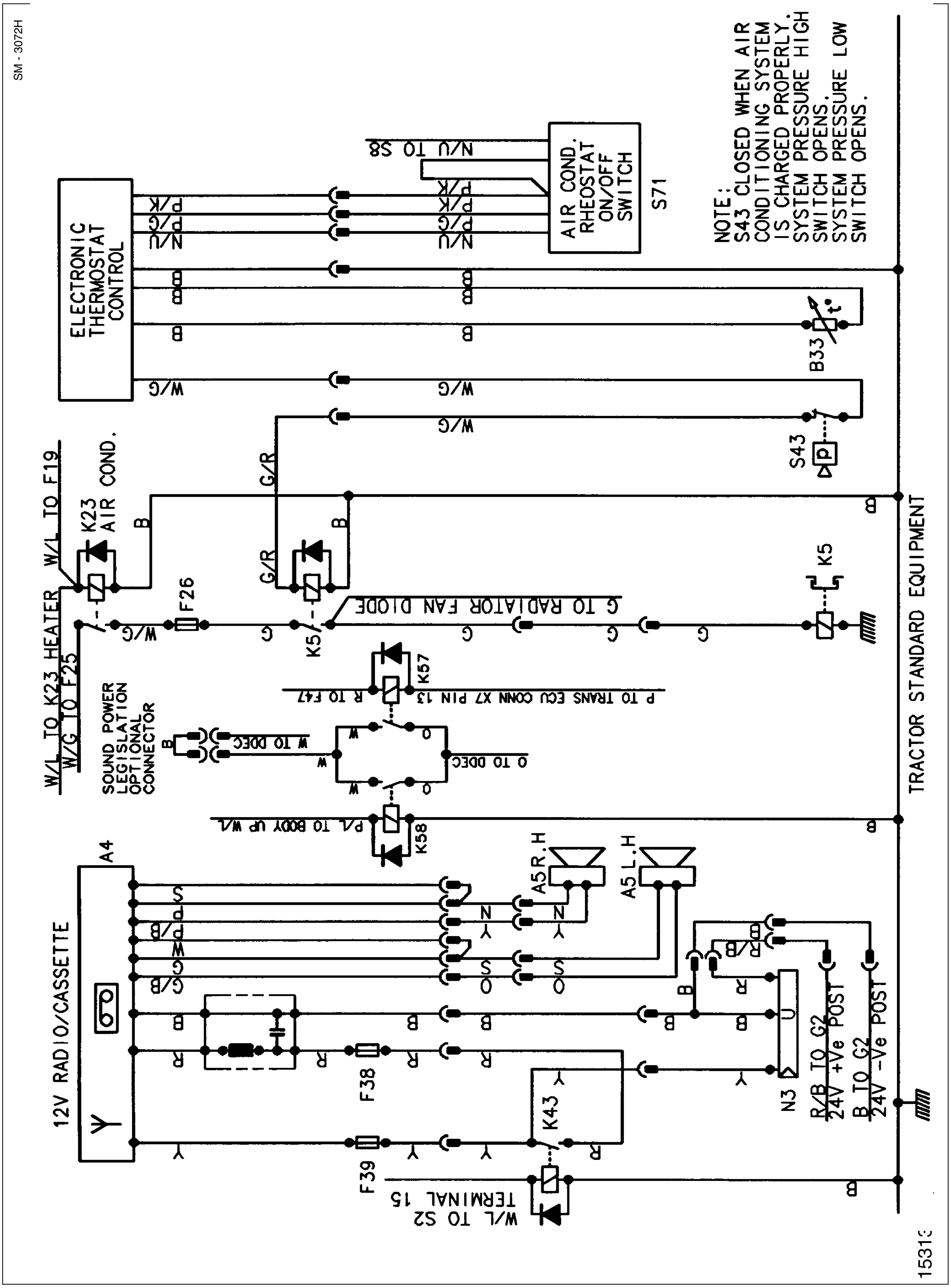


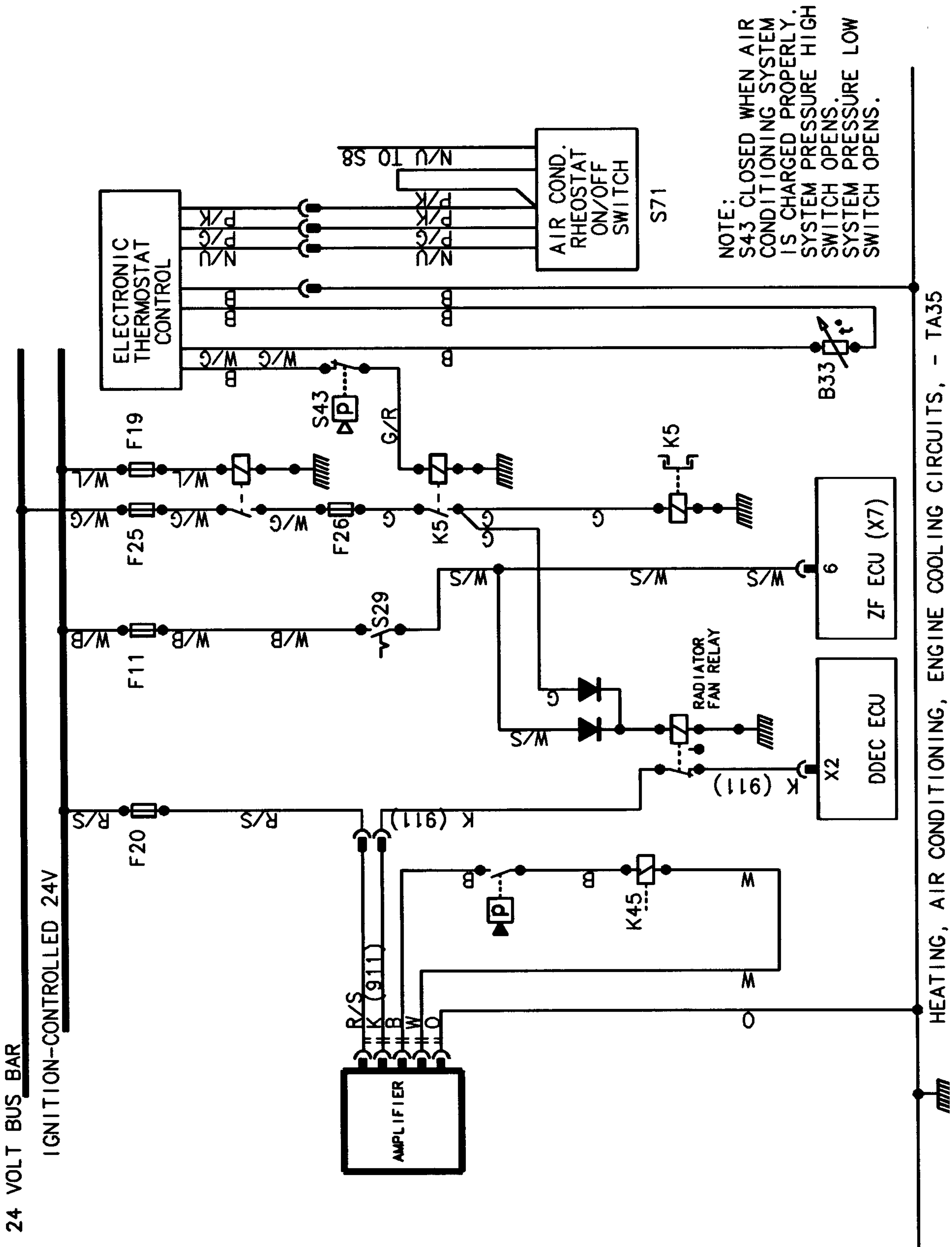
SM - 3072E
TRANSMISSION CONTROL MODULE EST-37
ZF TRANSMISSION MODULE INTERFACE EST-37
TRACTOR STANDARD EQUIPMENT
VISUAL DISPLAY
DIAGNOSTIC
R TO PANEL LIGHTS
CAN
S40


SM - 3072F
24 VOLT BUS BAR
F32
X7
U TO N4
P TO K57
B TO K14
B TO G2
P/G TO K35
W/Y TO K14
W/S TO RADIATOR FAN DIODE
H27
S60
S29
S74
TA35 ONLY (For TA40, see page 10)
ENGINE COMPRESSION BRAKE OPTION W/S SPLICE POSITION AT PIN 6 OF THIS CONNECTOR
IGNITION-CONTROLLED 24V
F11
F12
K17
ENGINE COMPRESSION BRAKE OPTION W/B SPLICE POSITION
ZF 6WG310 TRANSMISSION TEREX HARNESS INTERFACE EST-37
X4
CAN
W/U (927) TO ENGINE DATA LINK PIN D
U/W (926) TO ENGINE DATA LINK PIN E
U (925) TO ENGINE DATA LINK PIN F
1

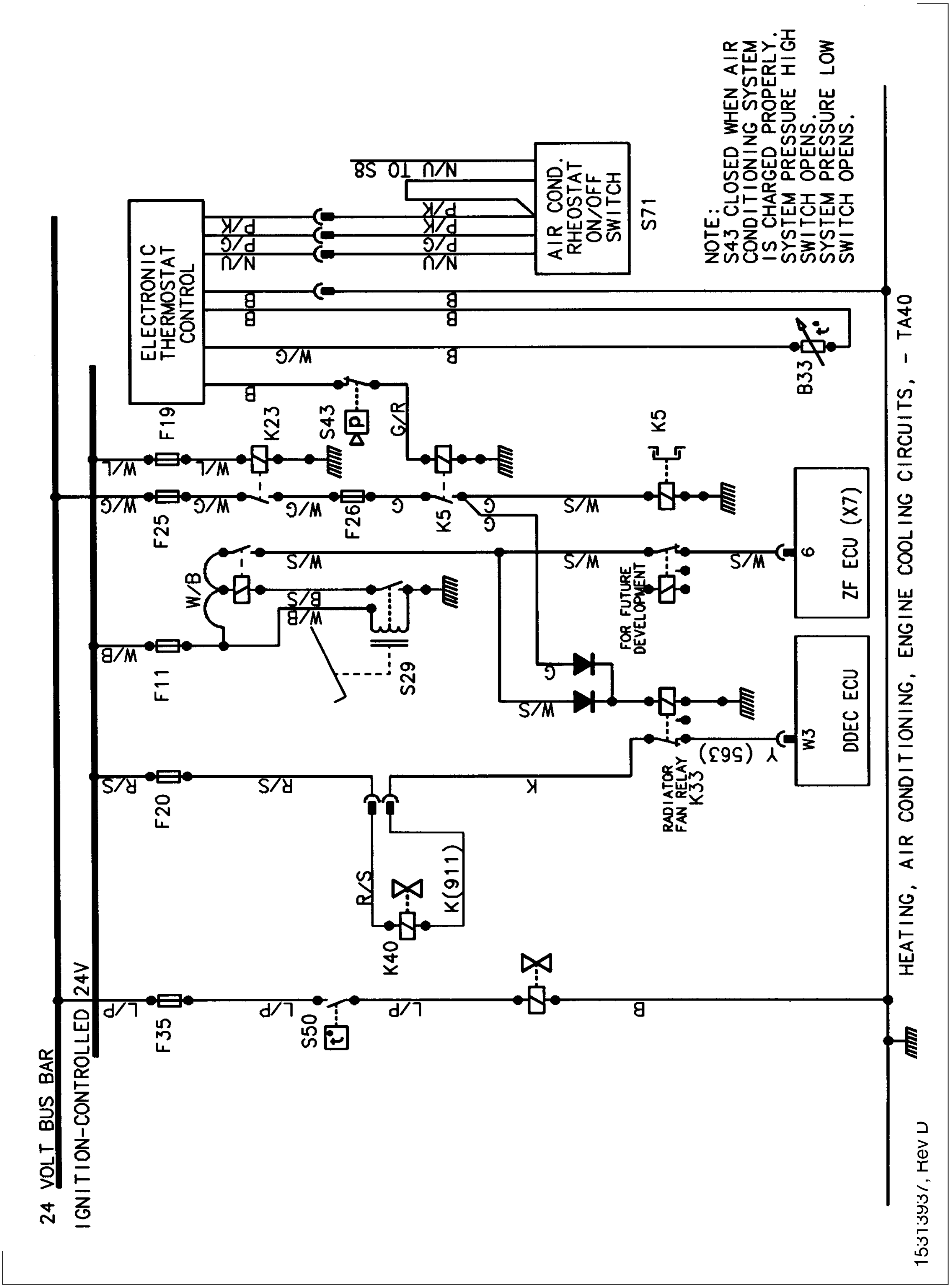


SM - 3072G
ZF 6WG310 TRANSMISSION TEREX HARNESS INTERFACE EST-37
ZF COMPONENT DESIGNATIONS
B1
B2
B3
Y1
Y2
Y3
Y4
Y5
Y6
B4
Y7
Y8
Y9
B9
ENGINE SPEED
TURBINE SPEED
INTERNAL GEAR SPEED
TRANS SUMP TEMP
TRANS OUTPUT SPEED
B13
K21
B21
K22
Y3
Y7 trans
Y7 axle
B32
S90 ZF COMP. S10
RETARDER TEST
X1
X2
X8
X9
15313937, Rev D

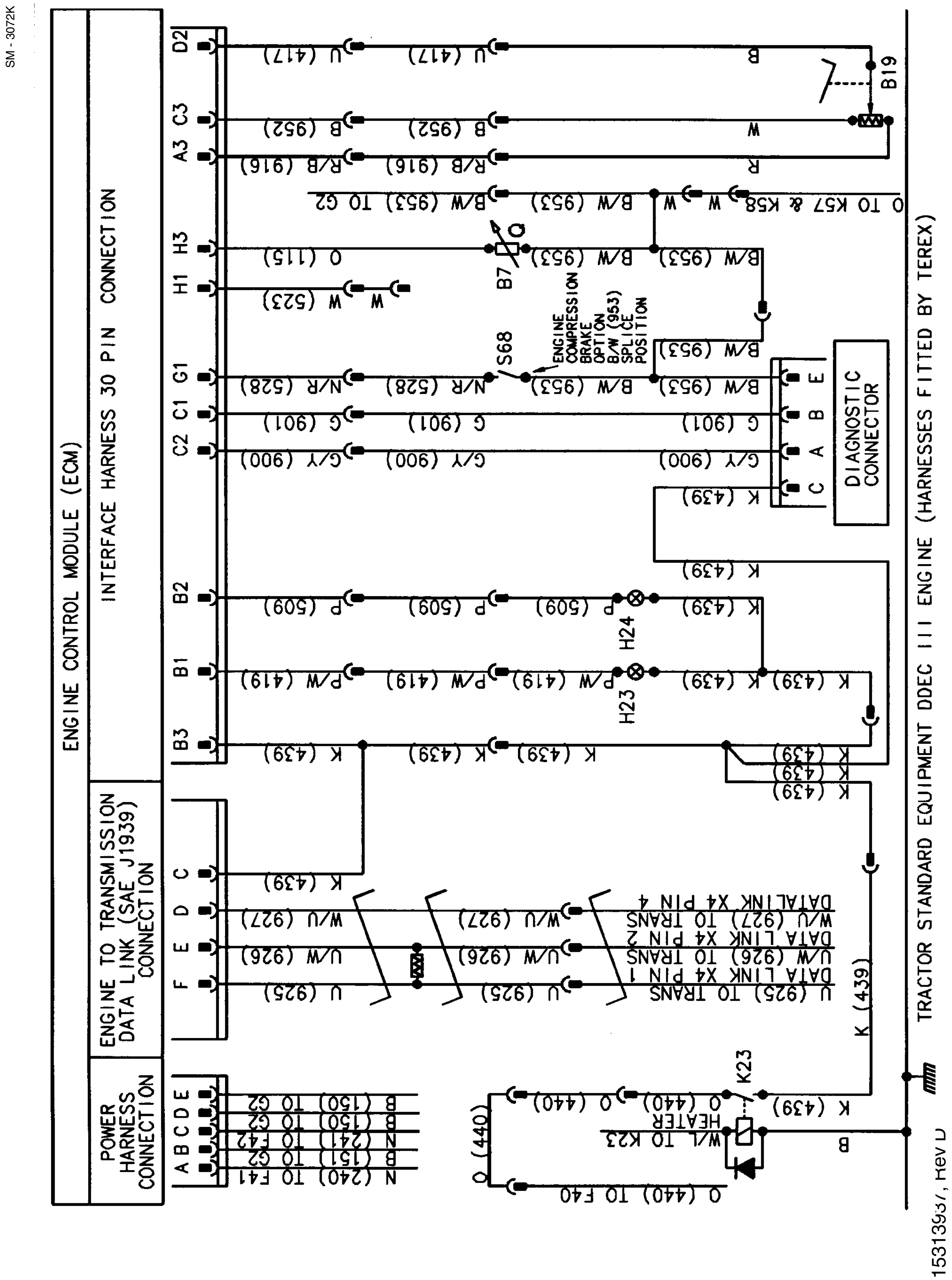

SM - 3072H
ELECTRONIC THERMOSTAT CONTROL
AIR COND. RHEOSTAT ON/OFF SWITCH
S71
N/U TO S8
NOTE: S43 CLOSED WHEN AIR CONDITIONING SYSTEM IS CHARGED PROPERLY. SYSTEM PRESSURE HIGH SWITCH OPENS. SYSTEM PRESSURE LOW SWITCH OPENS.
B33
S43
W/L TO F19
K23 AIR COND.
W/L TO K23 HEATER
W/G TO F25
F26
K5
G TO RADIATOR FAN DIODE
K57
P TO TRANS ECU CONN X7 PIN 13
R TO F47
SOUND POWER LEGISLATION OPTIONAL CONNECTOR
W TO DDEC
O TO DDEC
P/L TO BODY UP W/L
K58
TRACTOR STANDARD EQUIPMENT
A4
A5 R.H
A5 L.H
12V RADIO/CASSETTE
F38
F39
K43
W/L TO S2 TERMINAL 15
N3
R/B TO G2 24V +Ve POST
B TO G2 24V -Ve POST

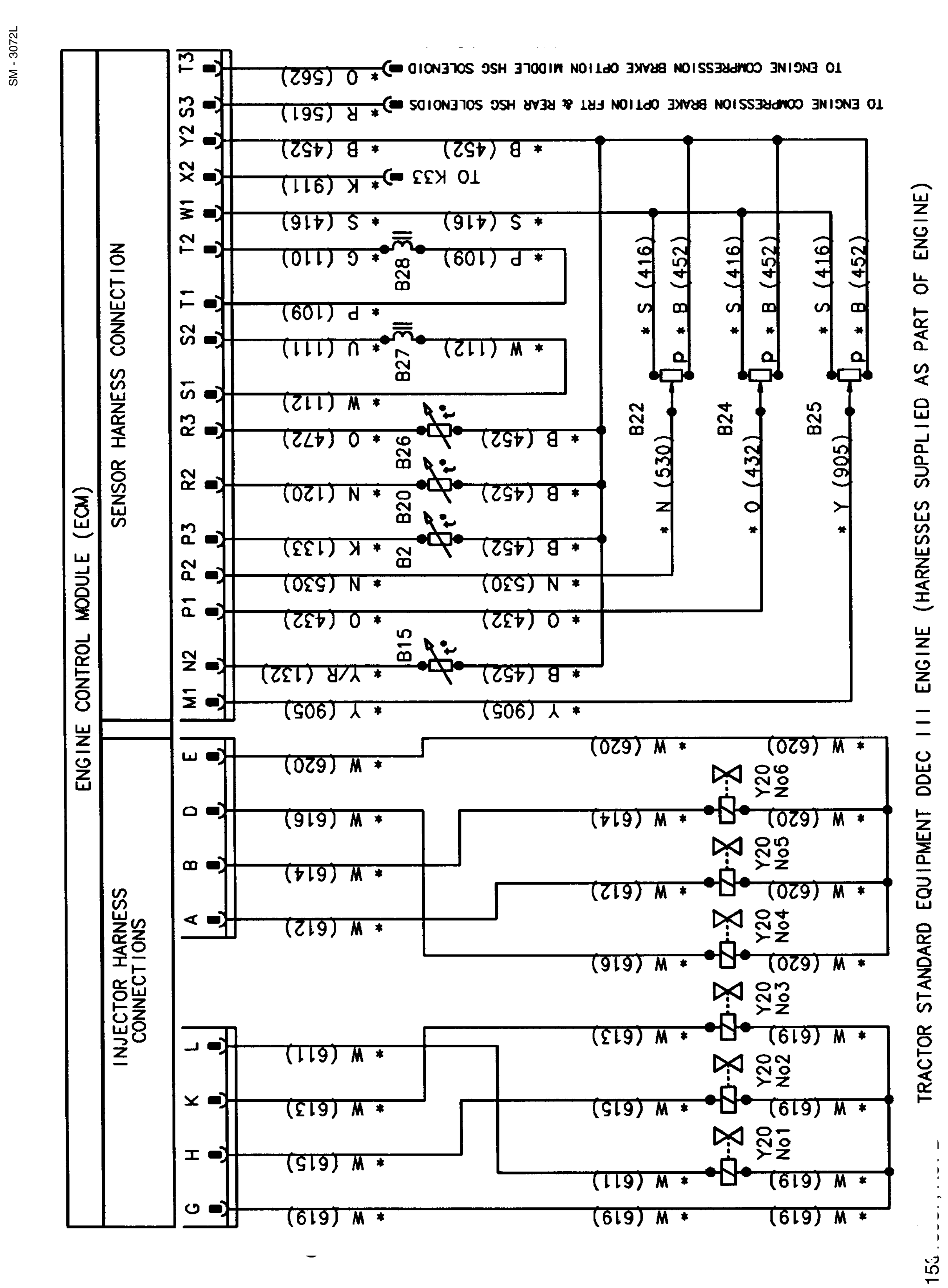


15313937, Rev D

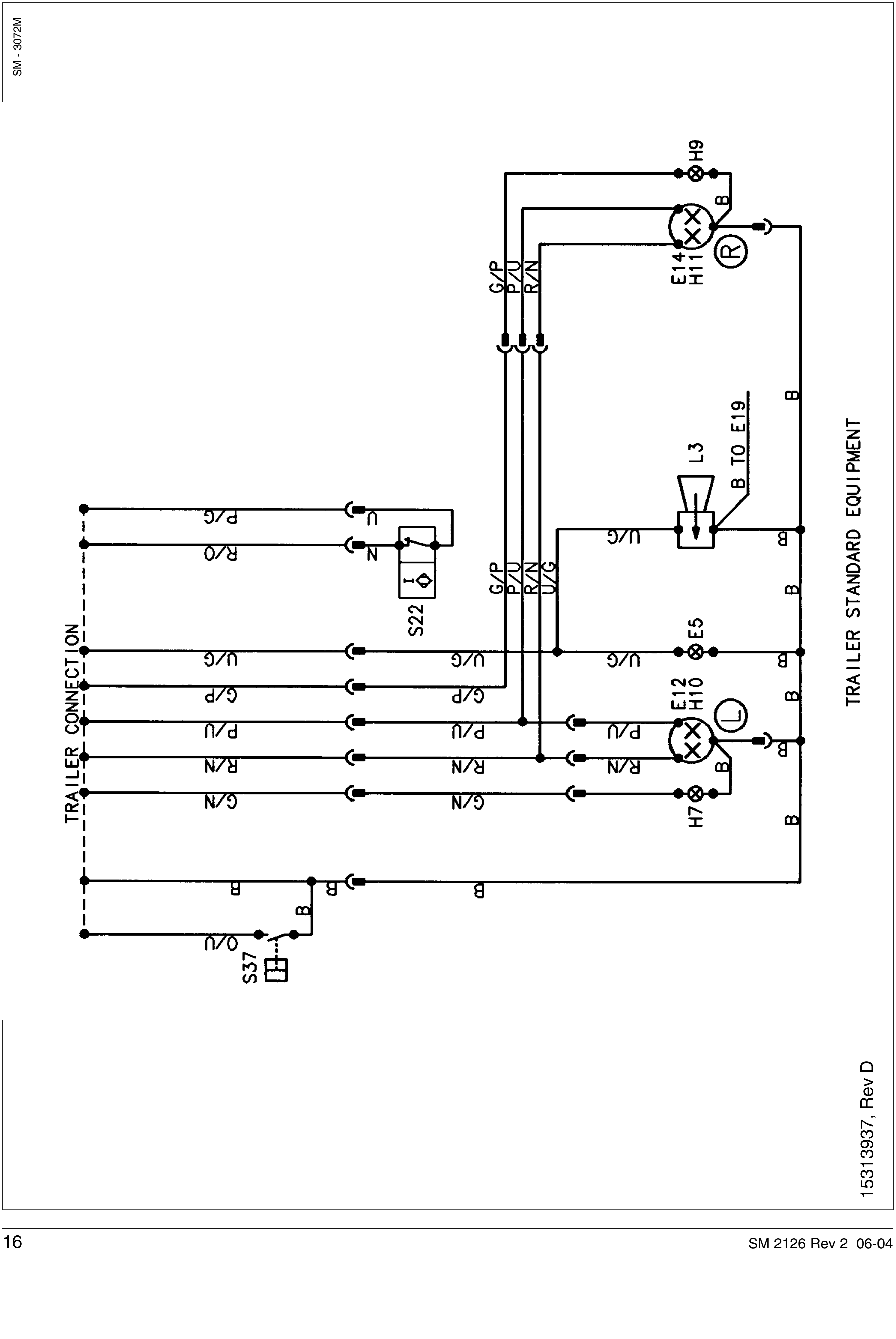


24 VOLT BUS BAR
IGNITION-CONTROLLED 24V
ELECTRONIC THERMOSTAT CONTROL
AIR COND. RHEOSTAT ON/OFF SWITCH
S71
N/U TO S8
NOTE:
S43 CLOSED WHEN AIR CONDITIONING SYSTEM IS CHARGED PROPERLY. SYSTEM PRESSURE HIGH SWITCH OPENS. SYSTEM PRESSURE LOW SWITCH OPENS.
F19
F25
F26
F11
F20
F35
K23
S43
K5
S29
K40
K(911)
S50
B33
FOR FUTURE DEVELOPMENT
RADIATOR FAN RELAY K33
Y (563)
ZF ECU (X7)
DDEC ECU
W3
HEATING, AIR CONDITIONING, ENGINE COOLING CIRCUITS, - TA40
1531393?, Rev D

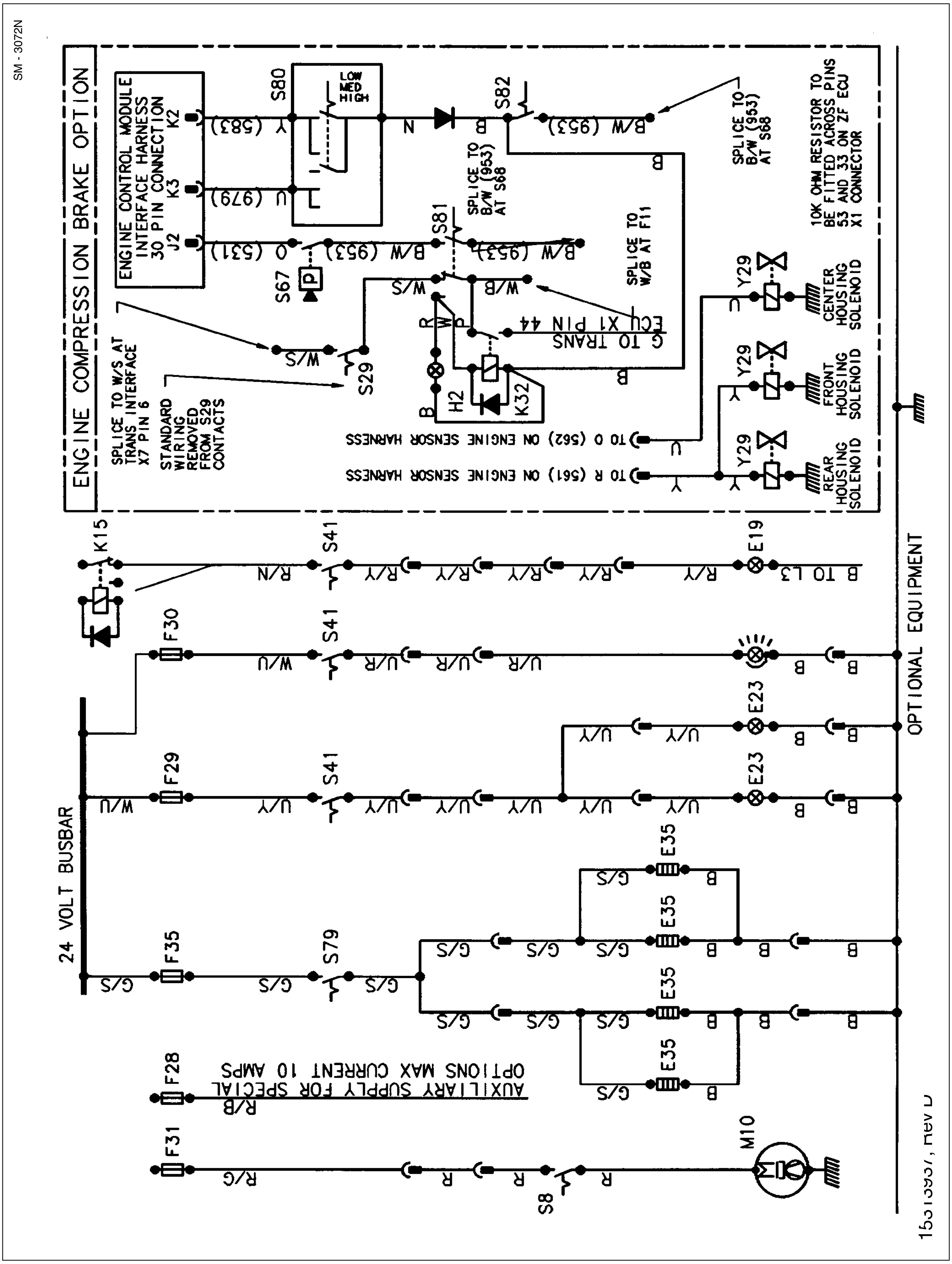

SM - 3072K
ENGINE CONTROL MODULE (ECM)
INTERFACE HARNESS 30 PIN CONNECTION
ENGINE TO TRANSMISSION DATA LINK (SAE J1939) CONNECTION
POWER HARNESS CONNECTION
DIAGNOSTIC CONNECTOR
ENGINE COMPRESSION BRAKE OPTION B/W (953) SPLICE POSITION
TRACTOR STANDARD EQUIPMENT DDEC III ENGINE (HARNESSES FITTED BY TEREX)
B19
B7
S68
H23
H24
K23
HEATER
15313937, Rev D



SM - 3072L
ENGINE CONTROL MODULE (ECM)
SENSOR HARNESS CONNECTION
INJECTOR HARNESS CONNECTIONS
TO ENGINE COMPRESSION BRAKE OPTION MIDDLE HSG SOLENOID
TO ENGINE COMPRESSION BRAKE OPTION FRT & REAR HSG SOLENOIDS
TO K33
B28
B27
B26
B20
B2
B15
B22
B24
B25
Y20 No1
Y20 No2
Y20 No3
Y20 No4
Y20 No5
Y20 No6
TRACTOR STANDARD EQUIPMENT DDEC III ENGINE (HARNESSES SUPPLIED AS PART OF ENGINE)

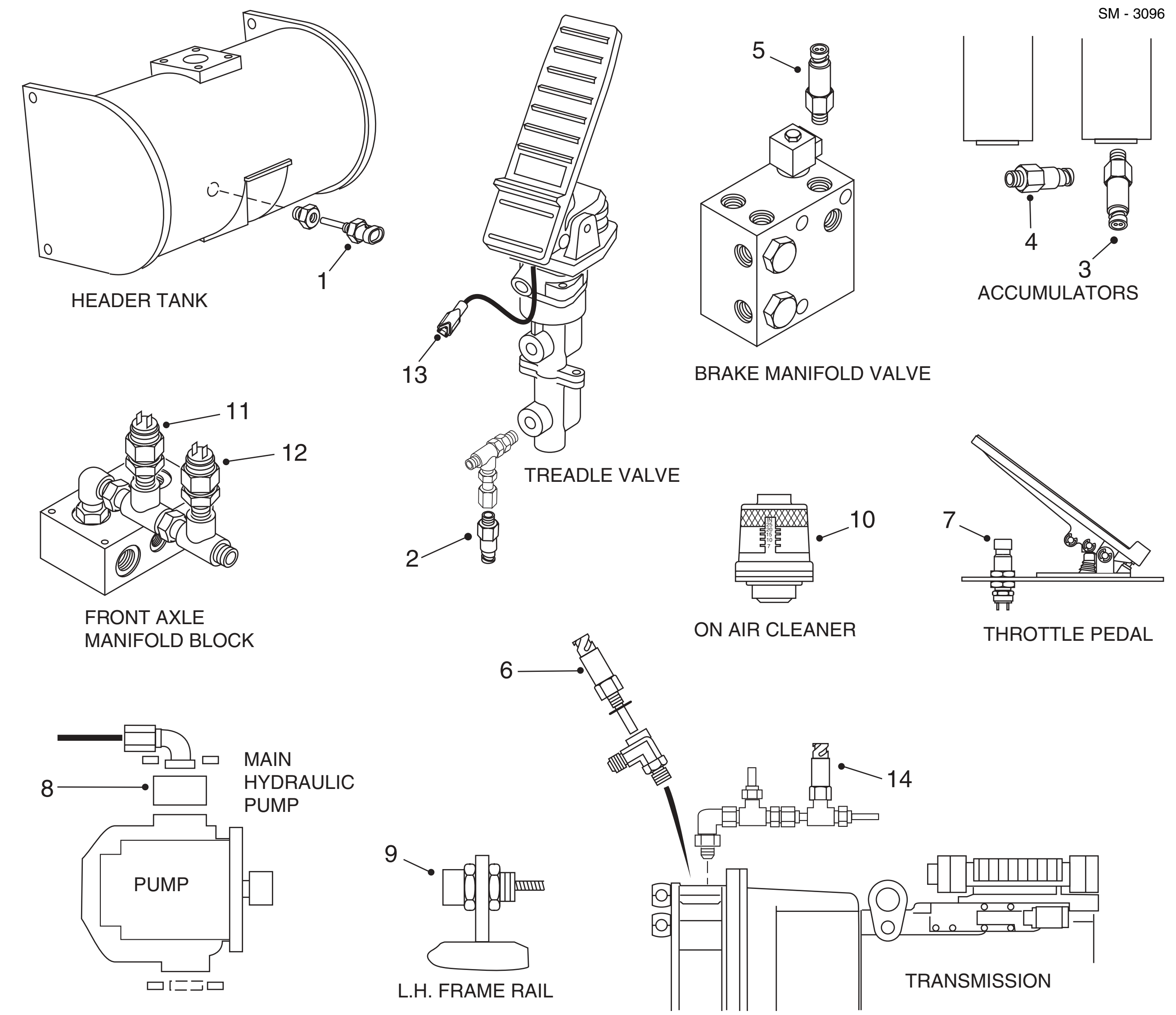


SM - 3072M
TRAILER CONNECTION
TRAILER STANDARD EQUIPMENT
H9
E14
H11
R
G/P
P/U
R/N
U/G
G/N
P/G
R/O
O/U
L3
B TO E19
E5
E12
H10
L
H7
S22
S37
B
U
N
15313937, Rev D



SM - 3072N
ENGINE COMPRESSION BRAKE OPTION
ENGINE CONTROL MODULE INTERFACE HARNESS 30 PIN CONNECTION
LOW
MED
HIGH
SPLICE TO B/W (953) AT S68
SPLICE TO W/B AT F11
SPLICE TO W/S AT TRANS INTERFACE X7 PIN 6
STANDARD WIRING REMOVED FROM S29 CONTACTS
ECU X1 PIN 44
G TO TRANS
TO O (562) ON ENGINE SENSOR HARNESS
TO R (561) ON ENGINE SENSOR HARNESS
10K OHM RESISTOR TO BE FITTED ACROSS PINS 53 AND 33 ON ZF ECU X1 CONNECTOR
CENTER HOUSING SOLENOID
FRONT HOUSING SOLENOID
REAR HOUSING SOLENOID
24 VOLT BUSBAR
OPTIONAL EQUIPMENT
B TO L3
AUXILIARY SUPPLY FOR SPECIAL OPTIONS MAX CURRENT 10 AMPS

* * * *



1 - Coolant Level Sender
2 - Stop Light Pressure Switch
3 - Rear Brake Pressure Switch
4 - Front Brake Pressure Switch
5 - Parking Brake Pressure Switch
6 - Oil Temperature Sender
7 - Kickdown Switch
8 - Emergency Steering Pressure Switch
9 - Body Up Proximity Switch
10 - Air Cleaner Restriction Indicator
11 - Brake Cooling Oil Temp. Switch
12 - Brake Cooling Oil Temp. Switch
13 - Retarder Proximity Switch
14 - Retarder Pressure Switch

Fig. 1 - Switches and Sensors

DESCRIPTION

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

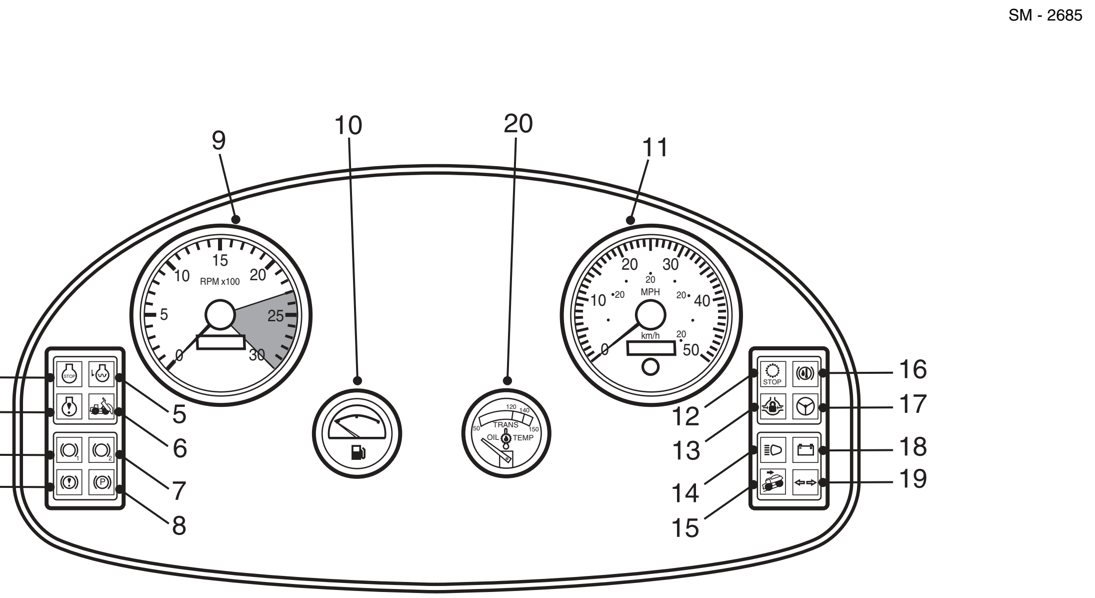
This section describes the location and function of various switches and sensors fitted to the vehicle to monitor all major components and systems. Gauges and warning lights located in the centre dash panel, relay this information to the operator.

Note: Always make sure all gauges, warning lights and controls are working properly before operating the vehicle.

Engine

The DDEC engine management system monitors the engine at all times and sends a signal to the engine check light (2, Fig. 2) and engine stop light (1, Fig. 2) on the dash panel to alert the operator of a fault in the engine circuit. Refer to Section 110-0030, ENGINE AND MOUNTING.

Engine Coolant Level Sender (1) - Located in the radiator header tank, the sender sends a signal to engine stop light (1, Fig. 2) indicating that engine coolant level is low.



1 - Engine Stop W/L
2 - Engine Check W/L
3 - Tractor Brakes Overstroke W/L
4 - Not Used On This Machine
5 - Not Used On This Machine
6 - Body Up W/L
7 - Trailer Brakes Overstroke W/L
8 - Parking Brake Ind/L
9 - Tachometer/Hourmeter
10 - Fuel Gauge
11 - Speedometer/Odometer
12 - Transmission Stop W/L
13 - Differential Lock Ind/L
14 - Headlight Main Beam Ind/L
15 - Retarder Apply Ind/L
16 - Brake Cooling Oil Temperature W/L
17 - Emergency Steering W/L
18 - Alternator Charging W/L
19 - Direction Indicator Ind/L
20 - Transmission Oil Temperature Gauge

Fig. 2 - Layout View of Instruments and Indicator/Warning Lights

Tachometer/Hourmeter (9, Fig. 2) - Driven from the alternator, the tachometer indicates the number of engine crankshaft revolutions per minute (rev/min). The needle shows the variations in engine operating speed. 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.

Tachometer Calibration Table - All units with standard tyres		
Unit	Engine	Pulses/revolution
TA25	Cummins QSC	17.40
TA27	Cummins QSL	17.40
TA30	Cummins QSM	16.68
TA35	DD Series 60	18.66
TA40	DD Series 60	18.66

2. Using a suitable screwdriver, depress and hold calibration button at the rear of the tachometer 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 tachometer is now calibrated.

Transmission

Refer to Section 120-0010, TRANSMISSION AND MOUNTING, for detailed information on switches and sensors fitted to the transmission.

Speedometer/Odometer (11, Fig. 2) - Driven by a signal from the transmission ECU, the speedometer indicates vehicle travel speed in kilometres per hour (km/h) and miles per hour (mph). 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.

Retarder Proximity Switch (13) - Incorporated in the treadle valve. The first 7° of pedal travel will request the transmission retarder. The retarder will engage, provided that the transmission 'Stop' warning light (12, Fig. 2) is out and the transmission is in lockup. Further depression of pedal will apply the service brakes. To disengage the retarder, release the treadle valve.

Retarder Pressure Switch (14) - The normally open (NO) pressure switch, located on top of the transmission, senses pressure in the transmission retarder line. As retarder pressure increases to 0.3 bar (4.4 lbf/in^2) and above, the circuit closes and sends a signal to illuminate the retarder apply indicator light (15, Fig. 2).

Oil Temperature Sender (6) - Sends a signal to indicate transmission oil temperature on the transmission oil temperature gauge (20, Fig. 2) in the cab.

Kickdown Switch (7) - Refer to Section 120-0010, TRANSMISSION AND MOUNTING, for detailed operation of the kickdown switch.

Braking System

Stop Light Pressure Switch (2) - The normally open (NO) pressure switch is located at a tee in 'B2' port of the treadle valve. As brake apply pressure increases to 2.7 bar (39 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 2.7 bar (39 lbf/in^2) the circuit opens and brake lights go out.

Rear Brake Pressure Switch (3) - The normally closed (NC) pressure switch, located below the rear brake accumulator, senses pressure in the rear brake circuit. The pressure switch sends a signal to illuminate 'Red' trailer brakes overstroke warning light (7, Fig. 2) when pressure drops below 115 bar (1 668 lbf/in^2). An audible buzzer also sounds.

Front Brake Pressure Switch (4) - The normally closed (NC) pressure switch, located below the front brake accumulator, senses pressure in the front brake circuit. The pressure switch sends a signal to illuminate 'Red' tractor brakes overstroke warning light (3, Fig. 2) when pressure drops below 115 bar (1 668 lbf/in^2). An audible buzzer also sounds.

Parking Brake Pressure Switch (5) - The normally closed (NC) pressure switch, located in the brake manifold valve, senses pressure in the parking brake (Pk) line. The pressure switch opens at a pressure of 4.9 bar (71 lbf/in^2) and sends a signal to illuminate 'Green' parking brake indicator light (8, Fig. 2) when the parking brake is applied.

Brake Cooling Oil Temperature Switch (11) - The normally open (NO) switch, located at the manifold block on the front axle, senses oil temperature in the brake cooling lines. The switch sends a signal to the two speed control valve to increase brake cooler fan speed when oil temperature reaches 50 °C.

Brake Cooling Oil Temperature Switch (12) - The normally open (NO) switch, located at the manifold block on the front axle, senses oil temperature in the brake cooling lines. The switch sends a signal to illuminate 'Red' brake cooling oil temperature warning light (16, Fig. 2) when oil temperature reaches 120 °C.

Steering

Emergency Steering Pressure Switch (8) - The normally closed (NC) pressure switch is located in a block at the rear outlet port of the main hydraulic pump. The pressure switch sends a signal to illuminate 'Red' emergency steering warning light

(17, Fig. 2) when pressure drops to 4.8 bar (70 lbf/in^2) or lower.

Air Cleaner

Air Cleaner Restriction Indicator (10) - Mounted on the air cleaner outlet pipe, the indicator indicates the degree of air cleaner element restriction as the yellow band rises in the gauge window. The filter element should be replaced if the yellow band locks in place when the engine is shut down. Reset the gauge by pressing the button on the gauge with the engine running.

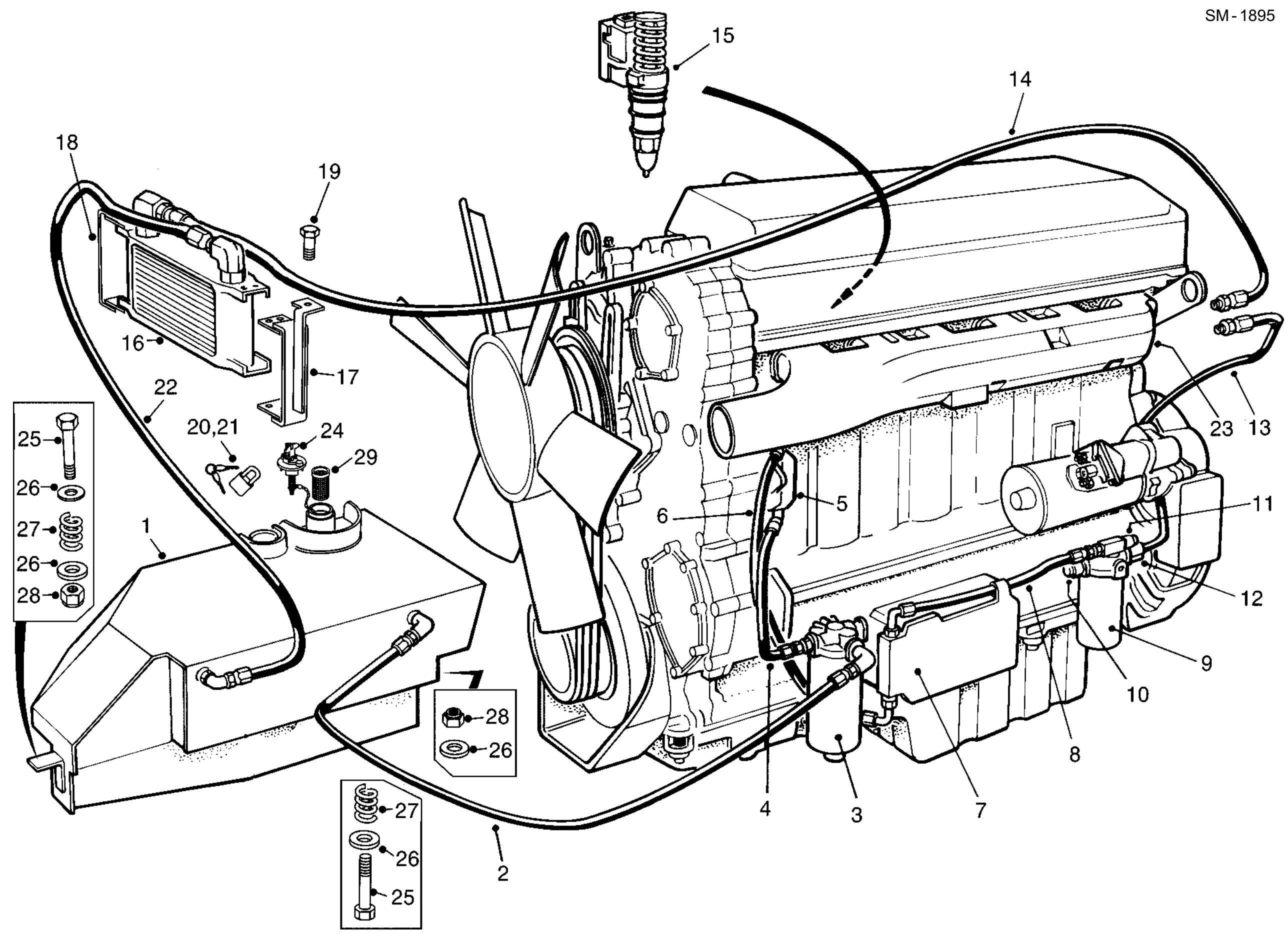
Body

Body Up Proximity Switch (9) - Mounted on the inside of the trailer left hand frame rail. When the body is raised off the trailer frame, the switch sends a signal to illuminate the 'Amber' 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 switch prevents the body being fully powered down onto the chassis. At a predetermined height, the switch automatically defaults the body control valve to the detented 'FLOAT' condition.

* * * *



1 - Fuel Tank
2 - Fuel Supply Line
3 - Primary Filter
4 - Fuel Line
5 - Fuel Pump
6 - Fuel Line
7 - ECM Cooling Plate
8 - Fuel Line
9 - Secondary Filter
10 - Fuel Pressure Sensor
11 - Fuel Temperature Sensor
12 - Shut Off Cock
13 - Fuel Line
14 - Fuel Line
15 - Electronic Unit Injector (EUI)
16 - Fuel Cooler
17 - Mounting Bracket
18 - Mounting Bracket
19 - Bolt
20 - Padlock
21 - Key
22 - Fuel Return Line
23 - Restricted Fitting
24 - Filler Cap
25 - Bolt
26 - Washer
27 - Spring
28 - Locknut
29 - Strainer

Fig. 1 - Fuel Lines and Components

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The fuel system consists of the DDEC electronic fuel system controls, fuel manifolds (integral with the cylinder head), primary fuel filter (3), secondary fuel filter (9), fuel pump (5), electronic control module (ECM) cooling plate (7), electronic unit injectors (15) fuel cooler (16), fuel tank (1) and the necessary connecting fuel lines.

There are two spin-on type fuel filters mounted on the left hand side of the engine. Primary fuel filter (3) is in the fuel flow and acts as a strainer and secondary fuel filter (9) filters the fuel after having passed through primary fuel filter (3). The word 'Primary' or 'Secondary is cast into the top of the respective adaptor.

Fuel pressure sensor (10) is installed into the side of secondary fuel filter (9) and sends an electronic signal to the ECM telling it what the engine fuel pressure is at any given speed.

Fuel temperature sensor (11) is installed in a tee on the top of secondary fuel filter (9) and sends an electrical signal to the ECM indicating fuel inlet temperature. The ECM uses this information to calculate fuel consumption.

Note: Both fuel pressure sensor (10) and fuel temperature sensor (9) are non-serviceable items and should be replaced as individual units. No adjustment is required.

Fuel pump (5) is attached to a drive assembly mounted on the rear side of the gear case at the front LH side of the engine and transfers fuel from fuel tank (1) to the electronic unit injectors (15).

The electronic unit injector (15) is a lightweight, compact unit that injects diesel fuel directly into the combustion chamber. The amount of fuel injected and the beginning of injection timing is determined by the ECM. The ECM sends a command pulse which activates the injector solenoid.

The EUI performs four functions:

a - Creates the high fuel pressure required for efficient injection.
b - Meters and injects the exact amount of fuel required to handle the load.
c - Atomizes the fuel for mixing with the air in the combustion chamber.
d - Permits continuous fuel flow for component cooling.

Electronic unit injectors are self compensating and virtually eliminate engine tune-ups.

Note: Never apply 12 V directly to terminals on the injector as it will burn out. Before removing injectors, the fuel passages must be blown out to prevent fuel flow from entering the cylinder head.

ECM cooling plate (7) is mounted in front of the ECM on the LH side of the engine and absorbs heat generated by the ECM. Fuel from fuel pump (5) outlet line (6) flows through ECM cooling plate (7) to absorb this heat.

Fuel cooler (16) is mounted on the front of the radiator and cools fuel returning to fuel tank (1).

Flexible fuel lines (2, 4, 6, 8, 13, 14 & 22) are used to facilitate connection of lines leading to and from fuel tank (1), and to minimize the effects of any vibration in the installation. A 2.03 mm (0.08 in) restricted orifice is incorporated in the fuel return fitting (23) at rear of engine to maintain fuel pressure in the system. The restricted orifice is designed to provide the proper fuel system pressure under all conditions.

Note: Do not alter or substitute another size of orifice since this may alter engine performance and emissions.

Note: Do not use restricted fittings anywhere else in the fuel system and do not substitute a standard fitting for the restricted fitting.

When installing fuel lines, it is recommended that connections be tightened only sufficiently to prevent leakage of fuel; thus flared ends of the fuel lines will not become twisted or fractured because of excessive tightening.

A fuel tank breather/filter assembly is incorporated into the fuel filler cap (24), allowing fuel tank (1) to vent to atmosphere, preventing pressure from building up within fuel tank (1) assembly.

OPERATION

Numbers in parentheses refer to Fig. 1.

Fuel is drawn from fuel tank (1) through primary fuel filter (3) and enters fuel pump (5). Leaving fuel pump (5) under pressure, the fuel flows through ECM cooling plate (7), through secondary fuel filter (9) to the engine cylinder head. The fuel flows to electronic unit injectors (15) in the cylinder head through passages integral with the cylinder head. Surplus fuel exits at the rear of the cylinder head just above the inlet, flows through fuel cooler (16) and back to fuel tank (1). Restricted fitting (23) at rear of engine maintains fuel pressure in the system.

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. Operate steering right and left several times to relieve pressure in the steering system.

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

3. If required, remove mounting hardware securing the front grille on the hood assembly and remove grille for access to the fuel cooler (16).

4. Pull on handle to release hood catch mechanism and raise hood.

5. Remove padlock (20) and remove filler cap (24) from fuel tank (1).

6. Remove fuel strainer (29) from fuel tank (1) and clean with clean diesel fuel.

7. With a suitable container in position, remove drain plug from bowl in the underside of fuel tank (1) and drain fuel from fuel tank (1). Reinstall drain plug and tighten securely when fuel tank (1) is completely drained.

8. Identify and tag fuel lines (2, 14 & 22) and, with a suitable container available to catch leakage, disconnect fuel lines (2, 14 & 22). Cap open line ends and elbows to prevent entry of dirt.

9. Remove locknuts (28), bolts (25), washers (26) and springs (27) securing fuel tank (1) assembly in the tractor frame. Using a suitable lifting device, remove fuel tank (1) assembly from the vehicle.

10. If required, remove fuel cooler (16). Refer to Section 210-0100, HYDRAULIC OIL COOLER.

11. If required, remove rubber pads from the tractor frame. Be sure to remove all rubber and adhesive from the tractor frame.

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.

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

1. If removed, apply a suitable adhesive to new rubber pads 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 (25), washer (26), spring (27), washer (26) and locknut (28), as shown in Fig. 1. Tighten locknut (28) 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 (25), washers (26), springs (27), washers (26) and locknuts (28), as shown in Fig. 1. Tighten locknuts (28) until spring compresses to a length of 31.75 mm (1.25 in).

5. Remove blanking caps and secure fuel lines (2, 14 & 22) to elbows, as identified at removal.

6. If removed, install fuel cooler (16). Refer to Section 210-0100, HYDRAULIC OIL COOLER.

7. Install fuel strainer (29) 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 (24) assembly on fuel tank filler neck. Tighten filler cap (24) securely and secure in place with padlock (20).

10. Lower hood assembly and secure front grille assembly to the hood with mounting hardware removed at removal.

11. 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 (2, 14 & 22) and tighten if required.

12. Remove wheel blocks from all road wheels.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

⚠ **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 (29) and filler cap (24). Remove and clean fuel strainer and filler cap as required.

Every 10 Hours/Daily:
Make a visual check for fuel leaks at all engine mounted fuel lines and connections, fuel cooler, and at the fuel tank suction and return lines. Examine lines for leaks and check all fittings, clamps and ties carefully.

Make sure that fuel lines 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.

Every 250 Hours:
Replace the primary and secondary fuel filters as follows:

Note: There is a fuel system shut off cock on the discharge side of the secondary fuel filter. Closing this valve will prevent loss of fuel prime at time of filter replacement.

1. Close shut off valve at secondary fuel filter and, using a strap type filter wrench, remove and discard both the primary and secondary fuel filters from the engine.

2. Fill the replacement filters and coat the gaskets slightly with clean fuel oil as specified in Section 300-0020, LUBRICATION SYSTEM.

3. Start new primary fuel filter on the filter adaptor and tighten it by hand until the gasket contacts the adaptor fully with no side movement of the filter evident. Tighten an additional 1/2 of a turn.

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

4. Repeat step 3 to install a new secondary fuel filter.

5. Start the engine and check for leaks. If any leaks are noted, have them corrected.

Every 250 Hours:
Open the drain at the bottom of the fuel tank to drain off any water and/or sediment. Check the seal in fuel tank filler neck cap and clean filler neck screen and cap. Check the condition of all fuel lines and replace if required. Clean and inspect fins on fuel cooler.

Every 1 000 Hours:
Remove filler cap (24) from filler neck. With the handle in the up and rotated position, remove the two screws securing the filter assembly to the cap. Discard 'O'-rings. Clean top of filler cap (24) and valve cavity. Install new filter assembly to filler cap (24) 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 liner, 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.

TROUBLESHOOTING

Locating Air Leaks in Fuel Lines

Air drawn into the fuel system may result in uneven running of the engine, black or white smoking and stalling when idling, or a loss of power. Poor operation is particularly noticeable at lower engine speeds. If air is found in the fuel, the source will normally be between the fuel tank and the fuel pump.

Check for loose, faulty or improper fuel line connectors. Presence of an air leak may be detected by following the procedures under 'Checking Fuel Flow'.

Checking Fuel Flow

1. Disconnect the fuel return line from the fitting at the fuel tank and hold the open end in a suitable container.

2. Start and run the engine at maximum rev/min and measure the fuel flow. Nominal fuel return spill with the standard 2.03 mm (0.08 in) restricted fitting is 4.1 litres/min (65 US gal/min).

3. Immerse the end of the fuel return line in the fuel. Air bubbles rising to the surface of the fuel will indicate air being drawn into the fuel system on the suction side of the pump. If air is present, tighten all fuel lines connections between the fuel tank and fuel pump.

4. If the fuel flow is insufficient for satisfactory engine performance then proceed as follows:

a. Replace the primary and secondary fuel filters, as described under 'Maintenance'. Start the engine and run it at maximum rev/min and recheck the fuel flow. If fuel flow is still unsatisfactory, perform step 'b'.

b. Check the fuel lines for restrictions due to pinching, kinking or other damage. Be sure the correct restricted fitting is installed at the return port of the fuel tank. If no problem is found, substitute another fuel pump that is known to be operating correctly and recheck the fuel flow. When changing the fuel pump, inspect the fuel pump drive assembly, hubs and coupling. Clean all fuel lines with compressed air and be sure all fuel connections are tight.

c. Disconnect the fuel lines from the ECM cooling plate and, using a suitable connector, connect the two fuel lines, bypassing the cooling plate. Run the engine at maximum rev/min and recheck the fuel flow. If the fuel flow with the cooling plate bypassed is normal, the cooling plate should be 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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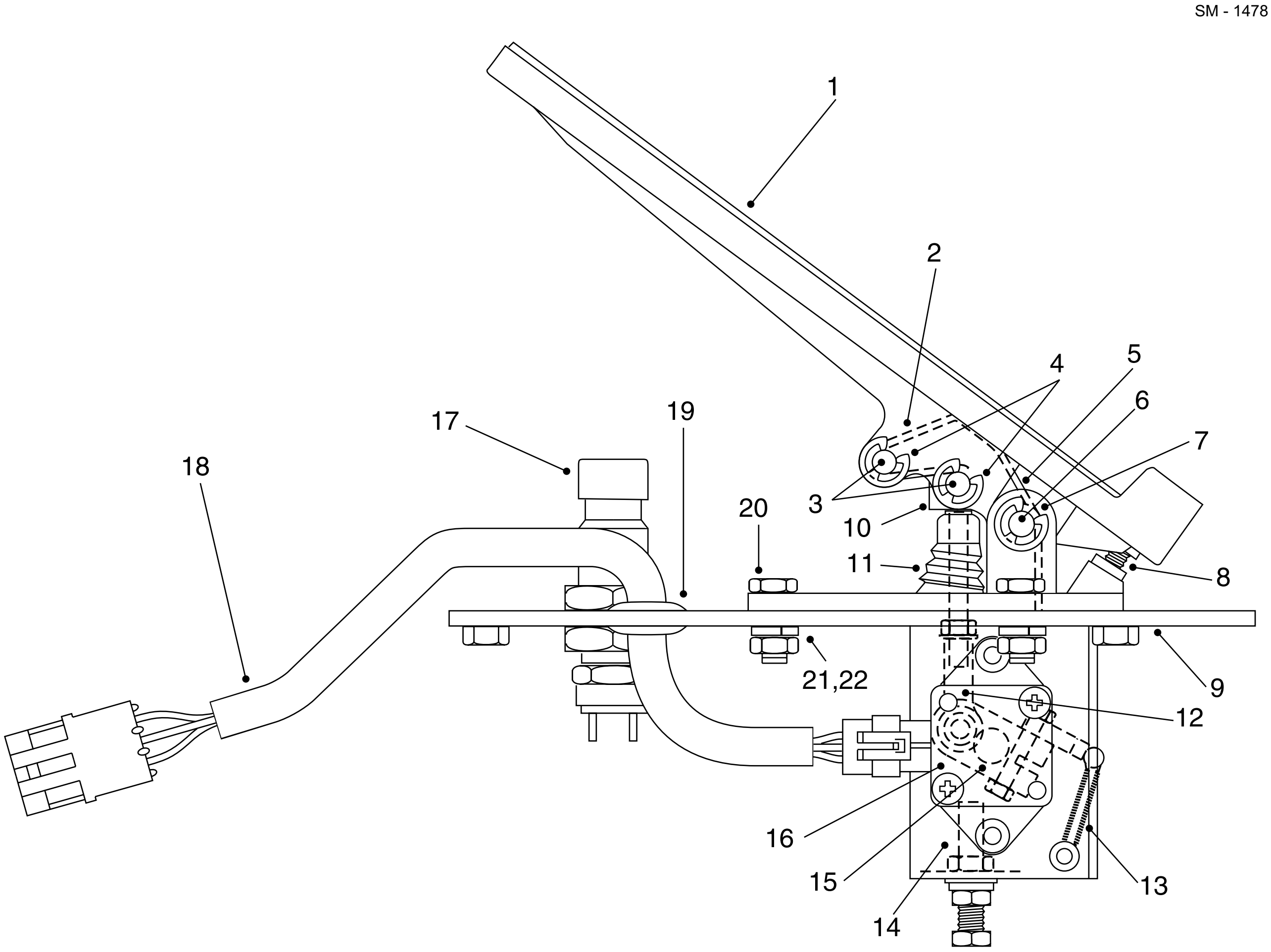

- 1 - Pedal Assembly
- 2 - Spring
- 3 - Pin
- 4 - 'E' Clip
- 5 - Spring
- 6 - Pin
- 7 - Bearing
- 8 - Pedal Stop
- 9 - Plate
- 10 - Pivot Block
- 11 - Bellows
- 12 - Rod End
- 13 - Spring
- 14 - Lever Stop
- 15 - Lever
- 16 - Sensor
- 17 - Kickdown Switch
- 18 - Harness
- 19 - Grommet
- 20 - Bolt
- 21 - Nut
- 22 - Lockwasher

Fig. 1 - Electronic Foot Pedal and Kickdown Assembly

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The electronic foot pedal assembly provides an electrical signal to the engine's fuel control system in proportion to the degree of pedal actuation. Maximum and minimum stops are built into the pedal assembly during manufacture. The pedal assembly comes preset and therefore no adjustment is necessary.

Note: The DDEC controlled engine will override the pedal position until the engine is warmed up to the correct operating temperature. The engine MUST be started with foot 'OFF' pedal assembly (1).

Kickdown switch (17), which can be used when automatic range is selected, allows for the possibility of selecting a lower gear by pressing down fully on pedal assembly (1) 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. To disengage the transmission kickdown, allow pedal assembly (1) to return to the full load or part load position. Refer to Section 120-0010, TRANSMISSION AND MOUNTING

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, ensure the body is fully lowered, apply the parking brake and switch off the engine. Turn steering wheel in both directions several times to relieve any pressure in the steering circuit.

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

3. Disconnect electrical harness (18) and kickdown switch (17) harness.

4. Move cab floor mat back and clear from pedal assembly (1) and mounting plates.

5. Remove mounting hardware securing plate (9) and pedal assembly (1) to cab floor plate. Remove plate (9) and pedal assembly (1).

6. Remove bolts (20), nuts (21) and lockwashers (22) securing pedal assembly (1) to plate (9). Remove pedal assembly (1) from plate (9).

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 pedal assembly (1) on plate (9) and secure with bolts (20), lockwashers (22) and nuts (21).

2. Secure plate (9) and pedal assembly (1) to the cab floor plate with mounting hardware removed during removal.

3. Connect electrical harness (18) and kickdown switch (17) harness.

4. Position floor mat on cab floor and ensure that pedal assembly (1) is free to operate.

5. Place the battery master switch in the 'On' position, remove wheel blocks and start the engine. Ensure that pedal assembly (1) operates correctly.

Note: The engine MUST be started with the foot 'OFF' pedal assembly (1).

MAINTENANCE

Limited repair of the electronic foot pedal assembly is by replacement of parts only. Refer to vehicle Parts Book for part numbers of overhaul kits.

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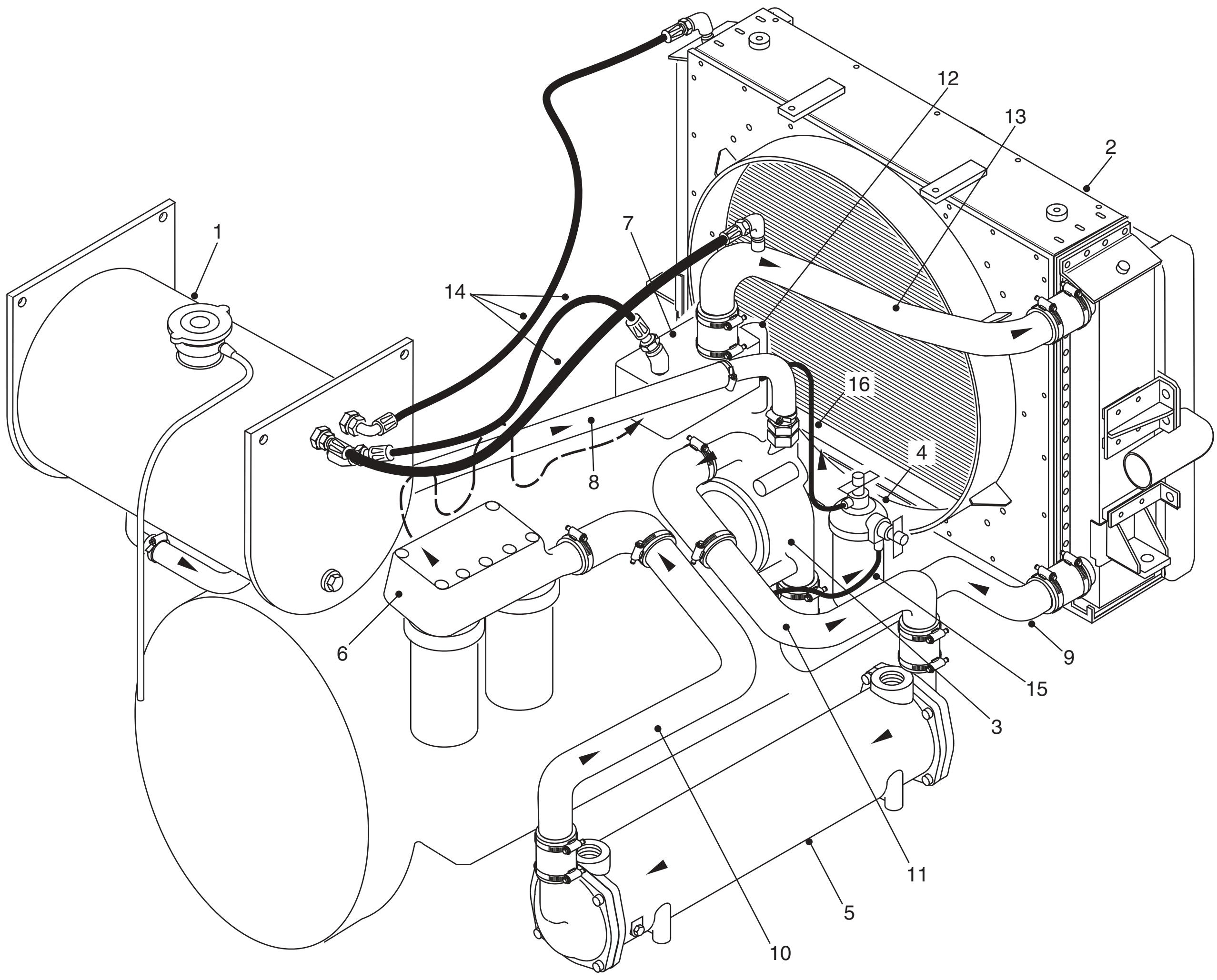


1 - Header Tank	5 - Transmission Oil Cooler	9 - Radiator Outlet Pipe	13 - Radiator Inlet Pipe
2 - Radiator Assembly	6 - Engine Oil Cooler	10 - Coolant Pipe	14 - Deaeration Lines
3 - Engine Water Pump	7 - Thermostat Housing	11 - Coolant Pipe	15 - Filter Inlet Line
4 - Coolant Filter	8 - Make-up Line	12 - Bypass Line	16 - Filter Outlet Line

Fig. 1 - Cooling Lines and Flow

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

A radiator and fan cooling system is used on Series 60 engines installed in these vehicles. This system has a centrifugal type water pump (3) to circulate coolant throughout the system. Two full blocking type thermostats located in thermostat housing (7), attached to the right hand side of the cylinder head, control the flow of coolant.

The main components of the cooling system are; header tank (1), radiator assembly (2), engine water pump (3), coolant filter (4), transmission oil cooler (5), engine oil cooler (6) and thermostat housing (7).

Attached to the front of radiator assembly (2) are an air-to-air charge cooler, a fuel cooler and a hydraulic oil cooler.

OPERATION

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

Upon starting a cold engine or when the coolant is below operating temperature, the coolant is restricted at thermostat housing (7) and bypass line (12) provides water circulation within the engine during the warm-up period.

Note: Engine coolant thermostats start to open at 88° C (190° F) and are fully open at 96° C (205° F).

Engine water pump (3) draws coolant from the radiator through radiator outlet pipe (9). Engine water pump (3) then pumps coolant through coolant pipe (10) into transmission oil cooler (5). Coolant flows through transmission oil cooler (5), drawing heat from the transmission oil cooler, and then flows through coolant pipe (11) and into engine oil cooler (6). The coolant then flows through the engine block and passes up through the cylinder head to thermostat housing (7).

Aerated coolant is drawn off to header tank (1) from thermostat housing (7) through deaeration line (14). Excess coolant at header tank (1) is discharged through an overflow line from the filler neck.

When the coolant reaches operating temperature, the thermostats open allowing coolant to flow into the radiator through radiator inlet pipe (13). The coolant passes through a series of tubes in radiator assembly (2) core, where the coolant temperature is lowered by the air stream created by the revolving fan, and into the radiator outlet pipe (9) to be re-circulated back through the system.

Aerated coolant is drawn off to header tank (1) from the radiator, radiator inlet pipe (13) and thermostat housing (7) through deaeration lines (14). Excess coolant at header tank (1) is discharged through an overflow line from the filler neck.

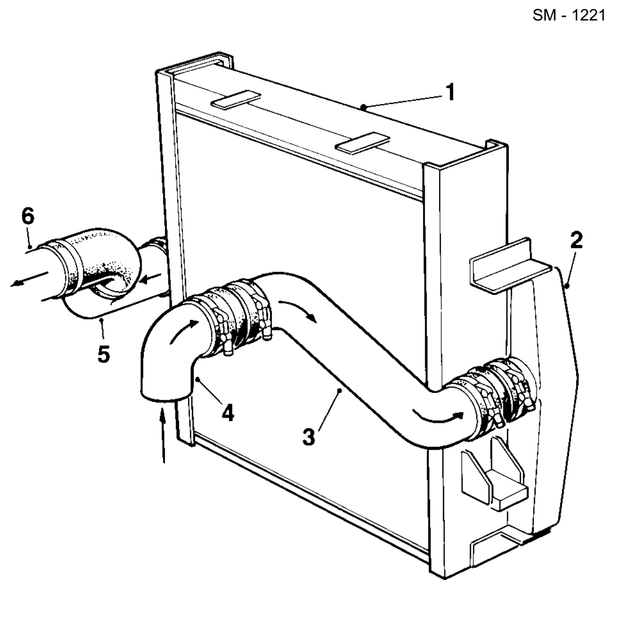
The use of antifreeze is mandatory with the cooling system. The lack of coolant flow through the radiator with the thermostats closed allows the coolant in radiator assembly (2) to freeze under low ambient temperature conditions.

Coolant Filter

The cooling system is protected by a replaceable spin-on type coolant filter (4) and conditioner mounted on the gear case cover at the front right hand side of the engine. The filter provides mechanical filtration by means of a closely packed element through which the coolant passes. Any impurities such as sand and rust particles suspended in the cooling system will be removed by the straining action of the element. The removal of these impurities will contribute to longer engine water pump (3) life and proper operation of the thermostats.

Coolant filter (4) also serves to condition the coolant by softening the water to minimize scale deposits, maintain an acid-free condition and act as a rust preventive. Corrosion inhibitors are placed in the element and dissolve into the coolant, forming a protective rustproof film on all of the metal surfaces of the cooling system.

Coolant flows from engine water pump (3) through filter inlet line (15) and into coolant filter (4). Coolant flows through the filter element and exits through filter outlet line (16) and into the engine block. Shut-off cocks on both filter lines allow coolant filter (4) to be replaced with the minimum loss of coolant.



1 - Radiator Assembly
2 - Air-to-Air Charge Cooler
3 - Inlet Pipe
4 - Outlet Pipe
5 - Outlet Pipe
6 - Inlet Pipe

Fig. 2 - Air-to-Air Charge Cooler Lines and Flow

Air-To-Air Charge Cooling

Numbers in parentheses refer to Fig. 2.

In the air system used on the Series 60 engines, outside air drawn into the engine through the air cleaner, passes through the air filter element and is pulled into the turbocharger where it is compressed. It then exits the turbocharger through outlet pipe (4) and enters air-to-air charge cooler (2), mounted on the front of radiator assembly (1), through inlet pipe (3). The hot air travels through a series of tubes in air-to-air charge cooler (2) core, where the air temperature is lowered from approximately 149° C (300° F) to below 38° C (100° F). From here the air flows through outlet pipe (5) and into the engine intake manifold through inlet pipe (6). From the engine intake manifold the air travels into the cylinders where it mixes with atomized fuel from the injectors. This cooler air aids combustion, thereby increasing fuel economy.

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 pressure control cap from the radiator header tank or attempt to drain the coolant until the engine has cooled. Once the engine has cooled, use extreme caution when removing the cap. Always release pressure from the system by depressing the pressure relief button on the cap. Remove 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.**

Every 10 Hours (Daily)

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 coolant inhibitor MUST be checked. If the concentration is low, engine damage will result. Conversely, over-inhibiting antifreeze solutions can result in silicate dropout. Refer to 'Test Kit Procedures'.

Check cooling fan for cracks, loose rivets and bent or loose blades. Check fan mounting and tighten if required. Replace cooling fan if damaged.

Check coolant lines, pipes and components for leaks and wear.

Every 50 Hours

Check all drive belts for wear and tension. Refer to Section 110-0030, ENGINE AND MOUNTING for belt tension specifications.

Every 500 Hours

Replace coolant/conditioner filter. Check and replenish coolant inhibitor as required.

Note: Failure to use and maintain coolant and coolant inhibitor mixture at sufficient concentration levels can result in damage to the cooling system and its related components. Conversely, over-concentration of coolant and/or inhibitor can result in poor heat transfer, leading to engine dropout, or both. Always maintain concentrations at recommended levels.

Inspect water pump drain hole to make sure it is open.

Note: A small chemical build up or streaking at the drain hole may occur. This is not an indication of a defective water pump or seal. If coolant does not leak from the drain hole under normal operating conditions, do not replace the water pump.

Inspect the radiator and air-to-air charge cooler fins and, if necessary, clean with a quality grease solvent such as mineral spirits and dry with compressed air.

Note: Fuel oil, kerosene or gasoline should not be used to clean fins.

Note: It may be necessary to clean radiator and air-to-air charge cooler fins more frequently if the vehicle is being operated in extremely dusty or dirty areas.

> ⚠ **WARNING**
> **To prevent possible injury when using compressed air, wear adequate eye protection and do not exceed 2.75 bar (40 lbf/in²).**

Every 2 000 Hours

Replace all drive belts. Refer to Section 110-0030, ENGINE AND MOUNTING.

Note: Replace all belts in a set when one is worn. Single belts of similar size should not be used as a substitute for a matched belt set. Premature belt wear can result because of belt length variation.

Every 4 000 Hours

Drain, flush and refill the cooling system. Inspect all components that make up the cooling system and make necessary repairs at this time.

Note: Mix coolant and water solution at the proper concentration before adding to the cooling system. This should prevent over or under coolant concentration problems.

DRAINING AND FLUSHING

> **WARNING**
> **Do not remove the pressure control cap from the radiator header tank or attempt to drain the coolant until the engine has cooled. Once the engine has cooled, use extreme caution when removing the cap. Always release pressure from the system by depressing the pressure relief button on the cap. Remove 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.**

1. With the engine cool, drain the coolant from the engine and radiator assembly.

2. Refill the cooling system with clean, soft water and a good radiator cleaning compound. If the engine is warm, fill slowly to prevent the rapid cooling and distortion of the metal castings.

3. Start the engine and operate the vehicle for fifteen minutes to circulate the solution completely.

4. Stop the engine and allow to cool. With the engine cool, drain the cooling system completely.

5. Refill the cooling system with clean, soft water and operate it for fifteen minutes.

6. Stop the engine and allow to cool. With the engine cool, drain the cooling system completely.

7. Refill the cooling system with the proper mix of antifreeze and clean, soft water.

8. Entrapped air must be purged after filling the cooling system. To do this, allow the engine to warm up with the pressure cap on the remote header tank removed. With the transmission in neutral, increase engine speed above 1 000 rev/min and add coolant as required. Vent the cock on the water return line at the water-jacketed turbocharger until a steady stream of water (no air) is seen. Close the cock.

9. Install the pressure cap on the remote header tank after the coolant level has stabilized at the bottom of the header tank filler neck.

Note: If the engine overheats and the coolant level is satisfactory, the cooling system may require cleaning with a descaling solvent and back-flushing.

Back-flushing Engine Jacket

Whenever the engine water jacket is rust clogged, pressure back-flushing should be used after the draining of the cleaning compound. Be certain to remove both thermostats from thermostat housing before beginning back-flushing operation.

1. Close shut-off cocks at coolant/conditioner filter.

2. Remove both thermostats from thermostat housing and clamp flushing gun to front neck of the water manifold.

3. Temporarily block engine water pump inlet opening and fill engine jacket with clean, soft water.

4. Unblock water pump inlet opening and blow water from the engine jacket with air from flushing gun clamped to neck of water manifold. Use full air pressure.

5. Repeat operation by alternately filling engine with clean, soft water and blowing out with air until flushing water runs out clean.

6. Open shut-off cocks at the water filter.

Back-flushing Radiator

1. Disconnect all coolant lines at the engine.

2. Clamp flushing gun to lower hose on the radiator and fill the radiator with clean, soft water from the gun.

3. Apply air pressure gradually increasing to a pressure of 0.7 bar (10 lbf/in²). DO NOT EXCEED THIS PRESSURE.

4. Alternatively fill radiator with clean, soft water and flush with air until water runs out clear.

RECOMMENDED COOLANTS

Antifreeze

Use genuine Detroit Diesel Power Cool or an equivalent ethylene glycol base coolant (low silicate formulation) that meets or exceeds the standard of either the GM 6038-M formulation (GM 1899-M performance) or ASTM D 4985 requirements.

A 50% antifreeze/water solution is normally used as a factory fill. Concentrations over 70% are not recommended because of poor heat transfer capability, adverse freeze protection and possible silicate dropout. Concentrations below 30% offer little freeze, boil over or corrosion protection. Refer to graph in Fig. 3.

Antifreeze solution should be used year-round to provide freeze and boil over protection as well as a stable environment for seals and hoses. In extremely hot environments, clean, soft, properly inhibited water may be used if Detroit Diesel Maintenance Product supplemental corrosion inhibitors are also added in the right concentration. If water is used, supplemental coolant additive levels should be increased from 3% to 6% by volume.

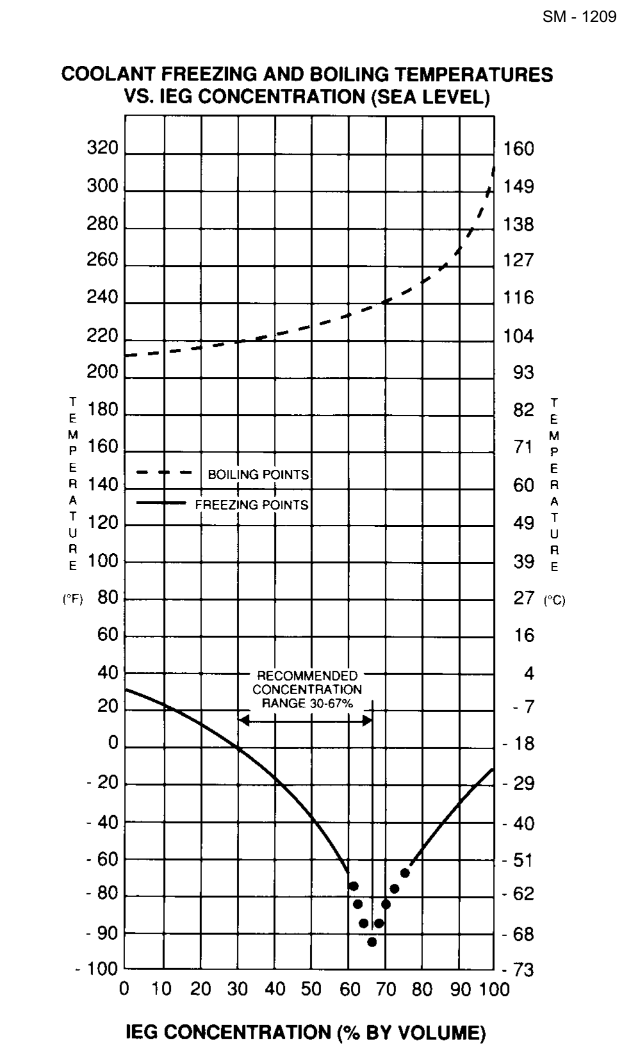


Fig. 3 - Coolant Freezing and Boiling Temperatures versus Inhibited Ethylene Glycol (IEG) Concentration (Sea Level)

Only non-chromate inhibitors should be used with coolant solutions. Chromate coolant inhibitors are not compatible with ethylene glycol antifreeze (low silicate formulation) and if these compounds are combined a green sludge will be produced. This sludge will deposit on cooling system passages and reduce heat transfer from the engine to coolant.

Methyl alcohol-based antifreeze is not recommended for use because of its effect on the nonmetallic components of the cooling system and its low boiling point. Methoxy propanol-based antifreeze is also not recommended for use because it is not compatible with fluoroelastomer seals found in the cooling system.

Soluble oil additives are not approved for use in the cooling system. A small amount of oil adversely affects heat transfer; 1.25% concentration increases the fire deck temperature 6% and 2.5% concentration increases fire deck temperature 15%.

Supplemental Coolant Additives (SCA)

SCA's provide protection for the cooling system components. The coolant must have the proper concentration of SCA's. Detroit Diesel Maintenance products are recommended for use in all Detroit Diesel Engines.

The proper application of SCA will provide:

a - pH control to prevent corrosion.
b - Water-softening to deter formation of mineral deposits.
c - Cavitation protection to reduce the effects of cavitation.

Install a new precharge coolant filter at initial cooling system fill and whenever the coolant is changed. Replace the precharge filter with a maintenance filter after 250 hours then every 500 hours thereafter. Refer to the vehicle Parts Book for coolant filter part numbers.

Note: Selection of the correct coolant filter element is vital when precharging the cooling system and at maintenance intervals. A fully formulated cooling

SCA Concentration Limitations Table650

	MINIMUM PPM	MAXIMUM PPM
Boron (B)	1 000	1 500
Nitrite (NO2)	800	2 400
Nitrates (NO3)	1 000	2 000
Silicon (Si)	50	250
Phosphorous (P)	0	500
pH	8.5	10.5

system **must not** have SCA's added at initial fill.

The concentration of SCA will gradually deplete during normal engine operation and should be checked after every filter change. Additional SCA must be added to the coolant when it becomes depleted below the level specified in the table on the following page.

Maintenance dosage of SCA must only be added if nitrite concentration is less than 800 parts per million (PPM). If nitrite concentration is greater than 800 PPM, do not add additional SCA. Refer to 'Test Kit Procedures'.

Test Kit Procedures

Coolant Test Strips should be used to measure nitrite and glycol concentrations (See Special Tools). Cavitation/corrosion protection is indicated on the strip by the level of nitrite concentration. Freeze/boil over protection is determined by glycol concentration. Use the test strips as follows:

a. Dip the strip into coolant for one second. Remove and shake briskly to eliminate excess fluid.

b. Immediately compare end pad (% glycol) to the colour chart.

c. Sixty seconds (one minute) after dipping, compare the nitrite pad.

For best results make the tests while the coolant is between 10° - 60° C (50° - 140° F). Wait at least 60, but not longer than, 75 seconds before reading the nitrite level. Promptly replace and tighten container cap after each use. Discard unused strips if they have turned light pink or tan.

Note: Failure to properly maintain coolant with SCA can result in damage to the cooling system and its related components. Conversely, over-concentration of SCA inhibitor can result in poor heat transfer, leading to engine damage. Always maintain concentrations at recommended levels.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of the coolant test strips and general service tools required. These strips and tools are available from your dealer.

COOLING SYSTEM DIAGNOSIS CHART TABLE651

Engine coolant temperature too high	Low coolant level	Fill cooling system to correct fill level
		Check for leaks and repair
	Faulty radiator pressure cap	Check pressure cap, replace if required
	Air in cooling system	Purge air from cooling system
	Front of radiator obstructed preventing free flow of air	Remove obstruction and clean radiator fins
	Fan drive belts broken or slipping	Adjust or replace fan belts
	Thermostats not opening	Replace thermostats
	Restricted cooling system passages	Flush cooling system
	Faulty engine water pump	Repair or replace water pump
Engine coolant temperature too low	Thermostats remain open or open at too low a temperature	Replace thermostats
	Leakage around thermostat seals	Replace thermostat seals
	Extremely cold weather	Cover radiator or install radiator shutters

* * * *

DESCRIPTION

Numbers in parentheses refer to Figs. 2 through 5.

The braking system on the machine uses brake cooling oil to cool the brake packs. This cooling oil is separate from the hydraulic oil used in the main hydraulic systems.

A brief description of the individual components used in the brake cooling system are listed below. Detailed service and operating instructions can be found in the relevant component sections of this manual.

Service Brakes

Refer to Section 165-0015, BRAKE ASSY - OCDB.

The service brakes are of the enclosed, forced oil-cooled multiple disc type. The service brakes are actuated by hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. **DO NOT use BRAKE FLUID (J 1703).** Multiple discs within the brake packs are cooled by brake cooling oil as specified in Section 300-0020, LUBRICATION SYSTEM.

The brake pack is bolted to the stub axle and houses a sandwich of friction discs splined to a hub rotor. There are six friction discs in each of the front axle brake packs, four in the centre and rear axle brake packs.

When the treadle valve is actuated, hydraulic oil enters the brake pack and forces the piston against the rotating friction discs which react with stationary stator plates. The stator plates are retained by scalloped tangs at the outside diameter, which in turn transfers the reaction torque to the rigid outside housing, slowing or stopping wheel rotation.

In an emergency situation, application of the park/emergency valve will actuate the service brakes and the parking brake to bring the machine to a halt. In this condition, a restriction in the 'Px' line from the brake manifold valve will slow oil flow from the parking brake allowing the service brakes to actuate momentarily ahead of the parking brake.

Triple Pump (1)

Refer to Section 250-0040, TRIPLE PUMP.

The triple pump is mounted off the transmission power takeoff. It is a triple gear type pump, which supplies various circuits:

a) front section (closest to driveshaft) supplies brake actuation circuit and engine cooling circuit.
b) middle section combines with front section to supply engine cooling circuit.
c) rear section supplies the brake cooling circuit.

The triple pump is assembled for left hand (anticlockwise) rotation, as viewed from the driveshaft end.

Note: Never drive a pump in the wrong direction of rotation, as pump seizure may result.

Brake Coolant Tank (2)

Refer to Section 250-0025, BRAKE COOLANT TANK.

The brake coolant tank is the reservoir for the brake cooling oil. It is mounted off the left hand frame rail in front of the fender and is secured in three places.

Integral with brake coolant tank assembly are filter assembly, oil level sight gauge, strainer, manifold block, low pressure relief valve (8) and access covers. Located on top of the tank is filler cap, breather and walkway plate. Heatshields are fitted to front and side of tank.

Low Temperature Unloader Valve (3)

Refer to Section 210-0045, LOW TEMPERATURE UNLOADER VALVE.

The low temperature unloader valve is located on the hydraulic cradle, below the hydraulic diverter tube.

The low temperature unloader valve receives hydraulic supply from the engine cooling section (mid section) of the triple gear pump (1). An integral two way solenoid cartridge controls flow to the hydraulically driven engine cooling fan. The pressure relief valve controls circuit pressure to a preset 205 bar (2970 lbf/in²).

Pressure Relief Valve (4)

Refer to Section 250-0120, PRESSURE RELIEF VALVE.

Mounted on the disc brake oil cooler casing on the right hand fender, the pressure relief valve limits the maximum pressure in the brake cooling circuit. The pressure relief valve is installed between the triple gear pump (1) and the two speed control valve (5).

Two Speed Control Valve (5)

Refer to Section 250-0065, TWO SPEED CONTROL VALVE.

Mounted on the disc brake oil cooler casing on the right hand fender, the two speed control valve regulates the fan speed of the disc brake oil cooler. The two speed control valve is supplied by the rear section of the triple gear pump (1), via pressure relief valve (4).

Disc Brake Oil Cooler (6)

Refer to Section 210-0050, DISC BRAKE OIL COOLER.

The disc brake oil cooler is mounted on the right hand fender adjacent to the main hydraulic tank. The fan within the brake oil cooler is driven by a hydraulic motor. The speed of the fan is dependant on the oil flow being supplied to the motor from the two speed control valve (5).

Brake cooling oil enters the top of the cooler and flows through the cooler before exiting at the bottom. There are three inlet ports and three outlet ports, one for each axle.

Motor/Triple Pump Assembly (7)

Refer to Section 250-0045, MOTOR/TRIPLE PUMP ASSEMBLY.

Mounted on the left hand frame rail, adjacent to the brake coolant tank, the motor/triple pump assembly consists of three pump elements coupled to a single direction hydraulic motor.

The motor is supplied with hydraulic oil from the rear section of the triple gear pump (1), via the disc brake oil cooler (6). The motor and pump elements are connected by a common shaft, therefore motor rotation causes pump elements to draw brake cooling oil from brake coolant tank (2). Cooling oil is then pumped to low pressure relief valve (8), before being supplied to brake packs.

Low Pressure Relief Valve (8)

The low pressure relief valve, mounted on the brake coolant tank (2), ensures that only low pressure cooling oil is supplied to the brake packs. There are three pressure relief valves housed in valve, one for each axle, which are set at 1.5 bar (22 psi).

CHECKING SYSTEM PRESSURE

⚠ WARNINGS
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.

1. Ensure that hydraulic oil has reached operating temperature, position the vehicle in a level work area and apply the parking brake. Block all road wheels.

2. Connect a hydraulic gauge, capable of recording a pressure of 0 - 345 bar (0 - 5 000 lbf/in²), to diagnostic check point at brake cooling section of triple pump.

3. Increase the engine speed to 2 200 rpm and note the reading on the gauge. Pressure should be 110 bar (1600 lbf/in²).

4. If pressure is low, triple pump should be checked. Refer to Section 250-0040, TRIPLE PUMP.

5. Shut off the engine and remove the pressure gauge from triple pump. Remove wheel blocks.

'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 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 of spanner (wrench).

f. Check that a satisfactory hose or tube routing has been achieved.

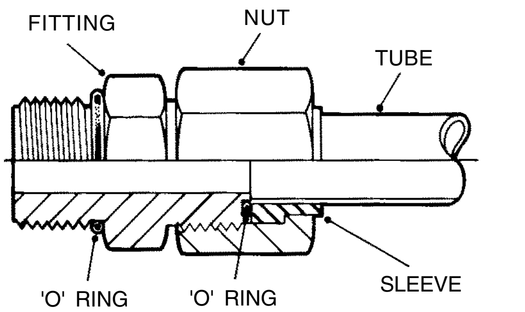


Fig. 1 - Assembly of Typical ORFS Connector

BRAKE COOLING OIL

The brake cooling system should be kept filled with brake cooling oil as specified in Section 300-0020, LUBRICATION SYSTEM.

Whenever there is a system failure, the brake cooling oil should be drained, the entire system flushed, oil filter replaced, oil screens thoroughly cleaned and clean brake cooling oil added to eliminate all metal particles or foreign matter.

SERVICE TOOLS

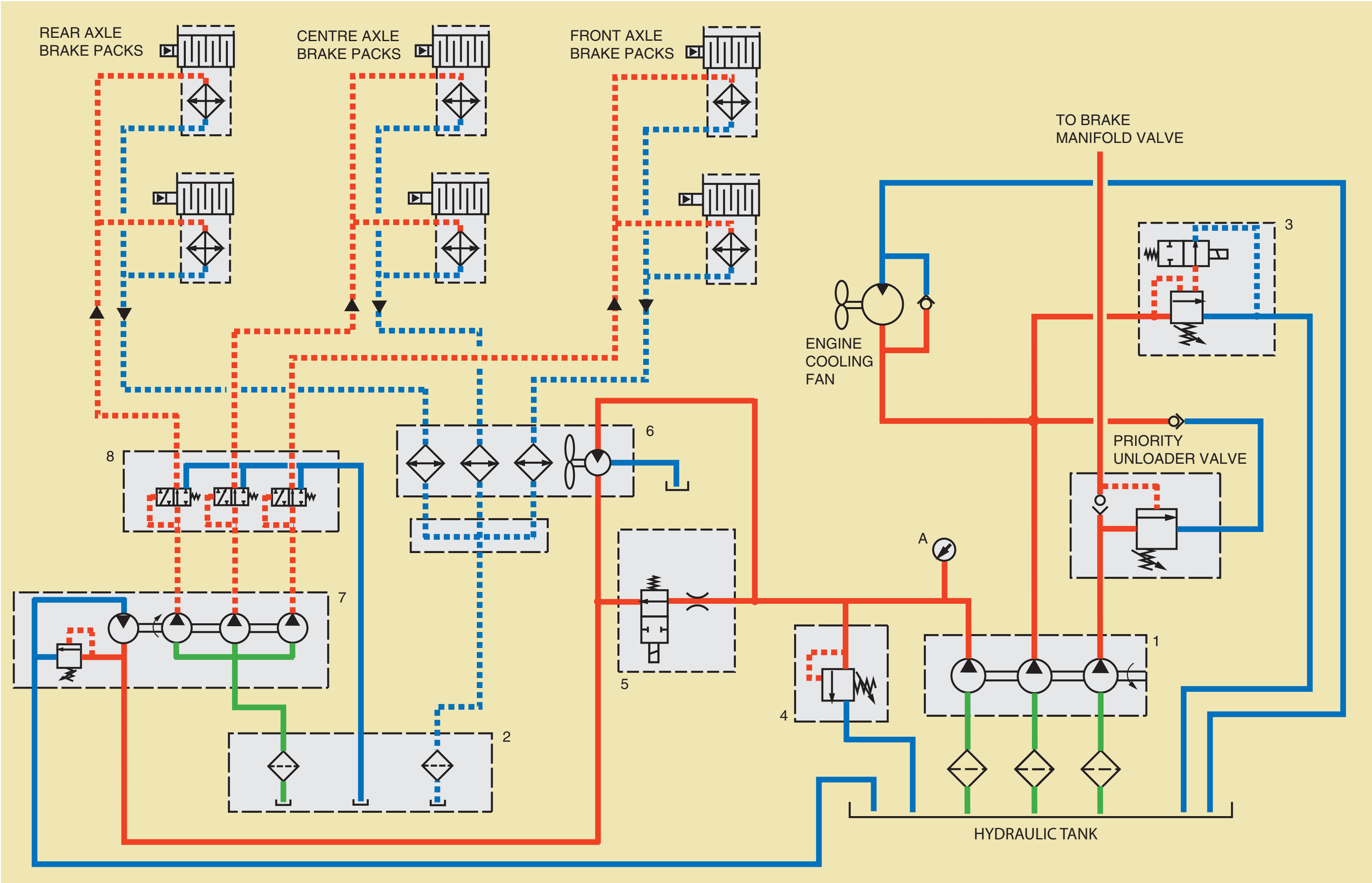
It is recommended that the following tools are used when carrying out pressure or temperature checks during maintenance procedures. These tools, along with other general service tools, are available from your dealer. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of these tools.

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 762 mm (30 in) of vacuum to 345 bar (5 000 lbf/in^2).

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.



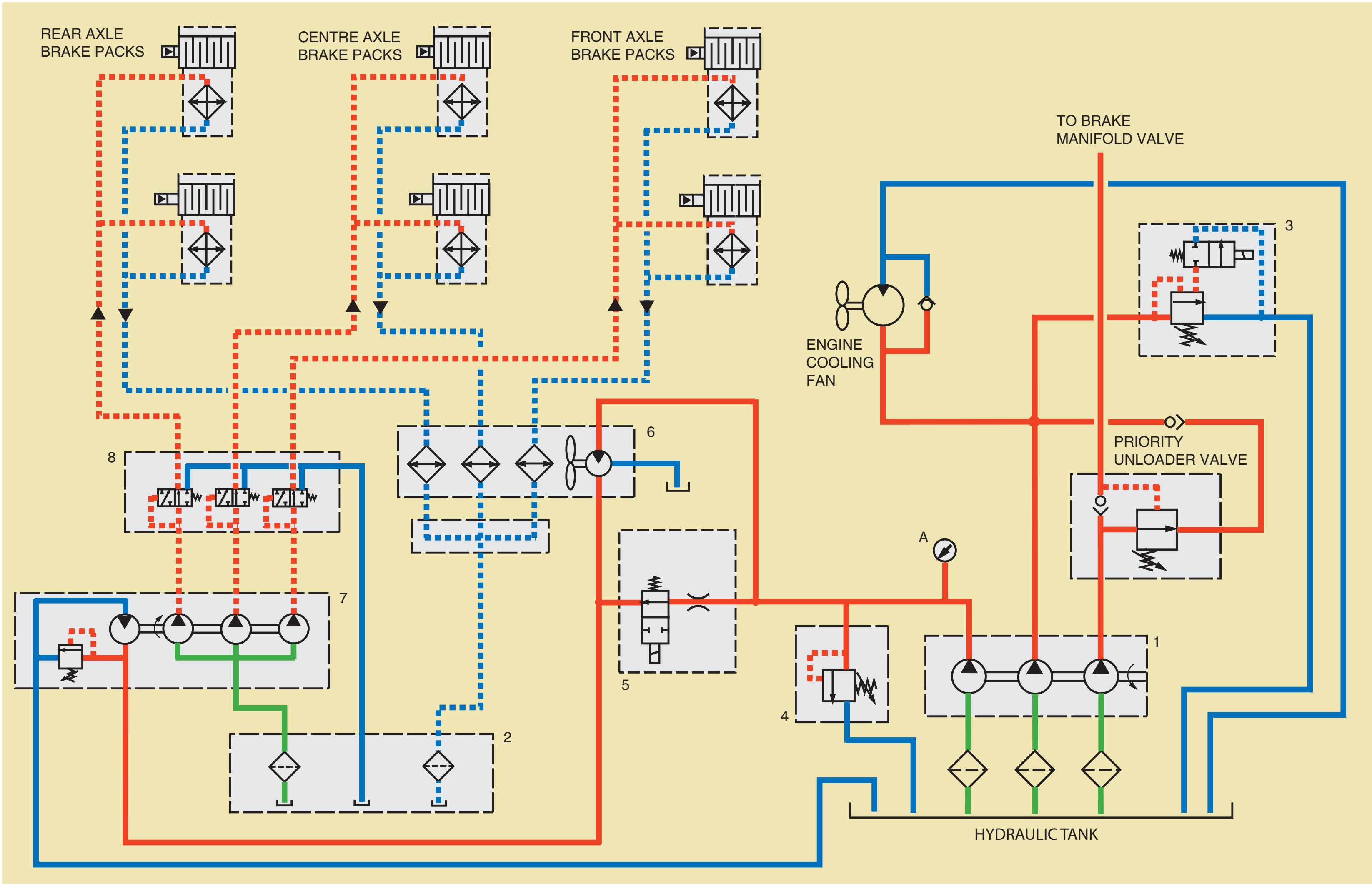
COMPONENTS
1 - Triple Pump
2 - Brake Coolant Tank
3 - Low Temperature Unloader Valve
4 - Pressure Relief Valve
5 - Two Speed Control Valve
6 - Disc Brake Oil Cooler
7 - Motor/Triple Pump Assembly
8 - Low Pressure Relief Valve

PRESSURE TEST POINTS
A - Brake Cooling System Pressure

COLOUR CODES
Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil
Intermittent Red/Blue - Brake Cooling Oil

SM-2772A

Fig. 2 - Brake Cooling System Schematic - Engine Running, Brakes Charging, Low Temperature Unloader Valve Energised



COMPONENTS
1 - Triple Pump
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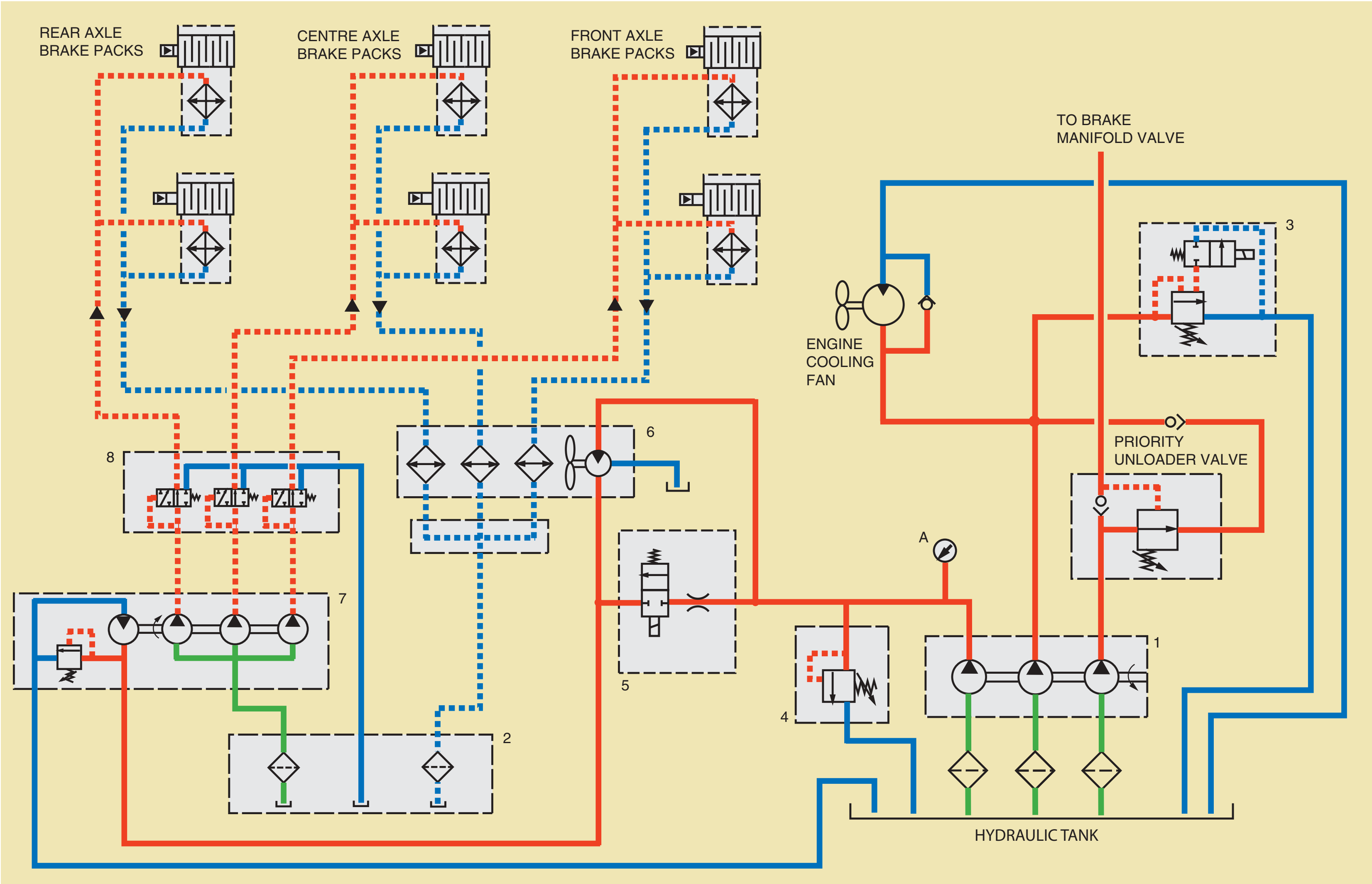
8 - Low Pressure Relief Valve

PRESSURE TEST POINTS
A - Brake Cooling System Pressure

COLOUR CODES
Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil
Intermittent Red/Blue - Brake Cooling Oil

Fig. 3 - Brake Cooling System Schematic - Engine Running, Brakes Charged, Low Temperature Unloader Valve De-Energised

SM-2772B



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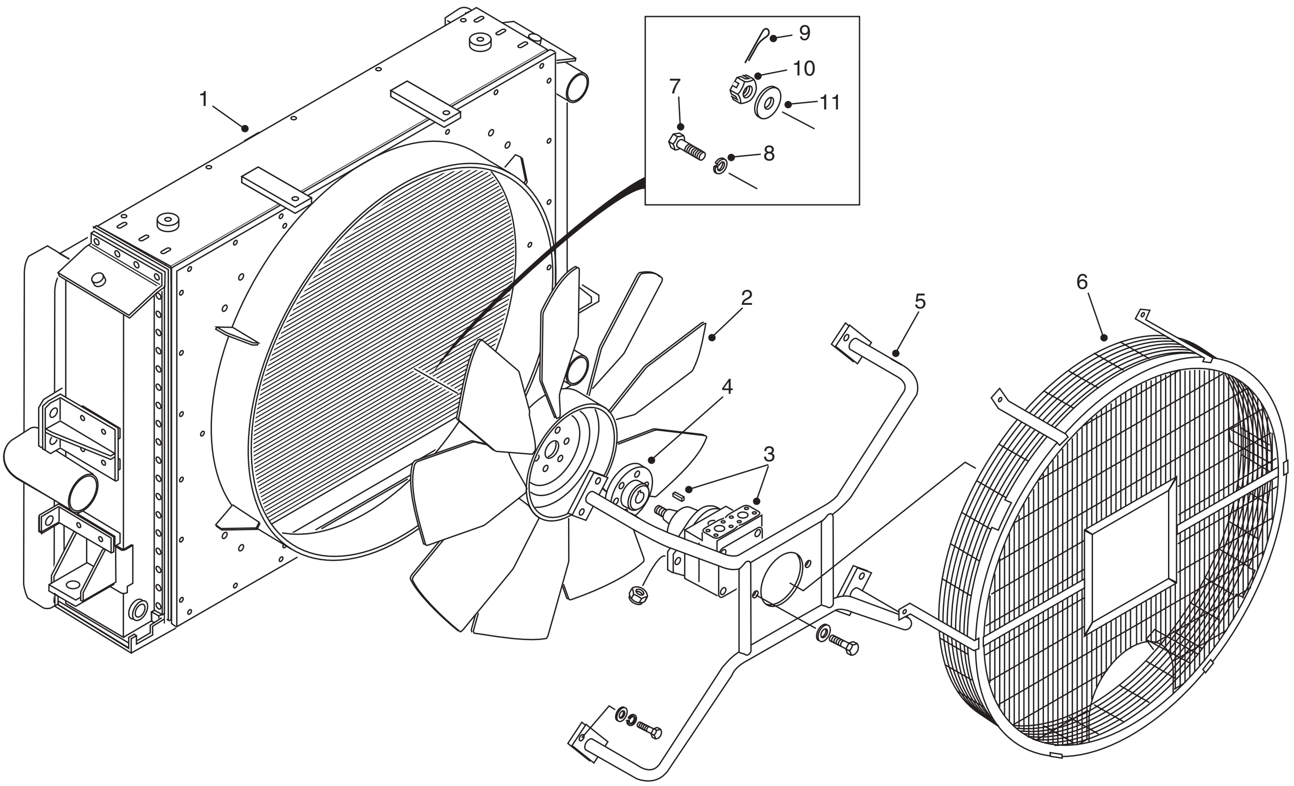
COMPONENTS
1 - Triple Pump
2 - Brake Coolant Tank
3 - Low Temperature Unloader Valve
4 - Pressure Relief Valve
5 - Two Speed Control Valve
6 - Disc Brake Oil Cooler
7 - Motor/Triple Pump Assembly
8 - Low Pressure Relief Valve

PRESSURE TEST POINTS
A - Brake Cooling System Pressure

COLOUR CODES
Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil
Intermittent Red/Blue - Brake Cooling Oil

Fig. 4 - Brake Cooling System Schematic - Engine Running, Brakes Charged, Low Temperature Unloader Valve Energised

SM - 2772C



1 - Radiator	5 - Motor Carrier Frame	9 - Split Pin
2 - Fan	6 - Fan Guard	10 - Slotted Nut
3 - Fan Motor	7 - Bolt	11 - Washer
4 - Fan Hub Adaptor	8 - Lockwasher	

Fig. 1 - Exploded View Of Hydraulic Fan Drive

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1.

Note: The rate of fan speed change and maximum fan speed is preset to the cooling needs of the engine.

The hydraulic fan drive system uses an electrical signal from the engine electronic control module (ECM) to provide the appropriate fan speed necessary to satisfy any cooling demand. The fan (2) is driven by a single vane type hydraulic motor (3), which is supplied by a dedicated engine cooling section of the triple gear pump. The fan motor (3) can also be supplied by the brake section of the triple gear pump when accumulators are charged. Refer to Section 250-0040, TRIPLE PUMP, and Section 250-0000, BRAKING SYSTEM SCHEMATIC.

After the accumulators are charged, oil from the brake section of the triple pump will be forced to the fan motor (3), causing the fan (2) to rotate. At pre-determined conditions, an electrical signal closes the low temperature unloader valve. The oil from the engine cooling section of the triple pump is then directed to the fan motor (3), increasing oil flow through fan motor (3). Hence fan speed is increased until the fan (2) is fully engaged. Refer to Section 210-0045, LOW TEMPERATURE UNLOADER VALVE.

When electrical signal reopens the low temperature unloader valve, oil from engine cooling section of triple pump is returned to tank, reducing oil flow through fan motor (3) therefore decreasing fan speed.

The hydraulic fan drive system has a failsafe feature, ie. if the electrical signal to the low temperature unloader valve fails, the valve will close causing maximum oil flow through fan motor (3), driving fan (2) at maximum speed.

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 machine on a level floor. Switch off the engine and operate the steering several times to discharge the steering system.

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

3. Remove mounting hardware securing hood assembly to the machine and, using suitable lifting equipment, remove hood assembly as described in Section 100-0040, HOOD.

4. Remove radiator assembly from machine as described in Section 210-0040, RADIATOR AND MOUNTING.

5. Support radiator assembly with suitable lifting equipment. Remove fan guard (6) and motor carrier frame (5) from radiator assembly.

6. Remove two bolts, nuts and washers securing fan (2) and motor (3) assembly to the motor carrier frame (5). Remove fan (2) and motor (3) assembly from motor carrier frame (5).

7. Remove six bolts (7) and lockwashers (8) securing fan (2) to fan hub adaptor (4) on motor (3). Remove fan (2) from fan hub adaptor (4).

8. Remove split pin (9), slotted nut (10) and washer (11) from motor (3) shaft. Remove fan hub adaptor (4) from motor (3).

MOTOR OVERHAUL

Numbers in parentheses refer to Fig. 2.

Internal parts of the motor are lubricated by the operating fluid itself; therefore, preventive maintenance is limited to keeping the fluid in the system clean. Dirt should not be allowed to accumulate on the motor or around the shaft seal. Check frequently that all fittings and bolts are tight.

DISASSEMBLY

1. Drain all fluid from the motor, and clean the external surface. Prepare a clean, lint free surface on which to place the internal parts for inspection and repair.

2. Remove the four housing screws (20) and carefully remove the end cap (1).

3. By using two 10-24 UNC-2B screws, remove the cartridge assembly (2-6) from the housing (9), giving it small oscillations around its axis. Be careful the cartridge assembly (2-6) does not explode: the rotor (2) and the cam ring (6) must be removed from the housing (9) at the same time.

4. With the same screws, remove the pressure plate (7).

Note: The cartridge assembly (2-6) and the pressure plate (7) may come out together if they are stuck by oil.

ASSEMBLY

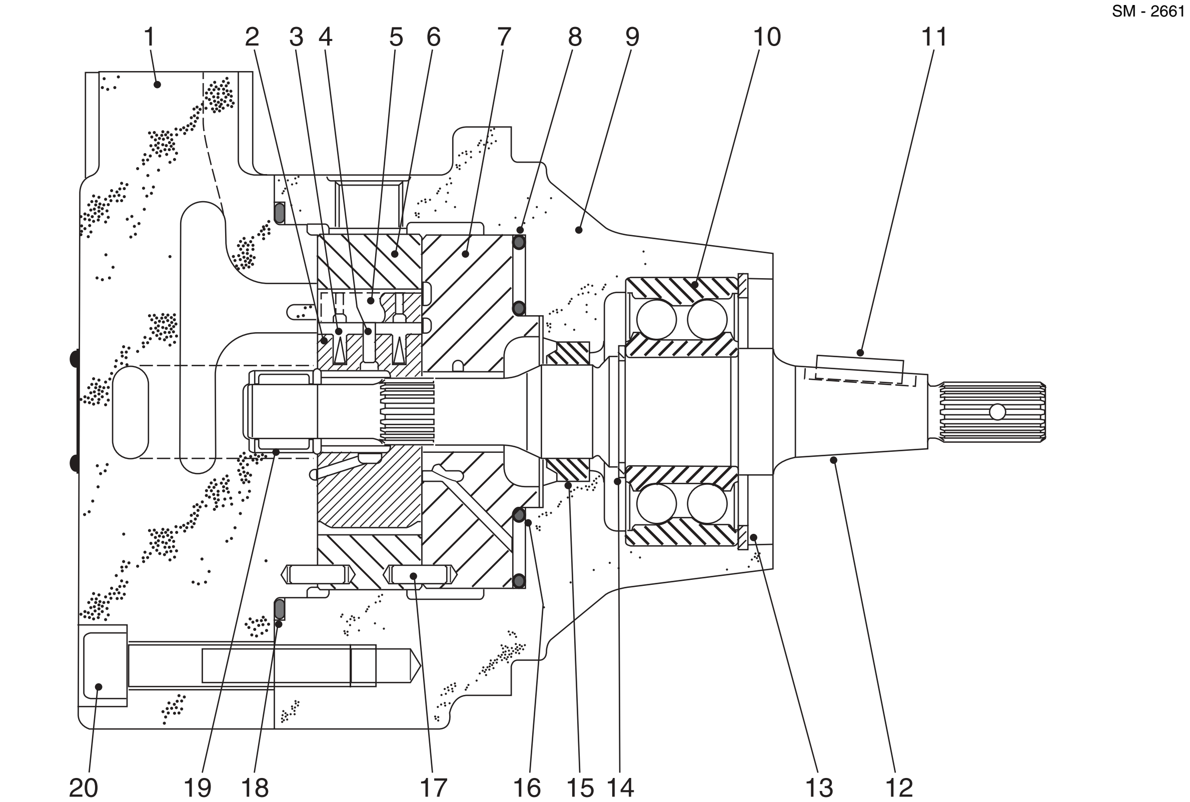
Note: Tighten all fasteners without special torques specified, to standard torques listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

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. Use clean hydraulic fluid to lubricate all the internal parts, including seals.

2. Install seal (16) on the pressure plate (7) spigot. Install seal (8) in the housing (9).

3. By using two 10-24 UNC-2B screws, install the pressure plate (7) inside the housing (9) and make sure it is completely inserted and seated on its two seals.



1 - End Cap	6 - Cam Ring	11 - Key	16 - Seal
2 - Rotor	7 - Pressure Plate	12 - Shaft	17 - Dowel Pin
3 - Spring	8 - Seal	13 - Retaining Ring	18 - Seal
4 - Pin	9 - Housing	14 - Retaining Ring	19 - Bearing
5 - Vane	10 - Bearing	15 - Seal	20 - Screw

Fig. 2 - Sectional View Of Hydraulic Motor

4. Install the two dowel pins (17) and two 10-24 UNC-2B screws on the cam ring (6). By using the screws, insert the cartridge assembly (2 - 6) into the housing (9), dowel pins (17) facing the corresponding hole on the pressure plate (7).

5. Be sure the cartridge assembly (2 - 6) is well seated on the pressure plate (7) by pushing with fingers on the vanes (5) and the cam ring (6) - they should not be lower than the cam ring surface.

6. Install seal (18) on the end cap (1) spigot. Insert the end cap (1) in the housing (9), the locating hole facing the dowel pin (17) on the cam ring (6). As the cap (1) is well inserted, less than 1 mm (0.04 in) between cap (1) and housing (9), rotate the end cap (1) to the specified porting combination.

7. Insert the four screws (20) and tighten to 100 Nm (74 lbf ft).

8. Check that it is possible to rotate the shaft (12), and fill the motor with oil before connecting the pipes.

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 fan hub adaptor (4) to motor (3) and secure using split pin (9), slotted nut (10) and washer (11).

2. Attach fan (2) to fan hub adaptor (4) using six bolts

(7) and lockwashers (8). Torque tighten bolts (7) to 54 - 61 Nm (40 - 45 lbf ft).

3. Install fan (2) and motor (3) assembly to motor carrier frame (5) and secure using bolts, nuts and washers.

4. Using suitable lifting equipment, position motor carrier assembly on the radiator assembly and secure using bolts, nuts and washers.

Note: Ensure there is even clearance, all the way round, between fan (2) and the fan shroud.

5. Install fan guard (6) to the radiator assembly and secure with mounting hardware, as removed at 'Removal'.

6. Using suitable lifting equipment, install radiator assembly to the machine as described in Section 210-0040, RADIATOR AND MOUNTING.

7. Position the hood assembly on the machine using a suitable lifting device. Secure hood assembly on the machine with mounting hardware, as described in Section 100-0040, HOOD.

8. Start the engine and check for correct operation of the fan (2). Refer to 'Testing' procedure contained in this section.

9. Remove wheel blocks.

TESTING

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 2 200 rev/min.

2. Maintain engine speed at 2 200 rev/min and disconnect harness from the low temperature unloader valve. Fan should automatically engage to full flow speed.

MAINTENANCE

Numbers in parentheses refer to Fig. 2.

Motor Cartridge Replacement

1. Disassemble the motor without removing the pressure plate (7).

2. Replace the cartridge assembly (2-6).

3. Reassemble the motor.

Note: To change the cam ring (6) only, or to reassemble an exploded cartridge assembly (2-6), it is necessary to compress the springs (3) under the vanes (5).

Motor End Cap Replacement

1. Disassemble the motor without removing the plate (7) or cartridge assembly (2-6).

2. Lubricate the needle bearing (19) of the new end cap (1).

3. Reassemble the motor.

Motor Shaft Replacement

1. Disassemble the motor.

2. Place the housing on a clean surface, shaft up. Remove the retaining ring (13) and extract the shaft (12) from the housing (9), by pulling it straight out to avoid damaging shaft seal (15).

3. Inspect the seal (15). If lips are damaged, replace seal (15).

4. Grease the seal (15) and the shaft (12) seal area.

5. Insert the shaft (12) into the housing (9), and install the retaining ring (13).

Motor Shaft Seal Replacement

1. Disassemble the motor.

2. Remove the shaft (12).

3. Place the housing (9) under a press, spigot up. Using a seal driver, extract the shaft seal (15) from the housing (9).

4. Grease the new seal (15) and install it on the seal driver.

5. Install the housing (9) under the press, large opening upward, and insert the shaft seal (15).

6. Reinstall the shaft (12), and reassemble the motor.

Every 10 Hours/Daily

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

Note: The 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 add any fluids or lubricants to the drive.

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

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

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

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

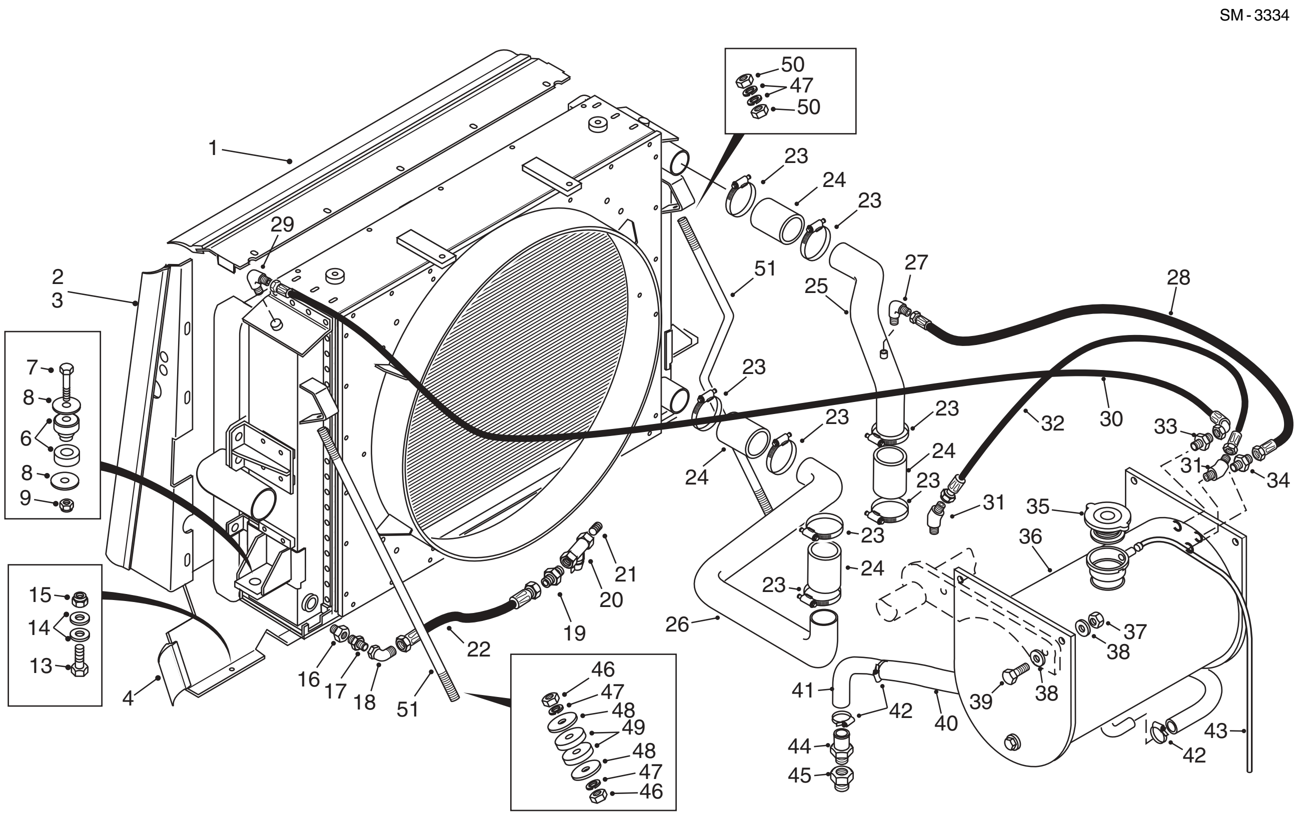
SPECIAL TOOLS

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

			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	7	Bolt	54 - 61	40 - 45
2	20	Screw	100	74

* * * *



1 - Top Baffle	14 - Washer	27 - Elbow	40 - Firemaster Hose
2 - LH Baffle	15 - Locknut	28 - Deaeration Line	41 - Make-up Line
3 - RH Baffle	16 - Bushing	29 - Elbow	42 - Clamp
4 - Bottom Baffle	17 - Connector	30 - Deaeration Line	43 - Overflow Line
5 - Support Bracket	18 - Elbow	31 - Elbow	44 - Connector
6 - Rubber Mounting	19 - Connector	32 - Deaeration Line	45 - Bushing
7 - Bolt	20 - Shut-Off Valve	33 - Connector	46 - Nut
8 - Snubbing Washer	21 - Plug	34 - Connector	47 - Locwasher
9 - Locknut	22 - Drain Hose	35 - Filler Cap	48 - washer
10 - Bolt	23 - Clamp	36 - Header Tank	49 - Rubber Mount
11 - Washer	24 - Hose	37 - Nut	50 - Nut
12 - Locknut	25 - Coolant Inlet Pipe	38 - Washer	51 - Brace Rod
13 - Bolt	26 - Coolant Outlet Pipe	39 - Bolt	

Fig. 1 - Exploded View of Radiator Mounting and Hoses

DESCRIPTION

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

Radiator assembly is mounted in front of the engine cooling fan at the front end of the vehicle. It is fed from header tank (36) located in front of the operators compartment and mounted to the goalpost arrangement.

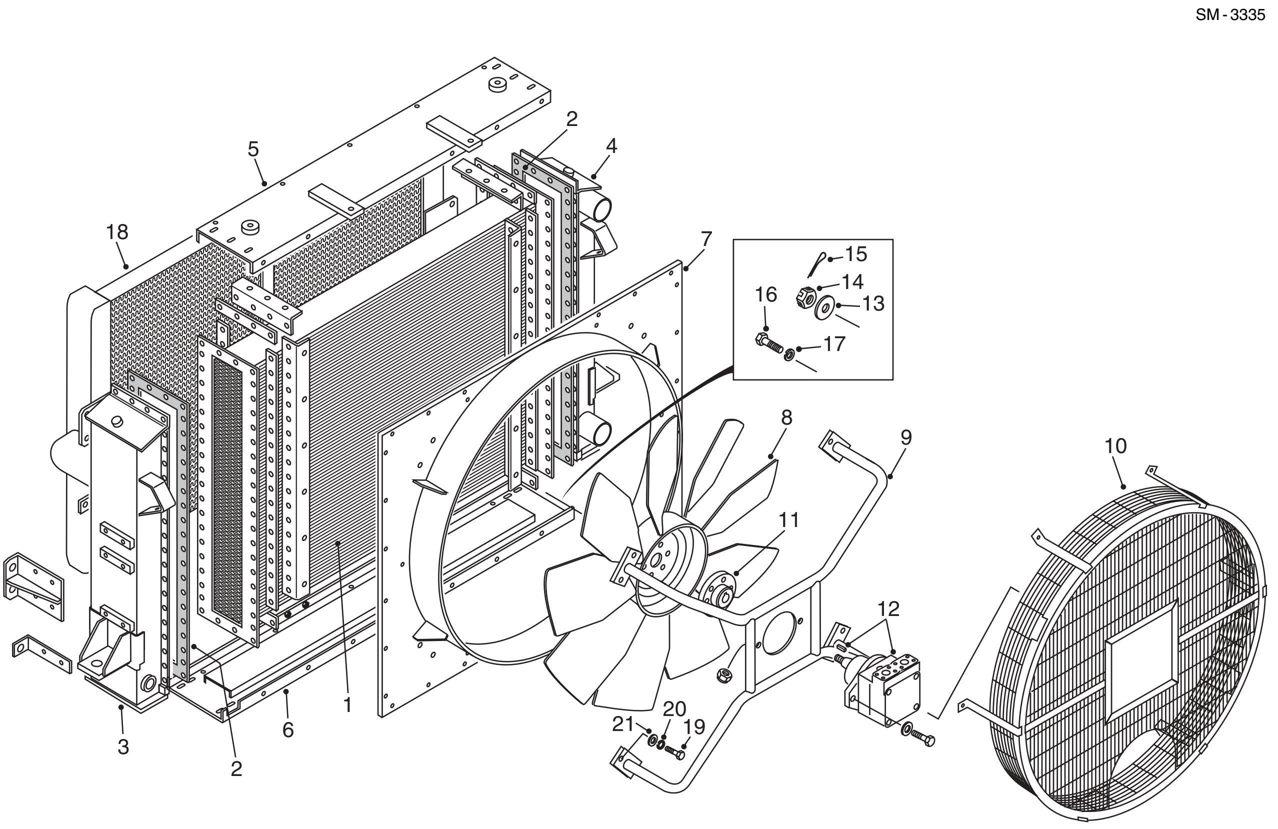
Mounted to the front of radiator assembly are an air-to-air charge cooler assembly, fuel cooler assembly and a hydraulic oil cooler assembly. Refer to Section 210-0000, COOLING SYSTEM.

Fan plate assembly (7, Fig. 2) improves the engine cooling fan efficiency, provides a more uniform distribution of air over radiator core (1, Fig. 2) and helps restrict recirculation of air within the engine compartment.

Recirculation baffle plates (1, 2, 3 & 4) around radiator assembly prevent hot air from the engine cooling fan being reintroduced into the cooling air circuit.

REMOVAL

Numbers in parentheses refer to Fig. 1 & 4, unless otherwise specified.



1 - Radiator Core	7 - Fan Plate Assy	12 - Fan Drive Motor	17 - Lockwasher
2 - Joint	8 - Fan	13 - Washer	18 - Charge Cooler Assy
3 - LH Tank	9 - Motor Carrier Frame	14 - Slotted Nut	19 - Bolt
4 - RH Tank	10 - Fan Guard Assy	15 - Split Pin	20 - Lockwasher
5 - Top Column	11 - Fan Hub Adaptor	16 - Bolt	21 - Washer
6 - Bottom Column			

Fig. 2 - Exploded View of Radiator Assembly

WARNING
Do not remove the pressure control cap from the radiator header tank or attempt to drain the coolant until the engine has cooled. Once the engine has cooled, use extreme caution when removing the cap. Remove 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.

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. Turn steering wheel several times to relieve any pressure in the steering circuit.

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 (35) carefully from header tank (36).

5. Remove plug (21) and open shut-off valve (20) at the bottom of radiator assembly and drain coolant into a suitable container. Close shut-off valve (20) when coolant is completely drained and refit plug (21).

6. Remove locknuts (46), lockwashers (47), washers (48) and rubber mountings (49) securing brace rods (51) to assembly.

7. Remove locknuts (50) and lockwashers (47) securing brace rods to the radiator assembly. Remove brace rods (51).

8. Ensure fuel lines connected to fuel cooler mounted at front of radiator assembly are identified for ease of installation and with suitable containers available to catch leakage, disconnect fuel lines. Fit blanking caps to open lines and ports.

9. Ensure hydraulic lines connected to hydraulic oil cooler mounted at front of radiator assembly are identified for ease of installation and with suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to open lines and ports.

10. Ensure hydraulic lines connected to fan drive motor (12, Fig. 2) mounted at rear of radiator assembly are identified for ease of installation and with suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to open lines and ports.

11. Disconnect deaeration line (30) from elbow (29) in radiator assembly and deaeration line (28) from elbow (27) in coolant inlet pipe (25). Identify lines for ease of installation and cap open lines and elbows.

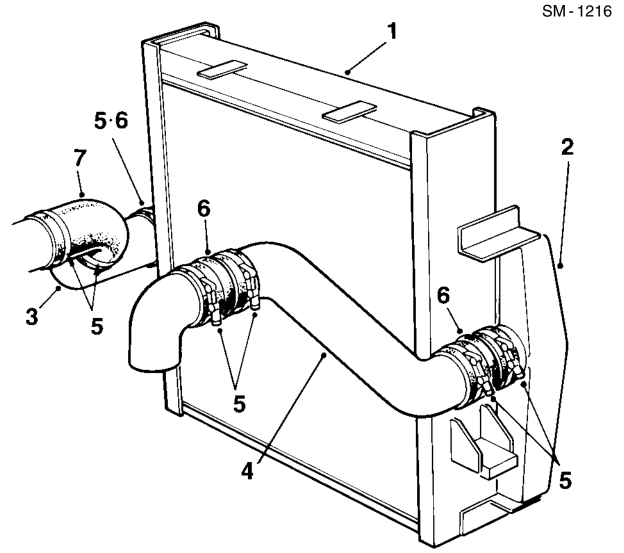
12. Disconnect all clips and clamps securing fuel cooler lines, hydraulic lines and deaeration lines attached to radiator assembly and coolant inlet pipe (25). Move all lines away from radiator assembly to prevent fouling on removal of radiator assembly.

13. Slacken clamps (23) and remove coolant inlet pipe (25), hoses (24) and clamps (23) from radiator assembly and engine thermostat housing.

14. Slacken clamps (23) and remove coolant outlet pipe (26), hoses (24) and clamps (23) from bottom of radiator assembly and engine water pump inlet.

15. Slacken clamps (5, Fig. 3) securing cooler hoses (6, Fig. 3) to air inlet pipe (4, Fig. 3) and remove air inlet pipe from charge cooler assembly (2, Fig. 3) and engine turbocharger.

16. Slacken clamps (5, Fig. 3) securing hose (6, Fig. 3) and elbow (7, Fig. 3) to air outlet pipe (3, Fig. 3) and remove air outlet pipe from charge cooler assembly (2, Fig. 3) and engine inlet manifold.



1 - Radiator Assembly
2 - Charge Cooler Assembly
3 - Air Outlet Pipe
4 - Air Inlet Pipe
5 - Clamp
6 - Hose
7 - Elbow

Fig. 3 - Air-To-Air Charge Cooler Piping

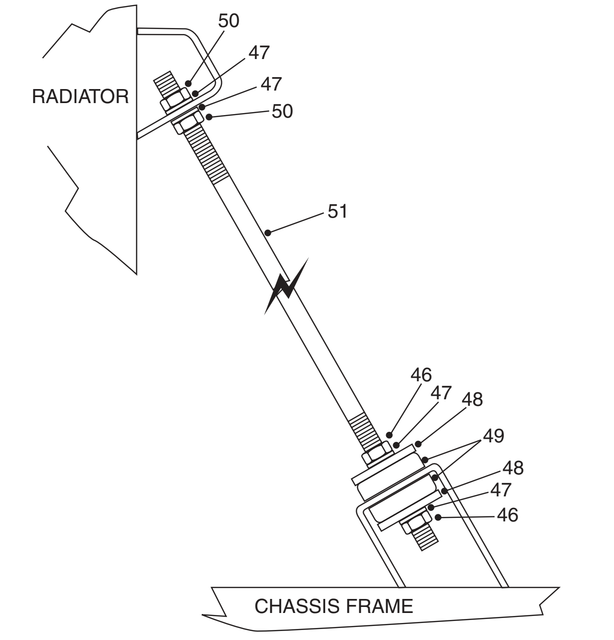


Fig. 4 - Radiator Support Detail

17. Install two eye bolts in lifting bosses on top of radiator assembly. Using suitable lifting equipment support radiator assembly.

18. Remove bolts (7), snubbing washers (8) and locknuts (9) securing radiator assembly to mounting brackets at the front of the frame.

19. Remove radiator assembly from the vehicle to a clean area for disassembly. Support radiator standing upright to allow access to front and rear of radiator.

20. If required, remove bolts (13), washers (14) and locknuts (15) securing bottom baffle (4) on the vehicle.

Note: If **Header Tank (36)** requires to be removed, follow steps 21 through 26.

21. With suitable container in position, remove lower drain plug from header tank (36) to ensure coolant has been drained from header tank (36). When all coolant has been drained, apply Loctite 225 to drain plug and reinstall in header tank (36).

22. Disconnect overflow line (43) from header tank (36).

23. Ensure deaeration lines (28, 30 & 32) connected to header tank (36) are identified for ease of installation and disconnect deaeration lines. Fit blanking caps to open lines and fittings.

24. Slacken clamp (42) and disconnect make-up line (41) from header tank (36). Blank off open line end.

25. Following removal instructions in Section 100-0040, HOOD AND MOUNTING, remove goalpost and header tank (36) as an assembly from the vehicle.

26. Remove bolts (39), nuts (37) and washers (38) securing header tank (36) to goalpost. Remove header tank (36) from goalpost.

DISASSEMBLY

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

1. Remove bolts and washers securing fan guard (10) to radiator assembly. Remove fan guard (10) from radiator assembly.

2. Remove bolts (19) and washers (20,21) securing motor carrier frame (9) to radiator assembly. Remove motor carrier frame (9) from radiator assembly.

3. Following removal instructions in Section 210-0010, COOLING FAN AND MOTOR, remove fan drive motor (12) from motor carrier frame (9).

4. Remove bolts and washers securing fan plate assembly (7) to radiator assembly. Remove fan plate assembly (7) from radiator assembly.

5. Lay radiator assembly down flat on wooden blocks with baffle plates (1, 2 & 3, Fig. 1) facing up.

6. Remove bolts and washers securing top baffle (1, Fig. 1) to radiator assembly. Remove top baffle (1, Fig. 1) from radiator assembly.

7. Remove bolts and washers securing LH baffle (2, Fig. 1) and RH baffle (3, Fig. 1) to radiator assembly. Remove baffles (2 & 3, Fig. 1) from radiator assembly.

Note: Take care not to damage radiator core, charge cooler (18) core, fuel cooler core and hydraulic oil cooler core during disassembly.

8. Remove mounting hardware securing fuel cooler and hydraulic oil cooler to radiator assembly. Note which radiator bolts are used for mounting coolers to aid in assembly. Remove coolers from radiator assembly.

9. Remove bolts, washers and spacers securing charge cooler (18) to mounting brackets. Remove charge cooler (18) from radiator assembly.

10. Identify mounting brackets for ease of assembling and remove bolts, washers and mounting brackets from side tanks (3 & 4).

11. Remove bolts, washers, lockwashers and nuts securing top column (5) to LH tank (3) and RH tank (4). Remove top column (5).

12. Remove bolts, washers, lockwashers and nuts securing bottom column (6) to LH tank (3) and RH tank (4). Remove bottom column (6).

13. Remove bolts, washers and nuts securing LH tank (3) to radiator core (1). If required, remove drain hose and fittings (16 - 22, Fig. 1) and elbow (29, Fig. 1) from LH tank (3). Remove LH tank (3) assembly and discard joint (2).

14. Remove bolts, washers and nuts securing RH tank (4) to radiator core (1). Remove RH tank (4) assembly and discard joint (2).

15. If damaged, remove rubber mountings (6, Fig. 1) from mounting brackets on side tanks (3 & 4) and discard.

INSPECTION

Numbers in parentheses refer to Fig. 2.

1. Steam clean all parts thoroughly with a suitable solvent.

2. Examine radiator core (1), charge cooler (18) core, fuel cooler core and hydraulic oil cooler 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 LH tank (3) and RH tank (4) 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 SPECIFICATION.

1. If removed, apply Loctite 225 to threads of bushing (16, Fig. 1) and install in LH tank (3).

2. Fit new joint (2) on radiator LH tank (3) and secure LH tank (3) to radiator core (1) and supports with bolts, washers and nuts.

3. Fit new joint (2) on radiator RH tank (4) and secure RH tank (4) to radiator core (1) and supports with bolts, washers and nuts.

Note: Tighten LH tank (3) and RH tank (4) to radiator core (1) from the centre out to ensure an evenly spread load.

4. If removed, apply Loctite 225 to threads of elbow (29, Fig. 1) and install in LH tank (3) noting orientation of elbow as identified at disassembly.

5. If removed, install new rubber mountings (6, Fig. 1) in mounting brackets on side tanks (3 & 4).

6. Position top column (5) to radiator assembly and secure to side tanks (3 & 4) with bolts, washers, lockwashers and nuts.

7. Position bottom column (6) to radiator assembly and secure to side tanks (3 & 4) with bolts, washers, lockwashers and nuts.

8. Secure mounting brackets to side tanks (3 & 4), as identified at disassembly, with bolts and washers.

9. Position charge cooler (18) to mounting brackets and secure with bolts, washers and spacers.

10. Install fuel cooler and hydraulic oil cooler to radiator assembly picking up mounting locations and hardware as identified at disassembly.

11. Install top baffle (1, Fig. 1) to top front of the radiator assembly and secure with bolts and washers.

12. Position side baffles (2 & 3, Fig. 1) to radiator assembly and secure with bolts and washers.

13. Fit drain hose and fittings (17 - 22, Fig. 1) to bushing (16, Fig. 1) in LH tank (3).

14. Position fan plate assembly (7) to radiator assembly and secure to supports and columns (5 & 6) using bolts and washers.

15. Fit fan drive motor (12) to motor carrier frame (9). Refer to Section 210-0010, COOLING FAN AND MOTOR.

16. Install motor carrier frame (9) to radiator assembly and secure with bolts (19), lockwashers (20) and washers (21).
Note: Ensure clearance around cooling fan tips to plate assembly is of equal dimension all round.
17. Position fan guard (10) to radiator assembly and secure using bolts and washers.

INSTALLATION

Numbers in parentheses refer to Fig. 1 & 4, 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, secure bottom baffle (4) to the vehicle with bolts (13), washers (14) and locknuts (15).

2. Using suitable lifting equipment, position radiator assembly to mounting brackets on the frame and secure with bolts (7), snubbing washers (8) and locknuts (9). Tighten bolts (7) to a torque of 165 Nm (122 lbf ft).

3. Install air inlet pipe (4, Fig. 3) between engine turbocharger and charge cooler assembly (2, Fig. 3) and secure with hoses (6, Fig. 3) and clamps (5, Fig. 3).

4. Install air outlet pipe (3, Fig. 3) between engine inlet manifold and charge cooler assembly (2, Fig. 3) and

secure with hoses (6, Fig. 3), elbow (7, Fig. 3) and clamps (5, Fig. 3).

5. Install coolant outlet pipe (26) between engine water pump inlet and bottom port on radiator assembly and secure with hoses (24) and clamps (23).

6. Install coolant inlet pipe (25) between engine thermostat housing and top port on radiator assembly and secure with hoses (24) and clamps (23).

7. If removed, apply Loctite 225 to threads of elbow (27) and install in coolant inlet pipe.

8. Remove blanking caps from deaeration lines (28 & 30) and connect deaeration line (28) to elbow (27) in coolant inlet pipe (25) and deaeration line (30) to elbow (29) in top of radiator assembly. Do not clip lines at this point.

9. Remove blanking caps from fuel cooler lines and fittings, hydraulic oil cooler lines and fittings, and fan drive motor (12, Fig. 2) lines and fittings. Connect all fuel lines to fuel cooler, hydraulic lines to hydraulic oil cooler and hydraulic lines to fan drive motor (12, Fig. 2) as identified at removal.

10. 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.

11. Fit 1-off nuts (50) and lockwashers (47) to each rod (51) and run up full length of thread. Locate rod end through holes on radiator support arms. Take remaining nuts (50) and lockwashers (47) and thread onto rod (51), securing brace rods to radiator brackets.

12. Fit 1-off nuts (46), lockwashers (47), washers (48) and rubber mounts (49) to both rods (51), run up full length of the thread. Locate rod ends trhough frame support brackets. Fit remaining nuts (46), lockwashers (47) washers (48) and rubber mounts (49) to end of rods (51) and tighten in accordance with standard torques listed in Section 300-0020, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

13. Ensure fittings, lines and pipes are securely tightened to prevent leaks at initial fill and start up.

Note: If **Header Tank (36)** was removed and has not yet been installed, proceed from step 14, however, if header tank (36) was not removed or has been reinstalled, proceed from step 20.

14. Fit header tank (36) to goalpost and secure using bolts (39), nuts (37) and washers (38).

15. Following installation instructions in Section 100-0040, HOOD AND MOUNTING, install header tank (36) and goalpost assembly on the vehicle.

16. Remove blanking from make-up line (41) and connect to header tank (36). Secure with clamp (42).

17. Remove blanking caps from deaeration lines (28, 30 & 32) and connect to appropriate fittings on header tank (36), as noted on removal.

18. Connect overflow line (43) to header tank (36).

19. 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.
Note: If make-up line (41) had been removed completely, ensure that firemaster hose (40) is correctly fitted and is properly clamped away from the engine turbocharger.

20. Refer to Section 210-0000, COOLING SYSTEM for correct selection of coolant. Fill the cooling system through filler in header tank (36) with coolant until coolant level stabilizes at the bottom of filler neck.

21. Check all line and pipe connections for leaks prior to starting the vehicle. Tighten as required.

22. 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.

23. Entrapped air must be purged after filling the cooling system. To do this, allow the engine to warm up with filler cap (35) still removed. With the transmission in neutral, increase engine speed above 1000 rev/min and add coolant as required. Vent the cock on the water return line at the water-jacketed turbocharger until a steady stream of water (no air) is seen. Close the cock.

24. Install filler cap (35) on header tank (36) after the coolant level has stabilized at the bottom of filler neck.

25. Following installation instructions in Section 100-0040, HOOD AND MOUNTING, install hood assembly on the vehicle.

Note: Check that gap between hood and cowl is correct 12 mm (0.5 in) maximum).

26. 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.

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.

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	7	Bolt	165	122

* * * *

DESCRIPTION

The low temperature unloader valve can be identified as item 3 in Section 210-0005, COOLING SYSTEM SCHEMATIC. Numbers in parentheses refer to Fig. 1.

Located on the hydraulic cradle, below the hydraulic diverter tube, the low temperature unloader valve houses the following:
(1) two way solenoid operated cartridge valve with open and closed positions
(2) relief valve cartridge assembly
(3) check valve cartridge assembly.

The low temperature unloader valve receives hydraulic supply from the engine cooling section (mid section) of the triple gear pump. An integral two way solenoid cartridge (1) controls flow to the hydraulically driven engine cooling fan. The pressure relief valve (2) controls circuit pressure to a preset 205 bar (2970 lbf/in²).

OPERATION

Numbers in parentheses refer to Fig. 1.

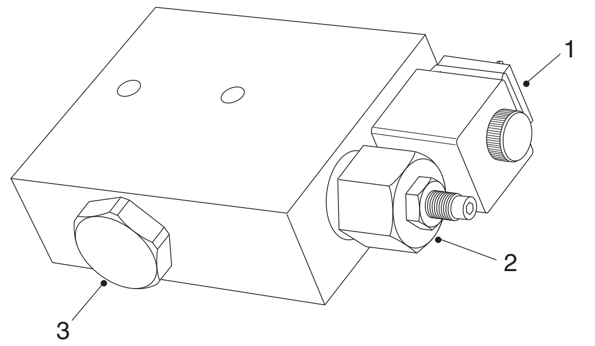
The low temperature unloader valve forms part of the engine cooling fan circuit. The integral solenoid valve (1) controls the two speed engine cooling fan motor and the relief valve (2) maintains a safe working circuit pressure of 205 bar (2970 lbf/in²).

The low temperature unloader valve has two ports, an inlet port (P) and an outlet port (T). The inlet port (P) is protected by the relief valve (2) which, although adjustable, should be preset to 205 bar (2970 lbf/in²). The relief valve has a separate internal pilot connection which, when vented to the outlet port (T), allows the relief valve to pass flow at a very low pressure from the inlet port (P) to the outlet port (T).

Refer to Fig. 2. The solenoid valve (1) provides a means to opening this pilot connection to the outlet port (T). This connection is made when the solenoid valve is energised. The solenoid valve is energised on ignition contact, when a 24V signal is supplied to the solenoid valve from the engine ECU. With the solenoid valve energised no pressure can be raised at the inlet port (P). A minimum flow will circulate the engine cooling fan motor allowing it to rotate. This minimum flow is supplemented by the relief flow via the priority unloader valve. Refer to Section 250-0075, PRIORITY UNLOADER VALVE.

Refer to Fig. 3. The solenoid valve (1) is de-energised when the voltage from the engine ECU drops to 0V.

SM - 2742



1 - Solenoid Valve
2 - Relief Valve
3 - Check Valve

Fig. 1 - Low Temperature Unloader Valve

SM - 2744

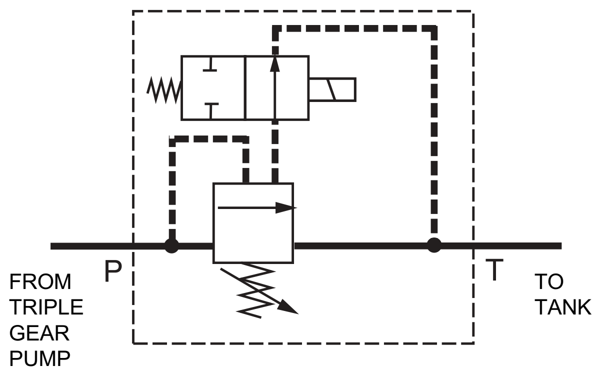


Fig. 2 - Low Temperature Unloader Valve - Solenoid Energised

SM - 2743

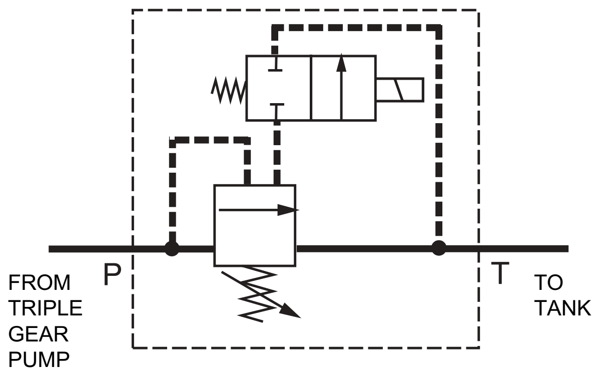


Fig. 3 - Low Temperature Unloader Valve - Solenoid De-energised

The voltage signal is cut to 0 volts when the engine E.C.U. senses any one of the following 4 pre-programmed parameters:

1. Engine coolant temperature reaches 96°C (205°F).

2. Engine oil temperature reaches 110°C (230°F).

3. Air intake temperature reaches 66°C (151°F).

4. Transmission retarder requested.

When the solenoid valve is de-energised, the flow is blocked in the pilot line, allowing the relief valve to operate at its preset 205 bar (2970 lbf/in²), therefore allowing pressure to be raised at the inlet port (P). This increase in hydraulic pressure forces more oil through the engine cooling fan motor, thus increasing the fan speed.

As soon as the cooling requirement is satisfied, engine ECU energises the solenoid valve by applying 24V (refer to Fig. 2). This will result in only minimum flow being supplied to engine cooling fan motor, therefore slowing engine cooling fan.

The low temperature unloader valve also has a integral check valve, that allows oil to pass from the outlet port (T) to the inlet port (P). This will happen when the pressure at the output port (T) is higher than the pressure at the inlet port (P).

FUNCTIONAL CHECK

Numbers in parentheses refer to Fig. 1.

Checking the proper operational function of the low temperature unloader valve can be simply executed by removing the electrical harness connection, while operating the engine at full throttle. An increase in engine cooling fan speed should be observed. However, it is advisable to check the pressure setting of the valve if proper operational function is questionable. Refer to following procedure for valve pressure check.

⚠ **WARNINGS**
To prevent personal injury and property damage, ensure wheel blocks and steering locking bar is installed prior to executing functional checks.

⚠ **Hydraulic fluid pressure will remain within the system after engine shut down. Operate the treadle pedal continuously until the pressure has dissipated before carrying out any work on the hydraulic system or serious injury could result.**

Follow directly from the checking procedure for the Priority Unloader Valve. Refer to Section 250-0075, PRIORITY UNLOADER VALVE.

1. Fit pressure gauge to the diagnostic check point on the brake manifold valve (port P1).

2. Remove electrical harness connection to solenoid valve (1). This will render the solenoid valve de-energised.

3. Increase engine rpm to full throttle (2200 rpm).

4. Take note of the gauge reading. This is the pressure setting of the low temperature unloader valve, which should be 205 bar (2970 psi).

5. If pressure setting is too low after following steps 1 through 4:

(a) Ensure engine is operating at full throttle (2200 rpm).
(b) Loosen lock nut on relief valve (2).
(c) Turn setting screw on relief valve (2) clockwise until correct pressure is observed on gauge.
(d) Re-tighten lock nut.

Note: Always adjust hydraulic pressure on the increase.

6. If pressure setting is too high after following steps 1 through 4:

(a) Reduce engine rpm to low idle (700 rpm).
(b) Depress foot brake pedal continuously to relieve pressure in the braking system.
(c) Loosen lock nut on relief valve (2).
(d) Turn setting screw on relief valve (2) counter clockwise 2 to 3 full turns.
(e) Return engine rpm to full throttle (2200 rpm).
(f) Adjust setting screw on relief valve (2) clockwise until correct pressure is observed on gauge.
(g) Re-tighten lock nut.

7. Re-connect electrical harness connection to solenoid valve (1) on completion.

FAULT DIAGNOSIS

Numbers in parentheses refer to Fig. 1.

There are 4 possible points of failure:

1. The solenoid (1) coil, although continuously rated they may fail after long periods of service. This failure is protected by the fail-safe design of the valve. If the

solenoid fails to energise, hydraulic pressure will be allowed to rise at the inlet port (P). This will default the engine cooling fan to run constant at the higher speed setting, thus safeguarding the engine against high operating temperatures.

Solenoid Coil Rating: 22 Watt continuous.

2. The solenoid cartridge valve (1) to which the solenoid is attached. Failure is only likely to occur due to contamination in the system. The valve (1) is a low leakage device and any contamination may cause either damage to the components or cause components to stick in position. Failure may be more difficult to detect due to the different modes of failure. Damage to the components will allow a progressively increasing leakage, eventually resulting in some flow not being shut off when the solenoid is selected. Sticking components could hold the system at either a low engine cooling fan speed or a high fan speed depending on what position the cartridge valve (1) is stuck.

3. The relief valve (2). Contamination is the only likely cause of failure, causing damage to the relief valve (2) seat. Failure will be difficult to detect as the result of contamination damage is likely to be loss of flow across the relief valve (2) seat at pressure. This loss of flow is difficult to detect until it becomes very excessive. For example when the solenoid valve (1) is energised, the relief valve (2) may not act due to the contamination, allowing pressure to be raised at the inlet port (P). This would default the engine cooling fan to the higher speed setting, even although preset parameters have not been attained.

4. The check valve (3). Contamination is the only likely cause of failure, causing damage to the non-return valve seat. Failure will be difficult to detect as the result of contamination damage is likely to be loss of flow across the check valve (3) seat at pressure. This loss of flow is difficult to detect until it becomes very excessive.

REMOVAL

Numbers in parentheses refer to Fig. 1.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, ensure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to execute the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Operate treadle valve continuously to relieve pressure in the braking system.

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

3. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

4. Clean low temperature unloader valve and surrounding area with a suitable solvent. Identify and tag all hydraulic lines connected to the low temperature unloader valve, to aid in 'Installation'.

5. With suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to all open lines.

6. Remove electrical harness connector from solenoid valve (1).

7. Remove bolts and lockwashers securing the low temperature unloader valve to the hydraulic cradle. Remove low temperature unloader valve from the cradle.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Note location and position of all hydraulic connectors and adaptors prior to removing them from valve body.

2. Remove knurled nut from end of the centre shaft of the solenoid. Slide off solenoid coil.

3. Unscrew solenoid cartridge valve (1) from valve body. Extract cartridge valve (1).

4. Remove relief valve (2) from valve body.

5. Remove check valve (3) from valve body.

INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Clean all parts with a suitable solvent and dry with compressed air.

2. Check port threads and make sure they are not damaged or stripped.

3. Check solenoid valve (1) seat and control spool. Ensure they are not worn, nicked, cracked or scored.

4. Check relief valve (2) for damage. Ensure relief valve (2) seat is not worn, nicked, cracked or scored.

5. Examine check valve assembly (3) for any wear or scoring.

It is not recommended that cartridge assemblies are disassembled for maintenance purposes. Ensure that valve assembly is cleaned prior to removal of any components and that no contaminant is allowed to enter the internal galleries.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Replace all seals on cartridge assemblies housed in low temperature unloader valve prior to re-assembly.

2. Install check valve cartridge (3) into low temperature unloader valve body and tighten assembly to 85 Nm (63 lbf ft).

3. Install relief valve cartridge (2) into low temperature unloader valve body and tighten assembly to 75 Nm (55 lbf ft).

4. Install solenoid cartridge valve (1) into low temperature unloader valve body and tighten assembly to 30 Nm (22 lbf ft).

5. Install hydraulic connectors and adaptors to correct ports and orientation.

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 250-0000, BRAKING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

1. Secure low temperature unloader valve to hydraulic cradle with bolts and lockwashers.

2. Remove blanking caps from hydraulic lines and install lines to the low temperature unloader valve as identified during 'Removal'.

3. Re-connect electrical harness connector to solenoid valve (1).

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. Place the battery master switch in the 'On' position, start the engine and bring hydraulic oil to operating temperature.

6. Check low temperature unloader valve and hydraulic line connections for leaks and tighten as required.

7. 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.

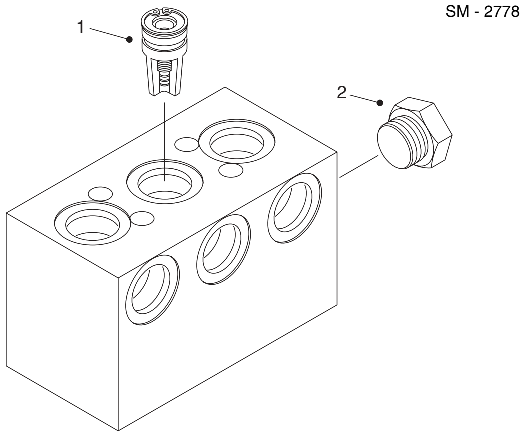
* * * *

DESCRIPTION

Numbers in parentheses refer to Fig. 1. The low pressure relief valve can be identified as item 8 in Section 210-0005, COOLING SYSTEM SCHEMATIC.

Mounted to the engine side of the brake coolant tank, the low pressure relief valve houses three separate relief valve cartridges (1).

The low pressure relief valve is installed between the motor/triple pump and the six brake packs (two per axle). Each relief valve (1) limits the maximum pressure of brake cooling oil supplied to each brake pack. One relief valve per axle. Refer to Section 250-0045, MOTOR/TRIPLE PUMP ASSEMBLY.



1 - Low Pressure Relief Cartridge 2 - Plug

Fig. 1 - Low Pressure Relief Valve

OPERATION

Numbers in parentheses refer to Fig. 1.

Refer to Fig. 2. Brake cooling oil is supplied to each inlet port of low pressure relief valve from a dedicated section of the motor/triple pump, and is then fed to a manifold block on each axle, which distributes oil to each brake pack. The common return line for the relief cartridges (1) feeds directly back to the brake coolant tank.

All three relief valve cartridges (1) are preset to 1.5 bar (22 lbf/in²). This setting limits the brake cooling oil pressure across each brake pack to 1.0 bar (14.5 lbf/in²) maximum. Brake pack oil pressure greater than 1.0 bar (14.5 lbf/in²) will be detrimental to the brake pack seals.

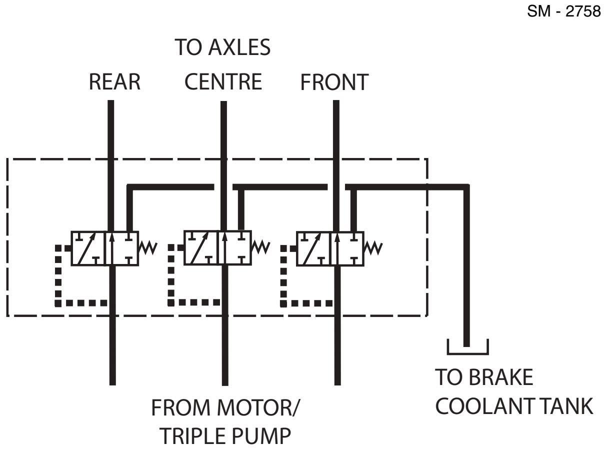


Fig. 2 - Low Pressure Relief Valve Schematic

FAULT DIAGNOSIS

Numbers in parentheses refer to Fig. 1. The valve could possibly fail one of two ways. Either the relief cartridge (1) remains open or closed.

If the relief cartridge (1) remains open, all of the brake cooling oil will be diverted straight back to the brake coolant tank, bypassing the disc brake oil cooler. This will result in dangerously high oil temperatures. If the relief cartridge (1) remains closed, oil pressure will be allowed to build up across the brake packs, eventually causing seals to be damaged.

If the relief cartridge (1) remains open or leaks excessively, the fault is likely to be due to debris on the relief cartridge (1) seat. In this case remove the relief cartridge (1) and clean. However, it is very likely that the seat will be damaged, so it is advised that a new cartridge (1) should be installed.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNING
To prevent personal injury and property damage, ensure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to execute the job safely.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Operate treadle valve continuously to relieve pressure in the braking system.

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

3. Remove blanking cap from remote drain line at the

bottom of the brake coolant tank. Install a length of hose on remote drain fitting, open drain cock and drain oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

4. Clean low pressure relief valve body and surrounding area with a suitable solvent. Ensure that no contaminant is allowed to enter the internal galleries. Identify and tag all hydraulic lines connected to the low pressure relief valve, to aid in 'Installation'.

5. With suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to all open lines.

6. Remove bolts securing low pressure relief valve to brake coolant tank. Remove low pressure relief valve. Fit blanking cap to open port in brake coolant tank.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Note position of all hydraulic connectors prior to removing them from valve body.

2. To remove relief valve cartridge(s) (1), remove the retaining circlip, taking care not to damage the bore.

3. Remove damaged or worn relief valve cartridge(s) (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 cartridge valves (1) seats. Ensure they are not worn, nicked, cracked or scored.

It is not recommended that any of the cartridge assemblies (1) are disassembled for maintenance purposes.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Replace all 'O' rings on hydraulic connectors.

2. Replace relief valve cartridge(s) (1) and secure with retaining circlip.

3. Install hydraulic connectors to valve body in correct orientation.

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 250-0000, BRAKING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

1. Remove blanking cap from tank and secure low pressure relief valve to mounting surface on brake coolant tank with bolts. Renew 'O' ring.

2. Remove blanking caps from hydraulic lines and install lines to the low pressure relief valve as identified during removal.

3. Fill brake coolant tank with oil as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 250-0025, BRAKE COOLANT TANK, for oil level. Install filler cap on brake coolant 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 low pressure relief valve 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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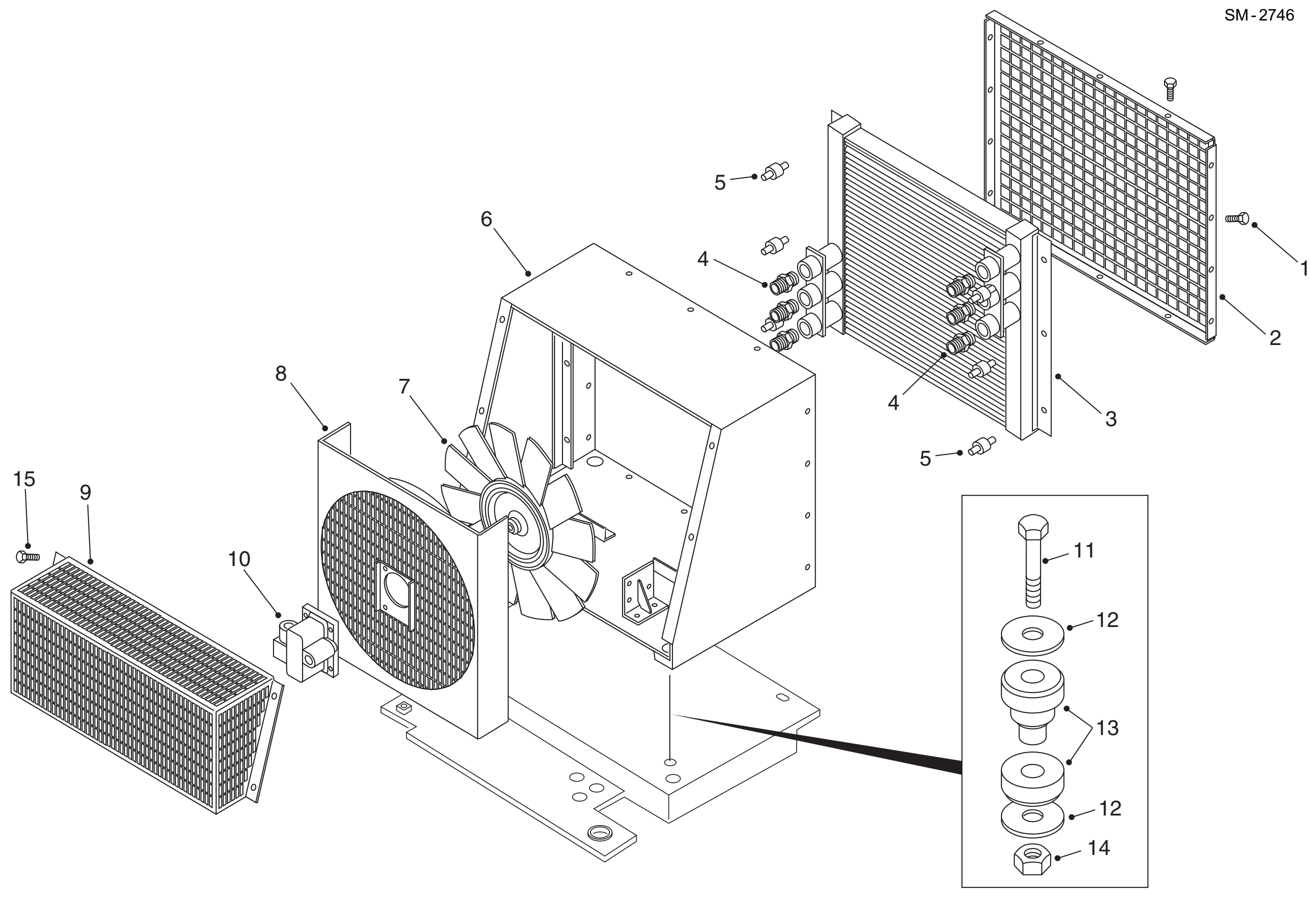

1 - Bolt	6 - Casing	11 - Bolt
2 - Front Cover	7 - Fan	12 - Washer
3 - Oil Cooler	8 - Fan Plate Assembly	13 - Isolation Mount
4 - Adaptor	9 - Rear Guard Assembly	14 - Locknut
5 - Anti-Vibration Mounting	10 - Hydraulic Motor	15 - Bolt

Fig. 1 - Exploded View Of Disc Brake Oil Cooler

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1. The disc brake oil cooler can be identified as item 6 in Section 210-0005, COOLING SYSTEM SCHEMATIC.

The disc brake oil cooler is a blast air type, mounted on the right hand fender adjacent to the main hydraulic tank. The fan (7) within the brake oil cooler is driven by a hydraulic motor (10). The motor (10) is supplied by a dedicated brake cooling section of the triple gear pump, via two speed control valve. The speed of the fan (7) is dependant on the oil flow being supplied to the motor (10) from the two speed control valve. Refer to Section 250-0065, TWO SPEED CONTROL VALVE.

Brake cooling oil enters the top of the oil cooler (3) and flows through the oil cooler (3) before exiting at the bottom. There are three inlet ports and three outlet ports, one for each axle.

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 machine on a level floor, apply the parking brake and switch off the engine. Operate the steering several times to discharge the steering system. Operate the treadle valve continuously to discharge the braking system.

2. Block all road wheels and place the battery master switch in the off position. Place steering lock bar in the locked position.

3. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

4. Remove blanking cap from remote drain line at the bottom of the brake coolant tank. Install a length of hose on remote drain fitting, open drain cock and drain brake cooling oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

5. Remove bolts (15) securing rear guard assembly (9) to casing (6). Remove rear guard assembly (9).

6. Clean disc brake oil cooler and surrounding area with a suitable solvent. Ensure all hydraulic lines connected to hydraulic motor (10) are identified for ease of installation and, with suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to all open lines.

7. Ensure all brake cooling lines connected to oil cooler (3) are identified for ease of installation and, with suitable containers available to catch leakage, disconnect brake cooling lines. Fit blanking caps to all open lines.

8. Identify and tag all hydraulic lines connected to two speed control valve and relief valve mounted to casing (6), to aid in 'Installation'. With suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to all open lines.

9. Remove bolts (1) securing front cover (2) to casing (6). Remove front cover (2).

10. Remove bolts (11), washers (12), isolation mounts (13) and nuts (14) securing disc brake oil cooler to fender.

11. Using suitable lifting equipment, remove brake oil cooler from the vehicle to a clean area for disassembly.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Remove bolts and washers securing two speed control valve to casing (6). Remove two speed control valve.

2. Remove bolts and washers securing relief valve to bracket on casing (6). Remove relief valve.

3. Remove bolts and washers securing fan plate assembly (8) to casing (6). Carefully remove fan plate assembly (8), complete with fan (7) and hydraulic motor (10) from casing (6).

4. Carefully remove fan (7) from hydraulic motor (10) shaft.

5. Remove nuts securing hydraulic motor (10) to fan plate assembly (8). Remove the hydraulic motor (10).

6. Loosen and remove nuts securing oil cooler (3) in casing (6). Carefully remove oil cooler (3) from casing (6).

MOTOR OVERHAUL

Numbers in parentheses refer to Fig. 1.

Internal parts of the hydraulic motor (10) are lubricated by the operating fluid itself; therefore, preventive maintenance is limited to keeping the fluid in the system clean. Dirt should not be allowed to accumulate on the motor or around the shaft seal. Check frequently that all fittings and bolts are tight.

ASSEMBLY

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.**

Generally assembly is the opposite of disassembly. Be careful not to damage oil cooler (3) when installing in casing (6).

Note: Ensure there is even clearance, all the way round, between fan (7) and fan plate assembly (8).

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.**

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 250-0000, BRAKING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

1. Using suitable lifting equipment, position brake oil cooler on vehicle and secure using bolts (11), washers (12), isolation mounts (13) and nuts (14).

2. Install front cover (2) to the casing (6) and secure with bolts (1).

3. Remove blanking caps from hydraulic lines and install lines to two speed control valve and relief valve as identified during 'Removal'.

4. Remove blanking caps from brake cooling lines and attach lines to oil cooler (3) as identified during 'Removal'.

5. Remove blanking caps from hydraulic lines and install lines to hydraulic motor (10) as identified during 'Removal'.

Note: Prior to start-up, ensure the hydraulic motor (10) is primed with clean hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM.

6. Install rear cover (9) to the casing (6) and secure with bolts (15).

7. 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.

8. Fill brake coolant tank with oil as specified in Section 300-0020, LUBRICATION SYSTEM. Fill until oil is halfway up sight glass. Install filler cap on brake coolant tank filler neck.

9. Place the battery master switch in the 'On' position, and start the engine. Top up oil levels in hydraulic tank and brake coolant tank as required. Bring hydraulic oil to operating temperature.

10. Check valves, motor (10) and hydraulic line connections for leaks and tighten as required.

11. Remove all blocking from road wheels and place steering lock bar in the stowed position.

12. Remove wheel blocks.

MAINTENANCE

Every 10 Hours/Daily

Check the fan and motor for debris or damage. Clean or replace as required. Check oil cooler fins for debris and clean as required.

Note: The 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 add any fluids or lubricants to the drive.

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

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

5. DO NOT disassemble motor assembly or associated parts that are still within the warranty coverage period.

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

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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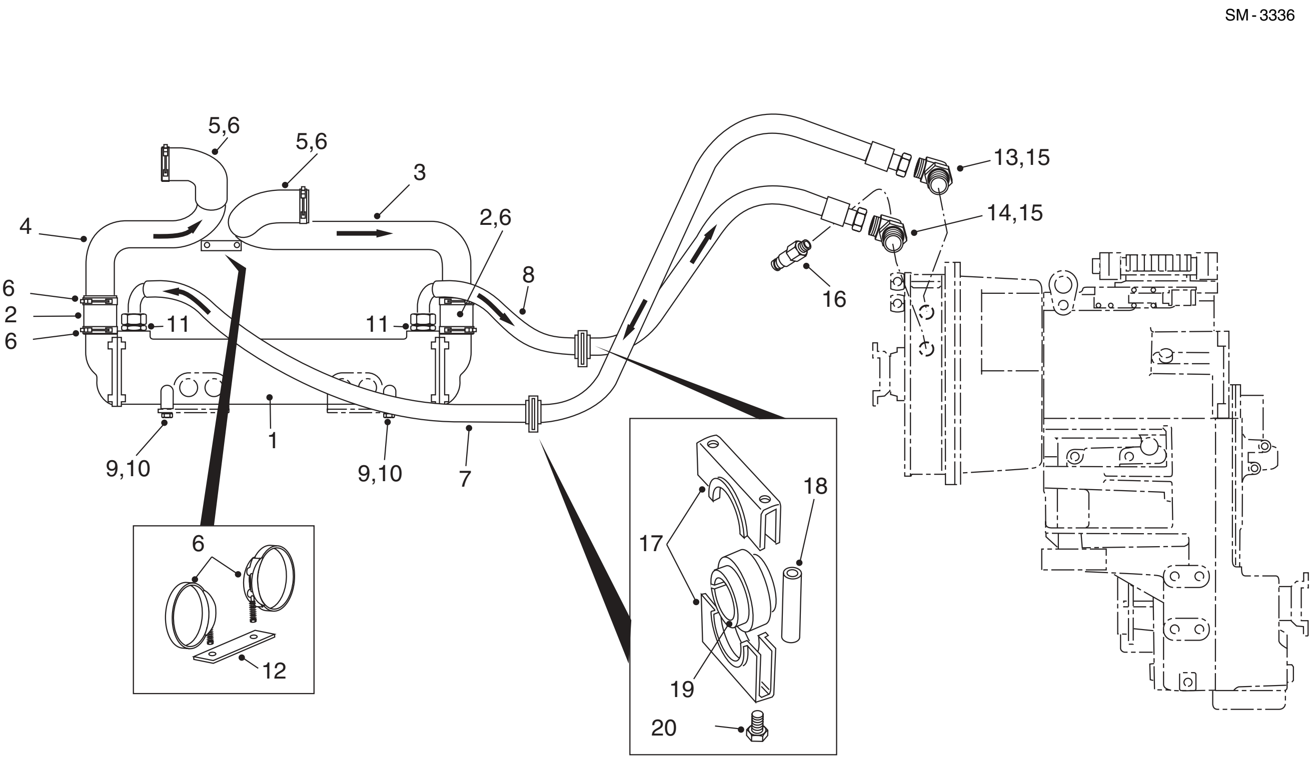


1 - Oil Cooler Assembly	6 - Clamp	11 - Adaptor	16 - Temp. switch
2 - Hose	7 - Oil Inlet Line	12 - Plate	17 - Clamp
3 - Water Inlet Pipe	8 - Oil Outlet Line	13 - Elbow	18 - Spacer
4 - Water Outlet Pipe	9 - Bolt	14 - Elbow	19 - Split Bushing
5 - Hose	10 - Lockwasher	15 - 'O'-Ring	20 - Bolt

Fig. 1 - Transmission Oil Cooler Lines

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1.

The transmission oil cooler is mounted on the inside of the right hand tractor frame rail and is connected in the water cooling and transmission oil circuits, between the radiator and transmission. The purpose of the transmission oil cooler is to maintain the transmission oil within its required operating temperature range.

Coolant is pumped from the engine water pump through water inlet pipe (3) and into oil cooler assembly (1). Coolant circulates through cooler tubes in oil cooler assembly (1) cooling transmission oil around the tubes and then flows through water outlet pipe (4) and into the engine oil cooler.

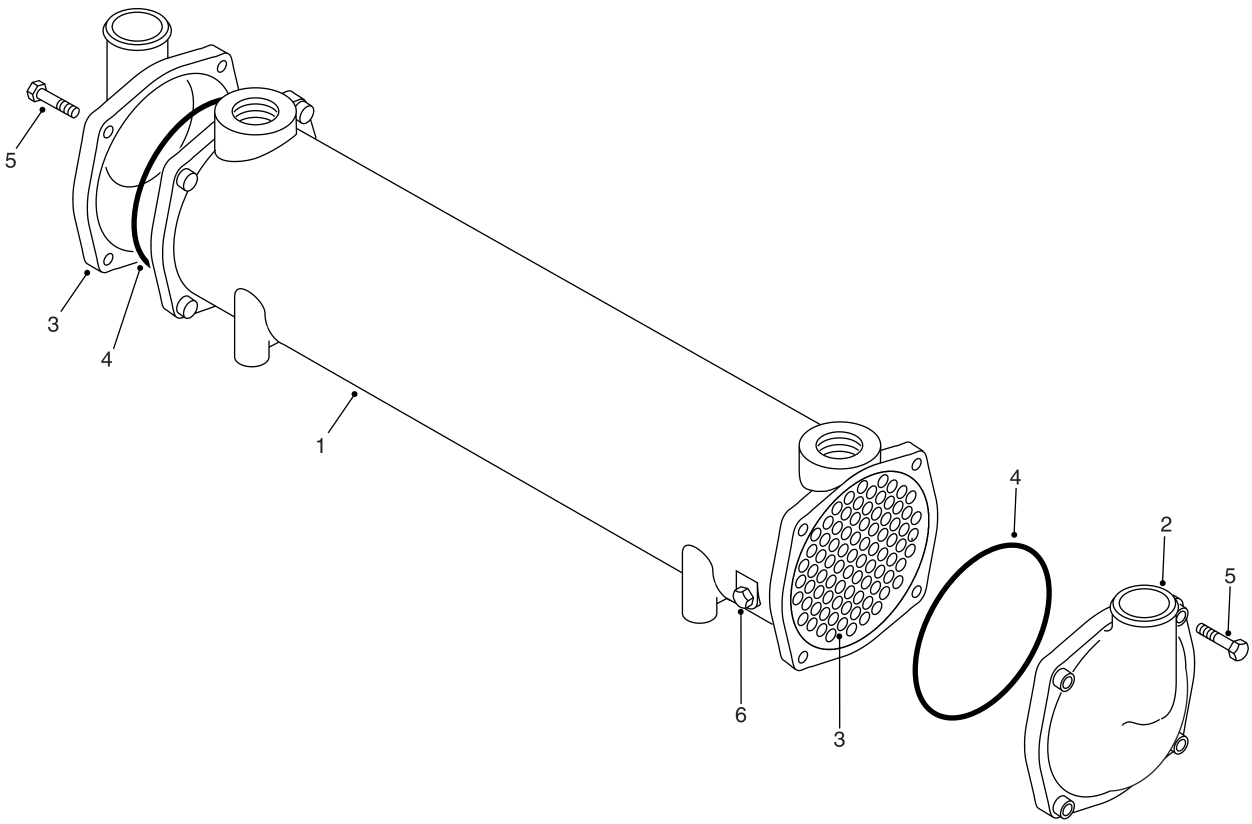
Transmission oil to be cooled enters oil cooler assembly (1) through oil inlet line (7), circulates around the cooler tubes within oil cooler assembly (1), and exits through oil outlet line (8) to return to the transmission.

Note: To obtain the maximum cooling effect, oil flow must always flow in the opposite direction to coolant flow through the transmission oil cooler 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 - Heat Exchanger
2 - Water Inlet Flange
3 - Water Outlet Flange
4 - 'O' Ring
5 - Bolt
6 - Plug

Fig. 2 - Exploded View of Transmission Oil Cooler

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Turn steering wheel several times to relieve any pressure in the steering circuit.

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 hood.

4. Open drain cock at the bottom of the radiator assembly and drain coolant into a suitable container. Close drain cock when coolant is completely drained.

5. Support engine sump guard with suitable blocking and remove mounting hardware securing rear of sump guard to the frame. Drop rear end of sump guard to allow access to remove oil cooler assembly (1).

6. Remove plug (6, Fig. 2) from oil cooler (1) and drain coolant into a suitable container. Reinstall plug (6, Fig. 2) when coolant is completely drained.

7. Remove oil inlet line (7) from adaptor (11) in oil cooler assembly (1). Drain any remaining oil in oil inlet line (7) into a suitable container. If required, remove adaptor (11) from oil cooler assembly (1).

8. Fit blanking cap to oil inlet line (7) and oil cooler assembly (1) port to prevent ingress of dirt.

9. Remove oil outlet line (8) from adaptor (11) in oil cooler assembly (1). Drain any remaining oil in oil outlet line (8) into a suitable container. If required, remove adaptor (11) from oil cooler assembly (1).

10. Fit blanking cap to oil outlet line (8) and oil cooler assembly (1) port to prevent ingress of dirt.

11. Loosen clamps (6) securing hoses (2) to water inlet pipe (3) and water outlet pipe (4). Slide hoses (2) along pipes to break connection at cooler flanges.

12. Support oil cooler assembly (1) with suitable lifting equipment and remove bolts (9) and lockwashers (10) securing oil cooler assembly (1) to its mounting. Remove oil cooler assembly (1) from the vehicle.

13. If required, remove nuts, clamps (6) and plate (12) securing water inlet pipe (3) and water outlet pipe (4) together.

14. If required, loosen clamps (6) securing elbows (5) to engine water pump inlet and engine oil cooler inlet and remove water inlet pipe (3) and water outlet pipe (4) from the vehicle.

15. If oil inlet line (7) and oil outlet line (8) are to be replaced proceed as follows.

16. Remove bolts (20) and one half of clamp (17). Remove split bushings (19) from lines (7 & 8).

17. Disconnect lines (7 & 8) from elbows (13 & 14) and remove from the vehicle.

18. If required, remove elbows (13 & 14) and 'O' rings (15) from transmission inlet and outlet ports. Remove and discard 'O' rings (15).

CLEANING AND DISASSEMBLY

Numbers in parentheses refer to Fig. 2.

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 where 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 for service intervals and coolant selection procedures.

Cleaning Oil Side

In the event of a major mechanical failure, the transmission oil cooler assembly should be cleaned thoroughly or replaced.

1. Clean transmission oil cooler before sludge hardens. After transmission oil cooler is completely drained, circulate a solution of Agmasol PS40 through the cooler core (1) to remove sludge.

2. If cooler tubes are badly clogged, circulate an oakite or alkaline solution through cooler (1). Solution should be circulated through cooler (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 is. Flush thoroughly with clean hot water.

Cleaning Water Side

1. Match mark cooler flanges (2 & 3) and heat exchanger (1) to aid in 'Assembly'.

2. Remove bolts (5) securing water inlet flange (2) and 'O' ring (4) to heat exchanger (1). Remove water inlet flange (2) from heat exchanger (1) and discard 'O' ring (4).

3. Remove bolts (5) securing water outlet flange (3) and 'O' ring (4) to heat exchanger (1). Remove water outlet flange (3) from heat exchanger (1) and discard 'O' ring (4).

4. 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.

5. 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. 2.

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

1. Install new 'O' ring (4) to water inlet flange (2) and align flange to heat exchanger (1), as match marked at 'Disassembly'.

2. Secure water inlet flange (2) to heat exchanger (1)

with bolts (5). Tighten bolts (5) alternately to give an even seal around cooler flange area.

3. Install new 'O' ring (4) to water outlet flange (3) and align flange to heat exchanger (1), as match marked at 'Disassembly'.

4. Secure water outlet flange (3) to heat exchanger (1) with bolts (5). Tighten bolts (5) alternately to give an even seal around cooler flange area.

INSTALLATION

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

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 lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Using suitable lifting equipment, position oil cooler assembly (1) to frame rail and secure with bolts (9) and lockwashers (10).

2. Fit elbow (5) onto water inlet pipe (3) and fit inlet pipe to engine water pump inlet. Fit hose (2) on opposite end of water inlet pipe (3) and connect to water inlet flange (2, Fig. 2). Secure hose (2) and elbow (5) in position with clamps (6).

3. Fit elbow (5) onto water outlet pipe (4) and fit outlet pipe to engine oil cooler inlet. Fit hose (2) on opposite end of water outlet pipe (4) and connect to water outlet flange (3, Fig. 2). Secure hose (2) and elbow (5) in position with clamps (6).

4. Clip water inlet pipe (3) and water outlet pipe (4) together with clamps (6), plate (12) and nuts.

5. Install new 'O' rings (15) in elbows (13 & 14) and secure elbows to transmission inlet and outlet ports.

6. Remove blanking caps from oil inlet and outlet lines (7 & 8) and connect oil outlet line (8) and oil inlet line (7) to elbows (13 & 14) (inlet line (7) to the top port). Do not tighten oil inlet and outlet lines at this point.

7. Remove blanking caps from oil cooler assembly (1). If removed, install adaptors (11) in oil cooler assembly (1).

8. Install oil inlet line (7) to adaptor (11) in oil cooler assembly (1). Do not tighten securely at this point.

9. Install oil outlet line (8) to adaptor (11) in oil cooler assembly (1). Do not tighten securely at this point.

10. Fit split bushings (19) on oil inlet line (7) and outlet line (8). Fit split bushings (19) with lines in fixed half of clamp (17) and secure with remaining half of clamp (17), spacers (18) and bolts (20).

11. Ensure transmission oil lines are following a neat and tidy run and secure both ends of each line to their respective fittings.

12. Fill transmission with lubricant as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 120-0010, TRANSMISSION AND MOUNTING, for oil level check.

13. Remove filler cap on radiator header tank and fill radiator with coolant as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 210-0000, COOLING SYSTEM, for filling procedure and level check.

14. Check all line and pipe connections for noticeable leaks prior to starting the vehicle.

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 systems as required.

16. Using suitable lifting equipment, raise engine sump guard and secure with mounting hardware removed during removal.

17. Lower hood assembly and 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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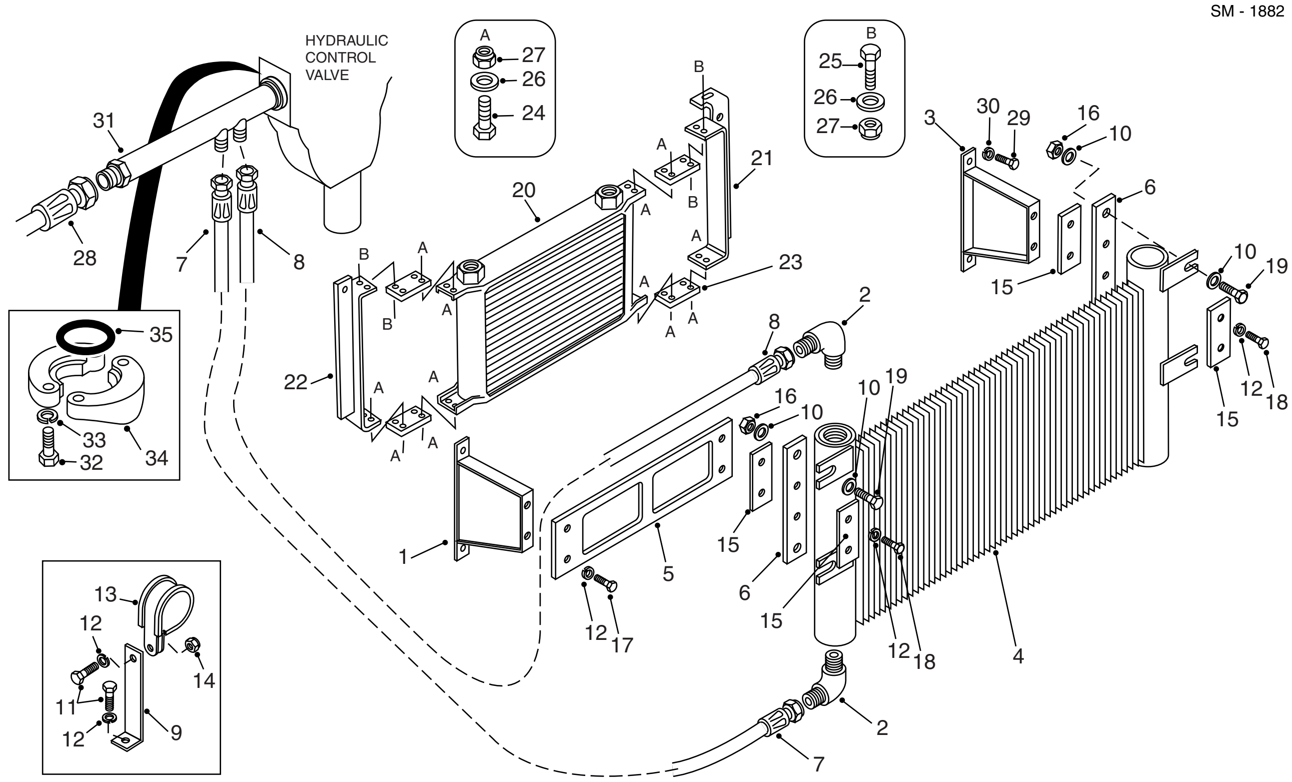


1 - Bracket
2 - Elbow
3 - Bracket
4 - Hydraulic Oil Cooler
5 - Bracket
6 - Fleximount
7 - Oil Outlet Line
8 - Oil Inlet Line
9 - Bracket
10 - Washer
11 - Bolt
12 - Lockwasher
13 - Clip
14 - Nut
15 - Plate
16 - Lockwasher
17 - Bolt
18 - Bolt
19 - Bolt
20 - Fuel Cooler
21 - Fuel Cooler Bracket
22 - Fuel Cooler Bracket
23 - Fleximount
24 - Bolt
25 - Bolt
26 - Washer
27 - Locknut
28 - Hydraulic Line
29 - Bolt
30 - Washer
31 - Diverter Tube
32 - Bolt
33 - Lockwasher
34 - Split Flange
35 - 'O' Ring

Fig. 1 - Exploded View of Hydraulic Oil Cooler, Lines and Mounting

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1.

The air cooled hydraulic oil cooler (4) is mounted on the front of the radiator assembly with the purpose of cooling hydraulic oil circulating through the hydraulic system.

Hydraulic oil cooler (4) is connected at diverter tube (31) between the return port on the body control valve and the inlet to the hydraulic tank filter assembly.

Note: When hydraulic oil cooler (4) is fitted, the return port used is the port on the body control valve normally fitted with a blanking plate. Refer to Section 230-0060, BODY CONTROL VALVE.

Hydraulic oil enters the top port on hydraulic oil cooler (4) through oil inlet line (8) from diverter tube (31). Oil passes through a series of tubes in the cooler core, where the oil temperature is reduced by air flow through the cooler fins, before exiting hydraulic oil cooler (4) from the bottom port of the cooler. Oil returns to diverter tube (31) through oil outlet line (7) and returns to tank through the hydraulic oil filter.

Note: The fitting closest to the port on the body control valve is the supply to the cooler 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, 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, ensure the body is fully lowered, apply the parking brake and switch off the engine. Turn steering wheel several times to relieve any pressure in the steering circuit.

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

3. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

4. Remove mounting hardware securing the front grille on the hood assembly and remove grille for access to hydraulic oil cooler (4).

5. Pull on handle to release hood catch mechanism and raise hood.

6. Remove oil outlet line (7) from hydraulic oil cooler (1) and drain oil into a suitable container.

7. Remove oil inlet line (8) from hydraulic oil cooler (1) and drain any remaining oil into a suitable container.

8. Remove bolts (18), lockwasher (12) and plate (15) securing oil cooler (4) to brackets (1 & 5).

9. Remove bolts (17) and lockwashers (12) securing bracket (5) to bracket (1) and remove bracket (5).

10. Remove bolts (29) and lockwasher (30) securing bracket (1) to fuel cooler bracket (22) and the radiator assembly and remove bracket (3).

11. Remove bolts (29), lockwasher (30) securing bracket (3) fuel cooler bracket (21) and the radiator assembly and remove bracket (3).

12. If required remove bolt (24) washer (26) and locknut (27) securing fleximount (23) to fuel cooler (20) and brackets (21) and (22).

13. Disconnect oil inlet & outlet line (7 & 8) and filter line (28) from diverter tube. Blank off open ends and plug ports to prevent ingress of dirt.

14. If required remove bolts (32), lockwasher (33) and split flanges (34) securing diverter tube (31). Remove diverter tube (31), discard 'O' ring (35) and blank off open end.

15. Remove bolt (11), lockwasher (12), nuts (14) and clips (13) securing lines (7 & 8).

16. If oil inlet & outlet lines (7 & 8) require to be replaced, note location of all clips (13) and remove lines from the vehicle.

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.

3. After hydraulic oil cooler is completely drained, circulate a solution of Agmasol PS40 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 in parentheses refer to Fig. 1.

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

1. Remove blanking cap from body control valve and diverter tube (31).

2. Install new ‘O‘ ring (35) in split flange end of diverter tube (31) and connect to body control valve with split flanges (34), bolts (32) and lockwasher (33). Do not tighten bolts (32) securely at this point.

3. Connect hydraulic filter line (28) to diverter tube (31). Remove blanking caps from hydraulic lines and connect hydraulic filter line (28) to diverter tube.

4. Tighten bolts (32), lockwasher (33) at split flange fitting on diverter tube (31) after correct line installation has been obtained.

5. If oil inlet line (8) and oil outlet line (7) were removed, position lines on the vehicle following the route taken before removal. Do not clip line in position at this stage.

6. Connect lines (8) & (7) to fittings on diverter tube (31) (outlet line (7) to inside fitting on tube). Tighten line fittings at diverter tube.

7. Secure bracket (3) to fuel cooler bracket (21) with bolt (29), lockwasher (30).

8. Secure bracket (1) to fuel cooler bracket (22) and radiator assembly with bolts (29), lockwasher (30).

9. Reinstall fuel cooler (20) securing fleximount (23) with bolts (24), washer (26) and locknut (27).

10. Install bracket (5) to bracket (1) with bolts (17), lockwasher (12).

11. Fit fleximount (6) to hydraulic oil cooler (4). Secure with bolts (19), washer (10) and locknut (16).

12. Locate plate (15) either side of fleximount (6) and secure to brackets (5) & (3) with bolt (18), lockwasher (12).

13. Connect oil inlet line (8) to elbow (2) in top of hydraulic oil cooler (4) and oil outlet line to elbow (2) in bottom port.

14. Remove bottom bolt (18) and lockwasher (12) from bracket (5) and secure oil outlet line (7) to bracket (5) with clips (13), bolt (18) and lockwasher (12).

15. Clip oil inlet line (8) and oil outlet line (7) with clips (13) as noted at removal. Use tie clips where required to maintain tidy line routing.

16. Fill hydraulic oil tank with hydraulic fluid specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK, for correct fill level. Install filler cap on hydraulic tank.

17. Check all line and pipe connections prior to starting the vehicle.

18. Place the battery master switch in the 'On' position, start the engine and check for leaks. Tighten lines and fittings as required.

19. Lower hood assembly and secure front grille assembly to the hood with mounting hardware removed at removal. Remove all 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.

* * * *

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

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 (7) meters an oil volume proportional to the amount of turn. This volume of oil flows through flow amplifier valve (5) and is led to the appropriate side of cushioned steering cylinders (8). Steering valve (7) returns automatically to its neutral position when turning is completed.

Emergency steering pressure is provided by a wheel 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 used in the steering system are listed below. Detailed service and operating instructions can be found in the relevant component sections of this manual.

Hydraulic Tank (1)

Refer to Section 230-0040, HYDRAULIC TANK.

The hydraulic tank is the common reservoir for the steering, braking and body hoist systems. It is mounted off the frame and fender bracket at the rear right hand side of the tractor.

Integral with the hydraulic tank assembly are the hydraulic oil filter, oil strainer and oil level sight gauge. Located on top of the tank assembly is the filler cap and breather.

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 dual manifold check valve (6) to the flow amplifier valve (5). A priority spool within the flow amplifier valve (5) directs oil supply from the main hydraulic pump to the steering valve.

The maximum oil delivery rate of the pump is fixed by the width of its respective gear set and the speed at which the driveshaft is turned.

The pump 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 travel as pump seizure may result.

Emergency Valve (4)

Refer to Section 220-0140, EMERGENCY VALVE.

Located on the inside of the front left hand side frame rail, the emergency valve forms part of the emergency steering system. It is connected to the main output line of the wheel driven **Emergency Steering Pump (3)** mounted on the transmission.

Dual Manifold Check Valve (6)

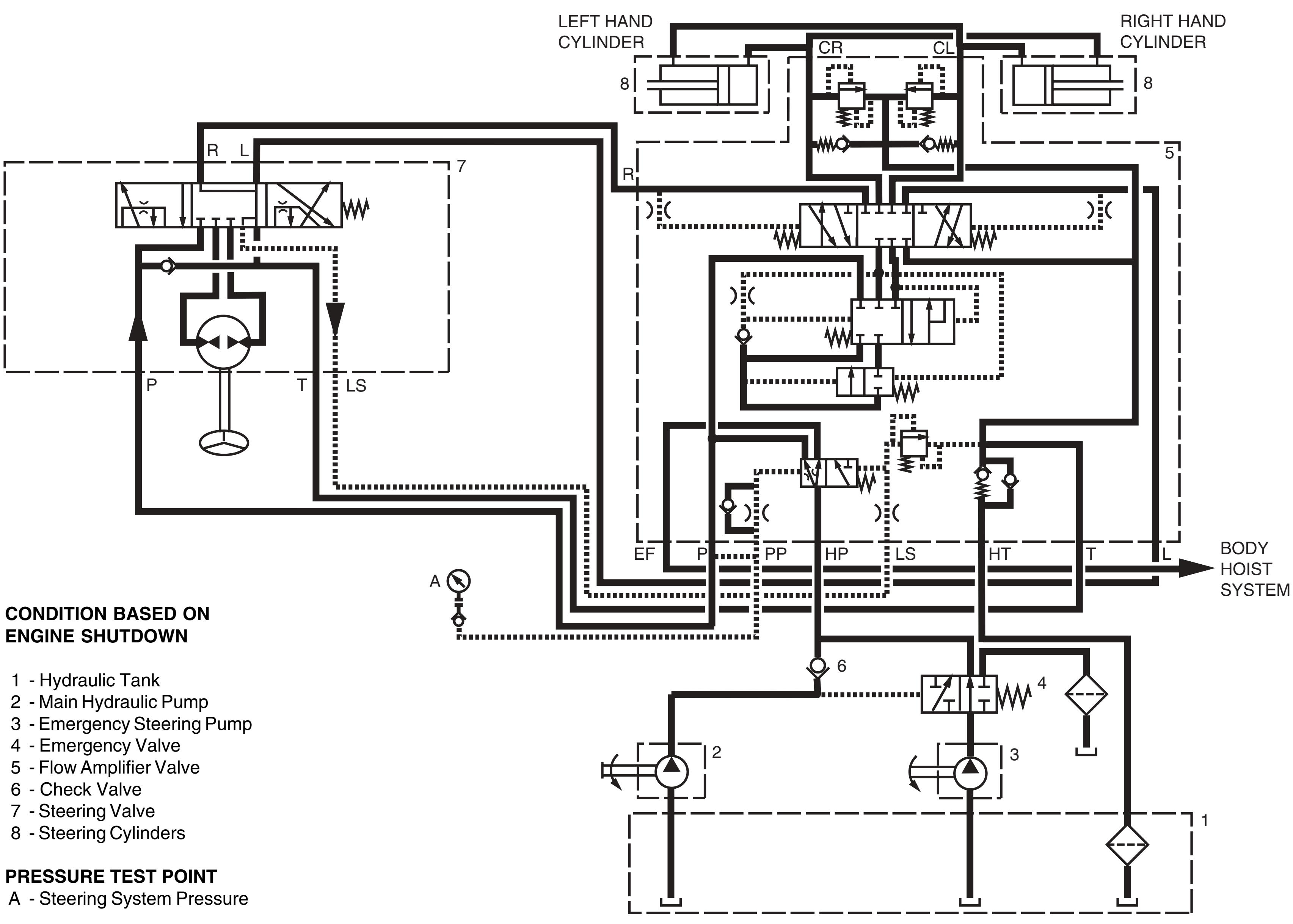
Located on the inside of the front left hand side frame rail, the dual manifold check valve is supplied by the main hydraulic pump (2). A pilot line to the emergency valve (4) holds off the emergency valve (4) when the main hydraulic pump (2) is operating. The dual manifold check valve distributes oil from the main hydraulic pump (2) to the flow amplifier valve (5) under normal operating conditions. If the main hydraulic pump (2) fails, the emergency valve (4) directs oil to the flow amplifier valve (5) via the dual manifold check valve.

Flow Amplifier Valve (5)

Refer to Section 220-0100, FLOW AMPLIFIER VALVE.

The flow amplifier valve amplifies the oil flow from the steering valve to the steering cylinders by eight. It is mounted on the cradle assembly at the rear of the cab and consists of the following:

Counter pressure & anti-cavitation valve maintains a back pressure of 5 bar (73 lbf/in²) to give improved suction during steering and prevent cavitation in the steering cylinder circuit.



CONDITION BASED ON ENGINE SHUTDOWN

1 - Hydraulic Tank
2 - Main Hydraulic Pump
3 - Emergency Steering Pump
4 - Emergency Valve
5 - Flow Amplifier Valve
6 - Check Valve
7 - Steering Valve
8 - Steering Cylinders

PRESSURE TEST POINT

A - Steering System Pressure

Fig. 1 - Steering System Schematic - Neutral Position

System relief valve is set to control maximum working pressure in the steering system to 206 bar (3 000 lbf/in^2).

Priority spool directs oil supply from the pump when engine is running, to steering valve port 'P' and through the 'EF' passage to the body control valve.

Shock & anti-cavitation valves limit shock pressures in the steering cylinders to 241 bar (3 500 lbf/in^2). The shock valves sense cylinder shock pressure when there is no steering taking place. Shock pressure is absorbed in the cylinder circuit and is not transmitted to the steering valve. The anti-cavitation part of the valve prevents cavitation in the cylinder circuit.

Amplifier spool controls the amount of oil flowing into the directional spool 'HP' passage.

Directional spool when moved in either direction against the return springs, sends oil pressure to the steering cylinders for right or left turns.

Various orifices, orifice drillings and check valves are located within the valve assembly.

Steering Valve (7)

Refer to Section 220-0190, STEERING VALVE.

The steering valve is connected to the steering column and controls hydraulic flow in the steering system. A pressure relief line in the neutral position, between steering cylinder ports 'L' & 'R' and tank return port 'T', means that the steering valve must only be used with flow amplifier valve (5).

Steering Cylinders (8)

Refer to Section 220-0120, STEERING CYLINDER.

There are two single stage, double acting, cushioned steering cylinders on the vehicle. The cylinder base end is connected to the front frame and piston rod end is connected to the rear frame. Single stage, double acting means that the piston rod can have oil applied to either side, extending or retracting the piston rod.

The cushioning effect is obtained by a tapered spear at the base end of the cylinder body entering a cavity in the piston rod through a cushioning sleeve. This gradually slows the piston which in turn helps to control destructive shock effects when the piston bottoms.

Cylinder mounting is by pins through spherical bearings in the cylinder base and piston rod ends. The spherical bearings permit a limited amount of cylinder misalignment when travelling over rough terrain.

Pressure Test Point

A diagnostic pressure test point, located in the manifold at the rear left hand side of the tractor frame, provides a quick and easy method of checking steering system pressure. The pressure is taken from a tee at port 'PP' of the flow amplifier valve. System pressure is 206 bar (3 000 lbf/in^2).

'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. 2.

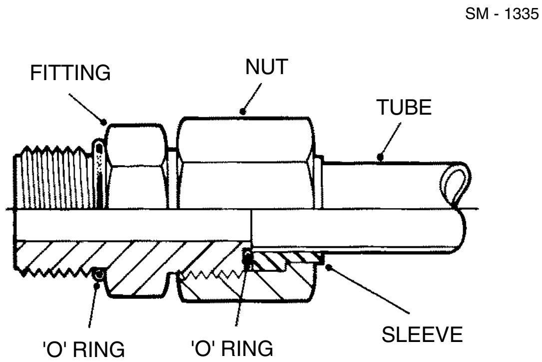


Fig. 2 - Assembly of Typical ORFS Connector

a. Ensure 'O' ring/seal is in place and that 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 of spanner (wrench).

f. Check that a satisfactory hose or tube routing has been achieved.

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. Remove wheel blocks from all road wheels, start the engine and let it idle. Add oil to the hydraulic tank as required. When the hydraulic tank is filled to the maximum level 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 hydraulic 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 specified in Section 300-0020, LUBRICATION SYSTEM.

SERVICE TOOLS

It is recommended that the following tools are used when carrying out pressure or 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 762 mm (30 in) of vacuum to 345 bar (5 000 lbf/in^2).

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.

AMPLIFIER VALVE DIAGNOSIS		TABLE627
CONDITION	REASON	REMEDY
Too few steering wheel turns from stop to stop	Dirty, leaky or missing check valve	Clean or renew check valve
Steering over-reacting	Amplifier spool stuck in open position	Disassemble and check amplifier spool movement
Too many steering wheel turns from stop to stop Steering too slow	Amplifier spool stuck in closed position	Disassemble and check amplifier spool movement
Prolonged hard point when beginning to turn the steering wheel Amplification is delayed and sets in suddenly	Dirty orifice in directional spool	Clean or replace orifice
	Dirty orifice in amplifier spool	Clean or replace orifice
	Dirty orifice in valve housing	Clean or replace orifice
	Dirty orifice in 'LS' port	Clean or replace orifice
	Blocked up throttle check valve in 'PP' port	Clean or replace throttle check valve
Steering wheel can be turned rapidly	Setting of shock & anti-cavitation valve set too low	Untighten the counter nut and adjust the valve setting screw with an allen key. Tighten the counter nut to secure.
	Leaking or hanging shock & anti-cavitation valve	Disassemble shock & anti-cavitation valve and renew, if necessary
No end stop feeling	Missing end stop in directional spool	Mount end stop
Steering has insufficient force to turn the wheels at standstill	System relief valve adjusted too low	Remove plug and adjust pressure setting with an allen key
	Steering unit spool and sleeve installed in wrong manner to each other. No 'LS' signal can be built up.	Disassemble steering unit and turn the spool and sleeve to the right position
	Steering unit spool and sleeve worn	Change steering unit
No function at all	Oil flows direct from pump to tank in the steering unit	Manual steering ball is missing
Short hard point when beginning to turn the steering wheel	Air in the 'LS' and 'PP' lines	Bleed 'LS' and 'PP' lines
	Clogged orifice in 'LS' port and/or clogged check valve in 'PP' port	Clean the orifice and/or check valve

STEERING VALVE DIAGNOSIS		TABLE626
CONDITION	REASON	REMEDY
Steering wheel does not centre	Binding in steering linkage to valve	Align as required
	Worn gear wheel	Replace parts
	Broken neutral position springs	Replace neutral position 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 gear wheel	Replace gear wheel
Hard steering	See 'Slow Steering'	
Opposite steering	Lines hooked up incorrectly	Reconnect correctly
	Wrong orientation between gear wheel and gear rim	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 neutral position springs	Replace neutral position springs, drain and flush system
No steering action	Sleeve and spool locked together	Disassemble and repair or replace

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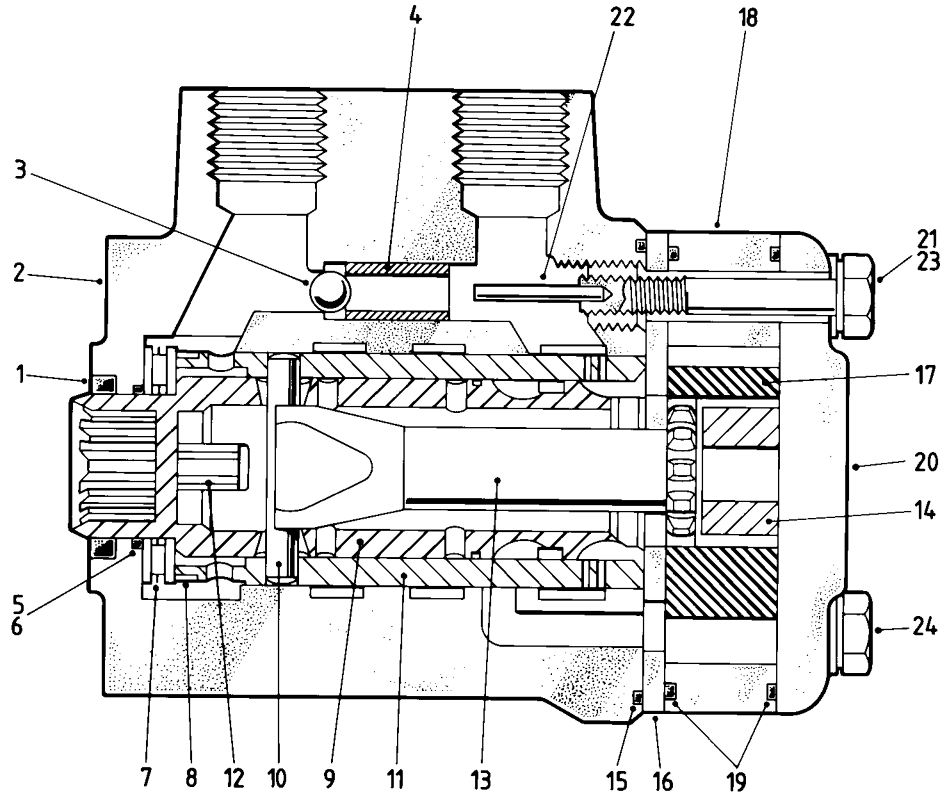


1 - Seal Ring
2 - Valve Housing
3 - Check Valve Ball
4 - Bushing
5 - 'O' Ring
6 - Kin Ring
7 - Bearing Assembly
8 - Ring
9 - Spool
10 - Cross Pin
11 - Sleeve
12 - Neutral Position Spring
13 - Driveshaft
14 - Spacer
15 - 'O' Ring
16 - Distributor Plate
17 - Gear Wheel
18 - Gear Rim
19 - 'O' Ring
20 - End Cover
21 - Washer
22 - Roll Pin
23 - Bolt
24 - Bolt

Fig. 1 - Sectional View of Steering Valve

DESCRIPTION

Numbers in parentheses refer to Fig. 1. Letters in parentheses refer to Fig. 3.

The Steering Valve can be identified as item 7 in Section 220-0000, STEERING SYSTEM SCHEMATIC.

The steering valve is connected to the steering column and controls hydraulic flow in the steering system. A pressure relief line in the neutral position, between steering cylinder ports 'L' & 'R' and tank return port 'T', means that the steering valve must only be used with a flow amplifier valve. Refer to Section 220-0100, FLOW AMPLIFIER VALVE.

The steering valve consists of valve housing (2), bearing assembly (7), spool (9), sleeve (11), driveshaft (13), gear wheel (17) and gear rim (18).

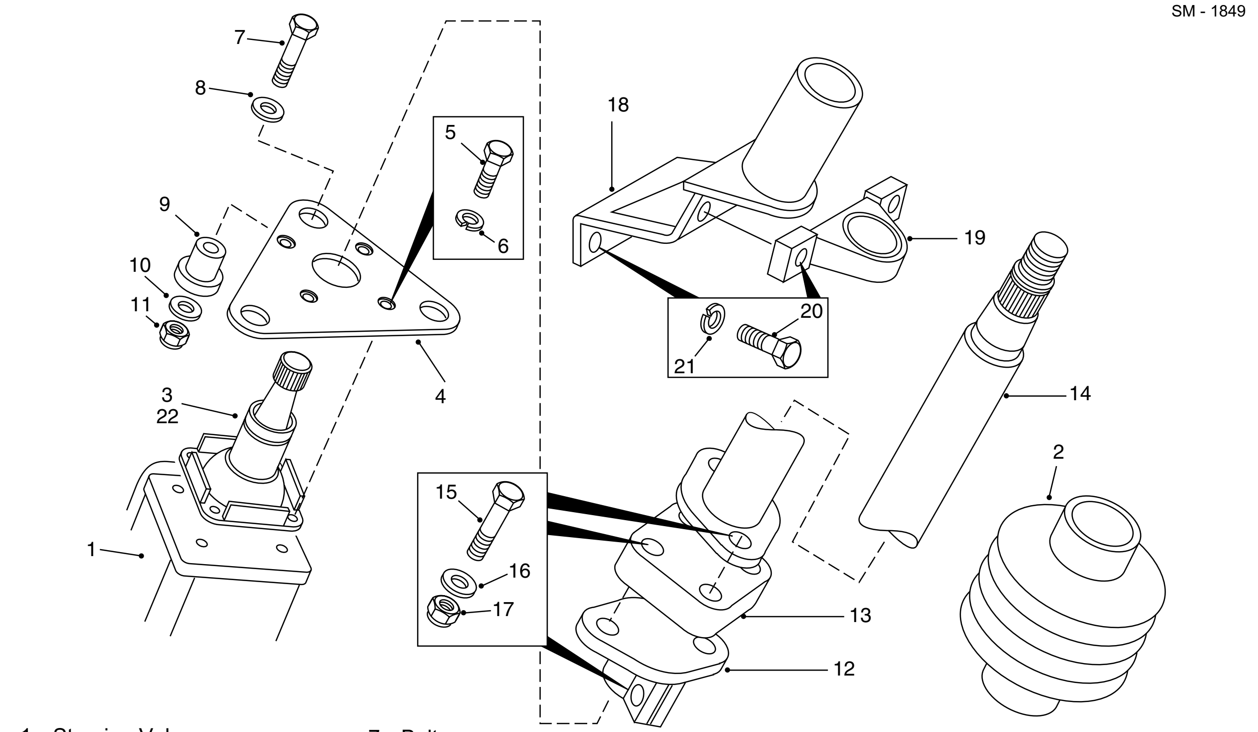
OPERATION

Refer to Fig. 3 for port identification.

There are five ports on the steering valve:

Port 'P' - Inlet from flow amplifier valve
Port 'T' - Return to tank
Port 'L' - Supply to LH steering circuit
Port 'R' - Supply to RH steering circuit
Port 'LS' - Load sensing line to flow amplifier valve

For operation of the steering valve refer to Section 220-0100, FLOW AMPLIFIER VALVE.



1 - Steering Valve
2 - Bellows
3 - Steering Column
4 - Bracket
5 - Bolt
6 - Washer
7 - Bolt
8 - Washer
9 - Rubber Mount
10 - Washer
11 - Locknut
12 - Coupling
13 - Flex Coupling
14 - Steering Shaft
15 - Bolt
16 - Washer
17 - Nut
18 - Bracket
19 - Bearing Assembly
20 - Bolt
21 - Lockwasher
22 - Nitrile Seal

Fig. 2 - Exploded View of Steering Valve Mounting

REMOVAL

Numbers in parentheses refer to Fig. 2.

> ⚠ **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. Turn steering wheel in both directions several times to relieve any pressure in the steering circuit.

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

3. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

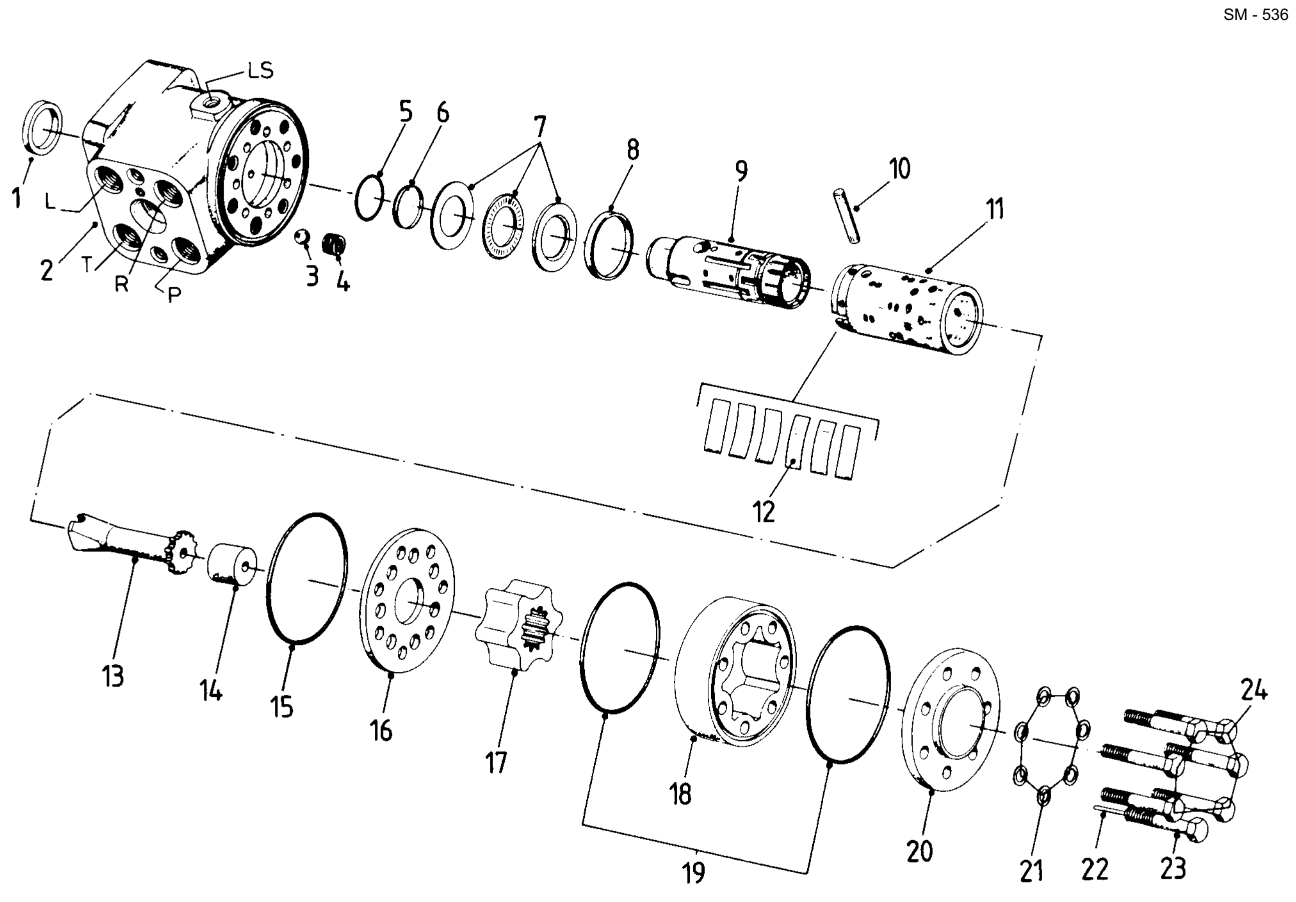
4. Pull floor mat back and remove mounting hardware securing access cover to the floor plate.

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. Fit blanking caps to all open lines.

6. Slide bellows (2) over steering column (3) to allow access and loosen bolt (5), washer (16) and nut (17) which tightens coupling (12) onto steering column (3).

7. Support steering valve (1) and remove mounting bolts (5) and washers (6) securing steering valve (1) to steering column (3) and bracket (4). Remove steering valve (1) to a clean area for disassembly.

8. If required, remove bolts (7), washers (8 & 10), locknuts (11), rubber mounts (9) and bracket (4) from the floor plate. Discard rubber mounts (9), if damaged.



1 - Seal Ring	7 - Bearing Assembly	13 - Driveshaft	19 - 'O' Ring
2 - Valve Housing	8 - Ring	14 - Spacer	20 - End Cover
3 - Check Valve Ball	9 - Spool	15 - 'O' Ring	21 - Washer
4 - Bushing	10 - Cross Pin	16 - Distributor Plate	22 - Roll Pin
5 - 'O' Ring	11 - Sleeve	17 - Gear Wheel	23 - Bolt
6 - Kin Ring	12 - Neutral Position Spring	18 - Gear Rim	24 - Bolt

Fig. 3 - Exploded View of Steering Valve Assembly

DISASSEMBLY

Numbers in parentheses refer to Figs. 1 & 3.

1. Place steering valve assembly in a soft jawed vice, end cover (20) up.

2. Remove bolts (23 & 24) and washers (21) securing end cover (20) to valve housing (2). Remove end cover (20) from valve housing (2). Remove roll pin (22) from bolt (23).

3. Remove gear rim (18), gear wheel (17) and spacer (14) from valve housing (2). Remove and discard 'O' rings (19) from gear rim (18).

4. Remove driveshaft (13) from valve housing (2).

5. Remove distributor plate (16) from valve housing (2).

6. Unscrew and remove bushing (4) from valve housing (2). Remove and discard 'O' ring (15) from valve housing (2).

7. Remove valve housing (2) assembly from the vice and shake out check valve ball (3).

8. Take care to keep cross pin (10) in sleeve (11) and spool (9) horizontal. Cross pin (10) can be seen through the open end of spool (9). Press spool (9) inwards and remove with sleeve (11), ring (8) and bearing assembly (7).

Note: The outer (thin) bearing race can sometimes 'stick' in valve housing (2). Ensure that bearing race has been removed from valve housing (2).

9. Using bolt (23) and roll pin (22), press cross pin (10)

from sleeve (11) and spool (9).

10. Carefully remove spool (9) from sleeve (11) and press neutral position springs (12) from spool (9).

11. Remove and discard seal ring (1), 'O' ring (5) and kin ring (6) from valve housing (2).

INSPECTION

1. Clean all parts in a suitable solvent and dry with clean, lint free cloths.

2. Check all parts for wear or damage and replace if necessary.

ASSEMBLY

Numbers in parentheses refer to Figs. 1 & 3.

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

Note: Before assembly, lubricate all parts with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM.

1. Install the two flat neutral position springs (12) in their slot in spool (9). Install the curved neutral position springs (12) between the flat ones and press into place.

2. Line up neutral position spring (12) set.

3. Guide spool (9) into sleeve (11).

Note: When assembling spool (9) and sleeve (11) only one of two possible ways of positioning neutral position springs (12) slot is correct. There are three slots in spool (9) and three holes in sleeve (11) in the end opposite to neutral position springs (12) slot. Place the slots and holes opposite each other so that parts of the holes in sleeve (11) are visible through the slots in spool (9).

4. Press neutral position springs (12) together and push into place in sleeve (11). Line up neutral position springs (12) and centre them.

5. Install ring (8) down over sleeve (11). Ensure ring (8) rotates free of neutral position springs (12).

6. Install cross pin (10) into spool (9) and sleeve (11) assembly.

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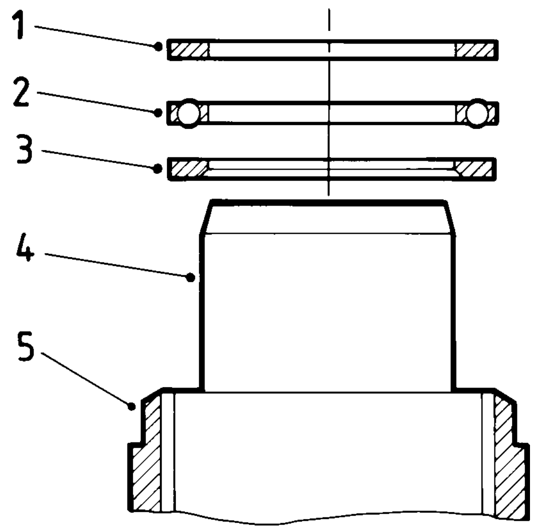

1 - Outer Bearing Race
2 - Needle Bearing
3 - Inner Bearing Race
4 - Spool
5 - Sleeve

Fig. 4 - Installation of Bearing Assembly

7. Install bearing assembly (7) on spool (9) as shown in Fig. 4.

8. Turn valve housing (2) until spool (9) and sleeve (11) bore is horizontal. Using assembly tool shown in Fig. 7, guide the outer part into valve housing (2) bore.

9. Install new kin ring (6) and 'O' ring (5) on assembly tool guide. Install the guide in inner part of assembly tool.

10. Hold the outer part of the assembly tool in the bottom of valve housing (2) and guide the inner part of the tool until it bottoms.

11. Press and turn 'O' ring (5) and kin ring (6) into position in valve housing (2).

12. Draw the inner and outer parts of the assembly tool out of valve housing (2) bore, leaving the guide from the inner part in the bore.

13. With a light turning movement guide spool (9) and sleeve (11) assembly into valve housing (2).

Note: Install spool (9) and sleeve (11) assembly with cross pin (10) in the horizontal position.

14. Spool (9) and sleeve (11) assembly will push assembly tool guide out of valve housing (2) when installed. 'O' ring (5) and kin ring (6) are now installed in position.

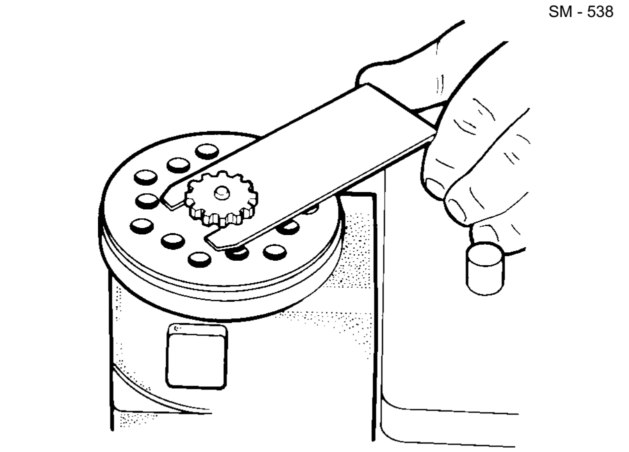

Fig. 5 - Positioning Driveshaft (13) With Mounting Fork

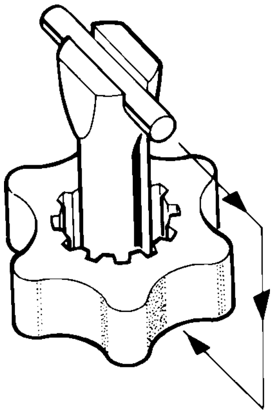

Fig. 6 - Relationship of Shaft To Gear

15. Secure valve housing (2) in a soft jawed vice, end cover (20) up.

16. Install check valve ball (3) into the hole, as shown in Fig. 3.

17. Screw threaded bushing (4) lightly into check valve ball (3) hole. The top of bushing (4) must lie just below the surface of valve housing (2).

18. Install new 'O' ring (15) in valve housing (2).

19. Install distributor plate (16) on valve housing (2), ensuring channel holes match the holes in valve housing (2).

20. Insert driveshaft (13) in spool (9) bore ensuring that the slot is parallel with cross pin (10).

21. Place driveshaft (13), as shown in Fig. 5, so that it is held in position with the mounting fork (shown in Fig. 8).

22. Install new 'O' rings (19) in gear rim (18). Install gear wheel (17) and gear rim (18) on driveshaft (13).

Note: Install gear wheel (17) on driveshaft (13) so that a tooth base in gear wheel (17) is positioned in relation to the shaft slot, as shown in Fig. 6. Turn gear rim (18) to line up the seven through holes to valve housing (2).

23. Install spacer (14) in gear wheel (17).

24. Install end cover (20) in position on valve housing (2). Remove mounting fork tool from assembly.

25. Install roll pin (22) in bolt (23) and install bolt (23) with washer (21) in bushing (4) hole.

26. Secure end cover (20) with remaining washers (21) and bolts (24). Tighten bolts (23 & 24) to a torque of 30 Nm (22 lbf ft).

27. Turn valve housing (2) in vice and install seal ring (1) in valve housing.

28. Plug valve housing (2) ports to prevent ingress of dirt prior to installation.

INSTALLATION

Numbers in parentheses refer to Fig. 2.

Note: Tighten all fasteners without special torques specified to 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 blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

1. If removed, secure rubber mounts (9) and bracket (4) to cab floor plate with bolts (7) washers (8 & 10) and locknuts (11). Tighten bolts (7) to a torque of 30 Nm (22 lbf ft).

2. Install steering valve (1) through bracket (4) and secure to steering column (3) and bracket (4) with bolts (5) and washers (6).

3. Tighten bolt (5), washer (16), nut (17) and coupling (12) onto steering column (3). Slide bellows (2) down over steering column (3) and tuck lower lip under cab floor plate.

4. Connect all hydraulic lines to steering valve (1) as tagged at removal.

5. Fill hydraulic tank with hydraulic oil, as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to 'Filling and Bleeding The Steering System'.

6. Remove wheel blocks from all road wheels, place the battery master switch in the 'On' position, start the engine and operate the steering system. Check hydraulic lines and steering valve (1) for leaks. Tighten lines and fittings as required.

7. Secure access cover to cab floor plate with mounting hardware and install floor mat in position.

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. Remove wheel blocks from all road wheels, start up engine and let it idle. Add oil to the hydraulic tank as required. When the hydraulic tank is filled to the maximum level 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 oil in the hydraulic 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 specified in Section 300-0020, LUBRICATION SYSTEM.

SPECIAL TOOLS

Special tools required for assembly of the steering valve, are shown in Figs. 7 & 8. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of these tools and general service tools required. These tools are available from your dealer.

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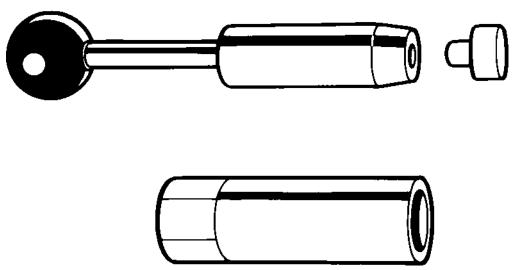

Fig. 7 - 'O' Ring and Kin Ring Assembly Tool

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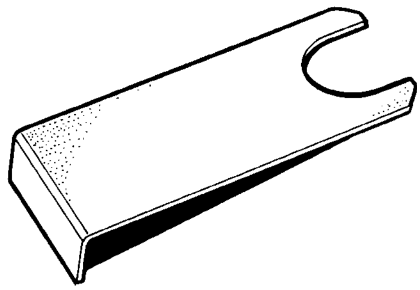

Fig. 8 - Driveshaft Mounting Fork

STEERING VALVE DIAGNOSIS		TABLE626
CONDITION	REASON	REMEDY
Steering wheel does not centre	Binding in steering linkage to valve	Align as required
	Worn gear wheel	Replace parts
	Broken neutral position springs	Replace neutral position 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 gear wheel	Replace gear wheel
Hard steering	See 'Slow Steering'	
Opposite steering	Lines hooked up incorrectly	Reconnect correctly
	Wrong orientation between gear wheel and gear rim	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 neutral position springs	Replace neutral position springs, drain and flush system
No steering action	Sleeve and spool locked together	Disassemble and repair or replace

SPECIAL TORQUE SPECIFICATIONS				TABLE077
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1 & 3	23 & 24	Bolt	30	22
2	7	Bolt	30	22

* * * *

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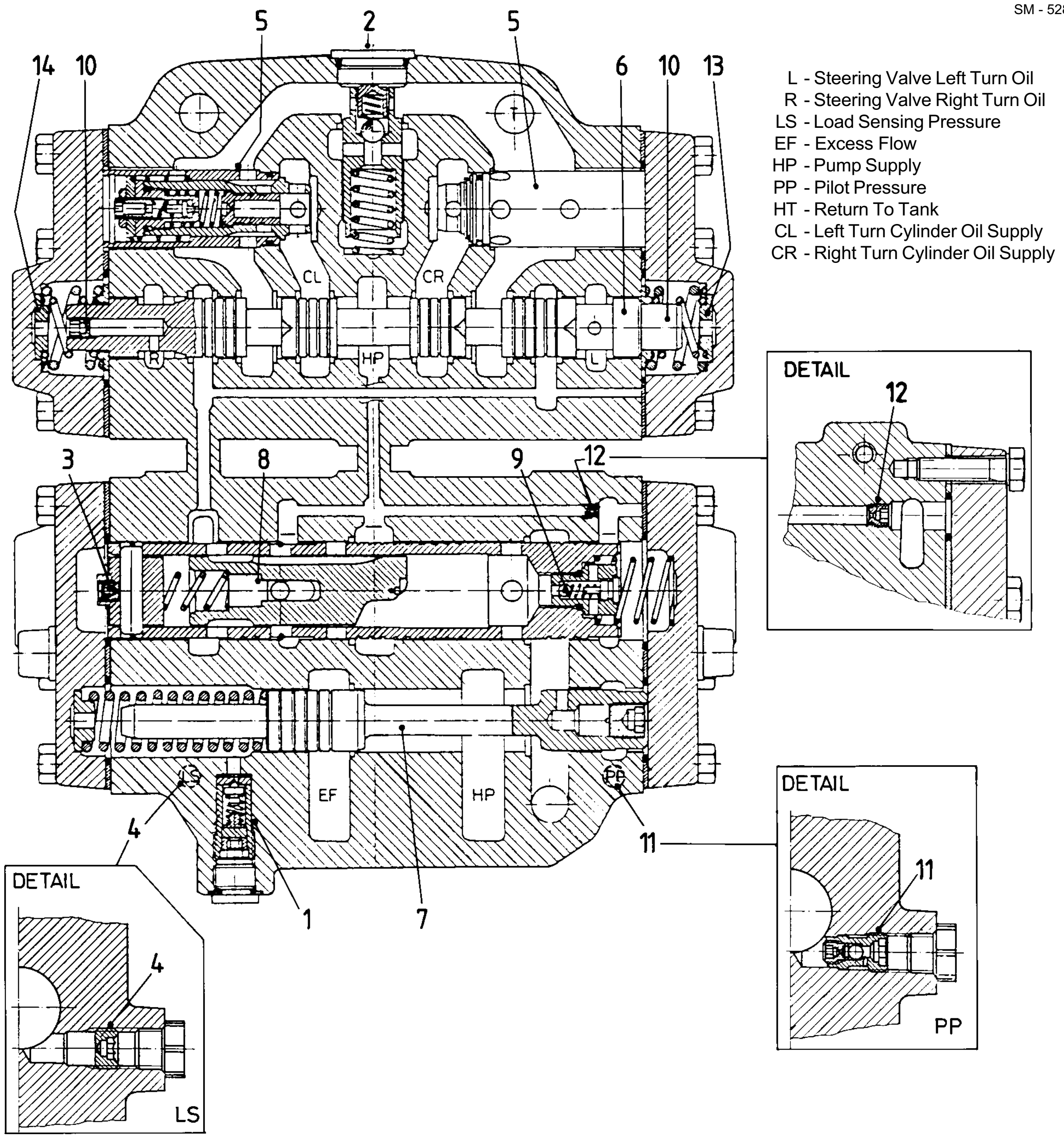

1 - System Relief Valve
2 - Counter Pressure & Anti-cavitation Valve
3 - Orifice
4 - Orifice
5 - Shock & Anti-cavitation Valve
6 - Directional Spool
7 - Priority Spool
8 - Amplifier Spool
9 - Check Valve
10 - Orifice
11 - Throttle Check Valve
12 - Orifice
13 - Cover
14 - Cover

Fig. 1 - Sectional View of Flow Amplifier Valve

DESCRIPTION

Numbers in parentheses refer to Figs. 1 & 6. Letters in parentheses refer to Figs. 1 & 2.

The Flow Amplifier Valve can be identified as item 5 in Section 220-0000, STEERING SYSTEM SCHEMATIC.

The flow amplifier valve amplifies the oil flow from the steering valve to the steering cylinders by eight. It is mounted at the rear of the cab and consists of the following:

Counter pressure & anti-cavitation valve (2)

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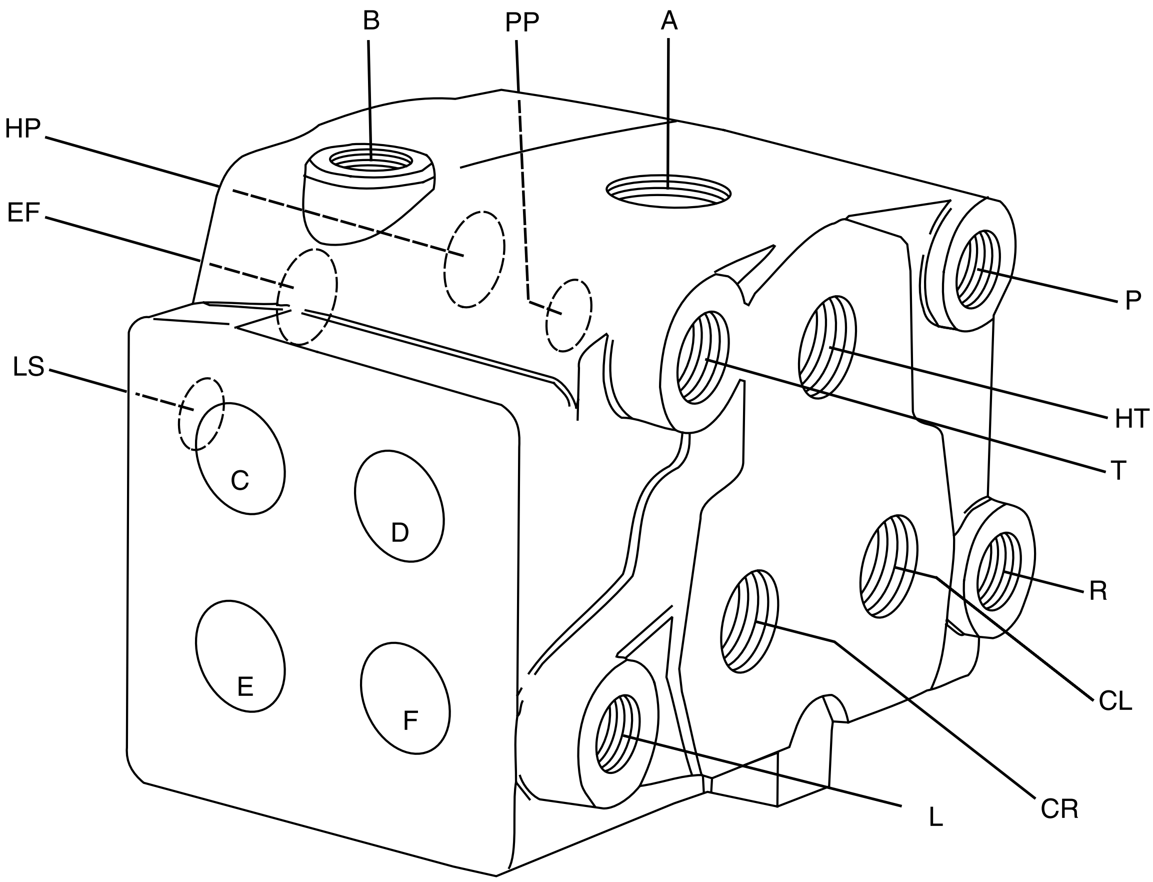

A - Counter Pressure and Anti-cavitation Valve
B - System Relief Valve
C - Priority Spool
D - Shock and Anti-cavitation Valve
E - Amplifier Spool
F - Directional Spool
LS - Load Sensing Pressure
EF - Excess Flow

HP - Pump Supply
PP - Pilot Pressure
P - Pump Supply To Steering valve
HT - Return To Tank
T - Steering valve Tank Return
R - Steering valve Right Turn Oil
CL - Left Turn Cylinder Oil Supply
CR - Right Turn Cylinder Oil Supply
L - Steering valve Left Turn Oil

Fig. 2 - Flow Amplifier Valve Port Identification

maintains a back pressure of 5 bar (73 lbf/in²) to give improved suction during steering and prevent cavitation in the steering cylinder circuit.

System relief valve (1) (Port 'B') is set to control maximum working pressure in the steering system to 206 bar (3 000 lbf/in²).

Priority spool (7) (Port 'C') directs oil supply from the pump when engine is running, to steering valve port 'P', through the 'EF' passage to the body control valve.

Shock & anti-cavitation valves (5) (Port 'D') limit shock pressures in the steering cylinders to 241 bar (3 500 lbf/in²). The shock valves sense cylinder shock pressure when there is no steering taking place. Shock pressure is absorbed in the cylinder circuit and is not transmitted to the steering valve. The anti-cavitation part of the valve prevents cavitation in the cylinder circuit.

Amplifier spool (8) (Port 'E') controls the amount of oil flowing into directional spool (6) 'HP' passage.

Directional spool (6) (Port 'F') when moved in either direction against the return springs, sends oil pressure to the steering cylinders for right or left turns.

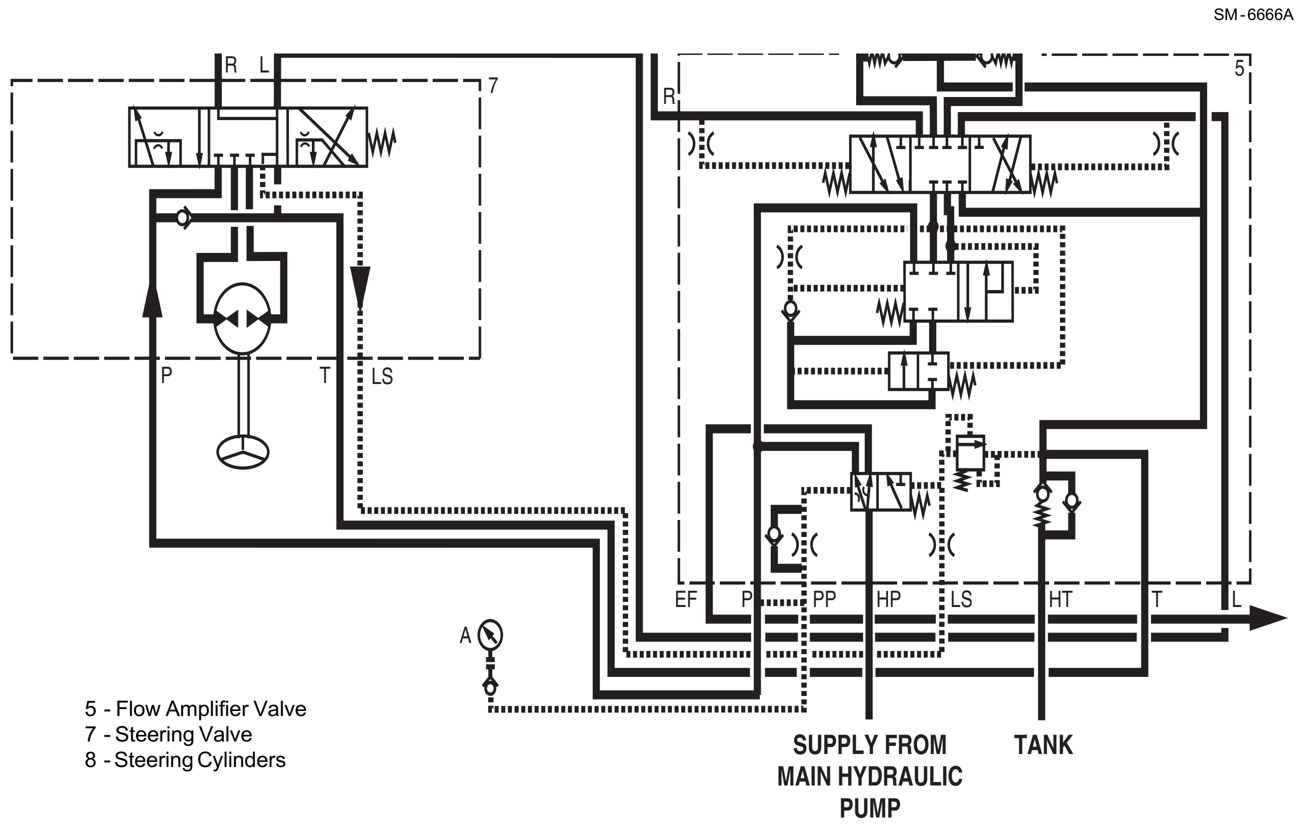

Fig. 3 - Hydraulic Schematic - Neutral Position

Orifice (3) meters oil in the left hand end of amplifier spool (8). During right or left hand turns this oil will balance amplifier spool (8).

Orifice (4) meters working pressure in the load sensing line 'LS' during normal steering operation and dead heads at system relief valve (1).

Check valve (9) is located in the right hand end of amplifier spool (8).

Orifices (10) are threaded into the ends of directional spool (6). Their purpose is to control the movement of directional spool (6) which controls the oil flow to the steering cylinders.

Throttle check valve (11) is located in pilot pressure port 'PP'.

Orifice (12) is threaded in the cross passage above amplifier spool (8) and meters oil in the right hand end of amplifier spool return spring area.

Orifice drillings are located in covers (13 & 14) at either end of directional spool (6).

OPERATION

Neutral Position

Numbers in parentheses refer to Figs. 1 & 6. Refer to Fig. 3 for hydraulic schematic of the flow amplifier valve and steering valve operating in the neutral position.

Oil flows out of the hydraulic tank, through the main hydraulic pump, through check valves and enters the flow amplifier valve at port 'HP'. Oil flows through priority spool (7) and dead heads at amplifier spool (8).

At the same time, oil flows through priority spool (7), exits from port 'P' and flows into the steering valve at port 'P'. This pressure is dead headed at the steering valve and, as the pressure builds up, pilot pressure is tapped off of line 'P' and flows through port 'PP' to the left hand end of priority spool (7).

This pressure moves priority spool (7) to the right, thus opening the main supply 'HP' line to the 'EF' passage. Oil exits from port 'EF' to the inlet port 'P' on the body control valve. At the same time, a restricted pressure in line 'P' maintains the pilot pressure on the left hand end of priority spool (7).

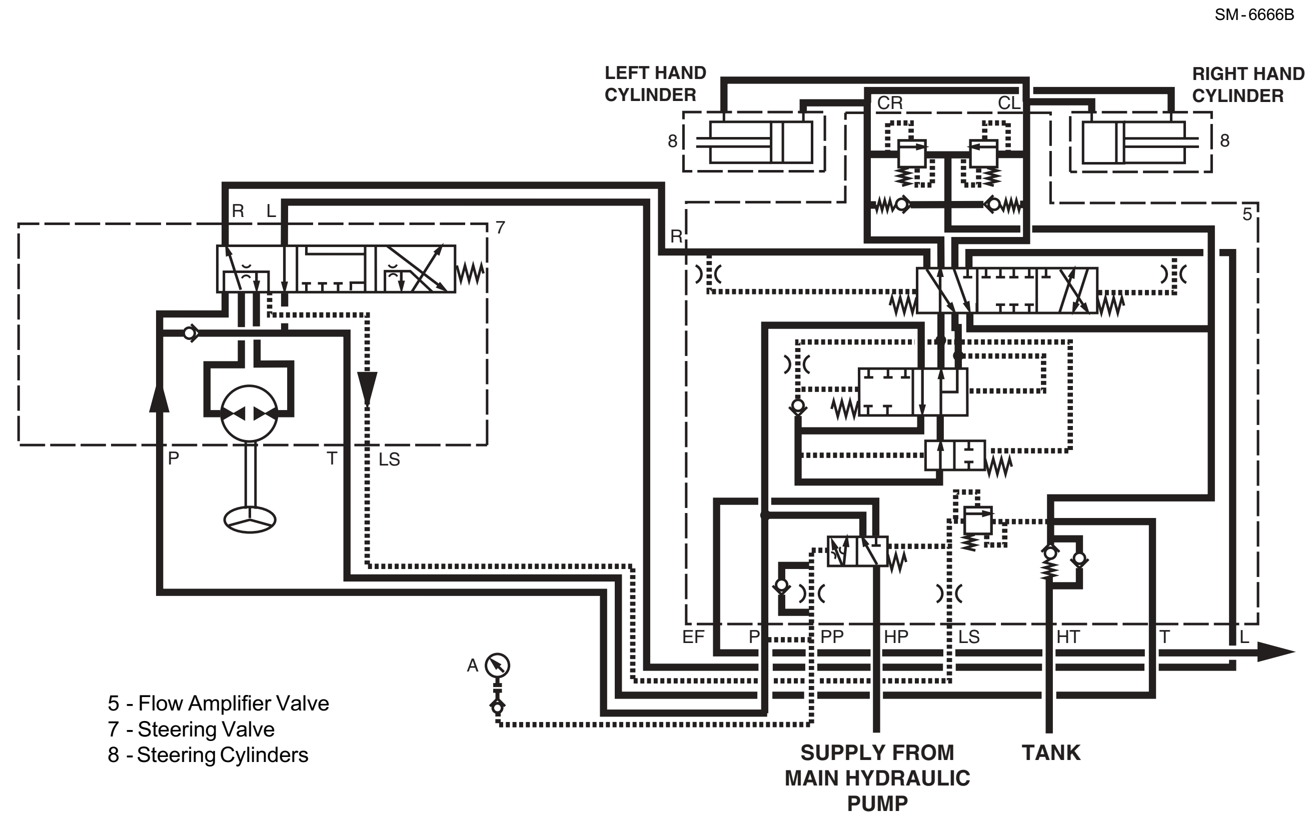

Fig. 4 - Hydraulic Schematic - Right Turn

In this condition, the body control valve has priority over the steering valve. If oil is not required to operate the body hoist cylinders, the oil flows through the body control valve and back to tank.

Right Hand Turn

Numbers in parentheses refer to Figs. 1 & 6. Refer to Fig. 4 for hydraulic schematic of the flow amplifier valve and steering valve operating in the right turn position.

On turning the steering wheel for a right turn application, oil flows from the steering valve 'LS' port to the flow amplifier valve 'LS' port. The oil flows through the load sensing orifice and into the spring cavity of priority spool (7) moving the spool to the left. This movement allows oil to flow out of port 'P' in the flow amplifier valve and into port 'P' in the steering valve.

Oil leaves the steering valve through port 'R' and into the left hand end of directional spool (6). This pressure moves directional spool (6) to the right allowing a pilot pressure to act on the right hand end of amplifier spool (8). Pilot pressure overcomes spring pressure on the left hand end of amplifier spool (8) moving amplifier spool (8) to the left. This movement allows the main oil flow from priority spool (7) and pilot flow through directional spool (6) to merge at directional spool (6) and flow through port 'CR' to the steering cylinders.

Return oil from the opposite ends of the steering cylinders flows into port 'CL' and through directional spool (6). Oil then flows through counter pressure & anti-cavitation valve (2) and back to tank.

In this condition remaining oil supplied from the main hydraulic pump, is available for the body hydraulics or is returned to tank.

Left Hand Turn

Numbers in parentheses refer to Figs. 1 & 6. Refer to Fig. 5 for hydraulic schematic of the flow amplifier valve and steering valve operating in the left turn position.

On turning the steering wheel for a left turn application, oil flows from the steering valve 'LS' port to the flow amplifier valve 'LS' port. The oil flows through the load sensing orifice and into the spring cavity of priority spool (7) moving the spool to the left. This movement allows oil to flow out of port 'P', in the flow amplifier valve, and into port 'P' in the steering valve.

Oil leaves the steering valve through port 'L' and into

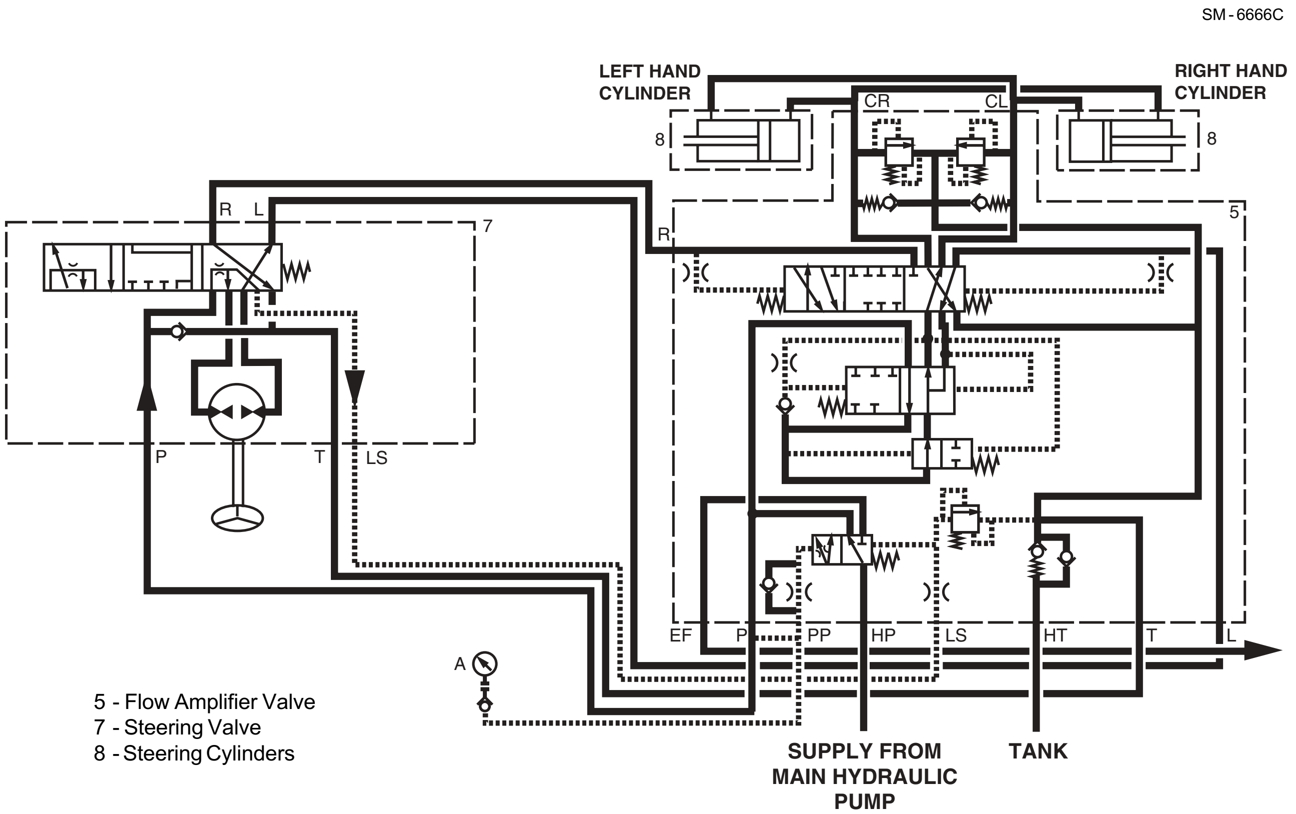

Fig. 5 - Hydraulic Schematic - Left Turn

the right hand end of directional spool (6). This pressure moves directional spool (6) to the left allowing a pilot pressure to act on the right hand end of amplifier spool (8). Pilot pressure overcomes spring pressure on the left hand end of amplifier spool (8) moving amplifier spool (8) to the left. This movement allows the main oil flow from priority spool (7) and pilot flow through directional spool (6) to merge at directional spool (6) and flow through port 'CL' to the steering cylinders.

Return oil from the opposite ends of the steering cylinders flows into port 'CR' and through directional spool (6). Oil then flows through counter pressure & anti-cavitation valve (2) and back to tank.

In this condition, remaining oil supplied from the main hydraulic pump, is available for the body hydraulics or is returned to tank.

REMOVAL

⚠ 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. Turn steering wheel in both directions several times to relieve any pressure in the steering circuit.

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

3. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

4. Disconnect mounting hardware securing hydraulic guard to the unit and remove hydraulic guard.

5. Clean outer area of the flow amplifier valve with a suitable solvent. Ensure all hydraulic lines connected to the flow amplifier 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 and fittings.

6. Disconnect mounting hardware securing flow amplifier valve to the vehicle. Remove flow amplifier valve to a clean area for disassembly.

DISASSEMBLY

Numbers in parentheses refer to Figs. 1 & 6. Letters in parentheses refer to Figs. 1 & 2.

System Relief Valve (1)

1. Unscrew plug (31) and remove from housing (36). Discard 'O' ring seal (32).

2. Unscrew system relief valve (1) and remove from housing (36). Remove and discard 'O' ring seal (33) from housing (36).

3. If required, hold system relief valve (1) body with pipe pliers and unscrew adjusting screw from the body.

Counter Pressure & Anti-cavitation Valve (2)

1. Unscrew plug (34) and remove from housing (36). Discard 'O' ring (35).

2. Remove counter pressure & anti-cavitation valve (2) from housing (36) by removing, small spring, steel ball, piston housing and large spring, in that order.

Spools (6, 7 & 8)

1. Remove screws (15 & 17) and lockwashers (16 & 18) securing cover (13) to housing (36). Remove cover (13) from housing (36).

2. Remove spring stop (27), springs (28 & 29) and spring guide (30) from directional spool (6).

3. Remove spring stop (23) and spring (24) from priority spool (7).

4. Remove plate (21) and discard 'O' rings (19 & 20).

5. Remove screws (15 & 17) and lockwashers (16 & 18) securing cover (14) to housing (36). Remove cover (14) from housing (36).

6. Remove spring stop (27), springs (28 & 29) and spring guide (30) from directional spool (6).

7. Remove spring (26) from amplifier spool (8).

8. Remove plate (22) and discard 'O' rings (19, 20 & 25).

9. Remove directional spool (6), priority spool (7) and amplifier spool (8) assemblies from housing (36).

Note: Directional spool (6), priority spool (7), amplifier spool (8) and check valve (9), are not sold separately and are supplied as part of an assembly with housing (36). Further disassembly of the spools is therefore not required.

Shock & Anti-cavitation Valves (5)

1. Prise shock & anti-cavitation valves (5) from housing (36) with a screwdriver. Take care not to damage valves or housing.

Note: Shock & anti-cavitation valve (5) is available only as an assembly.

Orifices (4 & 12) and Throttle Check Valve (11)

1. Unscrew orifice (4) from 'LS' port in housing (36).

2. Unscrew throttle check valve (11) from 'PP' port in housing (36).

3. Unscrew orifice (12) from cover (14) face in housing (36).

INSPECTION

Numbers in parentheses refer to Figs. 1 & 6.

Clean and examine all parts for wear and damage. If directional spool (6), priority spool (7), amplifier spool (8) or housing (36) are damaged beyond repair, replace as a unit.

Replace all 'O' rings and seals.

ASSEMBLY

Numbers in parentheses refer to Figs. 1 & 6. Letters in parentheses refer to Figs. 1 & 2.

Note: Before assembly, lubricate all parts with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM.

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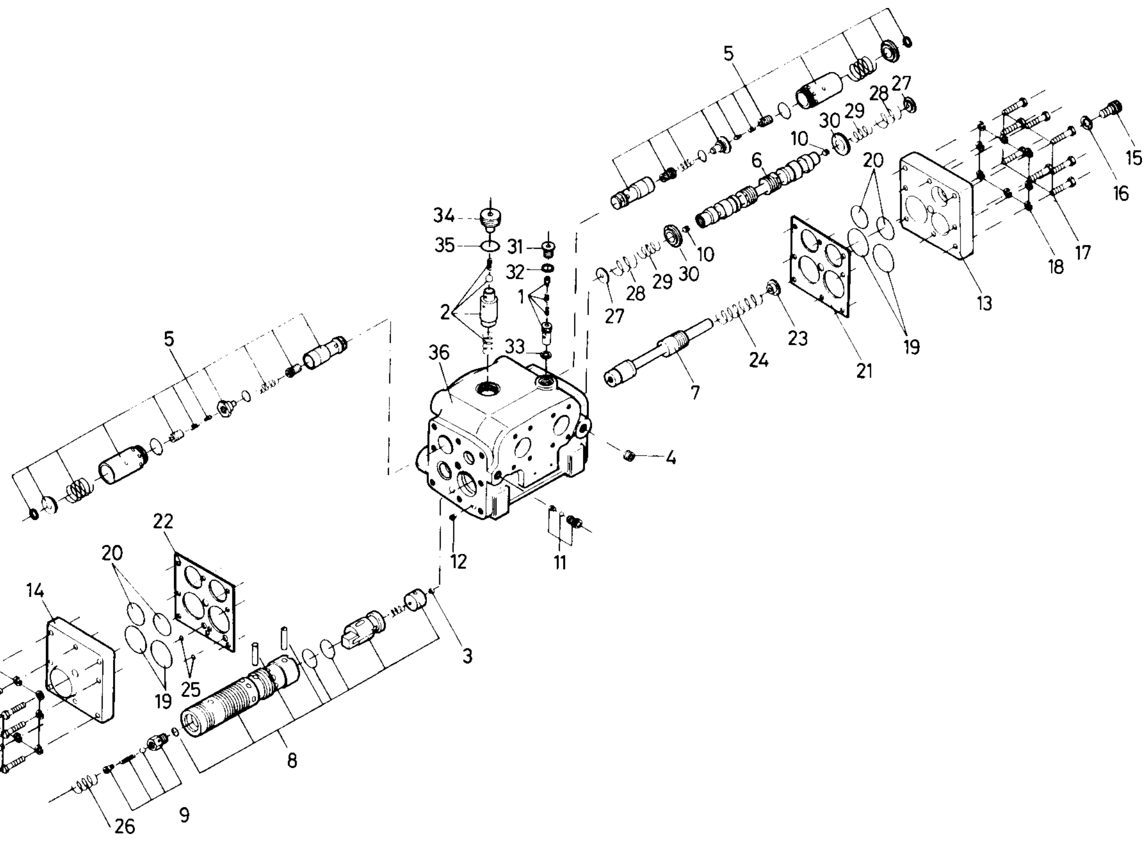

1 - System Relief Valve	10 - Orifice	19 - 'O' Ring	28 - Spring
2 - Counter Pressure & Anti-cavitation Valve	11 - Throttle Check Valve	20 - 'O' Ring	29 - Spring
3 - Orifice	12 - Orifice	21 - Plate	30 - Spring Guide
4 - Orifice	13 - Cover	22 - Plate	31 - Plug
5 - Shock & Anti-cavitation Valve	14 - Cover	23 - Spring Stop	32 - 'O' Ring Seal
6 - Directional Spool	15 - Screw	24 - Spring	33 - 'O' Ring Seal
7 - Priority Spool	16 - Lockwasher	25 - 'O' Ring	34 - Plug
8 - Amplifier Spool	17 - Screw	26 - Spring	35 - 'O' Ring
9 - Check Valve	18 - Lockwasher	27 - Spring Stop	36 - Housing

Fig. 6 - Exploded View Of Flow Amplifier Valve

1. Install orifice (12) in cover (14) face of housing (36) and tighten to a torque of 5 ± 1 Nm (45 ± 10 lbf in).

2. Install throttle check valve (11) in 'PP' port of housing (36) and tighten to a torque of 10 ± 3 Nm (90 ± 25 lbf in).

3. Install orifice (4) in 'LS' port of housing (36) and tighten to a torque of 10 ± 3 Nm (90 ± 25 lbf in).

4. Install shock & anti-cavitation valves (5) in port 'D' of housing (36). Secure shock & anti-cavitation valves (5) by hand.

5. If removed, install orifice (10) in each end of directional spool (6) and tighten to a torque of 5 ± 1 Nm (45 ± 10 lbf in).

6. Install directional spool (6), priority spool (7) and amplifier spool (8) assemblies, in their respective ports of housing (36).

7. Install spring (26) on amplifier spool (8) at cover (14) end of housing (36).

8. Install spring guide (30), springs (28 & 29) and spring stop (27), in that order, on directional spool (6), at cover (14) end of housing (36).

9. Install new 'O' rings (19, 20 & 25) on plate (22) and

position in place on cover (14) end of housing (36).

10. Secure cover (14) on housing (36) with lockwashers (16 & 18) and screws (15 & 17). Tighten screws (15) to a torque of 80 ± 10 Nm (710 ± 90 lbf in) and screws (17) to 25 ± 5 Nm (220 ± 45 lbf in).

11. Install spring (24) and spring stop (23) on priority spool (7) at cover (13) end of housing (36).

12. Install spring guide (30), springs (28 & 29) and spring stop (27), in that order, on directional spool (6), at cover (13) end of housing (36).

13. Install new 'O' rings (19 & 20) on plate (21) and position in place on cover (13) end of housing (36).

14. Secure cover (13) on housing (36) with lockwashers (16 & 18) and screws (15 & 17). Tighten screws (15) to a torque of 80 ± 10 Nm (710 ± 90 lbf in) and screws (17) to 25 ± 5 Nm (220 ± 45 lbf in).

15. Install counter pressure & anti-cavitation valve (2) in port 'A' of housing (36) as follows:

a. Smear large spring with vaseline and install in piston housing. Install piston housing assembly in housing (36).

b. Insert steel ball in piston housing.

c. Insert new 'O' ring (35) on plug (34) and insert small spring in plug (34).

d. Install plug (34) assembly in housing (36) and tighten to a torque of 25 ± 3 Nm (220 ± 25 lbf in).

16. If removed, install adjusting screw in system relief valve (1) body, as removed at disassembly.

17. Install new 'O' ring seal (32) in port 'B' of housing (36).

18. Screw system relief valve (1) into port 'B' in housing (36). Tighten system relief valve (1) to a torque of 30 ± 3 Nm (265 ± 25 lbf in).

19. Install new 'O' ring seal (32) on plug (31) and secure in housing (36). Tighten plug (31) to a torque of 60 ± 5 Nm (530 ± 45 lbf in).

INSTALLATION

Note: Tighten all fasteners without special torques specified to 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 blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.**

1. Install flow amplifier valve on the vehicle and secure with mounting hardware removed during removal.

2. Connect hydraulic lines and tubes to flow amplifier valve, as tagged at removal.

3. Fill hydraulic oil tank with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap on hydraulic tank.

4. Place the battery master switch in the 'On' position, remove all wheel blocks, start the engine and operate steering and body systems. Check hydraulic lines and tubes for leaks. Tighten as required.

5. Check hydraulic tank oil level and replenish as required.

RELIEF VALVE - PRESSURE CHECK

Numbers in parentheses refer to Figs. 1 & 6.

1. Attach a 276 bar (4 000 lbf/in²) pressure gauge to remote steering pressure check point at the rear left hand side of the tractor frame.

2. With the engine and hydraulic oil at operating temperature, continuously steer into the LH stop at full throttle. The pressure should rise to 206 bar (3 000 lbf/in²) and remain stable. Repeat this test 10 - 12 times.

3. Repeat the above test, continuously steering into the RH stop.

4. If required, adjust relief valve pressure as follows:

a. Remove plug (31) from housing (36).

b. Screw adjusting screw with an allen key, clockwise to increase the pressure reading, or anticlockwise to reduce the pressure reading.

c. Install plug (31) in housing (36) and tighten to a torque of 60 ± 5 Nm (530 ± 45 lbf in).

5. Repeat steps 2 and 3 to ensure pressure reading remains constant.

SPECIAL 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.

AMPLIFIER VALVE DIAGNOSIS TABLE076

CONDITION	REASON	REMEDY
Too few steering wheel turns from stop to stop	Dirty, leaky or missing check valve (9)	Clean or renew check valve (9)
Steering over-reacting	Amplifier spool (8) stuck in open position	Disassemble and check amplifier spool (8) movement
Too many steering wheel turns from stop to stop Steering too slow	Amplifier spool (8) stuck in closed position	Disassemble and check amplifier spool (8) movement
Prolonged hard point when beginning to turn the steering wheel Amplification is delayed and sets in suddenly	Dirty orifice (10) in directional spool (6)	Clean or replace orifice (10)
	Dirty orifice (3) in amplifier spool (8)	Clean or replace orifice (3)
	Dirty orifice (12) in valve housing	Clean or replace orifice (12)
	Dirty orifice (4) in 'LS' port	Clean or replace orifice (4)
	Blocked up throttle check valve (11) in 'PP' port	Clean or replace throttle check valve (11)
Steering wheel can be turned rapidly	Setting of shock & anti-cavitation valve (5) set too low	Untighten the counter nut and adjust the valve setting screw with an allen key. Tighten the counter nut to secure.
	Leaking or hanging shock & anti-cavitation valve (5)	Disassemble shock & anti-cavitation valve (5) and renew, if necessary
No end stop feeling	Missing end stop in directional spool (6)	Mount end stop
Steering has insufficient force to turn the wheels at standstill	System relief valve (1) adjusted too low	Remove plug and adjust pressure setting with an allen key
	Steering unit spool and sleeve installed in wrong manner to each other. No 'LS' signal can be built up.	Disassemble steering unit and turn the spool and sleeve to the right position
	Steering unit spool and sleeve worn	Change steering unit
No function at all	Oil flows direct from pump to tank in the steering unit	Manual steering ball is missing
Short hard point when beginning to turn the steering wheel	Air in the 'LS' and 'PP' lines	Bleed 'LS' and 'PP' lines
	Clogged orifice in 'LS' port and/or clogged check valve in 'PP' port	Clean the orifice and/or check valve

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf in
1 & 6	1	System Relief Valve	30 ± 3	265 ± 25
1 & 6	4	Orifice	10 ± 3	90 ± 25
1 & 6	10	Orifice	5 ± 1	45 ± 10
1 & 6	11	Throttle Check Valve	10 ± 3	90 ± 25
1 & 6	12	Orifice	5 ± 1	45 ± 10
1 & 6	15	Screw	80 ± 10	710 ± 90
1 & 6	17	Screw	25 ± 5	220 ± 45
1 & 6	31	Plug	60 ± 5	530 ± 45
1 & 6	34	Plug	25 ± 3	220 ± 25

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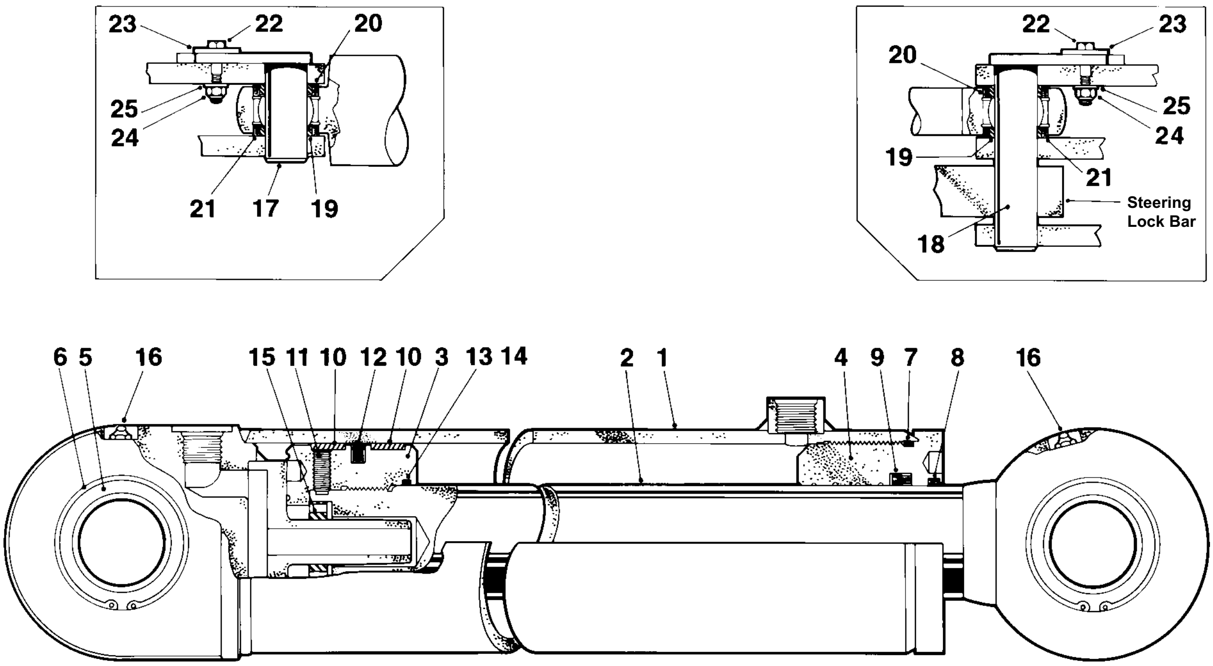


1 - Cylinder Body
2 - Piston Rod
3 - Piston
4 - End Cap
5 - Spherical Bearing
6 - Circlip
7 - 'O' Ring
8 - Rod Seal
9 - Wiper
10 - Bearing Ring
11 - Grub Screw
12 - Piston Seal
13 - 'O' Ring
14 - Backup Ring
15 - Cushion Sleeve
16 - Lube Fitting
17 - Pin
18 - Pin
19 - Spacer
20 - Seal (if fitted)
21 - Seal (if fitted)
22 - Bolt
23 - Hardened Washer
24 - Locknut
25 - Washer

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 8 in Section 220-0000, STEERING SYSTEM SCHEMATIC.

There are two single stage, double acting, cushioned steering cylinders on the vehicle. The cylinder base end is connected to the front frame and piston rod (2) end is connected to the rear frame. Single stage, double acting means that piston rod (2) can have oil applied to either side, extending or retracting the piston rod.

The cushioning effect is obtained by a tapered spear at the base end of cylinder body (1) entering a cavity in piston rod (2) through cushioning sleeve (15). This gradually slows piston (3) which in turn helps to control destructive shock effects when piston (3) bottoms.

Cylinder mounting is by pins (17 & 18), spacers (19), seals (20 & 21, if fitted) and spherical bearings (5) secured with circlips (6). Spherical bearings (5) permit a limited amount of cylinder misalignment when travelling over rough terrain.

Note: Refer to Section 220-0100, FLOW AMPLIFIER VALVE for steering operation.

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. Turn steering wheel in both directions several times to relieve any pressure in the steering circuit.

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

3. Support steering cylinder with blocks or suitable lifting device.

4. Position a suitable oil container at line ends of one cylinder. Ensure all hydraulic lines connected to the steering cylinder assembly are identified for ease of installation and disconnect hydraulic lines. Fit blanking caps to all open lines and fittings to prevent ingress of dirt.

5. Remove locknut (24), washer (25), hardened washer (23) and bolt (22) securing pin (18) at piston rod (2) end of cylinder assembly. Remove pin (18), spacers (19) and seals (20 & 21, if fitted) from piston rod (2) end of cylinder assembly.

6. Remove locknut (24), washer (25), hardened washer (23) and bolt (22) securing pin (17) at base end of cylinder assembly. Remove pin (17), spacers (19) and seals (20 & 21, if fitted) from base end of cylinder assembly.

7. Remove cylinder assembly to a clean area for disassembly. Drain oil from cylinder assembly into a suitable container.

8. Repeat steps 2 through 6 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 the cylinder, preventing a vacuum when parts are withdrawn from cylinder body (1).

2. Remove circlips (6) from base end of cylinder body (1) and piston rod (2) end. Press out spherical bearings (5).

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. Support piston rod (2) at the rod eye and withdraw from cylinder body (1). Ensure centre lines of piston rod (2) and cylinder body (1) remain on the same axis during removal of piston rod (2).

5. Place piston rod (2) on supports which will not damage the piston rod diameter.

6. Remove and discard piston seal (12) and bearing rings (10) from piston (3).

7. Remove grub screw (11) from bearing ring (10) 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 (13) and backup ring (14) from piston (3).

10. Remove cushion sleeve (15) from piston rod (2).

11. Remove end cap (4) assembly from piston rod (2). Remove and discard rod seal (8), wiper (9) and 'O' ring (7) from end cap (4).

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 (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 (5) and cushion sleeve (15) for wear and replace if necessary.

5. Replace all seals, 'O' rings and wipers.

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 (8), wiper (9) and 'O' ring (7), in end cap (4). Install end cap (4) assembly over piston rod (2) thread taking care not to damage rod seal (8) on the thread.

3. Install cushion sleeve (15) in piston rod (2) end.

4. Install new 'O' ring (13) and backup ring (14) in piston (3).

5. Apply Loctite 242 to the first two threads of piston rod (2) and, 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 1 356 Nm (1 000 lbf ft).

6. Insert grub screw (11) through bearing ring (10) groove in piston (3) and into groove machined in piston rod (2). Tighten grub screw (11) to a torque of 49 Nm (36 lbf ft). Ensure the extreme of grub screw (11) is below the level of bearing ring (10) groove.

7. Insert new piston seal (12) and new bearing rings (10) on piston (3).

8. Fully grease piston (3) OD and 'O' ring (7) in end cap (4).

9. Sling piston rod (2) in a manner to allow careful leading of assembled piston rod (2) into cylinder body (1). Take care not to damage piston seal (12) on cylinder body (1) threads.

10. After piston (3) is installed in cylinder body (1), push piston rod (2) into cylinder body (1) maintaining centre lines of piston rod (2) and cylinder body (1) along the same axis.

11. Before piston rod (2) is fully home, and with slings still taking some of piston rod (2) weight, engage end cap (4) thread and screw home.

12. Push piston rod (2) to the mid-stroke position and, using special tool which can be fabricated as shown in Fig. 2, tighten end cap (4) to a torque of 542 Nm (400 lbf ft).

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.

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 blocking materials and lifting equipment are 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 (19) and seals (20 & 21) on base end of cylinder and insert pin (17). Secure pin (17) with bolt (22), hardened washer (23), washer (25) and locknut (24).

3. Install spacers (19) and seals (20 & 21) on rod end of cylinder and insert pin (18). Secure pin (18) with bolt (22), hardened washer (23), washer (25) and locknut (24).

4. Repeat steps 1 through 3 for opposite cylinder.

5. Connect the hydraulic oil lines to the cylinder ports as tagged during removal.

6. Lubricate pins at lube fittings (16) with lubricant specified in Section 300-0020, LUBRICATION SYSTEM.

7. 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.

8. Place the battery master switch in the 'On' position, remove all wheel blocks, start the engine and operate the steering from lock to lock several times to purge air from the steering lines. Check steering lines and fittings for leaks and tighten as required.

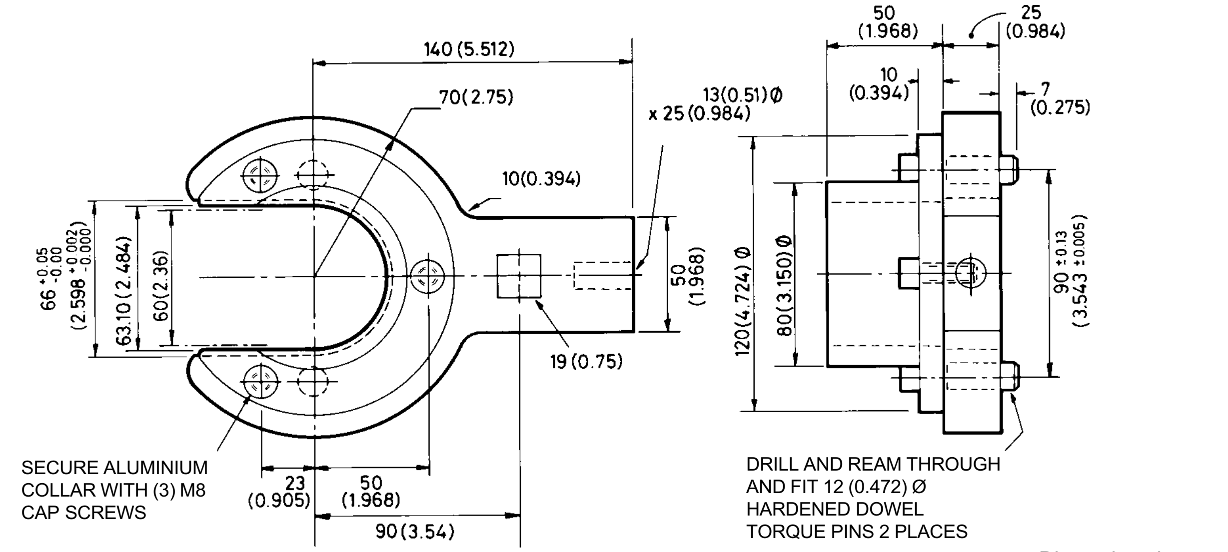
MAINTENANCE

Visually inspect steering cylinders and mounting regularly for leaks and damage. Repair/replace as required. Lubricate cylinder pins every 50 hours through lube fittings (16, Fig. 1) with lubricant specified in Section 300-0020, LUBRICATION SYSTEM.

SPECIAL TOOLS

Special tools for removal and installation of the piston and end cap can be fabricated as shown in Figs. 2 & 3. 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.

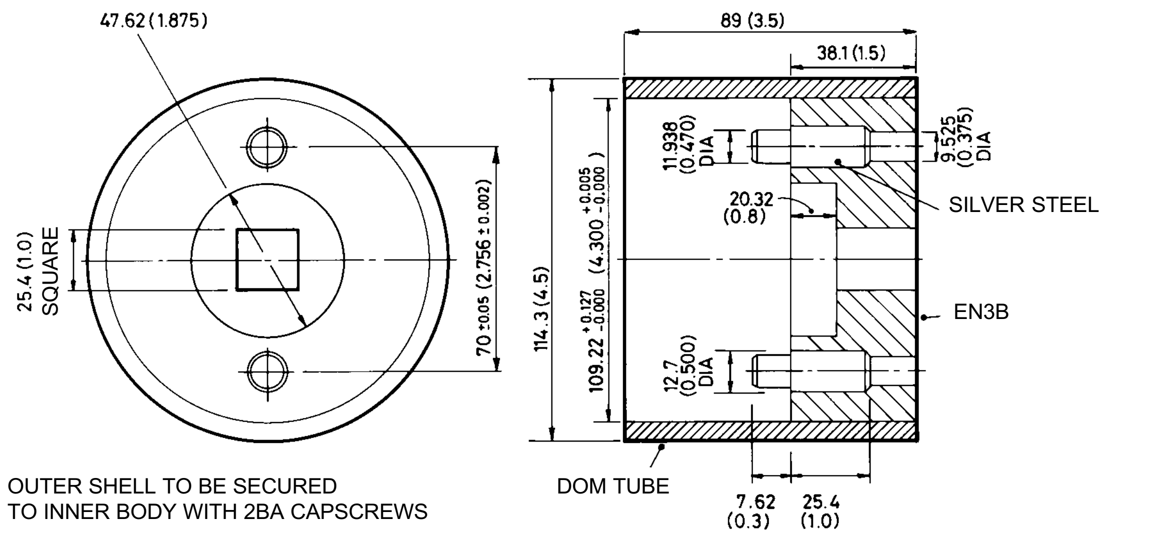
SM - 407



Dimensions in mm (inches)

Fig. 2 - End Cap Torque Tool

SM - 408



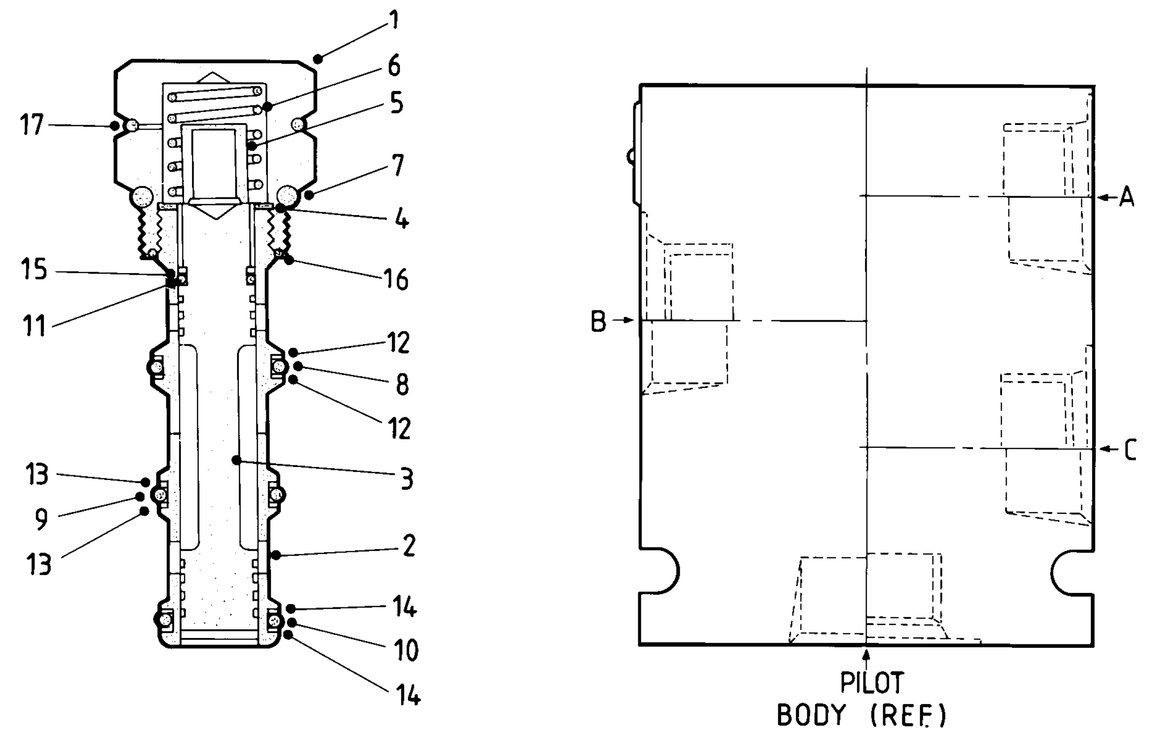
Dimensions in mm (inches)

Fig. 3 - Piston Torque Tool

SPECIAL TORQUE SPECIFICATIONS				TABLE074
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	3	Piston	1 356	1 000
1	4	End Cap	542	400
1	11	Grub Screw	49	36

* * * *

SM - 542



1 - Retainer
2 - Cage
3 - Spool
4 - Spring Ring
5 - Spring
6 - Spring
7 - 'O' Ring
8 - 'O' Ring
9 - 'O' Ring
10 - 'O' Ring
11 - 'O' Ring
12 - Backup Washer
13 - Backup Washer
14 - Backup Washer
15 - Backup Washer
16 - Sealing Washer
17 - 'O' Ring

Fig. 1 - Sectional View of Emergency Valve

DESCRIPTION

The Emergency Valve can be identified as item 4 in Section 220-0000, STEERING SYSTEM SCHEMATIC.

Located on the inside of the front left hand side frame rail, the emergency valve forms part of the emergency steering system. It is connected to the main output line of the wheel driven emergency steering pump on the transmission.

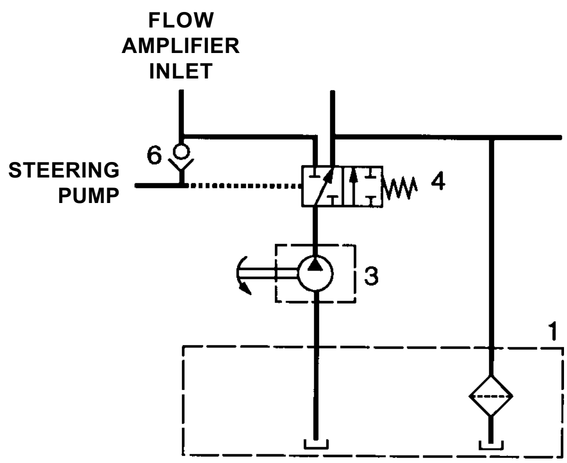
OPERATION

Normal Steering

Numbers and letters in parentheses refer to Fig. 1. Refer to Fig. 2 for hydraulic schematic of emergency valve during normal steering operation.

During normal operation, pilot pressure from the main hydraulic pump acts on spool (3), pushing the spool to the right. The emergency steering pump draws oil from the hydraulic tank and pumps it to port 'B' of the emergency valve. The oil is directed through the emergency valve, exits at port 'C' and returns to the hydraulic tank.

SM - 543



1 - Hydraulic Tank
3 - Emergency Pump
4 - Emergency Valve
6 - Check Valve

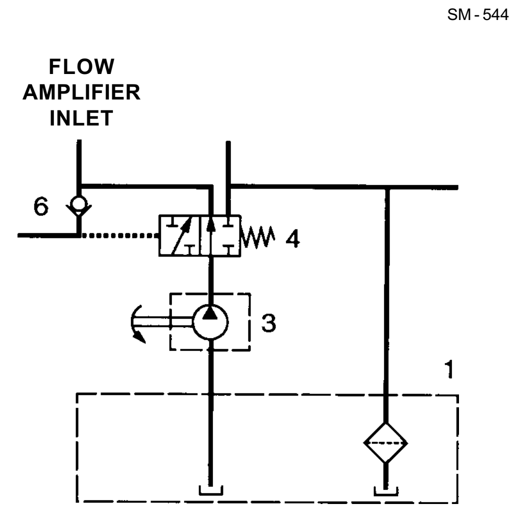
Fig. 2 - Emergency Valve - Normal Steering Operation

Emergency Steering

Numbers and letters in parentheses refer to Fig. 1. Refer to Fig. 3 for hydraulic schematic of emergency valve during emergency steering.

In the event of loss of pressure from the steering pump, springs (5 & 6) return spool (3) to the left. The emergency steering pump draws oil from the hydraulic tank and pumps it to port 'B' of the emergency valve. The oil is directed through the emergency valve and exits at port 'A' to supply the steering system.

A pressure switch, installed in the block at the top 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.



1 - Hydraulic Tank
3 - Emergency Pump
4 - Emergency Valve
6 - Check Valve

Fig. 3 - Emergency Valve - Emergency Steering Operation

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. Turn steering wheel in both directions several times to relieve any pressure in the steering circuit.

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 cradle assembly at the rear of the cab 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

The emergency valve is a non-serviceable item except in the instance of damage being caused to the seals. Should a fault be diagnosed the cartridge assembly can be unscrewed from the housing for inspection. Check for sticking spool or faulty seals.

Refer to the vehicle's parts book for part numbers of the cartridge kit and seal kit for the emergency valve.

* * * *

DESCRIPTION

Numbers in parentheses refer to Figs. 2 through 5.

Oil supply to the body hoist system is by common components to both the body and steering systems. Refer to Section 220-0000, STEERING SYSTEM SCHEMATIC.

Hydraulic oil is drawn from the hydraulic tank (1) by the main hydraulic pump and pumped to the flow amplifier valve via double check valve. A priority spool within the flow amplifier valve directs oil supply from the main hydraulic pump to the steering valve, and, through the 'EF' port to body control valve (2).

A brief description of the individual components shown in the body hoist system schematic are listed below. Detailed service and operating instructions can be found in the relevant component sections of this manual.

Hydraulic Tank (1)

Refer to Section 230-0040, HYDRAULIC TANK.

The hydraulic tank is the common reservoir for the steering, braking and body hoist systems. It is mounted off the frame and fender bracket at the rear right hand side of the tractor.

Integral with the hydraulic tank assembly are the hydraulic oil filter, oil strainer and oil level sight gauge. Located on top of the tank assembly is the filler cap and breather.

Body Control Valve (2)

Refer to Section 230-0060, BODY CONTROL VALVE.

The single spool body control valve is mounted to the cradle assembly at the rear of the cab. The control valve consists of a relief valve assembly and a four position control spool.

The four positions of the control spool are 'Raise', 'Hold', 'Lower' (Power Down) and 'Float'. The 'Float' position is detented and the control spool should be kept in this position at all times, except when Raising or Lowering the body.

A relief valve assembly at the pressure inlet, opens and allows oil to flow through hydraulic oil cooler (4) and back to hydraulic tank (1) when pressure in the hydraulic system exceeds 172 bar (2 500 lbf/in²).

Movement of the control spool is controlled by electrical signals from the body control joystick in the operators compartment. Refer to Section 230-0081, BODY CONTROL JOYSTICK.

Body Cylinders (3)

Refer to Section 230-0130, BODY CYLINDER.

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 eye end is connected at the body. Single stage double acting means that the piston rod can have oil applied to either end, extending or retracting the piston rod.

The cushioning effect when the cylinder is being extended is obtained by a tapered spear on the piston rod passing through a cushioned sleeve. This gradually slows the piston which in turn helps to control destructive shock effects when the piston reaches the full extent of its travel.

The cushioning effect when the cylinder is being retracted is obtained by a tapered spear at the base end of the cylinder body entering a cavity in the piston rod through a cushioning ring. This gradually slows the piston which in turn helps to control destructive shock effects when the piston bottoms.

Cylinder mounting is by pins, spacers and spherical bearings secured in place by circlips. Spherical bearings permit a limited amount of cylinder misalignment.

Pilot Supply Valve (5)

Refer to Section 230-0121, PILOT SUPPLY VALVE.

Mounted to the cradle assembly at the rear of the cab, 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).

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 - Located in the manifold at the rear left hand side of the tractor frame. The pressure is taken off the outlet tube from port 'EF' in the flow amplifier valve.
System Relief Pressure - 172 bar (2 500 lbf/in^2)

Test Point B - Located in tee piece at port 'U' of pilot supply valve (5).
Pilot Valve Pressure - 30 bar (435 lbf/in^2)

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.

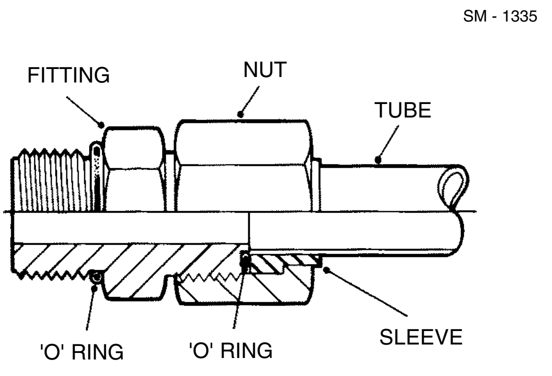


Fig. 2 - Assembly of Typical ORFS Connector

a. Ensure 'O' ring/seal is in place and that 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 of spanner (wrench).

f. Check that a satisfactory hose or tube routing has been achieved.

MAINTENANCE

Maintenance instructions, intervals and warnings contained in the individual component sections of this manual should be strictly adhered to.

Hydraulic Oil

The hydraulic tank should be kept filled with hydraulic fluid as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK for correct fill level and procedure.

SERVICE TOOLS

It is recommended that the following tools are used when carrying out pressure or 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 762 mm (30 in) of vacuum to 345 bar (5 000 lbf/in^2).

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 16 sec, loaded. Hydraulic oil pressure too low, should be 172 bar (2 500 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.
		Check anti-cavitation plug on suction line for tightness
	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 12 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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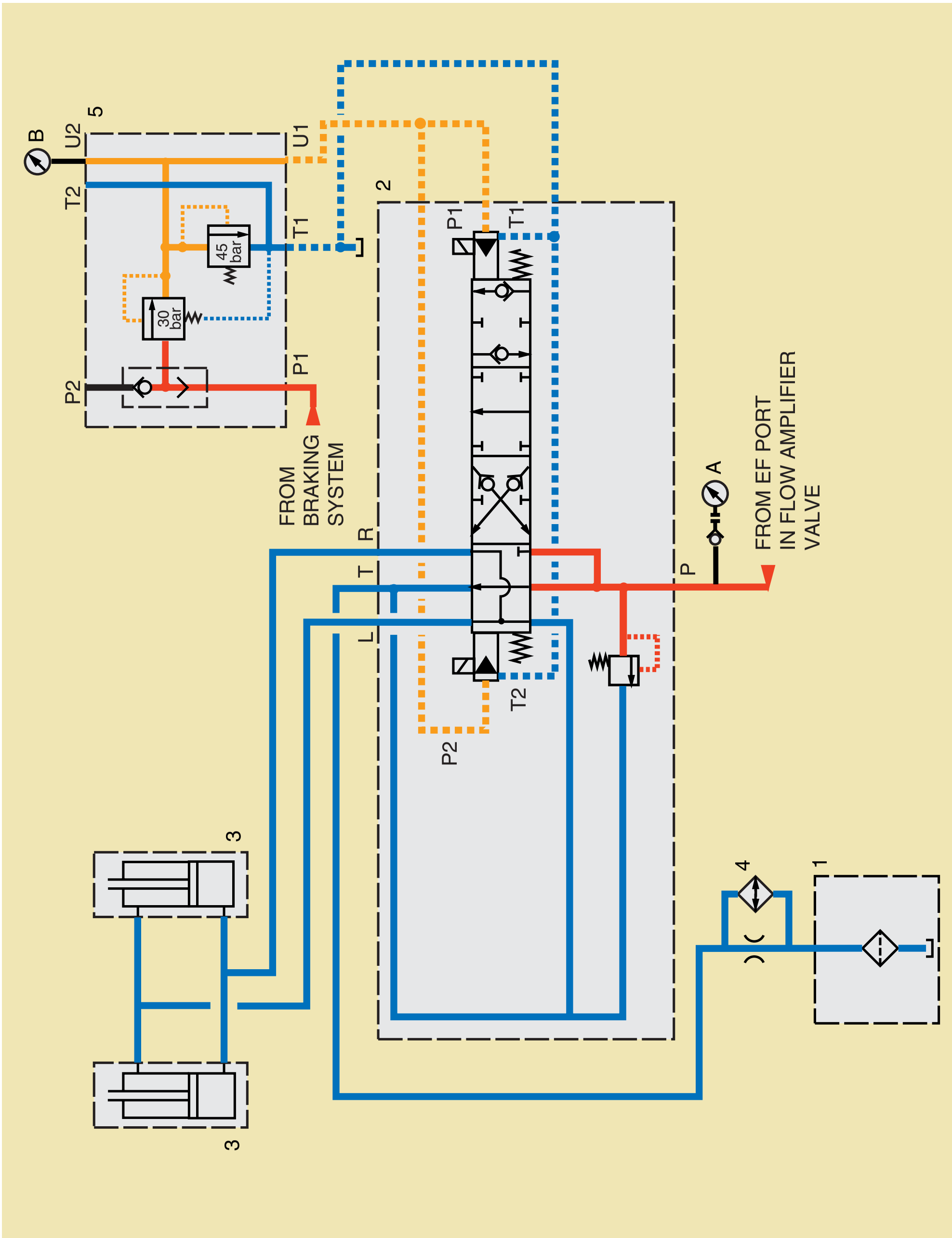


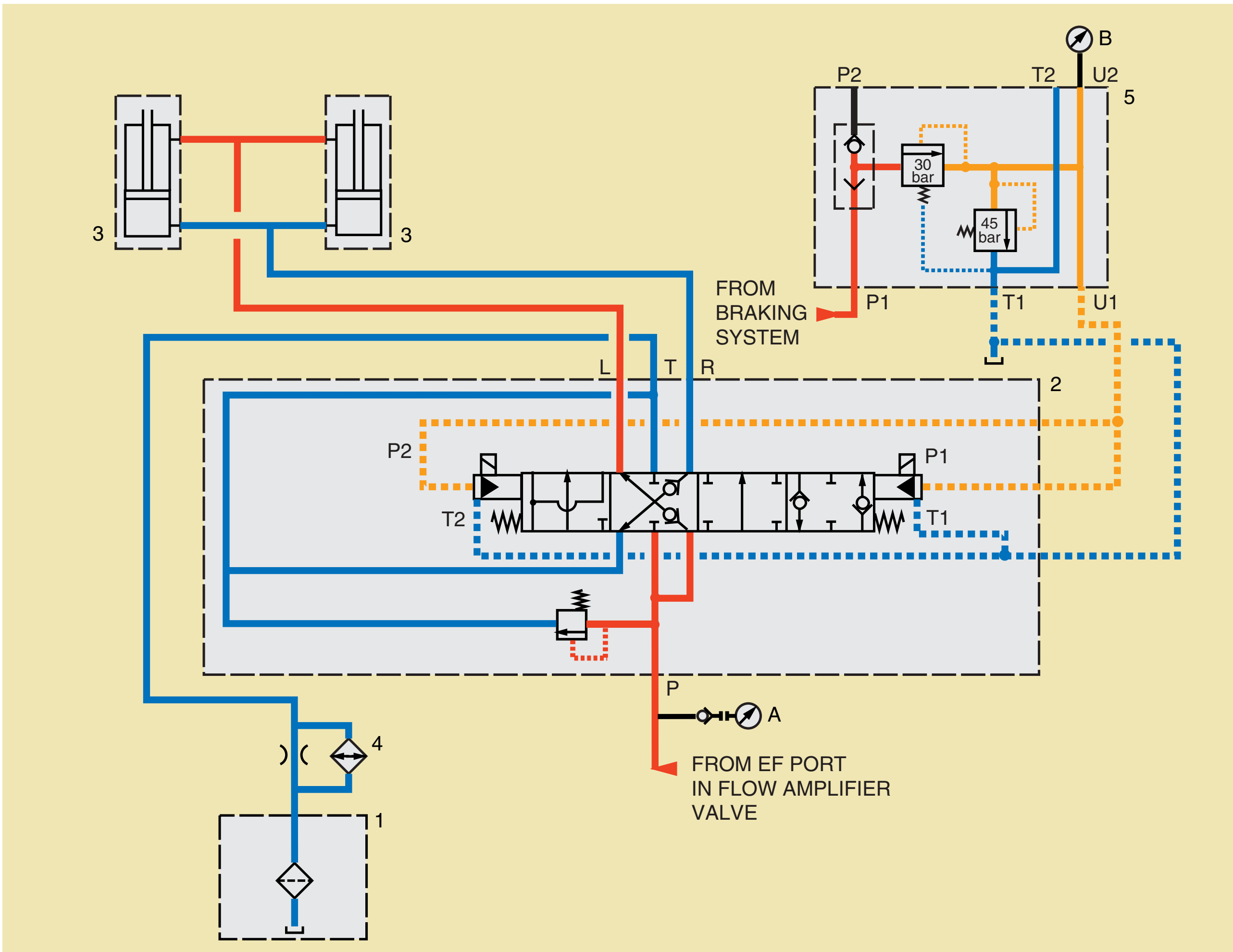
COMPONENTS

1 - Hydraulic Tank
2 - Body Control Valve
3 - Body Cylinders
4 - Hydraulic Oil Cooler
5 - Pilot Supply 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



COMPONENTS

1 - Hydraulic Tank
2 - Body Control Valve
3 - Body Cylinders
4 - Hydraulic Oil Cooler
5 - Pilot Supply 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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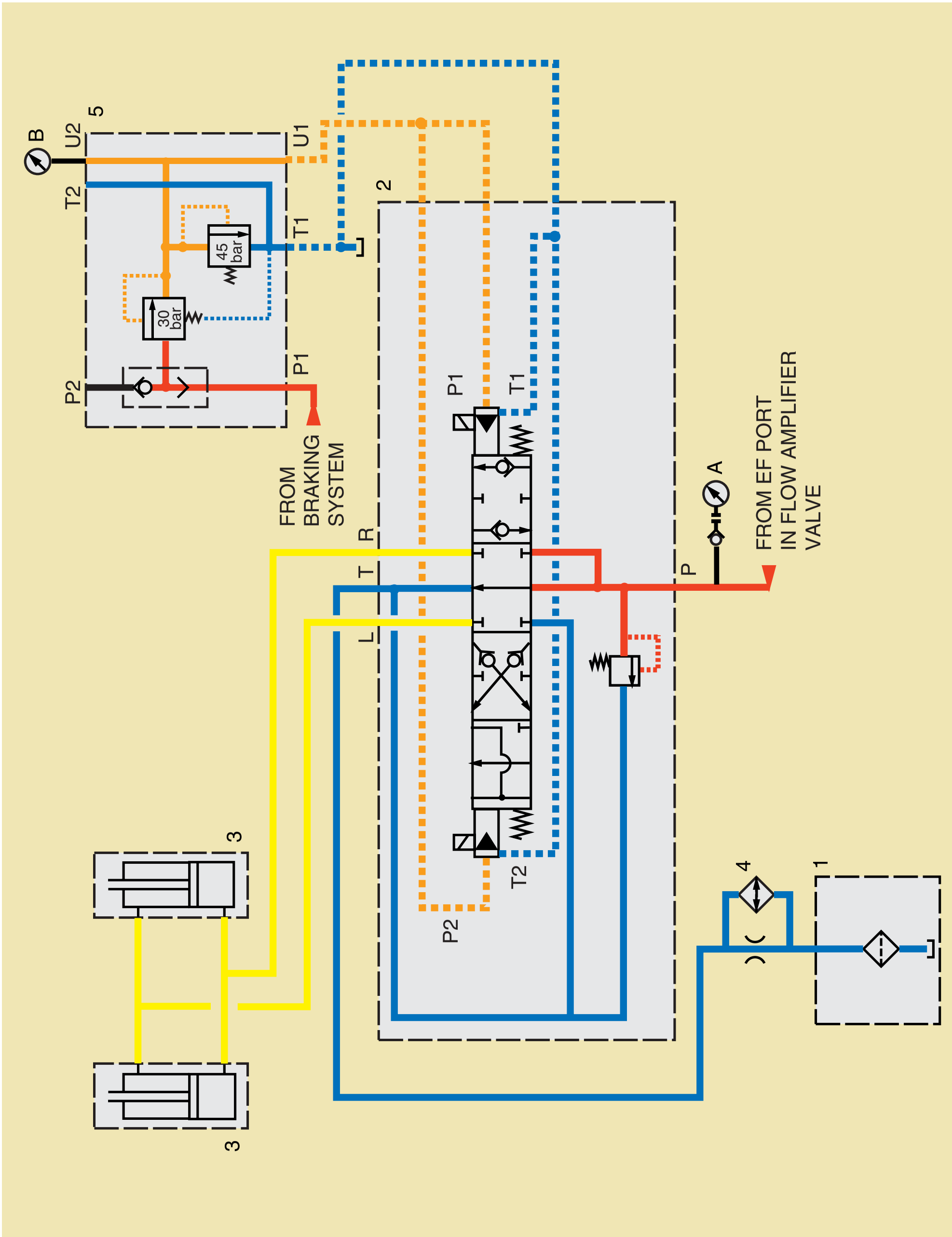

COMPONENTS

1 - Hydraulic Tank
2 - Body Control Valve
3 - Body Cylinders
4 - Hydraulic Oil Cooler
5 - Pilot Supply 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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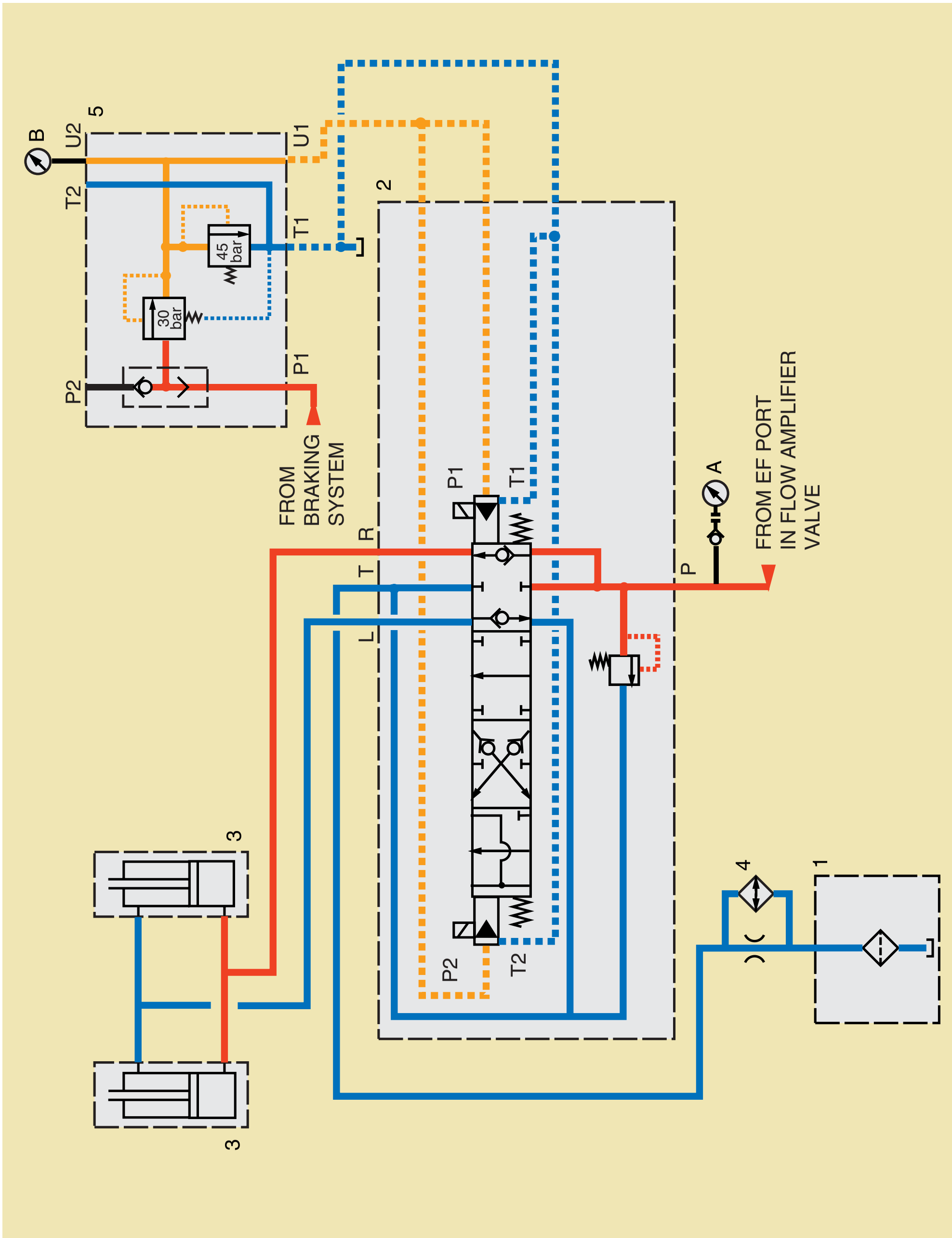


COMPONENTS

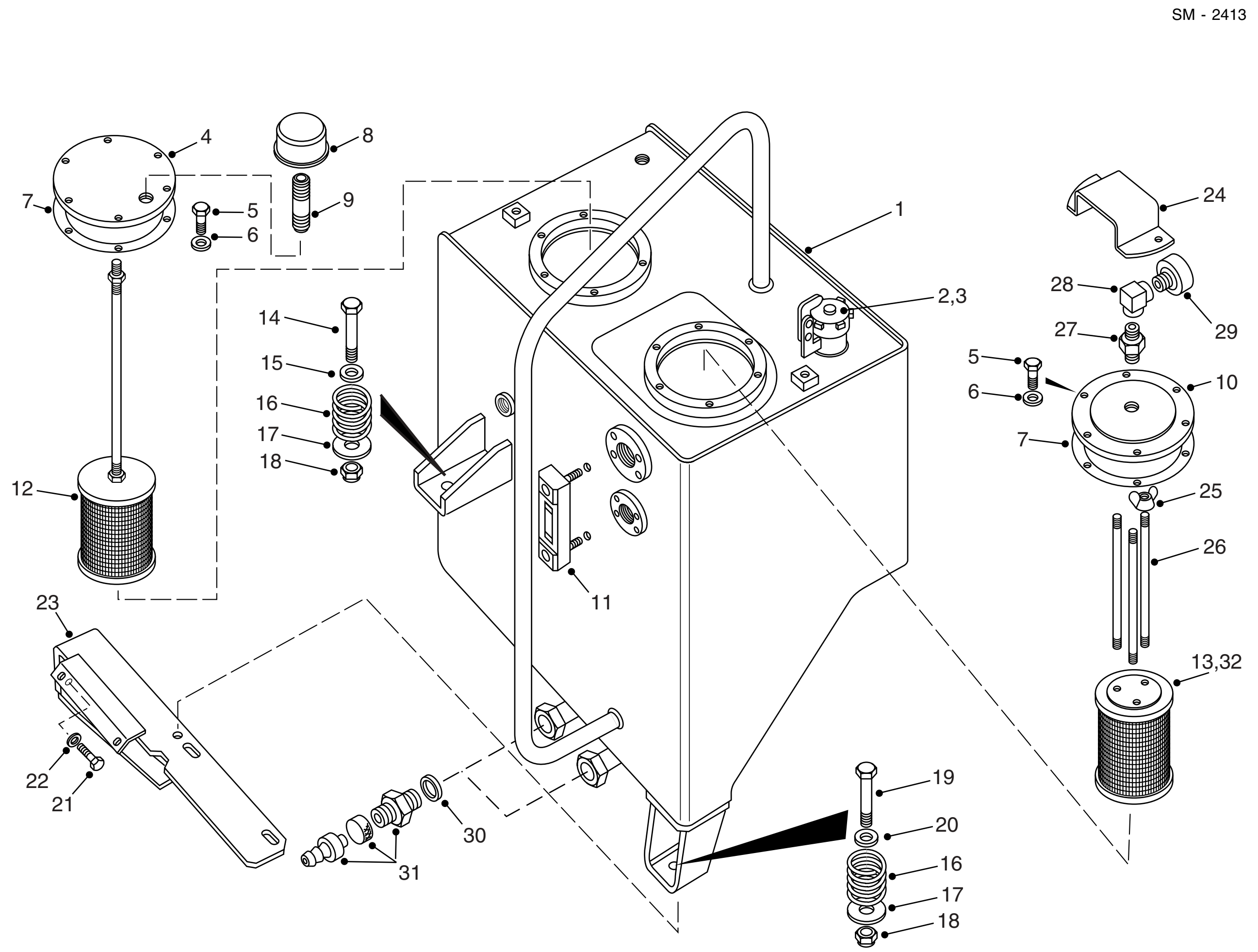
1 - Hydraulic Tank
2 - Body Control Valve
3 - Body Cylinders
4 - Hydraulic Oil Cooler
5 - Pilot Supply Valve

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

* * * *



1 - Hydraulic Tank	10 - Access Cover	19 - Bolt	28 - Elbow - 90°
2 - Filler Cap	11 - Sight Gauge	20 - Washer	29 - Visual Indicator
3 - Gasket	12 - Strainer	21 - Bolt	30 - Washer
4 - Access Cover	13 - Filter Assembly	22 - Lockwasher	31 - Valve Assembly
5 - Bolt	14 - Bolt	23 - Fender Bracket	32 - Element
6 - Lockwasher	15 - Washer	24 - Cover Plate	*33 - Padlock
7 - Gasket	16 - Spring	25 - Wing Nut	*34 - Key
8 - Breather	17 - Washer	26 - Rod	
9 - Nipple	18 - Locknut	27 - Adaptor	* - Not Shown

Fig. 1 - Exploded View of Hydraulic Tank and Mounting

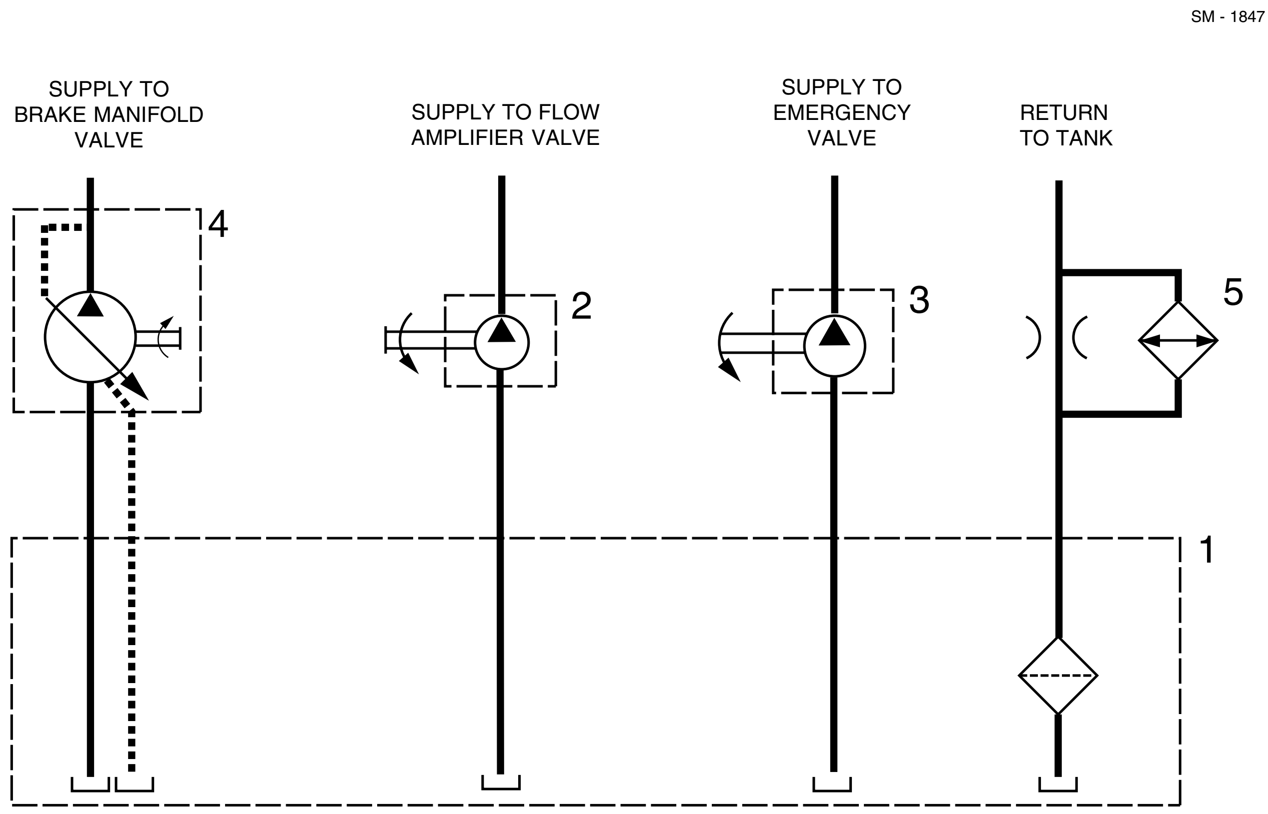
DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The hydraulic tank can be identified as item 1 in Section 230-0000, BODY SYSTEM SCHEMATIC.

The hydraulic tank (1) is the common reservoir for the steering, braking and body hoist systems. It is mounted off the frame and fender bracket (23) on springs (16), at three points, at the rear right hand side of the tractor.

Integral with hydraulic tank (1) assembly are filter assembly (13), oil level sight gauge (11), strainer (12) and access covers (4 & 10). Located on top of the tank is filler cap (2), breather (8) and filter visual indicator (29).



1 - Hydraulic Tank
2 - Main Hydraulic Pump
3 - Emergency Pump
4 - Brake Pump
5 - Hydraulic Oil Cooler

Fig. 2 - Hydraulic Schematic of Hydraulic Tank

OPERATION

Numbers in parentheses refer to Fig. 1, unless otherwise specified. Refer to Fig. 2 for hydraulic schematic of hydraulic tank.

Oil from hydraulic tank (1) is filtered through strainer (12) before it is pumped through the respective hydraulic systems.

The brake control oil is drawn from hydraulic tank (1) by brake pump (4, Fig. 2) and pumped to the brake manifold valve to supply the braking system. Refer to Section 250-0050, BRAKE MANIFOLD VALVE.

The steering and body hoist oil is drawn from hydraulic tank (1) by main hydraulic pump (2, Fig. 2) and pumped to the flow amplifier valve to supply the steering and body hoist systems. Refer to Section 220-0100, FLOW AMPLIFIER VALVE.

Emergency steering oil is drawn from hydraulic tank (1) by emergency pump (3, Fig. 2) and is pumped to the emergency valve. Should a failure occur at the main hydraulic pump the emergency pump will supply the steering system with oil to enable the vehicle to be brought to a safe halt.

Return oil from the hydraulic systems flows through hydraulic oil cooler (5, Fig. 2) and filter assembly (13 & 32) before entering the tank storage area. The filter assembly has a bypass valve which allows oil to bypass element (32) when it is cold or when the filter element is plugged. The bypass valve starts to open at a pressure differential of 1.5 bar (22 lbf/in^2) and is fully open at 3.5 bar (50 lbf/in^2). Visual indicator (29) shows red when element (32) requires to be changed.

MAINTENANCE

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 wheel blocks, blocking materials and lifting equipment are properly secured and of adequate 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, ensure the body is fully lowered, apply the parking brake and switch off the engine. Turn steering wheel in both directions several times to relieve any pressure in the steering circuit. Operate treadle valve continuously to discharge braking accumulators.

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

4. Check oil level and add if low. Sight gauge (11) should show half full. If oil is required, remove padlock (33) and filler cap (2) from hydraulic tank (1) and fill hydraulic tank with hydraulic oil specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (2) on hydraulic tank (1) and secure with padlock (33).

Replacing Hydraulic Oil

Hydraulic oil should be changed every 2 000 hours. Refer to Section 300-0020, LUBRICATION SYSTEM, for hydraulic oil used in the system.

Note: When replacing the hydraulic oil due to a hydraulic failure, or at recommended change interval, element (32) must be replaced and hydraulic tank (1), and strainer (12) cleaned thoroughly using a suitable solvent.

Replacing Filter Element

After first 100 hours of operation or when visual indicator (29) shows red, whichever comes first, clean filter assembly (13) and install new element (32).

Every 1 000 hours of operation or when visual indicator (29) shows red, whichever comes first, clean filter assembly (13) and install new element (32).

1. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine. Turn steering wheel in both directions several times to relieve any pressure in the steering circuit. Operate treadle valve continuously to discharge braking accumulators.

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

3. Remove bolts (5) and washers (6) securing cover plate (24) and access cover (10) to top of hydraulic tank (1). Remove access cover (10) and gasket (7) from hydraulic tank (1). Discard gasket (7).

4. Unscrew wing nuts (25) and remove filter assembly (13) from hydraulic tank (1).

5. Remove and discard element (32) from filter assembly (13).

6. Install new element (32) in filter assembly (13).

7. Install filter assembly (13) over rods (26) and secure in place with wing nuts (25).

8. Secure cover plate (24), access cover (10) and new gasket (7) on hydraulic tank (1) with bolts (5) and lockwashers (6).

9. Remove padlock (33) and filler cap (2) from hydraulic tank (1) and fill hydraulic tank with hydraulic oil specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (2) on hydraulic tank (1) and secure with padlock (33).

Cleaning/Replacing Strainer

Note: Strainer (12) should be cleaned every time hydraulic tank (1) is drained for any reason. Refer to 'Replacing Hydraulic Oil' for change interval.

1. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine. Turn steering wheel in both directions several times to relieve any pressure in the steering circuit. Operate treadle valve continuously to discharge braking accumulators.

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

3. Remove blanking cap from remote drain assembly (31) on the bottom of hydraulic tank (1). Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap on remote drain assembly (31).

4. Remove bolts (5), lockwashers (6), access cover (4) and gasket (7) from top of hydraulic tank (1). Discard gasket (7).

5. Unscrew and remove strainer (12) from the inside of hydraulic tank (1).

⚠ **WARNING**
Splashing liquid. Wear a suitable face shield when using compressed air to dry hydraulic tank and components.

6. Clean out the inside of hydraulic tank (1) and strainer (12) with a suitable solvent and dry with compressed air.

7. Inspect strainer (12) for damage and replace if required.

8. Install strainer (12) in hydraulic tank (1) and secure.

9. Place new gasket (7) and access cover (4) on hydraulic tank (1) and secure with bolts (5) and lockwashers (6).

10. Remove padlock (33) and filler cap (2) from hydraulic tank (1) and fill hydraulic tank with hydraulic oil specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (2) on hydraulic tank (1) and secure with padlock (33).

11. Place the battery master switch in the 'On' position and the steering lock bar in the 'Stowed' position, remove all wheel blocks, start the engine and operate the steering, braking and body hoist systems to circulate the oil.

12. Switch off the engine, check for leaks and check oil level as described under 'Checking Oil Level'.

TANK ASSEMBLY

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, ensure the body is fully lowered, apply the parking brake and switch off the engine. Turn steering wheel in both directions several times to relieve any pressure in the steering circuit. Operate treadle valve continuously to discharge braking accumulators.

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

3. Remove blanking cap from remote drain assembly (31) on the bottom of hydraulic tank (1). Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap on remote drain assembly (31).

4. Ensure all hydraulic lines connected to hydraulic tank (1) are identified for ease of installation and, with suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps and plugs to all open lines and fittings.

5. Install a suitable lifting device on lifting eyes of hydraulic tank (1) and remove locknuts (18), washers (15, 17 & 20), springs (16) and bolts (14 & 19) securing hydraulic tank (1) to fender bracket (23) and frame.

6. Carefully remove hydraulic tank (1) assembly from the unit to a clean work area for disassembly.

Disassembly

Numbers in parentheses refer to Fig. 1.

1. Remove internal components from hydraulic tank (1) as described under 'Maintenance'.

2. Remove padlock (33) and filler cap (2) from hydraulic tank (1).

3. Remove breather (8), nipple (9) and sight gauge (11) from hydraulic tank (1).

Inspection

Numbers in parentheses refer to Fig. 1.

> ⚠ **WARNING**
> **Splashing liquid. Wear a suitable face shield when using compressed air to dry hydraulic tank and components.**

1. Clean hydraulic tank (1) and components with a suitable solvent and dry with compressed air.

2. Inspect hydraulic tank (1) for weld cracks and security of internal pipes and weld fitments.

3. Inspect breather (8), strainer (12) and filter assembly (13) for damage. Replace if required.

Assembly

Numbers in parentheses refer to Fig. 1.

1. Renew all seals and gaskets and install all internal components in hydraulic tank (1), as previously described under 'Maintenance'.

2. Install breather (8), nipple (9) and sight gauge (11) on hydraulic tank (1).

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.

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 hydraulic tank (1) in position on the vehicle and secure with bolts (14 & 19), washers (15, 17 & 20), springs (16) and locknuts (18). Tighten locknuts (18) until springs (16) are compressed to a length of 30 mm (1.18 in).

2. Install new 'O' rings and install all hydraulic lines and fittings to hydraulic tank (1), as tagged at removal.

3. Fill hydraulic tank (1) with hydraulic oil specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (2) on hydraulic tank (1) and secure with padlock (33).

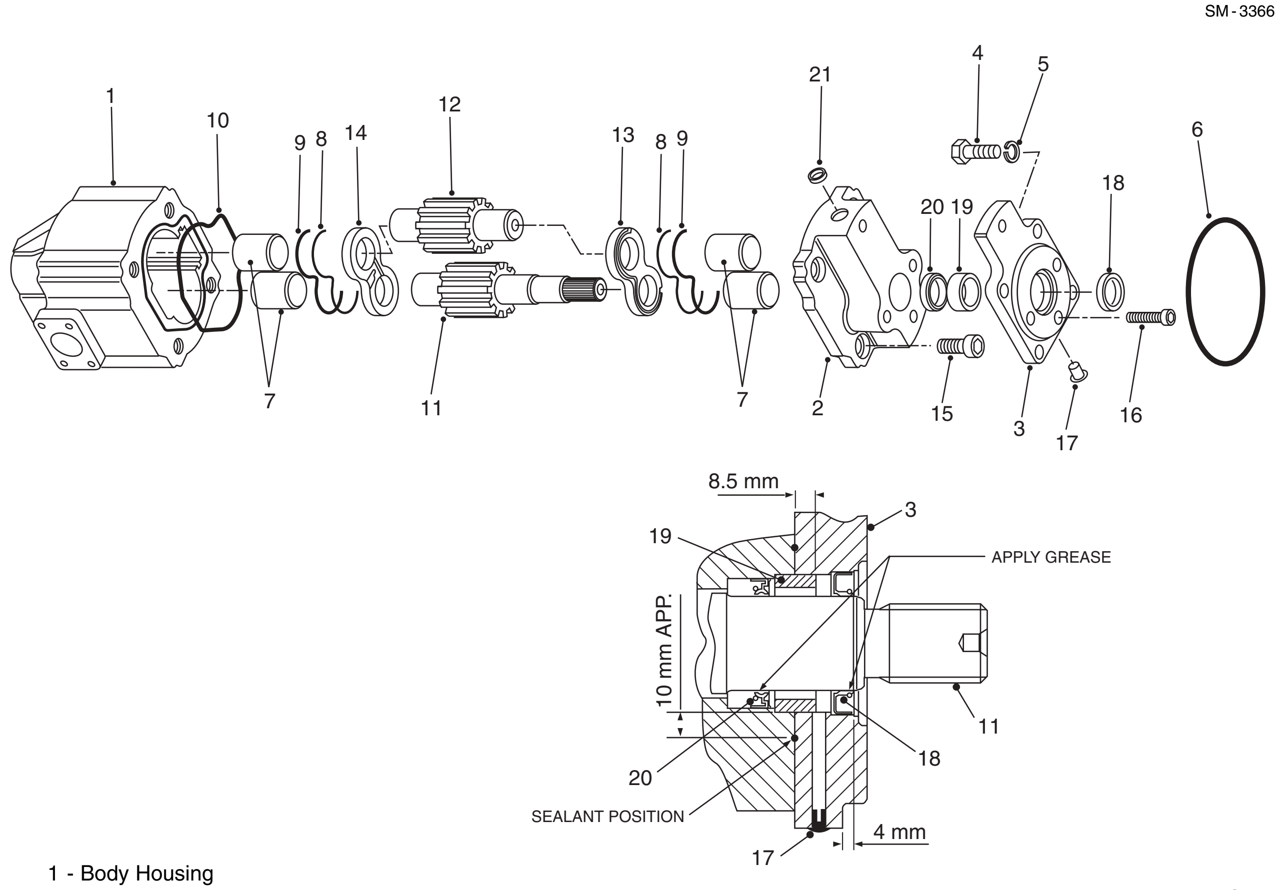
4. Place the battery master switch in the 'On' position and the steering lock bar in the 'Stowed' position, remove all wheel blocks, start the engine and operate the steering, braking and body hoist systems to circulate the oil.

5. Switch off the engine, check for leaks and check oil level as described under 'Checking Oil Level'.

SPECIAL 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.

* * * *



1 - Body Housing
2 - Front Cover
3 - Mounting Flange
4 - Bolt
5 - Washer
6 - 'O'-Ring
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

Fig. 1 - Exploded View of Hydraulic Pump

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

Mounted off the transmission power takeoff (PTO), the hydraulic pump supplies oil to the body control valve to operate the body hoist system. The hydraulic pump is a rotary gear pump mounted to the transmission housing and driven by the transmission gear train.

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 oil tank
Port 'B' - Pressure supply to body control valve

OPERATION

Numbers in parentheses refer to Fig. 1. Refer to Fig. 2 for typical pump operation.

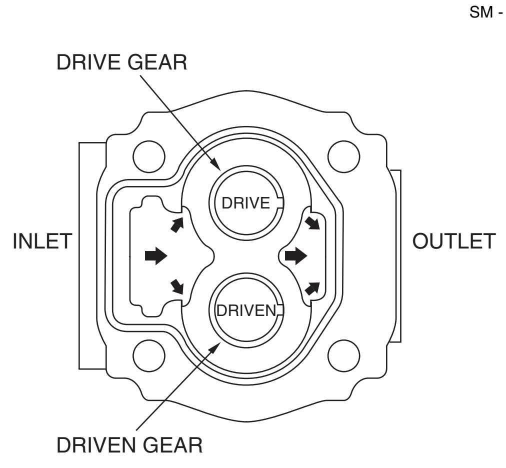


Fig. 2 - Typical Gear Pump Operation

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 body control valve. Refer to Section 230-0060, BODY CONTROL 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.

> ⚠ **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. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Operate steering right and left several times to relieve pressure in the steering system.

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

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. Clean pump housing and disconnect inlet line and outlet line from pump assembly. Drain oil in hydraulic lines into a suitable container. Cap hydraulic lines and plug pump ports to prevent ingress of dirt.

5. Support pump assembly with suitable lifting equipment. Remove bolts (4) and lockwashers (5) securing pump assembly to the transmission. Remove pump assembly from the transmission and discard 'O'-Ring (6).

6. 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).

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).

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.

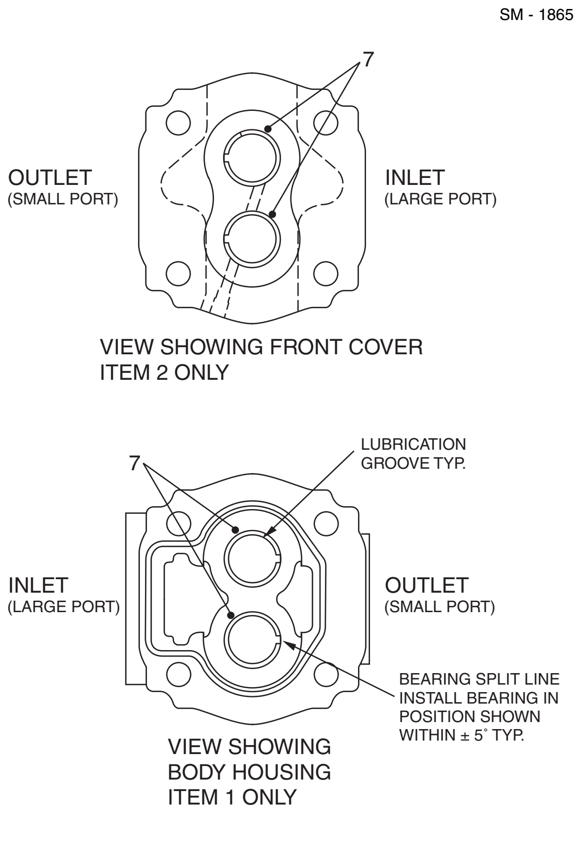


Fig. 3 - Bearing Lubrication Groove Position

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.

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.

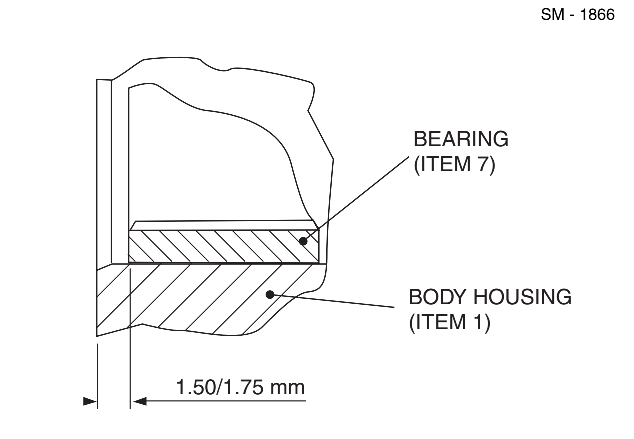


Fig. 4 - Bearing Insertion Depth

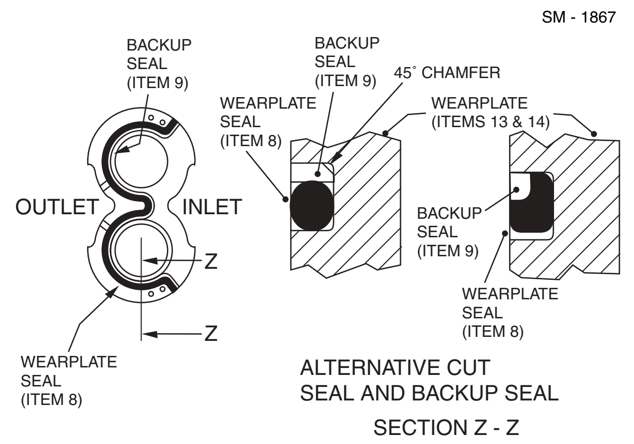


Fig. 5 - Wearplate Seal Fitting

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).

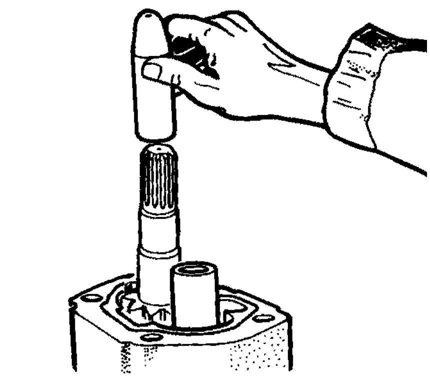


Fig. 6 - Installing Driveshaft and Gear in Body Housing

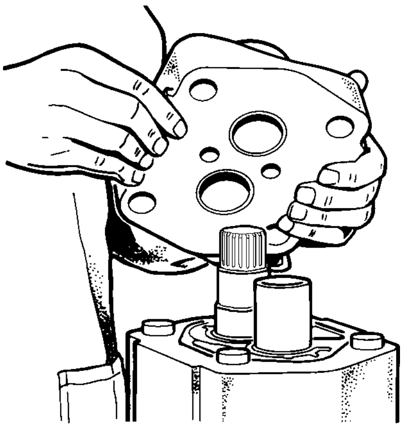


Fig. 7 - Installing Front Cover

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 lifting equipment is properly secured and of adequate capacity to do the job safely.**

1. Coat pump driveshaft with molybdenum disulphide grease and install gasket (20) on mounting face of the pump assembly.

2. Support pump assembly with suitable lifting equipment and position on the transmission housing. Secure pump assembly to transmission housing with bolts (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 oil tank with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap on hydraulic tank filler neck.

START-UP PROCEDURE

Before starting the engine and running the pump, back-off the system relief valve on the body control valve, until the adjusting screw spring tension is relieved. Refer to Section 230-0060, BODY CONTROL 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.

Note: Always install steering lock bar when working in the articulation area.

Place the battery master switch in the 'On' position and the steering lock bar in the 'Locked' position. Start the engine and run the pump at idle for two or three minutes and with no pressure. 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 230-0060, BODY CONTROL VALVE.

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 hydraulic oil should be drained and replaced. Refer to Section 230-0040, HYDRAULIC TANK, for hydraulic oil change procedures.

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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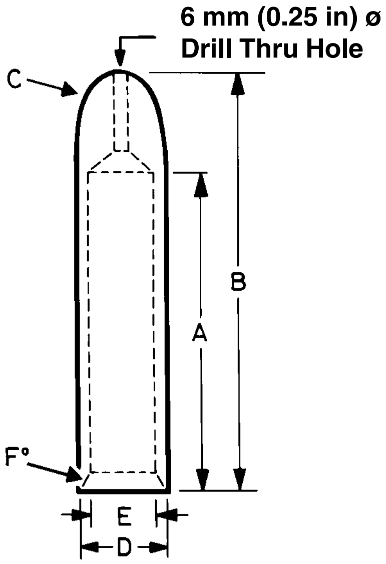


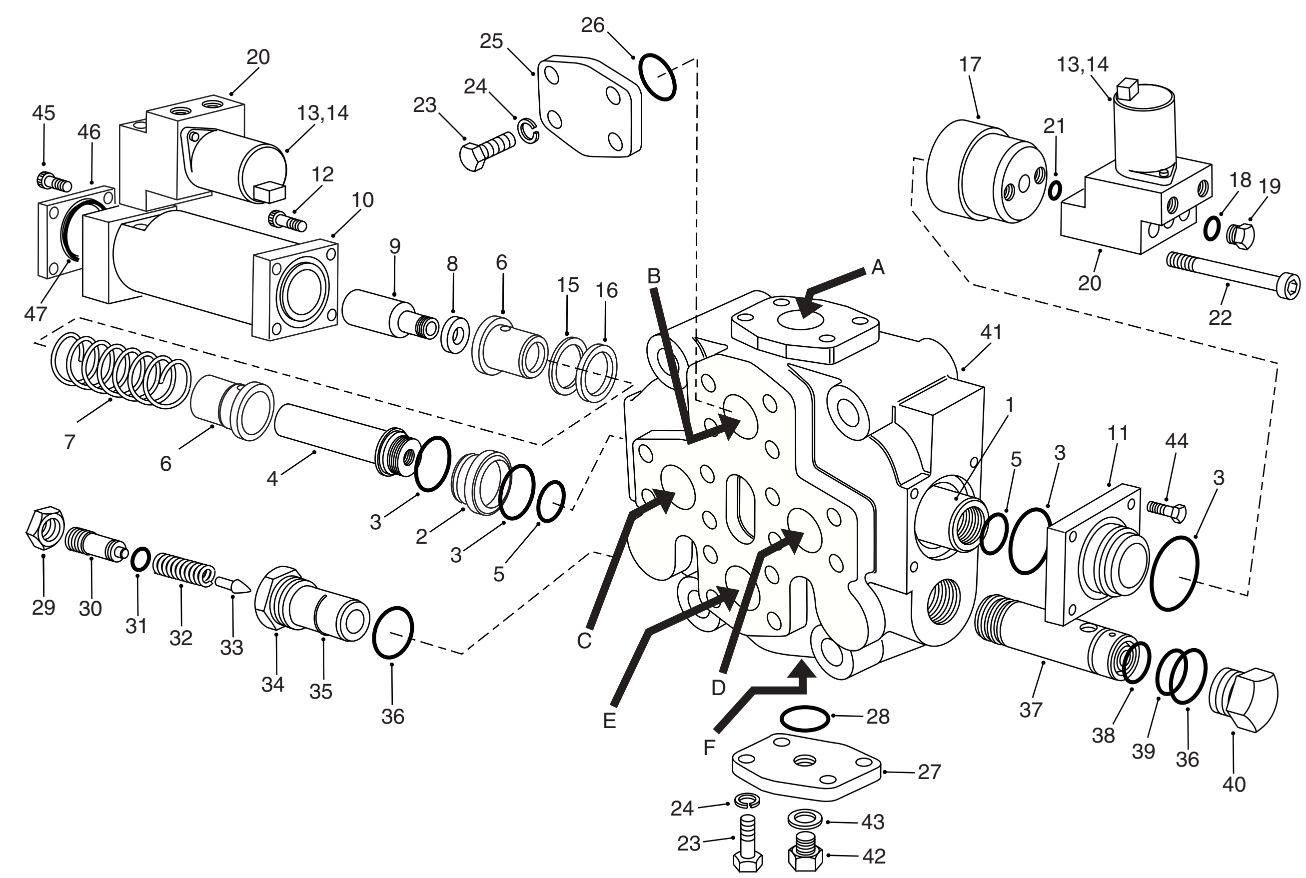
SPECIAL SLEEVE TOOL DIMENSIONS		TABLE190
DIMENSION	mm	in
A	85.7	3.375
B	114.3	4.50
C Radius	14.3	0.56
D Diameter	34.9758 + 0.000 - 0.0508	1.377 + 0.000 - 0.002
E Diameter	31.75 + 0.050 - 0.000	1.250 + 0.002 - 0.000
F° Chamfer	1.6 x 60°	0.063 x 60°

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

* * * *



1 - Control Spool
2 - Retainer
3 - 'O' Ring
4 - Spool Cap
5 - 'O' Ring
6 - Spring Retainer
7 - Spring
8 - Washer
9 - Shoulder Screw
10 - End Cap
11 - Seal Retainer
12 - Capscrew
13 - Pressure Reducing Valve
14 - Capscrew
15 - Shim (if fitted)
16 - Shim (if fitted)
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 - Cover Plate
28 - 'O' Ring
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
40 - Cap
41 - Valve Housing
42 - Plug
43 - Seal
44 - Bolt
45 - Capscrew
46 - End Plate
47 - 'O' Ring

Fig. 1 - Exploded View of Body Control Valve

DESCRIPTION

Numbers and letters in parentheses refer to Fig. 1.

The single spool body control valve, which is fitted with electro hydraulic operation, is mounted off the cradle assembly at the rear of the cab. The main components of the control valve assembly are a four position control spool (1), relief valve (37), check valve assembly and valve housing (41).

The position of the control spool is controlled by the body control joystick by means of electrical signals to the pressure reducing valves (13). Refer to Section 230-0060, 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 (41) has six ports as follows:

Port 'A' - Tank Return Port.
Port 'B' - Capped with blanking plate (25).
Ports 'C' & 'D' - Body Cylinder Ports.
Port 'E' - Pump Inlet Port. Also connected to hydraulic system diagnostic test point at rear of tractor frame.
Port 'F' - Cover (27) tapped to provide a diagostic test port.

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 172 bar (2 500 lbf/in²).

Pilot pressures can be checked at ports 'P1' and 'P2' which are located in mounting blocks (20). Refer to Section 230-0000, BODY SYSTEM SCHEMATIC for table of Body Control Valve pressure checks.

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 'E', flows around relief valve (37) assembly and control spool (1), and out of port 'A' 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 (41).

Oil from the pump enters port 'E', 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 'A' 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 (41) at port 'E', 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 (41) at port 'D'. The returning oil unseats check valve plunger and flows into the tank return passage. Oil exits from port 'A' 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 (41) 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 (41) at port 'E', flows around relief valve (37) assembly, past control spool (1), and, if the oil is not required by the cylinders, exits from port 'A' to the hydraulic oil tank.

Relief Valve

Numbers in parentheses refer to Fig. 1.

Relief valve (37) assembly, in valve housing (41), is set to relieve oil pressure in excess of 172 bar

(2 500 lbf/in²).

Should oil at the inlet side of the valve exceed 172 bar (2 500 lbf/in²), pilot poppet (33) will be forced off its seat. Oil will flow through an internal passage and exit from port 'A' 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.

> ⚠ **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. Operate steering right and left several times to relieve pressure in the steering system. Operate the treadle valve continuously to relieve pressure in the braking system.

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

3. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

4. Clean body control valve housing (41) 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'.

5. 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.

6. Support body control valve with a suitable lifting device and remove mounting hardware securing body control valve to the cradle assembly. Remove body control valve 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 bolts (23), lockwashers (24), blanking plate (25) and 'O' ring (26) from port 'B' in valve housing (41). Discard 'O' ring (26).

2. If required, remove bolts (23), lockwashers (24), cover plate (27) and 'O' ring (28) from port 'F' in valve housing (41). Discard 'O' ring (28). If required, remove plug (42) and seal (43) from cover plate (27).

Control Spool

1. Clean the entire body control valve assembly with a suitable solvent and dry thoroughly. Remove caps from valve housing (41) ports.

2. If required, clamp body control valve assembly in a soft jawed vice. Take care to avoid damaging valve housing (41) 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 (41), end cap (17).

7. Remove capscrews (12) securing end cap (10) assembly to valve housing (41). Remove end cap (10). If required, remove bolts (45) and end plate (46) from end cap (10). Remove and discard 'O' ring (47).

8. Carefully withdraw spool and spring pack assembly from valve housing (41). Remove and discard 'O' rings (3 & 5).

Note: 'O' rings (3 & 5) can be replaced without disassembly of the spring mechanism.

9. If necessary, the centring mechanism can be removed from the spool assembly. Remove shoulder screw (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 (41) ports.

2. If desired, clamp body control valve assembly in a soft jawed vice. Take care to avoid damaging valve housing (41) machined surfaces.

3. Release locking nut (29) and slacken adjusting screw (30) until loose.

4. Remove cap (34) from valve housing (41) and discard 'O' ring (36).

5. Withdraw spring (32) and poppet (33) from valve housing (41) bore.

6. Remove plug (40) from the opposite end of valve housing (41) and discard 'O' ring (36).

7. Push out relief valve (37) assembly from bore in valve housing (41). 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 (41) bores and control spool (1) for grooves, deep scratches or excessive wear.

Note: If condition of valve housing (41) 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 'B' of valve housing (41). Install blanking plate (25) and secure using bolts (23) and lockwashers (24).

3. If removed, install new 'O' ring (28) on port 'F' of valve housing (41). Install cover plate (27) and secure using bolts (23) and lockwashers (24). If removed, install plug (42) and new seal (43) to cover plate (27).

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 shoulder screw (9).

Note: Apply 3 drops of Loctite 243 to the spool cap (4) threads prior to reassembly.

2. Replace 'O' rings (3 & 5) on spool and spring pack assembly.

3. Refit spool and spring pack assembly to valve housing (41).

4. Install end cap (10) to valve housing (41) and secure using capscrews (12). Tighten capscrews (12) to a torque of 30 Nm (22 lbf ft).

5. If removed, fit new 'O' ring (47) and install end plate (46) on end cap (10) using capscrews (45). Tighten capscrews (45) to a torque of 30 Nm (22 lbf ft).

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).

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 (41).

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 (40) and install plug (40) in valve housing (41). Tighten plug (40) to a torque of 150 Nm (110 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 (41) bore. Tighten cap (34) to a torque of 150 Nm (110 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 in place on the machine. Secure body control valve to the cradle assembly 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:

Note: If adjustment only is to be carried out, the procedure for blocking the machine as described in 'Removal, must be strictly adhered to.

> ⚠ **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 - 207 bar (0 - 3 000 lbf/in²), to remote diagnostic pressure point.

2. Start engine and raise body completely.

3. Check reading on pressure gauge. Slacken locking nut (29) and turn adjusting screw (30) until a pressure reading of 172 bar (2 500 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.

4. Secure locking nut (29) in place and operate body. Re-check relief valve pressure and adjust if required.

5. Check body control valve assembly and hydraulic lines for leaks. Tighten as required.

6. Remove all blocking from road wheels and place 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.

* * * *

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.

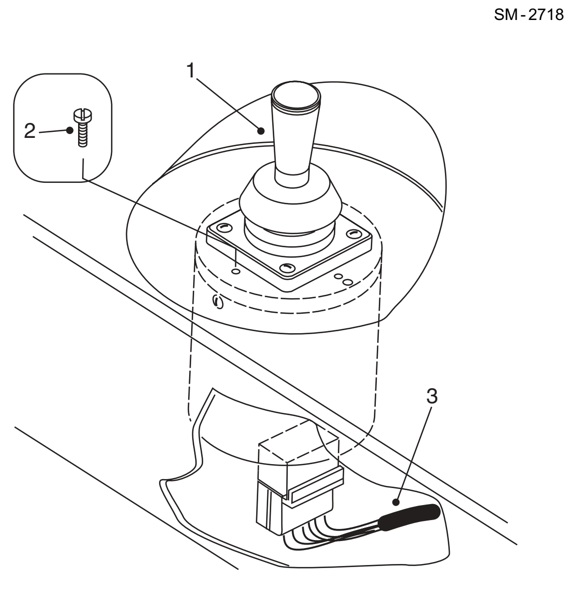
'HOLD' - Moving the joystick to this position while the body is being raised or lowered traps the oil in the body hoists to stop and hold the body at any desired height. The joystick will remain in the 'HOLD' position when released.

'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.



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 are properly secured and of adequate capacity to do the job safely.**

1. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine. Operate the steering right and left several times to relieve pressure in the steering system.

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

the 'Off' position.

3. Disconnect harness (3) from connector port on the bottom of body control joystick (1).

4. 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.

5. Remove body control joystick (1) from mounting location.

6. 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.

7. Reconnect harness (3) to connector port on the bottom of the body control joystick (1).

8. 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.

9. 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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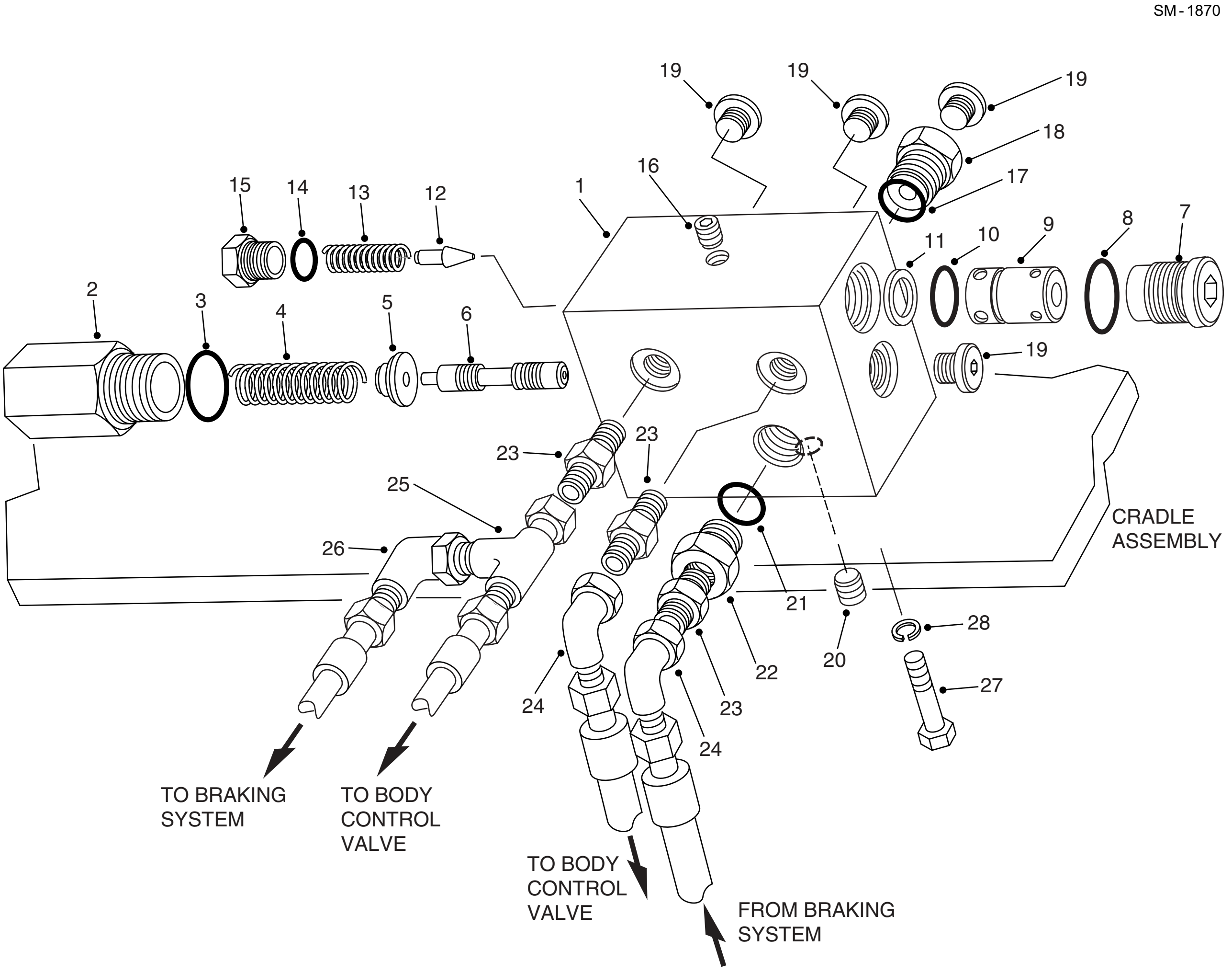

1 - Valve Body	7 - Plug	13 - Spring		
2 - Spring Cover	8 - 'O' Ring	14 - 'O' Ring	19 - Plug	24 - Elbow
3 - 'O' Ring	9 - Seat	15 - Plug	20 - Plug	25 - Tee Piece
4 - Control Spring	10 - 'O' Ring	16 - Plug	21 - 'O' Ring	26 - Elbow
5 - Spring Guide	11 - Spacer	17 - 'O' Ring	22 - Reducer	27 - Bolt
6 - Control Spool	12 - Pilot	18 - Adaptor	23 - Adaptor	28 - Lockwasher

Fig. 1 - Exploded View of Pilot Valve

DESCRIPTION

The pilot supply valve can be identified as item 5 in the layout drawing in Section 230-0000, BODY SYSTEM SCHEMATIC.

Mounted off the cradle assembly at the rear of the cab, the pilot supply valve is located in the hydraulic servo control lines. See Fig. 2 for schematic symbol.

The pilot supply valve is a direct acting pressure reducing valve which steps down the supply pressure of 185 bar (2 682 lbf/in²) to 30 bar (435 lbf/in²). Intregal of the pilot supply valve is a relief valve which opens at 45 bar (652 lbf/in²).

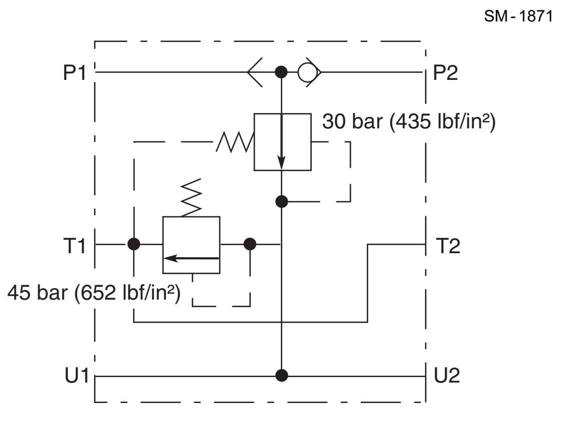

Fig. 2 - Pilot Supply Valve Schematic Symbol

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. Operate steering right and left several times to relieve pressure in the steering system. Operate treadle valve continuously to relieve pressure in the braking system.

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

3. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

4. Clean pilot valve (1) and surrounding area with a suitable solvent. Identify and tag all hydraulic lines connected to pilot valve (1), to aid in 'Installation'.

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 (27) and lockwashers (28) securing pilot valve (1) to cradle assembly. Remove pilot valve (1).

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Note location of elbows (24), Tee piece (25) 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).

6. Install elbows (24), Tee piece (25) and adaptors (23) 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 250-0000, BRAKING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

1. Secure pilot valve (1) to cradle assembly with bolts (27) and lockwashers (28).

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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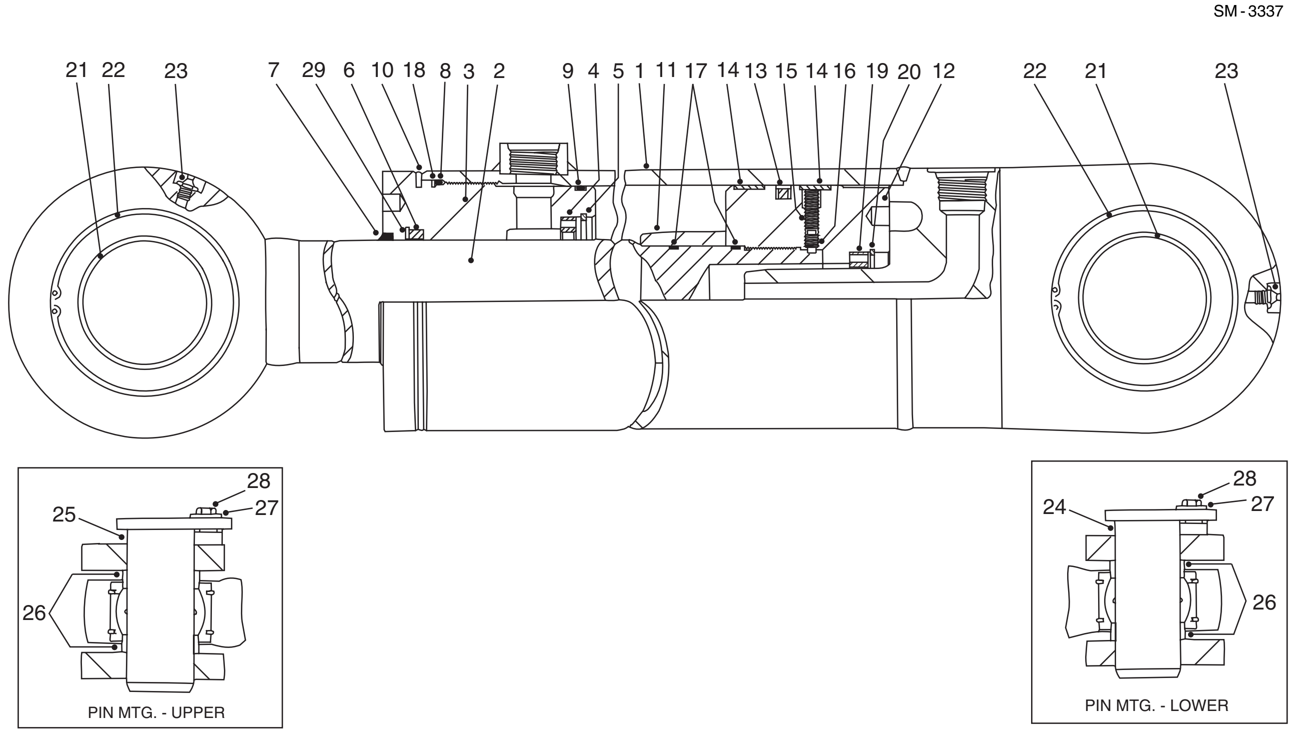


1 - Cylinder Body			
2 - Piston Rod	9 - 'O' Ring	16 - Grub Screw	23 - Lube Fitting
3 - End Cap	10 - Lock Ring	17 - 'O' Ring	24 - Lower Pin
4 - Cushion Sleeve	11 - Cushion Spear	18 - Backup Ring	25 - Upper Pin
5 - Circlip	12 - Piston	19 - Cushion Ring	26 - Spacer
6 - Rod Seal	13 - Piston Seal	20 - Circlip	27 - Washer
7 - Wiper	14 - Bearing Ring	21 - Spherical Bearing	28 - Bolt
8 - 'O' Ring	15 - Grub Screw	22 - Circlip	29 - Nylon Ring

Fig. 1 - Sectional View Of Body Cylinder and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

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) eye end is connected at the body. Single stage double acting means that piston rod (2) can have oil applied to either end, extending or retracting the piston rod.

The cushioning effect when the cylinder is being extended is obtained by tapered spear (11) on piston rod (2) passing through cushion sleeve (4). This gradually slows piston (12) which in turn helps to control destructive shock effects when piston (12) reaches the full extent of its travel.

The cushioning effect when the cylinder is being retracted is obtained by a tapered spear at the base end of cylinder body (1) entering a cavity in piston rod (2) through cushion ring (19). This gradually slows piston (12) which in turn helps to control destructive shock effects when piston (12) bottoms.

Cylinder mounting is by pins (24 & 25), spacers (26) and spherical bearings (21) secured in place by circlips (22). Spherical bearings (21) permit a limited amount of cylinder misalignment.

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, ensure the body is fully lowered, apply the parking brake and

switch off the engine. Turn steering wheel in both directions several times to relieve any pressure in the steering circuit.

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

3. Position a suitable oil container at line ends of the cylinder. Ensure hydraulic lines connected to the body cylinder assembly are identified for ease of installation and disconnect hydraulic lines. Fit blanking caps to all open lines and fittings to prevent entry of dirt.

4. Install a suitable strap around one body cylinder assembly and attach to a suitable lifting device. Remove bolt (28), washer (27) and upper pin (25) connecting piston rod (2) eye end to the body. If due to lack of maintenance the upper pin can not be removed from the front, there is plate on the inside of the body that can be removed to allow access to the rear of the pin to ease removal. This plate is tack welded in place so a grinder is required to remove it.

> ⚠ **WARNING**
> **Exercise extreme caution when lowering the cylinder from the body, as the cylinder will swing out sharply as it leaves its mounting.**

5. Lower cylinder slowly and remove spacers (26).

6. Remove bolt (28), washer (27) and lower pin (24) connecting base end of body cylinder to the frame.

7. Remove spacers (26) and remove cylinder to a clean area for disassembly.

8. Repeat steps 2 through 7 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 (22) from base end of cylinder body (1) and piston rod (2) end. Press out spherical bearings (21).

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).

Note: Approximate weight of piston rod (2) is 318 kg (700 lb), therefore, correct slinging is important along the length of the rod to prevent subsequent damage.

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 bearing rings (14) from piston (12).

8. Remove grub screws (15 & 16) from bearing 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 (17) from piston rod (2). Discard 'O' rings (17).

11. Remove cylinder end cap (3) from piston rod (2). Remove and discard cushion sleeve (4), circlip (5), rod seal (6), nylon ring (29), wiper (7), backup ring (18) and 'O' rings (8 & 9).

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 (2) if defective area is irreparable.

4. Check spherical bearing (21) 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 (21) in base end of cylinder body (1) and piston rod (2) end. Secure spherical bearings (21) with circlips (22).

Note: Install circlip (22) to base end of cylinder ensuring that it is facing down when the cylinder is mounted to the unit.

2. Install new cushion ring (4), circlip (5), rod seal (6), nylon ring (29), 'O' rings (8 & 9) and backup ring (18) in end cap (3).

3. Apply Loctite 242 to the first two threads on end cap (3). Load end cap (3) over piston rod (2) thread taking care not to damage rod seal (6) on the thread.

4. Install new 'O' rings (17) on piston rod (2) and replace cushion spear (11).

5. 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).

6. Insert piston grub screw (16) through bearing ring (14) groove in piston (12) and into groove machined in piston rod (2). Tighten grub screw (16) to a torque of 49 Nm (36 lbf ft).

7. Lock grub screw (16) in place with grub screw (15) and 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 bearing ring (14) groove.

8. Ensure cushion ring (19) and circlip (20) are secure in piston (12).

9. Insert new piston seal (13) and new bearing rings (14) in piston (12).

10. Fully grease piston (12) OD and 'O' rings (8 & 9) in end cap (3).

Note: Approximate weight of piston rod (2) is 318 kg (700 lb), therefore, correct slinging is important along the length of the rod to prevent subsequent damage.

11. 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 threads.

12. 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.

13. 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.

14. Push piston rod (2) to the fully retracted position and torque tighten end cap (3) to 237 Nm (175 lbf ft).

15. 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 (circlip (22) facing down) ready for mounting.

2. Install spacers (26) in base end of cylinder, align spherical bearing (21) with bores in frame mounting and install lower pin (24) through mounting bores, spacers (26) and spherical bearing (21). Secure lower pin (24) to the frame with washer (27) and bolt (28). Tighten bolt (28) to a torque of 66 Nm (49 lbf ft).

3. Install spacers (26) in piston rod (2) eye end of cylinder, align spherical bearing (21) with bores in body and install upper pin (25) through mounting bores, spacers (26) and spherical bearing (21). Secure

upper pin (25) to the body with washer (27) and bolt (28). Tighten bolt (28) to a torque of 66 Nm (49 lbf ft).

4. Remove blanking caps from hydraulic lines and connect the lines to the cylinder ports as tagged during removal.

5. Lubricate pins at lube fittings (23) with lubricant as specified in Section 300-0020, LUBRICATION SYSTEM.

6. Repeat steps 1 through 5 for installation of the opposite cylinder.

7. 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.

8. Place the battery master switch in the 'On' position, start the engine and operate the body. Check lines and fittings for leaks and tighten as required.

9. Remove wheel blocks from all road wheels.

MAINTENANCE

Visually inspect body cylinders, lines and mounting regularly for leaks and damage. Repair/replace as required. Lubricate cylinder pins every 50 hours through lube fittings (23, Fig. 1) with lubricant specified in Section 300-0020, LUBRICATION SYSTEM.

SPECIAL TOOLS

Special tools required for removal and installation of the piston and end cap can be fabricated as shown in Figs. 2 & 3. 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.

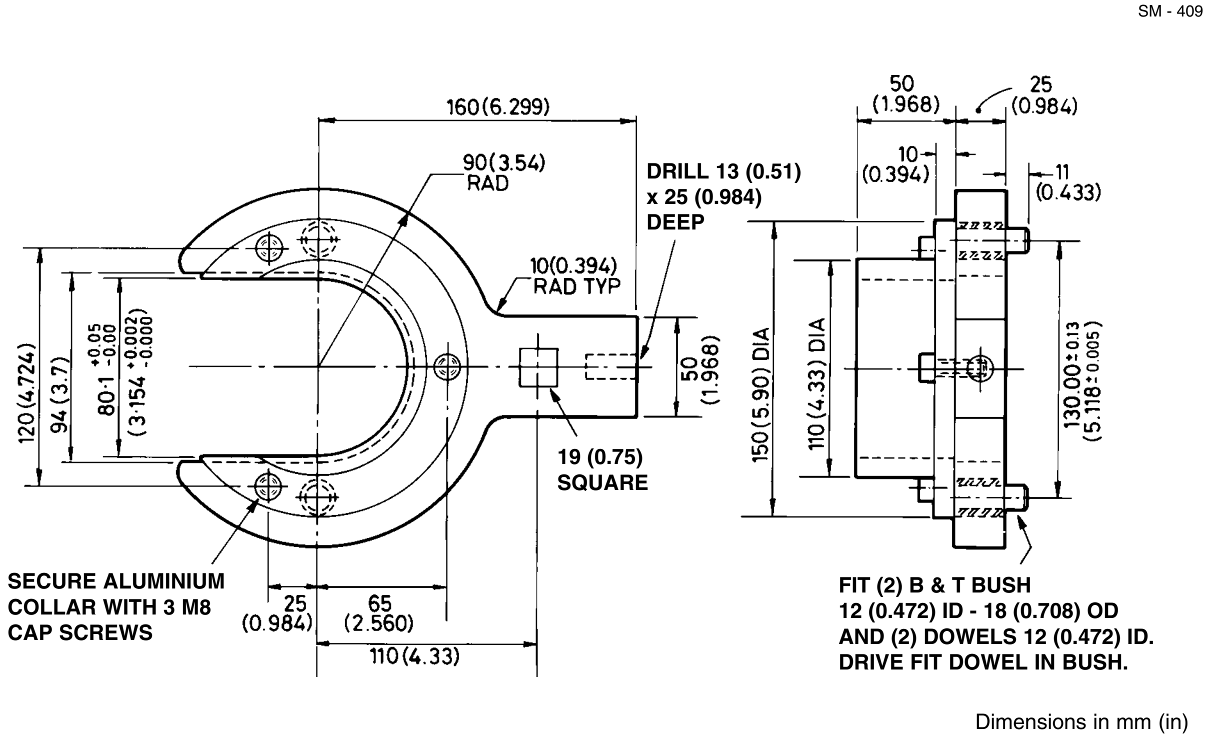


Fig. 2 - End Cap Torque Tool

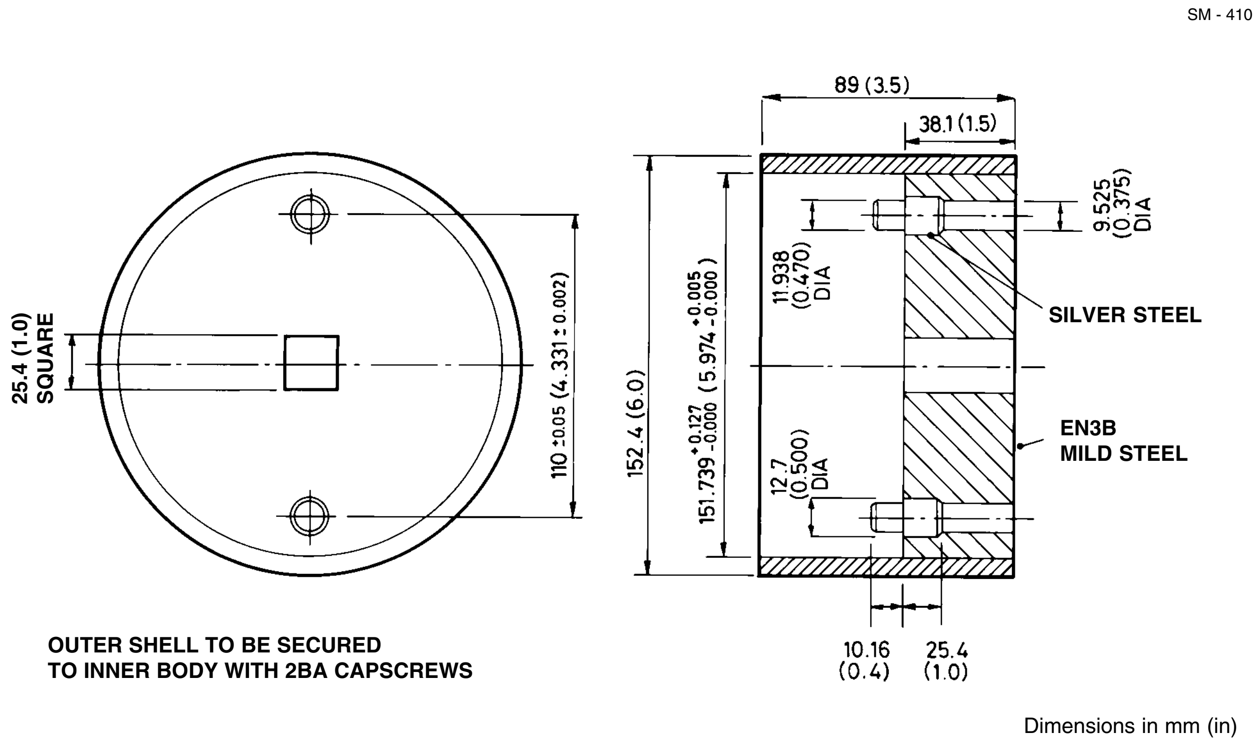


Fig. 3 - Piston Torque Tool

SPECIAL TORQUE SPECIFICATIONS			TABLE070	
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	3	End Cap	237	175
1	12	Piston	1 356	1 000
1	15 & 16	Grub Screw	49	36
1	28	Bolt	66	49

* * * *

DESCRIPTION

Numbers in parentheses refer to Figs. 2 through 5.

The hydraulic braking system is of closed centre design wherein constant pressure is stored in accumulators and is regulated as required to retard or stop the machine.

A brief description of the individual components used in the braking system are listed below. Detailed service and operating instructions can be found in the relevant component sections of this manual.

Service Brakes

Refer to Section 165-0015, BRAKE ASSY - OCDB.

The service brakes are of the enclosed, forced oil-cooled multiple disc type. The service brakes are actuated by hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. **DO NOT use BRAKE FLUID (J 1703).** Multiple discs within the brake packs are cooled by brake cooling oil as specified in Section 300-0020, LUBRICATION SYSTEM.

The brake pack is bolted to the stub axle and houses a sandwich of friction discs splined to a hub rotor. There are six friction discs in each of the front axle brake packs, four in the centre and rear axle brake packs.

When the treadle valve is actuated, hydraulic oil enters the brake pack and forces the piston against the rotating friction discs which react with stationary stator plates. The stator plates are retained by scalloped tangs at the outside diameter, which in turn transfers the reaction torque to the rigid outside housing, slowing or stopping wheel rotation.

In an emergency situation, application of the park/ emergency valve will actuate the service brakes and the parking brake to bring the machine to a halt. In this condition, a restriction in the 'Px' line from the brake manifold valve will slow oil flow from the parking brake allowing the service brakes to actuate momentarily ahead of the parking brake.

Parking Brake

Refer to Section 170-0010, PARKING BRAKE AND MOUNTING.

The parking brake consists of a sliding calliper acting on a brake disc on a rear driveline and is of 'Inverted Design' i.e. requiring pressure to hold it off.

Operation is by a spring applied/hydraulically released actuator. The actuator is connected through a slack adjuster to the power screw shaft that is screwed into the piston in the calliper head assembly. The calliper head assembly slides on anchor plate guides in a bracket assembly bolted to the trailer frame.

A push control on the right hand dash panel activates the solenoid on the brake manifold valve controlling oil pressure from the front brake circuit accumulator to the actuator. Application of the push control releases oil from the actuator allowing internal springs in the actuator to apply the parking brake. Pulling out the push control directs oil pressure from the front brake circuit accumulator to the actuator, compressing internal springs, to release the parking brake.

In an emergency situation, application of the park/ emergency valve will actuate the service brakes and the parking brake to bring the machine to a halt. In this condition, a restriction in the 'Px' line from the brake manifold valve will slow oil flow from the parking brake allowing the service brakes to actuate momentarily ahead of the parking brake.

Hydraulic Tank

Refer to Section 230-0040, HYDRAULIC TANK.

The hydraulic tank is the common reservoir for the steering, body hoist and brake actuation systems. It is mounted off the frame and fender bracket at the rear right hand side of the tractor.

Integral with the hydraulic tank assembly are the hydraulic oil filter, oil strainer and oil level sight gauge. Located on the top of the tank assembly is the filler cap and breather.

Triple Pump (1)

Refer to Section 250-0040, TRIPLE PUMP.

The triple pump is mounted off the transmission power takeoff. It is a triple gear type pump, which supplies various circuits:

a) front section (closest to driveshaft) supplies brake actuation circuit and engine cooling circuit.
b) middle section combines with front section to supply engine cooling circuit.
c) rear section supplies the brake cooling circuit.

The triple pump is assembled for left hand (anticlockwise) rotation, as viewed from the driveshaft end.

Note: Never drive a pump in the wrong direction of rotation, as pump seizure may result.

Accumulator pressure is monitored by pressure switches (4) in the brake lines.

Brake Manifold Valve (2)

Refer to Section 250-0050, BRAKE MANIFOLD VALVE.

The brake manifold valve is mounted off the cradle assembly at the rear of the cab alongside the directional control valve. It distributes hydraulic oil flow from the priority unloader valve, to the treadle valve, front and rear brake circuit accumulators and parking brake at the rear wheels. It also provides appropriate returns to tank for the hydraulic oil.

Parking Brake Pressure Switch (3)

Located in the brake manifold valve body it senses pressure in the parking brake (Px) line. The pressure switch closes at a pressure of 4.9 bar (71 lbf/in^2) and sends a signal to illuminate the parking brake indicator light when the parking brake is applied.

Brake Circuit Pressure Switches (4)

Front brake circuit pressure switch is located in a tee piece below the front brake accumulator. The rear brake circuit pressure switch is also located in a tee piece below the rear brake accumulator. The pressure switches sense pressure in the front and rear brake circuits and send a signal to warning lights on the dash (a buzzer also sounds) when the pressure drops below 115 bar (1 668 lbf/in^2).

Brake Accumulators (5)

Refer to Section 250-0060, ACCUMULATOR.

There are two brake accumulators mounted on the cradle assembly at the rear of the cab; one for the front brake system and the other for the rear. The accumulator is of the piston type and is precharged with nitrogen to 55 bar (800 lbf/in^2). It consists of a charging valve assembly, cylinder assembly and piston. The charging valve is equipped with a locking feature which, when opened, will allow precharge to be checked or accumulator charged.

The piston acts as a separator dividing the cylinder assembly into two sections. The section nearest the charging valve contains the nitrogen precharge. Hydraulic oil from the priority unloader valve flows through accumulator check valves in the brake manifold valve and into the other section of the accumulators.

Treadle Valve (6)

Refer to Section 250-0070, TREADLE VALVE.

The treadle valve controls the level of hydraulic fluid pressure applied to front and rear brakes and the maximum pressure available to these circuits. It is operated by a foot pedal in the operators cab and, with the engine running, is automatically applied by the solenoid on the brake manifold valve.

The first 7° of pedal travel will activate the transmission retarder. Further depression of pedal will apply service brakes.

Stop Light Pressure Switch (7)

A pressure switch located at a tee in the 'B2' line energizes (illuminates) the vehicle's stop lights on application of the treadle valve.

Directional Control Valve (8)

Refer to Section 250-0090, DIRECTIONAL CONTROL VALVE.

The directional control valve is mounted off the cradle assembly at the rear of the cab alongside brake manifold valve (2). It is located in the 'Px' hydraulic circuit between brake manifold valve (2) and treadle valve (6). The 'Px' circuit hydraulically actuates treadle valve (6) when the park/emergency control switch is activated. It also controls automatic service brake, applied pressure bleed down, with engine shutdown.

Brake Accumulator (9)

The small brake accumulator, located between the brake manifold valve (2) and the pilot supply valve, is pre-charged to 30 bar (435 lbf/in^2).

Priority Unloader Valve (10)

Refer to Section 250-0075, PRIORITY UNLOADER VALVE.

Mounted off the cradle assembly at the rear of the cab, the priority unloader valve distributes hydraulic oil flow from the front section of the triple pump to the brake manifold valve as it's first priority. Once the maximum pressure is achieved in the brake circuit, the valve then switches to supplement flow to the engine cooling fan motor.

CHECKING SYSTEM PRESSURE

WARNINGS
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.

Hydraulic fluid pressure will remain within the system after engine shut down. Operate the treadle pedal continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.

1. Position the vehicle in a level work area, apply the parking brake, switch off the engine and turn steering wheel in both directions several times to relieve any pressure in the steering circuit.

2. Operate the treadle valve continuously to relieve pressure in the braking system. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

3. Remove mounting hardware securing cover plate to cradle assembly at the rear of the cab. Remove cover plate to gain access to brake manifold valve.

4. Connect a hydraulic gauge, capable of recording a pressure of 0 - 345 bar (0 - 5 000 lbf/in²), to remote diagnostic pressure point on brake manifold valve.

5. Place the battery master switch in the 'On' position, start the engine and monitor system pressure gauge. Priority unloader valve pressure setting should be 170 bar (2 465 lbf/in²).

6. Pressure setting can be adjusted as described by Section 250-0075, PRIORITY UNLOADER VALVE.

Note: Actuating pressure for the front and rear brake circuits is 138 ± 6.9 bar (2 000 ± 100 lbf/in²) and can be checked at remote diagnostic test points. Refer to 'Pressure Test Points'.

7. Shut off the engine and remove the pressure gauge from brake manifold valve.

8. Secure cover plate to the cab wall with mounting hardware.

9. Remove wheel blocks, place the steering lock bar in the 'Stowed' position, start the engine and check the braking system for proper operation.

Pressure Test Points

Two diagnostic pressure test points, located in the manifold at the rear left hand side of the tractor frame, provide a quick and easy method of checking front and rear brake system pressure. The pressure is taken from the 'B1' (front) and 'B2' (rear) brake circuits.

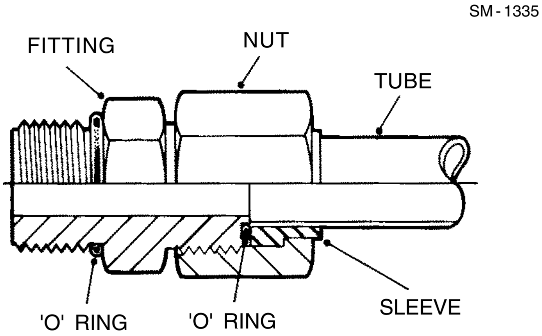


Fig. 1 - Assembly of Typical ORFS Connector

'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 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 of spanner (wrench).

f. Check that a satisfactory hose or tube routing has been achieved.

BLEEDING THE BRAKING SYSTEM

1. Fill hydraulic tank with oil specified in Section 300-0020, LUBRICATION SYSTEM. Fill brake coolant tank with oil specified in Section 300-0020, LUBRICATION SYSTEM. Switch on engine and operate systems until correct operating pressures are recorded.

2. Check oil level in both tanks and add oil if low. Oil should be halfway up sight gauge on both tanks.

> ⚠ **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.**

3. Ensure gear shift selector is in neutral, block all road wheels, secure shipping bar in position and release the park/emergency brake.

4. Install a clear length of tubing over bleed nipple on one of the brake packs. Position the opposite end of the tubing into a suitable container.

5. Crack open bleed nipple and operate treadle valve gently to bleed air in the brake lines.

6. When the oil from the brake pack is clear (not cloudy or creamy) close bleed nipple and remove length of tubing.

> ⚠ **WARNING**
> **Do not operate the vehicle until all air is bled from the braking system.**

7. Perform steps 4 through 6 for the remaining five brake packs until the brake system is clear of air.

8. Check hydraulic oil level and add oil if low. Fill hydraulic tank with oil specified in Section 300-0020, LUBRICATION SYSTEM. Oil should show halfway up sight gauge on the hydraulic tank.

9. Check brake cooling oil level and add if low. Fill brake coolant tank with oil specified in Section 300-0020, LUBRICATION SYSTEM. Oil should show halfway up sight gauge on brake coolant tank.

HYDRAULIC OIL

The braking system should be kept filled with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM.

Whenever there is a hydraulic system failure, the oil should be drained, the entire system flushed, oil filters replaced, oil screens thoroughly cleaned and clean hydraulic oil added to eliminate all metal particles or foreign matter.

SERVICE TOOLS

It is recommended that the following tools are used when carrying out pressure or 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.

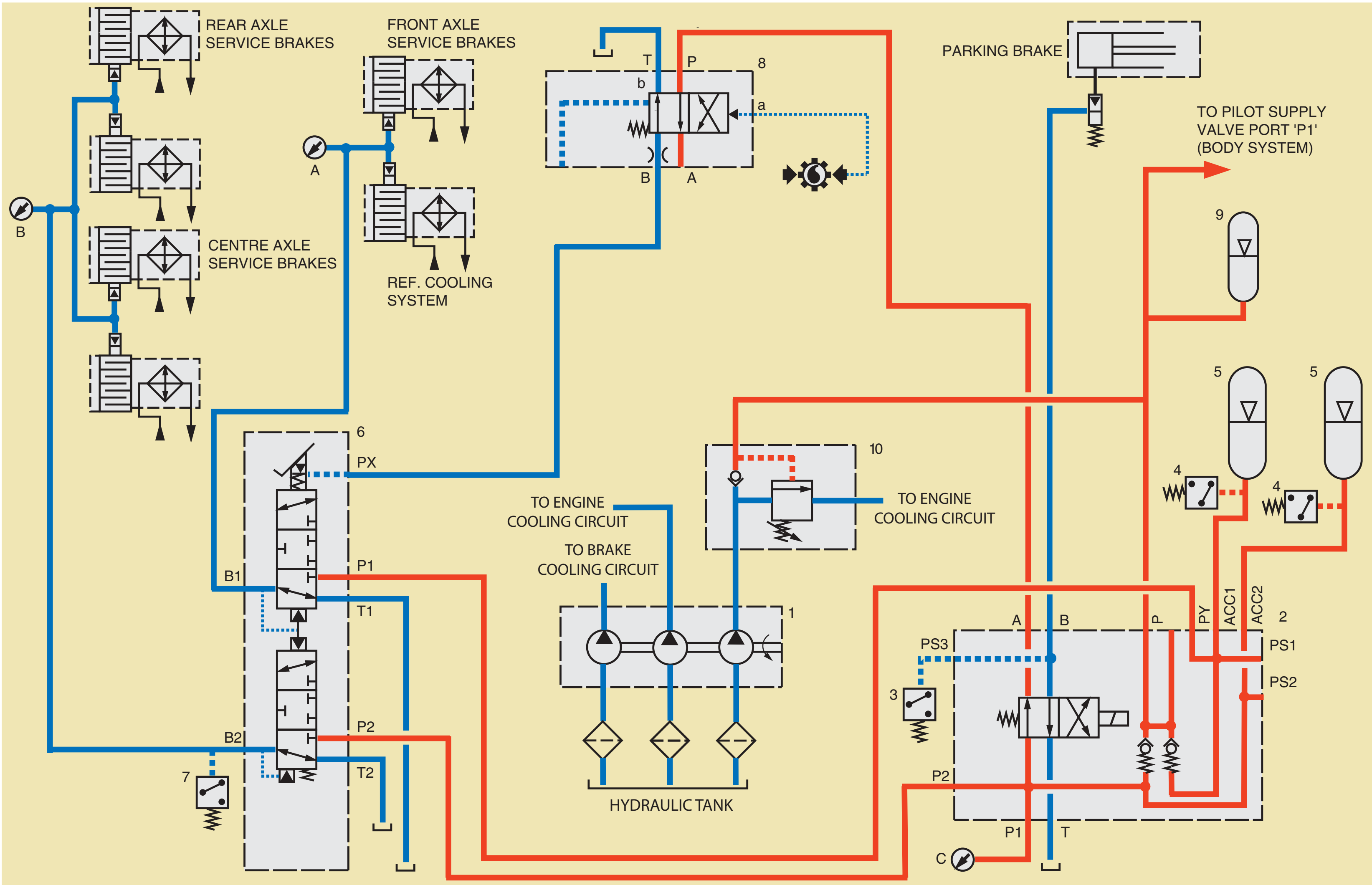
Multi-gauge

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 762 mm (30 in) of vacuum to 345 bar (5 000 lbf/in^2).

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.

BRAKING SYSTEM DIAGNOSIS		
CONDITION	REASON	REMEDY
Inadequate braking	Low System Pressure	Check oil level Check oil condition Check for leakage Check system pressure and adjust as required
	Treadle valve delivery pressure below normal	Check front and rear brake circuits Check treadle valve operation Check for leakage (modular assembly)
	Brake surfaces inefficient	Check friction disc wear Check brake packs for leakage Replace seals or components as required
Brakes do not release	Defective treadle valve	Repair or replace defective components Check adjustments (pedal return)
	Loose or broken wire in brake manifold valve circuit	Repair circuit as required
	Faulty solenoid	Replace defective component
	Faulty park/emergency switch	Repair or replace as required
	Restriction in tank return line	Clear restriction
	Seal bypass condition - parking brake assembly	Replace seals or component as required
Parking brake does not apply	Faulty park/emergency switch	Repair or replace as required
	Faulty solenoid	Replace defective component
	Faulty park brake assembly	Replace seals or component as required
	Blocked orificed check valve in brake manifold valve	Clean or replace orificed check valve
	Faulty brake manifold valve	Check brake manifold valve operation. Repair or replace valve as required
Emergency brakes do not apply	Faulty park/emergency switch	Repair or replace as required
	Faulty solenoid	Replace defective component
	No transmission pilot pressure at directional control valve	Check transmission pressure Check for restriction in pilot line
	Faulty directional control valve	Check spool operation. Repair or replace valve as required
	Oil leakage - service brakes	Check and repair
	Faulty park brake assembly	Replace seals or component as required
	Faulty brake manifold valve	Check brake manifold valve operation. Repair or replace valve as required.
	Faulty priority unloader valve	Check priority unloader valve operation. Refer to Section 250-0075, PRIORITY UNLOADER VALVE.



COMPONENTS

1 - Triple Pump
2 - Brake Manifold Valve
3 - Parking Brake Pressure Switch
4 - Brake Circuit Pressure Switches
5 - Brake Accumulators
6 - Treadle Valve
7 - Stop Light Pressure Switch
8 - Directional Control Valve
9 - Brake Accumulator
10 - Priority Unloader Valve

PRESSURE TEST POINTS

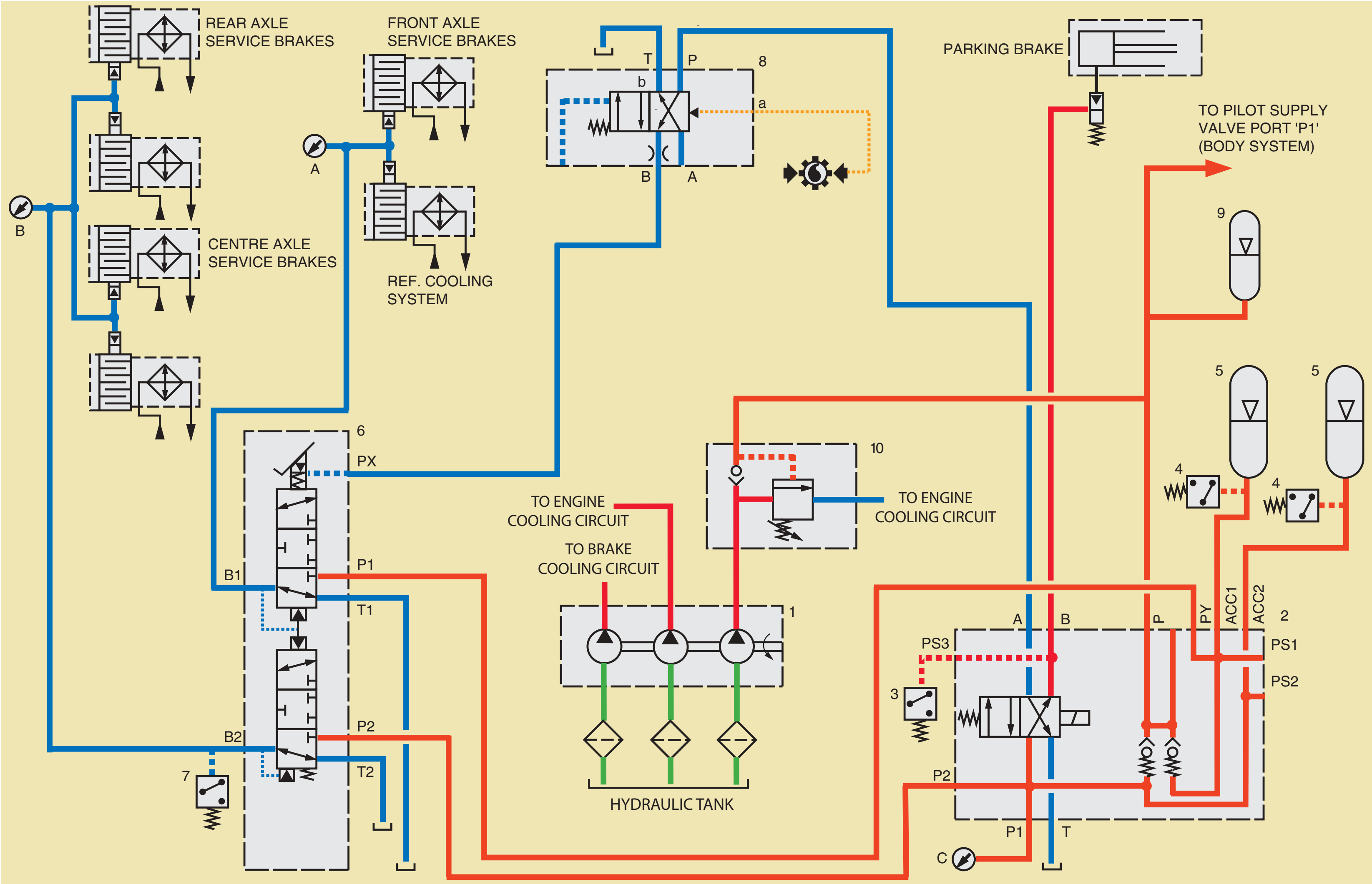
A - Front Brake System Pressure
B - Rear Brake System Pressure
C - Brake System Pressure

COLOUR CODES

Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

SM-2765A

Fig. 2 - Braking System Schematic - Engine Shutdown



COMPONENTS

1 - Triple Pump
2 - Brake Manifold Valve
3 - Parking Brake Pressure Switch
4 - Brake Circuit Pressure Switches
5 - Brake Accumulators
6 - Treadle Valve
7 - Stop Light Pressure Switch
8 - Directional Control Valve
9 - Brake Accumulator
10 - Priority Unloader Valve

PRESSURE TEST POINTS

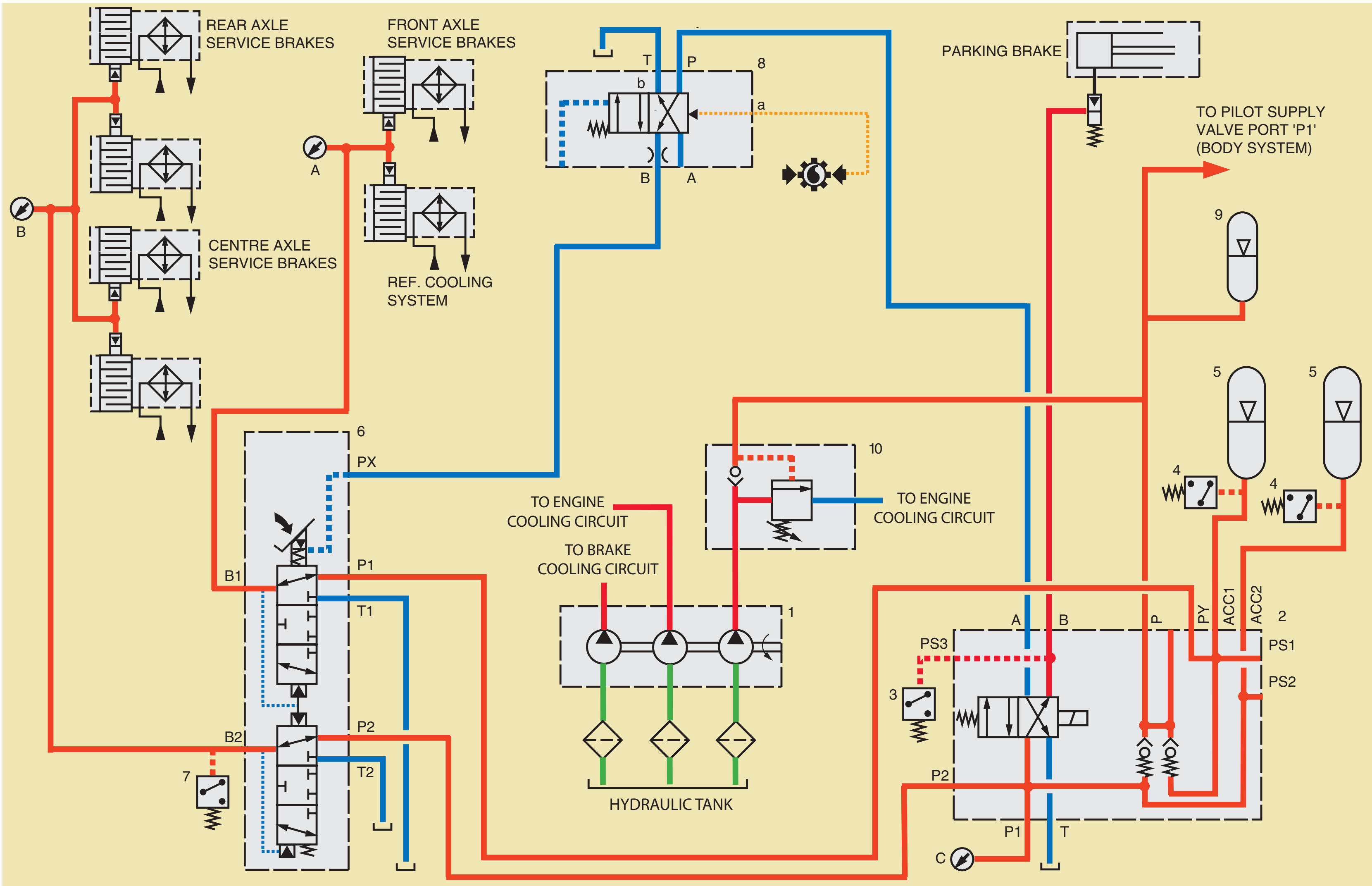
A - Front Brake System Pressure
B - Rear Brake System Pressure
C - Brake System Pressure

COLOUR CODES

Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

Fig. 3 - Braking System Schematic - Engine Running, Brakes Off

SM-2765B



COMPONENTS

1 - Triple Pump
2 - Brake Manifold Valve
3 - Parking Brake Pressure Switch
4 - Brake Circuit Pressure Switches
5 - Brake Accumulators
6 - Treadle Valve
7 - Stop Light Pressure Switch
8 - Directional Control Valve
9 - Brake Accumulator
10 - Priority Unloader Valve

PRESSURE TEST POINTS

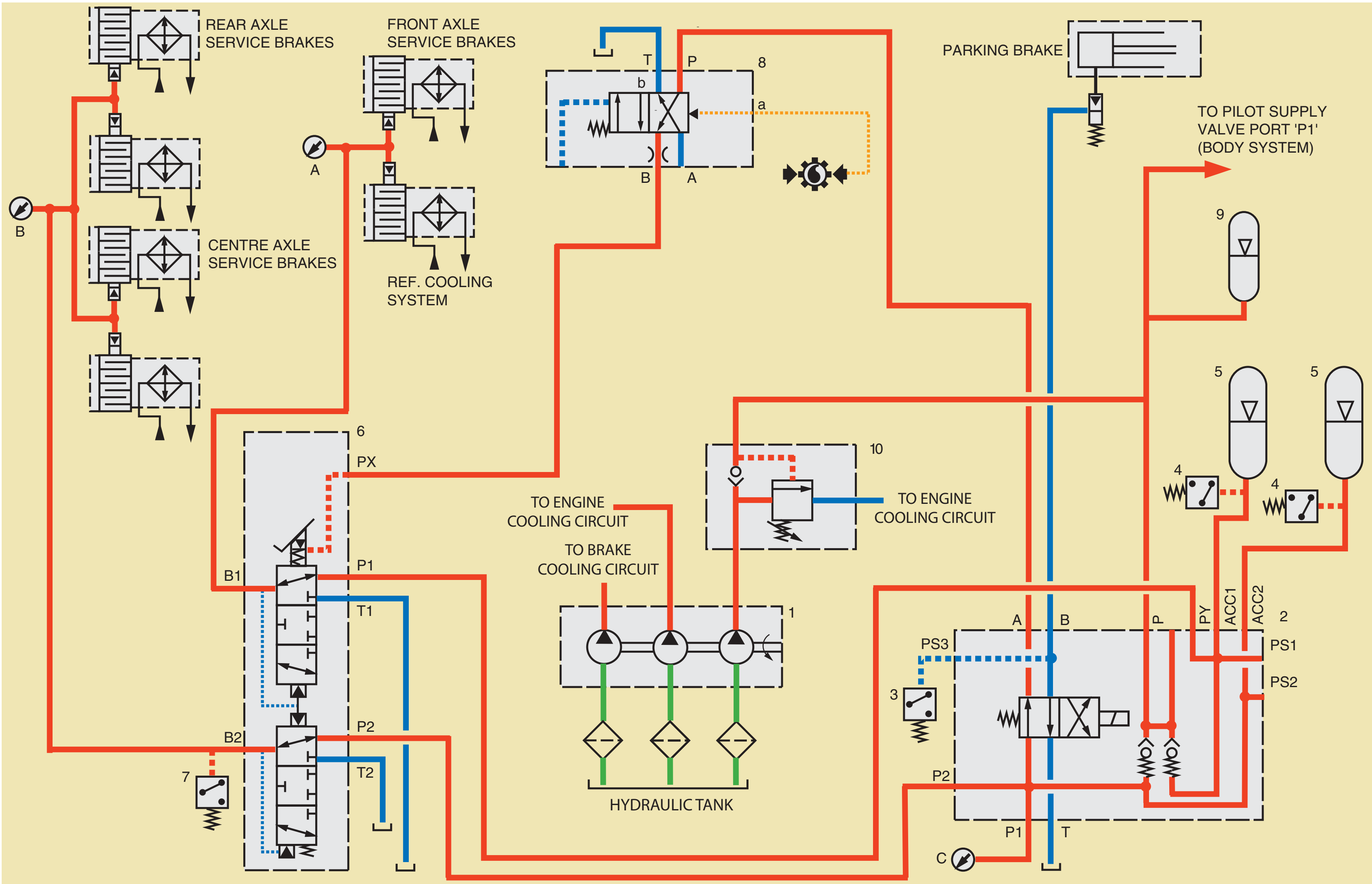
A - Front Brake System Pressure
B - Rear Brake System Pressure
C - Brake System Pressure

COLOUR CODES

Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

SM - 2765C

Fig. 4 - Braking System Schematic - Service Brakes Apply



COMPONENTS

1 - Triple Pump
2 - Brake Manifold Valve
3 - Parking Brake Pressure Switch
4 - Brake Circuit Pressure Switches
5 - Brake Accumulators
6 - Treadle Valve
7 - Stop Light Pressure Switch
8 - Directional Control Valve
9 - Brake Accumulator
10 - Priority Unloader Valve

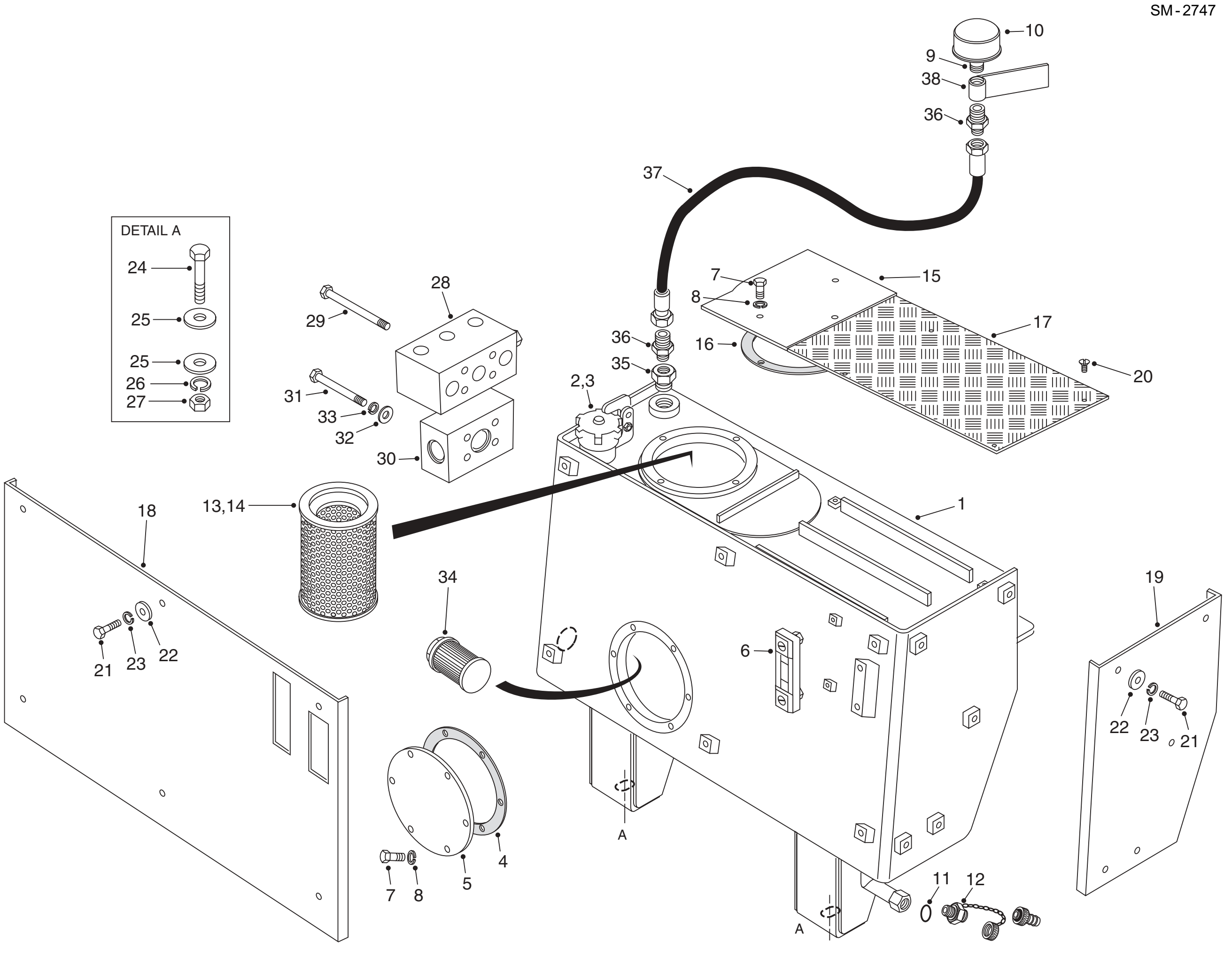
PRESSURE TEST POINTS

A - Front Brake System Pressure
B - Rear Brake System Pressure
C - Brake System Pressure

COLOUR CODES

Red - Pressurized Oil
Blue - Exhaust or Return Oil
Green - Intake Oil
Orange - Pilot Pressure
Yellow - Static Oil

Fig. 5 - Braking System Schematic - Park/Emergency Brake Apply



1 - Brake Coolant Tank
2 - Latch
3 - Cap Assembly
4 - Gasket
5 - Cover
6 - Sight Gauge
7 - Bolt
8 - Lockwasher
9 - Nipple
10 - Breather
11 - Seal
12 - Drain Valve
13 - Filter Assembly
14 - Element
15 - Cover Plate Assy
16 - Gasket
17 - Walkway Plate
18 - Heatshield
19 - Heatshield
20 - Screw
21 - Bolt
22 - Washer
23 - Lockwasher
24 - Bolt
25 - Washer
26 - Lockwasher
27 - Nut
28 - Relief Valve
29 - Screw
30 - Manifold Block
31 - Bolt
32 - Washer
33 - Lockwasher
34 - Strainer
35 - Bush
36 - Connector
37 - Hose Assembly
38 - Bracket

Fig. 1 - Exploded View of Brake Coolant Tank and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The brake coolant tank can be identified as item 2 in Section 210-0005, COOLING SYSTEM SCHEMATIC.

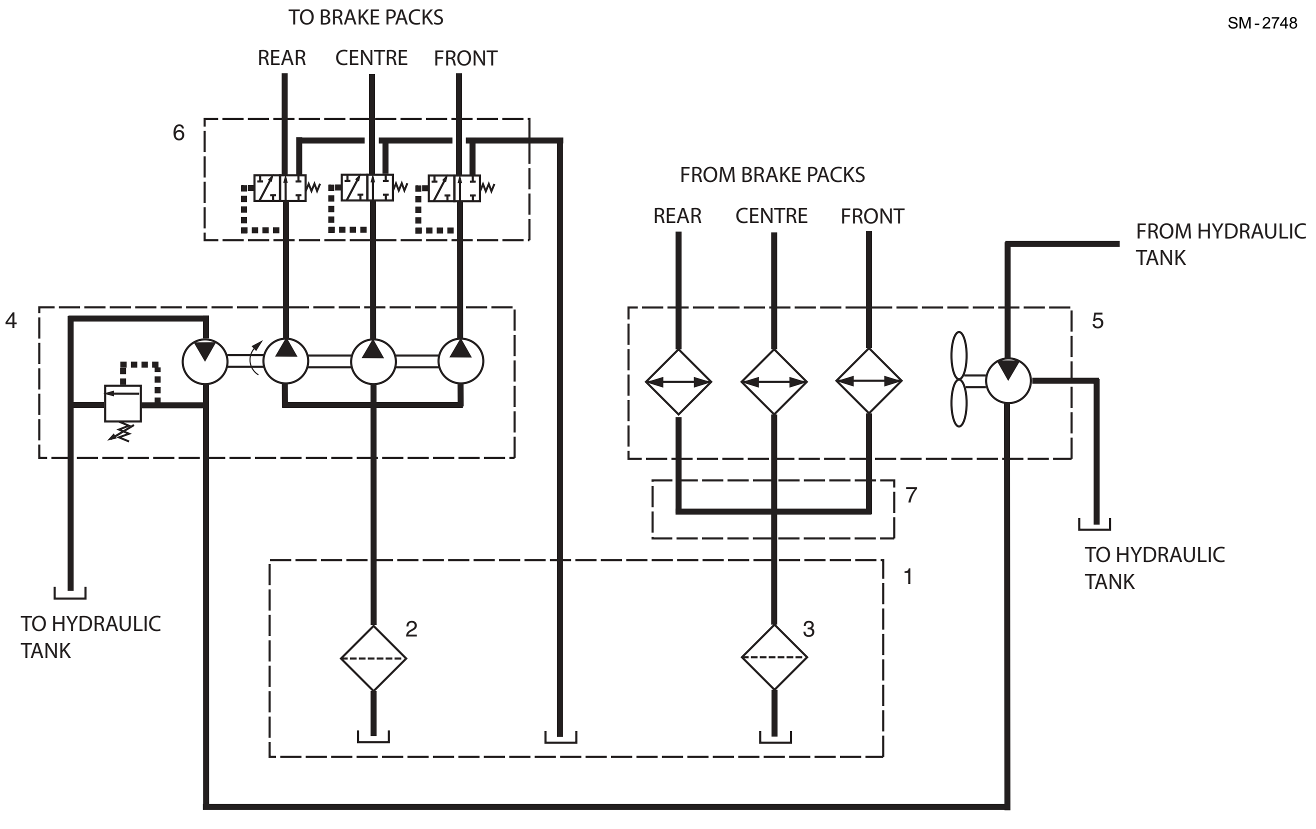
The brake coolant tank (1) is the reservoir for the brake cooling oil. It is mounted off the left hand frame rail in front of the fender and is secured in three places.

Integral with brake coolant tank (1) assembly are filter assembly (13), oil level sight gauge (6), strainer (34), manifold block (30), relief valve (28) and access covers (5 & 15). Located on top of the tank is filler cap (2), breather (10) and walkway plate (17). Heatshields (18 & 19) are fitted to front and side of tank.

OPERATION

Numbers in parentheses refer to Fig. 1, unless otherwise specified. Refer to Fig. 2 for hydraulic schematic of brake coolant tank.

Oil from brake coolant tank (1) is filtered through



1 - Brake Coolant Tank
2 - Strainer
3 - Filter
4 - Motor/Triple Pump
5 - Disc Brake Oil Cooler
6 - Low Pressure Relief Valve
7 - Manifold Block

Fig. 2 - Hydraulic Schematic of Brake Coolant Tank

strainer (34) before it is pumped through the brake cooling circuit.

The brake cooling oil is drawn from brake coolant tank (1) by motor/triple pump (4, Fig. 2) and pumped through the low pressure relief valve (6, Fig. 2) to supply each brake pack. Refer to Section 250-0045, MOTOR/ TRIPLE PUMP ASSEMBLY.

The low pressure relief valve (6, Fig. 2) ensures that only low pressure cooling oil is supplied to the brake packs. There are three pressure relief valves housed in valve (6, Fig. 2), one for each axle, which are set at 1.5 bar (22 psi).

Return oil from the brake packs flows through disc brake oil cooler (5, Fig. 2), manifold block (7, Fig. 2) and filter assembly (3, Fig. 2) before entering the tank storage area. The filter assembly has a bypass valve which allows oil to bypass element (14) when it is cold or when the filter element (14) is blocked.

MAINTENANCE

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 wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to do the job safely.

Checking Oil Level

1. Start up the machine and bring the oil to correct operating temperature.

2. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine.

3. Check oil level and add if low. Sight gauge (6) should show half full. If oil is required remove padlock, open latch (2) and remove filler cap (3) from brake coolant tank (1) and fill brake coolant tank with oil specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (3) on brake coolant tank (1) and secure with latch (2) and padlock.

Replacing Brake Cooling Oil

Brake cooling oil should be changed every 1 000 hours. Refer to Section 300-0020, LUBRICATION SYSTEM, for oil used in the system.

Note: When replacing the brake cooling oil due to a hydraulic failure, or at recommended change interval, element (14) must be replaced and brake coolant tank (1), and strainer (34) cleaned thoroughly using a suitable solvent. Breather (10) should also be replaced.

Note: When draining brake cooling oil, all six brake assemblies should also be drained. Refer to Section 165-0015, OIL COOLED DISC BRAKES.

Replacing Filter Element

After first 100 hours of operation clean filter assembly (13) and install new element (14).

Every 1 000 hours of operation, clean filter assembly (13) and replace filter element (14).

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

3. Remove blanking cap from remote drain assembly (12) on the bottom of brake coolant tank (1). Install a length of hose on remote drain fitting, open drain cock and drain brake cooling oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap on remote drain assembly (12).

4. Remove bolts (7) and washers (8) securing cover plate (15) and gasket (16) to top of brake coolant tank (1). Remove cover plate (15) and gasket (16) from brake coolant tank (1). Discard gasket (16).

5. Remove filter assembly (13) from brake coolant tank (1).

6. Remove and discard element (14) from filter assembly (13).

7. Install new element (14) in filter assembly (13).

8. Install filter assembly (13) in brake coolant tank (1).

9. Secure cover plate (15) and new gasket (16) on brake coolant tank (1) with bolts (7) and lockwashers (8).

10. Remove padlock, open latch (2) and remove filler cap (3) from brake coolant tank (1) and fill brake coolant tank with oil specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (3) on brake coolant tank (1) and secure with latch (2) and padlock.

Replacing Breather

Every 1 000 hours of operation, replace breather (10).

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

3. Unscrew breather (10) and discard. Install new breather (10).

Cleaning Strainer

Note: Strainer (34) should be cleaned every time brake coolant tank (1) is drained for any reason. Refer to 'Replacing Brake Cooling Oil' for change interval.

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

3. Remove blanking cap from remote drain assembly (12) on the bottom of brake coolant tank (1). Install a length of hose on remote drain fitting, open drain cock and drain brake cooling oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap on remote drain assembly (12).

4. Remove bolts (21) and washers (22 & 23) securing heatshield (18) to front of brake coolant tank (1). Remove heatshield (18) from tank.

5. Remove bolts (7), lockwashers (8), access cover (5) and gasket (4) from front of brake coolant tank (1). Discard gasket (4).

6. Unscrew and remove strainer (34) from the inside of brake coolant tank (1).

> ⚠ **WARNING**
> **Splashing liquid. Wear a suitable face shield when using compressed air to dry hydraulic tank and components.**

7. Clean out the inside of brake coolant tank (1) and strainer (34) with a suitable solvent and dry with compressed air.

8. Inspect strainer (34) for damage and replace if required.

9. Install strainer (34) in brake coolant tank (1) and secure.

10. Place new gasket (4) and access cover (5) on brake coolant tank (1) and secure with bolts (7) and lockwashers (8).

11. Install heatshield (18) and secure using bolts (21) and washers (22 & 23).

12. Remove padlock, open latch (2) and remove filler cap (3) from brake coolant tank (1). Fill brake coolant tank with oil specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (3) on brake coolant tank (1) and secure with latch (2) and padlock.

13. Place the battery master switch in the 'On' position and the steering lock bar in the 'Stowed' position, remove all wheel blocks and start the engine.

Note: The oil level will drop during initial start up due to brake assemblies and lines being charged.

14. Switch off the engine, check for leaks and check oil level as described under 'Checking Oil Level'.

TANK ASSEMBLY

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, ensure the body is fully lowered, 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. Remove blanking cap from remote drain assembly (12) on the bottom of brake coolant tank (1). Install a length of hose on remote drain fitting, open drain cock and drain oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap on remote drain assembly (12).

4. Ensure all cooling lines connected to brake coolant tank (1) are identified for ease of installation and, with suitable containers available to catch leakage, disconnect cooling lines. Fit blanking caps and plugs to all open lines and fittings.

5. Remove screws (20) and walkway (17) from top of tank. Install lifting eyes in brake coolant tank (1) and attach a suitable lifting device. Remove nuts (27), washers (25 & 26) and bolts (24) securing brake coolant tank (1) to frame.

6. Carefully remove brake coolant tank (1) assembly from the unit to a clean work area for disassembly.

Disassembly

Numbers in parentheses refer to Fig. 1.

1. Remove internal components from brake coolant tank (1) as described under 'Maintenance'.

2. Remove padlock, latch (2) and filler cap (3) from brake coolant tank (1).

3. Remove breather (10), nipple (9), connectors (36), bush (35) and hose (37).

4. Remove sight gauge (6) from brake coolant tank (1).

5. Remove bolts (21) and washers (22 & 23) securing heatshields (18 & 19) to brake coolant tank (1). Remove heatshields (18 & 19).

6. Remove screws (29) securing low pressure relief valve (28) to brake coolant tank (1). Remove valve (28).

7. Remove bolts (31) and washers (32 & 33) securing manifold block (30) to brake coolant tank (1). Remove manifold block (30).

Inspection

Numbers in parentheses refer to Fig. 1.

> ⚠ **WARNING**
> **Splashing liquid. Wear a suitable face shield when using compressed air to dry hydraulic tank and components.**

1. Clean brake coolant tank (1) and components with a suitable solvent and dry with compressed air.

2. Inspect brake coolant tank (1) for weld cracks and security of internal pipes and weld fitments.

3. Inspect breather (10), strainer (34) and filter assembly (13) for damage. Replace if required.

Assembly

Numbers in parentheses refer to Fig. 1.

1. Renew all seals and gaskets and install all internal components in brake coolant tank (1), as previously described under 'Maintenance'.

2. Fit filler cap (3), latch (2) and padlock.

3. Install breather (10), nipple (9) connectors (36), bush (35) and hose (37) in tank.

4. Fit sight gauge (6) to brake coolant tank (1).

5. Install heatshields (18 & 19) and secure using bolts (21) and washers (22 & 23).

6. Using new 'O' rings, install low pressure relief valve (28) and manifold block (30) on tank, using fasteners removed at 'Disassembly'.

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.

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 brake coolant tank (1) in position on the vehicle and secure with bolts (24), washers (25 & 26) and nuts (27).

2. Install new 'O' rings and install all cooling lines and fittings to brake coolant tank (1), as tagged at removal.

3. Fill brake coolant tank (1) with oil specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (3) on brake coolant tank (1) and secure with padlock.

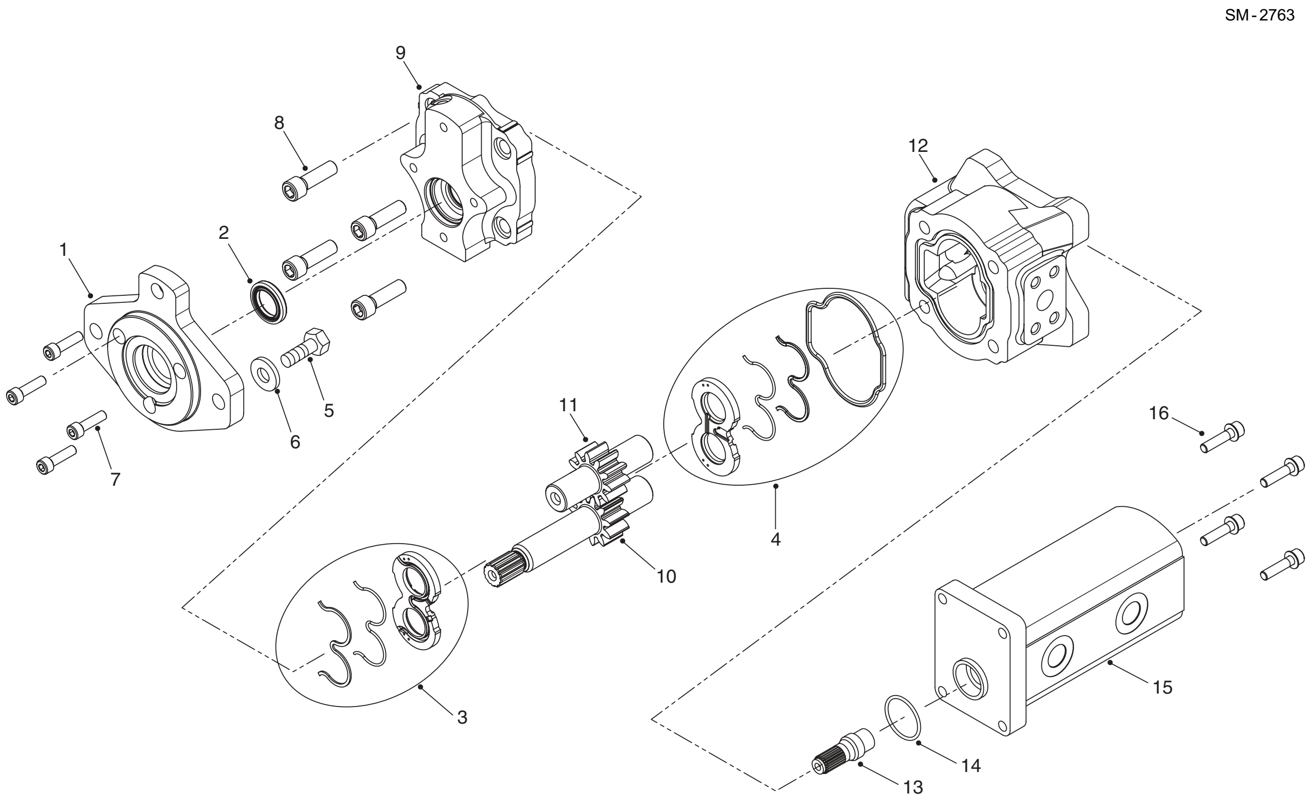
4. Place the battery master switch in the 'On' position and the steering lock bar in the 'Stowed' position, remove all wheel blocks, start the engine and bring the oil to correct operating temperature.

5. Switch off the engine, check for leaks and check oil level as described under 'Checking Oil Level'.

SPECIAL 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.

* * * *



1 - Mounting Flange
2 - Seal
3 - Front Seals
4 - Rear Seals
5 - Bolt
6 - Washer
7 - Bolt
8 - Bolt
9 - Front Cover
10 - Driveshaft & Gear
11 - Driven Gear
12 - Front Pump Housing
13 - Connecting Shaft
14 - 'O' Ring
15 - Rear Pumps
16 - Bolt

Fig. 1 - Exploded View of Triple Pump

DESCRIPTION

Numbers in parentheses refer to Fig. 1. The triple pump can be identified as item 1 in Section 210-0005, COOLING SYSTEM SCHEMATIC.

The triple gear pump, mounted off the transmission power takeoff, provides the following:

a) front section (closest to driveshaft) supplies the brake circuit as a priority, before augmenting engine cooling circuit via priority unloader valve. Refer to Section 250-0075, PRIORITY UNLOADER VALVE.

b) middle section combines with residual flow from front section to drive engine cooling fan motor. Low temperature unloader valve controls flow to fan motor. Refer to Section 210-0045, LOW TEMPERATURE UNLOADER VALVE.

c) rear section supplies the brake cooling circuit, driving the motors for the disc brake oil cooler and the motor/triple pump. Oil is supplied via two speed control valve. Refer to Section 250-0065, TWO SPEED CONTROL VALVE.

The three separate sections of the triple gear pump are connected together as one assembly. The front section consists of driveshaft & gear (10), driven gear (11) and front pump housing (12). Middle and rear pumps (15) are coupled to front pump by connecting shaft (13).

OPERATION

Numbers in parentheses refer to Fig. 1. Refer to Fig. 2 for the operation of a typical gear type hydraulic pump. Refer to Fig. 3 for hydraulic schematic of the triple pump operation.

As the drive gear rotates, the driven gear rotates in the

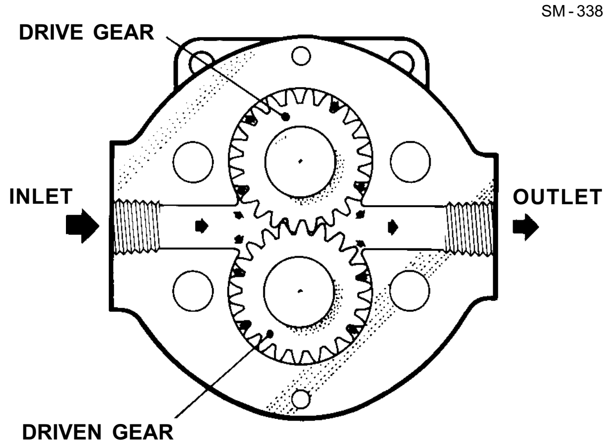


Fig. 2 - Typical Pump Operation

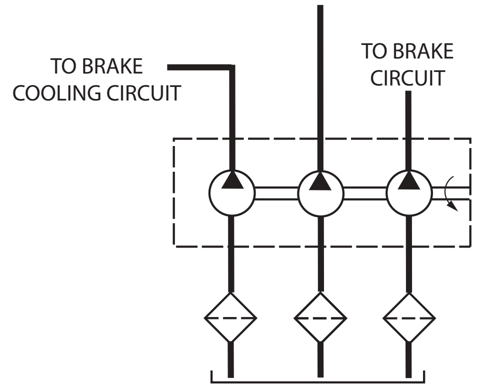


Fig. 3 - Hydraulic Schematic of Triple Pump Operation

opposite direction. The pockets between the gear teeth carry oil from the inlet port around the gear housing ID to the pump outlet port. As the gear teeth re-mesh, this oil is forced out of the outlet port of the gear housing. The maximum oil delivery rate of each section of the triple pump is fixed by the width of its respective gear set and the speed at which driveshaft (10) is turned.

Maximum delivery of front section = 59 litres/min.
Maximum delivery of middle section = 43 litres/min.
Maximum delivery of rear section = 19 litres/min.

The triple pump draws oil from the hydraulic tank, then pumps the oil to supply the various circuits. The triple pump is assembled for left hand (anticlockwise) rotation, as viewed from the driveshaft end.

REMOVAL

⚠ WARNINGS
Hydraulic fluid pressure will remain within the system after engine shut down. Operate the treadle valve continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.

⚠
To prevent personal injury and property damage, ensure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to execute 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. Place steering lock bar in the 'Locked' position.

3. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

4. Clean pump housing and tag and disconnect inlet and outlet lines from the pump. Drain oil in lines into a suitable container. Cap lines and pump ports to prevent ingress of dirt.

5. With suitable blocking or lifting equipment, support pump before loosening mounting bolts (5). Remove bolts (5) and washers (6) and lift pump clear. Move pump to a suitable work area for 'Disassembly'.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Place pump in a soft-jawed vice, driveshaft (10) down. Match mark all pump sections to aid assembly.

Note: Do not clamp vice on pump machined surfaces at any time.

2. Note location of all hydraulic connectors and adaptors and remove from triple pump.

3. Remove bolts (16) and washers securing front pump housing (12) to rear pumps (15).

4. Tap front pump housing (12) with a soft hammer if required to separate from rear pumps (15). If front pump housing (12) must be pried off, use care to avoid damaging machined surfaces.

5. Separate mounting flange (1) from front cover (9) by removing bolts (7). If it must be pried loose, use care to prevent damage to machined surfaces.

6. Remove bolts (8) securing front cover (9) to front pump housing (12) and carefully separate. If sections must be pried apart, use care to prevent damage to machined surfaces.

7. Remove front and rear seals (3 & 4) to allow driveshaft and gear (10) and driven gear (11) to be removed. Discard seal (2) from front cover (9).

8. Remove 'O' ring (14) and connecting shaft (13) from rear pumps (15).

9. Separate rear pumps (15) by removing nuts at rear of triple pump and prise apart, using care to prevent damage to machined surfaces.

ASSEMBLY

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.

1. Replace seals in rear pumps (15) and assemble. Fit nuts at rear and tighten.

2. Install new 'O' ring (14) and connecting shaft (13) to rear pumps.

3. Fit new rear seals (4) to front pump housing (12). Carefully install driveshaft and gear (10) and driven gear (11) into front pump housing (12).

4. Fit new front seals (3) to front pump housing (12) before fitting front cover (9) to front pump housing (12) with bolts (8). Torque bolts to 162 Nm (119 lbf ft).

5. Fit new seal (2) to front cover (9).

6. Assemble mounting flange (1) to front cover (9) using bolts (7). Torque bolts (7) to 46 Nm (34 lbf ft).

7. Assemble front pump housing (12) to rear pumps (15) and secure with bolts (16). Torque bolts to 40 Nm (29 lbf ft).

8. Install hydraulic connectors and adaptors to correct ports and orientation.

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, make sure blocking or lifting equipment is of adequate capacity and properly secured to do the job safely.**

1. With suitable lifting equipment position triple pump on transmission power takeoff. Secure with bolts (5) and washers (6). Torque bolts (5) to 73 Nm (54 lbf ft).

2. Fill all pump ports with clean hydraulic oil and connect lines to pump, as tagged during 'Removal.

3. Fill hydraulic tank with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK, for oil levels. Install filler cap on hydraulic tank filler neck.

4. Place the battery master switch in the 'On' position, start the engine and allow the machine to idle for at least two minutes. During this break-in period, the pump should run free and not develop excessive heat. If the pump becomes hot to touch, it is binding and might seize. The pump will then have to be removed and inspected. If the pump runs properly, speed and pressure can be increased to normal operating values.

5. Check pump mounting and hydraulic line connections for leaks and tighten as required.

6. Remove all blocking from road wheels and place steering bar in the 'Stowed' position.

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, filter replaced, oil screens thoroughly cleaned and fresh hydraulic oil installed to eliminate all metal particles or foreign matter.

FAILURE MODES

It is not recommended giving the triple gear pump a major overhaul, however replacement seal kits are available. Typical failure modes of triple pump are illustrated in table below.

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.

PART	TYPE OF WEAR	WEAR CAUSES	MATING COMPONENT DEFECT
Shaft seal	Lip wear external leakage.	- External contamination - High oil temperature - Overspeeding - High inlet pressure	Grooving of driveshaft.
Wearplates	Scoring/burning of faces adjacent to gear - low volumetric efficiency.	- Oil contamination - Cavitation - Starting pump dry - Running pump in reverse	Scoring or abrasive wear of gear side faces.
Wearplate back-up seal	Extrusion/melting of back-up - low volumetric efficiency.	- Over pressurisation - High oil temperature - Cavitation	This type of failure is likely to be accompanied by severe damage to wearplates gears and bearing.
Wearplate seal	Extrusion/seal failure - low volumetric efficiency.	- Over pressurisation - Excessive pressure cycle - Running pump in reverse	Damage to wearplate and backup seal may also occur with this type of fault.
Bearings	Smooth even wear with a tendancy for bearing surface to change colour from grey to bronze, indicating that the PTFE overlay is wearing through - the bearing is coming to end of its useful life.	- Long service life - Working for high percentage of duty cycle close to peak pressure rating - High oil temperature - Low oil viscosity	Gear journals are likely to show even polishing with light scoring due to contamination passing intermittently through the bearings. Replace pump section.
Bearings	Total bearing failure with heavy scoring, overheating and possible bearing meltdown.	- Oil contamination - Over pressurisation - High oil temperature - Oil starvation - Low viscosity or grade - Inferior oil quality - Cavitation - Running pump in reverse	Usually results in severe damage to all the major pump components. Pump is almost certainly beyond economic repair.

* * * *

DESCRIPTION

Numbers in parentheses refer to Fig. 1. The motor/ triple pump (1) can be identified as item 7 in Section 210-0005, COOLING SYSTEM SCHEMATIC.

Mounted off brackets on the left hand frame rail, adjacent to the brake coolant tank, the motor/triple pump assembly consists of three pump elements coupled to a single direction hydraulic motor. The hydraulic motor within the assembly is protected by a relief valve (2).

OPERATION

Numbers in parentheses refer to Fig. 1.

Refer to Fig. 2. The motor is supplied with hydraulic oil from the brake cooling section of the triple gear pump, via the disc brake oil cooler. The motor and pump elements are connected by a common shaft, therefore motor rotation causes pump elements to draw brake cooling oil from brake coolant tank. Cooling oil is then pumped to low pressure relief valve, before being supplied to brake packs. Refer to Section 210-0046, LOW PRESSURE RELIEF VALVE.

A sealing arrangement within the assembly prevents cross contamination of hydraulic oil from triple gear pump with brake cooling oil from brake coolant tank. The relief valve (2) limits the pressure through the motor to 100 bar (1450 lbf/in^2).

Note: Direction of rotation is clockwise as viewed from shaft end, and is indicated by an arrow.

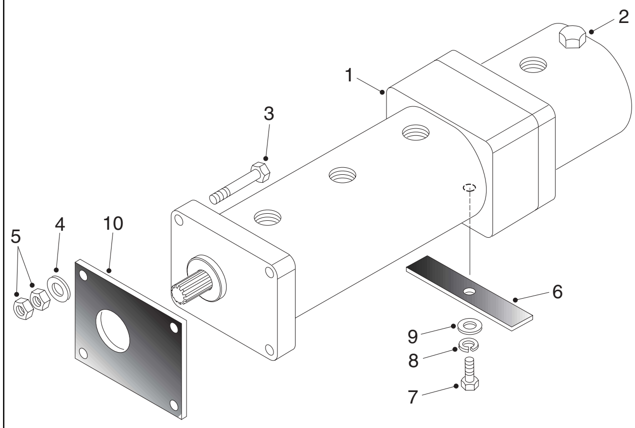
REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNINGS
Hydraulic fluid pressure will remain within the system after engine shut down. Operate the treadle valve continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.

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

SM - 2761



1 - Motor/Triple Pump	6 - Rubber Plate
2 - Relief Valve	7 - Bolt
3 - Bolt	8 - Lockwasher
4 - Washer	9 - Washer
5 - Nut	10 - Rubber Plate

Fig. 1 - Motor/Triple Pump

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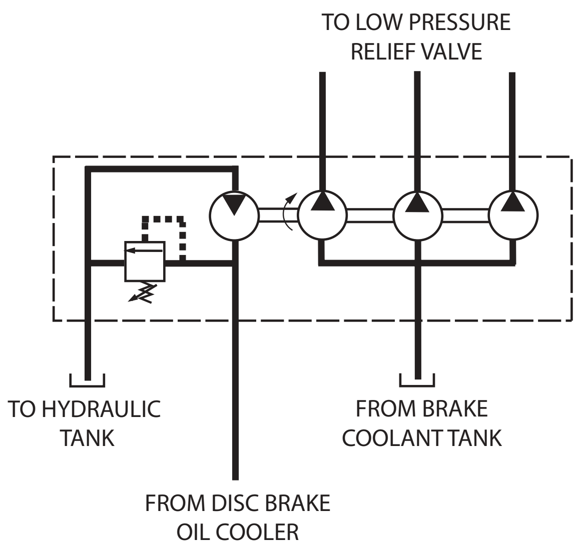

Fig. 2 - Motor/Triple Pump Schematic

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. Place steering lock bar in the 'Locked' position.

3. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

4. Remove blanking cap from remote drain line at the bottom of the brake coolant tank. Install a length of hose on remote drain fitting, open drain cock and drain brake cooling oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

5. Clean motor/triple pump (1) assembly and surrounding area with a suitable solvent. Identify and tag all hydraulic lines connected to motor/triple pump (1), to aid in 'Installation'.

6. With suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to all open lines.

7. Remove bolt (7), washers (8 & 9) and rubber plate (6) securing motor/triple pump (1) to bracket.

8. Remove nuts (5), washers (4), bolts (3) and rubber plate (10) securing motor/triple pump (1) to bracket.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Place motor/triple pump (1) assembly in a soft-jawed vice, and clamp on body. Match mark pump sections and motor to aid in assembly.

Note: Do not clamp vice on machined surfaces of the assembly at any time.

2. Note location of all hydraulic connectors and adaptors and remove from motor/triple pump (1).

3. Unscrew and remove relief valve (2) from motor/triple pump (1) body.

4. Remove hexagon socket bolts and washers from motor/triple pump (1) to separate motor section from pump elements. Tap motor section with a soft hammer if required.

Note: Do not attempt to pry the motor/triple pump (1) assembly apart with a large screwdriver or pry bar. The machined surfaces of the assembly may be damaged.

5. Remove bolts from motor section if further disassembly is required.

6. Remove nylock nuts to allow pump elements to be separated.

Note: Do not attempt to pry the pump elements apart with a large screwdriver or pry bar. The machined surfaces may be damaged.

7. Remove and discard seals that are to be replaced with new seals in kit.

INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Clean all parts in a suitable solvent and dry with compressed air.

2. Check ports threads and make sure they are not damaged or stripped.

3. Check relief valve cartridge (2) for damage. Ensure valve seat is not worn, scored or cracked.

It is not recommended that the valve cartridge (2) is disassembled for maintenance purposes. Ensure that assembly is cleaned prior to removal of any components and that no contaminant is allowed to enter the internal galleries.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. From seal kit, replace seals on motor section and pump elements prior to re-assembly.

2. Lightly oil parts prior to re-assembly.

3. Assemble three pump elements together and secure with threaded rods and nylock nuts.

4. If disassembled, assemble motor section and secure with bolts.

5. Install motor section to pump elements and secure with hexagon socket bolts and washers.

6. Refit relief valve (2) to motor/triple pump (1) body.

7. Install hydraulic connectors and adaptors to correct ports and orientation.

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 250-0000, BRAKING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

1. Secure motor/triple pump (1) assembly to brackets with mounting hardware as removed at 'Removal'.

2. Remove blanking caps from hydraulic lines and install lines to motor/triple pump as identified during 'Removal'.

3. Fill brake coolant tank with oil as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 250-0025, BRAKE COOLANT TANK, for oil levels. Install filler cap on brake coolant tank filler neck.

4. Fill hydraulic tank with hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK, for oil levels. Install filler cap on hydraulic tank filler neck.

5. Place the battery master switch in the 'On' position, start the engine and bring hydraulic oil to operating temperature.

6. Check motor/triple pump (1) and hydraulic line connections for leaks and tighten as required.

7. Remove all blocking from road wheels and place steering lock bar in the 'Stowed' position.

FAULT DIAGNOSIS

Numbers in parenthesis refer to Fig. 1.

Refer to following fault diagnosis chart. As stated previously, it is not recommended that the relief valve (2) cartridge assembly is disassembled for maintenance purposes. Ensure that motor/triple pump (1) is cleaned off prior to removal of any components and that no contaminant is allowed to enter the internal galleries.

If investigation shows that the relief valve (2) is in good clean condition and fit for use, the seals should be replaced prior to re-assembly. Any damage to the motor section or any of the pump elements would necessitate a new motor/triple pump (1) assembly.

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.

FAULT DIAGNOSIS

CONDITION	REASON	ACTION
Non rotation of shaft	No oil supply.	Check pressure at rear section of triple gear pump. Pressure should be 110 bar (1600 psi) at 2200 rpm, when oil is at operating temperature.
	Internal relief valve (2) sticking.	Clean/replace relief valve.
	Relief valve faulty.	Check - refer to Section 250-0120, RELIEF VALVE.
Brake packs overheating	No brake cooling oil supply.	Check oil level in brake cooling tank.
	Pump elements damaged.	Replace motor/triple pump.

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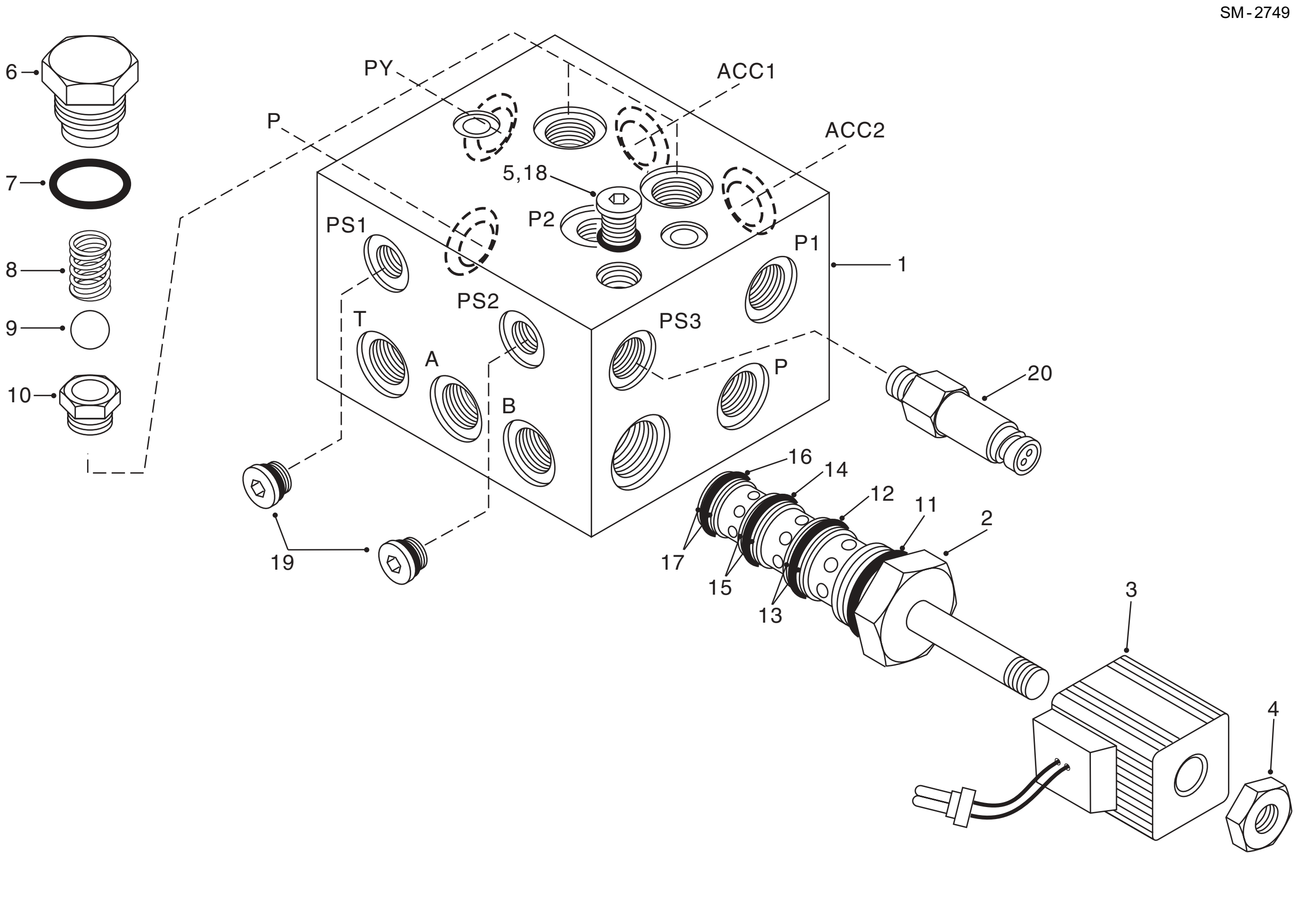


1 - Valve Body	6 - Retainer	11 - 'O' Ring	16 - 'O' Ring
2 - Solenoid Cartridge	7 - 'O' Ring	12 - 'O' Ring	17 - Backup Rings
3 - Solenoid Coil	8 - Spring	13 - Backup Rings	18 - 'O' Ring
4 - Locknut	9 - Check Ball	14 - 'O' Ring	19 - Plug
5 - Plug	10 - Seat	15 - Backup Rings	20 - Park Brake Pressure Switch

Fig. 1 - Exploded View of Brake Manifold Valve

DESCRIPTION

The brake manifold valve can be identified as item 2 in Section 250-0000, BRAKING SYSTEM SCHEMATIC.

Mounted off the cradle assembly at the rear of the cab, the brake manifold valve distributes hydraulic oil flow from the priority unloader valve to the treadle valve, front and rear brake circuit accumulators, priority unloader accumulator and parking brake at the rear wheels. The valve also provides appropriate returns to tank for the hydraulic oil.

OPERATION

Numbers in parentheses refer to Fig. 1. Refer to Figs. 2 and 3 for hydraulic schematics.

Hydraulic oil from the priority unloader valve enters the brake manifold valve at port 'P'. Oil pressure moves check balls (9) from their seats (10) and allows oil to flow through ports 'ACC1' and 'ACC2' to the brake accumulators.

Pressurised oil exits the brake manifold valve through port 'PY' and flows to port 'P1' on the treadle valve, and, through port 'P2' on the brake manifold valve to port 'P2' on the treadle valve.

Solenoid Cartridge - De-energized

When the emergency brake switch is activated (pushed in), the electrical signal between the switch and solenoid coil (3) is opened, de-energizing solenoid cartridge (2). Oil flows through solenoid cartridge (2) and exits the brake manifold valve through port 'A' to the directional control valve. The oil travels through the directional control valve and into the 'Px' port in the treadle valve for an emergency brake application.

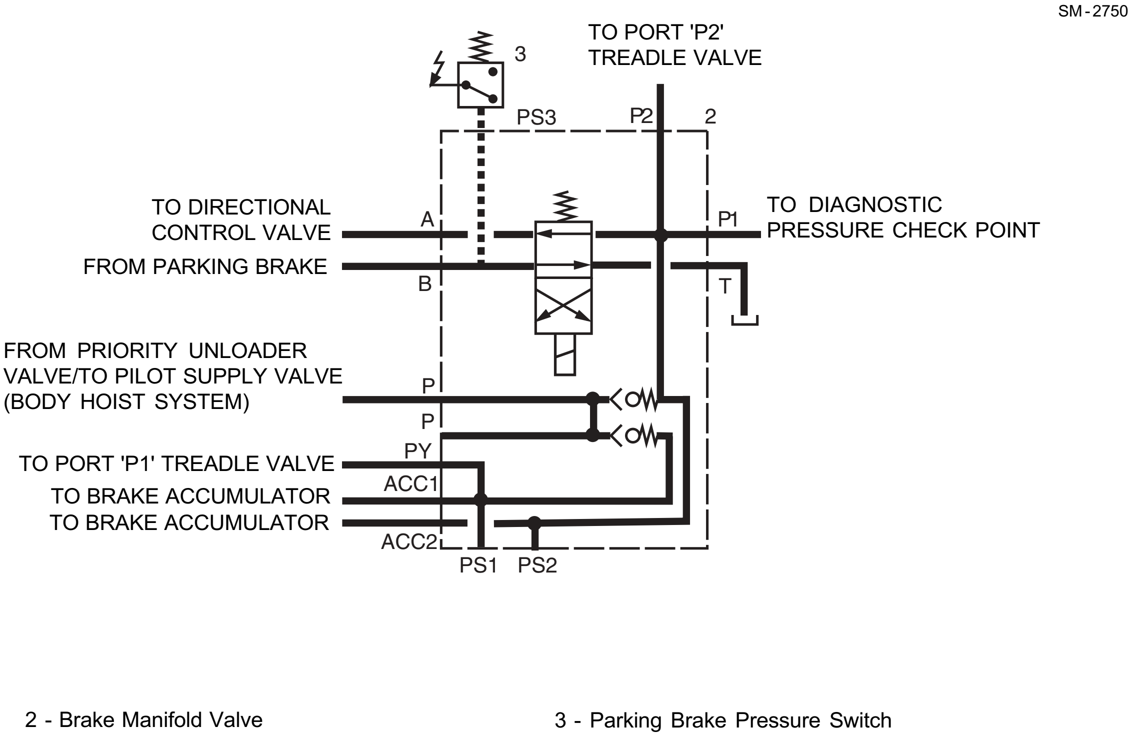


Fig. 2 - Emergency Brake Switch Activated - Solenoid Cartridge De-energized

Return oil from the parking brake circuit enters the brake manifold valve at port 'B'. The oil flows through solenoid cartridge (2) and exits the brake manifold valve at port 'T' to the hydraulic tank. With no pressure in the parking brake circuit to hold the parking brake off, the parking brake is applied.

Solenoid Cartridge - Energized
When the emergency brake switch is deactivated (pulled out), the electrical signal between the switch and solenoid coil (3) is closed, energizing solenoid cartridge (2). Oil flows through solenoid cartridge (2) and exits the brake manifold valve at port 'B' to the parking brake circuit to release the parking brakes.

Return oil from the 'Px' port on the treadle valve flows through the directional control valve and into the brake manifold valve at port 'A'. The oil travels through solenoid cartridge (2) and exits the brake manifold valve at port 'T' to the hydraulic tank.

Pressure Switches
Accumulator pressure switches fitted to bottom of brake accumulators send a signal to illuminate warning lights in the dash panel when the pressure drops below 115 bar (1 668 lbf/in²).

Parking brake pressure switch (20) sends a signal to illuminate the parking brake light in the dash panel when the pressure in the parking brake circuit drops below 4.9 bar (71 lbf/in²).

REMOVAL
Numbers in parentheses refer to Fig. 1.

> ⚠ **WARNINGS**
> **Hydraulic fluid pressure will remain within the system after engine shut down. Operate the treadle valve continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.**
>
> ⚠ **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, switch off the engine and turn steering wheel in both directions several times to relieve any pressure in the steering circuit.

2. Operate the treadle valve continuously to relieve pressure in the braking system. Block all road wheels, place the steering lock bar in the 'Locked' position and the

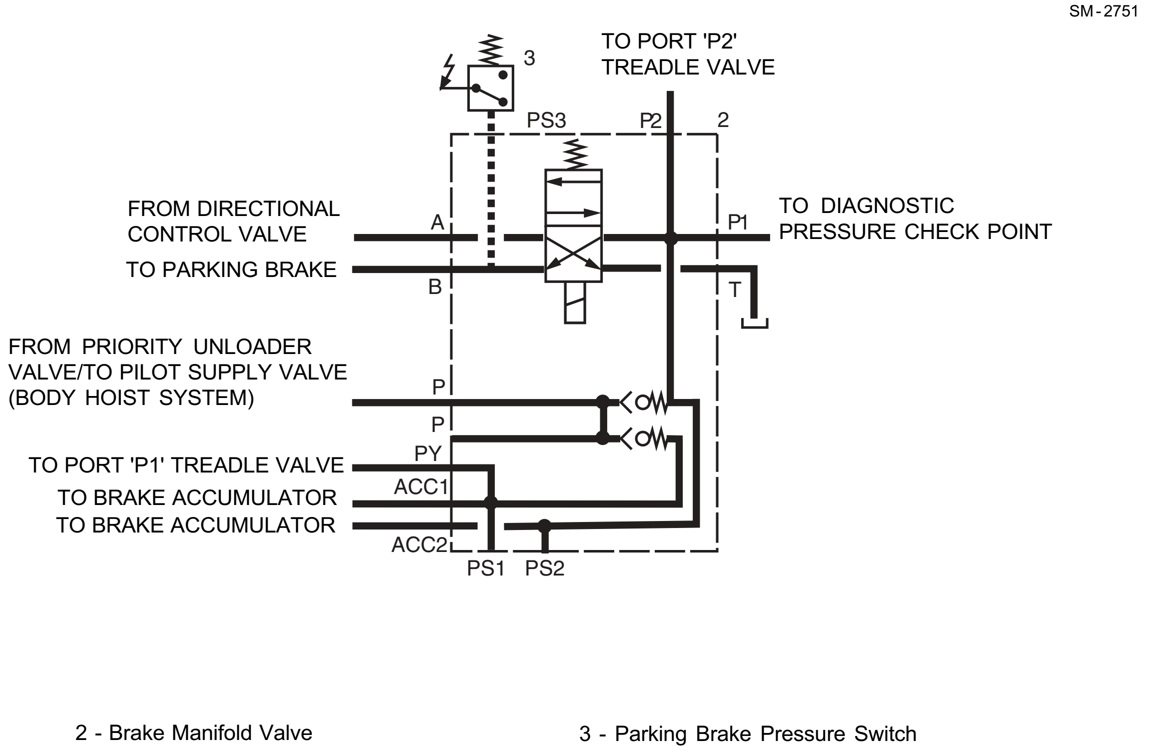


Fig. 3 - Emergency Brake Switch Deactivated - Solenoid Cartridge Energized

battery master switch in the 'Off' position.

3. Remove and tag electrical connections to solenoid coil (3) and pressure switch (20).

4. Clean brake manifold valve assembly and surrounding area with a suitable solvent. Ensure all hydraulic lines connected to the brake manifold 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.

5. Release and remove mounting hardware securing brake manifold valve to cradle assembly at rear of cab. Remove assembly from the vehicle.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Clamp valve body (1) lightly in a soft jawed vice, retainers (6) face up. Do not overtighten jaws. Remove retainers (6) from valve body (1) and discard 'O' rings (7).

2. Remove plug (5) from valve body (1) and discard 'O' ring (18).

3. Carefully remove valve body (1) assembly from the vice and remove springs (8) and check balls (9) from valve body (1).

4. If required, clamp valve body (1) lightly in soft jawed vice and remove check ball seats (10).

5. Rotate valve body (1) in vice until solenoid coil (3) is facing up. Lightly clamp valve body (1) in vice and remove locknut (4) and solenoid coil (3) from solenoid cartridge (2).

6. Remove solenoid cartridge (2) assembly from valve body (1) and discard 'O' rings (11, 12, 14 & 16) and backup rings (13, 15 & 17).

7. Mark valve body (1) port identification on pressure switch (20) and remove from valve body (1).

8. Remove plugs (19) from valve body (1) and discard 'O' rings.

9. If required, note orientation and remove hydraulic line connectors from ports in valve body (1).

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Install new 'O' rings (11, 12, 14 & 16) and backup

rings (13, 15 & 17) on solenoid cartridge (2) as shown in Fig. 1.

2. Install solenoid cartridge (2) assembly in valve body (1) and tighten securely. Install solenoid coil (3) on solenoid cartridge (2) and secure with locknut (4).

3. Rotate valve body (1) in vice until retainer (6) face is up. Install new 'O' ring (18) on plug (5) and install plug (5) assembly in valve body (1).

4. If removed, apply Loctite 603 to threads of seats (10) and install seats (10) in valve body (1). Tighten seats (10) to a torque of 20 Nm (15 lbf ft). See Fig. 4.

5. Install one check ball (9) on seat (10) and spring (8) on check ball (9). Install new 'O' ring (7) on retainer (6) and carefully place retainer (6) assembly over spring (8) in valve body (1). Tighten retainer (6) securely in valve body (1). See Fig. 4.

6. Repeat step 5 for second check ball, spring and retainer assembly.

7. Install pressure switch (20) in valve body (1) as noted during disassembly.

8. Install new 'O' rings on plugs (19). Fit plugs (19) to valve body (1).

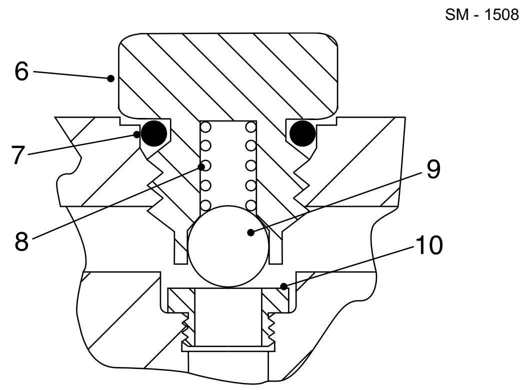
9. If removed, install hydraulic line connectors in valve body (1) as noted during disassembly.

INSTALLATION

Note: Tighten all fasteners to 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.

1. Position brake manifold valve assembly to the cradle assembly, at the rear of the cab and secure with mounting hardware.



6 - Retainer
7 - 'O' Ring
8 - Spring
9 - Check Ball
10 - Seat

Fig. 4 - Section Through Check Ball Assembly

2. Remove blanking caps from hydraulic lines and connect to brake manifold valve as noted during removal.

3. Connect electrical connections to solenoid coil (3) and pressure switch (20) as noted during removal.

4. Check oil level in the hydraulic tank and add oil if required. Refer to Section 230-0040, HYDRAULIC TANK for correct fill level, and, Section 300-0020, LUBRICATION SYSTEM for oil specification.

5. Place the battery master switch in the 'On' position, remove wheel blocks, start the engine and bring hydraulic oil to operating temperature.

6. Check brake manifold valve and hydraulic line connections for leaks and tighten as required.

7. Shut off engine and make sure a full service brake application is made followed by a parking brake application.

8. Repeat all braking and engine shut down cycles several times and check for appropriate application/ release cycle several times.

9. Check all connections again for leaks and tighten as required.

10. Place steering lock bar in the 'Stowed' position.

MAINTENANCE

Inspect the brake manifold valve regularly for any signs of leakage or damage and repair/replace as required.

Note: Limited repair of the brake manifold valve is by replacement of parts only.

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.

SPECIAL TORQUE SPECIFICATIONS

			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	10	Seat	20	15

*   *   *   *

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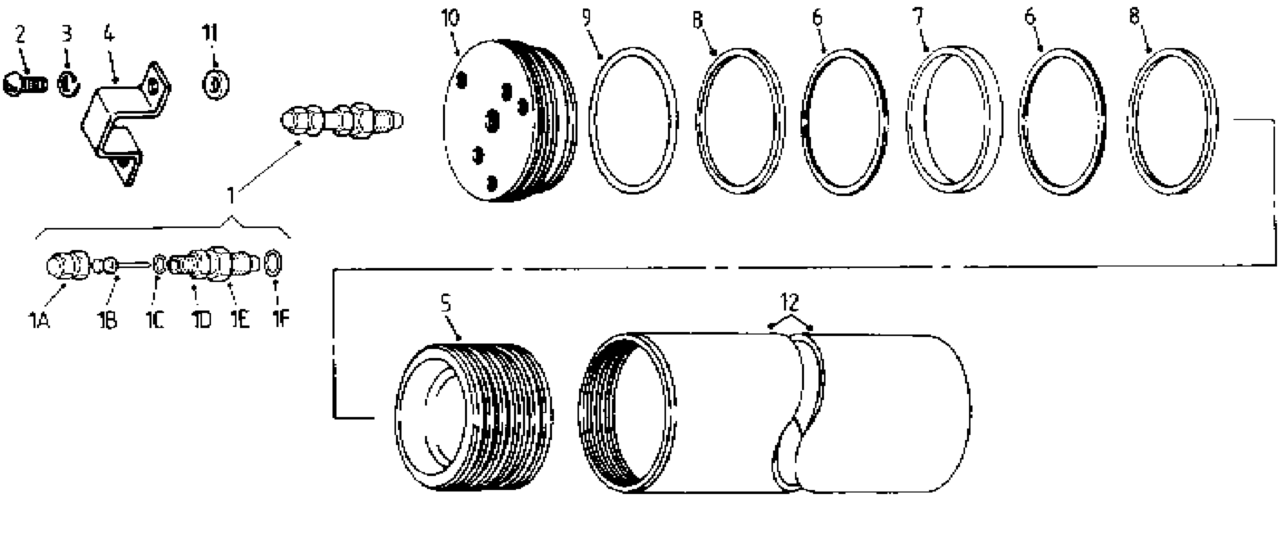


1 - Charging Valve
1A - Cap
1B - Core
1C - 'O' Ring
1D - Locknut
1E - Body
1F - 'O' Ring
2 - Screw
3 - Lockwasher
4 - Protector
5 - Piston
6 - Backup Rings
7 - 'V' Section Ring
8 - Wear Rings
9 - 'O' Ring
10 - End Cap
11 - Pad
12 - Cylinder

Fig. 1 - Exploded View of Accumulator

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The brake accumulators can be identified as items 5 and the pressure switches as items 4 in Section 250-0000, BRAKING SYSTEM SCHEMATIC.

There are two brake accumulators mounted at the rear of the cab; the left hand accumulator supplies pressure for the front brake circuit, and the right hand accumulator supplies pressure for the rear brake circuit and the parking brake circuit. The accumulator is of the piston type and is precharged with nitrogen to 55 bar (800 lbf/in²). It consists of charging valve (1), end cap (10), cylinder (12) and piston (5). Charging valve (1) is equipped with a locking feature. Loosening locknut (1D) will open the valve so that the precharge can be checked or the accumulator charged.

OPERATION

Numbers in parentheses refer to Fig. 1.

Piston (5) acts as a separator dividing cylinder (12) into two sections. The section nearest charging valve (1) contains the nitrogen precharge. Hydraulic oil from the brake section of the triple gear pump flows through accumulator check valves in the brake manifold valve and into the other section of the accumulators.

Accumulator pressure is monitored by pressure switches fitted to bottom of accumulators, which send a signal to illuminate warning lights in the dash panel when the pressure drops below 115 bar (1 668 lbf/in²).

TESTING

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

⚠ **Accumulators are charged with Nitrogen. The service pressure is 55 bar (800 lbf/in²) at 21° C (70° F). To prevent personal injury and property damage do not attempt to remove any valves or fittings until all nitrogen pressure is completely relieved.**

⚠ WARNING
Hydraulic fluid pressure will remain within the system after engine shut down. Operate the treadle pedal continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.

Testing Charging Valve For Leakage

Numbers in parentheses refer to Fig. 1.

1. Remove screws (2), lockwashers (3), protector (4) and pads (11) from accumulator.

2. Remove cap (1A) from charging valve (1) and loosen locknut (1D). Coat open end of charging valve (1) with soapy water. Bubbles indicate leaky valve core (1B).

3. Attempt to reseat the valve core by depressing and releasing it quickly once or twice. Recheck for leakage. If leakage continues, discharge the accumulator as described under 'Discharging Nitrogen' in this section.

4. Replace valve core (1B). Tighten locknut (1D) to 11 Nm (100 lbf in) and replace valve cap (1A) finger tight.

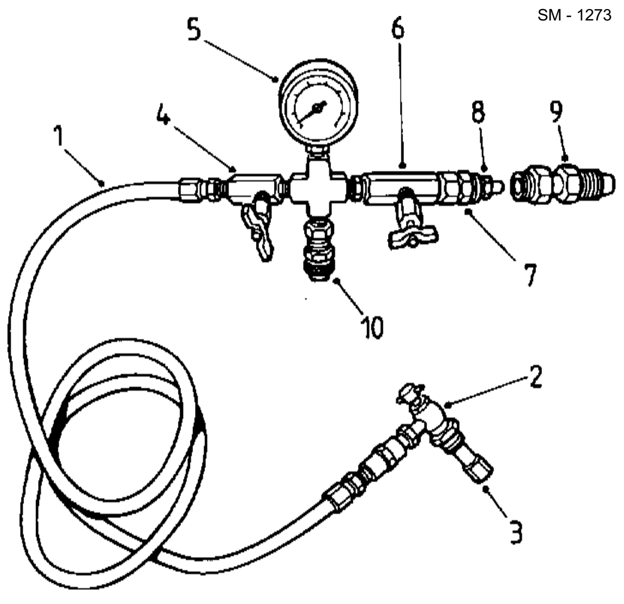
Testing Precharge Pressure

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

Note: The nitrogen pressure in an accumulator is directly affected by changes in nitrogen temperature. The cylinder pressure will increase or decrease proportionally with temperature changes. An accumulator pressure reading can vary about 4.3 bar (62 lbf/in²) with 22° C (72° F) temperature change. Such temperature changes could easily occur between noon and midnight of the same day. Refer to the table at the end of this section for nitrogen pressures at ambient temperatures of other than 21° C (70° F).

To test accumulator precharge pressure or to charge the accumulator, a charging assembly kit can be used. Refer to Fig. 2.

1. Position the vehicle in a level work area, apply the parking brake, switch off the engine and turn steering wheel in both directions several times to relieve any pressure in the steering circuit.



1 - Line	6 - Tank Valve
2 - Valve Chuck	7 - Gland Fitting
3 - Valve Extension	8 - Gland Nut
4 - Cylinder Valve	9 - Cylinder Adaptor
5 - Pressure Gauge	10 - Bleeder Valve

Fig. 2 - Charging Assembly Kit

2. Operate the treadle valve continuously to relieve pressure in the braking system. Block all road wheels and place battery master switch in the 'Off' position.

3. Check accumulator mountings to be sure the accumulator is held tightly in position.

4. Remove cap (1A, Fig. 1) from accumulator charging valve (1, Fig. 1). Attach charging line (1) to charging valve by rotating 'T' handle of valve chuck (2) anticlockwise until it stops then screw the swivel nut down on the valve. Loosen locknut (1D, Fig. 1) by turning anticlockwise one to two turns.

5. Turn 'T' handle clockwise until charging valve core is depressed. Be sure bleeder valve (10) is tight and does not leak, and valves (4 & 6) are closed.

6. To read accumulator precharge pressure, slowly open cylinder valve (4). Pressure gauge (5) will register precharge pressure, it should be 55 bar (800 lbf/in²) at 21° C (70° F) ambient temperature. Refer to the table at the end of this section for nitrogen pressures at ambient temperatures of other than 21° C (70° F).

7. Close cylinder valve (4) and open bleeder valve (10) to dissipate gauge pressure. Close bleeder valve (10) after pressure is relieved. If the accumulator needs charged, leave line (1) and valve chuck (2) attached to charging valve (1, Fig. 1)). Charge the accumulator as described under 'Charging The Accumulator'.

8. If precharge pressure is correct, rotate 'T' handle anticlockwise until it stops. Tighten locknut (1D, Fig. 1) on charging valve (1, Fig. 1) to 11 Nm (100 lbf in). Loosen the swivel nut and remove gauging head.

9. Install cap (1A, Fig. 1) on charging valve (1, Fig. 1) and tighten finger tight.

10. Remove wheel blocks and place the battery master switch in the 'On' position.

CHARGING THE ACCUMULATOR

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

Note: Either oil or water pumped nitrogen can be used to charge the accumulator. Both types are readily available from a local compressed gas dealer.

⚠ **WARNINGS**
Do not use Oxygen or any gas other than Nitrogen to charge an accumulator. Oxygen under pressure coming into contact with oil or grease will cause a violent explosion. Always double check to make sure you are using Nitrogen to prevent personal injury and property damage.

⚠ **A high pressure nitrogen pressure regulator must be used with the charging assembly kit. Failure to use pressure regulator could cause property damage, personal injury or death.**

1. Attach line (1) and the swivel nut to charging valve (1, Fig. 1) as described in steps 1 through 4 under the heading 'Testing Precharge Pressure'. Be sure valves (4 & 6) are closed.

2. Attach gauging head to nitrogen bottle by screwing down on gland nut (8).

3. Open tank valve (6) slowly; pressure shown on pressure gauge (5) is tank pressure.

4. Open cylinder valve (4) slowly and charge accumulator to 55 bar (800 lbf/in^2) at 21° C (70° F) ambient temperature, closing valve occasionally. Refer to the table at the end of this section for nitrogen pressures at ambient temperatures of other than 21° C (70° F).

5. To check accumulator charge, close tank valve (6), relieve pressure between tank and pressure gauge (5) by opening bleeder valve (10) momentarily. This will allow gauge needle to settle, thus giving correct pressure reading of accumulator charge.

6. When the correct pressure for the ambient temperature has been reached, close valves (4 & 6) tightly. Bleed pressure off pressure gauge (5) by opening bleeder valve (10). Close bleeder valve when all pressure is bled off from the gauge and unscrew gland nut (8) from the nitrogen bottle.

7. Rotate 'T' handle of valve chuck (2) anticlockwise until it stops, tighten locknut (1D, Fig. 1) to 11 Nm (100 lbf in), loosen the swivel nut and remove gauging head.

8. Check charging valve (1, Fig. 1) for leakage using soapy water. Reinstall valve cap (1A, Fig. 1) and tighten finger tight.

DISCHARGING NITROGEN

Numbers in parentheses refer to Fig. 1.

Make sure charging valve (1) is closed internally by turning locknut (1D) clockwise. Remove cap (1A) and core (1B) from charging valve (1). Slowly turn locknut (1D) anticlockwise to open charging valve (1).

Do not remove charging valve (1) until all the gas has been completely evacuated.

⚠ **WARNING**
Do not try to discharge the accumulator by depressing charging valve core (1B).

REMOVAL

Numbers in parentheses refer to Fig. 3, 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.

Accumulators are charged with Nitrogen. The service pressure is 55 bar (800 lbf/in²) at 21° C (70° F). To prevent personal injury and property damage do not attempt to remove any valves or fittings until all nitrogen pressure is completely relieved.

1. Position the vehicle in a level work area, apply the parking brake, switch off the engine and turn steering wheel in both directions several times to relieve any pressure in the steering circuit.

2. Operate the treadle valve continuously to relieve pressure in the braking system. Block all road wheels and place battery master switch in the 'Off' position.

3. Remove screws (2, Fig. 1), lockwashers (3, Fig. 1) and protector (4, Fig. 1).

4. Discharge nitrogen from the accumulators as described under 'Discharging Nitrogen'.

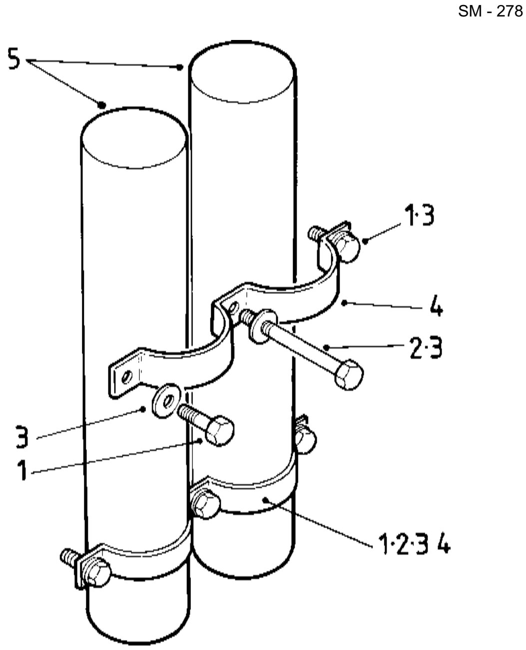
5. Disconnect hydraulic lines from underside of accumulators and drain oil into a suitable container. Cap open lines and fittings to prevent entry of dirt.

6. Support accumulators with an adequate sling and lifting device. Remove bolts (1 & 2), washers (3) and clamps (4). Remove accumulators to a clean area for disassembly.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

WARNING
Accumulators are charged with Nitrogen. The service pressure is 55 bar (800 lbf/in²) at 21° C (70° F). To prevent personal injury and property damage do not attempt to remove any valves or fittings until all nitrogen pressure is completely relieved.



1 - Bolt
2 - Bolt
3 - Washer
4 - Clamp
5 - Accumulator

Fig. 3 - Accumulator Installation

1. Make sure all nitrogen gas has been released before starting to disassemble the accumulator. Refer to section on 'Discharging Nitrogen'.

2. Remove charging valve (1) from end cap (10).

3. With accumulator lying horizontal, hold accumulator cylinder (12) with a strap wrench.

4. Install pins in three equally spaced holes in end cap (10), then use a long bar working against the pins to remove end cap from cylinder (12). Remove and discard 'O' ring (9).

5. Grip cast web of piston (5) with pliers and, while rotating, pull piston from cylinder (12). Remove and discard wear rings (8), backup rings (6) and 'V' section ring (7).

INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Wash metal components with a suitable solvent and thoroughly air dry.

2. Inspect piston (5) for cracks or burrs. Replace piston (5) if excessively scored or worn.

3. Use an inspection lamp to check the bore of accumulator cylinder (12) for scratches or scoring. Minor nicks, scratches or light scoring of the bore can be removed by using crocus cloth. Dress the bore until all apparent imperfections have been removed. Replace complete accumulator assembly if the inside of cylinder (12) is excessively scored or worn.

4. Inspect threads in end cap (10) and threads in cylinder (12) for damage. Replace all parts worn or damaged beyond repair.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Lubricate ‘O’ ring (9), wear rings (8), backup rings (6), 'V' section ring (7) and inside of cylinder (12) with hydraulic oil prior to assembly.

2. Install new 'V' section ring (7), backup rings (6) and wear rings (8) on piston (5).

3. Insert piston (5) into cylinder (12) with cupped end facing the open end of the cylinder. Do not let 'V' section ring (7) drag on cylinder threads. Use a hammer and wood block to tap piston into place until all of piston is 50 mm (2.0 in) below beginning of honed bore. Keep pressure against piston while tapping 'V' section ring (7) through the bore chamfer, otherwise piston will bounce back, damaging the 'V' section ring.

4. Install new 'O' ring (9) on end cap (10) and install end cap (10) in cylinder (12). Tighten cap so that it is flush with the end of cylinder (12) within 1.59 - 2.38 mm (0.0625 - 0.0938 in) above or below.

5. Install charging valve (1). Tighten locknut (1D) clockwise to 11 Nm (100 lbf in) to close charging valve, insert valve core (1B), replace valve cap (1A) and tighten finger tight.

6. Test accumulator hydraulically for leakage or failure at 255 - 276 bar (3 700 - 4 000 lbf/in^2). Discharge after testing.

INSTALLATION

Numbers in parentheses refer to Fig. 3.

Note: Tighten all fasteners without special torques specified to 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 lifting equipment is properly secured and of adequate capacity to do the job safely.

1. Position accumulators on mounting bracket with the oil inlet ports downward.

2. Attach clamps (4) securely with washers (3) and bolts (1 & 2).

3. Remove caps installed at removal and install hydraulic lines securely to the oil inlet port at the bottom of the accumulators.

4. Charge the accumulator with Nitrogen gas as described under 'Charging the Accumulator' in this section.

5. 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.

6. Place the battery master switch in the 'On' position, start the engine and check for leaks. Tighten lines and fittings as required. Remove wheel blocks.

MAINTENANCE

Inspect accumulator assembly for leaks. If leaks are found, disassemble and replace all 'O' rings and seals. Inspect hydraulic lines for wear and leaks. Replace/ tighten lines as required.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of the charging assembly kit and other general service tools required. These tools are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS					TABLE017
			TORQUE		
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft	lbf in
1	1D	Locknut	11	-	100

AMBIENT TEMPERATURE - NITROGEN PRE-CHARGE PRESSURE			TABLE051
AMBIENT TEMPERATURE		NITROGEN PRE-CHARGE PRESSURE	
°C	°F	bar	lbf/in^2
-18	0	47.7	692
-12	10	48.8	708
-7	20	49.8	723
-1	30	50.9	738
5	40	52	754
10	50	53	769
16	60	54.1	785
21	70	55	800
27	80	56.2	815
32	90	57.3	831
38	100	58.3	846
43	110	59.4	862
49	120	60.5	877
54	130	61.5	892

WARNING
This vehicle is equipped with precharged nitrogen gas cylinders of more than 2.8 bar (40 lbf/in^2). Special permits may be required when transporting the vehicle or cylinders by any method while cylinders are charged. For shipment, contact the appropriate agency in the country involved. Consult your dealer for further permit information.

* * * *

DESCRIPTION

Numbers in parentheses refer to Fig. 1. The two speed control valve can be identified as item 5 in Section 210-0005, COOLING SYSTEM SCHEMATIC.

Mounted on the disc brake oil cooler casing on the right hand fender, the two speed control valve regulates the fan speed of the disc brake oil cooler. The two speed control valve houses two valves: two way solenoid operated cartridge (1) and flow regulator cartridge (2).

The two speed control valve is supplied by a dedicated brake cooling section (rear section) of the triple gear pump, via pressure relief valve. The solenoid cartridge (1) controls flow to the hydraulically driven disc brake oil cooler fan motor. The flow regulator cartridge (2) controls the flow rate through the solenoid to a preset supply of 10 litres/min.

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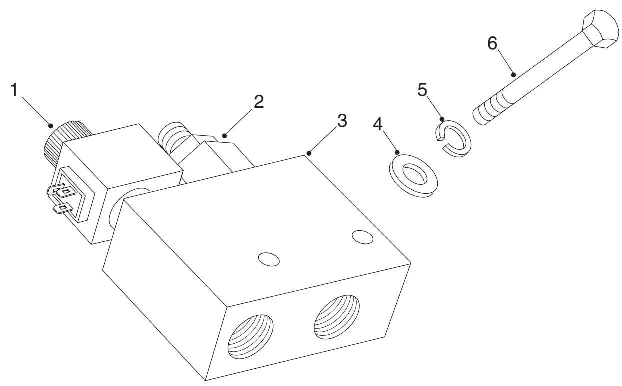

1 - Solenoid Cartridge
2 - Flow Regulator Cartridge
3 - Valve Body
4 - Washer
5 - Lockwasher
6 - Bolt

Fig. 1 - Two Speed Control Valve

OPERATION

Numbers in parentheses refer to Fig. 1.

The two speed control valve has 2 ports, an inlet port and an outlet port. The inlet port is connected to the outlet port via the flow regulator cartridge (2) and the two way solenoid cartridge valve (1).

Refer to Fig. 2. The two speed control valve forms part of the disc brake oil cooler fan speed control system. With the solenoid cartridge (1) de-energised, the majority of the available hydraulic oil will be allowed to flow through the two speed control valve at a rate of 10 litres/min. The remainder of the available hydraulic oil will be forced to circulate the disc brake oil cooler fan motor, thus rotating the fan.

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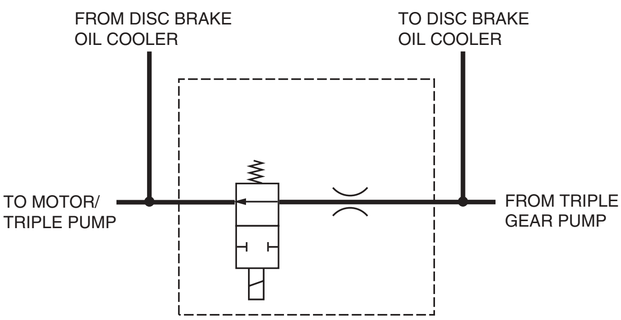

Fig. 2 - Two Speed Control Valve - Solenoid De-energised

Refer to Fig. 3. The normally open temperature switch on the front axle manifold valve closes when disc brake cooling oil temperature reaches 50°C (122°F), energising the solenoid cartridge (1). When the solenoid cartridge (1) is energised, hydraulic oil is prevented from flowing through the valve and is forced through the disc brake oil cooler fan motor, thus increasing the fan speed.

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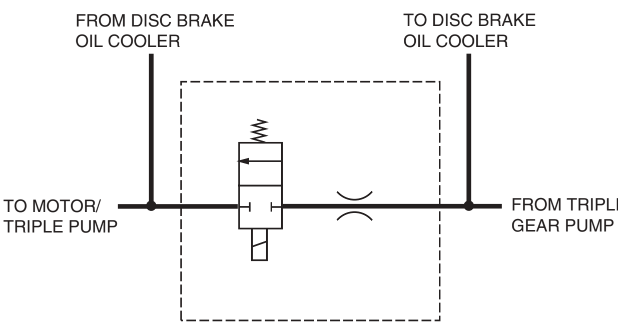


Fig. 3 - Two Speed Control Valve - Solenoid Energised

FUNCTIONAL CHECK

Numbers in parentheses refer to Fig. 1.

To check proper operational function of the two speed control valve, refer to following procedure.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, ensure wheel blocks and steering locking bar is installed prior to executing functional checks.**

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

2. Disconnect electrical harness from temperature switch at front axle manifold block (switch nearest manifold block). Refer to Section 190-0270, SWITCHES AND SENSORS.

3. Start engine and allow to idle.

4. Bridge connection on the temperature switch harness. This will energise the solenoid cartridge (1) in the two speed control valve.

5. Observe increase in disc brake oil cooler fan speed.

6. If fan speed does not increase, investigate fault on two speed control valve solenoid cartridge (1) and associated wiring.

FAULT DIAGNOSIS

Numbers in parentheses refer to Fig. 1. There are 4 possible points of failure:

1. Temperature switch failure. The disc brake oil cooler temperature switch, mounted on the front axle manifold block, should close when disc brake cooling oil temperature rises above 50°C (122°F). Failure to close will result in the solenoid cartridge (1) remaining de-energised and the disc brake oil cooler fan will remain at the slower speed setting. (Refer to Functional Checks). Failure to energise the solenoid cartridge (1) will result in higher disc brake cooling oil temperatures.

2. The solenoid coil, although continuously rated they may fail after long periods of service. Failure will be evident as the higher speed operation of the disc brake oil cooler fan will not be possible. (See temperature switch failure above).

Solenoid Coil Rating: 14 W.

3. The cartridge valve (1) to which the solenoid is attached. Failure is only likely to occur due to contamination in the system. The valve is a low leakage device and any contamination may cause either damage to the components or cause components to stick in position. Failure may be more difficult to detect due to the different modes of failure. Damage to the components will allow a progressively increasing leakage, eventually resulting in some flow not being shut off when the solenoid is energised. Sticking components could hold the system at either a low fan motor speed or a high fan motor speed, depending on where the assembly has stuck.

4. Flow regulator cartridge (2). Contamination is the only likely cause of failure, causing damage to the relief valve seat. Failure will be difficult to detect as the result of contamination damage is likely to be a variation in the flow across the valve when the solenoid is de-energised. This change of flow is difficult to detect until it becomes very excessive. Erratic disc brake oil cooler fan speed may be evident.

REMOVAL

Numbers in parentheses refer to Fig. 1.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, ensure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to execute the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Operate treadle valve continuously to relieve pressure in the braking system.

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

3. Remove guard from rear of disc brake oil cooler. Refer to Section 210-0050, DISC BRAKE OIL COOLER.

4. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

5. Clean two speed control valve and surrounding area with a suitable solvent. Identify and tag all hydraulic lines connected to two speed control valve, to aid in 'Installation'.

6. With suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to all

open lines.

7. Remove electrical harness connector from solenoid (1).

8. Remove bolts (6) and washers (4 & 5) securing two speed control valve to disc brake oil cooler casing. Remove two speed control valve from casing.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Note location of all hydraulic connectors and adaptors and remove from valve body (3).

2. Remove knurled nut from end of the centre shaft of the solenoid. Slide off solenoid coil.

3. Unscrew solenoid cartridge valve (1) from valve body (3). Extract cartridge valve (1).

4. Remove flow regulator cartridge (2) from valve body (3).

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 solenoid cartridge valve (1) seat and control spool. Ensure they are not worn, nicked, cracked or scored.

4. Check flow regulator cartridge (2) for damage. Ensure valve seat is not worn, scored or cracked.

It is not recommended that any of the cartridge assemblies are disassembled for maintenance purposes. Ensure that valve assembly is cleaned prior to removal of any components and that no contaminant is allowed to enter the internal galleries.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Replace all seals on solenoid cartridge (1) and flow regulator cartridge (2) valves prior to re-assembly.

2. Install flow regulator cartridge (2) into valve body (3) and torque to 75 Nm (55 lbf ft).

3. Install solenoid cartridge (1) into valve body (3) and torque to 30 Nm (22 lbf ft).

4. Install solenoid over cartridge valve (1) centre shaft and re-tighten knurled nut.

5. Install hydraulic connectors and adaptors to correct ports and orientation.

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 250-0000, BRAKING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

1. Secure two speed control valve to disc brake oil cooler casing with bolts (6), washers (4) and lockwashers (5).

2. Remove blanking caps from hydraulic lines and install lines to the two speed control valve as identified during 'Removal'.

3. Reconnect electrical harness connector to solenoid (1).

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. Place the battery master switch in the 'On' position, start the engine and bring hydraulic oil to operating temperature.

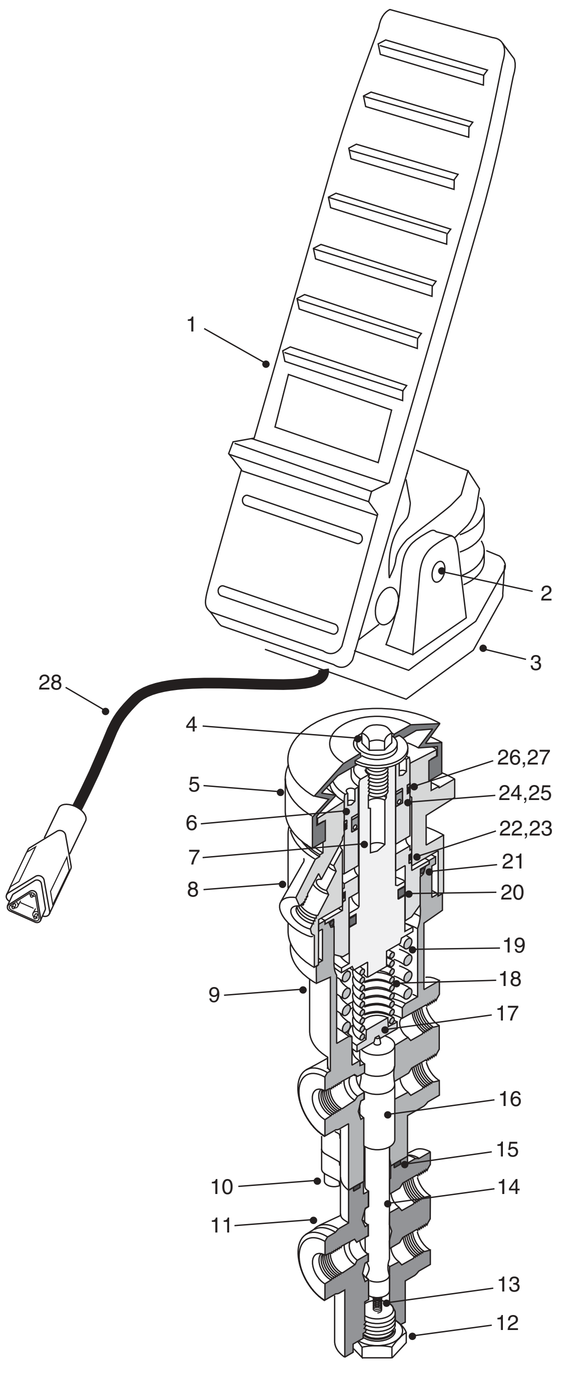
6. Check two speed control valve and hydraulic line connections for leaks and tighten as required.

7. 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.

*   *   *   *



1 - Pedal Assembly	8 - Valve Body - Pilot	15 - 'O' Ring	22 - Backup Ring
2 - Pivot Pin	9 - Valve Body - Upper	16 - Regulator Spool - Upper	23 - 'O' Ring
3 - Actuator Base	10 - Capscrew	17 - Spring Seat	24 - Polypak Seal
4 - Adjusting Screw	11 - Valve Body - Lower	18 - Regulator Spring	25 - Backup Ring
5 - Boot	12 - Plug	19 - Return Spring - Piston	26 - 'O' Ring
6 - Piston Guide	13 - Return Spring - Spool	20 - Glyde Ring Assembly	27 - Backup Ring
7 - Piston	14 - Regulator Spool - Lower	21 - 'O' Ring	28 - Proximity Switch

Fig. 1 - Sectional View of Treadle Valve Assembly

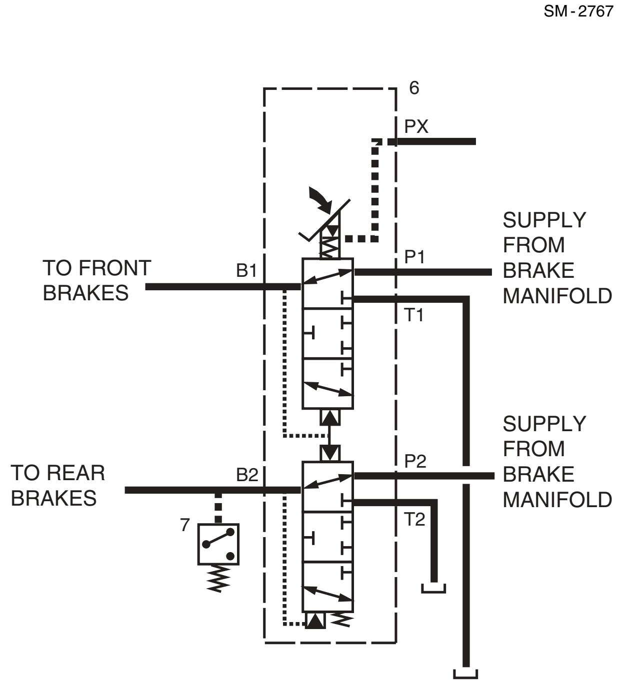


Fig. 2 - Normal Service Brake Application

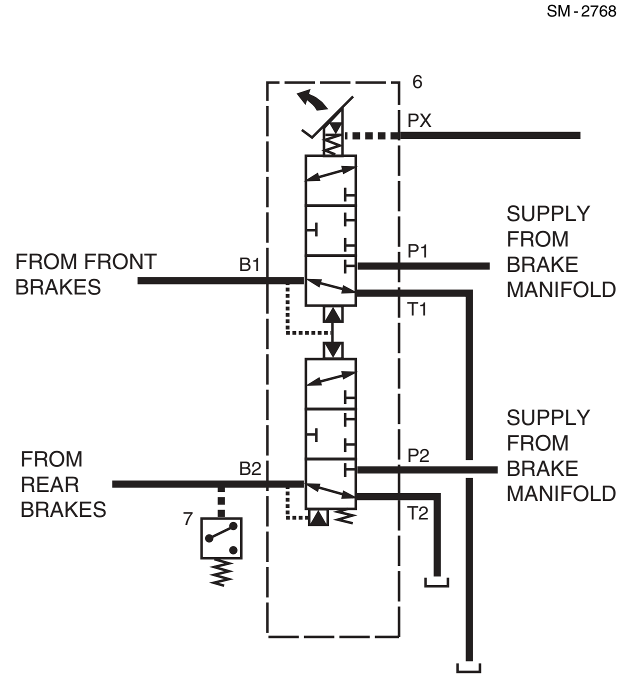


Fig. 3 - Normal Service Brake Release

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

Note: The treadle valve can be identified as item 6 in Section 250-0000, BRAKING SYSTEM SCHEMATIC.

The tandem circuit modulating treadle valve is a closed centre controller which controls the level of hydraulic oil pressure applied to the front and rear brakes and the maximum pressure available to these circuits. It is operated by a foot pedal in the operators cab and with the engine running, is automatically applied by the brake manifold valve. Refer to Section 250-0050, BRAKE MANIFOLD VALVE.

The tandem circuit modulating treadle valve consists of an upper and lower spool, the lower spool being of a smaller diameter. As the foot pedal is depressed the upper spool is pushed down and the lower spool is pilot applied by the pressure in the brake circuit of the upper spool.

In the normal position, brake pedal assembly (1) and upper and lower regulator spools (16 & 14) are in the up position. In this condition the notched area near the top of regulator spools (16 & 14) is exposed to the tank cavity in valve body (9 & 10), the lower portion of the notched area is exposed to the regulated pressure outlet ports of the valve. This effects a direct link between the tank port 'T' and the regulated outlet ports 'B1' and 'B2'. While upper and lower regulator spools (16 & 14) are in this position the brakes are released.

A proximity switch (28), which requests the transmission retarder, is fitted to the treadle valve. The first 7° of pedal travel will activate the proximity switch (28) and request the transmission retarder. A warning light on the dash will also be illuminated by pressure switch fitted at transmission. The normally open switch closes at 0.3 bar (4.35 lbf/in²). Further depression of the treadle valve then applies the brakes. Refer to Section 120-0010, TRANSMISSION AND MOUNTING.

A pressure switch located at a tee in the 'B2' line energizes (illuminates) the vehicles stop lights on application of the treadle valve.

OPERATION

Numbers in parentheses refer to Fig. 1.

Normal Service Brake Application

Refer to Fig. 2. When the operator depresses pedal assembly (1), piston (7) is moved down and pushes on regulator spring (18) which in turn, pushes upper regulator spool (16) down and pilot pressure pushes lower regulator spool (14) down. As regulator spools (16 & 14) move down, the metering notches move out of the tank cavity and close outlet ports 'B1' and 'B2' off to tank port 'T'. Regulator spools (16 & 14) continue to move downward until the lower edge of the

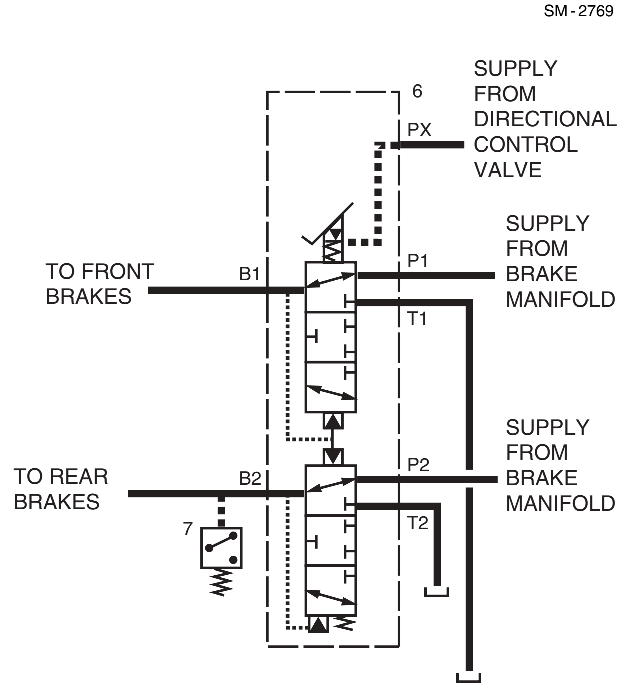


Fig. 4 - Park/Emergency Brake Application

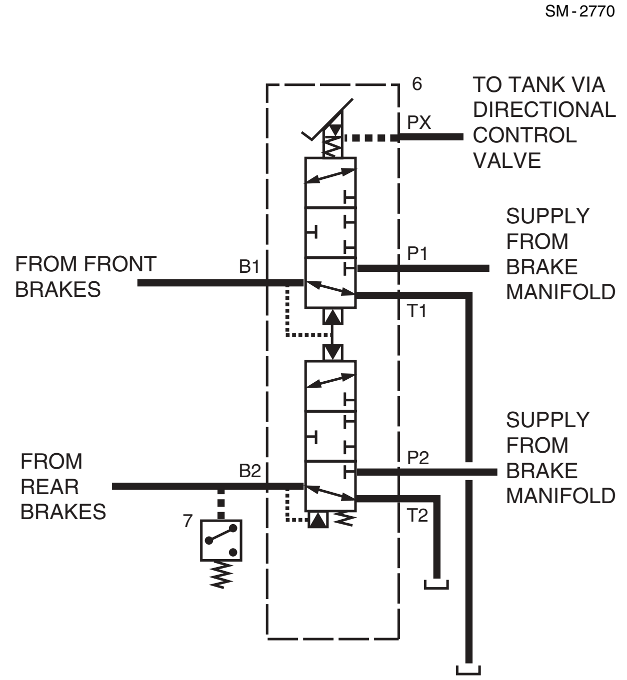


Fig. 5 - Park/Emergency Brake Release

metering notches become exposed to the inlet pressure ports. This movement opens inlet ports 'P1' and 'P2' to outlet ports 'B1' and 'B2' respectively.

As hydraulic pressure builds in the brake, oil flows through the small orifice in the side of regulator spools (16 & 14) and into the cavities below the spools. As pressure rises in the brake it also rises in the cavities below the spools forcing regulator spools (16 & 14) upwards closing outlet ports 'B1' and 'B2'. Regulator spools (16 & 14) are now balanced between the brake pressure and the pressure of regulator spring (18) generated by the operators force on pedal (1) assembly. Regulator spools (16 & 14) have closed off the inlet ports, outlet ports and the tank port and will remain in this position as long as pedal (1) assembly is not moved. If the operator further depresses pedal (1) assembly, regulator spools (16 & 14) will move down and build more pressure in the brake until it balances the pedal force.

Normal Service Brake Release

Refer to Fig. 3. When the operator releases pedal (1) assembly, regulator spools (16 & 14) will become unbalanced and move upwards, opening outlet ports 'B1' and 'B2' to tank. At this point, oil in the 'B1' and 'B2' lines is released to tank through tank port 'T', releasing the brakes.

Emergency Stop Brake Application/ Release

Refer to Fig. 4. Pressing/pushing of the emergency control knob results in the de-energization of the brake manifold valve solenoid. This allows full pressure to enter the 'Px' port in the treadle valve simulating a full and immediate depression of pedal (1) assembly, i.e. pushing regulator spools (16 & 14) downwards and thereby applying maximum braking action.

Refer to Fig. 5. Releasing the emergency control knob will energize the brake manifold valve solenoid, allowing the pressure in the 'Px' line to fall via the return to tank port opened within the directional control valve. Outlet ports 'B1' and 'B2' are opened to tank port 'T' allowing oil in the 'B1' and 'B2' lines to return to tank, releasing the brakes.

REBUILD CRITERIA

Inspect the valve regularly for any signs of leakage or damage. Check the actuator for excessive cam rock and replace components if necessary.

The controller should be rebuilt if one or more of the following conditions exist:

1. Any sign of external leakage.

Note: Check all hydraulic lines and fittings to ensure leakage is not coming from there.

2. Failure of the pedal to return to full upright position.

3. Treadle valve holds pressure when in the neutral position.

4. Varying output pressure with the pedal fully depressed.

5. Output pressure tolerance for upper circuit should be within +/- 6.9 bar (+/- 100 lbf/in^2).

6. Output pressure tolerance for lower circuit should be within +/- 6.9 bar (+/- 100 lbf/in^2).

REMOVAL

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

⚠ Hydraulic oil pressure will remain within the system after engine shut down. Operate the treadle pedal continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.

1. Position the vehicle in a level work place, raise the body and secure in place with the body prop. Apply the parking brake, switch off the engine and turn steering wheel in both directions several times to relieve any pressure in the steering circuit.

2. Operate the treadle valve continuously to relieve pressure in the braking system. Block all road wheels and place battery master switch in the 'Off' position.

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

4. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

5. Move cab floor mat back and remove bolts and lockwashers securing service access plate to cab floor.

6. Clean treadle valve assembly and surrounding area with a suitable solvent. Ensure all hydraulic lines connected to the treadle 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 and treadle valve ports.

7. Tag and disconnect electrical connections from the proximity switch and stop light pressure switch.

8. Tag and disconnect electrical connections from the kick-down switch and accelerator pedal assembly.

9. Remove service access panel and attached valve assemblies to a clean area for 'Disassembly'.

10. Release and remove mounting hardware securing the treadle valve to the service access plate. Remove treadle valve assembly to a clean area for further 'Disassembly'.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Remove blanking caps from treadle valve ports and drain all oil from valve body ports by rotating the valve over a suitable container.

2. Secure the valve assembly upright in a table vice.

3. Remove pedal (1) from actuator cam by loosening two capscrews at the pedal heel. Note that capscrews need not be removed.

4. Loosen but do not remove nuts from 'U' bolts securing actuator pivot pin (2).

5. Loosen nut securing proximity switch (28) to actuator base and remove.

6. Remove pivot pin (2) from actuator base (3) with a punch and hammer. Remove actuator cam assembly and inspect for any abnormal wear or cracks. Set aside for assembly.

7. Remove boot (5) from pilot valve body (8).

8. Remove capscrews securing actuator base (3) to pilot valve body (8). Remove actuator base (3) from pilot valve body (8).

9. Remove adjusting screw (4) from pilot valve body (8).

10. Remove valve assembly from the vice.

11. With valve assembly horizontal, remove capscrews and separate pilot valve body (8) from upper valve body (9). Remove capscrews (10) and separate lower valve body (11) from upper valve body (9).

12. With the pilot valve body (8) upright on the work bench, hold with one hand and push the actuator piston (7) down with the other hand until piston guide (6) pops loose.

13. Turn pilot valve body (8) on its side on the work bench and remove piston guide (6) and actuator piston (7) from pilot valve body (8).

14. Remove glyde ring assembly (20) from actuator piston (7).

15. Remove 'O' rings (21, 23 & 26), backup rings (22, 25 & 27) and Polypak seal (24) from piston guide (6) and discard.

16. Turn upper valve body (9) on its side on the work bench and remove piston return spring (19), regulator spring (18), spring seat (17) and upper regulator spool (16) from upper valve body (9).

17. Turn lower valve body (11) on its side on the work bench and remove lower regulator spool (14) and spool return spring (13) from lower valve body (11). Remove and discard 'O' ring (15) from counterbore in lower valve body (11).

18. Secure lower valve body (11) upright in a table vice and remove plug (12) and 'O' ring from lower valve body (11). Discard 'O' ring. Remove lower valve body (11) from the vice.

INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Clean all parts with a suitable cleaning solvent.

2. Inspect actuator piston (7) and piston guide (6) for damage and wear. If axial grooves are seen or if any wear is evident, replace actuator piston (7) and piston guide (6) as a matched set.

3. Lightly lubricate regulator spools (14 & 16). Place upper and lower regulator spools (14 & 16) into corresponding regulator bore in valve body and push the spool lightly through the bore. Each regulator spool must be able to move freely and smoothly the entire length of the regulator bore. If it cannot, regulator spool and valve must be replaced as a matched set.

Note: Never replace just the spool or valve. They must be replaced as a matched set.

4. Inspect each spring carefully for cracks or breaks. Any spring with a crack or break must be replaced. Also, if the treadle valve was not reaching proper regulated pressure, replace all regulator springs.

5. Inspect threaded inserts in actuator cam, actuator base (3) and pedal assembly (1). If any of the threads are damaged, the inserts must be replaced.

6. Clean pilot valve body (8) thoroughly to remove all residual adhesive or particles of boot (5). Using a knife or suitable scraper, thoroughly clean the sides of pilot body (8) by scraping the lip where the pilot body contacts the boot (5).

SUB-ASSEMBLY

Numbers in parentheses refer to Fig. 1.

Note: All metal parts should be thoroughly cleaned with a suitable solvent, dried, and lubricated with a light weight oil before assembly. This valve is built to extremely close manufacturing tolerances. Great care should be taken to keep components protected from contamination prior to and during assembly.

Threaded Inserts

1. Position actuator base (3) upside down on the work bench and support directly under each of the four floor mounting holes. Install threaded inserts into actuator base (3) by tapping lightly with a small hammer until insert flanges become flush with actuator base (3). Be sure actuator base (3) is supported to prevent breaking. Thoroughly clean actuator base (3) assembly and set aside.

2. Position actuator cam upside down on the work bench and support it at the centre hole. Insert threaded insert by tapping lightly with a small hammer until its flange becomes flush with actuator cam surface. Be sure actuator cam is supported to prevent breaking. Thoroughly clean actuator cam assembly and set aside.

3. Position pedal (1) upside down on the work bench and support it directly above the two holes near its centre. Install threaded inserts by tapping lightly with a small hammer until their flanges becomes flush with pedal (1) surface. Be sure pedal (1) is supported to prevent breaking.

4. Install oval point screws into inserts and screw down

until 12.7 mm (0.5 in) of screws protrude below insert flanges. Make sure that both screws are adjusted to the same dimension.

5. If removed, install capscrews into pedal (1) and install washers and nuts onto capscrews. Screw nuts on flush with the ends of capscrews and set the assembly aside.

Piston Guide

1. Install Polypak seal (24) and backup ring (25) into seal groove of piston guide (6). See Fig. 6.

Note: Be sure Polypak seal (24) is installed so that the internal 'O' ring will be facing the bottom of the valve when the actuator piston (7) is installed into the upper valve body (9).

2. Install 'O' ring (21) into seal groove above threads on piston guide (6).

3. Apply a thin film of oil to Polypak seal (24) and outer 'O' ring seal of piston guide (6).

4. Install backup rings (22 & 27) and 'O' rings (23 & 26) into seal grooves of piston guide (6). See Fig. 6.

Actuator Piston

Note: Glyde ring (20) assembly consists of an 'O' ring and a split glyde ring.

1. Install 'O' ring into the 'O' ring groove located at the large diameter end of actuator piston (7).

2. Install split glyde ring over the 'O' ring. Twist and squeeze the split glyde ring into a small circle before installing to ensure a tight fit over the 'O' ring.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Hold upper valve body (9) horizontally. Lightly lubricate upper regulator spool (16) and insert into regulator bore of upper valve body (9).

Note: Slide spool (16) back and forth in the regulator bore to ensure spool will slide smoothly and freely.

Note: Remove upper regulator spool (16) from bore and set aside for future assembly.

2. Hold upper valve body (9) upright and install spring seat (17), regulator spring (18) and piston return spring (19) into upper valve body (9).

3. Install actuator piston (7) assembly into piston guide (6), hold upper valve body (9) assembly upright and screw actuator piston (7) and piston guide (6) assembly into upper valve body (9). Tighten piston guide (6) assembly using a suitable spanner.

4. Secure pilot valve body (8) to upper valve body (9) with capscrews. Tighten capscrews evenly to a torque of 16 - 17 Nm (140 - 150 lbf in).

5. Lightly lubricate upper regulator spool (16) and install into regulator bore of upper valve body (9) assembly. The spherical end of regulator spool (16) should be at the towards the top of valve body (9) assembly.

Note: Set aside upper valve body (9) assembly for future assembly.

6. Hold lower valve body (11) horizontally. Lightly lubricate lower regulator spool (14) and insert into regulator bore of lower valve body (11).

Note: Slide spool (14) back and forth in the regulator bore to ensure spool will slide smoothly and freely.

7. Insert spool return spring (13) into regulator spool (14).

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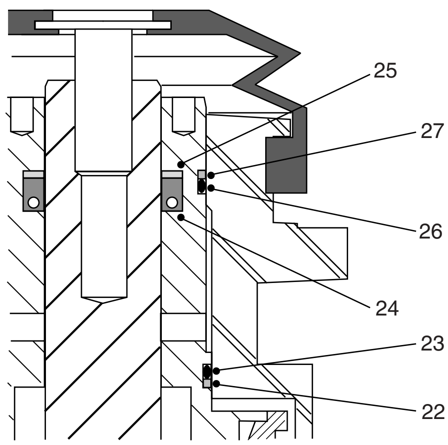


22 - Backup Ring
23 - 'O' Ring
24 - Polypak Seal
25 - Backup Ring
26 - 'O' Ring
27 - Backup Ring

Fig. 6 - Piston Guide Seal Installation

8. Install new 'O' ring on plug (12) and install into the counter bore on the bottom of lower valve body (11). Tighten plug (12) to a torque of 17 - 20 Nm (150 - 180 lbf in).

9. Lightly lubricate 'O' ring (15) and install into the counter bore in the top end of lower valve body (11).

10. Assemble lower valve body (11) to upper valve body (9) assembly, with correct port orientation as shown in Fig. 1, and secure with capscrews (10). Tighten capscrews (10) evenly to a torque of 16 - 17 Nm (140 - 150 lbf in).

11. Coat threads of adjusting screw (4) with a thin film of Loctite Primer T 747. Allow primer to cure (minimum of one minute), then screw adjusting screw (4) into actuator piston (7) all the way down until they bottom on the threads.

Note: It is extremely important to bottom-out adjustment screw (4) to prevent over pressurization during initial adjustment procedure. Excessive regulated output pressure could cause premature failure of regulator springs.

TESTING AND ADJUSTMENTS

Numbers in parentheses refer to Fig. 1.

Note: A hydraulic test fixture with capabilities similar to the one shown in Fig. 7 is required.

1. Position the valve in the test fixture to allow plunger to be activated by hand using a lever. See Fig. 8.

2. Attach pilot input supply pressure to the 'Px' port of valve body.

3. Attach main supply input pressure to 'P1' and 'P2' ports of valve body.

4. Attach tank return lines to 'T1' and 'T2' ports of valve body.

5. Attach output ports 'B1' and 'B2' to test lines. Check that all ports are used.

6. Set supply line pressure to 170 ± 3.5 bar (2 465 ± 50 lbf/in²).

7. Set pilot supply pressure to 170 ± 3.5 bar (2 465 ± 50 lbf/in²).

8. Return line pressure during this test is not to exceed 0.34 bar (5 lbf/in²).

9. Test valve with 10W hydraulic oil at 50° ± 6° C (120° ± 10° F).

Setting Manual and Pilot Pressure

1. Install actuator base (3) and secure to valve using capscrews, washers and nuts. Torque tighten capscrews to 20 - 21 Nm (180 - 190 lbf in). Install pivot pin (2) in actuator base (3) by itself without installing pedal assembly (1).

2. By taking a screw driver or pry bar and placing it under pivot pin (2) and on top of adjusting screw (4), you will be able to actuate the piston. See Fig. 8.

3. Gradually apply pressure to check for leaks. Make sure adjusting screw (4) is screwed all the way down on the threads.

4. Adjust adjusting screw (4) up (anticlockwise) in small increments until the output pressure is 138 ± 6.9 bar (2 000 ± 100 lbf/in²) at port 'B1' with adjusting screw (4) contacting actuator base (46) (fully actuated). See Fig. 8. Fine adjustment will require only turning the screw in 1/8 turn increments.

5. Cycle valve 50 times using pilot apply.

6. Actuate valve as quickly as possible. The output pressure must reach 138 ± 6.9 bar (2 000 ± 100 lbf/in²) within 1.0 seconds. Measurement of time begins the moment force is applied to move the piston.

7. With the input pressure supplied, check internal (tank) leakage of the valve at zero output pressure and full manual apply pressure. At zero output pressure, the valve must not pass more than 50 cc/min, through each tank port. At full regulated pressure, the valve must not pass more than 75 cc/min, through each tank port. If leakage is greater than specified, rebuild of the valve will be required.

8. Recheck regulated output pressures after cycling. If they have changed, readjust.

9. Apply Loctite 290 to the threads of the adjusting screw (4). Leave valve for a minimum of two minutes to allow Loctite to cure.

Note: Use a syringe to apply Loctite to threads of screw. Do not allow Loctite to spill over onto outer diameter of piston. If Loctite is allowed to set up between piston and piston guide it can result in a stuck valve.

FINAL ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Remove pivot pin (2) from actuator base (3).

2. Install boot (5) over lip of pilot valve body (8) and over head of adjusting bolt (4). Apply a light coating of Loctite Activator 710 between head of adjusting bolt (4) and boot (5). Apply Loctite 410 adhesive to boot (5) and head of adjusting bolt (4).

3. Insert pivot pin (2) through the hole in actuator base (3), through the holes in 'U' bolts, and through the pivot pin hole in the other side of actuator base (3). As pivot pin (2) is being inserted, install pedal return springs.

4. Centre pivot pin (2) and secure with nuts and washers on 'U' bolts. Tighten nuts to a torque of 16 - 17 Nm (140 - 150 lbf in).

5. Install pedal assembly (1) on actuator cam and secure with capscrews, washers and nuts.

6. Install deadband adjustment screw. Thread the screw into actuator cam until the screw contacts the flanged adjusting screw (4).

PROXIMITY SWITCH INSTALLATION AND ADJUSTMENT

Numbers in parentheses refer to Fig. 1.

1. Install proximity switch (28) into the actuator base (3) until switch is flush to 0.125" (3.18mm) above the boss on the actuator base (3).

2. Lock the proximity switch into this position with the lower jam nut.

3. Install adjusting screw and jam nut into the pedal.

4. Thread the adjusting screw into the pedal until the switch activates. Thread screw into the pedal 1/4 to 1/2 turn more.

5. Slowly apply pedal and note the pressure at which the switch 'trips'. Readjust the switch to trip at 2.5 lbf/in^2 (0.17 bar). Threading the set screw 'in' will raise the 'trip' point; backing the set screw 'out' will lower the 'trip' point. Secure the set screw with the jam nut once the proper setting is achieved.

ADDITIONAL TESTING AND ADJUSTMENT

Numbers in parentheses refer to Fig. 1.

1. Depress pedal assembly (1) as quickly as possible. The output pressure on the circuits must reach 138 ± 6.9 bar (2 000 ± 100 lbf/in^2) at port 'B1' and port 'B2' within 1 second. Measurement of time begins the moment force is applied to move pedal (1).

2. Set the deadband by placing a 0.64 mm (0.025 in) shim between the actuator base and the pedal return stop. See Fig. 9.

4. Turn adjustment screw (4) down (clockwise) until it is touching actuator cam.

5. Continue turning adjustment screw (4) clockwise until you start to see a pressure reading on the pressure gauge then back-off adjustment screw (4) 1/8 turn (anticlockwise).

6. Lock adjustment screw (4) with jam nut and remove the shim stock. Apply a few drops of Loctite 290 to adjustment screw (4) and nut.

Pedal Angle Adjustment

1. Loosen nuts at the rear of actuator cam. Do not loosen nuts on 'U' bolts.

2. Adjust pedal assembly (1) angle by turning screws located in the top face or ribbed side of pedal assembly (1). Clockwise will raise the angle and anticlockwise will lower the angle.

3. Adjust the two screws evenly. When the desired pedal angle is achieved, apply Loctite 243 on screws.

4. While holding the pedal down, retighten the rear capscrews and nuts.

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 250-0000, BRAKING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

1. Position treadle valve assembly on service access panel and secure with mounting hardware.

2. Secure service access panel to cab floor using bolts and lockwashers as removed at 'Removal'.

3. Remove blanking caps and connect hydraulic lines

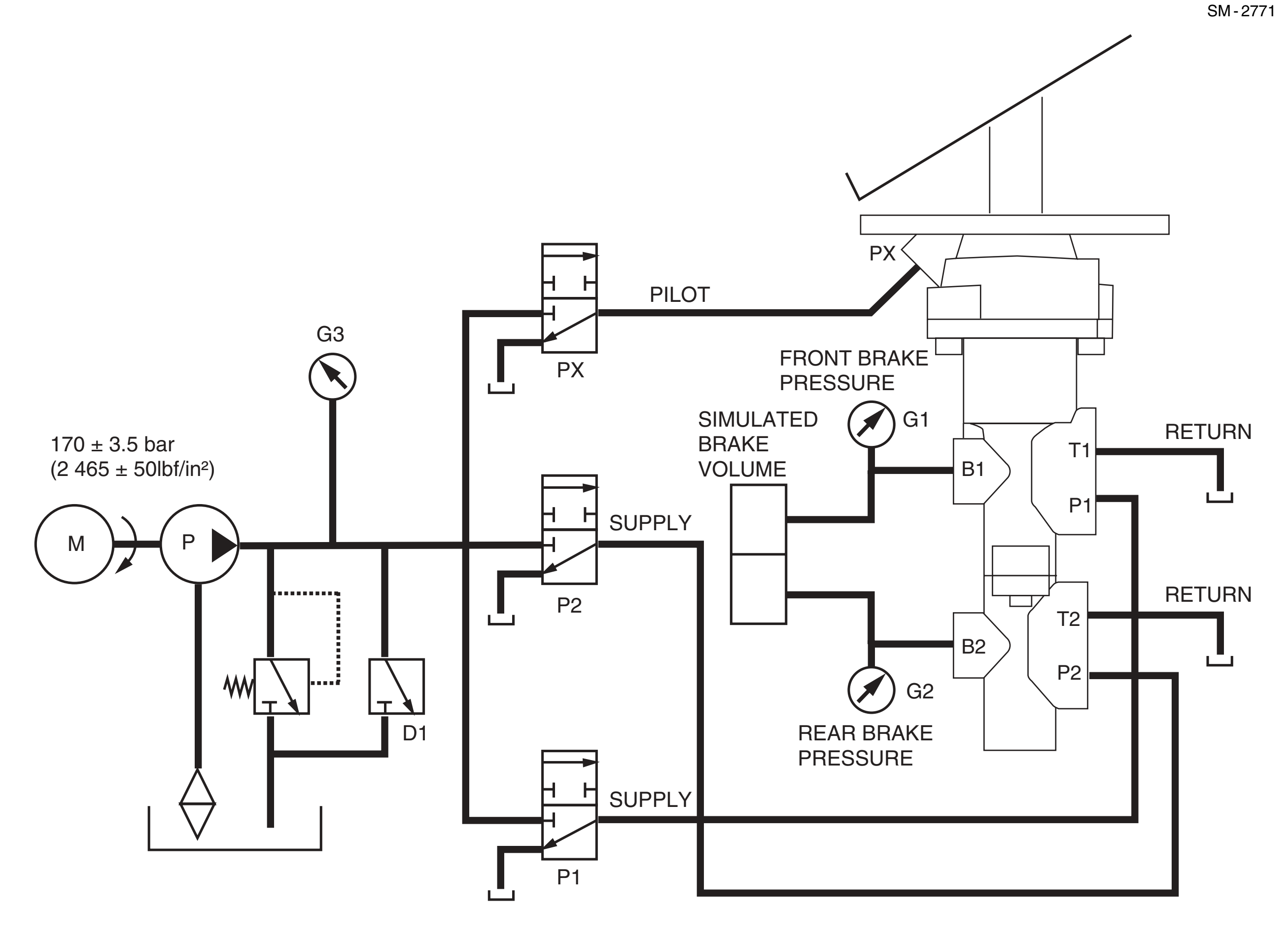


Fig. 7 - Typical Test Fixture

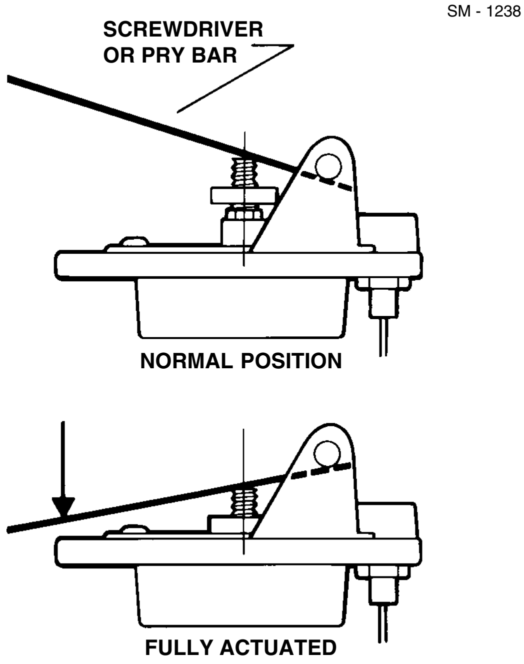


Fig. 8 - Actuator Piston Actuation

to the treadle valve assembly as noted at 'Removal'.

4. Connect electrical connections to the stop light pressure switch as noted at 'Removal'.

5. Connect electrical connections to the kick-down switch and accelerator pedal assembly as noted at 'Removal'.

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

7. Place the battery master switch in the 'On' position, start the engine and bring hydraulic oil to operating temperature.

8. Apply the brakes and check for oil leaks. Tighten line connections and fittings as necessary.

Note: When performing Step 9, make sure that parking brake applies and releases appropriately.

9. Check brake operations by actuating pedal and park

emergency control.

10. Shut off engine and check hydraulic tank oil level. Replenish as necessary.

11. Position floor mat on cab floor and ensure that the pedal assembly is free to operate.

SERVICE

Numbers in parentheses refer to Fig. 1.

Brake Actuating Pressure

Note: Test front 'B1' and rear 'B2' brake circuit actuating pressures at remote diagnostic test points (at the rear LH side of the tractor frame) and adjust if necessary.

1. Connect a hydraulic gauge capable of recording a pressure of 0 - 207 bar (0 - 3 000 lbf/in^2) to remote diagnostic pressure point for front 'B1' brake pressure.

2. Start engine and bring hydraulic oil temperature to operating temperature.

3. Actuate treadle valve fully and check reading on pressure gauge. Pressure reading should be 138 ± 6.9 bar (2 000 ± 100 lbf/in^2).

4. Repeat steps 1 through 3 at remote diagnostic pressure point for rear 'B2' brake pressure.

Note: Actuating pressure for the front and rear brake circuits is 138 ± 6.9 bar (2 000 ± 100 lbf/in^2), however, system pressure is 170 bar (2 465 lbf/in^2) and can only be checked at the pressure check point in the manifold valve. Refer to Section 250-0050, BRAKE MANIFOLD VALVE.

Note: If the pressures to the brake circuits have been determined as low or high, the pressures can be raised or lowered by an in service (in situ) adjustment.

5. Remove pedal assembly (1) from actuator cam by loosening two capscrews at the pedal heel. Note that capscrews need not be removed.

6. Loosen but do not remove nuts from 'U' bolts securing actuator pivot pin (2).

7. Remove pivot pin (2) from actuator base (3) with a punch and hammer. Remove actuator cam assembly.

8. Remove boot (5) from valve body.

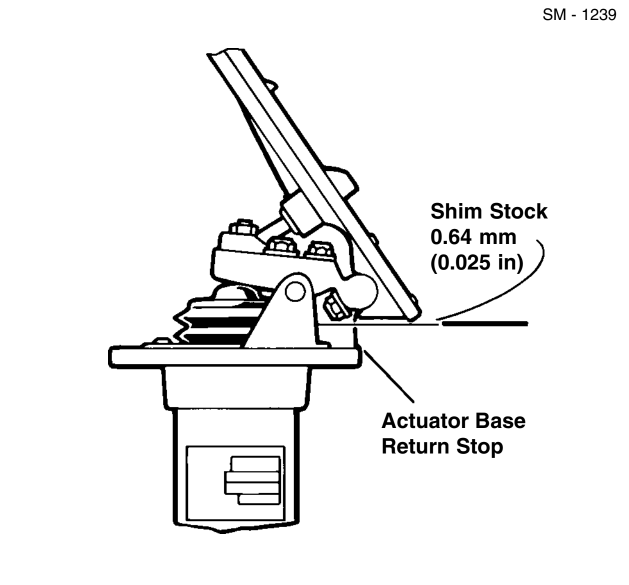


Fig. 9 - Deadband Adjustment

9. Slacken adjusting screw (4) in valve body.

10. Install pivot pin (2) in actuator base (3) and by taking a screw driver or pry bar and placing it under pivot pin (2) and on top of adjusting screw (4), you will be able to actuate each circuit individually.

11. Start engine to ensure full hydraulic pressure.

12. Test front 'B1' and rear 'B2' brake circuit actuating pressures at remote diagnostic test points (at the rear LH side of the tractor frame) and adjust if necessary. Pressures should be 138 ± 6.9 bar (2 000 ± 100 lbf/in^2).

Note: Turning adjustment screw (4) up (anticlockwise) will increase the pressure while turning it down (clockwise) will decrease the pressure. Fine adjustment will require only turning the collar in 1/8 turn increments.

14. When pressure is set correctly, apply Loctite 290 to the threads of adjustment screw (4). Leave valve for a minimum of two minutes to allow Loctite to cure.

Note: Use a syringe to apply Loctite to threads of screw. Do not allow Loctite to spill over onto outer diameter of piston. If Loctite is allowed to set up between piston and piston guide it can result in a stuck valve.

15. Shut down the engine.

16. Remove pivot pin (2) from actuator base (3).

17. Install boot (5) over lip of valve body and over head of adjusting bolt (4). Apply a light coating of Loctite Activator 710 between head of adjusting bolt (4) and boot (5). Apply Loctite 410 adhesive to boot (5)and head of adjusting bolt (4).

18. Insert pivot pin (2) through the hole in actuator base (3), through the holes in 'U' bolts, and through the pivot pin hole in the other side of actuator base (3). As pivot pin (2) is being inserted, install pedal return springs.

19. Centre pivot pin (2) and secure with nuts and washers on 'U' bolts. Tighten nuts to a torque of 16 - 17 Nm (140 - 150 lbf in).

20. Install pedal assembly (1) on actuator cam and secure with capscrews, washers and nuts.

Brake Signal Pressure Switch

Attach a continuity tester to black and brown wires on signal pressure switch located at a tee in the 'B2' line. The circuit should be open.

Note: As brake pressure increases to 2.7 bar (39 lbf/in^2) the circuit should close.

MAINTENANCE

General

Check all hydraulic brake lines and fittings at treadle valve for leaks and damage. Tighten/replace as required.

Every 1 000 Hours

Check front and rear brake pressures at remote diagnostic test points. If the pressures are outwith the specified pressure range, inspect the valve and take relevant action (adjust pressures, strip down and repair valve or replace valve).

SPECIAL 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.

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf in
1	10	Capscrew	16 - 17	140 - 150
1	12	Plug	17 - 20	150 - 180
1	28	Capscrew	16 - 17	140 - 150
1	30	Plug	21 - 24	190 - 210
1	35	Plug	10 - 11	90 - 100

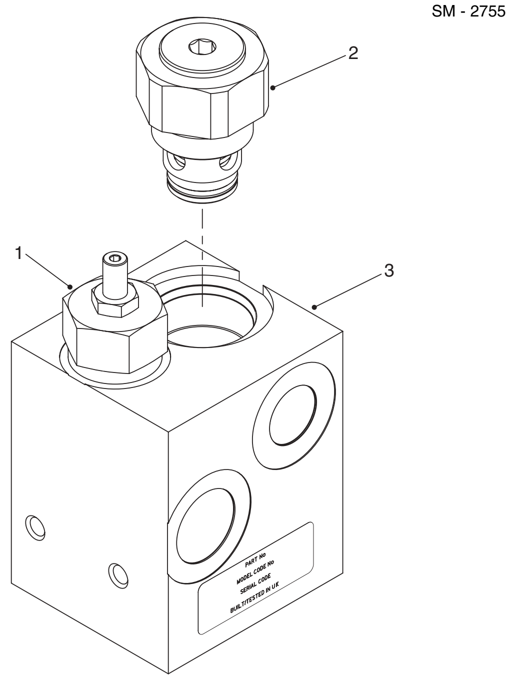
* * * *

DESCRIPTION

The priority unloader valve can be identified as item 10 in Section 250-0000, BRAKING SYSTEM SCHEMATIC. Numbers in parentheses refer to Fig. 1.

Located on the right hand side of the hydraulic cradle, the priority unloader valve comprises of an aluminium body (3) with an integral check valve (2) and unloader relief valve (1).

The priority unloader valve receives hydraulic supply from the brake section of the triple gear pump. The priority unloader valve controls pressure to the treadle valve and the brake accumulators, via the brake manifold valve. Refer to Section 250-0050, BRAKE MANIFOLD VALVE.



1 - Unloader Relief Valve
2 - Check Valve
3 - Valve Body

Fig. 1 - Priority Unloader Valve

OPERATION

Numbers in parentheses refer to Fig. 1.

Refer to Fig. 2. The priority unloader valve forms part of the brake actuation circuit. Main hydraulic supply pressure is delivered by the brake section (front section) of the triple gear pump. The priority unloader valve maintains pressure within the brake circuit to 170 bar (2465 lbf/in²). This is achieved by internally sensing the pressure within the brake circuit. When the system pressure is below the defined setting of 170 bar (2465 lbf/in²), the unloader relief valve (1) connects the supply pressure to the brake manifold valve by unseating the check valve (2), allowing the brake accumulators to charge. When the brake circuit pressure is attained, the unloader relief valve (1) diverts supply pressure to engine cooling circuit to supplement the engine cooling fan motor. The check valve (2) is now closed, isolating the brake circuit.

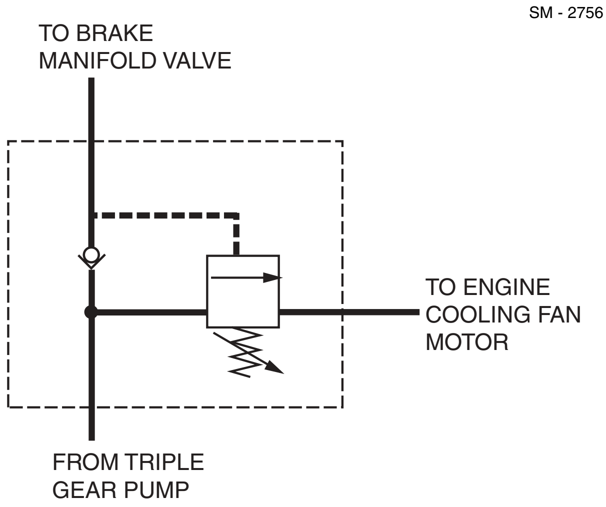


Fig. 2 - Priority Unloader Valve Schematic

FUNCTIONAL CHECK

Numbers in parentheses refer to Fig. 1.

The priority unloader valve, although adjustable, should be preset to 170 bar (2465 lbf/in²). Refer to following procedure for valve pressure check and adjustment.

⚠ **WARNING**
Hydraulic fluid pressure will remain within the system after engine shut down. Operate the treadle valve continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.

⚠ **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. Attach appropriate pressure gauge to the diagnostic check point on the brake manifold valve (Port P1).

2. Start truck and allow pressures to increase with engine at low idle, until all warning lights are extinguished.

3. Take note of the gauge reading; this is the pressure setting of the priority unloader valve. Valve should be set at 170 bar (2465 lbf/in²).

4. If pressure setting is too low after following steps 1 through 3:

(a) Ensure engine is operating at low idle.

(b) Loosen lock nut on unloader relief valve (1).

(c) Turn setting screw on unloader relief valve (1) clockwise (CW) until correct pressure is observed on gauge.

(d) Re-tighten lock nut.

Note: Always adjust hydraulic pressure on the increase.

5. If pressure setting is too high after following steps 1 through 3:

(a) Stop engine and operate treadle valve continuously to dissipate pressure in brake accumulators.

(b) Loosen lock nut on unloader relief valve (1).

(c) Turn setting screw on unloader relief valve (1) counter clockwise (CCW) 2 to 3 full turns.

(d) Re-start engine and allow pressures to rise with engine at low idle, until all warning lights are extinguished.

(e) Turn setting screw clockwise (CW) until correct pressure is observed on gauge.

(g) Re-tighten lock nut.

REMOVAL

Numbers in parentheses refer to Fig. 1.

> ⚠ **WARNING**
> **To prevent personal injury and property damage, ensure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to execute the job safely.**

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Operate treadle valve continuously to relieve pressure in the braking system.

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

3. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

4. Clean priority unloader valve body (3) and surrounding area with a suitable solvent. Identify and tag all hydraulic lines connected to the priority unloader valve, to aid in 'Installation'.

5. With suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to all open lines.

6. Remove bolts and lockwashers securing the priority unloader valve to the hydraulic cradle. Remove priority unloader valve.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

It is not recommended that any of the cartridge assemblies are disassembled for maintenance purposes. Ensure that valve assembly is cleaned off prior to removal of any components and that no contaminant is allowed to enter the internal galleries.

1. Note location and position of all hydraulic connectors and adaptors prior to removing them from valve body (3).

2. Remove unloader relief valve (1). Check for wear, scoring or contamination.

3. Remove check valve (2). Check for wear, scoring or contamination.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Replace all 'O' rings on hydraulic connectors and adaptors.

2. Replace all seals on unloader relief valve (1) and check valve (2) prior to assembly.

3. Locate unloader relief valve (1) in valve body (3) and tighten to 95 Nm (70 lbf ft).

4. Locate check valve (2) in valve body (3) and tighten to 95 Nm (70 lbf ft).

5. Install hydraulic connectors and adaptors to correct

ports and orientation.

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 250-0000, BRAKING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

1. Secure priority unloader valve to hydraulic cradle with bolts and lockwashers.

2. Remove blanking caps from hydraulic lines and install lines to the priority unloader valve 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 priority unloader valve 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.

FAULT DIAGNOSIS

Refer to following fault diagnosis chart. As stated previously, it is not recommended that any of the cartridge assemblies are disassembled for maintenance purposes. Ensure that valve assembly is cleaned off prior to removal of any components and that no contaminant is allowed to enter the internal galleries.

If investigation shows that the cartridge assemblies are in good clean condition and fit for use, the seals should be replaced prior to re-assembly. Damage to the cartridge assemblies or valve body would necessitate a new priority unloader valve assembly.

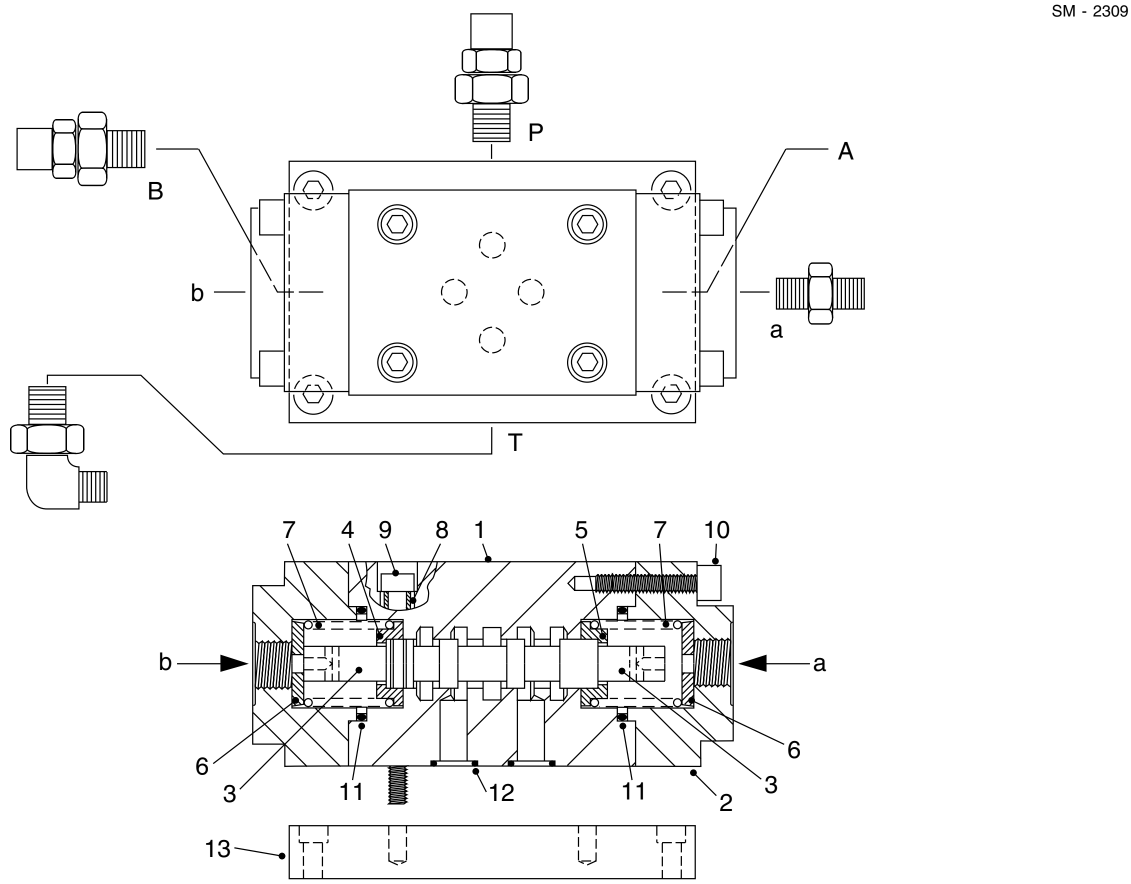
SPECIAL TOOLS

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.

PRIORITY UNLOADER VALVE FAULT DIAGNOSIS

CONDITION	REASON	ACTION
Rapid switching of unloader relief valve.	High leakage in brake circuit.	Check brake circuit for leakage.
	Internal leakage to priority unloader valve.	Replace priority unloader valve assembly.
	Check valve leaking or not seating properly.	Replace priority unloader valve assembly.
Circuit does not load or unload.	Unloader relief valve sticking.	Replace priority unloader valve assembly.
	Worn or damaged unloader relief valve.	Replace priority unloader valve assembly.

* * * *



1 - Valve Body Unit
2 - End Cover
3 - Spool
4 - Spring End Cap
5 - Spring End Cap
6 - Slide Washer
7 - Spring
8 - Spacer
9 - Allen Bolt
10 - Allen Bolt
11 - 'O' Ring
12 - 'O' Ring
13 - Sub Plate

Fig. 1 - Directional Control Valve

DESCRIPTION

Numbers and letters in parentheses refer to Fig. 1.

The directional control valve can be identified as item 8 in Section 250-0000, BRAKING SYSTEM SCHEMATIC.

The directional control valve is mounted on the cradle assembly at the rear of the cab alongside the brake manifold valve. It is located in the 'Px' hydraulic circuit between the brake manifold valve and the treadle valve. The 'Px' circuit hydraulically actuates the treadle valve when the park/emergency control switch is activated. It also controls automatic service brake applied pressure bleed down, with engine shutdown.

The directional control valve assembly comprises of a sub plate and valve body assembly. Hydraulic connections to the directional control valve assembly are made as follows:

Valve Body Assembly
Port 'a' - Transmission pilot pressure
Port 'b' - Case drain to tank

Sub Plate
Port 'A' - Plugged
Port 'B' - To 'Px' port at treadle valve
Port 'P' - Supply line from brake manifold valve
Port 'T' - Tank return

OPERATION

Numbers in parentheses refer to Fig. 1. Figs. 2 and 3 are shown with brake manifold valve de-energized.

Refer to Fig. 2. Engine shutdown, park/emergency control switch applied, results in a loss of transmission pilot pressure at port 'a'. The resultant spool (3)

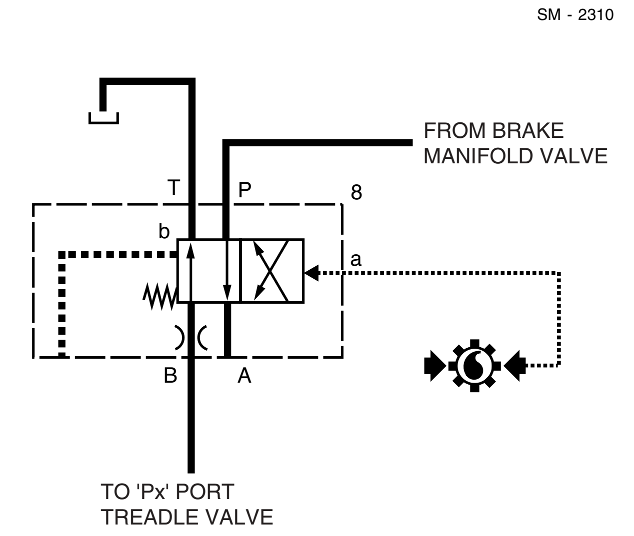


Fig. 2 - Directional Control Valve - De-energised

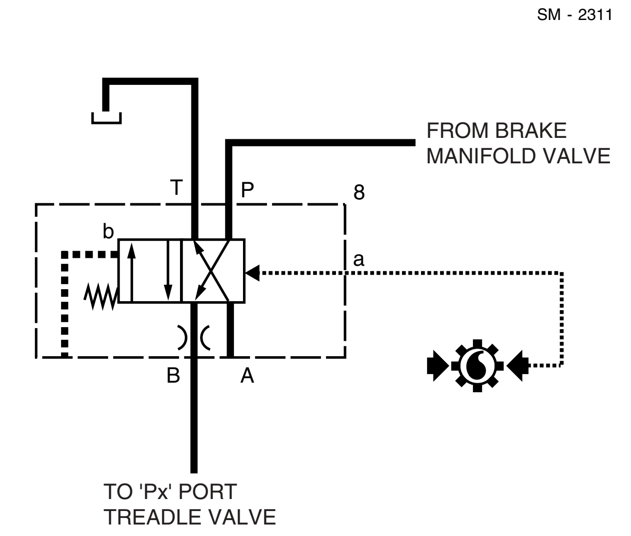


Fig. 3 - Directional Control Valve - Energised

movement under the influence of compressed spring (7) links port 'B' to port 'T' permitting a controlled bleed down of the applied service brakes to tank at port 'T'. This controlled bleed down permits a synchronised service brake release/mechanical park brake application. Refer to Section 250-0000, BRAKING SYSTEM SCHEMATIC.

Note: With engine shutdown, brake manifold valve pressure is dead headed at ports 'P' and 'A'.

Refer to Fig. 3. When the engine is running, transmission hydraulic pilot pressure enters the directional control valve through port 'a'. Spool (3) is pushed by this pressure and compresses spring (7) on port 'b' side of directional control valve. This movement internally links port 'P' to 'B' in sub plate (13).

With transmission pilot pressure operating at port 'a', the directional control valve (energised) has an open circuit between the brake manifold valve and port 'Px' in the treadle valve. This permits a flow of oil to either energise the 'Px' port at the treadle valve, or, exhaust the 'Px' port through the manifold block to tank, dependant on operation of the brake manifold valve. The brake manifold valve is controlled by the park/ emergency control switch.

Port 'b' is connected as a drain to tank to prevent excess oil forming a hydraulic lock within the directional control valve. This could result in erratic park brake operation.

REMOVAL

⚠ **WARNINGS**
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.

⚠ **Hydraulic fluid pressure will remain within the system after engine shut down. Operate the treadle pedal continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.**

1. Position the vehicle in a level work area, apply the parking brake, switch off the engine and turn steering wheel in both directions several times to relieve any pressure in the steering circuit.

2. Operate the treadle valve continuously to relieve pressure in the braking system. Block all road wheels and place battery master switch in the 'Off' position.

3. Remove mounting hardware securing cover plate to cradle assembly at the rear of the cab. Remove cover plate to gain access to directional control valve.

4. Ensure all hydraulic lines connected to the directional control 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 and fittings.

5. Release and remove mounting hardware and remove directional control valve from the vehicle. Move directional control valve to a clean area for disassembly.

DISASSEMBLY/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.

Note: With the exception of replacing 'O' rings (11 & 12), the directional control valve is a non serviceable item and should be replaced as a complete assembly. The 'O' rings can be replaced as follows:

1. Note orientation of valve body (1) to sub plate (13) to facilitate assembly.

2. Clamp sub plate (13) lightly in a soft jawed vice and remove allen bolts (9) and spacers (8).

3. Separate valve body (1) from sub plate (13) and discard 'O' rings (12).

4. Install new 'O' rings (12) in valve body (1) and fit valve body (1) to sub plate (13) as noted prior to disassembly. Install spacers (8) in valve body (1) and secure valve body (1) to sub plate (13) with allen bolts (9).

5. Remove allen bolts (10) and end covers (2) from valve body (1) and discard 'O' rings (11).

6. Install new 'O' rings (11) in end covers (2) and secure to valve body (1) with allen bolts (10).

BENCH TEST

Letters in parentheses refer to Fig. 1.

1. Install directional control valve on a test bench and connect as follows:

a. Install hydraulic supply capable of 0 - 159 bar (0 - 2 300 lbf/in²) to port 'P'.

b. Install hydraulic supply capable of 0 - 21 bar (0 - 300 lbf/in²) to port 'a'.

c. Install a suitable return line to port 'T'.

d. Install a pressure gauge suitable for 0 - 207 bar (0 - 3 000 lbf/in²) to port 'D'.

2. Make sure all control valves to supply lines are closed.

3. Turn on hydraulic power supplies and make sure hydraulic oil is at normal operating temperature.

4. Open control valve for port 'P' supply and adjust to give a supply reading of 185 bar (2 682 lbf/in²). Reading on pressure gauge at port 'B' should be zero.

Note: The directional control valve starts to de-energise (close) when transmission pilot pressure falls below 7 bar (100 lbf/in²) and is fully de-energised (closed) when transmission pilot pressure falls to 5.5 bar (80 lbf/in²).

5. Open control valve for port 'a' supply and slowly increase this supply pressure from 0 - 21 bar (0 - 300 lbf/in²) thus energising (opening) directional control valve. Pressure reading at port 'B' should now read 185 ± 7 bar (2 682 ± 100 lbf/in²). Reading on pressure gauge at port 'B' should begin to fall when supply pressure at port 'a' drops to 7 bar (100 lbf/in²). This rate of fall should reach a maximum rate when supply pressure at port 'a' drops to 5.5 bar (80 lbf/in²) or below. With supply pressure at port 'a' at 5.5 bar (80 lbf/in²) or less, pressure on gauge at port 'B' should quickly drop to almost zero, by exhausting to tank via port 'T'.

6. Slowly energise (open) control valve for port 'a' supply. Pressure reading at port 'B' should start to rise when pressure at port 'a' reaches 5.5 bar (80 lbf/in²). Rate of pressure increase at port 'B', should reach a maximum level, when supply pressure at port 'a' reaches 7 bar (100 lbf/in²) or above.

7. Close all control valves and turn off hydraulic supply pressures. Bleed off hydraulic supply lines and remove directional control valve from test bed for installation.

INSTALLATION

Note: Tighten all fasteners to 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.

1. Position directional control valve assembly on the vehicle and secure with mounting hardware removed at removal.

2. Remove blanking caps from hydraulic lines and fittings and connect to directional control valve as recorded at removal.

3. Secure cover plate to the cradle assembly with mounting hardware removed at removal.

4. 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.

5. Place the battery master switch in the 'On' position, remove all wheel blocks, start the engine and bring hydraulic fluid to operating temperature.

6. Apply all brakes in sequence. Check directional control valve for leaks and tighten connections as required.

7. Shut off engine and make sure a full service brake application is made followed by a parking brake application.

8. Repeat all braking and engine shut down cycles several times and check for appropriate application/ release cycle several times. Check for appropriate warning light indications.

9. Check all connections again for leaks and tighten as required. Check hydraulic oil tank level and replenish as required.

MAINTENANCE

Inspect directional control valve assembly for leaks. If leaks are found, replace seals with seal kit listed in the vehicle parts book. Inspect hydraulic lines for wear and leaks. Replace/tighten lines as required.

SPECIAL 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.

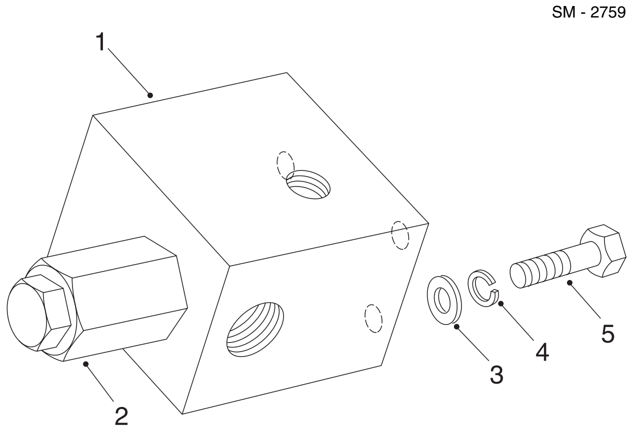
* * * *

DESCRIPTION

Numbers in parentheses refer to Fig. 1. The pressure relief valve can be identified as item 4 in Section 210-0005, COOLING SYSTEM SCHEMATIC.

Mounted on the disc brake oil cooler casing on the right hand fender, the pressure relief valve houses a direct acting relief valve cartridge (2).

The pressure relief valve is installed between the triple gear pump and the two speed control valve. Pressure relief valve limits the maximum pressure in the disc brake cooling circuit.



1 - Valve Body
2 - Relief Valve Cartridge
3 - Washer
4 - Lockwasher
5 - Bolt

Fig. 1 - Pressure Relief Valve

OPERATION

Numbers in parentheses refer to Fig. 1.

The pressure relief valve houses a direct acting pressure relief cartridge (2), set at 200 bar (2900 lbf/in^2). The relief cartridge (2) controls pressure supplied to brake cooling circuit by triple gear pump, bypassing excess pressure back to the main hydraulic tank.

REMOVAL

Numbers in parentheses refer to Fig. 1.

WARNINGS
Hydraulic fluid pressure will remain within the system after engine shut down. Operate the treadle valve continuously until the pressure has dissipated before carrying out any work on the braking system or serious injury could result.

To prevent personal injury and property damage, ensure wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to execute 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. Place steering lock bar in the 'Locked' position.

3. Remove guard from rear of disc brake oil cooler. Refer to Section 210-0050, DISC BRAKE OIL COOLER.

4. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

5. Clean pressure relief valve and surrounding area with a suitable solvent. Identify and tag all hydraulic lines connected to pressure relief valve, to aid in 'Installation'.

6. With suitable containers available to catch leakage, disconnect hydraulic lines. Fit blanking caps to all open lines.

7. Remove bolts (5) and washers (3 & 4) securing pressure relief valve to disc brake oil cooler casing. Remove pressure relief valve from casing.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Note location of all hydraulic connectors and adaptors and remove from valve body (1).

2. Remove relief valve cartridge (2) 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 relief valve cartridge (2) for damage. Ensure valve seat is not worn, scored or cracked.

It is not recommended that the cartridge assembly is disassembled for maintenance purposes. Ensure that valve assembly is cleaned prior to removal of any components and that no contaminant is allowed to enter the internal galleries.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Replace seals on relief valve cartridge (2).

2. Install relief valve cartridge (2) into valve body (1) and torque to 59 Nm (44 lbf ft).

3. Install hydraulic connectors and adaptors to correct ports and orientations.

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 250-0000, BRAKING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

1. Secure pressure relief valve to disc brake oil cooler casing with bolts (5), washers (3) and lockwashers (4).

2. Remove blanking caps from hydraulic lines and install lines to the pressure relief valve 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 pressure relief valve 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.

FAULT DIAGNOSIS

Refer to following fault diagnosis chart. As stated previously, it is not recommended that the cartridge assembly is disassembled for maintenance purposes. Ensure that valve assembly is cleaned off prior to removal of any components and that no contaminant is allowed to enter the internal galleries.

If investigation shows that the cartridge assembly is in good clean condition and fit for use, the seals should be replaced prior to re-assembly. Damage to the cartridge assembly or valve body would necessitate a new pressure relief valve assembly.

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.

FAULT DIAGNOSIS

CONDITION	REASON	ACTION
Cannot raise pressure.	No oil supply.	Check triple gear pump. Check hydraulic oil level.
	Relief valve sticking.	Clean relief valve.
	Relief valve spring broken	Replace relief valve cartridge.
Circuit pressure too high.	Relief valve sticking.	Clean relief valve.
Overheating.	Relief valve worn.	Replace relief valve cartridge.

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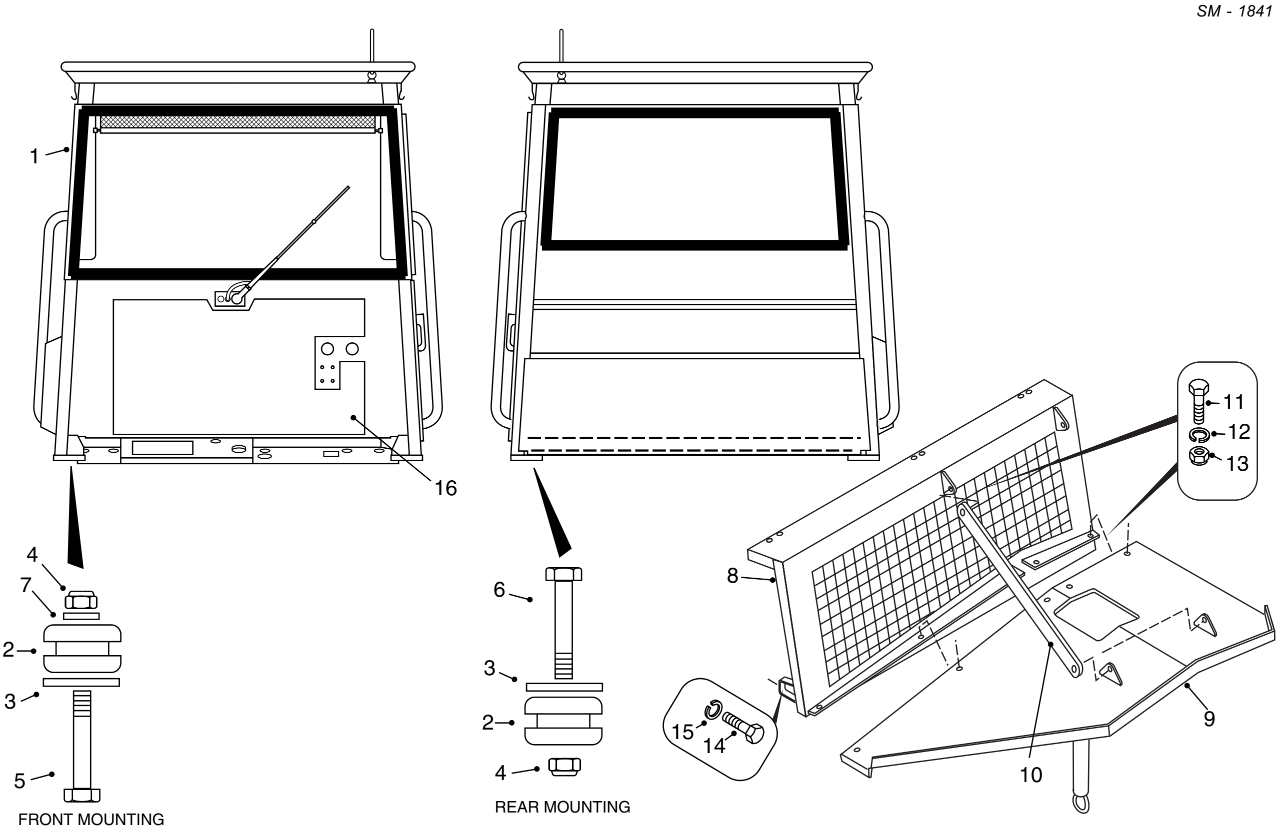


1 - Cab Assembly
2 - Isolation Mount
3 - Washer
4 - Locknut
5 - Bolt
6 - Bolt
7 - Hardened Washer
8 - Rear Window Guard
9 - Spill Guard
10 - Support
11 - Bolt
12 - Lockwasher
13 - Locknut
14 - Bolt
15 - Lockwasher
16 - Firewall Barrier Mat

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).*

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.**

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. Operate steering right and left several times to relieve pressure in the steering system.

2. Operate the treadle valve continuously to discharge the brake accumulators, 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 (inside cab) to release hood catch and lift up hood assembly.

4. Disconnect the following cables and connectors in the order given, to prevent serious damage to the vehicles electrical components.

a - Battery earth cables
b - Battery supply cables
c - Alternator earth cables
d - Alternator supply cables
e - Body hydraulics joystick
f - Transmission (Est-37) connector
g - ECM interface harness connector (30 pin RHS)
h - ECM power harness connector (5 pin RHS)
i - ECM sensor harness connector (30 pin LHS)
j - ECM engine to transmission datalink connector (6 pin RHS)

5. Carefully loosen brake pipes at base of both accumulators to check that brake pressure has been discharged. Tighten brake pipes.

6. Remove blanking cap from remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain hydraulic oil into a suitable container. Close drain cock, remove hose and reinstall blanking cap.

7. Remove mounting hardware and cover plate from front left hand of cab assembly (1). Tag and disconnect electrical harnesses and connections.

8. Tag and disconnect the harnesses and hoses at the underside of the manifold on the right-hand side of the cab. Disconnect cab earth strap at rear left hand cab leg.

> ⚠ **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.**

9. Evacuate air conditioning system and disconnect air conditioner lines. Refer to Section 260-0130, AIR CONDITIONING. Fit blanking caps to all open lines and fittings.

10. 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.

11. 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.

12. Remove mounting hardware securing the treadle valve and accelerator pedal mounting plate to the cab floor and lower the assembly from the cab.

13. With a suitable container in position, drain the cooling system. Refer to Section 210-0000, COOLING SYSTEM.

14. Remove mounting hardware and cover plate from cradle assembly at rear left hand side of the cab.

15. Ensure brake lines and steering lines are identified for ease of installation and with suitable containers available to catch leakage, disconnect lines. Fit blanking caps to all open lines and ports.

16. Unhook hoses from elastic supports at underside of spill guard (9) and secure hoses away from guard so as not to foul when lifting the cab.

17. Attach suitable lifting equipment to support spill guard (9) and remove bolts (11), lockwashers (12) and locknuts (13) securing spill guard (9) and supports (10) to window guard (8). Taking care to prevent damage to *exhaust stack, carefully lift spill guard (9) from unit.*

18. Disconnect ball joint and clips securing hood release cable to goalpost and lock mechanism.

19. Remove mounting hardware securing air cleaner assembly to right hand fender. Slacken mounting clamp at air cleaner intake pipe and draw air cleaner, complete with rubber hose, away from intake pipe and cowl. Cover open ends to prevent entry of dirt.

20. Attach suitable lifting equipment to the cab lifting points and raise lifting equipment to take up the slack.

21. 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.

22. 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 lifting equipment 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. Slide cowl assembly into position and secure using mounting hardware removed during removal.

6. Position air cleaner assembly on right hand fender, reconnect intake pipe and tighten mounting clamp. Secure air cleaner to fender using mounting hardware removed during removal.

7. Reconnect ball joint to lock mechanism and secure hood release cable to goalpost using material removed during removal.

8. Attach suitable lifting equipment to spill guard (9) and taking care to prevent damage to exhaust stack, position onto mounting brackets on window guard (8) at rear of cab. Secure using bolts (11), lockwashers (12), locknuts (13) and supports (10).

9. Secure hoses to underside of spill guard (9) using elastic supports.

10. Connect brake lines and steering lines as identified at removal.

11. Install treadle valve and accelerator pedal mounting plate assembly and secure to cab floor with mounting hardware removed during removal.

12. 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.

13. Connect the heater hoses to the cab as identified at removal.

14. Connect air conditioning lines and charge air conditioning system. Refer to Section 260-0130, AIR CONDITIONING.

15. 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 left hand cab leg.

16. Connect electrical harnesses at cab bulkhead.

17. Fill the cooling system with coolant specified in Section 300-0020, LUBRICATION SYSTEM.

18. Connect electrical connections and cables in reverse order to removal, with battery earth cable last.

19. 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.

20. Ensure parking brake is applied and remove wheel blocks from all road wheels.

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.

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.

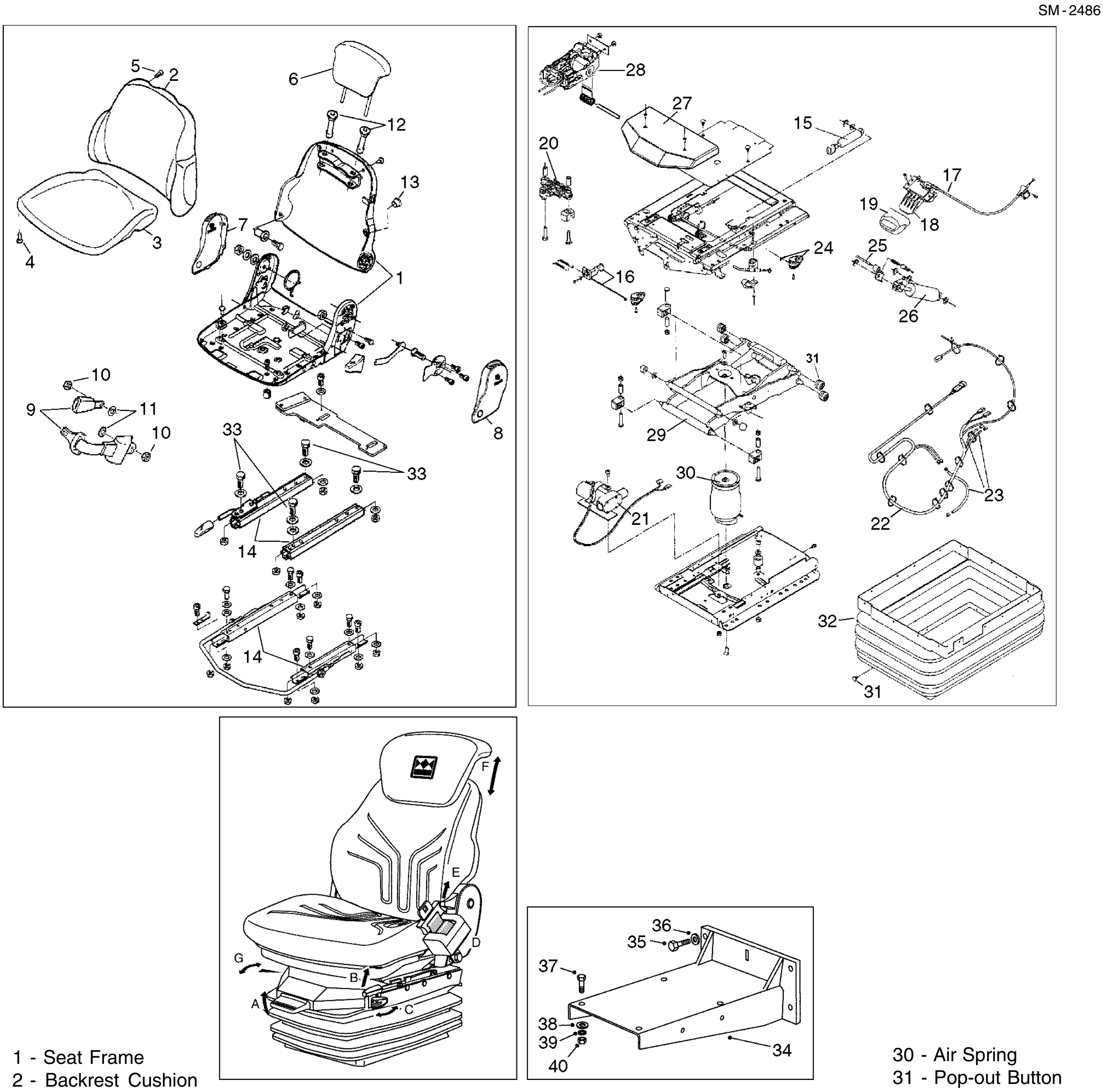
This should stop the leak immediately, but since some sealing compounds should be allowed to set before getting wet, wait a few minutes before testing.

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				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	4	Locknut	380	280

*   *   *   *



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. 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).

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.

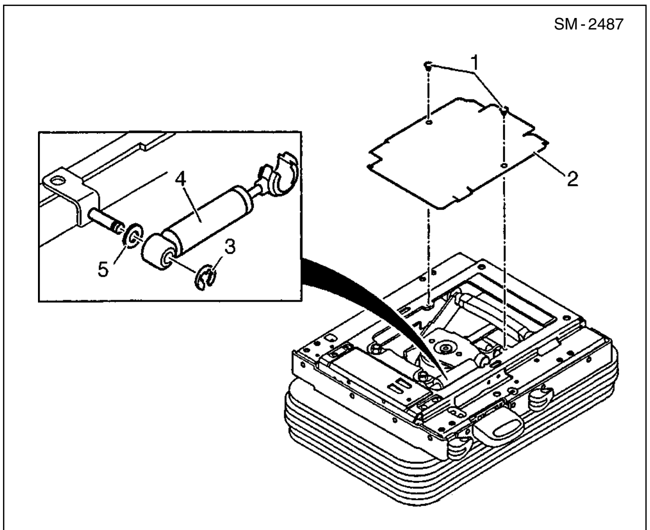


Fig. 2 - Exploded View of Horizontal Shock Absorber

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).

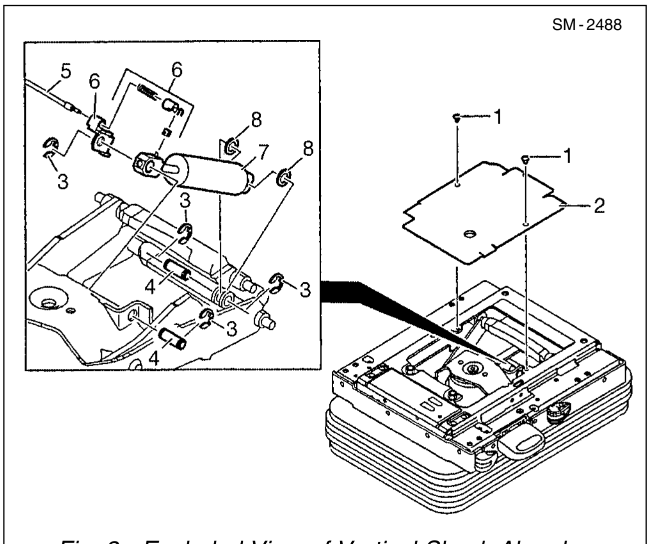


Fig. 3 - Exploded View of Vertical Shock Absorber

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).

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.

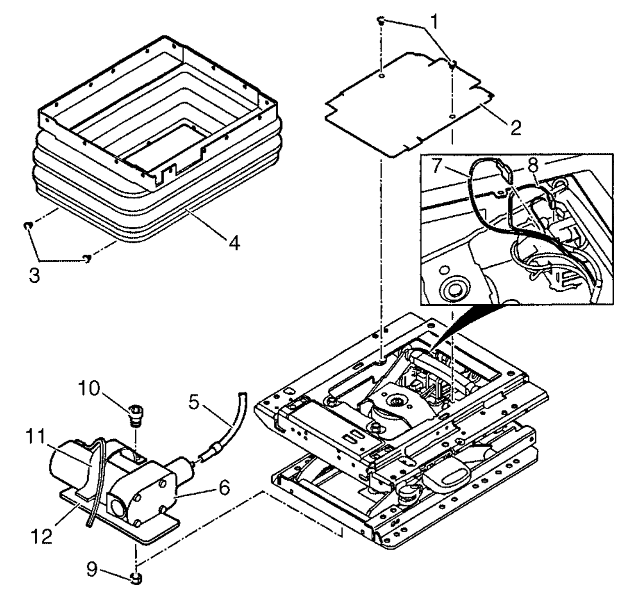


Fig. 4 - Exploded View of Compressor and Mounting

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).

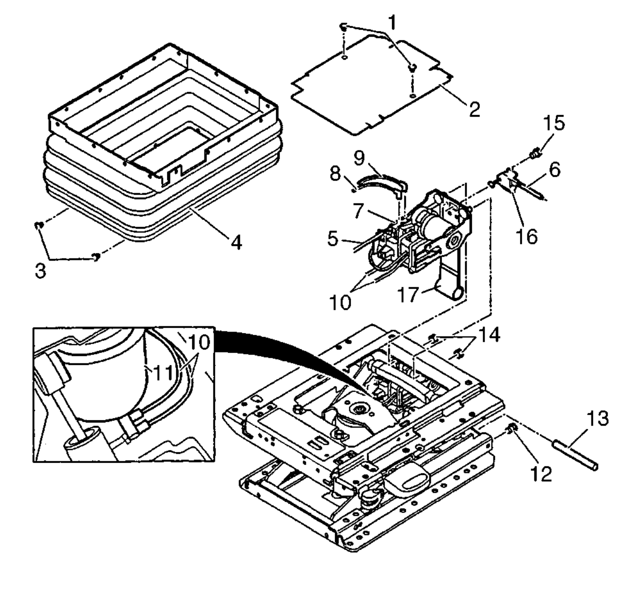


Fig. 5 - Exploded View of Level Controller and Mounting

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.

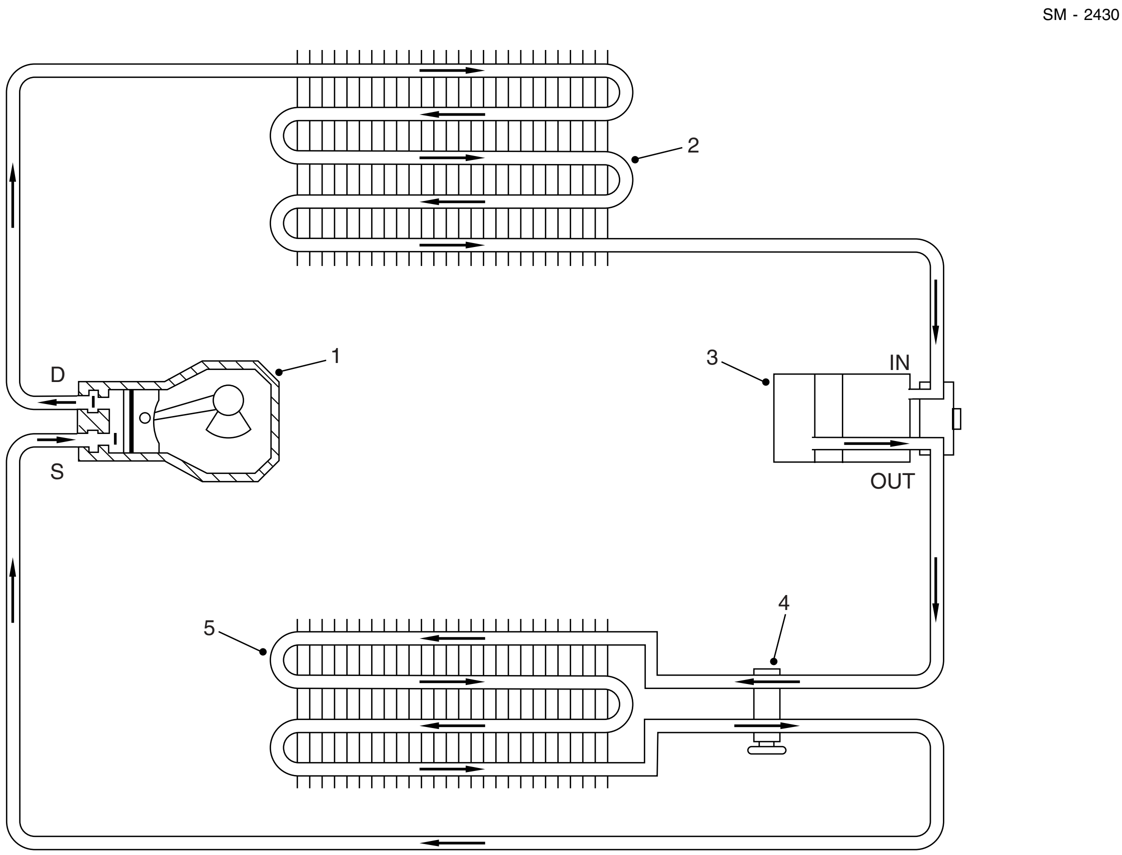
Lap belt (9) assembly should be inspected by the user on a regular basis. Replace lap belt (9) immediately if hardware is worn or damage, straps are nicked or frayed, buckle is not functioning correctly, loose stitching is found, or if the strap material has lost strength due to the effects of ultraviolet rays.

Note: Regardless of appearance, lap belt (9) must be removed and replaced at least once every three years.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	10	Nut	50	36
1	33	Allen Screw	25	18
5	14	Nut	25	18

* * * *



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 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.

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 R-134a contacts your skin, wash immediately with plenty of warm water. Remove any contaminated clothing with caution as it may adhere to the skin. If blistering or continued irritation occurs obtain immediate medical attention.**
>
> ⚠ **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 when burned produce gases 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. Operate steering right and left several times to relieve pressure in the steering system.

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 (45, Fig. 3) and lockwashers (46, Fig. 3) securing front cover and filter assemblies on air conditioner (1) outer box.

8. Disconnect harness (4, Fig. 3) and unhook control cable (47, Fig. 3) from water valve (48, Fig. 3).

9. Remove bolts (40, Fig. 3), lockwashers (41, Fig. 3) and washers (42, 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.

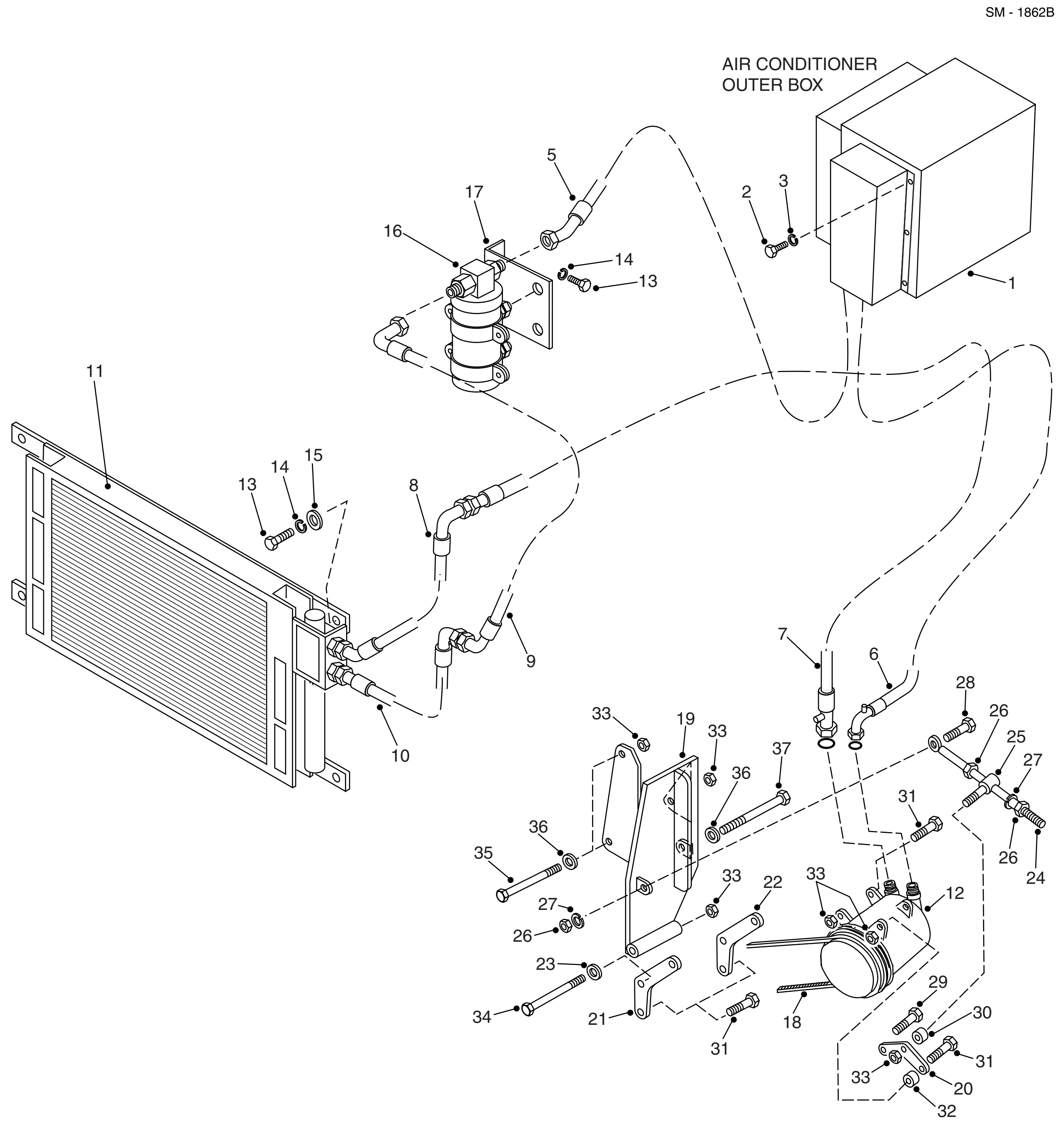
11. Support receiver/drier (16) and remove nuts securing receiver/drier (16) to mounting bracket (17). If necessary, remove bolts (13), lockwashers (14) and mounting bracket (17) from engine block.

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.

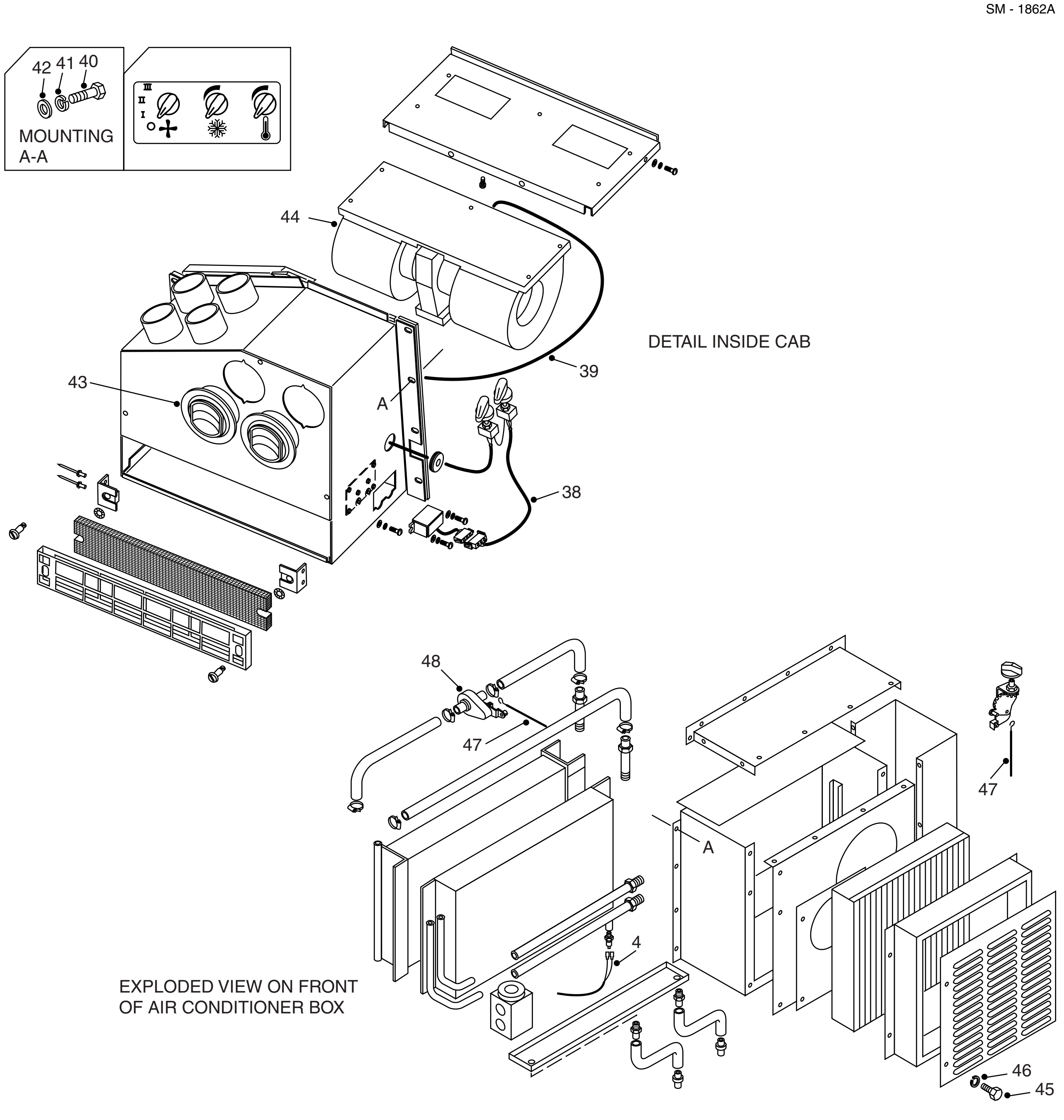
14. Tag refrigerant hoses (6 & 7) to aid in installation and carefully disconnect hoses from compressor (12). Cap compressor (12) fittings and refrigerant hoses (6 & 7) to prevent foreign matter from entering the system.

15. Disconnect electrical connection from compressor (12) clutch.



1 - Air Conditioner	11 - Condenser	20 - Adjuster Bracket	29 - Bolt
2 - Screw	12 - Compressor	21 - Adjuster Bracket	30 - Spacer
3 - Lockwasher	13 - Bolt	22 - Adjuster Bracket	31 - Bolt
5 - Refrigerant Hose	14 - Lockwasher	23 - Washer	32 - Spacer
6 - Refrigerant Hose	15 - Washer	24 - Adjuster Rod	33 - Locknut
7 - Refrigerant Hose	16 - Receiver/Drier	25 - Adjuster Block	34 - Bolt
8 - Refrigerant Hose	17 - Bracket	26 - Nut	35 - Bolt
9 - Refrigerant Hose	18 - 'V' Belt	27 - Lockwasher	36 - Washer
10 - Refrigerant Hose	19 - Bracket	28 - Bolt	37 - Bolt

Fig. 2 - Air Conditioner Lines and Mounting



4 - Harness
38 - Harness
39 - Harness
40 - Bolt
41 - Lockwasher
42 - Washer
43 - Cover
44 - Blower Unit
45 - Bolt
46 - Lockwasher
47 - Control Cable
48 - Water Valve

Fig. 3 - Air Conditioner Lines and Mounting

16. Slacken nuts (26) and lockwasher (27) on adjuster rod (24) to release tension on 'V' belt (18).

17. Slacken locknut (33) on bolt (34). 'V' belt (18) should now be free to slide off of groove in compressor (12).

18. Slacken nut (26) on bolt (28). Remove locknut (33) and spacer and slide adjuster block (25) clear of compressor (12). Remove bolt (28), lockwasher (27), nut (26) and adjuster rod assembly (24) from mounting bracket (19).

19. Support compressor (12) and remove bolt (34), washer (23) and locknut (33) 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 20 and 21.

20. If required, remove mounting hardware securing fan guard assembly to radiator shroud assembly. Refer to SECTION 210-0040, RADIATOR AND MOUNTING.

21. 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.

22. If required, remove bolts (35 & 37), locknuts (33), washers (36) and bracket (19) from engine timing case.

23. If required, disconnect all clamps and clips securing refrigerant hoses and harnesses to the vehicle. Remove hoses and harnesses from the vehicle.

24. If necessary to gain access to blower unit (44, Fig. 3), disconnect harnesses (38 & 39, Fig. 3) and air ducting tubes from air conditioning unit (located in the right hand side of the cab). Remove bolts (40, Fig. 3), lockwashers (41, Fig. 3), washers (42, Fig. 3) and slide cover (43, 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, slide air conditioner cover (43, Fig. 3) into position inside the cab and connect harnesses (38 & 39, Fig. 3) and air ducting tubes. Secure cover (43, Fig. 3) with bolts (40, Fig. 3) and lockwashers (41, Fig. 3).

2. If removed, position air conditioner (1) outer box assembly over aperture on right hand side of cab. Secure outer box assembly with bolts (40, Fig. 3), lockwashers (41, Fig. 3) and washers (42, Fig. 3).

3. Connect harness (4, Fig. 3) and attach control cable (47, Fig. 3) to water valve (48, Fig. 3).

4. Position front cover and filter assemblies on air conditioner (1) outer box and secure using bolts (45, Fig. 3) and lockwashers (46, Fig. 3).

5. Remove caps from end of refrigerant hoses (5 & 6) and ports on air conditioner (1) and connect hoses to ports as tagged at removal.

6. Route refrigerant hoses (5 & 6) behind the engine and along the LH side of the engine securing with clamps removed during removal.

7. If removed, install receiver/drier (16) to mounting bracket (17) and secure with nuts as removed at removal. Secure assembly to engine block with bolts (13) and lockwashers (14).

8. Remove caps from end of refrigerant hoses (5 & 9) and ports on receiver/drier (16) and connect hoses to ports as tagged at removal.

9. If removed, install condenser unit (11) to radiator assembly and secure with bolts (13), washers (15) and lockwashers (14).

10. Remove caps and connect refridgerant hoses (7, 8, 9 & 10) to radiator cowl and condenser unit (11) ports as tagged at removal.

11. If removed, install mounting bracket (19) to engine timing case and secure using bolts (35 & 37), washers (36) and locknuts (33) as shown in Fig. 2.

12. Fit compressor (12) to mounting bracket (19) and secure with bolt (34), washer (23) and locknut (33). 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 11 & 12.

13. Install new 'V' belt (18) onto rear groove on engine fan pulley and fit to rear groove on compressor (12).

14. 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.

15. Install spacer (30) on adjuster block (25). Locate adjuster block (25) through centre hole in adjuster bracket (20) and secure in place with locknut (33).

16. Support compressor (12) and position eyelet of adjuster rod (24) adjacent to lug on bracket (19) and secure with bolt (28), lockwasher (27) and nut (26).

17. Adjust tension of compressor 'V' belt with nuts (26) on adjuster rod (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.

18. Remove caps from end of refrigerant hoses (6 & 7) and ports on compressor (12) and connect hoses to ports as tagged at removal.

19. Connect electrical connection to compressor (12) clutch.

20. 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.

21. Charge the air conditioning system as described under 'Charging Procedure'.

22. Switch the battery master switch to the 'On' position, start up the engine and check for correct operation of the air conditioning system.

24. Secure cover to air conditioner (1) outer box using screws (2) and lockwashers (3). Lower hood assembly and remove wheel chocks.

MAINTENANCE

⚠ **WARNING**
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 R-134a contacts your skin, wash immediately with plenty of warm water. Remove any contaminated clothing with caution as it may adhere to the skin. If blistering or continued irritation occurs obtain immediate medical attention.

⚠ **WARNINGS**
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 when burned produce gases 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.
- 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.

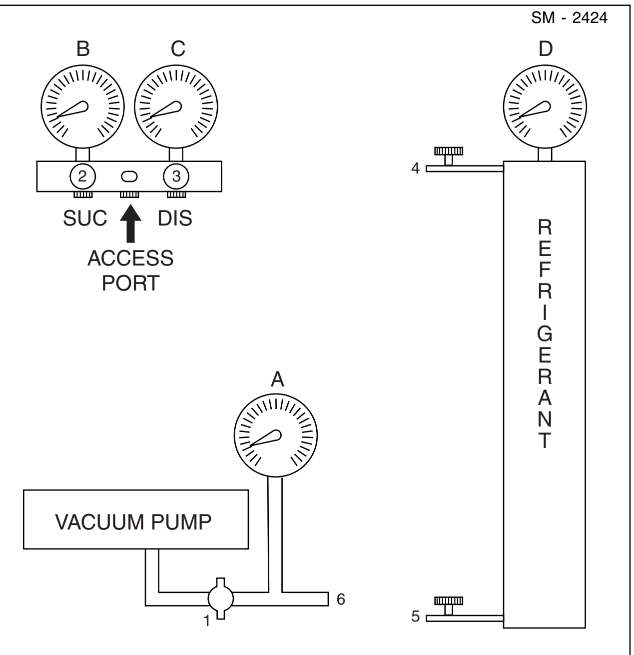
System Leak Testing

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.

DISCHARGING THE SYSTEM



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:

Fig. 4 - Standard Service Manifold

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.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Turn steering wheel several times to relieve pressure in the steering circuit.

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 then a 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'.

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/in^2) 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.

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

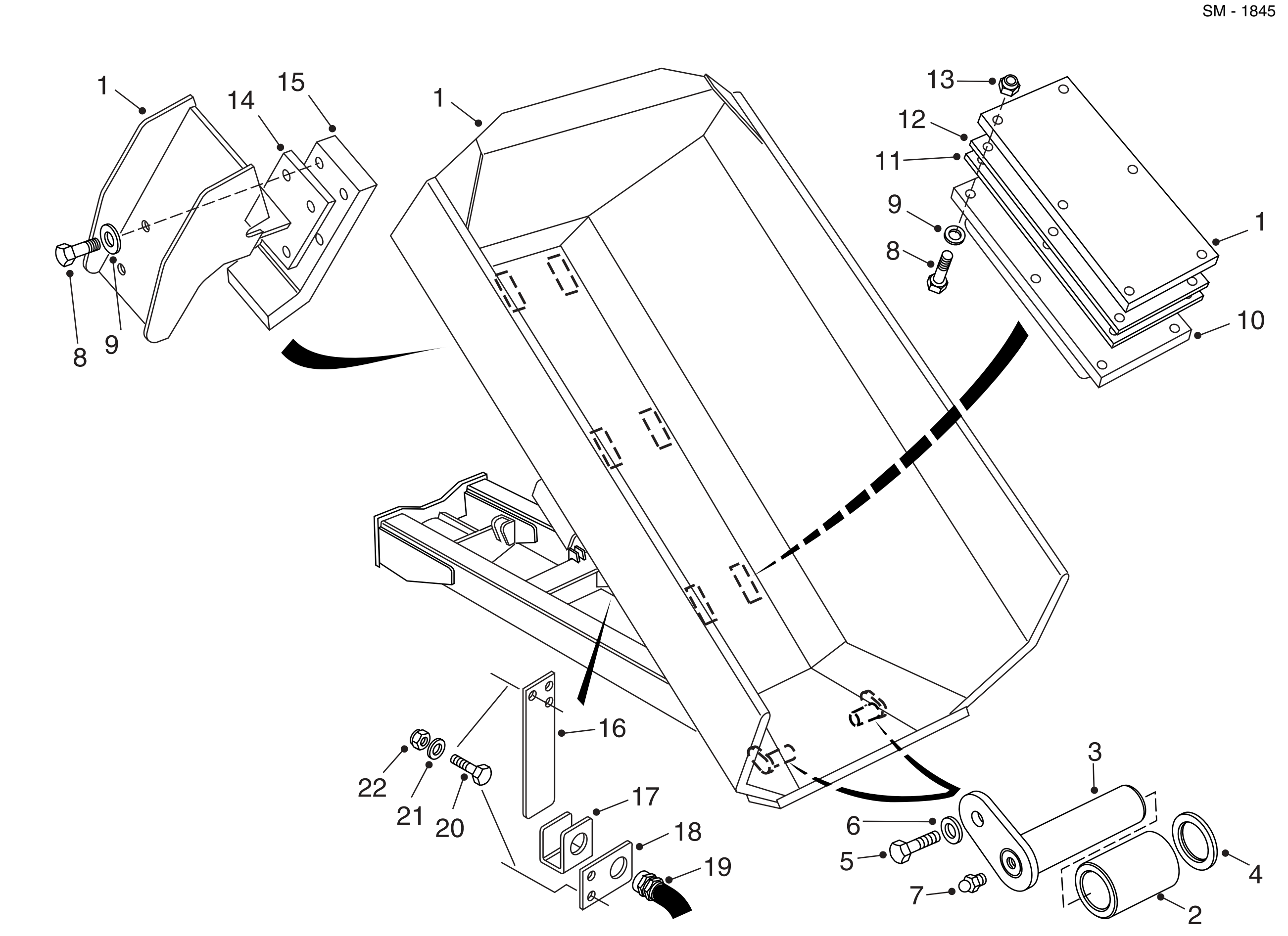
Refer to Section 300-0070, SERVICE TOOLS, for part numbers of special tools referenced in this section and general service tools and sealants required. These tools and sealants are available from your dealer.

AIR CONDITIONING DIAGNOSIS		TABLE158
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

AIR CONDITIONING DIAGNOSIS (CONT.)		
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 Conditiong 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

AIR CONDITIONING DIAGNOSIS (CONT.)		
CONDITION	PROBLEM	REMEDY
6. Air Conditiong 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

* * * *



1 - Body	7 - Grease Fitting	13 - Locknut	18 - Plate
2 - Bushing	8 - Bolt	14 - Spacer	19 - Proximity Switch
3 - Body Hinge Pin	9 - Washer	15 - Plate	20 - Bolt
4 - Shim	10 - Body Pad	16 - Plate	21 - Washer
5 - Bolt	11 - Shim	17 - Bracket	22 - Locknut
6 - Washer	12 - Shim		

Fig. 1 - Body and Mounting

DESCRIPTION

The standard body is an all welded construction with all wear plates fabricated from high hardness (min. 360 BHN) 10 150 bar (145 000 lbf/in²) yield strength material. Angled lower body sides reduce body impacts when loading and a tailshute angle of 25° provides good load 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 body cylinders which are cushioned at both ends of the stroke to reduce impact shocks. The body cylinders raise the body to a tipping angle of 65° in 16 seconds and powerdown the body in 12 seconds.

OPERATION

A body control joystick, mounted on the right hand dash panel, actuates the body control valve by means of electrical signals to the solenoid valves, which in turn operate 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 (19) prevents the body (1) 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 the body-up warning light goes out while the body is being raised, the 'POWER DOWN' operation will not be available and the body control valve will automatically default to the detented 'FLOAT' 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 chocks and lifting equipment are properly secured and of adequate capacity to do the job safely.**
>
> ⚠ **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. Turn steering wheel several times to relieve any pressure in the steering circuit.

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

3. Remove upper pins securing the body cylinders to body (1) and secure body cylinders clear of the body. Refer to Section 230-0130, BODY CYLINDER.

4. Using suitable lifting equipment, sling body (1) assembly at the four lifting points and take an initial strain.

Note: Approximate weight of body (1) assembly is 5 400 kg (11 905 lb).

5. Remove bolts (5) and washers (6) securing body hinge pins (3) through body (1) and pin mounting bores.

6. Remove body hinge pins (3) and shims (4) from body (1) and remove body (1) assembly from the vehicle. If necessary, remove bushing (2) from pin mounting bores.

Note: Do not remove body pads (10) and shims (11 & 12) unless body pads are being replaced.

7. If required, remove locknuts (13), washers (9) and bolts (8) securing body pads (10) and shims (11 & 12) to body (1) assembly. Remove and discard body pads (10) and shims (11 & 12).

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 chocks and lifting equipment are properly secured and of adequate capacity to do the job safely.**

1. If removed, install bushing (2) to pin mounting bores.

2. Using suitable lifting equipment, sling body (1) assembly and position over the trailer frame.

Note: Approximate weight of body (1) assembly is 5 400 kg (11 905 lb).

3. Align body hinge pin (3) bores in body (1) with bores in

the trailer frame. Install body hinge pins (3) and shims (4) and secure with bolts (5) and washers (6).

4. Secure body cylinders to body (1) assembly with pins and mounting hardware removed during removal. Refer to Section 230-0130, BODY CYLINDER.

5. Lubricate body hinge pins (3) and body cylinder pins with lubricant specified in Section 300-0020, LUBRICATION SYSTEM. Lubricate slowly until excess lube is seen.

6. If removed, install body pads (10) and body guide plates (15) on body (1) as described under 'Body Shimming Procedure'.

7. Remove lifting equipment from body (1) and wheel chocks from all road wheels.

8. 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 (10) should be replaced as a set to maintain load distribution along the chassis. 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 chassis.

1. Raise body (1) clear of the trailer frame and lay body pads (10) (metal face down) roughly in position on the frame.

2. Lower body (1) onto body pads (10).

3. Centralise body (1) to the frame and place shims (11 & 12) under the front two body pads (10) until all other pads are clear of body (1).

4. Slide shims (11 & 12) under the other body pads (10) until they just make contact with body (1).

5. Raise body (1) and install body pads (4) and shim packs (11 & 12) to their relative brackets on body (1) securing with bolts (8), washers (9) and locknuts (13).

6. Lower body (1) and check shimming.

7. Install body guide plates (15) with spacers (14) to mounting brackets on body (1) setting gap between plate (15) and the frame at 5 - 10 mm (0.2 - 0.4 in). Secure plate (15) and spacers (14) to mounting brackets with bolts (8) and washers (9).

MAINTENANCE

Every 50 Hours: Lubricate body hinge pins and body cylinder pins with lubricant specified in Section 300-0020, LUBRICATION SYSTEM. Lubricate slowly until excess lube is seen.

* * * *

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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.

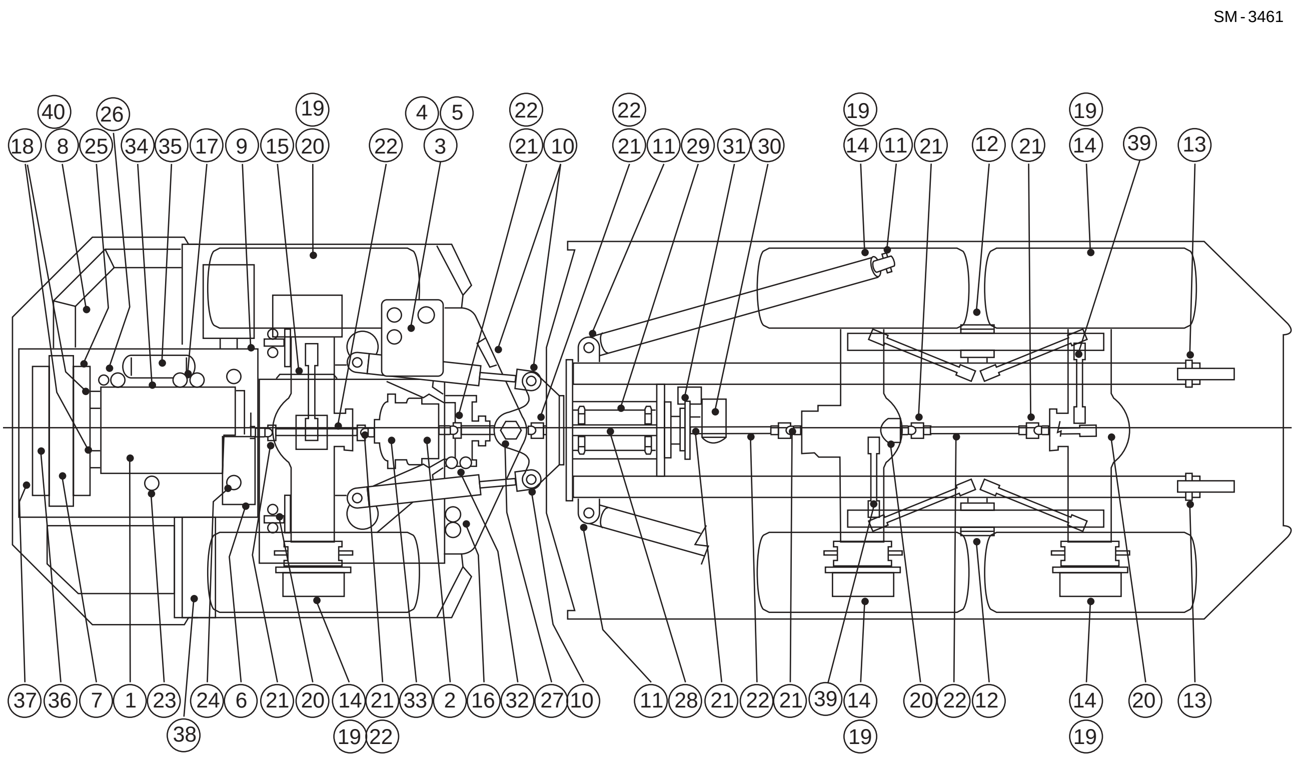
Lubricant change and service periods must be established on the basis of individual job conditions utilizing oil sampling and recommendations from lubricant suppliers.

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.



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	EO	As required. See Note 3
	3	Hydraulic Tank	Check oil level. Add if low.	1	HO	As required
	38	Brake Coolant Tank (TA40 only)	Check oil level. Add if low	1	HTO	As required
	4	Hydraulic Oil Filter Indicator	Check. Replace element if required.	1		
	6	Radiator Top Tank	Check coolant level. Add if low.	1		
	8	Fuel Tank	Check fuel level. Add if low.	1		As required
10	-	Fuel Lines	Check for leaks.			
	-	Turbocharger	Check for leaks.			
	-	Hydraulic Systems	Check for proper operation.			
	9	Air Filter Restriction Gauge	Check. Replace element if required.	1		
	-	Air Cleaner Vacuator Valve	Check for proper operation.	1		
	-	Tyres	Check condition and pressure.	6		Refer to Page 3
	-	Transmission Oil Gauge	Check temperature readings.			
	-	General	Check for debris, leaks and damage.			
	28	Oscillation Bushes	Lube.	2	EP, NLGI	See Note 1
	12	Suspension Beam and Panhard Bushings	Lube.	6	EP, NLGI	See Note 1
	13	Body Hinge Pins	Lube.	2	EP, NLGI	See Note 1
	14	Wheel Rim Nuts (TA40)	Check torque.	138		540 Nm (400 lb ft)
	14	Wheel Rim Nuts (TA35)	Check torque.	138		730 Nm (540 lb ft)
50	15	Cab Ventilation Filter	Inspect and clean if required.			
	18	Drive Belts	Check tension. Adjust if required.			See Engine Manual
	-	Battery Electrolyte	Check level. Add if low.	2		As Required.
150	-	Engine Air Cleaner	Check. Clean inlet screen.	1	-	-
	1	Engine	Drain oil and refill.	1	EO	See Page 13
	7	Radiator	Clean and inspect radiator fins.	1		See Note 6
	8	Fuel Tank	Drain water and sediment from tank.	1	-	-
	10	Steering Cylinder Pins	Lube.	4	EP, NLGI	See Note 1
250	11	Body Cylinder Pins	Lube.	4	EP, NLGI	See Note 1
	17	Engine Oil Filters	Replace.	3	EO	See Page 13
	-	Transmission Breather	Clean if required.	1	-	-
	19	Wheel Planetaries	Check oil level. Add if low.	6	EPL	As required

LUBRICATION AND SERVICE CHART (Continued)

Interval Hours	Ref. Points	Identification	Service Instructions	No. of Points	Lubricant	Service Quantities
	20	Differentials	Check oil level. Add if low.	3	EPL & LZ	As required
	23	Primary Fuel Filter	Replace.	1		
	24	Secondary Fuel Filter	Replace.	1		
250	28	Oscillation Pivot	Check end float. Adjust if required.	2		
	30	Parking Brake Slack Adjuster	Lube	1		
	31	Parking Brake Pads	Check wear. Replace/adjust if required.	2		
	-	Service Brake Pads (TA35)	Check wear. Replace if required	12		
	36	Fuel Cooler	Clean and inspect cooler fins.	1		See Note 6
	37	Charge Air Cooler	Clean and inspect cooler fins.	1		See Note 6
	25	Coolant Filter	Replace	1		
	-	Coolant Inhibitor	Check inhibitor concentration.			
	26	Water Pump	Inspect drain hole. Clean if required	1		
500	-	Engine Mounting Bolts	Check torque.	4		265 Nm (195 lb ft)
	-	Transmission Mounting Bolts	Check torque.	4		Front 300 Nm (220 lb ft) Rear 265 Nm (195 lb ft)
	-	Engine Crankcase Pressure	Check and record.			
750	5	Hydraulic Oil Filter	Clean housing and replace element.	1		
	-	Engine Air Cleaner	Replace element			
	-	Alternator	Check terminals and wiring.			
	2	Transmission	Drain oil and refill.	1	EO	See Page 13
	8	Fuel Tank	Replace cap filter/cartridge.	1		
	15	Cab Ventilation Filter	Replace.	1		
	19	Wheel Planetaries (TA35)	Drain oil and refill.	6	EPL	See Page 13
	20	Differentials (TA35)	Drain oil and refill.	3	EPL & LZ	See Note 4
	27	Articulation Bearing	Lube.	2	EMS19057	See Note 2
1 000	29	Driveshaft Bearings	Check oil level. Add if low.	1	EPL	To fill plug. See Note 5
	32	Transmission Oil Filters	Replace.	2		
	33	Transmission Internal Oil Filter	Clean.	1		
	38	Brake Coolant Tank (TA40 only)	Drain oil and refill.Change filter/breather	1	HTO	See Page 14
	38	Brake Coolant Tank Breather	Replace	1		TA40 Only
	-	Exhaust System	Check for leaks. Repair if damaged.			
	-	Crankcase Breather	Clean.	1		
	-	Door Hinges	Lube.	2	EP, NLGI	See Note 1
	-	Service Brakes (TA40)	Check wear indicator pins	6		
	1	Engine	Steam clean	1		
	7	Radiator and Cooling System	Drain, flush and refill.		Coolant	See Page 13
2000	21/22	Drivelines (Low Maintenance)	Check for leaks and damage.	-	-	See Page 12
	27	Articulation Pivot Nut	Check torque	1		1 425 Nm (1 050 lb ft)
	36	Fuel Cooler	Strip, clean and inspect	1		
	37	Charge Air Cooler	Strip, clean and inspect	1		
	18	Drive Belts	Replace all belts.			
	40	OCDB Filter	Replace.			
2 250	3	Hydraulic Tank	Drain oil and refill.	1	HO	See Page 13
	-	Suction Screens and Strainers	Clean.	2		
4 000	-	Thermostats and Seals	Replace.			
6 000	34	Engine Oil Cooler	Strip, clean and inspect.	1		
	35	Transmission Oil Cooler	Strip, clean and inspect.	1		

Note: Use 'Lubrication and Service Chart' in conjunction with 'Notes on Lubrication and Service Chart' and 'Miscellaneous Servicing' contained on the following pages.

Notes on 'Lubrication and Service Chart'

Note - Capacities given are approximate - work to dipstick, sight gauges or level plugs.

Note 1 - Lubricate slowly until excess lube is seen.

Note 2 - Remove plugs and fit lube fittings. Lubricate slowly until excess lube is seen. Remove fittings and refit plugs.

Note 3 - Check with the engine idling and the transmission at its normal operating temperature.

Note 4 - When refilling centre axle ensure that 3rd differential unit is primed with 1 litre (1.75 UK pints) of oil before filling drive head.

Note 5 - Remove plug from port on underside of oscillation hub. Plug is removed to drain the cavity of any oil that enters the cavity when filling. Remove grommet and level plug on side of oscillation hub. Add oil if required. Refit all plugs.

Note 6 - Clean radiator, condenser and cooler fins more often when operating under extremely dusty conditions.

EO - Engine Oil. Refer to 'Recommended Lubricants'.

* - Refer to chart under 'Recommended Lubricants'.

HO - Hydraulic Oil. Refer to 'Recommended Lubricants'.

EPL - Extreme Pressure Lubricant specification MIL-L-2105 D.

EP, NLGI - Extreme Pressure, Lithium No. 2 Grease (which may, or may not, contain Molybdenum).

*EP, NLGI - Extreme Pressure, Lithium No. 2 Grease (without Molybdenum).

EMS19057 - Extreme Pressure, Lithium Complex Grease. Refer to 'Recommended Lubricants'.

HTO - Hydraulic Transmission Oil. Refer to 'Recommended Lubricants'.

LZ - Lubrizol 6178

PAG Oil - Polyalklene Glycol (PAG) Compressor Lubricating Oil - Low Viscosity (ISO46).

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 (Dana Axles) - After first 10 hours of operation re-torque nuts to 540 Nm (400 lbf ft). Check torque every 50 hours (weekly) thereafter.
Wheel Rim Nuts (ZF Axles) - After first 10 hours of operation re-torque nuts to 730 Nm (540 lbf ft). Check torque every 50 hours (weekly) thereafter.

EVERY 10 HOURS OF OPERATION (DAILY)

Walk Around Inspection - Inspect the vehicle 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 Cleaner - Change air cleaner element only when the yellow band of the air restriction gauge locks up in the orange. Service vacuator valve 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. To allow checking before starting as well as immediately after shutting down the engine, the oil dipstick is provided with two types of marks:

1. Dot Marks - Before starting up after a major shut down period the oil level should be up to the top dot mark (Cold level).

2. Dash Marks - Upon shutting down the engine at low idling (wait 1 to 2 minutes) the oil level should be up to, but not over, the top dash mark (Hot level).

Transmission - Check oil level and add oil if low. Refer to Section 120-0010, TRANSMISSION AND MOUNTING, for correct oil level check procedure.

Hydraulic Tank - Check oil level and add oil if low. With the engine off and body down the oil should be visible in the bottom of the top sight gauge.

Brake Coolant Tank (TA40 only) - Check oil level and add if low.

Radiator - 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 coolant inhibitor 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 remote mounted filters, clean internal filter and finger magnet. Refill transmission.

Differentials - Drain lubricant and refill to level plug.
Note: When refilling centre axle ensure that 3rd differential unit is primed with 1 litre (1.75 UK pints) of oil before filling drive head.

Planetaries - Drain lubricant and refill to level plug.

Hydraulic Oil Filter - Clean filter housing and install new element at 100 hours of operation, or when indicated, whichever comes first.
Note: A 6 micron filter is used to flush the system. This is replaced with a 12 micron filter for normal use. See vehicle Parts Book for filter part numbers.

Brake Cooling Oil Filter (TA40 only) - Clean filter within brake coolant tank after 100 hours of operation.

EVERY 250 HOURS OF OPERATION

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.

Service Brakes (TA35) - Check pads and discs for wear and 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).

Service Brakes (TA40) - Check indicator wear pins for signs of wear and replace friction plates where necessary. Test for proper function.
Note: This service interval applies to normal driving. Check the pins more frequently under more severe conditions. In the fully worn plate condition the indicator pin is flush with the bottom of the counterbore.

Parking Brake - Check pads and discs for wear and 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).

Oil Can Points - Oil working parts with engine oil.

EVERY 1 000 HOURS OF OPERATION (6 MONTHS)

Transmission - Drain oil, replace remote mounted filters, clean internal filter and finger magnet. Refill transmission.

Hydraulic Oil Filter - Clean filter housing and install new element when indicated, or after 1 000 hours of operation, whichever comes first.

Brake Coolant Tank (TA40 only) - Drain oil, replace filter and breather. Refill brake coolant tank.

Axles (ZF) - Drain lubricant and refill to level plug.
Note: When refilling centre axle ensure that 3rd differential unit is primed with 1 litre (1.75 UK pints) of oil before filling drive head.

Parking Brake - Check pads and disc for wear. Adjust or replace if required. Test for proper function. Thickness of pad friction material should never be allowed to wear below 3 mm (0.12 in).

Articulation Vertical Bearings - IMPORTANT - Use only grease which conforms to EMS19057 specification. Remove plugs and fit lube fittings. Lubricate slowly until excess lube is seen. Remove lube fittings and refit plugs.

Driveshaft Bearings - Remove plug from port on underside of oscillation hub. Plug is removed to drain the cavity of any oil that enters the cavity when filling. Remove grommet and level plug on side of oscillation hub. Add oil if required. Refit all plugs.

Grease Points - Grease door hinges.

EVERY 2 000 HOURS

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.

Axles (Dana) - Drain lubricant and refill to level plugs.
Note: When refilling centre axle ensure that 3rd differential unit is primed with 1 litre (1.75 UK pints) of oil before filling drive head.

Hydraulic Oil Tank - Drain oil, remove and clean suction screens and strainers. Reinstall suction screens and strainers and refill hydraulic oil tank.

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 vehicle. Maintenance procedures should be carried out in conjunction with any additional procedures contained in the relevant manufacturers 'Operation and Maintenance Manual', at the intervals specified.

RECOMMENDED LUBRICANTS

COMPONENT	LUBRICANT	*CAPACITY	SPECIFICATIONS	API CODE	SAE GRADE
Engine (Including Filters)	Engine Oil with 1.00% sulphated ash limit is recommended. Sulphated ash must not exceed 1.85% limit	37 litre (9.8 US gal)	MIL-L-2104 F	CG-4 or CF-4	15W-40
Transmission (Including Filters) (dry fill)	Engine Oil with 1.85% max. sulphated ash limit	56 litre (14.8 US gal)	MIL-L-2104 C/D/E MIL-L-46152 C/D/E (See Note 1)	CD, CE, CF, SF & SG	See Trans. Oil Table.
Transmission (Including Filters) (wet fill)	Engine Oil with 1.85% max. sulphated ash limit	28 litre (7.4 US gal)	MIL-L-2104 C/D/E MIL-L-46152 C/D/E (See Note 1)	CD, CE, CF, SF & SG	See Trans. Oil Table.
Hydraulic System (Including Lines)	Hydraulic Transmission Oil	209 litre (55 US gal)	See Hydraulic Oil Table (See Note 2)		
Cooling System	Anti-freeze, Ethylene Glycol	80 litre (21.1 US gal)			
Differential - Dana (Front)	Extreme Pressure Gear Lubricant	37.5 litre each (9.9 US gal)	MIL-L-2105 D (See Note 3)	GL-5	80W-90 LS
Differential - Dana (Centre)	Extreme Pressure Gear Lubricant	38 litre (10 US gal)	MIL-L-2105 D (See Note 3)	GL-5	80W-90 LS
Differential - Dana (Rear)	Extreme Pressure Gear Lubricant	31.5 litre (8.3 US gal)	MIL-L-2105 D (See Note 3)	GL-5	80W-90 LS
Planetaries - Dana	Extreme Pressure Gear Lubricant	8.5 litre each (2.2 US gal)	MIL-L-2105 D (See Note 3)	GL-5	80W-90 LS
Differentials - ZF (Front,Centre,Rear)	Extreme Pressure Gear Lubricant	31 litre each (8.2 US gal)	MIL-L-2105 D (See Note 3)	GL-5	80W-90 LS
Planetaries - ZF	Extreme Pressure Gear Lubricant	9 litre each (2.4 US gal)	MIL-L-2105 D (See Note 3)	GL-5	80W-90 LS
Fuel Tank	Diesel Fuel Oil with max. sulphur 0.5%	463 litre (122 US gal)	DIN EN590		
Grease Nipples**	Extreme Pressure Lithium Grease				No.2 Consistency
Driveshaft through Bearings	Extreme Pressure Gear Lubricant	1.50 litre (0.40 US gal)	MIL-L-2105 D	GL-5	80W-90
Articulation Bearings	Extreme Pressure Lithium Complex		EMS 19057		
Air Conditioning Compressor	Polyalklene Glycol (PAG) Compressor Lubricating Oil - Low Viscosity	0.125 litre (0.033 US gal)	ISO46 SP 10		
Brake Cooling System (TA40 only)	Hydraulic Transmission Oil	199 litre (52.6 US gal)	MIL-L-2104 E MIL-L-46152 B/C	CF,CD,SF	

***** - Capacities given are approximate, work to dipstick, sight gauges or level plugs.

****** - Refer to the 'Lubrication and Service Chart' for the different applications. DO NOT use on the Articulation bearings.

Note 1 - Operation below the minimum temperatures listed for the oil used without proper pre-heat 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 2 - Hydraulic Transmission Oil meeting Specification EMS19058 is also suitable for use in the hydraulic system.

Note 3 - Axles have limited slip differentials. If use of a standard SAE 90 oil results in very loud noise and jerking of the wheels when driving slowly round sharp corners, an EP oil with limited slip additives should be used.

Note 4 - 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

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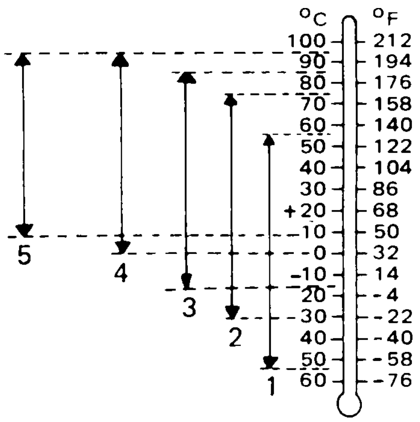
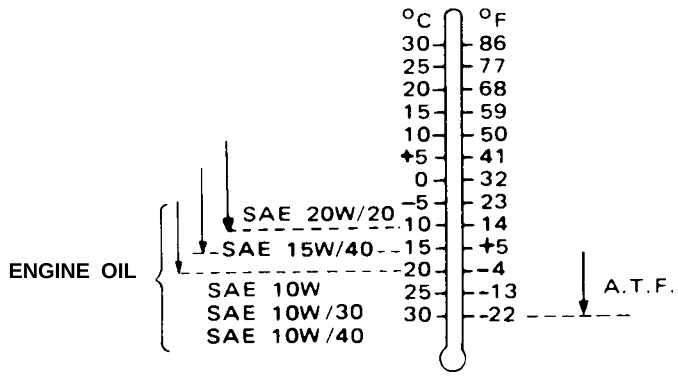


	SAE	API CODE	MIL-SPEC
1	-	-	MIL-H-5606A
2	DEXRON Auto Trans. Fluid		
3	10W	CC/CD	MIL-L-2104 B/C
4	20W/20	CC/CD	MIL-L-2104 B/C
5	30	CC/CD	MIL-L-2104 B/C

TRANSMISSION OIL

SM - 639



(See Note 4)

Note - Consult your lubricant supplier for correct viscosity of lubricant when ambient temperatures are consistently above or below those listed.

* * * *

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: The Company reserves the right to make changes in the design or construction of tools and equipment without obligation to incorporate such changes in tools and equipment previously sold.

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
15270180 - Belt Tension Gauge - Poly 'V' Belt
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
15269809 - Internal Micrometer - 50 to 210 mm
15269810 - Internal Micrometer - 2 to 8 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)

Series 60 Engine

DDEC IV Electronic Diagnostic

15275098 - Detroit Diesel Multi Kit, consisting of PRO-LINK Diagnostic Data Reader and cables, Detroit Diesel 6 pin Adaptor Cable and Multi-Cartridge.
15273793 - Detroit Diesel Diagnostic Link (Diskette)
15273794 - Detroit Diesel Diagnostic Link (CD)
15269239 - High Impedance Digital Multimeter Kit
15270271 - Diagnostic Jumper Wire Kit
15273795 - DDEC Repair Kit
15270310 - Detroit Diesel 6 pin Adaptor Cable
15269038 - Portable Printer for use with DDR, complete with 110 V AC Adaptor
15269039 - Portable Printer for use with DDR, complete with 220 V AC Adaptor
15269040 - Printer Paper for use in above printers - 5 rolls
15275096 - DDEC III/IV Card
15273084 - Multi-Cartridge
15268971 - PRO-LINK Diagnostic Data Reader and cables

The following tools are recommended for Engine Maintenance Procedures. These tools should be used in conjunction with procedures outlined in the Series 60 Engine service manual.

Cylinder Block

15270266 - Cup Plug Driver Set
15270305 - Handle
15270303 - Cylinder Block Pressure Test Kit
15270255 - Cylinder Liner Installation Tool
15270275 - Cylinder Liner Removal Tool
15270289 - Dowel Installation Tool
15270286 - Dowel Remover/Installer (No. 6 Main Bearing Saddle)
15270260 - Engine Cylinder Block and Stand Adaptor Plates
15270253 - Eye Bolts - Block Lifting
15270273 - Guide Studs - Bull Gear/Flywheel Housing
15270272 - Guide Studs - Cylinder Head
15270290 - Guide Studs - Flywheel/Crankshaft Pulley
15270285 - Guide Studs - Gear Case/Exhaust Manifold
15270274 - Guide Studs - Oil Cooler Housing
15270287 - Main Bearing Remover/Installer

Cylinder Head

15270293 - Cup Plug Installer - Rocker Shaft
15270261 - Cylinder Head - Engine Stand Adaptor
15270262 - Cylinder Head Lifter Bracket
15270279 - Cylinder Head Pressure Test Kit
15270282 - Socket - Rocker Arm Shaft Stud
15270259 - Pilot; Valve Seat Grinder (Hall-Toledo)

15270295 - Valve Button Retainer Expander
15270248 - Valve Guide Installer
15270250 - Valve Guide Remover
15270251 - Valve Seat Insert Installer (Exhaust)
15270247 - Valve Seat Insert Installer (Intake)
15270240 - Valve Seat Remover (Exhaust)
15270241 - Valve Seat Insert Remover (Intake)
15270252 - Valve Spring Compressor (head installed)
15270257 - Valve Stem Seal Installer
15270296 - Head Bolt Resurface
15270304 - Injector Timing Tool
15270302 - Rocker Arms and Shaft Assembly

Crankshaft
15270281 - Crankshaft Protector
15270291 - Engine Barring Tool
15270267 - Front/Rear Oil Seal Expander
15270268 - Front/Rear Oil Seal Installer (std. OS and wear sleeve)
15270309 - Front/Rear Oil Seal Remover

Piston, Piston Rings and Connecting Rod
15270239 - Piston Ring Pliers
15270278 - Connecting Rod Guides
15270288 - Piston/Connecting Rod Holding Fixture
15270276 - Piston, Fire Ring Groove Gauge (2.5 mm ring)
15270297 - Piston, Fire Ring Groove Gauge (3.5 mm ring)
15270256 - Piston Ring Compressor
15270294 - Cylinder Kit Lifter

Gear Train
15270284 - Accessory Drive Service Set
15270277 - Camshaft Gear Pilot
15270265 - Camshaft Gear Torque Holding Tool
15270254 - Camshaft/Idler Gear Lash Adjusting Tool
15270263 - Crankshaft Gear/Remover/Installer
15270264 - Gear Case Alignment Plug
15270269 - Water Pump Lash and Impeller Slip Tester
15270298 - Accessory Drive Gear Lash Tool
15270300 - Water Pump Gear Lash Tool

Fuel System
15270271 - Diagnostic Jumper Wire
15268969 - Fuel Filter Wrench
15270283 - Fuel Pump Gear Installer
15270237 - Fuel Pump Holding Fixture
15270299 - Fuel Pump Service Kit
15269235 - Group I Terminal Removal Tool
15269234 - Group I Terminal Crimping Tool
15270245 - Group II Terminal Removal
15270258 - Group II Terminal Crimping Tool
15269237 - Group III Terminal Removal Tool
15270270 - Group III Terminal Crimping Tool
15269238 - PROM removal Tool
15270307 - Brass Wire Buffing Wheel (Injector spray nozzle)
15270235 - Oil Seal Installer Handle
15270236 - Oil Seal Installer Adaptor
15270238 - Oil Seal Remover
15270249 - Injector Tube Installation/Removal Tool

Air Intake System
15270243 - Turbocharger Inlet Shield
15270301 - Turbocharger Gauge Arm Tool
15270306 - Dial Indicator Set

Lube System
15270274 - Oil Cooler Housing Guide Studs
15270246 - Band Type Oil Filter Wrench

Cooling System
15270242 - Radiator and Cooling System Pressure Tester
15270280 - Water Pump Service Tool Kit
15270269 - Water Pump Lash and Impeller Slip Tester
15270300 - Water Pump Gear Lash Tool
15270308 - Thermostat Seal Installation Tool
15270305 - Handle
15270292 - Fan Hub/Air Compressor Drive Service Kit

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
15270195 - Ring
15270196 - Threaded Insert
15270092 - Puller
15270093 - Puller
15270098 - Driver
15270197 - Driver
15270198 - Driver
15270199 - Driver
15270200 - Driver
15270201 - Driver
15270104 - Driver
15270202 - Driver
15270203 - Driver
15270204 - Driver
15270112 - Measuring Pin
15270115 - Set of Eye Bolts
15270205 - Back-off Screws - M10
15270119 - Adjusting Screws - M10
15270206 - Back-off Screws - M8
15270116 - Adjusting Screws - M8

15270207 - Back-off Screws - M12
15270208 - Adjusting Screws - M5
15270209 - Adjusting Screws - M12
15270210 - Adjusting Screws - M12 x 1.5
15269899 - Hot Air Blower 220 V
15269900 - Hot Air Blower 110 V
15270211 - Backup Tool
15270120 - Clamping Yoke
15269942 - Handle
15270212 - Hoist
15270213 - Pulling Hook
15270214 - Ring Nut
15270215 - Hoist
15270216 - Internal Puller
15270217 - Backup Tool
15270218 - Mounting Rail
15270127 - Guide Plate
15270131 - Pry Bar
15270219 - Adjusting Spanner
15270220 - Hook Spanner
15270221 - Hook Spanner
15270222 - Insert for Torque Spanner
15270223 - Extension
15270224 - Extension
15270225 - Hook Spanner
15270226 - Hook Spanner
15270227 - Pressing Sleeve
15270228 - Pressing Ring
15270229 - Pressure Piece
15270230 - Backup Ring
15270231 - Test Cover
15270139 - Striker
15270233 - Internal Snap Ring Pliers
15270145 - External Snap Ring Pliers
15270234 - Two Leg Puller
15270149 - Two Leg Puller
15270150 - Three Leg Puller
15270151 - PR-78A Tester
15270311 - Harness
15270153 - Foil
15270725 - PR-68 Tester
15269943 - Spanner
15271103 - Hook Spanner
15271105 - Hook Spanner
15272559 - Ring Clamp
15272560 - Bearing Puller
15272561 - Bearing Remover
15273664 - AEB Starter

Articulation and Oscillation Pivot

15269101 - Thrust Nut Tool

Axles and Differentials

15269088 - Helical Gear Tool
15269089 - Oil Seal Bumper Tool
15269090 - Hub Spanner
15272390 - Hub Seal Tool
15500012 - Large Face Seal Insertion Tool
15500013 - Small Face Seal Insertion Tool
15500014 - Plate Centralising Tool
15500015 - Ring Gear Alignment Tool
15500016 - Hub Guide Sleeve
15500439 - Setting Gauge
15271107 - Puller
15269895 - Insert
15269898 - Handle
15275464 - Driver
15269899 - 220V Hot Air Blower
15269900 - 110V Hot Air Blower
15269929 - Lifting Pliers
15269946 - Puller Set
15272560 - Bearing Puller
15270113 - Gauge Blocks
15269948 - Straight Edge
15270114 - Digital Depth Gauge
15269934 - Measuring Shaft
15270120 - Clamping Yoke
15271101 - Back-Up Tool
15270121 - Handle
15500882 - Socket
15500883 - Centering Bracket
15500884 - Wheel Bolt Puller
15500885 - Driver
15500886 - Press Ring
15500887 - Gripping Insert
15500888 - Gripping Insert
15500889 - Reducer
15500890 - Socket
15500891 - Socket
15500892 - Gripping Insert
15500893 - Shim
15500894 - Shim
15500895 - Torque Spanner
15500896 - Driver
15500897 - Magnetic Stand
15500898 - Dial Indicator
15500899 - Micrometer
15500900 - Adjusting Nut
15500905 - Extractor
15500906 - Puller
15500907 - Fixture
15500908 - Socket
15500909 - Driver
15500910 - Connector Air Compressor
15500911 - Indicator
15500912 - Driver

Front Suspension

15269095 - Hydraulic Jack

15269096 - Power Press
15269097 - Press Tool

Steering Valve

15270173 - 'O' Ring and Kin Ring Assembly Tool
15270174 - Driveshaft Mounting Fork

Nitrogen Charging

09359489 - Charging Assembly

Cooling and Air Conditioning

15270181 - Coolant Test Strips
15269816 - Refractometer - °C Scale
15269817 - Refractometer - °F Scale
15269844 - Portable High Vacuum Charging Station - R-134a Gas
15269845 - Halogen Leak Tester

Cab

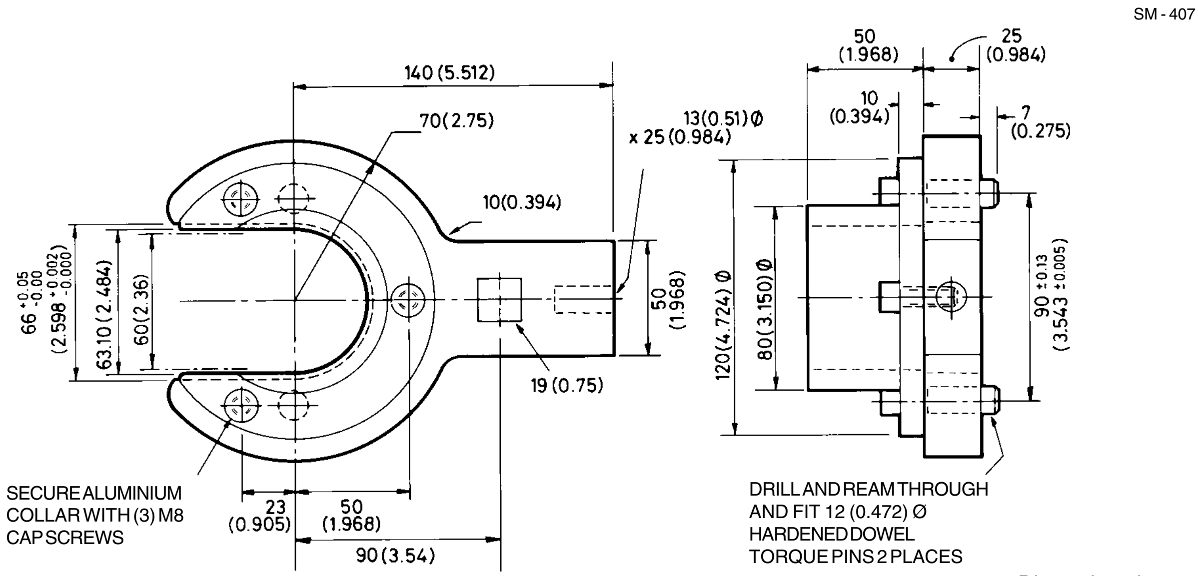
15271016 - Glass Removal Tool
15271017 - Bonding Kit (Quick Dry)

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
15303808 - Silicon Grease (Dielectric)

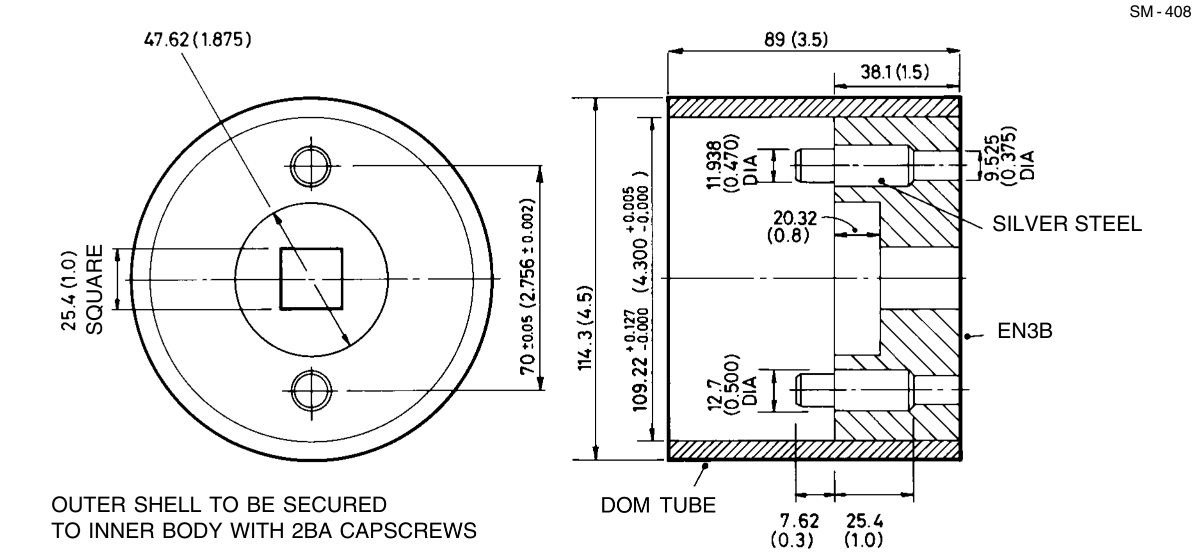
Fabricated Tools

The service tools shown in Figs. 1 through 4 can be fabricated as shown.



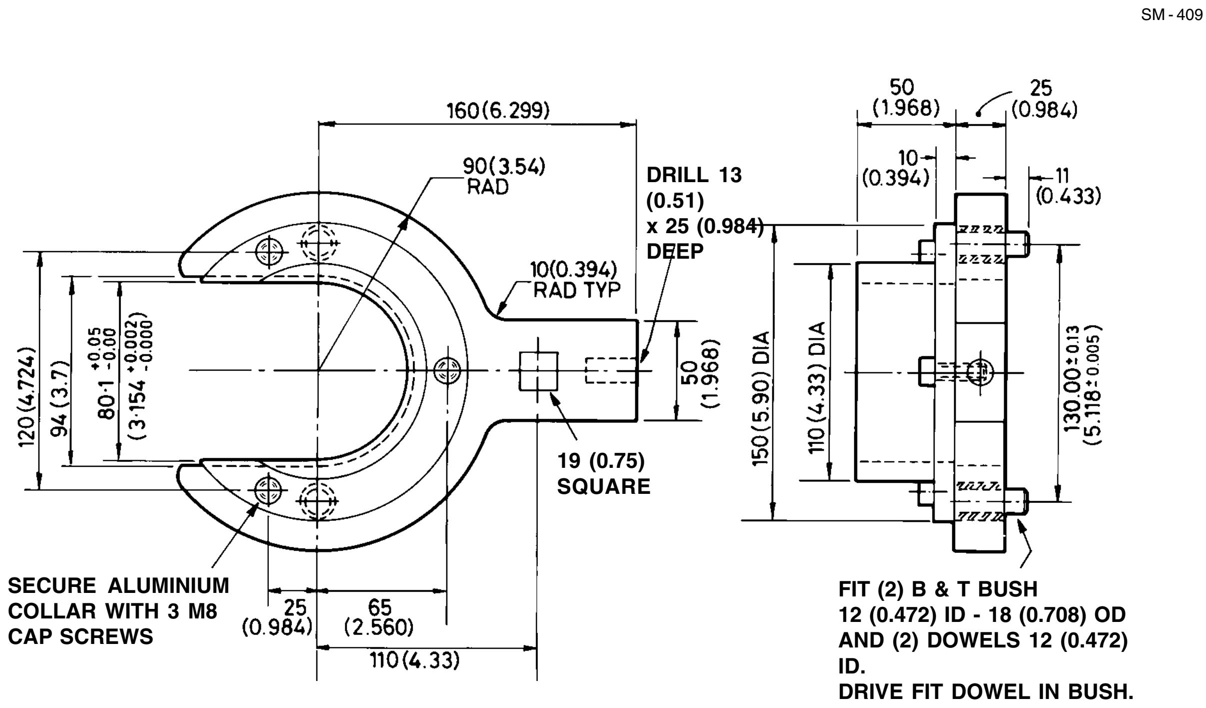
Dimensions in mm (inches)

Fig. 1 - End Cap Torque Tool (Section 220-0120, STEERING CYLINDER)



Dimensions in mm (inches)

Fig. 2 - Piston Torque Tool (Section 220-0120, STEERING CYLINDER)



Dimensions in mm (in)

Fig. 3 - End Cap Torque Tool (Section 230-0130, BODY CYLINDER)

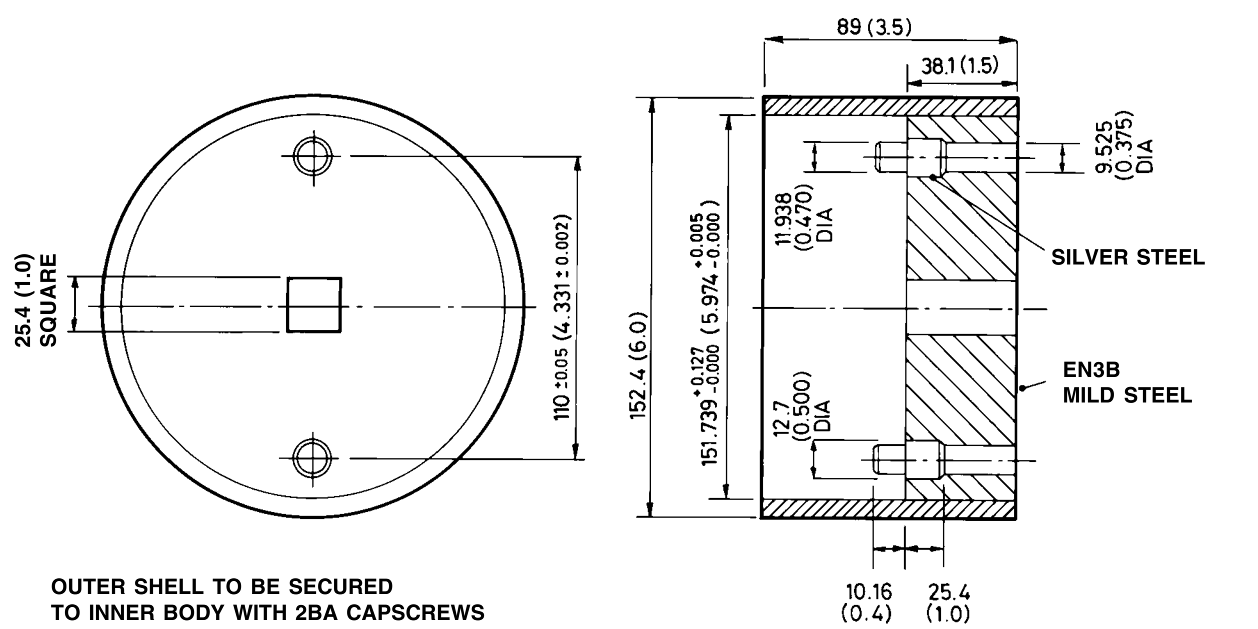


Fig. 4 - Piston Torque Tool (Section 230-0130, BODY CYLINDER)

* * * *

> ⚠ 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.

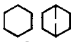
To prevent the threaded bolts and nuts used on this equipment from being overstressed during assembly, and to establish a uniform value to which these fasteners can be safely tightened, the following torque tables have been compiled.

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.

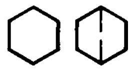
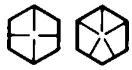
To provide a quick method for determining the GM material classification of a particular standard bolt or nut, compare the bolt head markings to those in the appropriate tables, then locate the maximum torque value for that bolt size in the column under that marking.

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

RECOMMENDED MAXIMUM TORQUES (IMPERIAL) ± 10% TABLE145

Size	 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	
	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	

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

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.

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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