TEREX

TEREX Equipment Limited Maintenance Manual

MAINTENANCE MANUAL

TA27 - TA30

15503430
SM889/892/
894/897/908

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TEREX

TEREX Equipment Limited Maintenance Manual Re-order

MAINTENANCE MANUAL

TA27 - TA30

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TEREX

TEREX Equipment Limited Maintenance Manual - Introduction

MAINTENANCE MANUAL

TA27 - TA30

For further information on the subject matter detailed within this Maintenance Manual, please refer to Terex Equipment Limited Operator Handbooks and Product Parts Books.

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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.

Safety Alert Symbol
The safety alert symbol is used to alert you to a potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.

Hazard Classification
A multi-tier hazard classification system is used to communicate potential personal injury hazards. The following signal words used with the safety alert symbol indicate a specific level of severity of the potential hazard. Signal words used without the safety alert symbol relate to property damage and protection only. All are used as attention getting devices throughout this manual as well as on deals and labels fixed to the machinery to assist in potential hazard recognition and prevention.

DANGER	**DANGER** indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	**WARNING** indicates an potentially hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	**CAUTION** indicates an potentially hazardous situation which, if not avoided, may result in minor or moderate injury.
CAUTION	**CAUTION** used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

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

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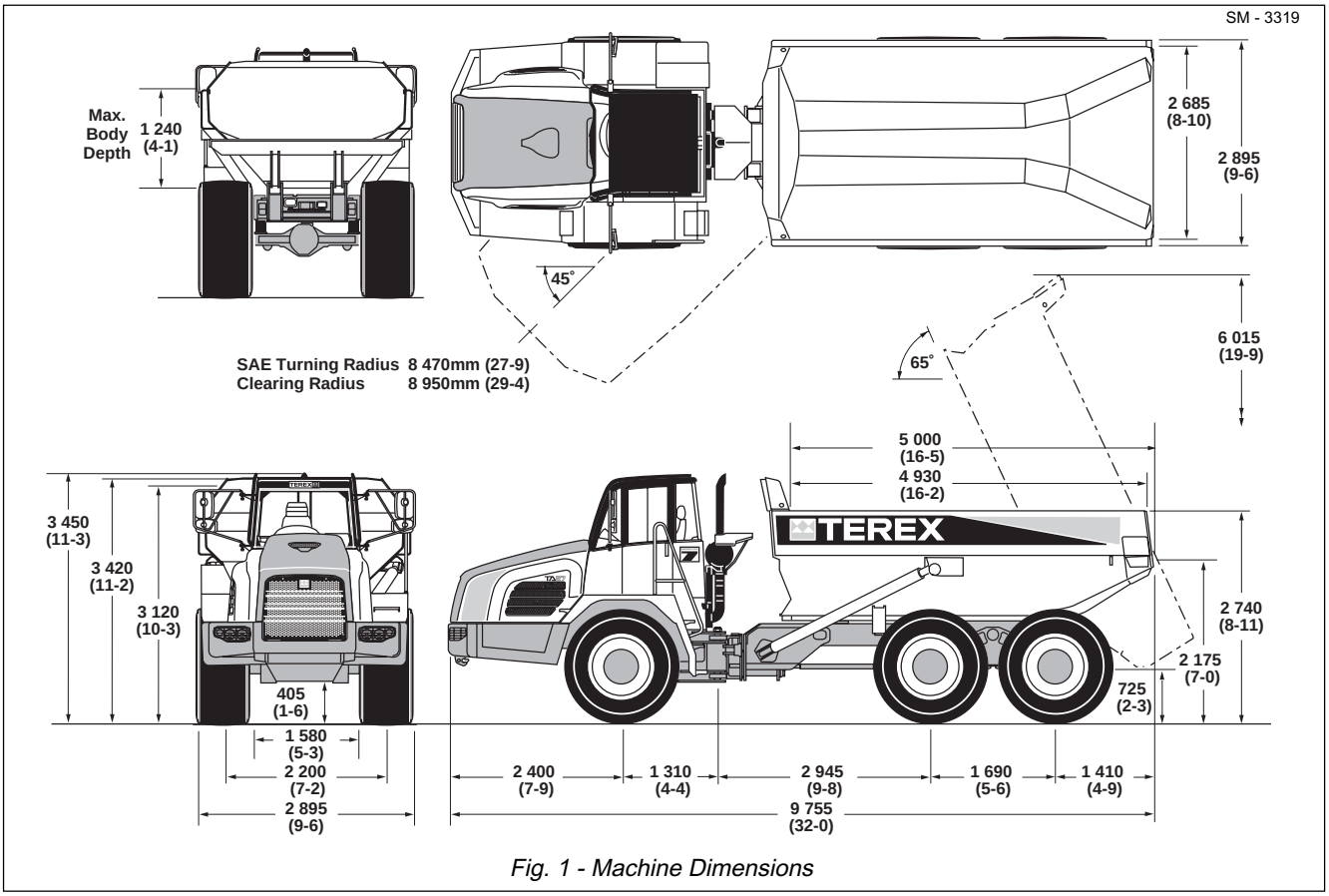

Fig. 1 - Machine Dimensions

ENGINE

Make/Model ..... Cummins QSM11
Type ..... Four cycle diesel, turbocharged with air-to-air charge cooling, water-cooled. Electronic management.

Gross power at 1800 rev/min ..... 272 kW (365 hp)
Net power at 2100 rev/min ..... 238 kW (319 hp)

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

Maximum Torque ..... 1673 Nm (1234 lbf ft) at 1400 rev/min
Number of cylinders/configuration ..... 6, in line
Bore x Stroke ..... 125 x 147 mm (4.92 x 5.79 in)
Piston Displacement ..... 10.8 litres (661 in³)
Air cleaner ..... Dry type, double element
Starting ..... Electric
Maximum Speed (No load) ..... 2350 rev/min
Maximum Speed (Full load) ..... 2100 rev/min
Idle Speed ..... 750 rev/min

TRANSMISSION

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

Pressures:
- Main ..... 16 + 2 bar (232 + 30 lbf/in²)
- Lockup (Wk) ..... 14 ± 1 bar (190 ± 15 lbf/in²)
- Converter 'IN' ..... 10.5 bar (152 lbf/in²) at 2300 rev/min
- Converter 'OUT' ..... 4.8 bar (70 lbf/in²) at 2300 rev/min
- Converter Relief Valve ..... 8.5 bar (123 lbf/in²)
- Retarder ..... 5.5 bar (80 lbf/in²)

Temperatures:
- Normal ..... 80° - 110° C (176° - 230° F)
- Maximum (Retarder Mode) ..... 145° C (293° F)

Stall Speed ..... 1718 ± 50 rev/min

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

Forward						
Gear	1	2	3	4	5	6
km/h	5.6	8.7	13.6	21.1	31.0	51.0
mile/h	3.5	5.4	8.5	13.1	19.3	31.7

Reverse			
Gear	1	2	3
km/h	5.6	13.6	31.0
mile/h	3.5	8.5	19.3

AXLES

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

Transverse differential locks are activated by a request from the foot operated switch.

Ratios:

Differential	3.875:1
Planetary	5.71:1
Total Reduction	22.12:1

SUSPENSION

Front: Axle is carried on the leading arms of a sub-frame which pivots on the main frame. Suspension is by rubber elements with four heavy duty hydraulic dampers.

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 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.

WHEELS AND TYRES

Wheels: ..... 5-piece earthmover rims with 12 stud fixing

Size:

Standard	25 x 19.50 in for 23.5 R25** tyres
Optional	25 x 22.00 in for 750/65 R25** tyres

Tyres:

Standard	23.5 R25**
Optional	750/65 R25**

Inflation Pressures (Bridgestone):

	Front	Rear
23.5 R25**	4.35 bar (63 lbf/in²)	4.35 bar (63 lbf/in²)
750/65 R25**	3 bar (44 lbf/in²)	3 bar (44 lbf/in²)

Inflation Pressures (Michelin):

	Front	Rear
23.5 R25**	3.5 bar (51 lbf/in²)	3.5 bar (51 lbf/in²)
750/65 R25**	2.75 bar (40 lbf/in²)	2.75 bar (40 lbf/in²)

Inflation Pressures (Pirelli):

	Front	Rear
23.5 R25**	4.3 bar (62 lbf/in²)	4.3 bar (62 lbf/in²)

Inflation Pressures (Continental):

	Front	Rear
23.5 R25**	4.25 bar (62 lbf/in²)	4.25 bar (62 lbf/in²)

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

HYDRAULIC SYSTEM

Braking, steering and body hoist systems are controlled by a main hydraulic valve mounted on frame. Systems are supplied with oil from a common tank by the main hydraulic pump, driven from power takeoff on transmission. System components are protected by full flow filtration on the return line.

Pump:

Type	Piston
Capacity at 2100 rev/min	4.9 l/s (77.4 US gal/min)

Brakes

Full hydraulic braking system with enclosed, oil-immersed 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 ..... 60 ± 5.2 bar (870 ± 75 lbf/in²)

Braking surface (tractor)	22000 mm² (34.1 in²)/brake
Braking surface (trailer)	22000 mm² (34.1 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.

Steering

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

System Pressure	241 bar (3500 lbf/in²)
Steering Angle to either side	45°
Lock to Lock Turns, steering wheel	4

Body Hoist

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

System Pressure	220 bar (3 200 lbf/in²)
Control Valve	Pilot Operated, Closed Centre
Body Raise Time (loaded)	12 sec
Body Lower Time (power down)	7.5 sec

ELECTRICAL SYSTEM

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

BODY

Of all welded construction, fabricated from high hardness (min. 360 BHN) 1000 MPa (145000 lbf/in²) yield strength steel. 25° tail chute angle provides good load retention without tailgate.

Plate Thicknesses:
- Floor and Tailchute ..... 14 mm (0.55 in)
- Sides ..... 12 mm (0.47 in)
- Front ..... 8 mm (0.31 in)

Volume:
- Struck (SAE) ..... 12.5 m³ (16.4 yd³)
- Heaped 2:1 (SAE) ..... 15.5 m³ (20.3 yd³)

SERVICE CAPACITIES

Fuel tank ..... 390 l (103 US gal)
Hydraulic System ..... 202 l (53.4 US gal)
Engine Crankcase and filters ..... 34 l (9.0 US gal)
Cooling System ..... 55 l (14.5 US gal)
Transmission (including cooler) ..... 63 l (16.6 US gal)
Differentials - Front & Rear (each) ..... 28 l (7.4 US gal)
Differential - Centre ..... 31 l (8.2 US gal)
Planetaries - Front ..... 11 l (3.0 US gal)
Planetaries - Centre & Rear (each) ..... 7.5 l (2.0 US gal)
Hand Pump Tank ..... 1 l (0.26 US gal)
Air Conditioning Compressor ..... 0.125 l (0.033 US gal)

VIBRATION AND SOUND INFORMATION

Operator Ear (ISO 6394) ..... 78 dbA

*Exterior Sound Rating (ISO 6395) ..... 108 dbA
* - The above result is for the mode giving the highest exterior sound level when measured and operated as per the prescribed procedures of the standard. Results shown are for the vehicle in base configuration.

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

Hand and Arm Vibration

The weighted root mean square acceleration to which the hand and arms of the operator are exposed is less than 2.5 m/s² under normal operating conditions.

Whole Body Vibration

Under simulated field duty cycle, the weighted root mean square acceleration emission of the machine to which the body is subjected is less than 0.5 m/s².

Note 1: Whole body vibrations on construction machines are influenced by many factors independent of machine design, for example ground conditions, working methods, correct seat adjustment, operator input to vehicle speed. It is therefore not possible to state one single value which is representative of operator's exposure to whole body vibrations.
The single whole-body emission value listed above is determined under particular operating and terrain conditions. In accordance with EN474 it is not intended to be used to determine the whole-body vibration exposure to the operator using this machine.

Note 2: It is recognized that the appropriate design of operator's seat is the most effective construction measure to minimize the whole-body vibration emission of a particular machine family.

This machine is equipped with an operator's seat which meets the criteria of EN ISO 7096 representing vertical vibration under severe operating conditions.

The seat in this machine has been tested with input spectral class EM1 and has a seat transmissibility factor SEAT >1.1.

Vehicle Weights	23.5 R25 Tyres	
Standard Vehicle	**kg**	**lb**
Net Distribution		
Front Axle	11724	25793
Centre Axle	5205	11451
Rear Axle	5276	11709
Vehicle, Net	**22205**	**48953**
Payload	**25000**	**55115**
Gross Distribution		
Front Axle	15880	34936
Centre Axle	15592	34302
Rear Axle	15733	34830
Vehicle, Gross	**47205**	**104068**
Bare Chassis	17335	38213
Body	4100	9040
Body Hoists (Pair)	530	1 170

Ground Pressures		
At 15% sinkage of unloaded radius and specified weights		
23,5 R25	**Net**	**Loaded**
Front	118 kPa (17.1 psi)	161 kPa (23.3 psi)
Rear	53 kPa (7.6 psi)	158 kPa (22.9 psi)
750/65 R25	**Net**	**Loaded**
Front	87 kPa (12.6 psi)	119 kPa (17.3 psi)
Rear	40 kPa (5.8psi)	119 kPa (17.3 psi)

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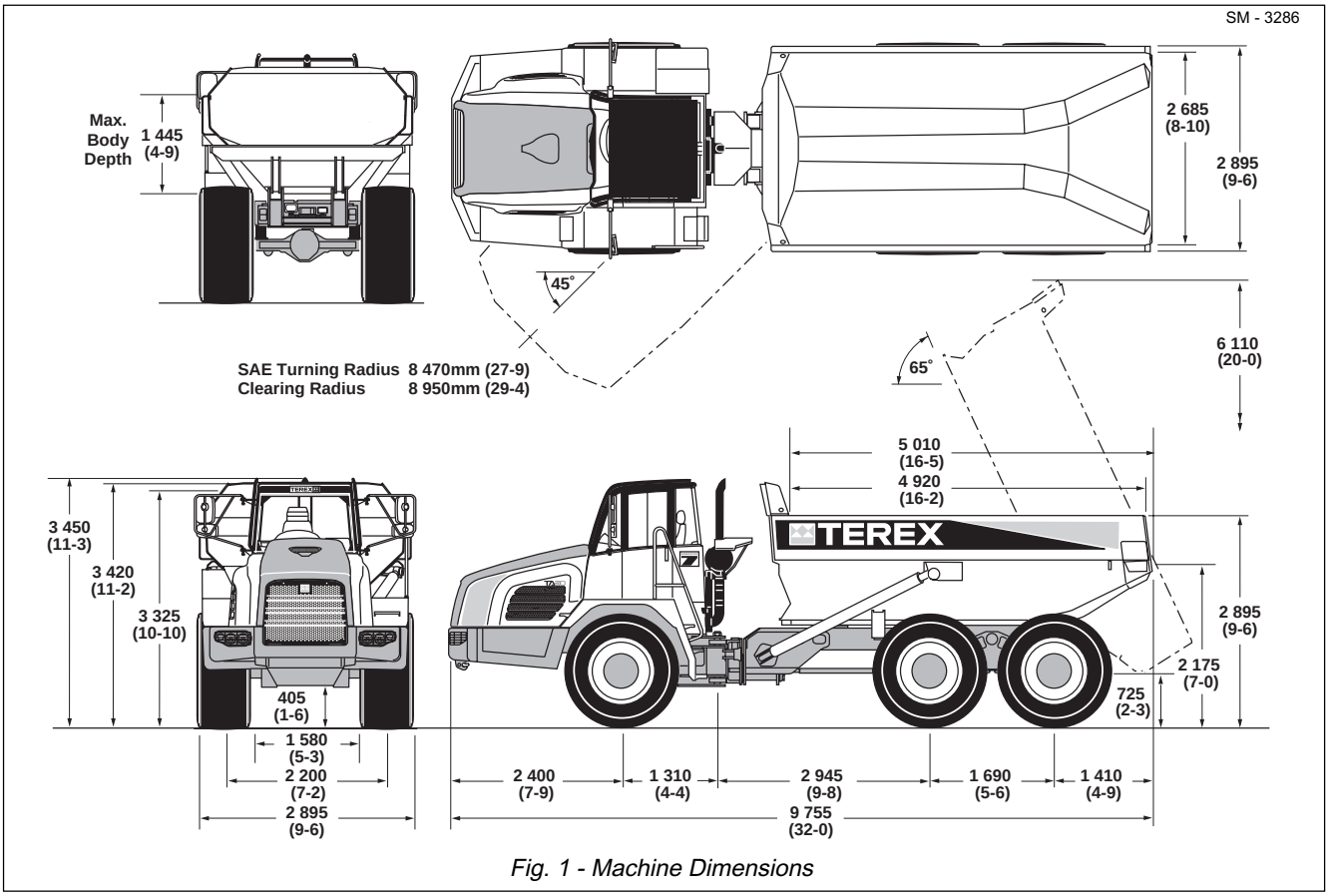

Fig. 1 - Machine Dimensions

ENGINE

Make/Model ..... Cummins QSM11
Type ..... Four cycle diesel, turbocharged with air-to-air charge cooling, water-cooled. Electronic management.

Gross power at 1800 rev/min ..... 287 kW (385 hp)
Net power at 2100 rev/min ..... 248 kW (333 hp)

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

Maximum Torque ..... 1775 Nm (1309 lbf ft) at 1400 rev/min
Number of cylinders/configuration ..... 6, in line
Bore x Stroke ..... 125 x 147 mm (4.92 x 5.79 in)
Piston Displacement ..... 10.8 l (661 in³)
Air cleaner ..... Dry type, double element
Starting ..... Electric
Maximum Speed (No load) ..... 2350 rev/min
Maximum Speed (Full load) ..... 2100 rev/min
Idle Speed ..... 750 rev/min

TRANSMISSION

Make/Model ..... ZF 6WG 310 RPC Automatic with manual override. The transmission assembly consists of a torque converter close-coupled to a countershaft-type gearbox with integral output transfer gearing. Automatic shifting throughout the range, with kickdown feature. Lockup action in all forward gears. A torque proportioning output differential transmits drive permanently to front and rear axles. This differential may be locked by the driver for use in difficult traction conditions. Standard integral hydraulic retarder which automatically operates should the engine overspeed. Blocked filter indicator and filter bypass system provide valve block with additional protection from unfiltered oil.

Pressures:
- Main ..... 16 + 2 bar (232 + 30 lbf/in²)
- Lockup (Wk) ..... 12 ± 2 bar (174 ± 30 lbf/in²)
- Converter 'IN' ..... 10.5 bar (152 lbf/in²) at 2300 rev/min
- Converter 'OUT' ..... 4.8 bar (70 lbf/in²) at 2300 rev/min
- Converter Relief Valve ..... 8.5 bar (123 lbf/in²)
- Retarder ..... 5.5 bar (80 lbf/in²)

Temperatures:
- Normal ..... 80 °C - 110 °C (176 °F - 230 °F)
- Maximum (Retarder Mode) ..... 145 °C (293 °F)

Stall Speed ..... 1805 ± 50 rev/min

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

Forward						
Gear	1	2	3	4	5	6
km/h	5.6	8.7	13.6	21.1	31.0	51.0
mile/h	3.5	5.4	8.5	13.1	19.3	31.7

Reverse			
Gear	1	2	3
km/h	5.6	13.6	31.0
mile/h	3.5	8.5	19.3

General Information - Technical Data TA30

Section 000-0000

AXLES

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

Transverse differential locks are activated by a request from the foot operated switch. Locking of transverse differential locks is actuated simultaneously with the transmission output differential lock.

Ratios:
- Differential 3.875:1
- Planetary 5.71:1
- Total Reduction 22.12:1

SUSPENSION

Front: Axle is carried on the leading arms of a sub-frame which pivots on the main frame. Suspension is by rubber elements with four heavy duty hydraulic dampers.

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 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.

WHEELS AND TYRES

Wheels: ..... 5-piece earthmover rims with 12 stud fixing
Size:
- Standard ..... 25 x 19.50 in for 23.5 R25** tyres
- Optional ..... 25 x 22.00 in for 750/65 R25** tyres

Tyres:
- Standard 23.5 R25**
- Optional 750/65 R25**

Inflation Pressures (Bridgestone):

	Front	Rear
23.5 R25**	4.75 bar (69 lbf/in²)	4.75 bar (69 lbf/in²)
750/65 R25** ..	3.25 bar (47 lbf/in²)	3.25 bar (47 lbf/in²)

Inflation Pressures (Michelin):

	Front	Rear
23.5 R25**	4.0 bar (58 lbf/in²)	4.0 bar (58 lbf/in²)
750/65 R25**	3.0 bar (44 lbf/in²)	3.0 bar (44 lbf/in²)

Inflation Pressures (Pirelli):

	Front	Rear
23.5 R25**	4.8 bar (70 lbf/in²)	4.8 bar (70 lbf/in²)

Inflation Pressures (Continental):

	Front	Rear
23.5 R25**	5.0 bar (73 lbf/in²)	5.0 bar (73 lbf/in²)

Inflation Pressures (Marangoni):

	Front	Rear
750/65 R25**	3.0 bar (43 lbf/in²)	3.0 bar (43 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

Braking, steering and body hoist systems are controlled by a main hydraulic valve mounted on frame. Systems are supplied with oil from a common tank by the main hydraulic pump, driven from power takeoff on transmission. System components are protected by full flow filtration on the return line.

Pump:
- Type ..... Piston
- Capacity at 2 100 rev/min ..... 4.9 l/s (77.4 US gal/min)

Brakes

Full hydraulic braking system with enclosed, oil-immersed 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 ..... 60 ± 5.2 bar (870 ± 75 lbf/in²)

Braking surface (tractor) ..... 22000 mm² (34.1 in²)/brake
Braking surface (trailer) ..... 22000 mm² (34.1 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.

Steering

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

System Pressure ..... 241 bar (3 500 lbf/in²)
Steering Angle to either side ..... 45°
Lock to Lock Turns, steering wheel 4

Body Hoist

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

System Pressure ..... 220 bar (3200 lbf/in²)
Control Valve ..... Pilot Operated, Closed Centre
Body Raise Time (loaded) ..... 12 sec
Body Lower Time (power down) ..... 7.5 sec

ELECTRICAL SYSTEM

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

BODY

Of all welded construction, fabricated from high hardness (min. 360 BHN) 1000 MPa (145000 lbf/in²) yield strength steel. 25° tail chute angle provides good load retention without tailgate.

Plate Thicknesses:
- Floor and Tailchute ..... 14 mm (0.55 in)
- Sides ..... 12 mm (0.47 in)
- Front ..... 8 mm (0.31 in)

Volume:
- Struck (SAE) ..... 13.8 m³ (18.0 yd³)
- Heaped 2:1 (SAE) ..... 17.5 m³ (22.9 yd³)

SERVICE CAPACITIES

Fuel tank ..... 398 l (103 US gal)
Hydraulic System ..... 202 l (53.4 US gal)
Engine Crankcase and filters ..... 34 l (9.0 US gal)
Cooling System ..... 55 l (14.5 US gal)
Transmission (including cooler) ..... 63 l (16.6 US gal)
Differentials - Front & Rear (each) ..... 28 l (7.4 US gal)
Differential - Centre ..... 31 l (8.2 US gal)
Planetaries - Front ..... 11 l (3.0 US gal)
Planetaries - Centre & Rear (each) ..... 7.5 l (2.0 US gal)
Hand Pump Tank ..... 1 l (0.26 US gal)
Air Conditioning Compressor ..... 0.125 l (0.033 US gal)

VIBRATION AND SOUND INFORMATION

Operator Ear (ISO 6394) ..... 78 dbA

*Exterior Sound Rating (ISO 6395) ..... 109 dbA
* - The above result is for the mode giving the highest exterior sound level when measured and operated as per the prescribed procedures of the standard. Results shown are for the vehicle in base configuration.

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

Hand and Arm Vibration

The weighted root mean square acceleration to which hand and arms of the operator are exposed is less than 2.5m/s² under normal operating conditions?

Whole Body Vibration

Under simulated field duty cycle, the weighted root mean square acceleration emission of the machine to which the body is subjected is less than 0.5 m/s².

Note 1: Whole body vibrations on construction machines are influenced by many factors independent of machine design e.g ground conditions, working methods, correct seat adjustment, operator input to vehicle speed.

It is therefore not possible to state one single value which is representative of operator's exposure to whole body vibrations.
The single whole-body emission value listed above is determined under particular operating and terrain conditions. In accordance with EN474 it is not intended to be used to determine the whole-body vibration exposure to the operator using this machine.

Note 2: It is recognized that the appropriate design of operator's seat is the most effective construction measure to minimize the whole-body vibration emission of a particular machine family.

This machine is equipped with an operator's seat which meets the criteria of EN ISO 7096 representing vertical vibration under severe operating conditions.

The seat in this machine has been tested with input spectral class EM1 and has a seat transmissibility factor SEAT >1.1.

Vehicle Weights	23.5 R25 Tyres	
Standard Vehicle	**kg**	**lb**
Net Distribution		
Front Axle	11753	25913
Centre Axle	5315	11718
Rear Axle	5417	11942
Vehicle, Net	**22485**	**49573**
Payload	**28000**	**61730**
Gross Distribution		
Front Axle	16821	37086
Centre Axle	16740	36904
Rear Axle	16924	37313
Vehicle, Gross	**50485**	**111303**
Bare Chassis	17555	38703
Body	4400	9700
Body Hoists (Pair)	530	1170

Ground Pressures		
At 15% sinkage of unloaded radius and specified weights		
23,5 R25	**Net**	**Loaded**
Front	119 kPa (17.2 psi)	170 kPa (24.6 psi)
Rear	54 kPa (7.8 psi)	170 kPa (24.6 psi)
750/65 R25	**Net**	**Loaded**
Front	90 kPa (13.1 psi)	128 kPa (18.6 psi)
Rear	41 kPa (5.9 psi)	111 kPa (18.6 psi)

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Welding

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

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

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

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

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

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

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

General Welding Procedure

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

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

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

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.

* * * *

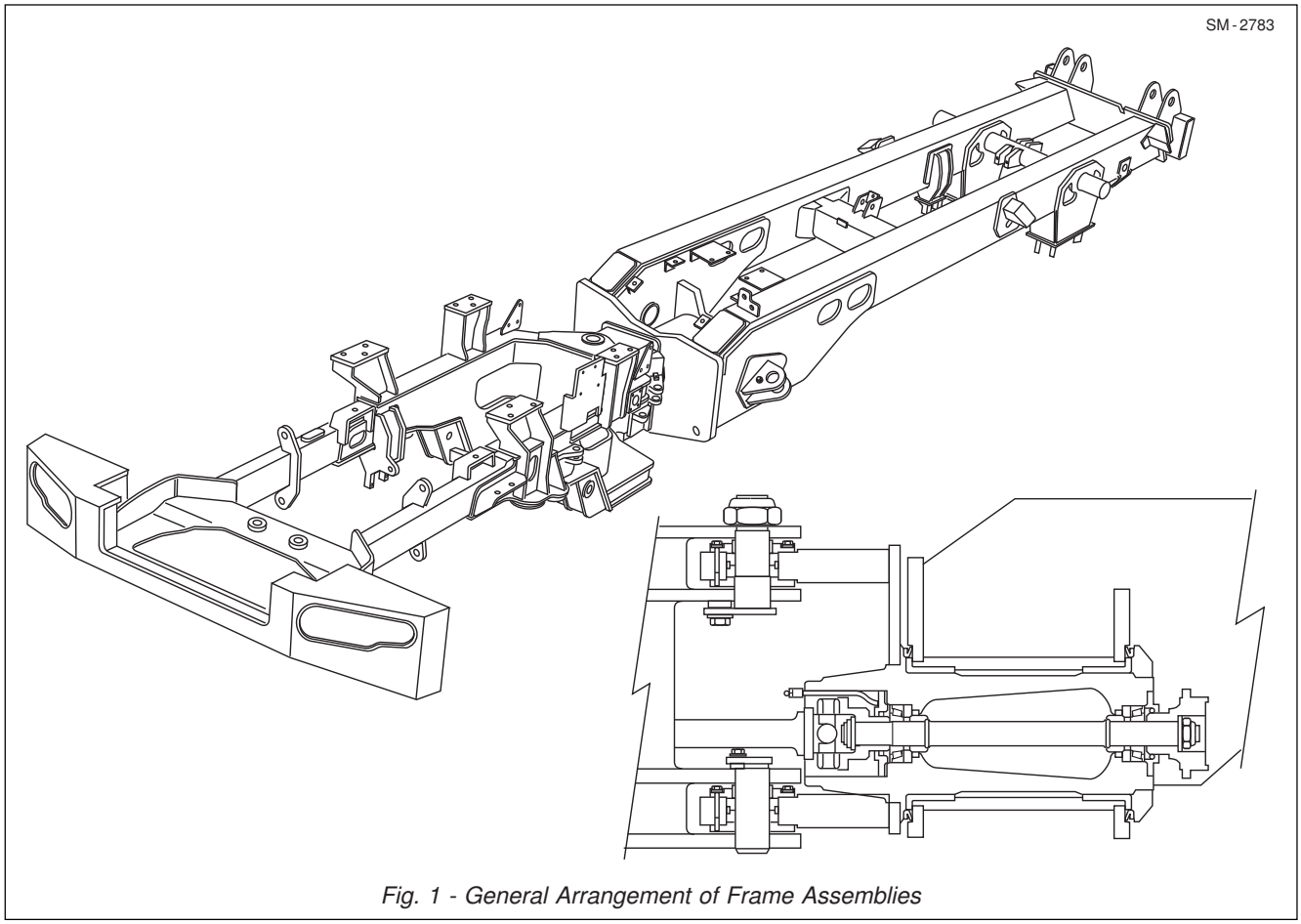

Fig. 1 - General Arrangement of Frame Assemblies

DESCRIPTION

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

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

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

Steering is by frame articulation to 45° either side by two widely spaced vertical pivot pins in taper roller bearings. Oscillation between the front and rear frames is provided by a large diameter cylindrical coupling carried on nylon bushes located in the rear frame. Longitudinal shocks are absorbed by the thrust faces of the nylon bushes. A large thrust nut, which is threaded to the end of the coupling and locked to the frame, secures the coupling in position. Wear on the thrust faces of the bushes is compensated by tightening this thrust nut.

INSPECTION AND MAINTENANCE

Inspection

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

Straightening

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

Welding

⚠ WARNINGS

Before any welding is done on a machine equipped with the Quantum Electronic Fuel System, disconnect the following in this order: Battery earth cable, battery supply cable, alternator earth cables, alternator supply cables, body hydraulics joystick and electrical connections at the engine ECM, transmission ECU and hydraulics ECU 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.

Reinforcement

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

Painting

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

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

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

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

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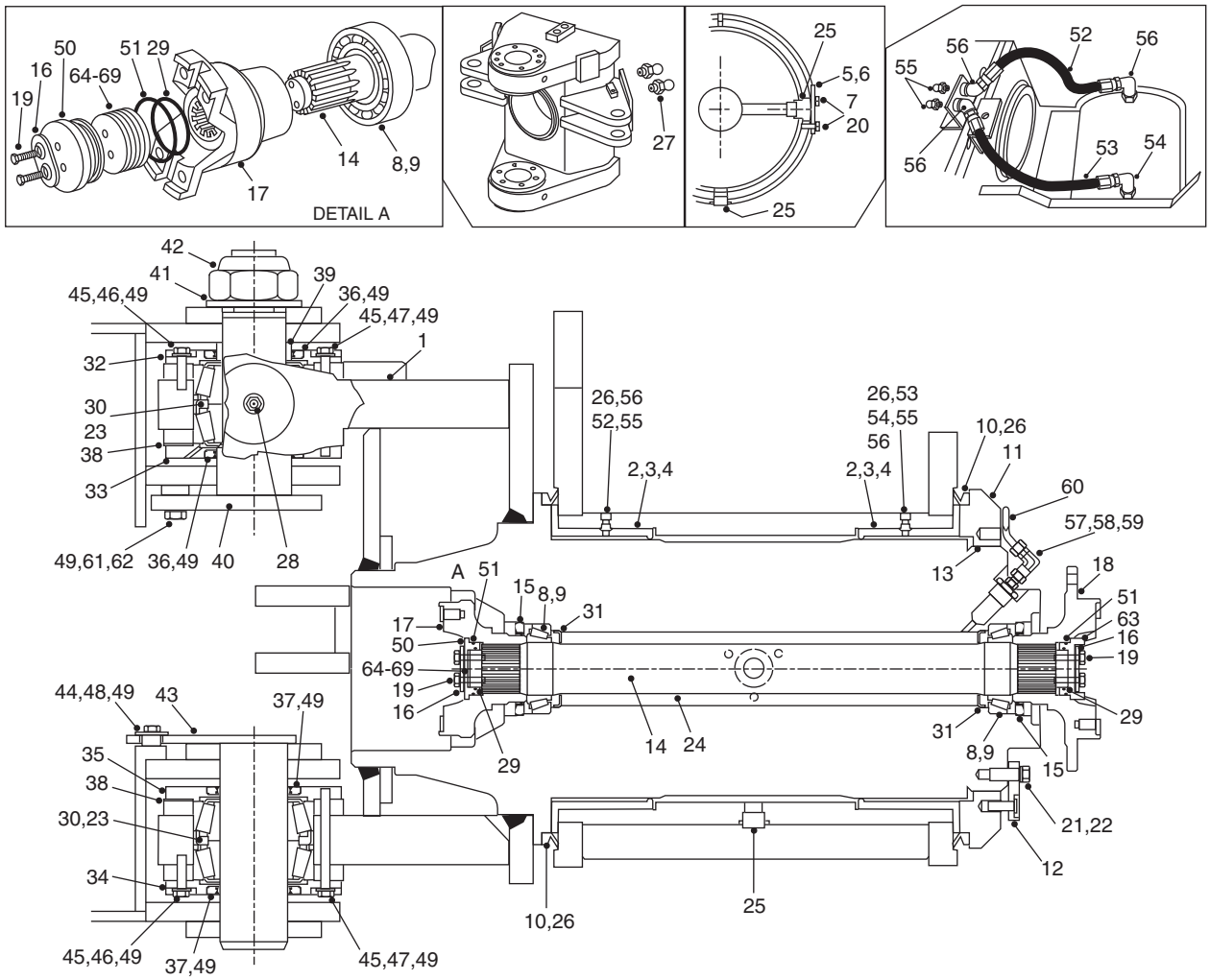

1 - Pivot Assembly	16 - Lockplate	27 - Lube Fitting	41 - Washer	55 - Lube Fitting
2 - Nylon Bush	17 - Front Yoke	28 - Plug	42 - Nut	56 - Elbow
3 - Loctite 648	18 - Brake Yoke	29 - 'O' Ring	43 - Lower Pin	57 - Adaptor
4 - Loc Quick Primer	19 - Bolt	30 - Bearing Assembly	44 - Hardened Washer	58 - Connector
5 - Gasket	20 - Washer	31 - Retaining Ring	45 - Washer	59 - Elbow
6 - Cover Plate	21 - Lockwasher	32 - Seal Housing	46 - Bolt	60 - Pipe Assembly
7 - Bolt	22 - Bolt	33 - Seal Housing	47 - Bolt	61 - Washer
8 - Bearing Assy - Cup	23 - Extreme Pressure	34 - Seal Housing	48 - Bolt	62 - Bolt
9 - Bearing Assy - Cone	Lithium No.2 Grease	35 - Seal Housing	49 - Loctite 243	63 - Thrust collar-Rear
10 - 'V' Ring Seal	24 - SAE 80W-90 EP	36 - Seal	50 - Thrustcollar-Front	64 - Shim
11 - Thrust Nut	Gear Oil	37 - Seal	51 - 'O' Ring	65 - Shim
12 - Locking Plate	25 - Plug	38 - Shim	52 - Hose Assembly	66 - Shim
13 - Antiseize Comp	26 - Extreme Pressure	39 - Spacer	53 - Hose Assembly	67 - Shim
14 - Driveshaft	Multipurpose Grease	40 - Upper Pin	54 - Connector	68 - Shim
15 - Seal				69 - Shim

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 Lockplate (16) , 2 0ff Front bolts (19) & Front thrust collar (50).

7. Remove and discard 'O' rings (29 & 51) from Thrust collar (50).

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.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 Lockplate (16) , 2 off Rear bolts (19) , Rear Thrust collar (63) & Brake yoke (18) from driveshaft (14). Identify front and rear ends of driveshaft (14).

21. Remove and discard 'O' rings (29 & 51) from Rear Thrust collar (63).

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).

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 bearing cup (8) into tractor end of pivot casing. Ensure it is firmly seated & that a 0.05mm (0.002") feeler gauge **cannot** be inserted between cup and mating face.

3. Check rear bearing cup (8) is firmly seated in the body end of the pivot casing, again ensuring 0.05mm (0.002") feeler gauge **cannot** be inserted between cup and mating face.

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

5. Support driveshaft (14) in a suitable fixture & tap one Bearing assembly cone (9) onto driveshaft (14) using a tubular mandrel.

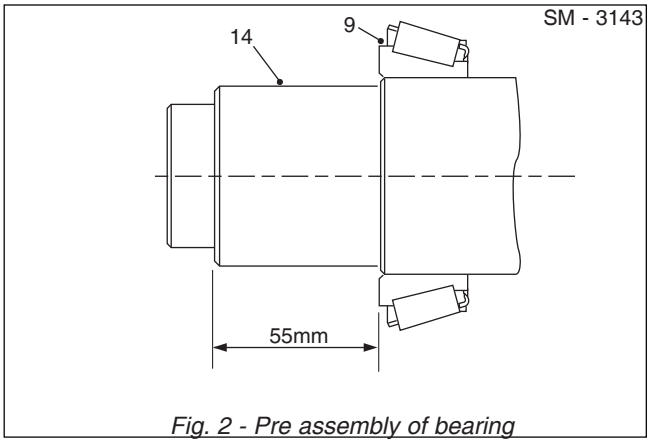

Fig. 2 - Pre assembly of bearing

6. Refer to Fig. 2, Maintain end face of cone approximately 55mm from end of spline face.

7. Insert driveshaft (14) into truck end of pivot casing until bearing assembly cone (9) seats firmly in the bearing asembly cup (8).

8. Apply loctite (3) to new seal (15) and fit over the driveshaft (14) with seal 'Lip' to bearing side.Press seal home using a mandrel.

9. Apply grease to splines of Front yoke (17) and slide onto the drive shaft (14).

10. Fit new 'O'-rings (29 & 51) to Front thrust collar (50) and fit collar over stub end of driveshaft (14) (align mating holes). Fit 2 off front bolts (19).

11. Tighten Front bolts (19) ; alternately 1/4 - 1/2 turns, drawing driveshaft (14) hard against the inner face of Front thrust collar (50). Shaft will be visible through inspection hole on the collar.

12. Lock Front yoke (17) from rotation by a suitable method / bar acting on the ground. Torque front bolts (19) to 54Nm/39 Ibf ft.

13. Using special mandrel (15270104) home locking plate (16) onto Bolts (19). Remove the clamping bar.

14. Slide Rear bearing asembly cone (9) onto rear end of drive shaft (14) until it seats in bearing assembly cup (8).

15. Position clamping bar assembly and screw central bolt hard against bolts (19) of front thrust collar (50), enabling body end bearing to be fully seated home.

16. Using mandrel and heavy hammer, drive Rear bearing assembly cone, fully into cup. Now remove clamp bar assembly from front end.

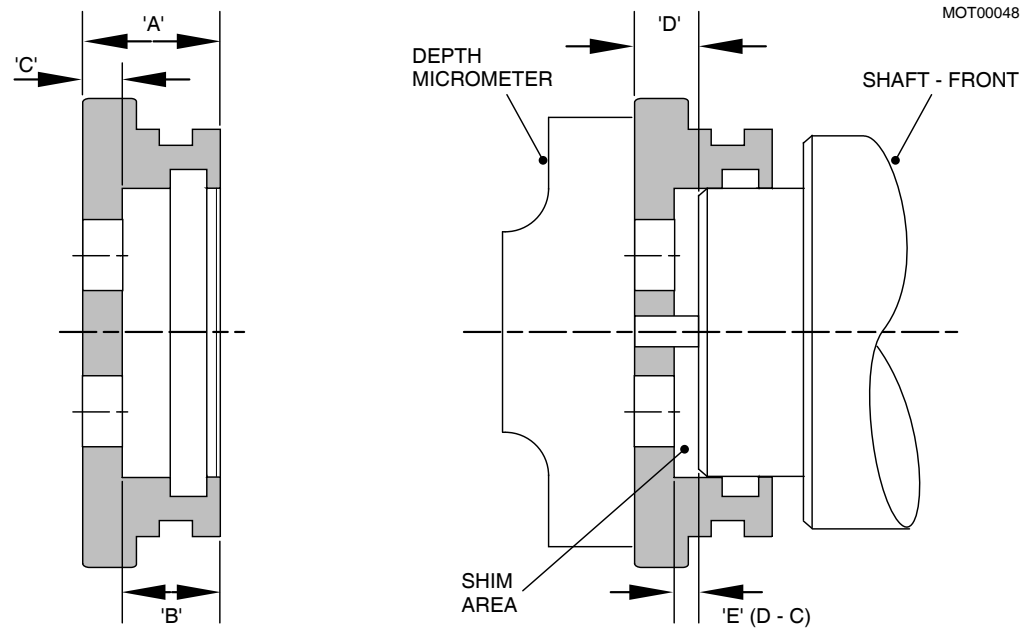

Fig. 3 - Measurements / various

17. Take remaining seal (15), apply loctite (3) and fit over drive shaft with seal 'Lip' to bearing side. Press seal home using a mandrel.

18. Apply grease to splines of brake yoke (18) and slide onto drive shaft (14). Ensure milled slots of driving flanges are aligned with those of brake yoke.

Note : For Measurment letters- refer to fig. 3, unless otherwise stated.

19. Before fitting of Rear Thrust collar (63) record Measurements as stated:

i) Measure total width 'A' of Rear thrust collar (63)

ii) Using Depth micrometer, measure inner bore depth 'B' of collar (63) and record value.

iii) Subtract 'B' from 'A' to determine recess dimension 'C'.

20. Fit Rear thrust collar (63) without 'O'-rings onto Drive shaft (14) and tighten Rear bolts (19) to a nominal torque of 15Nm/11lbf ft.

Note : a gap should be visible between end of shaft and inner face of collar.

21. Using a Depth micrometer, measure distance 'D' from collar (63) outer face to end face of drive shaft (14) via the hole in the collar and record the value.

22. The actual free air space 'E' to be shimmed between end of drive shaft (14) and compression face of Thrust collar (63) equals:

E='D' - 'C'.

23. Now add 0.6mm (0.024") to dimension 'E' to allow for oversize shims. This value is dimension 'F' (End float will be determined by subtraction).

24. Remove Rear bolts (19) and Rear thrust collar (63) from pivot body end and chap drive shaft (14) to free bearing.

25. Calculate the nominal combination of minimum number if shims (64) to achieve the size nearest to dimension 'F'. Record the appropriate part numbers and total nominal thickness value.

26. Select the shims (64) and measure the total actual thickness of the combination. Record this value.

27. Place the shim pack (64) in the rear thrust collar (63) , lock off the Brake yoke (18) from rotation by suitable method / bar on ground. Torque bolts (19) to full torque.

28. Remove the clamp and spin the yoke (18) to ensure driveshaft (14) free rotation.

29. Take a magnetic clock gauge located on the flange of pivot casing, needle acting on rear thrust collar (63)

end face. Check Brake yoke (18) float movement.

30. Take reading obtained and subtract a figure sufficient to give an end float in the range 0.05mm - 0.15mm (0.002" - 0.006"), reduce shim pack (64) accordingly.

31. Remove Rear thrust collar (63) and shims (64) and re-assemble with the apporpriate shims. Ensure 'O'-rings (29 & 51) are now fitted.

32. Lock Brake yoke (18) flange as before ,applying alternate 1/4 -1/2 turns on bolts (19). Torque to 54 Nm (39 lbf ft).

33. Remove the locking bar and confirm that the driveshaft (14) end float is in the range 0.05mm - 0.15mm (0.002" - 0.006") by moving the brake yoke (18) for and aft against the clock gauge.

34. Adjust and refit the shim pack (63) as necessary.

35. Float set correctly; Drive home locking plate (16) using a mandrel (15270104) . Re-check the end float.

36. 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).

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

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

39. 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).

40. 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).

41. 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).

42. 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.

43. 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.

44. 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).

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

46. 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).

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

48. 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.

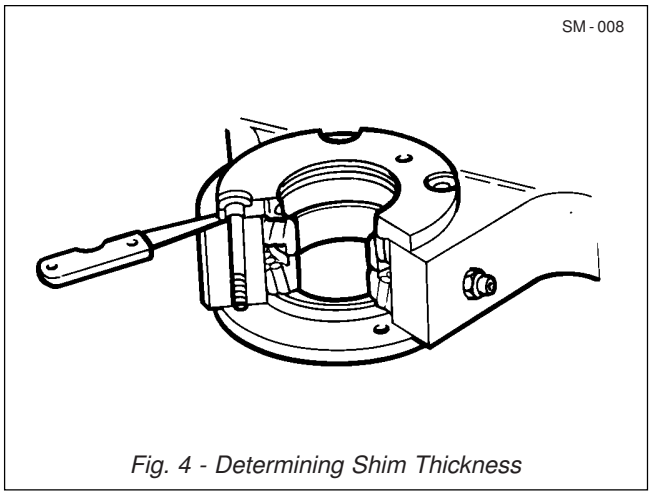

Fig. 4 - Determining Shim Thickness

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).

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. 4, 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.

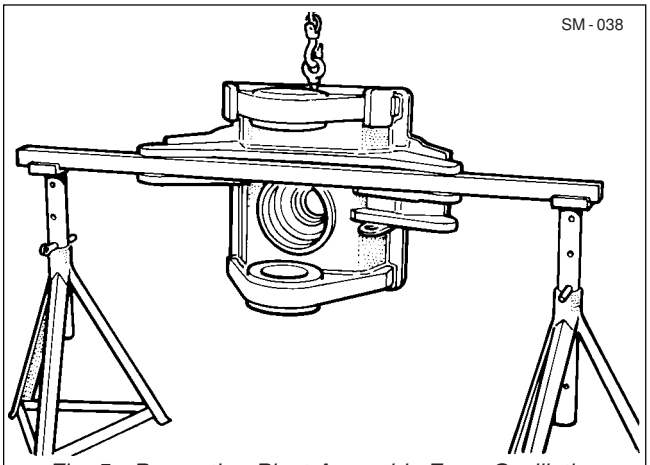

Fig. 5 - Preventing Pivot Assembly From Oscillating

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 bolts (19), Lockplate (16) & Rear thrust collar (63). Pull brake yoke (18) from driveshaft (14) .

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. 5.

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

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

16. Remove nylon oscillation bushes (2) with hammer and chisel.

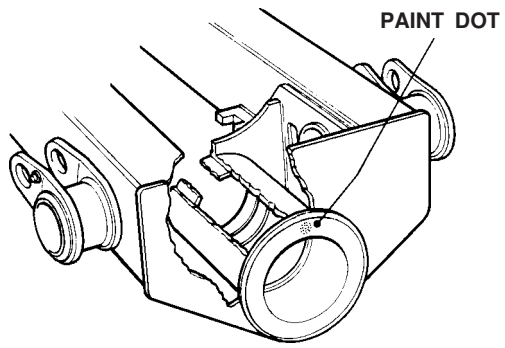

Fig. 6 - Installing Oscillation Bushes

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.

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. 6. 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 . 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. 5.

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 rear of driveshaft (14).

14. install Brake yoke (18) , Rear thrust collar (63) ensuring 'O'-rings (29& 51) are in place , shim pack (64) and bolts (19).

15. Lock off Brake yoke flange as before (18) with suitable clamping method. Torque bolts (19) to 73 Nm (lbf ft)

16. Take a magnetic clock gauge located on the flange of pivot casing , needle acting on Rear thrust collar (63) end face. Check Brake yoke (18) float movement. Ensure still within range 0.05mm - 0.15mm (0.002" - 0.006").
17. If float is incorrect, alter arrangement of shim pack (64) to bring within size.

18. Using special mandrel (15270104) home locking plate (16) onto bolts (19). Remove clamping bar.

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				
			TORQUE	
FIG. No.	ITEM No.	ITEM NAME	Nm	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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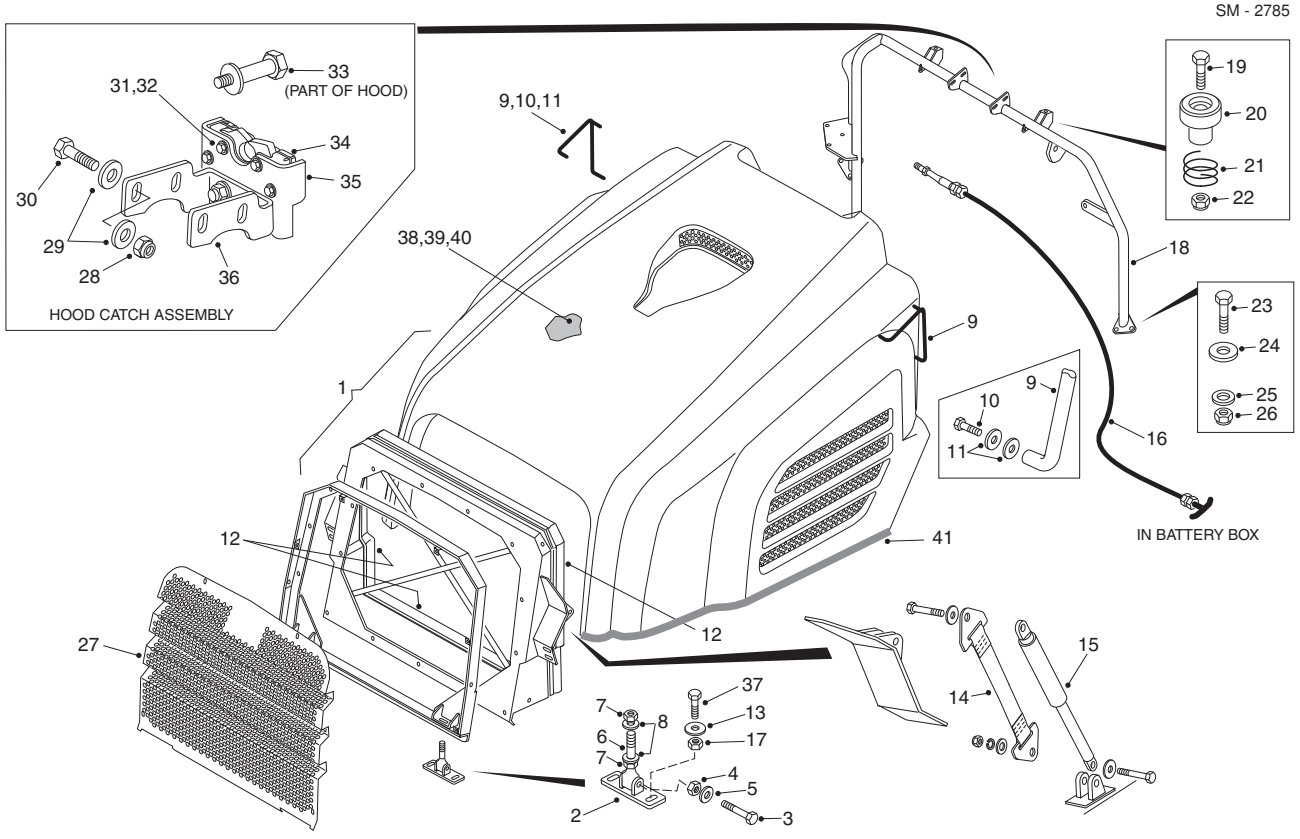

1 - Hood Assembly
2 - Hinge Assembly
3 - Bolt
4 - Nut
5 - Washer
6 - Adjustment Rod
7 - Nut
8 - Hardened Washer
9 - Hood Handle
10 - Bolt
11 - Washer
12 - Seal
13 - Washer
14 - Hood Retaining Strap
15 - Gas Strut
16 - Hood Catch Cable
17 - Nut
18 - Goalpost Assembly
19 - Bolt
20 - Hood Stop
21 - Spring
22 - Locknut
23 - Bolt
24 - Hardened Washer
25 - Washer
26 - Locknut
27 - Grille
28 - Locknut
29 - Washer
30 - Bolt
31 - Bolt
32 - Washer
33 - Striker Bolt
34 - Hood Catch
35 - Bracket Assembly
36 - Bracket Hood-catch
37 - Bolt
38 - Insulation quilt LHS
39 - Insulation quilt RHS
40 - Insulation quilt Top
41 - Lip Seal

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, washers, lockwashers and nuts securing grille (27) to grille subframe. Secure grille (27) clear of hood (1).

4. Pull cable assembly (16), handle inside battery box, to release hood catch and lift up hood (1). Secure hood (1) in raised position using suitable lifting equipment.

5. Carefully remove bolts, washers and nuts securing hood retaining straps (14) and gas struts (15).

Remove fasteners, hood retaining straps (14) and gas struts (15) from hood (1).

6. Remove bolts (37), washers (13) and nuts (17) securing hinge assemblies (2) to frame. Carefully lift hood (1) assembly from the machine.

7. If required, remove mounting hardware securing grille subframe to hood (1). Secure grille subframe clear of hood (1).

8. If required, remove bolts (10) and washers (11) securing handles (9) to hood (1). Secure handles (9) clear of hood (1).

Installation

Numbers in parentheses refer to Fig. 1.

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

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

1. If removed, secure handles (9) to hood (1) using bolts (10) and washers (11).

2. If removed, secure grille subframe to hood (1) using mounting hardware as removed at 'Removal'.

3. Using suitable lifting equipment, lift and position hood (1) on the machine and align holes in hinge assemblies (2) with mounting holes on frame. Secure hood (1) using bolts (37), washers (13) and nuts (17).

4. Carefully install hood straps (14) and gas struts (15) using mounting hardware as removed at 'Removal'.

5. With lifting equipment still in place, lower hood (1) to match with goalpost support assembly (18). Remove lifting equipment.

6. If required, adjust fitment of hood (1) to frame at hinge assemblies (2) and adjustment rod (6).

7. Install grille (27) to hood (1) and secure using bolts, washers, lockwashers and nuts.

8. Remove wheel blocks.

GOALPOST SUPPORT ASSEMBLY

Removal

Numbers in parentheses refer to Fig. 1.

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

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

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

3. Pull cable assembly (16), handle inside battery box, to release hood catch and lift up hood (1). Secure hood (1) in raised position.

4. Remove mounting hardware securing washer bottle to mounting bracket on the left hand side of goalpost support assembly (18). Secure washer bottle clear of goalpost support assembly (18).

5. Remove plate and mounting hardware securing transmission oil cooler to goalpost support assembly (18). If required, disconnect transmission oil cooler hoses.

6. Remove mounting hardware securing air cleaner intake tube to goalpost support assembly (18).

7. 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.

8. 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.

9. Disconnect electrical harness from coolant level sensor in header tank. Note routing of all hoses and harnesses attached to and through goalpost support assembly (18) and disconnect.

10. Disconnect hood cable (16) ball joint from cam plate assembly (33) and secure cable (16) clear of hood catch mechanism.

11. Check to make certain that all necessary line and

cable disconnections have been made, before lifting goalpost support assembly (18).

12. Attach suitable lifting equipment to goalpost support assembly (18). Remove bolts (23), washers (24 & 25) and locknuts (26) securing goalpost support assembly (18) to its mounting. Lift goalpost support assembly (18) from the machine.

13. If required, remove locknuts (22), bolts (19), hood stops (20) and springs (21) from goalpost support assembly (18).

14. If required, remove bolts (30), washers (29) and nuts (28) securing hood catch mechanism (31 - 36) to goalpost support assembly (18). Remove hood catch mechanism (31 - 36).

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 catch mechanism (28 - 38) to goalpost support assembly (18) with mounting hardware as removed at 'Removal'.

2. If removed, secure hood stops (20) and springs (21) to goalpost support assembly (18) with bolts (19) and locknuts (22).

3. Using suitable lifting equipment, lift and position goalpost support assembly (18) on the machine. Secure goalpost support assembly (18) to its mounting with bolts (23), washers (24 & 25) and locknuts (26).

4. Remove lifting equipment.

5. Connect hood cable (16) ball joint to cam plate assembly (33) and secure cable (16) using clips removed during 'Removal'.

6. Fit plate and mounting hardware securing transmission oil cooler to goalpost support assembly (18) as removed during 'Removal'. If necessary, reconnect transmission oil cooler hoses. Ensure transmission oil cooler contains sufficient oil. Refer to Section 210-0060, TRANSMISSION OIL COOLER.

7. Install washer bottle to mounting bracket on the left hand side of goalpost support assembly (18) and secure using mounting hardware as removed during 'Removal'.

8. Secure air cleaner intake tube to goalpost support assembly (18) using mounting hardware as removed during 'Removal'.

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

10. Connect electrical harness to coolant level sensor in header tank. Secure all hoses and harnesses to and through goalpost support assembly (18) following routing as noted at 'Removal'.

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

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

13. Lower hood assembly and check for correct alignment between hood (1) and goalpost support assembly (18) and for operation of hood catch mechanism.

14. Remove wheel blocks.

MAINTENANCE

Periodically check bolts (39), washers (13) and locknuts (17) and tighten when necessary.

Periodically check condition of hood catch mechanism and adjust and lubricate when necessary.

SPECIAL TOOLS

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

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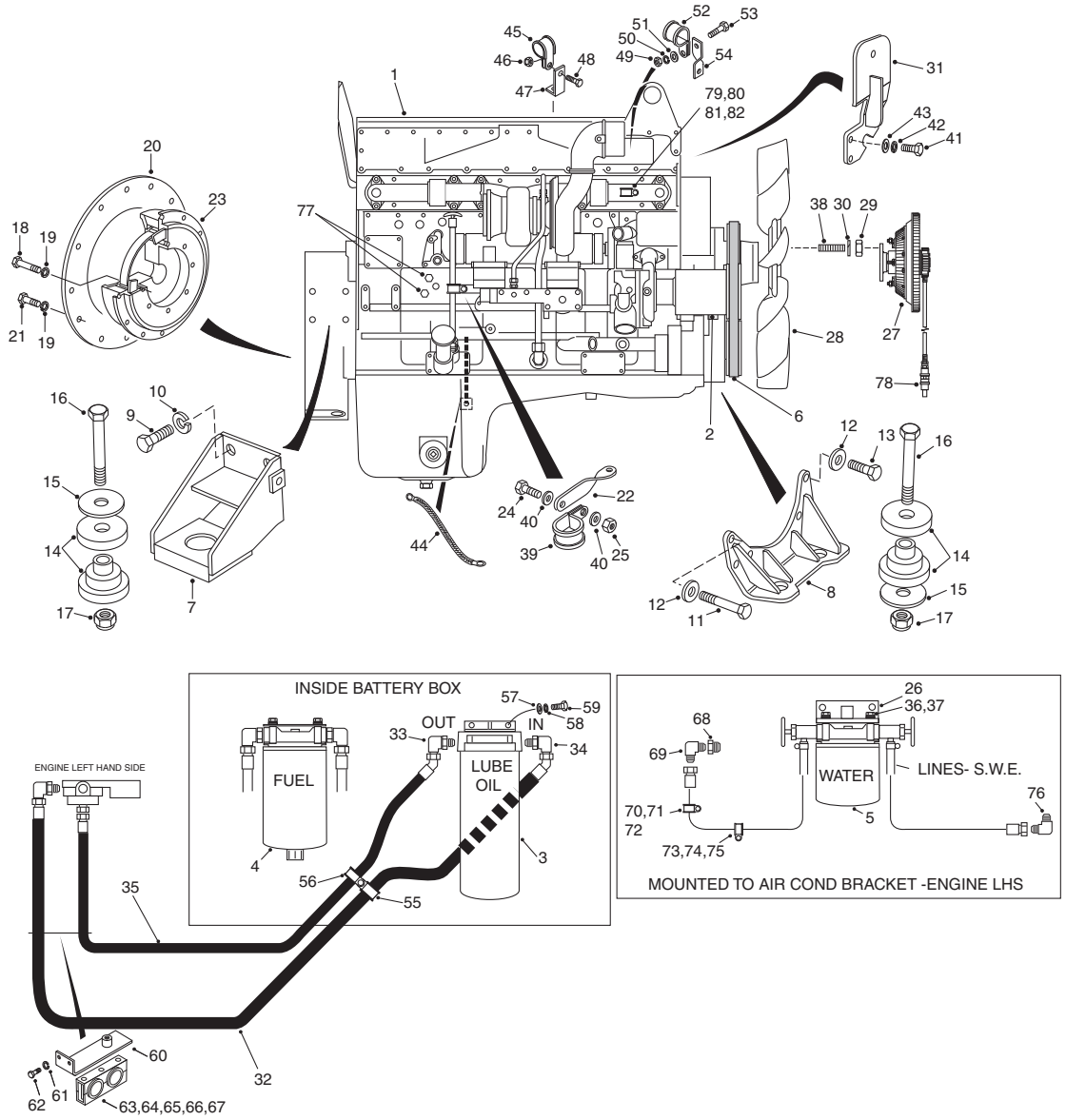


1 - Engine
2 - Alternator Belt
3 - Oil Filter
4 - Fuel Filter
5 - Coolant Filter
6 - Fan Belt
7 - Rear Mount
8 - Front Mounting Bracket
9 - Bolt
10 - Lockwasher
11 - Bolt
12 - Washer
13 - Bolt
14 - Isolation Mount
15 - Snubbing Washer
16 - Bolt
17 - Locknut
18 - Bolt
19 - Lockwasher
20 - Flywheel Guard
21 - Bolt
22 - Bracket
23 - Engine Coupling
24 - Bolt
25 - Nut
26 - Bracket Assembly
27 - Fan Clutch
28 - Fan
29 - Nut
30 - Washer
31 - Bracket
32 - Hose Assembly
33 - Elbow
34 - Elbow
35 - Hose Assembly
36 - Bolt
37 - Lockwasher
38 - Snubbing Washer
39 - P.Clip
40 - Washer
41 - Bolt
42 - Lockwasher
43 - Washer
44 - Earth Cable
45 - P.Clip
46 - Nut
47 - 'L' Bracket
48 - Bolt
49 - Nut
50 - Lockwasher
51 - Washer
52 - P.Clip
53 - Bolt
54 - Bracket
55 - Clip - Rubber
56 - Clip - Rubber
57 - Washer
58 - Lockwasher
59 - Bolt
60 - Brackey Assembly
61 - Lockwasher
62 - Bolt
63 - Bolt
64 - Nut-Stacking
65 - Bushing Split
66 - Bushing Split
67 - Clamp
68 - Reducer
69 - Elbow
70 - Bolt
71 - Locknut
72 - Clip
73 - Bolt
74 - Locknut
75 - Clip
76 - Elbow
77 - Plug
78 - Connector Kit
79 - Washer
80 - Clamp
81 - Bolt
82 - Nut

Fig. 1 - Engine and Mounting

DESCRIPTION

Numbers in parentheses refer to Figure 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 (8) and two rear mounts (7). Rubber isolation mounts (14) through engine mounts provide sufficient flexibility to absorb varying engine vibration and torsional loads.

Lube oil filter (3) and fuel filter (4) are remote mounted in the battery box on the left hand side of machine. The filters are of the throw away, spin-on type. Oil supplied by the engine oil pump passes through oil filter (3) before reaching the various moving parts of engine (1). Fuel drawn from the fuel tank passes through fuel filter (4) before reaching the fuel pump.

Engine coolant filter (5) is a replaceable spin-on type element mounted on the left hand side of engine (1). Refer to Section 210-0000, Cooling System.

QUANTUM ELECTRONIC FUEL SYSTEM

Description

Refer to Figure 2.

⚠ WARNING

Before any welding is done on a machine equipped with the Quantum Electronic Fuel System, disconnect the following 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.

The engine is equipped with Quantum Electronic Fuel System which controls the timing and amount of fuel injection by the electronic fuel system injectors. 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 Quantum Electronic Fuel 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 Fuel System Injectors where the precise amount of fuel is injected into the engine.

3. Electronic Fuel System Injectors - The injector 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.

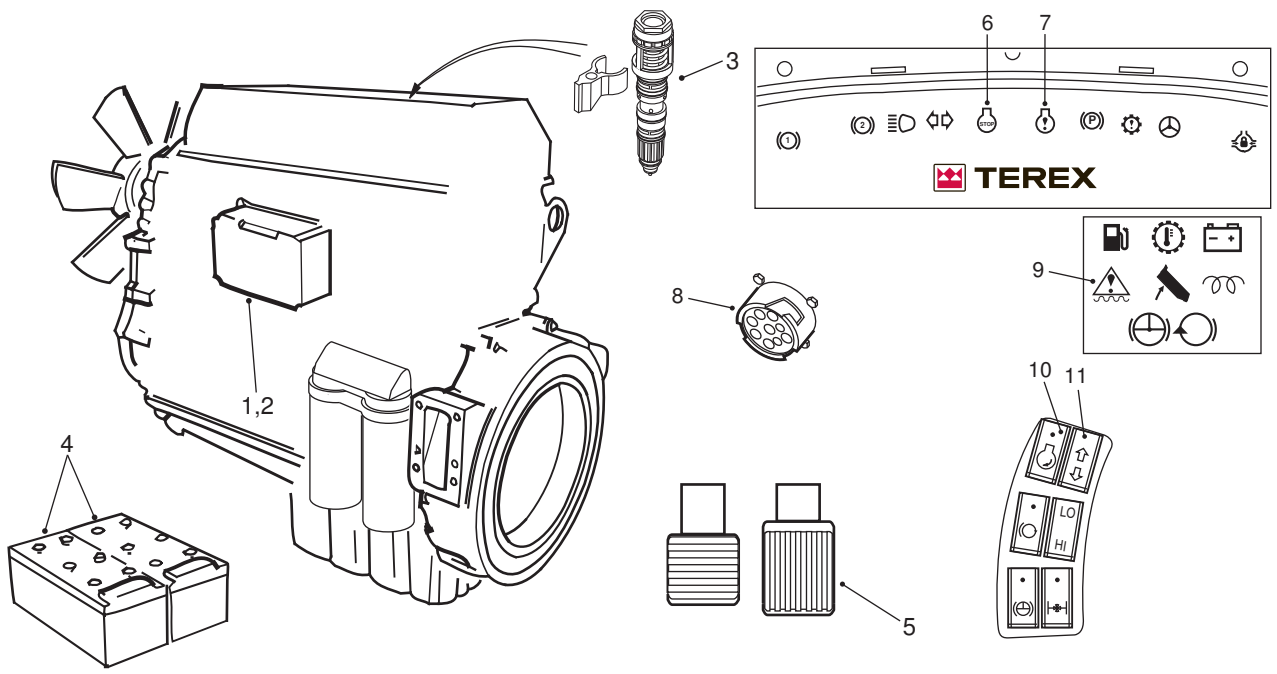
The injector performs four functions:

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 fuel system 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.

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



1 - Electronic Control Module (ECM)
2 - Programmable Read Only Memory (PROM)
3 - Electronic Fuel System Injectors
4 - Batteries
5 - Electronic Foot Pedal
6 - Stop Engine Light
7 - Check Engine Light
8 - Diagnostic Test Point
9 - Maintenance Light
10 - Engine Diagnostic Switch
11 - Engine Diagnostic Search Switch

Fig. 2 - Quantum Electronic Fuel System 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 engine MUST be started with foot 'OFF' the electronic foot pedal.

Do not place engine under full load at full speed immediately after starting. Always allow the engine to fully circulate lubricant and warm up gradually before operating at full speed and full load. Operate engine at top rated speed when maximum power is needed for the load.

6. 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.

7. Check Engine Light - When the 'Check Engine' light comes on, the computer has detected a fault in the engine. The fault should be diagnosed and corrected at the earliest opportunity.

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

9. Maintenance Light - The maintenance light will illuminate when it is time to change the engine oil. The maintenance monitor continuously monitors the time the engine has been operating and the amount of fuel burned to determine when it is time to change oil.

Note: Whenever an electrical fault has occurred, the maintenance monitor data can be inaccurate.

10. Engine Diagnostic Switch - To check for active codes:

a - turn the ignition key switch to the 'OFF' ('0') position.

b - press the diagnostic switch to the 'ON' position.

c - turn the ignition key switch to position '1'.

If no active codes are recorded, both the 'Stop' and 'Check' lights will illuminate and stay on.

If active codes are recorded the 'Stop' and 'Check'

lights will illuminate momentarily. The amber 'Check' and red 'Stop' lights will begin to flash the code of the recorded fault.

11. Engine Diagnostic Search Switch - When the engine is in diagnostic mode this switch is used to search through a list of fault codes, ie. pressing the top of the switch momentarily will advance to the next active fault code, pressing the bottom of the will go back to the previous code. If only one code is active, the system will continuously display the same fault code.

Operation

Numbers in parentheses refer to Fig. 2.

When the 'Stop' light on the dash panel illuminates, the ECM (1) 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.

The machine is equipped with an engine protection derate system, which records fault codes and illuminates appropriate warning lights when an out-of-range condition associated with any of the following sensors is found:

- Coolant temperature
- Coolant level
- Intake manifold temperature
- Oil pressure
- Oil temperature

The engine power and speed will be gradually reduced depending on the level of severity of the out-of-range condition. The operator MUST shut down the engine to avoid serious damage.

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

Whenever the 'Stop' (7) or 'Check' (6) light comes on, the Electronic Fuel System 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.

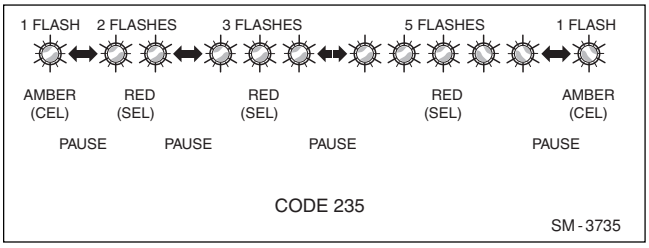
A special diagnostic data reader (INSITE) is available that can be plugged into the engine computer memory via the diagnostic test point (8). The reader is used to extract information related to the cause of the problem. Once the malfunction has been corrected, the Electronic Fuel System will return the engine to normal operation. The data reader can now distinguish between active codes and those stored in the historic code memory (inactive codes). Inactive codes can only be viewed using the data reader. The fault code recorded in the ECM memory will remain until it is erased by a technician.

⚠ WARNING

The operator of a Quantum-equipped vehicle must not attempt to use or read a data reader 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.

The operator can check for active faults by turning the ignition key switch to the 'OFF' position, switching the diagnostic switch (10) 'ON' and then turning the ignition key switch to position '1'.

If no active fault codes are recorded, both 'Stop' (7) and 'Check' (6) lights will come on and stay on. If active codes are recorded, both lights will come on momentarily. The amber 'Check' (6) and red 'Stop' (7) lights will begin to flash the code of the recorded fault. The fault codes flash in the following sequence: the amber light flashes once, then there is a pause where both lights are off. Then the numbers of the recorded fault code flash in red. There is a pause between each number. When the number is done, the amber light flashes again. e.g. amber flashes once - pause - red flashes twice - pause - red flashes three times - pause - red flashes five times - pause - amber flashes once, indicates fault code 235. The number will repeat in the same sequence until the the system is advanced to the next active fault code by diagnostic request switch (11), or the diagnostic switch (10) is switched to the 'OFF' position. Refer to 'Electronic Fuel System Diagnostic Codes' table for fault code descriptions.



ELECTRONIC FUEL SYSTEM DIAGNOSTIC CODES		
Error Code	**Description**	**Fault Lamp**
111	ECM Hardware Internal Failure - Mission disabling	Red
115	Engine Speed Sensor - Both signals lost	Red
121	Engine Speed Sensor - One signal lost	Amber
122	Boost Pressure Sensor - Component shorted high	Amber
123	Boost Pressure Sensor - Component shorted low	Amber
131	Throttle Position Sensor - Component shorted high	Red
132	Throttle Position Sensor - Component shorted low	Red
133	Remote Accelerator Pedal Position Sensor- Circuit shorted high	Red
134	Remote Accelerator Pedal Position Sensor- Circuit shorted low	Red
135	Oil Pressure Sensor - Component shorted high	Amber
141	Oil Pressure Sensor - Component shorted low	Amber
143	Oil Pressure Sensor - Data below normal range	Amber
144	Engine Coolant Temperature Sensor - Component shorted high	Amber
145	Engine Coolant Temperature Sensor - Component shorted low	Amber
147	Throttle Position Sensor - Circuit low frequency	Red
148	Throttle Position Sensor - Circuit high frequency	Red
151	Engine Coolant Temperature Sensor - Data above normal range	Amber
153	Intake Manifold Temperature Sensor - Component shorted high	Amber
154	Intake Manifold Temperature Sensor - Component shorted low	Amber
155	Intake Manifold Temperature Sensor - Data above normal range	Amber
187	Sensor Supply Voltage #2 - Circuit shorted low	Amber
211	Additional OEM/Vehicle Diagnostic Codes have been logged	None
212	Oil Temperature Sensor - Component shorted high	Amber
213	Oil Temperature Sensor - Component shorted low	Amber
214	Oil Temperature - Data above normal range	Red
219	Low Oil Level in Make up tank	Maint.
221	Ambient Air Pressure Sensor - Component shorted high	Amber
222	Ambient Air Pressure Sensor - Component shorted low	Amber
223	Engine Oil Burn Valve Solenoid - Circuit shorted low	Amber
227	Sensor Supply Voltage #2 - Circuit shorted high	Amber
234	Engine Speed - Data above normal range	Red
235	Engine Coolant Level - Data below normal range	Amber
237	External Speed Input (Multiple Unit Sychronization) - Data incorrect	Amber
241	Vehicle Speed Sensor Circuit - Data incorrect	Amber
242	Vehicle Speed Sensor Circuit - Tampering has been detected	Amber
245	Fan Clutch - Circuit shorted low	Amber
254	Fuel Shutoff Value - Component shorted low	Red
255	Fuel Shutoff Value - Component shorted high	Amber
285	SAE J1939 Multiplexing PGN timeout error	Amber
286	SAE J1939 Multiplexing configuration error	Amber
287	SAE J1939 Multiplexing accelerator pedal sensor system error	Red
288	SAE J1939 Multipexing Remote throttle data error	Red
293	Auxiliary Temperature Sensor Input #1 - Circuit shorted high	Amber
294	Auxiliary Temperature Sensor Input #1 - Circuit shorted low	Amber
295	Ambient Air Pressure Sensor - Circuit data incorrect	Amber
297	Auxiliary Pressure Sensor Input #2 - Circuit shorted high	Amber
298	Auxiliary Pressure Sensor Input #2 - Circuit shorted low	Amber
299	Engine Shutdown - Commanded by J1939	Amber
311	Injector Solenoid Valve Cylinder #1 Circuit - Grounded circuit	Amber
312	Injector Solenoid Valve Cylinder #5 Circuit - Grounded circuit	Amber
313	Injector Solenoid Valve Cylinder #3 Circuit - Grounded circuit	Amber
314	Injector Solenoid Valve Cylinder #6 Circuit - Grounded circuit	Amber
315	Injector Solenoid Valve Cylinder #2 Circuit - Grounded circuit	Amber

ELECTRONIC FUEL SYSTEM DIAGNOSTIC CODES		
Error Code	**Description**	**Fault Lamp**
319	Real Time Clock - Power interrupt	Maint
321	Injector Solenoid Valve Cylinder #4 Circuit - Grounded circuit	Amber
322	Injector Solenoid Valve Cylinder #1 Circuit - Open circuit	Amber
323	Injector Solenoid Valve Cylinder #5 Circuit - Open circuit	Amber
324	Injector Solenoid Valve Cylinder #3 Circuit - Open circuit	Amber
325	Injector Solenoid Valve Cylinder #6 Circuit - Open circuit	Amber
331	Injector Solenoid Valve Cylinder #2 Circuit - Open circuit	Amber
332	Injector Solenoid Valve Cylinder #4 Circuit - Open circuit	Amber
341	ECM - Data lost	Amber
343	ECM - Warning internal hardware failure	Amber
346	ECM - Warning software error	Amber
349	Transmission Output Shaft Speed High - Warning	Amber
352	Sensor Supply Voltage #1 - Circuit shorted low	Amber
381	Error detected in intake air heater relay circuit	Amber
386	Sensor Supply Voltage #1 - Circuit shorted high	Amber
387	Accelerator Pedal Position Sensor Supply Voltage - Circuit shorted high	Amber
388	Less than 6 VDC detected at engine brake circuit 1	Amber
392	Less than 6 VDC detected at engine brake circuit 2	Amber
412	Data transmission error on J1587/J1922 datalink	None
414	Data transmission error on J1587/J1922 datalink	None
415	Oil Pressure Sensor - Data indicates very low oil pressure	Red
418	Water in Fuel Indicator High	Maint
419	Error in intake manifold pressure sensor signal detected by ECM	Amber
422	Engine Coolant Level Sensor Signals - Data invalid	Amber
426	SAE J1939 datalink - cannot transmit	None
427	Data transmission on J1939 datalink not occuring at an acceptable rate	None
428	Water in Fuel Sensor - Circuit shorted high	Amber
429	Water in Fuel Sensor - Circuit shorted low	Amber
431	Accelerator Pedal Idle Validation Circuit - Data incorrect	Amber
432	Accelerator Pedal Idle Validation Circuit - Out of calibration	Red
433	Intake Manifold Pressure Sensor - Circuit data incorrect	Amber
434	Power Lost without ignition off	Amber
435	Engine Oil Pressure Sensor - Circuit data incorrect	Amber
441	Battery Voltage Low - Warning	Amber
442	Battery Voltage High - Warning	Amber
443	Accelerator Pedal Position Sensor Supply Voltage - Circuit shorted low	Amber
465	High voltage detected at wastegate actuator No. 1 circuit	Amber
466	Less than 6 VDC detected at wastegate actuator No. 1 circuit	Amber
489	Transmission Output Shaft Speed Low - Warning	Amber
491	High voltage detected at wastegate actuator No. 2 circuit	Amber
492	Less than 6 VDC detected at actuator No. 2 circuit	Amber
497	Error detected in multiple unit synch control sw. input pins 34 & 32 of OEM harness	Amber
527	Auxiliary Input/Output #2 - Circuit shorted high	Amber
528	OEM Alternate Torque Validation Switch - Data incorrect	Amber
529	Auxiliary Input/Output #3 - Circuit shorted high	Amber
551	Accelerator Pedal Idle Validation - Circuit shorted low	Amber
581	Fuel Supply Pump Inlet Pressure Sensor - Circuit shorted high	Amber
582	Fuel Supply Pump Inlet Pressure Sensor - Circuit shorted low	Amber
583	Fuel Supply Pump Inlet Pressure Low - Warning level	Amber
596	Electrical Charging System Voltage High - Warning level	Amber
597	Electrical Charging System Voltage Low - Warning level	Amber
598	Electrical Charging System Voltage Low - Critical level	Red
611	Engine Hot Shutdown	None
951	Cylinder Power Imbalance between cylinders	None

Maintenance Monitor

The maintenance monitor uses data received from the ECM to determine the amount of fuel burned and the time the engine has been operating to determine when it is time to change the oil. The operator must still be alert for any indications that the engine needs other service.

Note: Maintenance monitor is designed to alert the operator of the need for a routine maintenance stop. Maintenance records must still be maintained for historical purposes.

Note: Whenever an electrical fault has occurred, the maintenance monitor data can be inaccurate.

'Severe' oil drain interval duty cycle is the default setting for the maintenance monitor, however this can be adjusted by using diagnostic tools, to suit duty cycle and oil type used. Engine oil drain intervals are dependant on working environment and oil type used. Refer to 'Engine oil drain intervals by duty cycle (Hours)' table below. Refer to Section 300-0020, Lubrication System for recommended oil type.

The maintenance monitor will alert the operator of the need to change oil by flashing the maintenance light for approximately 12 seconds after key-on. The flashing sequence will be three quick flashes, followed by a pause. This flash sequence will go through five cycles in the 12 second period. This sequence will occur at every key-on until the maintenance monitor has been reset.

Note: The diagnostic switch must be OFF for the flashing sequence to occur.

Resetting the Maintenance Monitor - There are two ways to reset the maintenance monitor, depending on the engine ECU calibration.

1. Park machine on level ground, block road wheels, apply parking brake and switch off engine.

2. Turn key to position '1'.

3. Press engine diagnostic switch on for a minimum of 3 seconds, then switch off.

4. Press engine diagnostic switch on/off quickly, twice (less than 1 second per cycle).

5. Press engine diagnostic switch on for a minimum of 3 seconds, then switch off.

6. The maintenance light will flash three times. This means the maintenance monitor is reset.

Note: If the maintenance light does not flash as described, the reset sequence must be performed again.

7. Turn key to position '0'.

8. Remove blocks from road wheels.

Alternative method of resetting maintenance monitor is as follows:

1. Park machine on level ground, block road wheels, apply parking brake and switch off engine.

2. Turn keyswitch to position '1'.

3. Press engine diagnostic switch on.

4. Press and hold throttle pedal at 100% for 3 seconds, then release.

5. Press throttle pedal 100% on then off quickly, twice.

6. Press and hold throttle pedal at 100% for 3 seconds, then release.

7. The maintenance light will flash three times.

Note: If the maintenance light does not flash as described, the reset sequence must be performed again.

8. Press engine diagnostic switch off.

ENGINE OIL DRAIN INTERVALS BY DUTY CYCLE (HOURS)

	Severe	Heavy	Medium	Light
Fuel Consumption	> 13 gal/hr	10 to 13 gal/hr	8.5 to 10 gal/hr	< 8.5 gal/hr
API CF-4	150	200	250	300
API CG-4	250	300	400	500
API CH-4 or ACEA E5	300	350	500	600
CES20076 or CES20077	350	400	550	700

9. Turn key to position '0'.

10. Remove blocks from road wheels.

REMOVAL

Numbers in parentheses refer to Figure 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, inside battery box, to release hood catch and lift up hood.

5. Using hydraulic hand pump inside battery box, tilt cab and secure. Refer to Section 260-0010, Cab and Mounnting.

6. Remove mounting hardware securing air cleaner intake tube to goalpost assembly. Remove mounting hardware securing air cleaner to battery box. Slacken mounting clamp at air cleaner intake tube and draw air cleaner away from intake pipe. Cover open ends to prevent entry of dirt.

7. Carefully remove filler cap from header tank. With a suitable container in position, remove plug and open shut-off valve on the radiator assembly and drain the coolant.

8. 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.

9. With a suitable container in position, remove drain valve on the cooler and drain the oil. Remove transmission oil cooler from the vehicle. Refer to Section 210-0060, Transmission Oil Cooler.

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

11. Support guard plate under the engine (1) 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.

12. 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.**

13. Evacuate air conditioning system and disconnect air conditioner lines at the engine compressor. Refer to Section 260-0130, Air Conditioning.

14. Remove the radiator assembly from the vehicle. Refer to Section 210-0040, Radiator and Mounting.

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

16. Disconnect exhaust piping from the engine turbocharger.

17. Disconnect air cleaner intake pipe from engine turbocharger and remove from the engine (1).

18. Identify heater lines for ease of installation and with a suitable container in position, disconnect heater lines from the engine (1). Cap open line ends and fittings.

19. Identify fuel lines for ease of installation and with a suitable container in position, disconnect fuel lines from the engine (1). Cap open line ends and fittings.

20. Identify all electrical harnesses and cables for ease of installation and disconnect from the engine (1).

21. Disconnect clips securing items to the engine (1) that cannot be removed with the engine.

22. Remove guard from flywheel housing and disconnect driveline from the engine coupling and secure clear of the engine (1). Refer to Section 130-0010, Front Drivelines.

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

24. Remove locknuts (17), snubbing washers (15) and bolts (16) securing engine (1) to the frame through front mounting bracket (8) and rear mounting brackets (7).

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

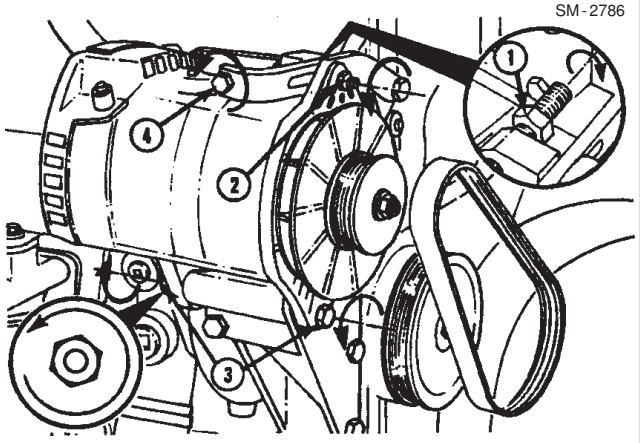
26. Carefully lift engine (1) clear of the frame, remove to a suitable work area and mount securely on a work stand.

DISASSEMBLY

Numbers in parentheses refer to Figure 1.

1. Remove bolts (11 & 13) and washers (12) securing front mounting bracket (8) to engine (1). Remove front mounting bracket (8).

2. Remove bolts (9) and washers (10) securing rear mounts to engine (1). Remove mounts (7).



1 - Locknut
2 - Capscrew
3 - Capscrew
4 - Adjusting Screw

Fig. 3 - Alternator Mounting

3. If required, remove rubber isolation mounts (14) from rear mounts (7) and front mounting bracket (8).

4. Loosen air conditioner compressor drive belt and remove compressor from engine (1). Refer to Section 260-0130, Air Conditioning.

5. Loosen alternator adjusting screw locknut (1, Fig. 3).

6. Loosen the adjustment link locking capscrew (2, Fig.3).

7. Loosen the alternator mounting capscrew (3, Fig. 3).

8. Turn the adjusting screw (4, Fig. 3) anticlockwise to release tension. Remove alternator belt (2).

9. Remove alternator mounting capscrew (3, Fig. 3) and adjustment link locking capscrew (2, Fig. 3). Remove alternator.

10. Disconnect the electrical connector (78) harness to fan clutch (27).

11. Remove nut (29), washers (30) and studs (38) securing fan (28) and clutch (27) to engine (1) fan hub.

12. Remove both fan (28) and clutch (27) together from the engine (1).

13. Loosen fan idler pulley shaft locknut. Loosen the adjusting link to slacken the fan belt (6). Remove fan belt (6).

14. Remove bracket supporting hoses from top of flywheel housing.

15. Remove bolts (21) and washers (19) securing flywheel guard (20) to flywheel housing, then remove flywheel guard (20) from engine (1).

16. Remove bolts (18) and washers (19) securing engine coupling (23) at rear of engine (1) then remove engine coupling (23).

17. Remove and discard filters (3, 4 & 5) from engine (1), as described in 'Maintenance'. Cover engine inlet ports to prevent entry of dirt.

18. Refer to 'Engine Manufacturers Service Manual' if engine service or repair is required.

INSPECTION

Numbers in parentheses refer to Figure 1.

1. Inspect rubber isolation mounts (14) for damage and replace if required.

2. Check mounting brackets (7 & 8) and mounting brackets on the front frame for cracks and/or damage. Repair or replace as necessary.

3. Inspect engine coupling (23) for damage and repair or replace as required.

ASSEMBLY

Numbers in parentheses refer to Figure 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 (3, 4 & 5) on engine (1), as described in 'Maintenance'.

2. Install engine coupling (23) to rear of engine (1) and secure with bolts (18) and washers (19). Tighten bolts (18) to a torque of 31 Nm (23 lbf ft).

3. Install flywheel guard (20) to flywheel housing and secure with bolts (21) and washers (19).

4. Install bracket supporting hoses to top of flywheel housing.

5. Fit fan belt (6) and tighten adjusting link to tighten fan belt (6). Refer to Engine Operation and Maintenance Manual for the correct fan belt (6) tension.

6. Tighten the fan idler pulley shaft locknut to 140 lbf ft (190 Nm). Check the belt tension again after the locknut is tightened.

7. Install fan (28) and clutch (27) to fan hub and secure with studs (38), nuts (29) and washers (30). Tighten nut (29) to a torque of 31 Nm (23 lbf ft).

8. Connect electrical connector (78) harness to fan clutch (27).

9. Install alternator on engine (1) and secure with adjustment link locking capscrew (2, Fig. 3) and alternator mounting capscrew (3, Fig. 3).

10. Fit alternator belt (2) between alternator pulley and accessory drive pulley. Turn adjusting screw (4, Fig. 3) clockwise to increase belt tension; anticlockwise to decrease belt tension. Refer to Engine Operation and Maintenance Manual for correct alternator belt (2) tension.

11. Tighten the adjusting screw locknut (1, Fig. 3) against the retainer. Tighten the adjustment link locking capscrew (2, Fig. 3) to 59 lbf ft (80 Nm).

12. Tighten the alternator mounting capscrew (3, Fig. 3) to 35 lbf ft (47 Nm).

13. Install air conditioning compressor and compressor drive belt on engine (1). Refer to Section 260-0130, Air Conditioning.

14. If removed, install rubber isolation mounts (14) to rear mounts (7) and front mounting bracket (8).

15. Install rear mounts (7) to engine (1) and secure with bolts (9) and washers (10).

16. Install front mounting bracket (8) to engine (1) and secure with bolts (11 & 13) and washers (12).

INSTALLATION

Numbers in parentheses refer to Figure 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 (16), snubbing washers (15) bolt (9) and locknuts (10) as shown in Fig. 1. Tighten bolts (16) to a torque of 298 Nm (220 lbf ft).

3. Connect driveline to the engine coupling (23). Install guard to flywheel housing. Refer to Section 130-0010, Front Drivelines.

4. Install radiator assembly on the vehicle. Refer to

Section 210-0040, Radiator and Mounting.

5. 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.

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

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

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

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

10. 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.

11. Install the goalpost and radiator header tank assembly on the vehicle. Refer to Section 100-0040, Hood and Mounting.

12. Ensure all cooling lines to radiator assembly, engine (1) and radiator header tank are correctly connected. Refer to Section 210-0040, Radiator and Mounting.

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

14. Secure air cleaner assembly to the battery box, rubber hose to the inlet pipe and intake tube to goalpost assembly with mounting hardware removed during removal.

15. Install transmission oil cooler on the vehicle. Refer to Section 210-0060, Transmission Oil Cooler.

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

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

18. Ensure shut-off valve at the bottom of the radiator assembly and any drain cocks on engine (1) water jacket are securely closed. Ensure shut off cocks at coolant filter (5) are open to allow flow through the filter.

19. Fill the cooling system with coolant. Refer to Section 210-0000, Cooling System.

20. Fill the engine with lubricant through oil filler to the top mark on dipstick. Refer to Section 300-0020, Lubrication System for oil specification.

21. Fill transmission oil cooler with oil. Refer to Section 210-0060, Transmission Oil Cooler.

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

23. Install hood assembly on the vehicle. Refer to Section 100-0040, Hood And Mounting.

24. Using hydraulic hand pump inside battery box, lower cab and secure. Refer to Section 260-0010, Cab and Mounting.

25. 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.

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 Figure 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 coolant level and air cleaner restriction. Check charge air piping for damage.

Engine (1) Oil Level Check - Position the vehicle on a level work area, apply the parking brake, shut off the engine and wait at least five minutes (to allow oil to drain to the oil pan) before checking the oil level. The oil level should be between the low (L) and high (H) marks on the dipstick. Add oil if low. Refer to Section 300-0020, Lubrication System for the oil specification.

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

Fuel Filter/Water Separator (4) - Drain the water and sediment from the separator daily. Position the vehicle on a level work area, apply the parking brake, shut off the engine and, with a suitable container below the drain valve to catch spillage, open the drain valve by hand. Turn the valve anticlockwise approximately 1.5 - 2 turns until draining occurs. Drain the filter sump until clear fuel is visible. Turn the valve clockwise to close the drain valve.

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

Cooling Fan (28) - Visually inspect the fan for cracks or damaged blades. Check the fan to make sure that mounting bolts (29) are secure. Tighten bolts as required. Replace any fan that is damaged.

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

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

Engine (1) Crankcase Breather - Check and clean the crankcase breather hose. Remove the breather hose and check internally for obstructions or sludge buildup. Clean or replace breather hose as necessary, to prevent excess crankcase pressure buildup.

Every 500 Hours

Engine Oil and Lube Oil Filter (3) - Replace the lubricating oil and oil filter (3).

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

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

Clean the area around the lube oil filter head and, using strap type filter wrench, remove lube oil filter (3). Discard lube oil filter (3) if it is not required for a failure analysis. Clean the gasket sealing surface of the filter head.

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

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

Apply a light film of clean lubricating oil to the gasket surface of the new filter and install the filter on the filter head. Turn the filter until the gasket contacts the filter head surface. Tighten the filter an additional 1/2 to 3/4 of a turn, or as specified by the filter manufacturer.

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

Check and clean the engine oil drain plug threads and the seal surface. Replace plug if damaged. Install and tighten the drain plug to a torque of 88 Nm (65 lbf ft). Fill the engine with clean lubricating oil specified in Section 300-0020, Lubrication System. The oil level should be between the low (L) and high (H) marks on the dipstick.

Engine oil pressure must be indicated on the gauge within 15 seconds after starting engine. If oil pressure is not reached within 15 seconds, shut off the engine immediately to avoid engine damage. Confirm the correct oil level in the oil pan.

Start the engine and operate at idle speed to inspect for leaks at the filter and oil drain plug. Shut off the engine, wait approximately ten minutes to let the oil drain back to the sump and check the oil level again.

Add oil as necessary to bring the level to the high (H) mark on the dipstick. Do not overfill the engine with oil.

Every 1000 Hours

Fuel Filter (4) - Clean the area around the fuel filter head and replace the fuel filter.

Position the vehicle on a level work area, apply the parking brake and switch off the engine. Using a strap type filter wrench, remove fuel filter (4) and discard the thread adaptor sealing ring. Clean the gasket surface of the filter head.

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

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

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

Coolant Filter (5) - Replace coolant filter (5) as follows:

Note: There is a shut off valve at the coolant inlet and outlet lines of coolant filter (5). Closing these valves will enable coolant filter (5) to be replaced without an excessive loss of coolant.

⚠ WARNING
Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50° C (120° F) before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

1. Remove the cooling system pressure cap from header tank.

2. Close shut off valves at coolant filter (5) inlet and outlet lines and, using filter wrench, remove and discard coolant filter (5) from engine (1).

⚠ WARNING
A small amount of coolant can leak when servicing the coolant filter with the shut off valves in the closed position. To avoid personal injury, avoid contact with hot coolant.

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

4. Lightly coat new coolant filter (5) seal with clean engine oil as specified in Section 300-0020, Lubrication System.

5. Start coolant filter (5) on the filter adaptor and tighten it by hand until the seal touches the adaptor filter head. Tighten an additional 1/2 to 3/4 of a turn after contact, or as specified by the filter manufacturer.

Note: Mechanical tightening of coolant filter (5) is not necessary and will distort or crack the adaptor. Tighten coolant filter by hand only.

6. Open shut off valves at coolant filter (5) inlet and outlet lines, and install pressure cap on header tank.

7. 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.

Every 2000 Hours

Engine Mounting Bolts (16) - Check torque on engine mounting bolts (16). If required, tighten to 298 Nm (220 lbf ft).

Engine (1) - Steam clean.

Engine (1) Overhead Set - Adjust the valves and injectors. Refer to Engine Operation and Maintenance Manual for details.

Engine (1) Water Pump - Inspect water pump weep hole and ensure it is not blocked.

Engine (1) Turbocharger Mounting Nuts - Tighten nuts to 65 Nm (50 lbf ft).

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				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
3	2	Capscrew	80	59
3	3	Capscrew	47	35
1	16	Bolt	298	220
-	-	Engine Drain Plug	88	65
1	18	Bolt	31	23
1	29	Nut	31	23

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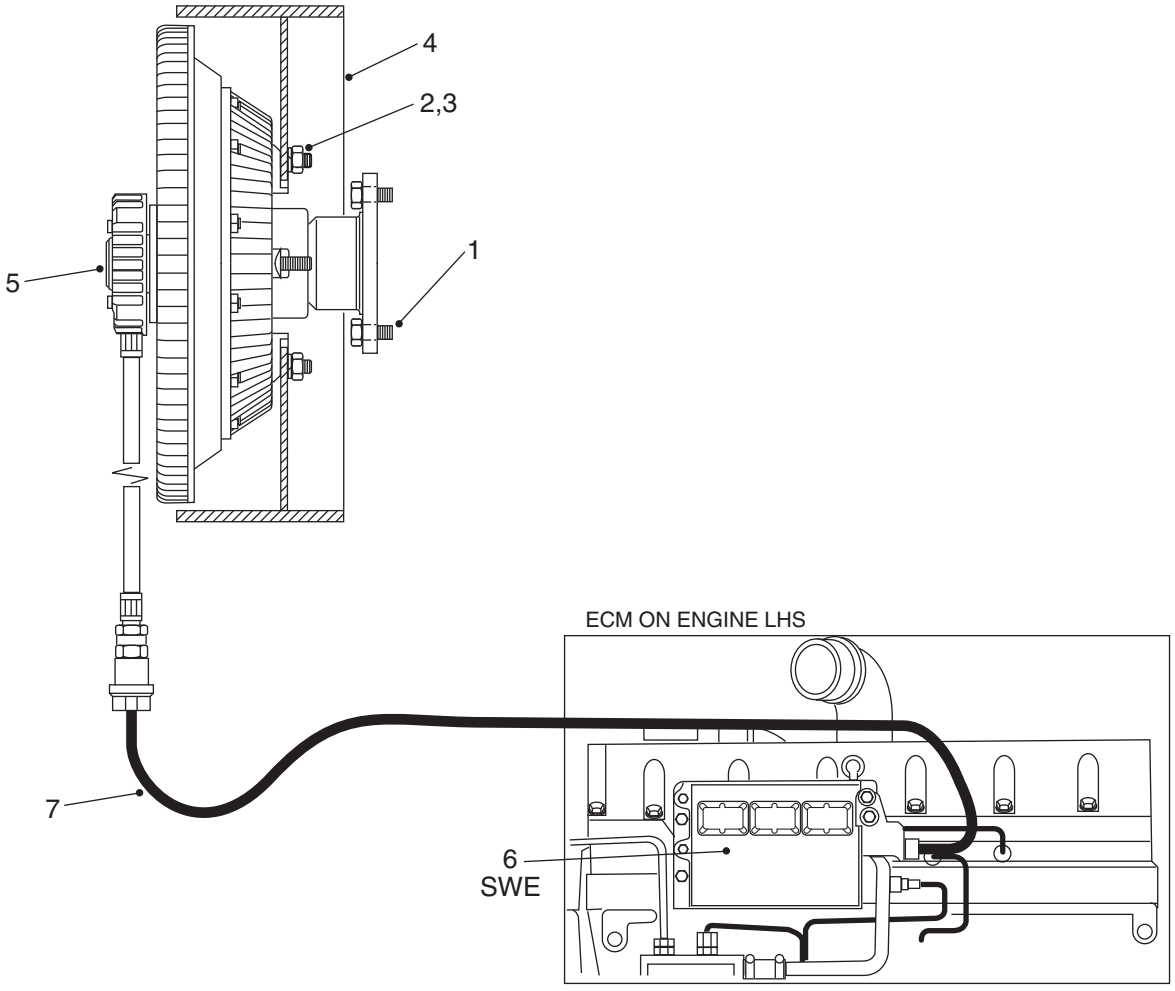

1 - Bolt
2 - Lockwasher
3 - Nut
4 - Fan
5 - EST Fan Drive
6 - Electronic Control Module (ECM)
7 - Harness

Fig. 1 - Typical Layout View of Cooling Fan and Electronic Clutch

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1.

Note: The rate of fan (4) speed change and maximum fan speed is preset to the cooling needs of the engine.

The electronic sensing technology (EST) fan (5) drive system uses a pulse width modulated signal from the engine electronic control module (6) to provide the appropriate fan speed necessary to satisfy any cooling demand.

At a pre-determined engine coolant temperature or engine air intake temperature, variable current signals from the ECM (6) give an increased fan speed. Any further rises in coolant/air intake temperature results in increased fan speed. The fan speed increases proportionally with the increase in temperature until the fan is fully engaged.

Note: The fan is fully engaged when the air conditioning is switched on.

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

The EST fan drive (5) has a failsafe feature, ie. if the electrical current to the fan drops to zero, the fan will be automatically engaged.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNINGS

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

⚠

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

1. Position the machine on a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine. 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. If required, remove mounting hardware securing hood assembly to the machine and, using suitable lifting equipment, remove hood assembly. Refer to Section 100-0040, HOOD AND MOUNTING.

4. Remove mounting hardware securing fan guards to the fan shroud. Remove fan guards from the machine. If required remove radiator from the machine. Refer to Section 210-0040, RADIATOR, HEADER TANK AND MOUNTING.

5. Disconnect harness (7) at the connector on the fan drive (5) braided cable.

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

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

INSTALLATION

Numbers in parentheses refer to Fig. 1.

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

⚠ WARNING

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

1. Install EST fan drive (5) on fan (4) mounting surface of housing and secure in place with lockwashers (2) and nuts (3).

2. Using suitable lifting equipment, position fan (4) assembly on the machine and secure to engine with bolts (1). Torque tighten bolts (1) to 31 Nm (23 lbf ft).

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

3. Connect harness (7) at the connector on the fan drive (5) braided cable.

4. If removed, install radiator on machine. Refer to Section 210-0040, RADIATOR, HEADER TANK AND MOUNTING. Install fan guards to the fan shroud and secure with mounting hardware, as removed at 'Removal'.

5. If removed, position the hood assembly on the machine using a suitable lifting device. Secure hood assembly on the machine with mounting hardware, as removed at 'Removal'. Refer to Section 100-0040, HOOD AND MOUNTING.

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

7. Remove wheel blocks.

TESTING

Static Test

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

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

Note: Rotation without resistance indicates a fault.

Basic Dynamic Test - Cut In/Cut Out

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

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

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

Basic Dynamic Test - Fan Drive Operation

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

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

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

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

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

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

Failsafe Check

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

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

2. Maintain engine speed at 2 100 rev/min and disconnect harness at the connector on the fan drive braided cable. Fan should automatically engage to full flow speed.

MAINTENANCE

Every 10 Hours/Daily

Check the fan for cracks or damaged blades. Clean or replace as required.

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

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

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

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

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

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

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

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

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	1	Bolt	31	23

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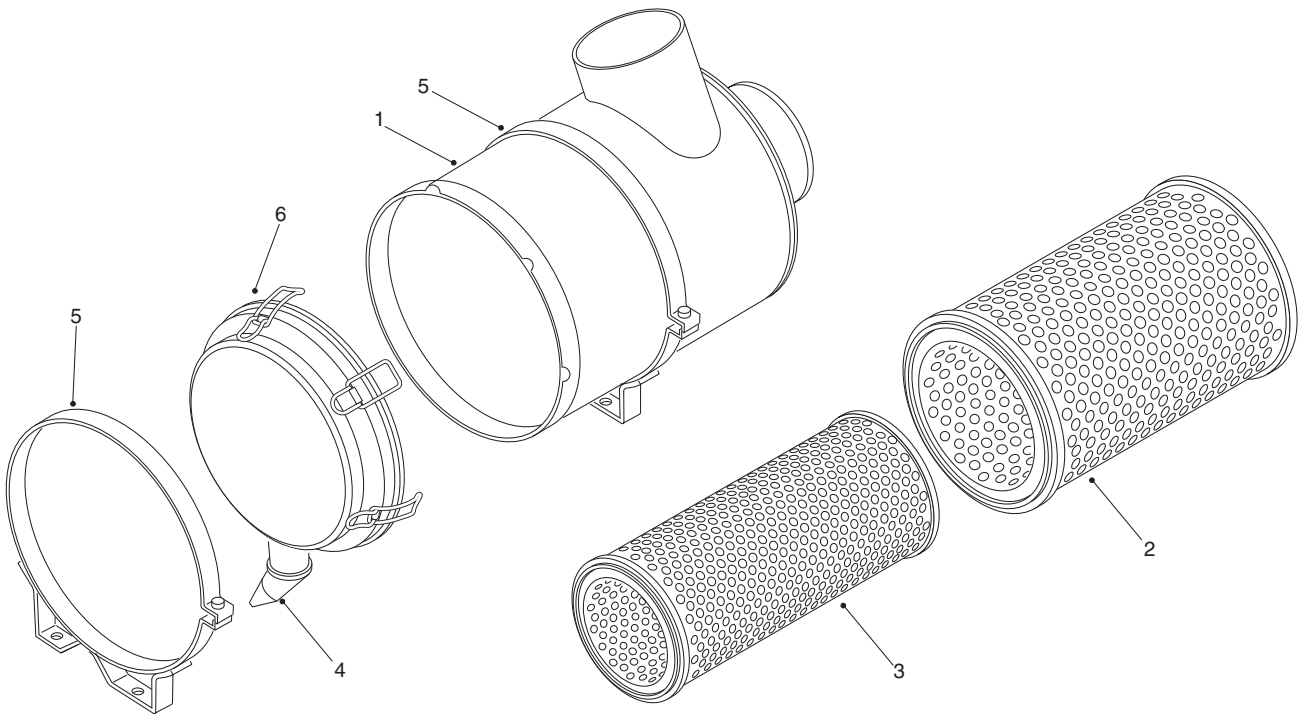


1 - Air Cleaner Body
2 - Primary Element
3 - Safety Element
4 - Vacuator Valve
5 - Mounting Band
6 - Cover Assembly

Fig. 1 - Exploded View of Typical Air Cleaner

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1.

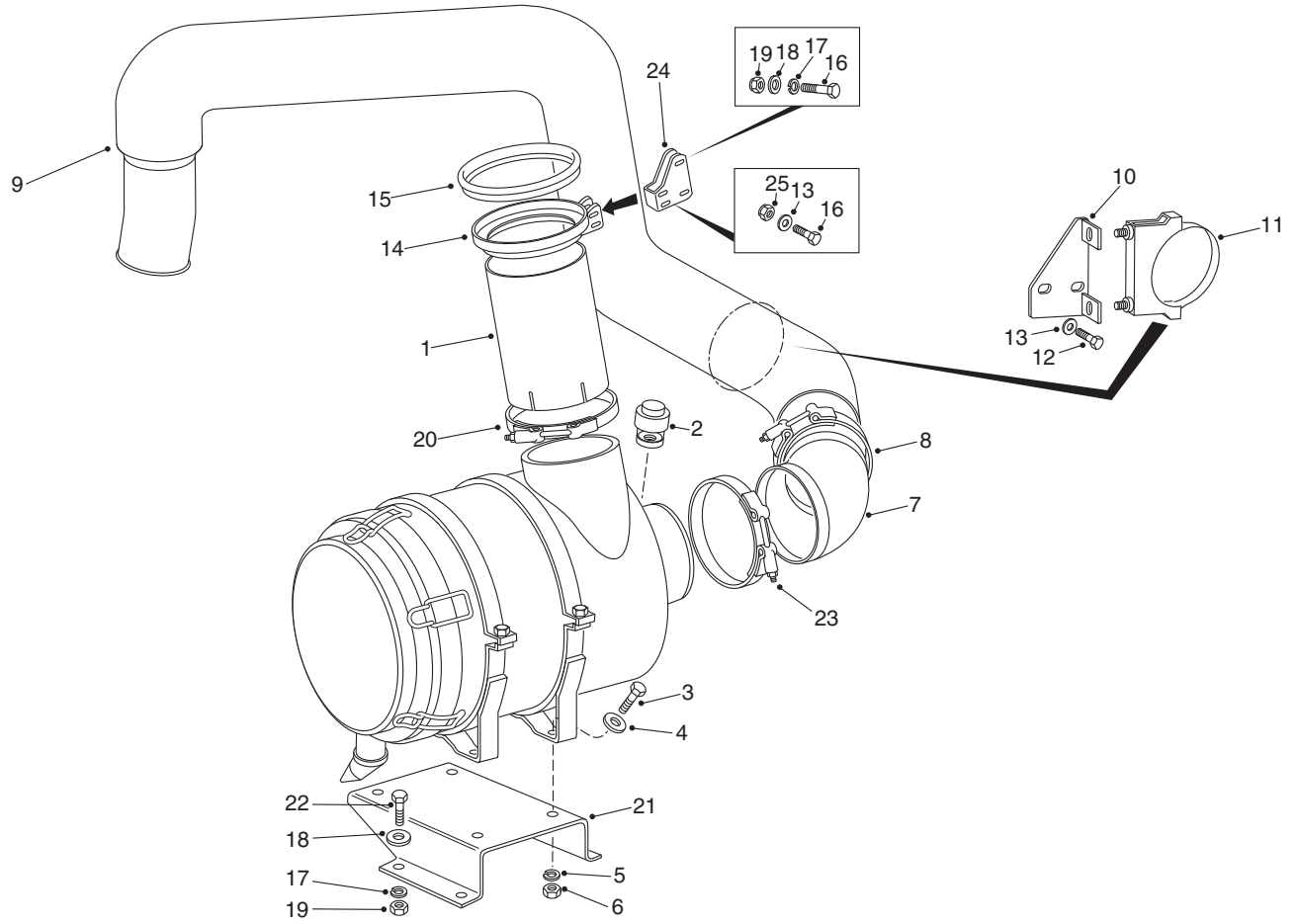
The dual dry element air cleaner is remote mounted horizontally on the left hand side of the machine. The air cleaner prolongs engine life by removing grit, dust and water from the air as it enters the engine. Grit and dust, combined with engine oil, forms a highly abrasive compound which can destroy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

A rubber vacuator valve (4) attached to end cover (6) in a downward position, ejects grit, dust and water while the engine is running. Vacuator valve (4) minimizes the need for daily servicing. Even though vacuator valve (4) is normally under a slight vacuum when the engine is running, pulsing of the vacuum opens and closes the rubber valve, expelling dust and water as they collect. When the engine is stopped, vacuator valve (4) opens and expels any accumulated grit, dust or water.

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

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

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



1 - Air Intake Tube
2 - Air Restriction Gauge
3 - Bolt
4 - Washer
5 - Lockwasher
6 - Nut
7 - Elbow
8 - Band Clamp
9 - Air Intake Tube
10 - Bracket
11 - Clamp
12 - Bolt
13 - Washer
14 - Retaining Bracket
15 - Seal
16 - Bolt
17 - Lockwasher
18 - Washer
19 - Locknut
20 - Clamp
21 - Air Cleaner Bracket
22 - Bolt
23 - Clamp
24 - Air Intake Coupling
25 - Nut

Fig. 2 - Exploded View of Typical Air Cleaner Mounting

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

AIR CLEANER

Removal

Numbers in parentheses refer to Fig. 2.

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

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

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

4. Remove bolts (16), washers (13) and nuts (25) securing coupling (24) to air intake tube (1).

5. Slacken clamps (8 & 23) securing elbow (7).

6. Remove bolts (3), washers (4), lockwashers (5) and nuts (6) securing air cleaner to bracket (21). Using suitable lifting equipment, support the air cleaner assembly and draw air cleaner assembly away from elbow (7).

7. Blank off all open ends with tape or cardboard to prevent entry of dirt.

8. If required, remove bolts (22), lockwashers (17), washers (18) and nuts (19) securing bracket (21) to the battery box. Remove bracket (21).

Disassembly

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

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

1. Release latches on cover assembly (6) and remove cover assembly from air cleaner body (1).

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

3. Open mounting bands (5) and remove from air cleaner body (1).

4. Slacken clamp (20, Fig. 2) and remove air intake tube (1, Fig. 2), complete with retaining bracket (14, Fig. 2) and seal (15, Fig. 2), from air cleaner body (1).

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

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

Assembly/Installation

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

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

Assembly and installation of the air cleaner assembly is the reverse of disassembly and removal. Reset air restriction gauge (2).

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

a. Check air intake tube (9) for defects and that clamps (8 & 23) (and those supplied with the engine) are securely tightened to ensure that there are no leaks in the system.

b. Check that air cleaner mounting bracket (21) is secure and that air cleaner is mounted securely.

MAINTENANCE

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

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

Check air restriction gauge (2, Fig. 2) daily (every 10 hours). The air cleaner elements should be serviced only when the maximum allowable restriction has been reached, as indicated by air cleaner restriction gauge (2, Fig. 2). The elements should not be serviced on the basis of visual observation as this would lead to over service. When restriction readings finally indicate a change, remove primary element (2) carefully and clean/replace as required. Refer to 'Primary Element'.

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

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

Check condition of clamps (8 & 23, Fig. 2), elbow (7, Fig. 2) and air intake tubes (1 & 9, Fig. 2). Tighten/ replace as necessary.

Primary Element

Numbers in parentheses refer to Fig. 1.

Although a paper primary element (2) is used, it is possible to remove excess dirt by tapping element.

1. Release latches on cover assembly (6) and remove cover assembly from air cleaner body (1).

2. Remove primary element (2) from air cleaner body (1) and clean/replace. It is advised to replace the element rather than attempt to clean thoroughly.

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

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

5. Install cover assembly (6) on air cleaner body (1) and secure with latches.

Secondary Element

Numbers in parentheses refer to Fig. 1.

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

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

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

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

4. Install cover assembly (6) on air cleaner body (1) and secure with latches.

Recommendations

Numbers in parentheses refer to Fig. 2.

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

2. It is very important that elbow (7) and air intake tube (9) from the air cleaner assembly to the engine be airtight or the purpose of the air cleaner will be completely defeated. All clamps (8 & 23) (and those supplied with the engine) should be checked frequently and tightened to prevent leaks.

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

MEASURING AIR RESTRICTION

Numbers in parentheses refer to Fig. 2.

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

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

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

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

Water Manometer

a. Remove air restriction gauge (2) from port in air cleaner assembly.

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

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

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

Vacuum Gauge

a. Remove air restriction gauge (2) from port in air cleaner assembly.

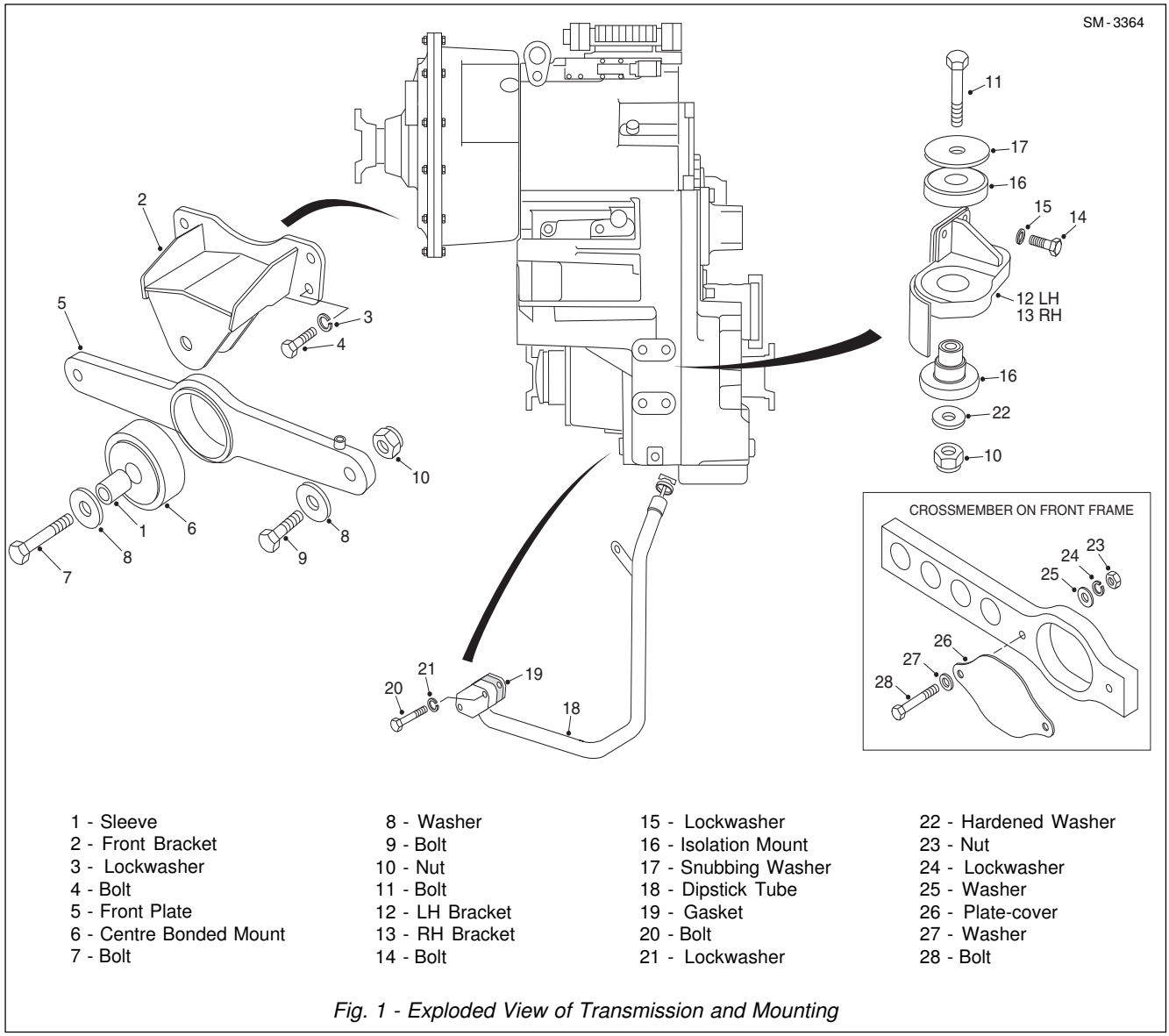
b. Connect the hose from the vacuum gauge to port and, with the engine drawing maximum air, take a note of the reading on the gauge.

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

SERVICE TOOLS

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

* * * *



1 - Sleeve	8 - Washer	15 - Lockwasher	22 - Hardened Washer
2 - Front Bracket	9 - Bolt	16 - Isolation Mount	23 - Nut
3 - Lockwasher	10 - Nut	17 - Snubbing Washer	24 - Lockwasher
4 - Bolt	11 - Bolt	18 - Dipstick Tube	25 - Washer
5 - Front Plate	12 - LH Bracket	19 - Gasket	26 - Plate-cover
6 - Centre Bonded Mount	13 - RH Bracket	20 - Bolt	27 - Washer
7 - Bolt	14 - Bolt	21 - Lockwasher	28 - Bolt

Fig. 1 - Exploded View of Transmission and Mounting

DESCRIPTION

Numbers in parentheses refer to Figure 1.

For transmission make, model and specification, refer to Section 000-0000, General Information. For transmission servicing and repair data refer to transmission manufacturer's service manual.

The transmission is supported by front plate (5), LH bracket (12) and RH bracket (13) which are bolted to the transmission and attached to front frame mounting brackets through centre bonded mount (6) and isolation mounts (16). Mounts (6 and 16) 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. An optional, wear-resistant hydrodynamic retarder integral to the transmission is available.

An engine dependent power takeoff at the rear of the transmission provides the drive for the main hydraulic pump which supplies the braking, 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 bracket assembly on top of transmission is the diff-lock/retarder valve which houses the retarder solenoid, axle differential lock solenoid and pressure reducing valve (refer to Figures 4 and 5).

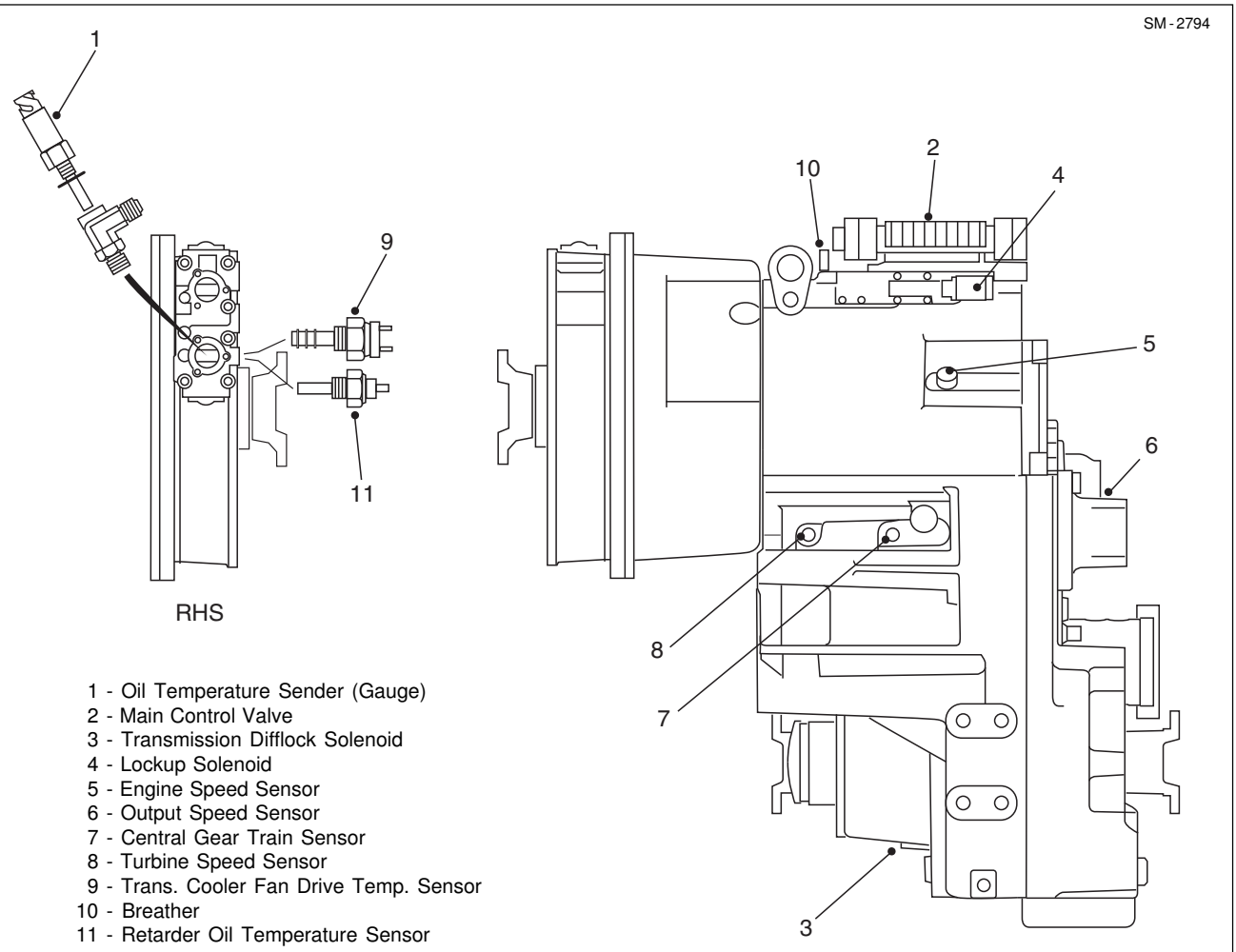


Fig. 2 - Location of Transmission Switches, Sensors and Solenoids

SWITCHES AND SENSORS

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

Transmission Oil Temperature

Oil temperature sender (1) sends a signal to indicate transmission oil temperature on the transmission oil temperature gauge in the cab. The gauge should read between 80° C (176° F) and 120° C (248° F) during normal operation and may reach 145° C (293° F) during retarder operation. If the needle remains at high temperatures 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 also 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.

Temperature sensor (9) sends a signal to the hydraulic ECU to operate the transmission cooler fan drive at a speed proportional to transmission oil temperature.

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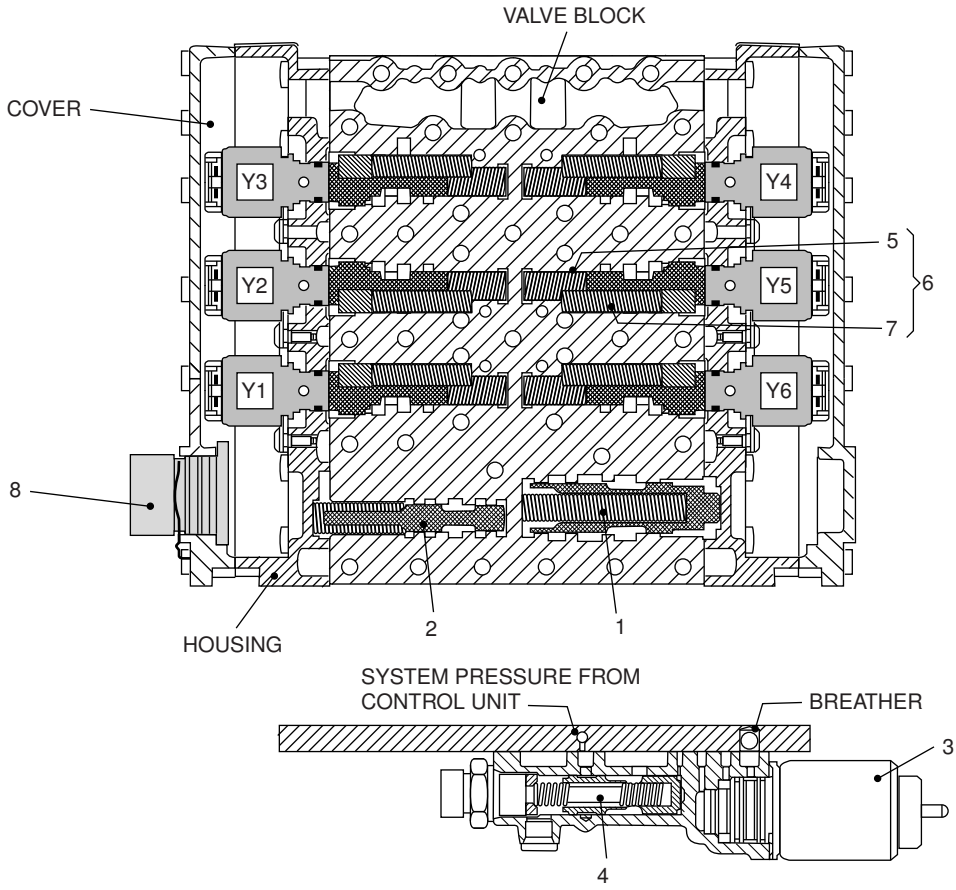


1 - Main Pressure Valve 16+2 bar
2 - Pressure Reduction Valve 9 bar
3 - Lockup Solenoid
4 - Lockup Reduction & Shift Valve
5 - Follow-on Slide
6 - Proportional Valve (P1 to P6)
7 - Vibration Damper
8 - Harness Connection
Y1 to Y6 - Pressure Regulators

Fig. 3 - Sectional View of Typical Control Unit with Lockup Clutch (Wk)

Lockup Clutch (Wk)

The transmission lockup clutch is automatically engaged. Engine speed is picked up by turbine speed sensor (8) which sends a signal to energise lockup solenoid (3, Fig. 3) when turbine speed reaches a predetermined level. Energising lockup solenoid (3, Fig. 3) will move lockup valve (4, Fig. 3) across, allowing oil to flow through the valve to engage lockup.

Gear Selection

The transmission can be engaged and disengaged under load by means of hydraulically controlled multi-disc clutches. All gears run in antifriction bearings and are constantly meshed. The gears, bearings and clutches are lubricated with cooled oil.

The transmission is equipped with six multi-disc clutches. These clutches are controlled via the six proportional valves (6, Fig. 3). Each proportional valve (6, Fig. 3) is composed of a pressure regulator (Y1 to Y6, Fig.3), follow-on slide (5, Fig. 3) and vibration damper (7, Fig. 3).

The control pressure of 9 bar for the actuation of the follow-on slides (5, Fig. 3) is created by the pressure reduction valve (2, Fig. 3). The pressure oil (16+2 bar) is directed via the follow-on slide (5, Fig. 3) to the respective clutch.

Due to the direct proportional control with separate pressure modulation for each clutch, the pressures to the clutches, which are taking place in the gear change, are controlled. In this way, a hydraulic 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 Pressure Switch

The differential pressure switch is located in the transmission filter head. The switch will close and record a fault code when the filters become blocked, indicating a filter change is required.

Note: The differential pressure switch is not operational when oil temperature is below 50 °C (122 °F) or when transmission output speed is greater than 2000 rev/min.

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 de-energized and hydraulic pressure is released at the transmission differential lock and applied at the centre axle differential lock. In this condition, the differential locks are engaged.

Note: The differential locks can be preselected when the machine is moving however, they will only engage on the move when the vehicle speed is below 20 km/hr. A Warning light will illuminate when the differential lock is selected (NOT attained).

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.

The procedure for checking the differential lock pressure is detailed in Section 140-0020, Differential Lock Controls.

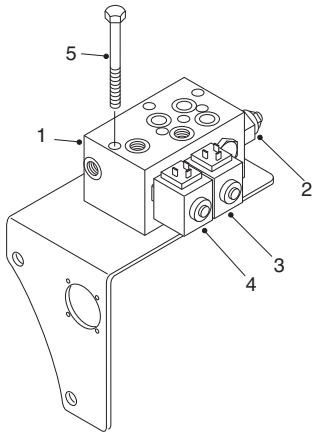
Note: Differential lock (pilot) pressure can only be tested with the differential lock NOT actuated.

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.

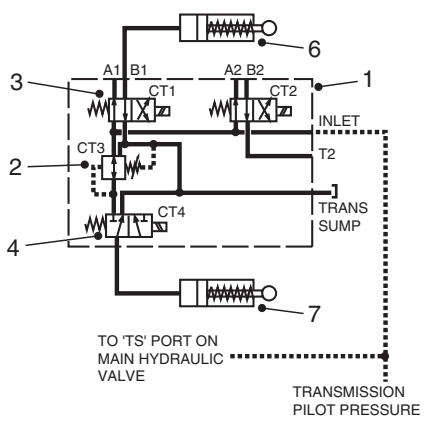
Retarder solenoid (4, Figs. 4 & 5) is energised on application of the retarder switch, located on the left hand switch bank, provided that the lockup clutch is engaged and the transmission 'Stop' warning light is OUT. Energizing the retarder solenoid will shift retarder solenoid valve and allow oil to flow through the valve to engage the retarder. The pressure reducing valve (2, Figures 4 and 5) reduces the inlet pressure from 16 bar (232 lbf/in^2) to 5.5 bar (80 lbf/in^2).

Pressing the retarder switch OFF will de-energize



1 - Valve
2 - Pressure Reducing Valve
3 - Axle Diff-lock Solenoid
4 - Retarder Solenoid
5 - Bolt

Fig. 4 - Diff-lock/Retarder Valve



1 - Valve
2 - Pressure Reducing Valve
3 - Axle Diff-lock Solenoid
4 - Retarder Solenoid
6 - Diff-lock
7 - Retarder

Fig. 5 - Diff-lock/Retarder Valve Schematic

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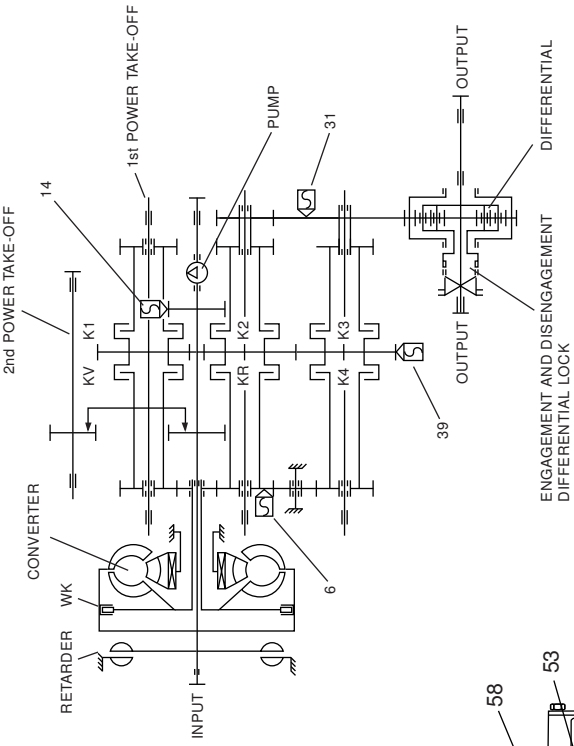
SCHEDULE OF MEASURING POINTS

Measurements to be carried out with oil at normal operating temperature of 80 ° C and operating at full speed.

MEASURING POINTS FOR PRESSURE OIL AND TEMPERATURE:

51 = Before the Convertor - Opening Pressure 8.5 bar
52 = Behind the Convertor - Opening Pressure 5 bar
53 = Clutch forward 16+2 bar KV
55 = Clutch reverse 16+2 bar KR
56 = Clutch 16+2 bar K1
57 = Clutch 16+2 bar K2
58 = Clutch 16+2 bar K3
60 = Clutch 16+2 bar K4
63 = Temperature 100° C behind the retarder (short time 150° C)
65 = System pressure 16+2
66 = Temperature 100° C behind the converter (short time 120° C)
67 = WK-Control pressure 13±1 bar



INDUCTIVE TRANSMITTERS AND SPEED SENSORS

6 = Inductive Transmitter n Turbine
14 = Inductive Transmitter n Engine
31 = Speed Sensor n Output and Speedometer
39 = Inductive Transmitter n Central Gear Train

	• PRESS REG. UNDER VOLTAGE						
SPEED	Y1	Y2	Y3	Y4	Y5	Y6	
F1			•		•		
F2		•	•				
F3					•	•	
F4		•				•	
F5				•	•		
F6		•		•			
R1	•		•				
R2	•					•	
R3	•			•			
N							
CLUTCH	KR	K4	K1	K3	KV	K2	
POS. VALVE	F	E	D	C	B	A	
POINTS	55	60	56	58	53	57	

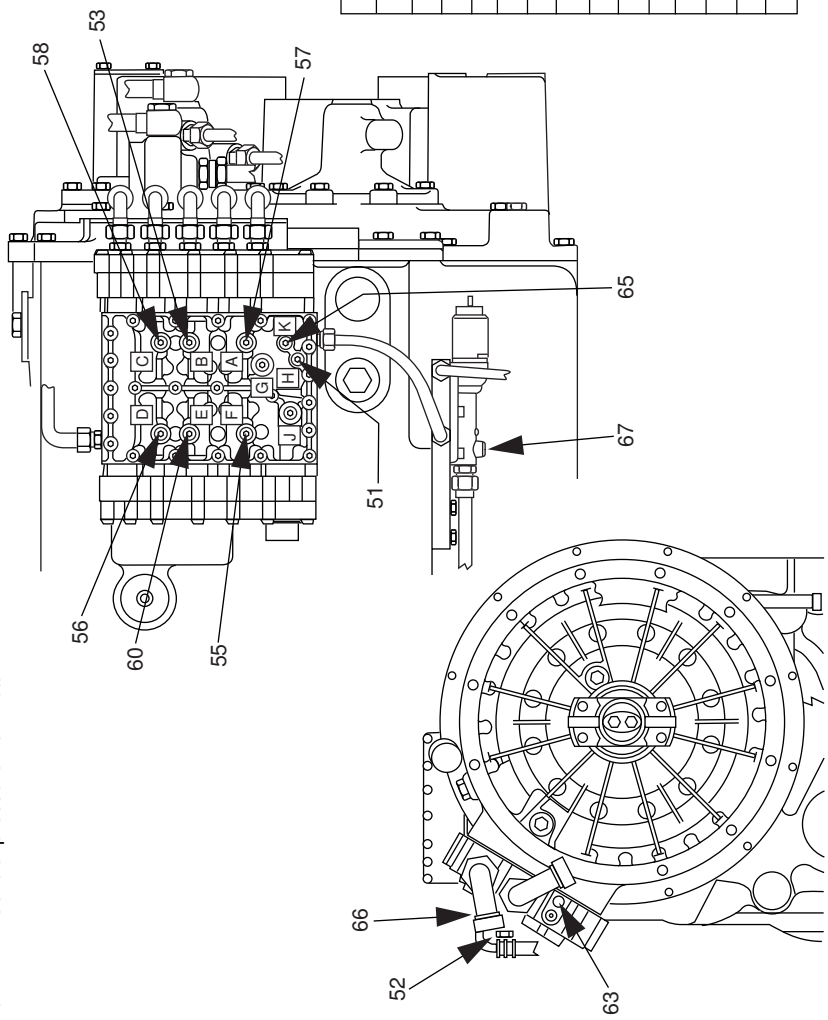


Fig. 6 - Typical Schedule of Measuring Points and Gear Pattern

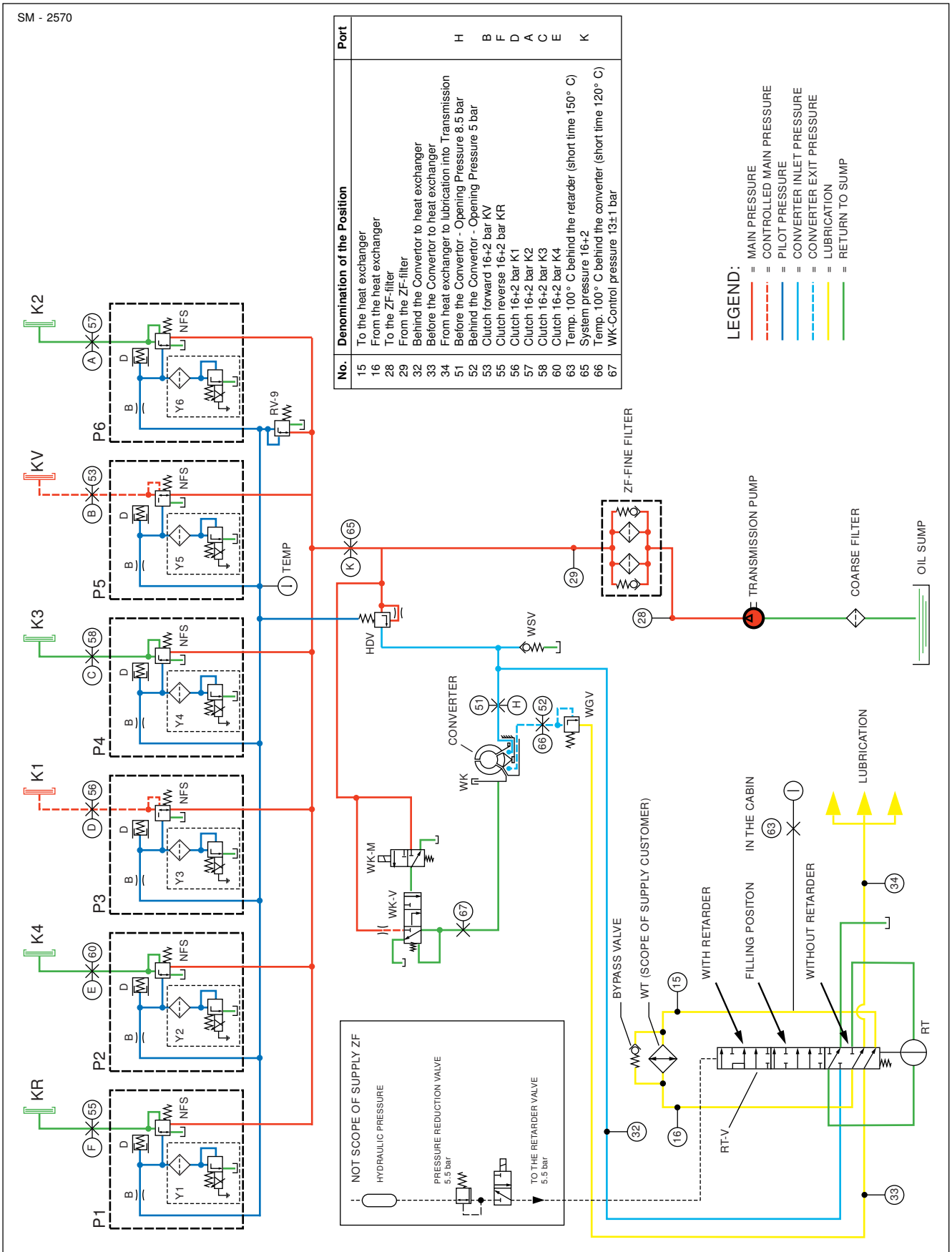


Fig. 7 - Oil Circulation Diagram for Typical Transmission with Lockup Clutch and Retarder

retarder solenoid and retarder solenoid valve will shift back to disengage the retarder.

Note: Irrespective of speed, the retarder will automatically disengage when the transmission oil temperature reaches 150° C (302° F).

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 to the right hand side of the gearshifter. 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 operator's 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 rotational pressure-compensated (RPC) system gives improved shift quality due to more accurate clutch filling, in addition to reduced clutch filling time.

The transmission provides six forward gears, three reverse gears and a neutral position. The gear positions are indicated on the VDU screen and on the LCD display located to the right of the operator, on the dash panel beside the gearshift controller . 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.

Note: When in manual mode, if the engine rev/min drops below 'lock up disengaging rev/min', the transmission will automatically downshift to the next lowest gear. A manual upshift will only be accepted if the transmission is in lock up.

Note: To perform a stall test, manual upshifts can be selected without lock up being engaged by special activation of the auto/manual button on the gearshift controller. The procedure is as follows:

1. Press the function button from neutral and move the gear lever forward to select automatic mode.
2. Press function button five times within four seconds.
3. Manually select the gear by pushing the lever to the right.

⚠ WARNING

Before any welding is done on a machine equipped with an EST-37 shift system, disconnect the following 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 the battery master switch to isolate the batteries before disconnecting any components.
After welding connect all of the above in the reverse order.

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 gear shifting when the predetermined values have been reached.

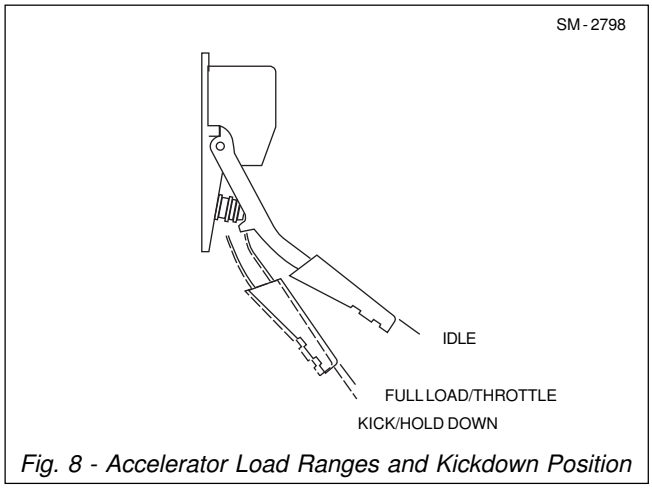
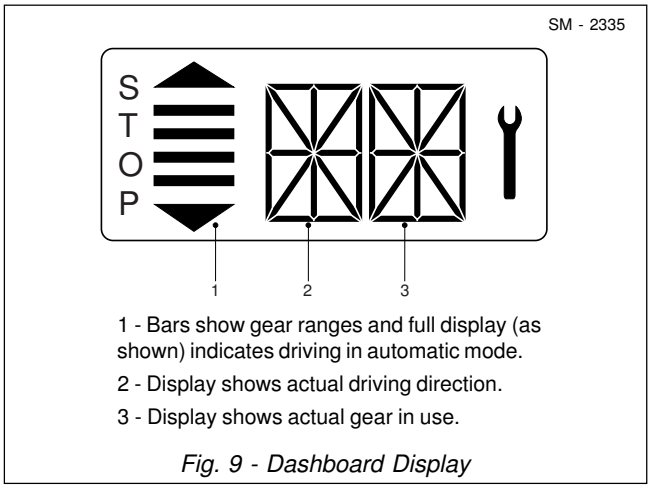


Fig. 8 - Accelerator Load Ranges and Kickdown Position



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. 9 - Dashboard Display

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.

When the gear is selected the park brake is automatically released.When Neutral is selected and the transmission output speed is less than 60RPM~1MPH, the paking brake applies automatically.

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).

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 Figure 8), 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 the 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 Figure 9):

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 120° C (248° F) during normal operation, or above 145° C (293° F) 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 1200-1500 rev/min. If the transmission oil temperature does not decrease into the normal 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 switch.

Note: The Parking brake is automatically applied in these operating conditions

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	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 engage a gear, first move shift selector to neutral position and again to F or R position
**	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 1st gear	
2 bars	Manual mode 2nd gear	
3 bars	Manual mode 3rd gear	
4 bars	Manual mode 4th gear, 5th gear, 6th gear (6WG)	
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)
WV	Warning high output speed (velocity)	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WL	Warning high transmission input torque (load)	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
WO	Warning high transmission output torque (load)	Changes between actual gear/direction while driving, in neutral only displayed if no fault is detected (spanner)
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	

Display during AEB-Mode - Continued

Symbol	Meaning	Remarks
▽ E	Engine speed too high, -> lower engine speed	
△T	Transmission oil temperature too low, -> heat up transmission	
▽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. Wrong device or wrong cable used	Transmission stays in neutral, you have to restart the TCU (ignition off/on)

Table Of Fault Codes

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	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 the 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 fault is taken back if TCU detects a valid signal for the position
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 the cables from TCU to shift lever • check signal combinations of shift lever positions F-N-R	fault is taken back if TCU detects a valid signal for the direction at the shift lever
13	LOGICAL ERROR AT ENGINE DERATING DEVICE TCU detected no reaction of engine while derating device activ	after selecting neutral, TCU changes to OP-Mode limp home	• check engine derating device	This fault is reset after power up of TCU
14	LOGICAL ERROR AT PARKBRAKE STATUS Parkbrake-status-signal measured by TCU and parkbrake-status-signal send by CAN don't fit • *one of the cables from status-switch to electronic box is broken* • *one of the status-switches is defective*	TCU shifts transmission to DCO-State OP-Mode: normal	• check the cables from electronic boxes to status switches • check signals of the status switches	
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 activ OP-Mode: transmission shutdown if selector activ	• check the 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

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
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 or disconnected due to mechanical problem* • *one of the cables from feedback axle connection - switch to TCU is broken*	OP-Mode: normal	• check the cables from TCU to feedback axle connection switch • check signals of the feedback axle connection switch	
17	S.C. TO GROUND AT CUSTOMER SPECIFIC FUNCTION NO. 1 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* • *customer specific function no. 1 device has an internal defect* • *connector pin is contacted to vehicle ground*	customer specific	• check the cable from TCU to customer specific function no. 1 device • check the connectors from customer specific function no. 1 to TCU • check the resistance of customer specific function no. 1 device	[1] see Figure 10
18	S.C. TO BATTERY VOLTAGE AT CUSTOMER SPECIFIC FUNCTION NO. 1 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* • *customer specific function no. 1 device has an internal defect* • *connector pin is contacted to battery voltage*	customer specific	• check the cable from TCU to customer specific function no. 1 device • check the connectors from customer specific function no. 1 to TCU • check the resistance of customer specific function no. 1 device	[1] see Figure 10
19	O.C. AT CUSTOMER SPECIFIC FUNCTION NO. 1 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* • *customer specific function no. 1 device has an internal defect* • *connector has no connection to TCU*	customer specific	• check the cable from TCU to customer specific function no. 1 device • check the connectors from customer specific function no. 1 device to TCU • check the resistance of customer specific function no. 1 device	[1] see Figure 10
1A	S.C. TO GROUND AT CUSTOMER SPECIFIC FUNCTION NO. 2 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* • *customer specific function no. 2 device has an internal defect* • *connector pin is contacted to vehicle ground*	customer specific	• check the cable from TCU to customer specific function no. 2 device • check the connectors from customer specific function no. 2 device to TCU • check the resistance of customer specific function no. 2 device	[1] see Figure 10
1B	S.C. TO BATTERY VOLTAGE AT CUSTOMER SPECIFIC FUNCTION NO. 2 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* • *customer specific function no. 2 device has an internal defect* • *connector pin is contacted to battery voltage*	customer specific	• check the cable from TCU to customer specific function no. 2 device • check the connectors from customer specific function no. 2 device to TCU • check the resistance of customer specific function no. 2 device	
1C	O.C. AT CUSTOMER SPECIFIC FUNCTION NO. 2 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* • *customer specific function no. 2 device has an internal defect* • *connector has no connection to TCU*	customer specific	• check the cable from TCU to customer specific function no. 2 device • check the connectors from customer specific function no. 2 device to TCU • check the resistance of customer specific function no. 2 device	
1D	S.C. TO GROUND AT CUSTOMER SPECIFIC FUNCTION NO. 3 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* • *customer specific function no. 3 device has an internal defect* • *connector pin is contacted to vehicle ground*	customer specific	• check the cable from TCU to customer specific function no. 3 device • check the connectors from customer specific function no. 3 device to TCU • check the resistance of customer specific function no. 3 device	
1E	S.C. TO BATTERY VOLTAGE AT CUSTOMER SPECIFIC FUNCTION NO. 3 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* • *customer specific function no. 3 device has an internal defect* • *connector pin is contacted to battery voltage*	customer specific	• check the cable from TCU to customer specific customer specific function no. 3 device • check the connectors from customer specific function no. 3 device to TCU • check the resistance of customer specific function no. 3 device	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
1F	O.C. AT CUSTOMER SPECIFIC FUNCTION NO. 3 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* • *customer specific function no. 3 device has an internal defect* • *connector has no connection to TCU*	customer specific	• check the cable from TCU to customer specific function no. 3 device • check the connectors from customer specific function no. 3 device to TCU • check the resistance of customer specific function no. 3 device	[1] see Figure 10
21	S.C. TO BATTERY VOLTAGE AT CLUTCH CUTOFF INPUT the measured voltage is too high: • *cable is defective and is contacted to battery voltage* • *clutch cut off sensor has an internal defect* • *connector pin is contacted to battery voltage*	clutch cutoff function is disabled OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the clutch cutoff sensor	
22	S.C. TO GROUND OR O.C. AT CLUTCH CUTOFF INPUT the measured voltage is too low: • *cable is defective and is contacted to vehicle ground* • *cable has no connection to TCU* • *clutch cut off sensor has an internal defect* • *connector pin is contacted to vehicle ground or is broken*	clutch cutoff function is disabled OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the clutch cutoff sensor	
23	S.C. TO BATTERY VOLTAGE AT LOAD SENSOR INPUT the measured voltage is too high: • *cable is defective and is contacted to battery voltage* • *load sensor has an internal defect* • *connector pin is contacted to battery voltage*	retarder function is affected TCU uses default load OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the load sensor sensor • check the assembly tolerances of load sensor	availability of retarder depends on default load
24	S.C. TO GROUND OR O.C. AT LOAD SENSOR INPUT the measured voltage is too low: • *cable is defective and is contacted to vehicle ground* • *cable has no connection to TCU* • *load sensor has an internal defect* • *connector pin is contacted to vehicle ground or is broken*	retarder function is affected TCU uses default load OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the load sensor sensor • check the assembly tolerances of load sensor	availability of retarder depends on default load
25	S.C. TO BATTERY VOLTAGE OR O.C. AT TRANSMISSION SUMP TEMPERATURE SENSOR INPUT the measured voltage is too high: • *cable is defective and is contacted to battery voltage* • *cable has no connection to TCU* • *temperature sensor has an internal defect* • *connector pin is contacted to battery voltage or is broken*	no reaction, TCU uses default temperature OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the 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 temperature OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the temperature sensor	
27	S.C. TO BATTERY VOLTAGE OR O.C. AT RETARDER / TORQUECONVERTER 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 temperature OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the temperature sensor	
28	S.C. TO GROUND AT RETARDER / TORQUECONVERTER 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 temperature OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the temperature sensor	
29	S.C. TO BATTERY VOLTAGE OR O.C. AT PARKING BRAKE SENSOR INPUT the measured voltage is too high: • *cable is defective and is contacted to battery voltage* • *cable has no connection to TCU* • *sensor has an internal defect* • *connector pin is contacted to battery voltage or is broken*	TCU uses default value OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the parking brake sensor	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
2A	S.C. TO GROUND PARKING BRAKE SENSOR INPUT the measured voltage is too low: • *cable is defective and is contacted to vehicle ground* • *sensor has an internal defect* • *connector pin is contacted to vehicle ground*	TCU uses default value OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the parking brake sensor	
2B	INCHSENSOR-SIGNAL MISMATCH the measured voltage from CCO and CCO2 signal don't match: • *cable is defective* • *sensor has an internal defect*	During inching mode: TCU shifts to neutral While not inching: no change OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check sensor	
2C	S.C. TO BATTERY VOLTAGE OR O.C. AT DLM TRACTION ADJUST DASHBOARD DEVICE INPUT the measured voltage is too high: • *cable is defective and is contacted to battery voltage* • *cable has no connection to TCU* • *sensor has an internal defect* • *connector pin is contacted to battery voltage or is broken*	TCU uses default value OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the DLM Traction Adjust dashboard device	
2D	S.C. TO GROUND DLM TRACTION ADJUST DASHBOARD DEVICE INPUT the measured voltage is too low: • *cable is defective and is contacted to vehicle ground* • *sensor has an internal defect* • *connector pin is contacted to vehicle ground*	TCU uses default value OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the DLM Traction Adjust dashboard device	
2E	S.C. TO BATTERY VOLTAGE OR O.C. AT DLM STEERING ANGLE SENSOR INPUT the measured voltage is too high: • *cable is defective and is contacted to battery voltage* • *cable has no connection to TCU* • *sensor has an internal defect* • *connector pin is contacted to battery voltage or is broken*	TCU uses default value OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the DLM STEERING ANGLE SENSOR	
2F	S.C. TO GROUND DLM STEERING ANGLE SENSOR INPUT the measured voltage is too low: • *cable is defective and is contacted to vehicle ground* • *sensor has an internal defect* • *connector pin is contacted to vehicle ground*	TCU uses default value OP-Mode: normal	• check the cable from TCU to the sensor • check the connectors • check the DLM STEERING ANGLE 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 the cable from TCU to the sensor • check the connectors • check the speed sensor	
32	S.C. TO GROUND AT ENGINE SPEED INPUT TCU measures a voltage less than 0.45V at speed input pin • *cable / connector is defective and is contacted to vehicle ground* • *speed sensor has an internal defect*	OP-Mode: substitute clutch control	• check the cable from TCU to the sensor • check the connectors • check the 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 the cable from TCU to the sensor • check the connectors • check the speed sensor • check the sensor gap	This fault is reset after power up of 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 the cable from TCU to the sensor • check the connectors • check the speed sensor	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
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 the cable from TCU to the sensor • check the connectors • check the 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 the cable from TCU to the sensor • check the connectors • check the speed sensor • check the 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 the cable from TCU to the sensor • check the connectors • check the 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 the cable from TCU to the sensor • check the connectors • check the 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 the cable from TCU to the sensor • check the connectors • check the speed sensor • check the sensor gap	This fault is reset after power up of TCU
3A	S.C. TO BATTERY VOLTAGE OR O.C. AT OUTPUT SPEED INPUT TCU measures a voltage higher than 12.5 V at speed input pin • *cable is defective and is contacted to battery voltage* • *cable has no connection to TCU* • *speed sensor has an internal defect* • *connector pin is contacted to battery voltage or has no contact*	special mode for gear selection OP-Mode: substitute clutch control if a failure is existing at turbine speed, TCU shifts to neutral OP-Mode: limp home	• check the cable from TCU to the sensor • check the connectors • check the 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* • *speed sensor has an internal defect*	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 the cable from TCU to the sensor • check the connectors • check the 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 the cable from TCU to the sensor • check the connectors • check the speed sensor • check the sensor gap	This fault is reset after power up of TCU
3D	TURBINE SPEED ZERO DOESN'T FIT TO OTHER SPEED SIGNALS	-	-	not used
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 the sensor signal of output speed sensor • check the sensor gap of output speed sensor • check the cable from TCU to the sensor	This fault is reset after power up of TCU

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
40	GEAR RANGE RESTRICTION SIGNAL CAN signal for gear range restriction is defective • *cluster controller is defective* • *interference on CAN-Bus*	no gear range restriction	• check cluster controller • check wire of CAN-Bus • check cable to cluster controller	
40	FCAN MESSAGE 'GEAR RANGE SELECT (ZF_3_IDENT)' contains invalid data	gear range set from 1st to 5th	• check FWD controller • check wire of CAN-Bus	
41	DECLUTCH MODULATION SELECTION SIGNAL	-	-	not used
41	TCU RECEIVES MESSAGES 'GEAR RANGE SELECT (ZF_3_IDENT)' AND 'FRONT WHEEL DRIVE STATUS' (V_IDENT_FWD) ALTHOUGH CONFIGURATION STATES THAT FWD CONTROLLER IS NOT INSTALLED	ignore FWD commands	• reconfigure with TCU Configuration Command (ID PC)	
50	FMR1 TIMEOUT Timeout of CAN-message FMR1 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* • *engine controller is defective*	TCU operates like jake brake is off and exhaut brake is off. OP-Mode: normal	• check engine controller • check wire of CAN-Bus • check cable to engine controller	
51	FMR2 TIMEOUT Timeout of CAN-message FMR2 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* • *engine controller is defective*	OP-Mode: substitute clutch control	• check engine controller • check wire of CAN-Bus • check cable to engine controller	
52	EAMODUL1 TIMEOUT Timeout of CAN-message EAM1 from I/O - controller • *interference on CAN-Bus* • *CAN wire/connector is broken* • *CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	TCU shifts to neutral and uses substitute gear selector OP-Mode: normal	• check I/O controller • check wire of CAN-Bus • check cable to I/O controller	
53	ABS TIMEOUT Timeout of CAN-message ABS from ABS - 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	• check ABS controller • check wire of CAN-Bus • check cable to ABS controller	
54	MDU1 TIMEOUT Timeout of CAN-message MDU1 from cluster controller • *interference on CAN-Bus* • *CAN wire/connector is broken* • *CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	TCU keeps old auto downshift information and old manual downshift information OP-Mode: normal	• check cluster controller • check wire of CAN-Bus • check cable to cluster controller	
54	DCT1 TIMEOUT Timeout of CAN-message DCT1 from display computer • *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: normal	• check display computer • check wire of CAN-Bus • check cable to display computer	
54	GEAR RANGE SELECT TIMEOUT Timeout of CAN-message 'Gear Range Select (ZF_3_IDENT)' • *interference on CAN-Bus* • *CAN wire/connector is broken* • *CAN wire/connector is defective and has contact to vehicle ground or battery voltage* • *FWD Controller is defective*	gear range set from 1st to 5th	• check wire of CAN-Bus • check FWD controller	
55	DNS1 TIMEOUT Timeout of CAN-message DNS1 from OMRON-master • *interference on CAN-Bus* • *CAN wire/connector is broken* • *CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	TCU shifts to neutral OP-Mode: normal	• check OMRON-master • check wire of CAN-Bus • check cable to OMRON-master	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
55	SCT1 TIMEOUT Timeout of CAN-message SCT1 from steering computer • *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: normal	• check steering computer • check wire of CAN-Bus • check cable to steering computer	
55	FLC1 TIMEOUT Timeout of CAN-message FCL1 from cluster controller • *interference on CAN-Bus* • *CAN wire/connector is broken* • *CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	TCU keeps old auto/man selection, old Clutch cutoff selection and old Clutch Cuttoff Setting OP-Mode: normal	• check cluster controller • check wire of CAN-Bus • check cable to cluster controller	
55	FRONT WHEEL DRIVE STATUS TIMEOUT Timeout of CAN-message 'Front Wheel Drive Status (V_IDENT_FWD)' • *interference on CAN-Bus* • *CAN wire/connector is broken* • *CAN wire/connector is defective and has contact to vehicle ground or battery voltage* • *FWD Controller is defective*	TCU shifts to neutral	• check wire of CAN-Bus • check FWD controller	
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 an 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	
59	TEST MODE SIGNAL CAN signal for test mode status is defective • *cluster controller is defective* • *interference on CAN-Bus*	Testmode is aborted, if activ	• check cluster controller • check wire of CAN-Bus • check cable to cluster controller	
5A	PARKBRAKE STATUS SIGNAL CAN signal for parkbrake status is defective • cluster *controller is defective* • *interference on CAN-Bus*	no reaction ????	• check cluster controller • check wire of CAN-Bus • check cable to cluster controller	
5B	SHIFT QUALITY SEL SIGNAL CAN signal for shift qualtiy selection is defective • *cluster controller is defective* • *interference on CAN-Bus*		• check cluster controller • check wire of CAN-Bus • check cable to cluster controller	Not used
5C	AUTO DOWNSHIFT SIGNAL CAN signal for automatic downshift is defective • cluster *controller is defective* • *interference on CAN-Bus*	last selection is kept	• check cluster controller • check wire of CAN-Bus • check cable to cluster controller	
5D	MANUAL DOWNSHIFT SIGNAL CAN signal for manual downshift is defective • cluster *controller is defective* • *interference on CAN-Bus*	last selection is kept	• check cluster controller • check wire of CAN-Bus • check cable to ???? controller	
5E	CCO REQUEST SIGNAL CAN signal for CCO request is defective • cluster *controller is defective* • *interference on CAN-Bus*	last selection is kept	• check cluster controller • check wire of CAN-Bus • check cable to ???? controller	
5F	SHIFT LEVER SIGNAL CAN signal for shift lever is defective • *I/O controller is defective* • *interference on CAN-Bus*	TCU shifts to neutral and uses informations from substitute shift lever OP-Mode: normal	• check I/O controller • check wire of CAN-Bus • check cable to I/O controller	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
5F	TRANSMISSION NEUTRAL REQUEST SIGNAL CAN signal for transmission Neutral Request is defective • steering computer *is defective* • interference on CAN-Bus	OP-Mode: normal	• check steering computer • check wire of CAN-Bus • check cable to steering computer	
5F	CAN MESSAGE ' FRONT WHEEL DRIVE STATUS (V_IDENT_FWD)' CONTAINS INVALID DATA	TCU shifts to neutral	• check FWD controller	
60	ADDITIONAL BRAKE STATUS SIGNAL CAN signal for additional park brake status is defective • *I/O controller is defective* • *interference on CAN-Bus*	no reaction OP-Mode: normal	• check *I/O* controller • check wire of CAN-Bus • check cable to I/O controller	
61	AEB REQUEST SIGNAL CAN signal for AEB request is defective • *I/O controller is defective* • *interference on CAN-Bus*	no reaction OP-Mode: normal Last selection is kept	• check *I/O* controller • check wire of CAN-Bus • check cable to I/O controller	
62	PTO TORQUE SIGNAL CAN signal for PTO torque is defective • *I/O controller is defective* • *interference on CAN-Bus*	no reaction, TCU uses default PTO torque signal OP-Mode: normal	• check *I/O* controller • check wire of CAN-Bus • check cable to I/O controller	
63	DRIVING MODE SIGNAL CAN signal for driving mode is defective • *I/O controller is defective* • *interference on CAN-Bus*	no reaction, TCU uses default driving mode signal OP-Mode: normal	• check *I/O* controller • check wire of CAN-Bus • check cable to *I/O* controller	
64	STARTING GEAR SIGNAL CAN signal for starting gear is defective • *I/O controller is defective (illegal starting gear)* • *interference on CAN-Bus*	no reaction, TCU uses default starting gear OP-Mode: normal	• check I/O controller • check wire of CAN-Bus • check cable to *I/O* 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	
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	
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* • *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 the cable from TCU to the gearbox • check the connectors from TCU to the gearbox • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10
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* • *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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
73	O.C. AT CLUTCH K1 the measured resistance value of the valve is out of limit. • *cable / connector is defective and has no contact to TCU* • *regulator has an internal defect*	TCU shifts to neutral OP-Mode: limp home if failure at another clutch is pending TCU shifts to neutral OP-Mode: TCU shutdown	• check the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10
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* • *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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10
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* • *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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10
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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10
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* • *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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10
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* • *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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10
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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10
7A	S.C. TO BATTERY VOLTAGE AT CONVERTER CLUTCH	no reaction OP-Mode: normal	• check the cable from TCU to the valve • check the regulator resistance [1)]	
7B	S.C. TO GROUND AT CONVERTER CLUTCH	no reaction OP-Mode: normal	• check the cable from TCU to the valve • check the regulator resistance [1)]	
7C	O.C. AT CONVERTER CLUTCH	no reaction OP-Mode: normal	• check the cable from TCU to the valve • check the regulator resistance [1)]	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
7D	S.C. TO GROUND AT ENGINE DERATING DEVICE • *cable is defective and is contacted to vehicle ground* • *engine derating device has an internal defect* • *connector pin is contacted to vehicle ground*	engine derating will be on until TCU power down even if fault vanishes (loose connection) OP-Mode: normal	• check the cable from TCU to the engine derating device • check the connectors from engine derating device to TCU • check the resistance [1] of engine derating device	[1] see Figure 10
7E	S.C. TO BATTERY VOLTAGE AT ENGINE DERATING DEVICE • *cable / connector is defective and is contacted to battery voltage* • *engine derating device has an internal defect*	no reaction OP-Mode: normal	• check the cable from TCU to the engine derating device • check the connectors from backup alarm device to TCU • check the resistance [1] of backup alarm device	
7F	O.C. AT ENGINE DERATING DEVICE 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 derating device has an internal defect* • *connector has no connection to TCU*	no reaction OP-Mode: normal	• check the cable from TCU to the engine derating device • check the connectors from engine derating device to TCU • check the resistance [1] of engine derating device	[1] see Figure 10
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* • *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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1] • check internal wire harness of the gearbox	[1] see Figure 10
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* • *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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1] • check internal wire harness of the gearbox	[1] see Figure 10
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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1] • check internal wire harness of the gearbox	[1] see Figure 10
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* • *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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1] • check internal wire harness of the gearbox	[1] see Figure 10
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* • *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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1] • check internal wire harness of the gearbox	[1] see Figure 10
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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1] • check internal wire harness of the gearbox	[1] see Figure 10

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
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* • *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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10
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* • *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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10
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 the cable from TCU to the gearbox • check the connectors from gearbox to TCU • check the regulator resistance [1)] • check internal wire harness of the gearbox	[1)] see Figure 10
8A	S.C. TO GROUND AT DLM TRANSVERSAL 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* • *device has an internal defect* • *connector pin is contacted to vehicle ground*	output will be on until TCU power down even if fault vanishes (loose connection) OP-Mode: normal	• check the cable from TCU to the valve • check the connectors • check the resistance of valve	[1)] see Figure 10
8B	S.C. TO BATTERY VOLTAGE AT DLM TRANSVERSAL 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* • *device has an internal defect* • *connector pin is contacted to battery voltage*	no reaction OP-Mode: normal	• check the cable from TCU to the valve • check the connectors • check the resistance of valve	[1)] see Figure 10
8C	O.C. AT DLM TRANSVERSAL 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* • *device has an internal defect* • *connector has no connection to TCU*	no reaction OP-Mode: normal	• check the cable from TCU to the valve • check the connectors • check the resistance of valve	[1)] seeFigure 10
8D	S.C. TO GROUND AT DLM INDICATOR LAMP 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* • *device has an internal defect* • *connector pin is contacted to vehicle ground*	output will be on until TCU power down even if fault vanishes (loose connection) OP-Mode: normal	• check the cable from TCU to the device • check the connectors • check the resistance of device	[1)] see Figure 10
8E	S.C. TO BATTERY VOLTAGE AT DLM INDICATOR LAMP 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* • *device has an internal defect* • *connector pin is contacted to battery voltage*	no reaction OP-Mode: normal	• check the cable from TCU to the device • check the connectors • check the resistance of device	[1)] see Figure 10
8F	O.C. DLM INDICATOR LAMP 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* • *device has an internal defect* • *connector has no connection to TCU*	no reaction OP-Mode: normal	• check the cable from TCU to the device • check the connectors • check the resistance of device	[1)] see Figure 10
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 the cable from TCU to the backup alarm device • check the connectors from backup alarm device to TCU • check the resistance [1)] of backup alarm device	[1)] see Figure 10

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
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 the cable from TCU to the backup alarm device • check the connectors from backup alarm device to TCU • check the resistance [1] of backup alarm device	[1] see Figure 10
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 the cable from TCU to the backup alarm device • check the connectors from backup alarm device to TCU • check the resistance [1] of backup alarm device	[1] see Figure 10
94	S.C. TO GROUND AT RELAY STARTER INTERLOCK 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* • *starter interlock relay has an internal defect* • *connector pin is contacted to vehicle ground*	no reaction OP-Mode: normal	• check the cable from TCU to the starter interlock relay • check the connectors from starter interlock relay to TCU • check the resistance [1] of starter interlock relay	[1] see Figure 10
95	S.C. TO BATTERY VOLTAGE AT RELAY STARTER INTERLOCK 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* • *starter interlock relay has an internal defect* • *connector pin is contacted to battery voltage*	no reaction OP-Mode: normal	• check the cable from TCU to the starter interlock relay • check the connectors from starter interlock relay to TCU • check the resistance [1] of starter interlock relay	[1] see Figure 10
96	O.C. AT RELAY STARTER INTERLOCK 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* • *starter interlock relay has an internal defect* • *connector has no connection to TCU*	no reaction OP-Mode: normal	• check the cable from TCU to the starter interlock relay • check the connectors from starter interlock relay to TCU • check the resistance [1] of starter interlock relay	[1] see Figure 10
97	S.C. TO GROUND AT PARK 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* • *park brake solenoid has an internal defect* • *connector pin is contacted to vehicle ground*	no reaction OP-Mode: normal	• check the cable from TCU to the park brake solenoid • check the connectors from park brake solenoid to TCU • check the resistance [1] of park brake solenoid	[1] see Figure 10
98	S.C. TO BATTERY VOLTAGE AT PARK BRAKE 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* • *park brake solenoid has an internal defect* • *connector pin is contacted to battery voltag*	no reaction optional: (some customers) TCU shifts to neutral caused by park brake feed back OP-Mode: normal	• check the cable from TCU to the park brake solenoid • check the connectors from park brake solenoid to TCU • check the resistance [1] of park brake solenoid	[1] see Figure 10
99	O.C. AT PARK BRAKE 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* • *park brake solenoid has an internal defect* • *connector has no connection to TCU*	no reaction optional: (some customers) TCU shifts to neutral caused by park brake feed back OP-Mode: normal	• check the cable from TCU to the park brake solenoid • check the connectors from park brake solenoid to TCU • check the resistance [1] of park brake solenoid	[1] see Figure 10
9A	S.C. TO GROUND AT CONVERTER LOCK UP CLUTCH 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* • *converter clutch solenoid has an internal defect* • *connector pin is contacted to vehicle ground*	no reaction OP-mode: normal	• check the cable from TCU to the converter clutch solenoid • check the connectors from converter clutch solenoid to TCU • check the resistance [1] of converter clutch solenoid	[1] see Figure 10
9B	O.C. AT CONVERTER LOCK UP CLUTCH 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* • *converter clutch solenoid has an internal defect* • *connector has no connection to TCU*	converter clutch always open, retarder not available OP-mode: normal	• check the cable from TCU to the converter clutch solenoid • check the connectors from converter clutch solenoid to TCU • check the resistance [1] of converter clutch solenoid	[1] see Figure 10

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
9C	S.C. TO BATTERY VOLTAGE AT CONVERTER LOCK UP CLUTCH 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* • *converter clutch solenoid has an internal defect* • *connector pin is contacted to battery voltage*	no reaction OP-mode: normal	• check the cable from TCU to the converter clutch solenoid • check the connectors from converter clutch solenoid to TCU • check the resistance [1] of converter clutch solenoid	[1] see Figure 10
9D	S.C. TO GROUND AT RETARDER 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* • *retarder solenoid has an internal defect* • *connector pin is contacted to vehicle ground*	no reaction OP-mode: normal	• check the cable from TCU to the retarder solenoid • check the connectors from retarder solenoid to TCU • check the resistance [1] of retarder solenoid	[1] see Figure 10
9E	O.C. AT RETARDER 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* • *retarder solenoid has an internal defect* • *connector has no connection to TCU*	no reaction OP-mode: normal	• check the cable from TCU to the retarder solenoid • check the connectors from retarder solenoid to TCU • check the resistance [1] of retarder solenoid	[1] see Figure 10
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 the cable from TCU to the retarder solenoid • check the connectors from retarder solenoid to TCU • check the resistance [1] of retarder solenoid	[1] see Figure 10
A1	S.C. TO GROUND AT DIFFLOCK OR AXLE CONNECTION 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 the cable from TCU to the difflock solenoid • check the connectors from difflock solenoid to TCU • check the resistance [1] of difflock solenoid	[1] see Figure 10
A2	S.C. TO BATTERY VOLTAGE AT DIFFLOCK OR AXLE CONNECTION 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 the cable from TCU to the difflock solenoid • check the connectors from difflock solenoid to TCU • check the resistance [1] of difflock solenoid	[1] see Figure 10
A3	O.C. AT DIFFLOCK OR AXLE CONNECTION 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 the cable from TCU to the difflock solenoid • check the connectors from difflock solenoid to TCU • check the resistance [1] of difflock solenoid	[1] see Figure 10
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 the cable from TCU to the warning device • check the connectors from warning device to TCU • check the resistance [1] of warning device	[1] see Figure 10
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 the cable from TCU to the warning device • check the connectors from warning device to TCU • check the resistance [1] of warning device	[1] see Figure 10
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 the cable from TCU to the warning device • check the connectors from warning device to TCU • check the resistance [1] of warning device	[1] see Figure 10

Fault Code (hex)	MEANING OF THE FAULT CODE **Possible reason for fault detection**	Reaction of the TCU	Possible steps to repair	Remarks
A7	S.C. TO GROUND AT CUSTOMER SPECIFIC FUNCTION NO. 4 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* • *customer specific function no. 4 device has an internal defect* • *connector pin is contacted to vehicle ground*	customer specific	• check the cable from TCU to customer specific function no. 4 device • check the connectors from customer specific function no. 4 device to TCU • check the resistance of customer specific function no. 4 device	[1] see Figure 10
A8	S.C. TO BATTERY VOLTAGE AT CUSTOMER SPECIFIC FUNCTION NO. 4 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* • *customer specific function no. 4 device has an internal defect* • *connector pin is contacted to battery voltage*	customer specific	• check the cable from TCU to customer specific function no. 4 device • check the connectors from customer specific function no. 4 device to TCU • check the resistance of customer specific function no. 4 device	[1] see Figure 10
A9	O.C. AT CUSTOMER SPECIFIC FUNCTION NO. 4 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* • *customer specific function no. 4 device has an internal defect* • *connector has no connection to TCU*	customer specific	• check the cable from TCU to customer specific function no. 4 device • check the connectors from customer specific function no. 4 device to TCU • check the resistance of customer specific function no. 4 device	[1] see Figure 10
AA	S.C. TO GROUND AT CUSTOMER SPECIFIC FUNCTION NO. 5 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* • *customer specific function no. 5 device has an internal defect* • *connector pin is contacted to vehicle ground*	customer specific	• check the cable from TCU to customer specific function no. 5 device • check the connectors from customer specific function no. 5 device to TCU • check the resistance of customer specific function no. 5 device	[1] see Figure 10
AB	S.C. TO BATTERY VOLTAGE AT CUSTOMER SPECIFIC FUNCTION NO. 5 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* • *customer specific function no. 5 device has an internal defect* • *connector pin is contacted to battery voltage*	customer specific	• check the cable from TCU to customer specific function no. 5 device • check the connectors from customer specific function no. 5 device to TCU • check the resistance of customer specific function no. 5 device	[1] see Figure 10
AC	O.C. AT CUSTOMER SPECIFIC FUNCTION NO. 5 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* • *customer specific function no. 5 device has an internal defect* • *connector has no connection to TCU*	customer specific	• check the cable from TCU to customer specific function no. 5 device • check the connectors from customer specific function no. 5 device to TCU • check the resistance of customer specific function no. 5 device	[1] see Figure 10
AD	S.C. TO GROUND AT CUSTOMER SPECIFIC FUNCTION NO. 6 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* • *customer specific function no. 6 device has an internal defect* • *connector pin is contacted to vehicle ground*	customer specific	• check the cable from TCU to function 6 device • check the connectors from customer specific function no. 6 device to TCU • check the resistance of function 6 device	[1] see Figure 10

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
AE	S.C. TO BATTERY VOLTAGE AT CUSTOMER SPECIFIC FUNCTION NO. 6 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* • *customer specific function no. 6 device has an internal defect* • *connector pin is contacted to battery voltage*	customer specific	• check the cable from TCU to customer specific function no. 6 device • check the connectors from customer specific function no. 6 device to TCU • check the resistance of customer specific function no. 6 device	[1] see Figure
AF	O.C. AT CUSTOMER SPECIFIC FUNCTION NO. 6 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* • *customer specific function no. 6 device has an internal defect* • *connector has no connection to TCU*	customer specific	• check the cable from TCU to customer specific function no. 6 device • check the connectors from customer specific function no. 6 device to TCU • check the resistance of customer specific function no. 6 device	[1] see Figure
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 pressure in the 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*	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 pressure in the system • check sensor gap at internal speed sensor • check sensor gap at output speed sensor	
	• *wrong signal at internal speed sensor* • *wrong signal at output speed sensor* • *wrong size of the sensor gap* • *clutch is defective*		• 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 pressure in the 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 calculated a difference speed at 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 pressure in the 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 THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	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 pressure in the 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 pressure in the 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 if configured OP-Mode: normal	-	
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 resitance)	
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	
BC	OVERSPEED OUTPUT TCU messures an transmission output speed above the defined threshold	No reaction OP-Mode: normal		

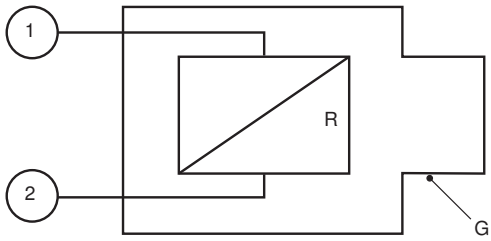
Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
BD	S.C. TO GROUND AT ENGINE BRKAE SOLENOID TCU detected a wrong voltage at the output pin, that looks like a s.c. to vehicle ground • *cable is defective and is contacted to vehicle ground* • *engine brake solenoid has an internal defect* • *connector pin is contacted to vehicle ground*	no reaction OP-mode: normal	• check the cable from TCU to the engine brake solenoid • check the connectors from engine brake solenoid to TCU • check the resistance [1)] of engine brake solenoid	[1)] see Figure 10
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 the cable from TCU to the engine brake solenoid • check the connectors from engine brake solenoid to TCU • check the resistance [1)] of engine brake solenoid	[1)] see Figure 10
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 the cable from TCU to the engine brake solenoid • check the connectors from engine brake solenoid to TCU • check the resistance [1)] of engine brake solenoid	[1)] see Figure 10
C0	ENGINE TORQUE OR ENGINE POWER OVERLOAD TCU calculates an engine torque or engine power above the defined thresholds	OP-Mode: normal		
C1	TRANSMISSION OUTPUT TORQUE OVERLOAD TCU calculates an transmission output torque above the defined threshold	OP-Mode: normal		
C2	TRANSMISSION INPUT TORQUE OVERLOAD TCU calculates an transmission input torque above the defined threshold	programmable :No reaction or shift to neutral OP-Mode: normal		
C3	OVERTEMP CONVERTER OUTPUT TCU measured a oil temperature at the converter ouput that is over the allowed threshold.	no reaction OP-Mode: normal	• cool down machine • check oil level • check temperature sensor	
C4	S.C. TO GROUND AT JOYSTICK STATUS INDICATOR 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* • *joystick status indicator has an internal defect* • *connector pin is contacted to vehicle ground*	no reaction OP-Mode: normal	• check the cable from TCU to joystick status indicator • check the connectors from joystick status indicator to TCU • check the resistance [1)] of joystick status indicator	
C5	S.C. TO BATTERY VOLTAGE AT JOYSTICK STATUS INDICATOR 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* • *joystick status indicator has an internal defect* • *connector pin is contacted to battery voltage*	no reaction OP-Mode: normal	• check the cable from TCU to joystick status indicator • check the connectors from joystick status indicator to TCU • check the resistance [1)] of joystick status indicator	
C6	O.C. AT JOYSTICK STATUS INDICATOR 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* • *joystick status indicator has an internal defect* • *connector has no connection to TCU*	no reaction OP-Mode: normal	• check the cable from TCU to joystick status indicator • check the connectors from joystick status indicator to TCU • check the resistance [1)] of joystick status indicator	
C7	S.C. TO GROUND AT OVERTEMP NEUTRAL INDICATOR 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* • *overtemp status indicator has an internal defect* • *connector pin is contacted to vehicle ground*	no reaction OP-Mode: normal	• check the cable from TCU to OVERTEMP NEUTRAL INDICATOR • check the connectors from OVERTEMP NEUTRAL INDICATOR to TCU • check the resistance [1)] of OVERTEMP NEUTRAL INDICATOR	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
C8	S.C. TO BATTERY VOLTAGE AT OVERTEMP NEUTRAL INDICATOR 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* • *overtemp status indicator has an internal defect* • *connector pin is contacted to battery voltage*	no reaction OP-Mode: normal	• check the cable from TCU to OVERTEMP NEUTRAL INDICATOR • check the connectors from OVERTEMP NEUTRAL INDICATOR to TCU • check the resistance [1)] of OVERTEMP NEUTRAL INDICATOR	
C9	O.C. AT OVERTEMP NEUTRAL INDICATOR 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* • OVETEMP *status indicator has an internal defect* • *connector has no connection to TCU*	no reaction OP-Mode: normal	• check the cable from TCU to OVERTEMP NEUTRAL INDICATOR • check the connectors from OVERTEMP NEUTRAL INDICATOR to TCU • check the resistance [1)] of OVERTEMP NEUTRAL INDICATOR	
CA	ENGINE_RETARDER CONFIG_TIMEOUT Timeout of CAN-message ENGINE_RETARDER CONFIG from EEC controller • *interference on CAN-Bus* • *CAN wire/connector is broken* • *CAN wire/connector is defective an 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 • *interference on CAN-Bus* • *CAN wire/connector is broken* • *CAN wire/connector is defective an 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	fault codes no. 21 to no. 2C may be a reaction of this fault
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 2C	• check cables and connectors to sensors, which are supplied from AU1 • check the power supply at the pin AU1 (should be appx. 5V)	
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 2C	• check cables and connectors to sensors, which are supplied from AU1 • check the power supply at the pin AU1 (should be appx. 5V)	
D3	LOW VOLTAGE AT BATTERY measured voltage at power supply is lower than 10 V (12V device) lower than 18 V (24V device)	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 VOLTAGE AT BATTERY measured voltage at power supply is higher than 18 V (12V device) higher than 32.5 V (24V device)	shift to neutral OP-Mode: TCU shutdown	• check power supply battery • check cables from batteries to TCU • check connectors from batteries to TCU	
D5	ERROR AT 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 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	
D7	S.C. TO GROUND AT DLM LONGITUDINAL 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* • *device has an internal defect* • *connector pin is contacted to vehicle ground*	output will be on until TCU power down even if fault vanishes (loose connection) OP-Mode: normal	• check the cable from TCU to the valve • check the connectors • check the resistance of valve	

Fault Code (hex)	MEANING OF THE FAULT CODE Possible reason for fault detection	Reaction of the TCU	Possible steps to repair	Remarks
D8	S.C. TO BATTERY VOLTAGE AT DLM LONGITUDINAL 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* • *device has an internal defect* • *connector pin is contacted to battery voltage*	no reaction OP-Mode: normal	• check the cable from TCU to the valve • check the connectors • check the resistance of valve	
D9	O.C. AT DLM LONGITUDINAL 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* • *device has an internal defect* • *connector has no connection to TCU*	no reaction OP-Mode: normal	• check the cable from TCU to the valve • check the connectors • check the resistance of valve	
E1	OPEN CIRCUIT AT DIRECTION SELECT SIGNALS TCU detected a o.c signals for the direction • *cable from shift lever to TCU is broken* • *cable is defective and is contacted to vehicle ground* • *shift lever is defective*	TCU shifts transmission to neutral OP-Mode: transmission shutdown	• check the cables from TCU to shift lever	
E2	OPEN CIRCUIT AT DIRECTION SELECT SIGNALS OF SHIFTER 2 TCU detected a o.c signals for the direction • *cable from shift lever to TCU is broken* • *cable is defective and is contacted to vehicle ground* • *shift lever is defective*	TCU shifts transmission to neutral OP-Mode: transmission shutdown	• check the cables from TCU to shift lever	
E3	S.C. TO BATTERY VOLTAGE AT DISPLAY OUTPUT TCU sends data to the display and measures allways a high voltage level on the connector • *cable or connectors are defective and are contacted to battery voltage* • *display has an internal defect*	no reaction OP-Mode: normal	• check the cable from TCU to the display • check the connectors at the display • change display	
E4	S.C. TO GROUND AT DISPLAY OUTPUT TCU sends data to the display and measures allways a high voltage level on the connector • *cable or connectors are defective and are contacted to vehicle ground* • *display has an internal defect*	no reaction OP-Mode: normal	• check the cable from TCU to the display • check the connectors at the display • change display	
E5	DISPID1_TIMEOUT Timeout of CAN-message DISPID1 from display controller • *interference on CAN-Bus* • *CAN wire/connector is broken* • *CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	TCU select parameter set with ID0 OP-Mode: Limp Home	• check display controller • check wire of CAN-Bus • check cable to display controller	
E5	CL1 TIMEOUT Timeout of CAN-message CL1 from cluster controller • *interference on CAN-Bus* • *CAN wire/connector is broken* • *CAN wire/connector is defective and has contact to vehicle ground or battery voltage*	TCU keeps old information for: status test mode status plock shift quality selection gear range restriction OP-Mode: normal	• check cluster controller • check wire of CAN-Bus • check cable to cluster controller	
E6	ILLEGAL ID REQUEST VIA CAN	transmission stay neutral OP-Mode: TCU shutdown		
F1	GENERAL EEPROM FAULT TCU can't read non volantile memoy • *TCU is defective*	no reaction OP-Mode: normal	• replace TCU	
F2	CONFIGURATION LOST TCU has lost the correct configuration and can't control the transmission. • *interference during saving data on non volatile memory* • *TCU is brand new or from another vehicle*	transmission stay neutral OP-Mode: TCU shutdown	• Reprogramm the correct configuration for the vehicle (e.g. with cluster controller,...)	

Fault Code (hex)	MEANING OF THE FAULT CODE **Possible reason for fault detection**	**Reaction of the TCU**	**Possible steps to repair**	**Remarks**
F2	FWD CONFIGURATION LOST TCU has lost the FWD configuration. • *interference during saving data on non volatile memory* • *TCU is brand new or from another vehicle*	gear range set from 1st to 4th	• reconfigure with TCU Configuration Command (ID PC)	
F3	APPLICATION ERROR something of this application is wrong	transmission stay neutral OP-Mode: TCU shutdown	• replace TCU !!	This fault occurs only if an test engineer did something wrong in the application of the vehicle
F4	LIMP HOME REQUEST **no fault!** indicates that another computer requested limp home via CAN	shift to neutral OP-Mode: limp home	• The external controller has to cancel the request	
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 OR INCHPEDAL CALIBRATION DATA LOST TCU was not able to read correct clutch adjustment parameters • *interference during saving data on non volatile memory* • *TCU is brand new*	default values = 0 for AEB offsets used OP-Mode: normal no Inchmode available	• execute AEB	

8.1 Actuator:

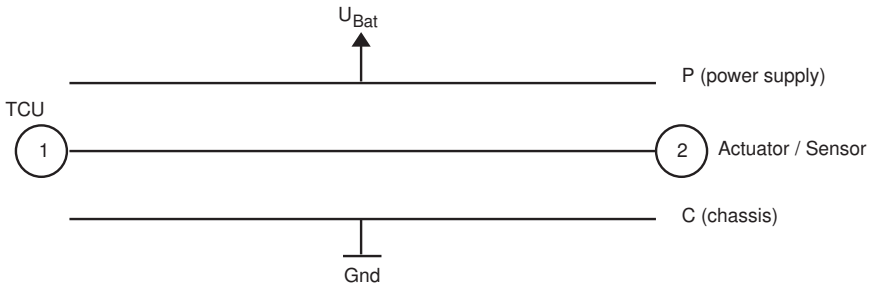


open circuit: $R_{12} \approx R_{1G} \approx R_{2G} \approx \infty$

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. 10 - Measuring Resistance at Actuator/Sensors and Cable

⚠ WARNING

Always select the correct drive direction and gear before releasing the parking brake.

⚠ WARNINGS

Never allow the machine to coast with the transmission in 'NEUTRAL'.

When running down a gradient the engine speed should not be allowed to drop below 1200 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.The parking brake will be applied automatically when the speed reduces to below 1m/h. Do not operate until the fault has been repaired.

Always select 'NEUTRAL' and apply the parking brake before leaving the operator's seat.

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 'lock up'. To disengage the retarder, press the top of the switch. The retarder will be disengaged when any of the conditions are out of range.

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 the 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 between 80°C (176°F) and 120°C (248° F). However, during retarder operation the gauge may reach 145°C (293°F). 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 the engine speed. The speed must be reduced by using the service brakes so that the oil is cooled down. Reduce the downgrade travel speed to avoid the oil overheating and possible damage to the transmission.

If the vehicle is approaching an overspeed condition, the transmission upshifts automatically through the gears (to 6th) to decrease the engine speed, whether in manual or automatic mode. The service brakes should be applied to reduce travel speed. With the accelerator pedal released, the retarder will automatically engage when the engine speed reaches 2000 rev/min and it will disengage at 1850 rev/min to prevent the engine from overspeeding.

With the accelerator pedal depressed, the retarder is automatically engaged at 2600 rev/min to decrease the engine speed. The retarder is disengaged at 2450 rev/min. A fault code will be displayed and recorded by the

ECU. If the oil temperature reaches 150°C (302°F) the retarder is disengaged and a fault code will be displayed and recorded by the ECU.

REMOVAL

Numbers in parentheses refer to Figure 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 perform the task 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 the steering right and left several times to relieve any pressure in the steering system.

2. Operate the treadle valve continuously to discharge the 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 - Transmission ECU (Est-37) connector
f - Engine ECM connectors
g - Body control lever
h - Hydraulics ECU

4. Place a suitable container under the transmission drain port, remove the drain plug and drain the oil. After draining, reinstall the drain plug and tighten it securely.

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

6. Remove the cab from the machine. Refer to Section 260-0010, Cab and Mounting. Ensure that all connections and lines connected to the cab are disconnected.

7. Disconnect all drivelines connected to the transmission and secure them clear of the transmission. Refer to Section 130-0010, Drivelines.

8. Identify and tag the oil filter hose assemblies (5, 6 and 7, Figure 11) to aid installation. Disconnect the hose assemblies (5, 6 and 7, Figure 11) and cap the open ends and the adapter (8, Figure 11) and elbows (9, 10 and 11, Figure 11) to prevent the entry of dirt.

9. Remove the filter bracket (1, Figure 11) from the exhaust cradle. Remove all exhaust tubes, the silencer, the exhaust stack and the exhaust cradle. Remove the engine air intake tube if required.

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 hydraulic pump. Disconnect hydraulic lines and cap lines and ports to prevent the ingress of contaminants.

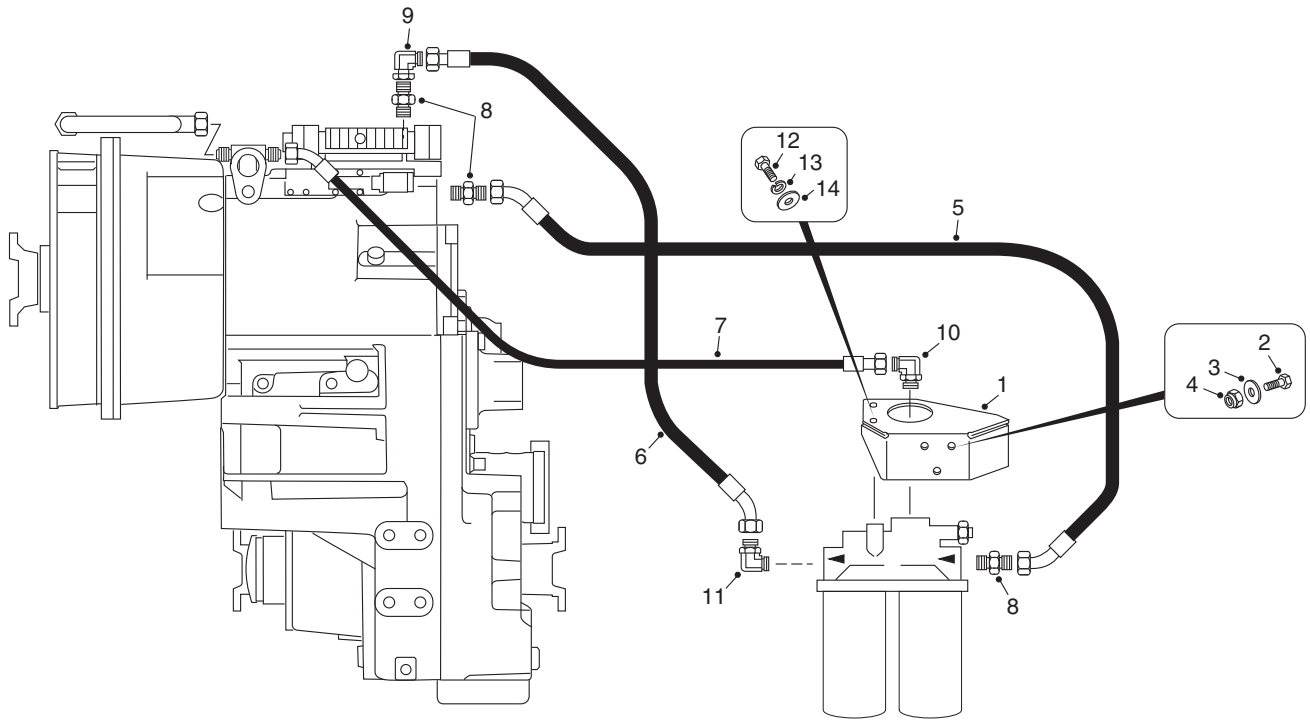
Note: The transmission can be removed from the vehicle without removing the hydraulic pump.

12. Identify, tag and disconnect the hydraulic lines at the main hydraulic valve. Cap lines and ports to prevent the ingress of contaminants.

13. Identify, tag and disconnect the transmission oil cooler lines from the transmission. Cap lines and ports to prevent the ingress of contaminants.

14. Identify, tag and disconnect hydraulic lines (6, 7, 8, 9 and 10, Figure 12) at the diff-lock/retarder valve. Cap lines and ports to prevent the ingress of contaminants.

15. Identify, tag and disconnect the hydraulic lines at the hydraulic tank. Cap lines and ports to prevent the ingress of contaminants.



1 - Filter Bracket
2 - Bolt
3 - Washer
4 - Locknut
5 - Hose Assembly
6 - Hose Assembly
7 - Hose Assembly
8 - Adapter
9 - Elbow
10 - Elbow
11 - Elbow
12 - Bolt
13 - Lockwasher
14 - Washer

Fig. 11 - Transmission Oil Filter Lines

16. Identify and tag the diagnostic hose assemblies (22 and 23, Figure 12) to aid in installation. Disconnect the hose assemblies (22 and 23, Figure 12) and cap the open ends and tee (21, Figure 12) and adapter (26, Figure 12) to prevent entry of dirt.

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

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

19. Remove locknut (10), hardened washer (22), bolt (11) and snubbing washer (17) securing the LH bracket (12) to the frame mounts.

20. Remove lock-nut (10), hardened washer (22), bolt (11) and snubbing washer (17) securing the RH bracket (13) to the frame mounts.

21. Remove the locknuts (10), washers (8) and bolts (9) securing the front bracket assembly to the frame mounts.

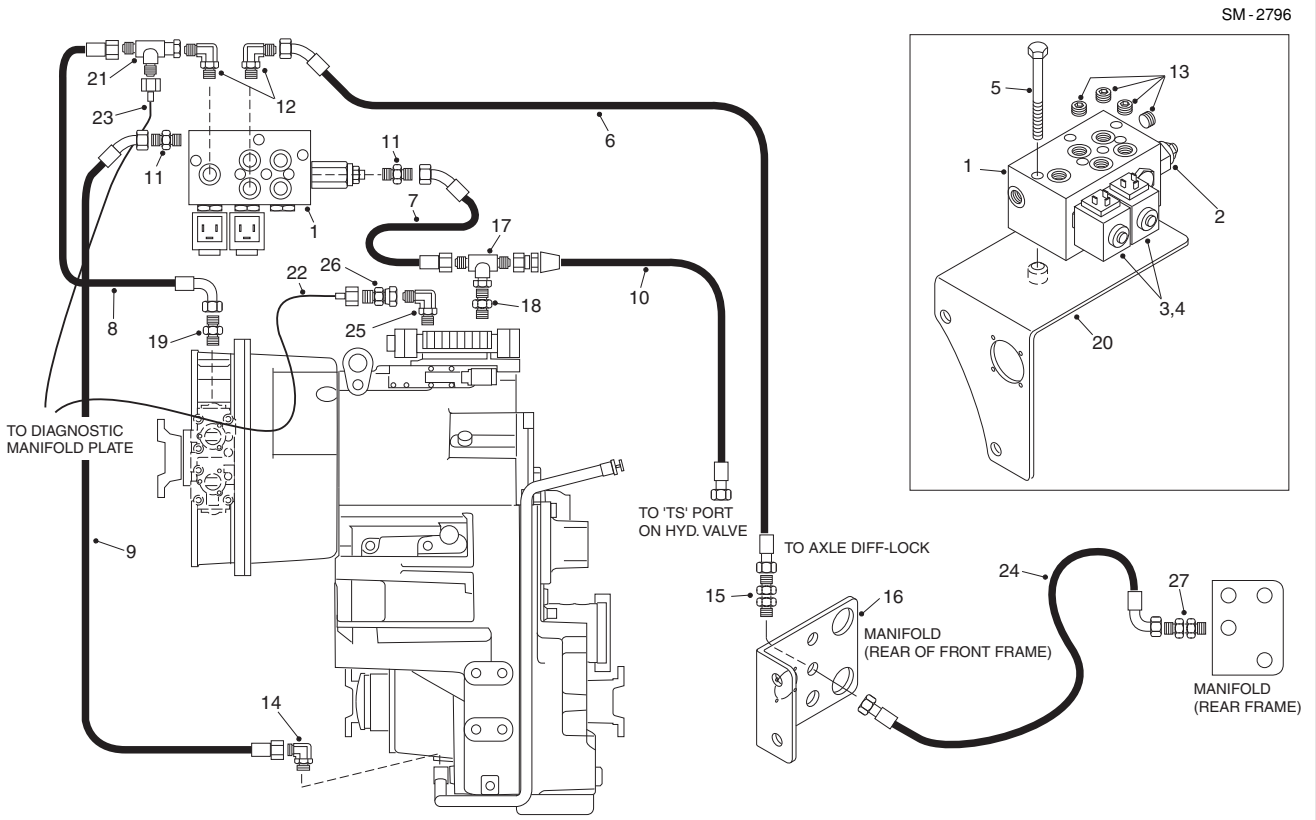
22. Check to make certain that all necessary line and cable disconnections have been made before lifting the transmission.

23. Carefully raise the transmission ensuring that no lines, cables or components foul during removal. The transmission may have to be pushed forward to allow the output yoke to clear the rear of the frame. When the transmission is clear of the frame assembly, move it to a suitable work area and mount it securely on a work stand.

DISASSEMBLY

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

1. Remove the bracket assembly (20, Figure 12)



1 - Differential Lock/Retarder Valve
2 - Pressure Reducing Valve
3 - Cartridge
4 - Coil
5 - Bolt
6 - Hose Assembly
7 - Hose Assembly
8 - Hose Assembly
9 - Hose Assembly
10 - Hose Assembly
11 - Adapter
12 - Elbow
13 - Plug
14 - Elbow
15 - Adapter
16 - Manifold Plate
17 - Tee
18 - Adapter
19 - Adapter
20 - Bracket Assy
21 - Tee
22 - Diagnostic Hose
23 - Diagnostic Hose
24 - Hose Assembly
25 - Elbow
26 - Adapter
27 - Adapter

Fig. 12 - Transmission Retarder And Diff-Lock Lines

complete with the diff lock/retarder valve (1, Figure 12). Remove the bolts (5, Figure 12) securing the diff lock/ retarder valve to the bracket assembly and remove the valve.

2. If required, the pressure reducing valve (2, Figure 12), solenoid cartridges (3, Figure12) and coils (4, Figure 12) can be removed from the diff lock/retarder valve.

3. Remove the bolts (14), lock washers (15) and LH bracket (12) from the transmission. Remove the isolation mount (16) from the LH bracket (12) and replace it if required.

4. Remove the bolts (14), lock washers (15) and RH bracket (13) from the transmission. Remove the isolation mount (16) from the RH bracket (13) and replace it if required.

5. Remove the bolts (4) and lock washers (3) securing the front bracket (2) and front plate (5) to the transmission.

6. Remove the mounting hardware securing the front plate (5) to the front bracket (2). Press out the centre bonded mount (6) from the front plate (5) and remove the sleeve (1).

7. Remove the mounting hardware securing the hydraulic pump to the transmission power take off. Refer to Section 230-0050, Hydraulic Pump.

8. If required, identify and tag the electrical connections to the engine speed sensor, output speed sensor, central gear train sensor and turbine speed sensor (5, 6, 7 and 8, Figure 2) and remove the sensors from the transmission.

9. If required, identify and tag the electrical connections to the oil temperature sender (gauge) (1, Figure 2), transmission oil cooler fan drive temperature switch (9, Figure 2) and retarder oil temperature sender (11, Figure 2), and remove them from the top of the transmission.

10. Remove the fasteners securing the dipstick tube (18) support bracket. Remove bolts (20), lock washers (21), dipstick tube (18) assembly and gasket (19) from the transmission.

11. Refer to the transmission manufacturer's service manual if transmission service or repair is required.

INSPECTION

Numbers in parentheses refer to Figure 1.

1. Check front bracket assembly (1, 2, 5 - 8), the LH bracket (12), the RH bracket (13) and the frame mounting brackets for cracks and damage. Repair or renew as required.

2. Check the general condition of the transmission assembly for wear and damage. Check for worn or damaged driveline flanges and excessive wear on mounting holes and isolation mounts (16).

3. Check the condition of all electrical harnesses and connections and repair/renew as required. Check the condition of all hydraulic lines on the transmission and renew if damaged.

ASSEMBLY

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

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, Stadard Bolt and Nut Torque Specifications.

1. Install a new gasket (19) on the dipstick tube (18) assembly and secure the assembly to the transmission with bolts (20) and lock washers (21). Secure the dipstick tube (18) to the support bracket with the fasteners previously removed.

2. If removed, install the oil temperature sender (gauge) (1, Figure 2), transmission oil cooler fan drive temperature switch (9, Figure 2) and retarder oil temperature sender (11, Figure 2) on the top of the transmission. Tighten the electrical connections securely.

3. If removed, install the engine speed sensor, output speed sensor, central gear train sensor and turbine speed sensor (5, 6, 7 and 8, Figure 2) in the transmission as shown in Figure 2. Tighten the electrical connections securely.

4. Install the hydraulic pump to the transmission power take off and secure it using the mounting hardware removed at Disassembly. Refer to Section 230-0050, Main Hydraulic Pump.

5. Install the centre bonded mount (6) and sleeve (1) to the front plate (5). Secure the front plate assembly to the front bracket (2) with the bolt (7), washer (8) and nut. Tighten the bolt (7) to 920 Nm (679 lbf ft).

Note: Clean, prime and seal the joint using Loctite 7063 cleaner, Loctite T primer and Loctite 648 retaining compound.

6. Secure the front bracket assembly to the transmission using the bolts (4) and lock washers (3). Tighten the bolts (4) to 225 Nm (166 lbf ft).

7. Secure the LH bracket (12) and RH bracket (13) to the transmission with bolts (14) and lock washers (15). Tighten the bolts (14) to 410 Nm (302 lbf ft).

Note: Clean, prime and seal the joint using Loctite 7063 cleaner, Loctite T primer and Loctite 648 retaining compound.

8. Secure the diff-lock/retarder valve (1, Figure 12) to the bracket assembly (20, Figure 12) with mounting hardware removed during Disassembly.

9. Mount the bracket assembly (20, Figure 12) and diff-

lock/retarder valve (1, Figure 12) to the transmission with the fasteners removed during Disassembly.

INSTALLATION

Numbers in parentheses refer to Figure 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 perform the task safely.

1. Lubricate the isolation mounts (16) with water or a suitable rubber lubricant and install them in the front frame mounts, with the spigots to the underside of the mounts.

2. 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.

3. Secure rear mounting brackets (12 and 13) to the frame mounts with the bolts (11), snubbing washers (17), hardened washers (22) and lock-nuts (10), as shown in Figure 1. Tighten the bolts (11) to a torque of 920 Nm (679 lbf ft).

4. Secure the front bracket assembly to the frame mounts with bolts (9), washers (8) and lock-nuts (10). Tighten the bolts (9) to a torque of 920 Nm (679 lbf ft).

5. Remove the lifting equipment from the lifting points on the transmission.

6. Remove the blanking caps from the hose assemblies (22 and 23, Figure 12), tee (21, Figure 12) and adapter (26, Figure 12) and connect the hose assemby (22, Figure 12) to the adapter (26, Figure 12), and the hose assembly (23, Figure 12) to the tee (21, Figure12).

7. Remove the blanking caps from the hydraulic tank hose assemblies and ports, and connect the hose assemblies to the hydraulic tank.

8. Remove the blanking caps from the hose assemblies (6, 7, 8, 9 and 10, Figure 12) and ports at diff-lock/retarder valve. Connect the hose assemblies to the diff-lock/retarder valve.

9. Remove the blanking caps from the transmission oil cooler lines and retarder ports, and connect the oil cooler lines. Refer to Section 210-0060,Transmission Oil Cooler.

10. Remove the blanking caps and connect the lines to the main hydraulic valve, as identified at removal.

11. Remove the blanking caps and connect the hydraulic lines to the hydraulic pump, as identified at removal.

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

13. Install the air intake tube (if removed), exhaust tubes, exhaust cradle, exhaust silencer and exhaust stack. Install the filter bracket (1, Figure 11) to the cradle.

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

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

16. Install the cab assembly on the front frame. Refer to Section 260-0010, Cab and Mounting.

17. Connect all harnesses and electrical connections at front of the cab.

18. Fill the hydraulic tank with hydraulic oil specified in Section 300-0020, Lubrication System. Refer to Section 230-0040, Hydraulic Tank for the fill level and procedure.

19. Fill the transmission with engine oil specified in Section 300-0020, Lubrication System. Check the oil level as described under 'Oil Level Check'.

Note: The transmission oil cooler should be primed

when refilling the transmission. Refer to Section 210-0060, Transmission Oil Cooler.

20. Connect the following cables and connectors in the order given to prevent serious damage to the engine's electrical components.

a - Hydraulics ECU
b - Body control lever
c - Engine ECM connectors
d - Transmission ECU (Est-37) connector
e - Alternator supply cables
f - Alternator earth cables
g - Battery supply cables
h - Battery earth cables

21. 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 the transmission to warm up and recheck all connections for leaks.

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

23. 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 oil lines. Check the condition of electrical harnesses and connections regularly.

The transmission breather (10, Figure 2) should be checked on a regular basis (every 250 hours), 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.

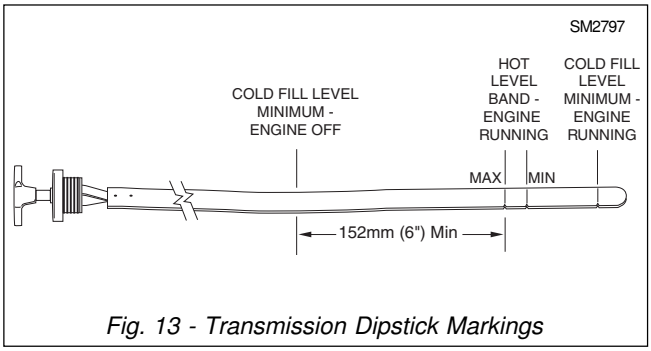


Fig. 13 - Transmission Dipstick Markings

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

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.

Topping Up Oil

If the transmission oil level has to be topped up, according to dipstick, oil should be added through the filler on the transmission oil cooler. The bleed plug on the top of the transmission oil cooler should be opened while adding oil. Allow the oil to drain into the system then recheck the level.

Oil and Filter Change

⚠ WARNING

When changing filter cartridges, it is imperative that new filter cartridges are the same part number and colour as the original cartridges.

The transmission oil and filter cartridges should be changed every 1000 hours, or sooner, depending on operating conditions. Clean the oil filter head when changing the filter cartridges. 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. Oil should be added to transmission as described in 'Topping Up Oil'.

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	

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 previous 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 instructor seat, adjacent to the ECU.

TROUBLESHOOTING

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

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 right hand dash panel).

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

2. Turbine speed sensor (8). Check across pins 3 and 4. Resistance should be 945 - 1155 ohms at a temperature of 20°C (68°F).

3. Central gear train speed sensor (7). Check across pins 5 and 6. Resistance should be 945 - 1155 ohms at a temperature of 20°C (68°F).

4. Output speed sensor (6). Check across pins 21 and 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 right hand dash panel).

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

Pressure can also be checked (see Fig. 6).

Temperature Sensors

The sump temperature sensor, located in the main control valve (2) can be checked at plug X8, pins 14 and 15. Resistance should be 1000 - 1500 ohms.

The retarder temperature sensor (11) can be checked at plug X9, pins 15 and 16. Resistance should be 800 - 1500 ohms.

The transmission oil cooler fan drive temperature sensor (9) can be checked by measuring resistance across terminals:
At 20°C (68°F), resistance should be 1020 - 1280 ohms.
At 60°C (140°F), resistance should be 219 - 261 ohms.
At 90°C (194°F), resistance should be 82 - 96 ohms.
At 120° C (248° F), resistance should be 36.3 - 40.7 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:

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)	120	0.1	Short circuit from CAN H to CAN L
	120	-	-
	120	Infinity	End resistor 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

Neutral - Pins 2 and 5
Forward - Pins 2 and 4
Reverse - Pins 2 and 6
Up - Pins 2 and 7
Down - Pins 2 and 8
Button - Pins 2 and 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.

Solenoid Coil Ratings

The following data should be referenced when checking solenoids:

1. Centre axle diff-lock solenoid (3, Figures 4 and 5) (at the valve on top of the transmission)
Resistance: 41 ohms
Current: 0.6 A

2. Transmission diff-lock solenoid (at transmission output to front axle)
Resistance: 30 ohms
Current: 0.8 A

3. Retarder solenoid (4, Figures 4 and 5) (at the valve on top of the transmission). The solenoid can be checked at plug X9, pins 9 and 10.
Resistance: 41 ohms
Current: 0.6 A

Differential Pressure Switch

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

Pressure Checks

Refer to Figure 6 for measurement points and pressures. The system pressure, convertor pressure and retarder pressure can be measured at the diagnostic test points in the battery box. 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	4	Bolt	225	166
1	7	Bolt	920	679
1	9	Bolt	920	679
1	11	Bolt	920	679
1	14	Bolt	410	302

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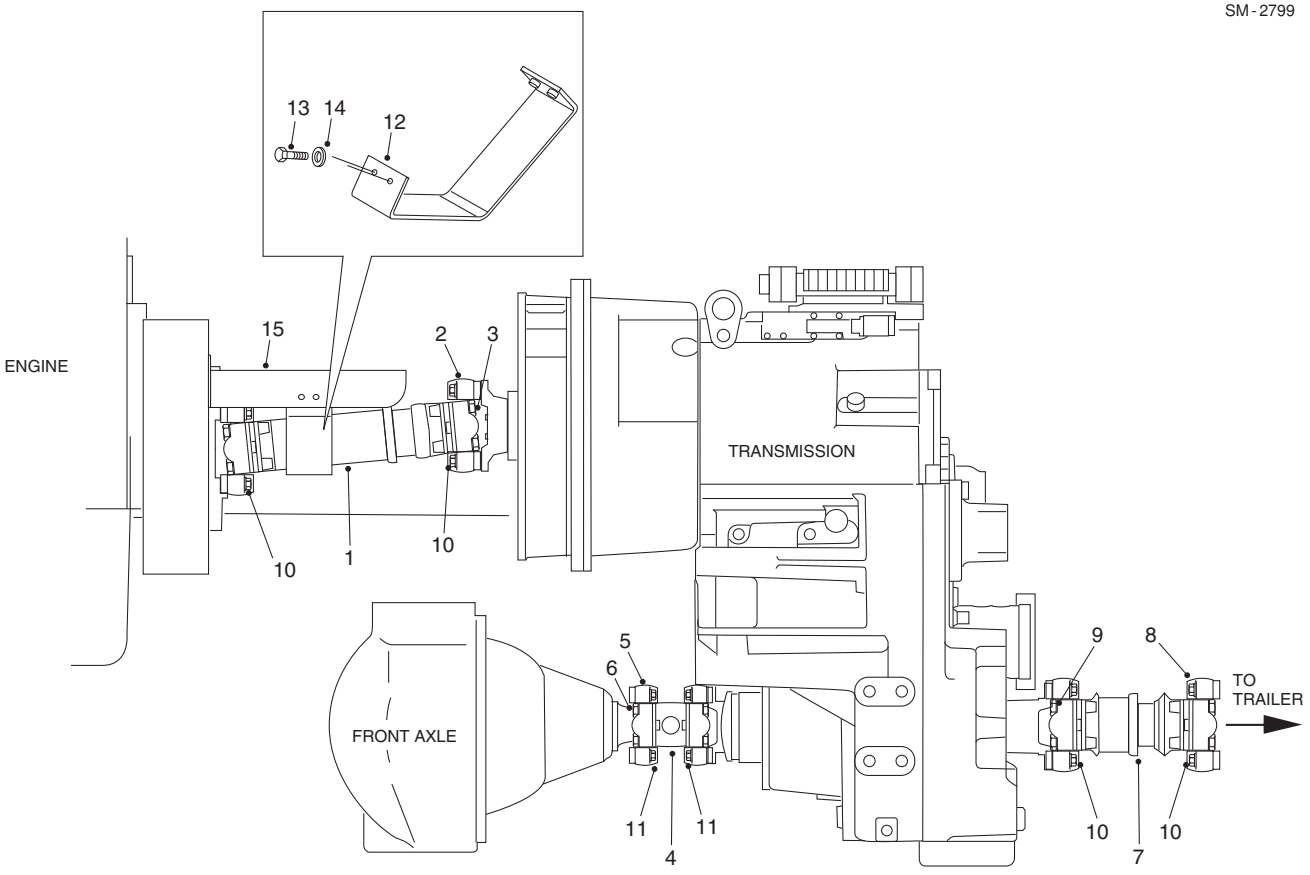


1 - Driveline Assembly
2 - Universal Joint
3 - Screw
4 - Driveline Assembly
5 - Universal Joint
6 - Screw
7 - Driveline Assembly
8 - Universal Joint
9 - Screw
10 - Capscrew
11 - Capscrew
12 - Anti-flail Guard
13 - Bolt
14 - Washer
15 - Bracket

Fig. 1 - Front Drivelines and Mounting

DESCRIPTION

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

The function of the driveline is to transmit rotating power from one point to another in a smooth and continuous action while allowing a degree of movement or misalignment of the components it connects.

The drivelines must operate through constantly changing relative angles between the components they are mounted to and must also be capable of changing length while transmitting torque.

A typical driveline consists of universal joints which allow some misalignment and permit the driveline to pivot in any direction, and, a light rigid hollow slip yoke and splined shaft assembly forming a slip joint.

The slip joint accommodates length variations generated during operation, preventing tension or compression loads from causing serious damage to the components.

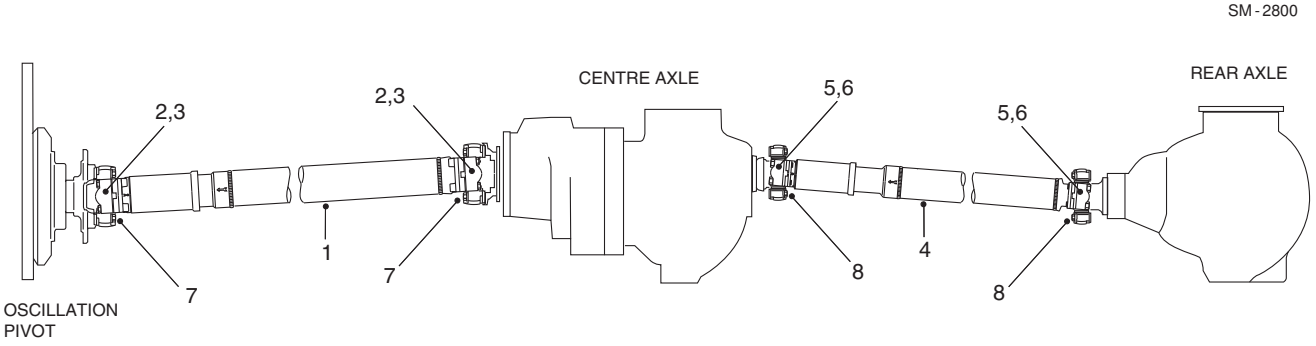
Note: Extra care should be taken when handling the drivelines since chips, dents, burrs or deformity on any rotating mass creates vibration and excessive wear during any operation.

There are three driveline assemblies installed between various components in the tractor frame as follows:

Driveline assembly (1) is connected between the engine drive and transmission input drive.

Driveline assembly (4) is connected between the front axle drive flange and transmission final drive.

Driveline assembly (7) connects the rear final drive of the transmission to the articulation and oscillation pivot.



1 - Driveline Assembly
2 - Universal Joint
3 - Screw
4 - Driveline Assembly
5 - Universal Joint
6 - Screw
7 - Capscrew
8 - Capscrew

Fig. 2 - Rear Drivelines and Mounting

There are two driveline assemblies connecting the centre and rear axles to the drive supplied from the transmission, through the pivot drive arrangement, as follows:

Driveline assembly (1, Fig. 2) is connected between the oscillation pivot drive arrangement and the centre axle.

Driveline assembly (4, Fig. 2) is connected between the centre axle and the rear axle.

REMOVAL

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

Note: Extra care should be taken when handling drivelines since carelessness can result in premature failure of the components. Chips, dents, burrs, or any other deformity of universal joints will prevent accurate mating. This will cause misalignment which is accompanied by vibration and excessive wear.

⚠ WARNINGS

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

⚠

To prevent serious injury or death, DO NOT go under the vehicle when the engine is running. Rotating shafts can be dangerous. You can snag clothes, skin, hair, hands, etc..

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

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

Note: Access to remove driveline assembly (1) can be obtained by tilting the cab. Refer to Section 260-0010, CAB AND MOUNTING.

3. Remove bolts (13) and washers (14) securing anti-flail guard (12) to bracket (15). Remove anti-flail guard (12).

4. Remove bracket (15) over driveline assembly (1) from engine flywheel housing.

5. Match mark universal joint (2) 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 (10) securing universal joints (2) to their mating components. Remove driveline assembly (1). If necessary tap driveline assembly (1) from its mating components with a soft faced hammer.

Note: Access to driveline assemblies (4 & 7) can be obtained from underneath the vehicle.

7. Match mark universal joints (5 & 8) and their mating surfaces to ensure correct mating alignment when installing driveline assemblies (4 & 7).

8. Remove capscrews (11) securing universal joints (5) to their mating components and remove driveline assembly (4). If necessary tap driveline assembly (4)

from its mating components with a soft faced hammer.

9. Remove capscrews (10) securing universal joints (8) to their mating components and remove driveline assembly (7). If necessary tap driveline assembly (7) from its mating components with a soft faced hammer.

Note: Access to driveline assemblies (1 & 4, Fig. 2) can be obtained from underneath the vehicle.

10. Match mark universal joints (2 & 5, Fig. 2) and their mating surfaces to ensure correct mating alignment when installing driveline assemblies (1 & 4, Fig. 2).

11. Remove capscrews (7, Fig. 2) securing universal joints (2, Fig. 2) to their mating components and remove driveline assembly (1, Fig. 2). If necessary tap driveline assembly (1, Fig. 2) from its mating components with a soft faced hammer.

12. Remove capscrews (8, Fig. 2) securing universal joints (5, Fig. 2) to their mating components and remove driveline assembly (4, Fig. 2). If necessary tap driveline assembly (4, Fig. 2) 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 joints (2) from driveline assembly (1).

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

4. Remove screws (3) and universal joints (2) from driveline assembly (1).

5. Repeat steps 1 to 4 for drivelines (4 & 7) and (1 & 4, Fig. 2)

INSPECTION

1. Clean all metal parts in a suitable solvent, and dry all parts with compressed air.

2. Inspect splines of shaft and yoke for nicks, burrs and excessive wear. Replace if wear is excessive or splines are nicked. Burrs may be removed with a fine file or medium India stone.

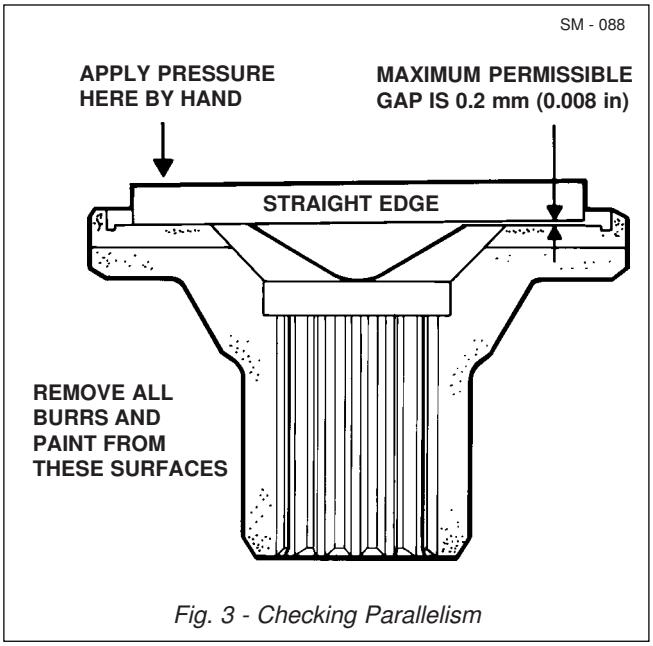


Fig. 3 - Checking Parallelism

3. Check the surfaces of the components that universal joints mate against for parallelism. Refer to Fig. 3.

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 (2) 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 (2) to shaft end of driveline assembly (1) and secure with screws (3).

5. Repeat steps 1 to 4 for drivelines (4 & 7) and (1 & 4, Fig. 2)

INSTALLATION

Numbers in parentheses refer to Fig. 1, unless

otherwise specified.

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

Note: Extra care should be taken when handling drivelines since carelessness can result in premature failure of the components. Chips, dents, burrs, or any other deformity of wing bearings will prevent accurate mating. This will cause misalignment which is accompanied by vibration and excessive wear.

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

⚠ To prevent serious injury or death, DO NOT go under the vehicle when the engine is running. Rotating shafts can be dangerous. You can snag clothes, skin, hair, hands, etc..

1. Position driveline assembly (7) on the vehicle as shown in Fig. 1 and align match marks on universal joints (8) with those on its mating surfaces.

2. Apply Loctite 648 to the threads of capscrews (10) and secure universal joints (8) to its mating surfaces with capscrews (10). Tighten capscrews (10) to a torque of 153 Nm (113 lbf ft).

3. Position driveline assembly (4) on the vehicle as shown in Fig. 1 and align match marks on universal joints (5) with those on its mating surfaces.

4. Apply Loctite 648 to the threads of capscrews (11) and secure universal joints (5) to its mating surfaces with capscrews (11). Tighten capscrews (11) to a torque of 153 Nm (113 lbf ft).

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

6. Apply Loctite 648 to the threads of capscrews (10) and secure universal joints (2) to its mating surfaces with capscrews (10). Tighten capscrews (10) to a torque of 153 Nm (113 lbf ft).

7. Secure bracket (15) over driveline assembly (1) with mounting hardware previously removed.

8. Secure anti-flail guard (12) to bracket (15) with bolts (13) and washers (14).

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

10. Apply Loctite 648 to the threads of capscrews (7, Fig. 2) and secure universal joints (2, Fig. 2) to its mating surfaces with capscrews (7, Fig. 2). Tighten capscrews (7, Fig. 2) to a torque of 153 Nm (113 lbf ft).

11. Position driveline assembly (4, Fig. 2) on the vehicle as shown and align match marks on universal joints (5, Fig. 2) with those on its mating surfaces.

12. Apply Loctite 648 to the threads of capscrews (8, Fig. 2) and secure universal joints (5, Fig. 2) to its mating surfaces with capscrews (8, Fig. 2). Tighten capscrews (8, Fig. 2) to a torque of 153 Nm (113 lbf ft).

13. Lower the cab, place the battery master switch in the 'On' position, ensure the parking brake is applied and start the engine. Remove wheel blocks from all road wheels.

MAINTENANCE

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.

SERVICE TOOLS

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

DRIVELINE DIAGNOSIS CHART		
CONDITION	REASON	REMEDY
Vibration or noise	Driveline bent or out of balance	Clean driveline in a suitable solvent. Inspect for contact with adjacent parts. If driveline is distorted or sprung, replace. If driveline does not run smoothly, and vibration is felt, remove driveline and dynamically balance the assembly.
	Driveline loose at yoke/flange	Check driveline mounting capscrews for tightness. If loose, replace capscrews and torque tighten to the proper specification.
Excessive wear of universal joints	Poor yoke/flange alignment and/or run-out	Check yoke/flange for alignment, run-out and balance. Repair or replace as required.
	Driveline imbalance	Check to see if balance weights are missing or if driveline is distorted. If driveline is distorted, replace; if weights are missing, check balance of driveline dynamically and rebalance.

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	10	Capscrew	153	113
1	11	Capscrew	153	113
2	7	Capscrew	153	113
2	8	Capscrew	153	113

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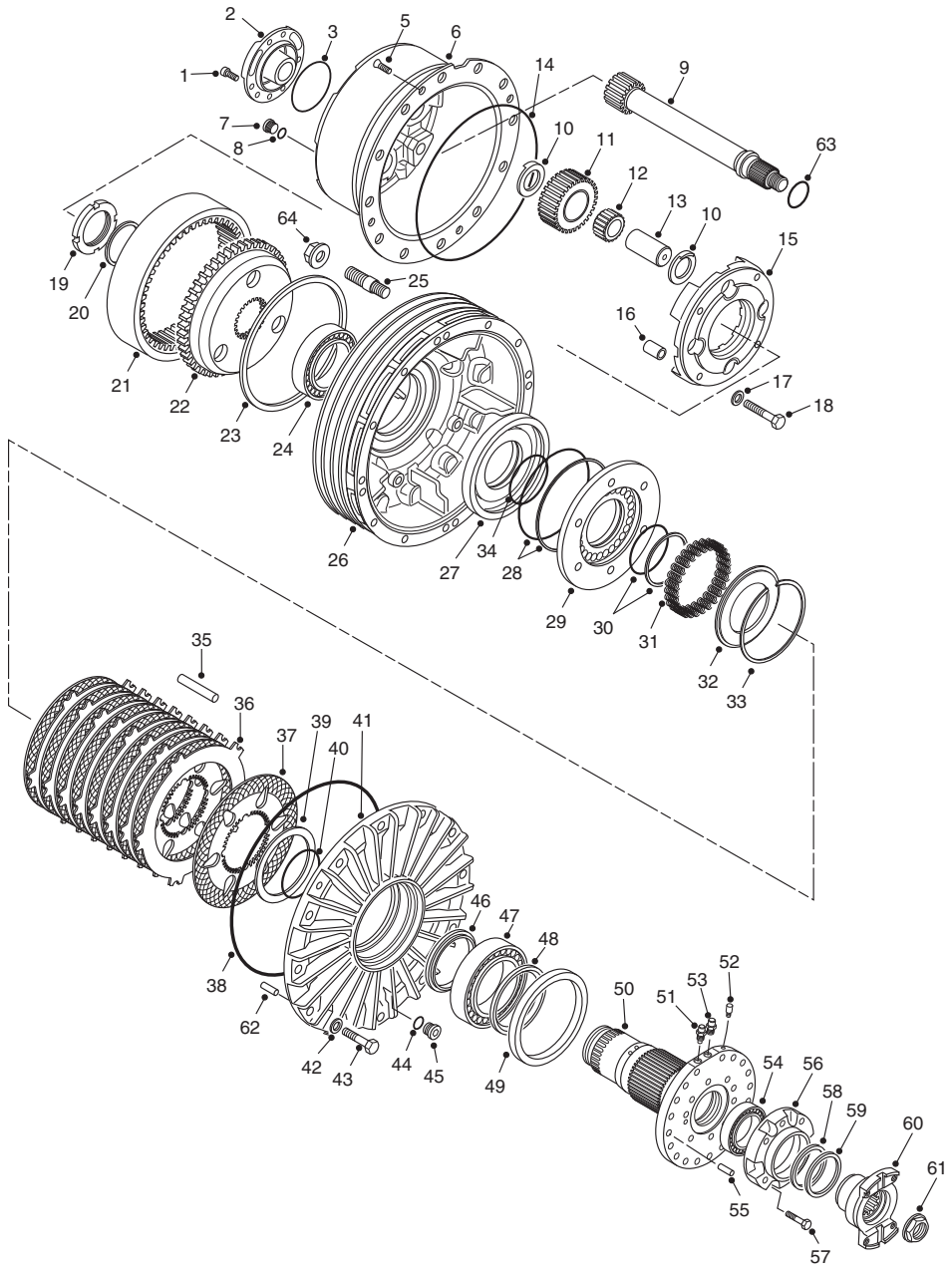


1 - Capscrew
2 - Cover
3 - O-ring
4 - Pin
5 - Bolt
6 - Planet Carrier
7 - Plug
8 - Seal ring
9 - Dowel Pin
10 - Washer
11 - Planet Gear
12 - Caged Needle Brg
13 - Planet Pin
14 - O-ring
15 - Planet Carrier
16 - Shear Pin
17 - Washer
18 - Bolt
19 - Slotted Nut
20 - Shim
21 - Ring Gear
22 - Ring Gear Carrier
23 - Snap Ring
24 - Roller Brg
25 - Wheel Bolt
26 - Wheel Hub
27 - Cylinder
28 - Seal rings
29 - Piston
30 - Seal rings
31 - Disc Spring
32 - Thrust Washer
33 - Snap Ring
34 - O-ring
35 - Pin
36 - Steel Disc
37 - Inner Disc
38 - O-ring
39 - Seal Ring
40 - O-ring
41 - Wheel Hub
42 - Washer
43 - Bolt
44 - Seal ring
45 - Drain Plugs
46 - Intermediate ring
47 - Roller Brg
48- Spindle
49- Seal
50- Hub Carrier
51- Breather
52- Breather
53- Seal ring
54- Adaptor
55- Bolt
56- Seal ring
57- Plug
58- Dowel Pin
59- Seal ring
60- Snapring
61- O-ring
62 - Axle Housing
63 - Sun gear shaft
64- Wheel Nut

Fig. 1 - Exploded View of Planetary and Wheel

OPERATION

Numbers and letters in parentheses refer to Fig. 1.

Power from the differential is transmitted through a fully floating axle sun gear shaft (9). As sun gear shaft (9) rotates in a clockwise direction, 4-off planet gears (11) meshed with sun gear shaft (9) rotate anticlockwise. Ring gear (21) is splined to hub carrier (50) and does not rotate but causes planet gears (11), which are meshed with ring gear (21), to move around it in a clockwise direction. As planet carrier (6) is bolted to wheel hub (26) the wheel then rotates in a clockwise direction.

REMOVAL AND DISASSEMBLY

Numbers in parentheses refer to Fig. 1.
Note: On dismantling, clean all parts in paraffin or suitable cleaner, place on a clean work surface.

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

⚠ To prevent personal injury and property damage, the procedure for removing tyre and rim assembly described in Section 160-0050, WHEEL, RIM AND TYRE, must be strictly followed.

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

1. Before attempting to remove the road wheels, drive the vehicle onto a level, solid concrete floor, preferably after a short run to warm the oil.

2. Apply the parking brake and switch off the engine.

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

4. Whilst road wheels are still on the ground, loosen wheel nuts (64).

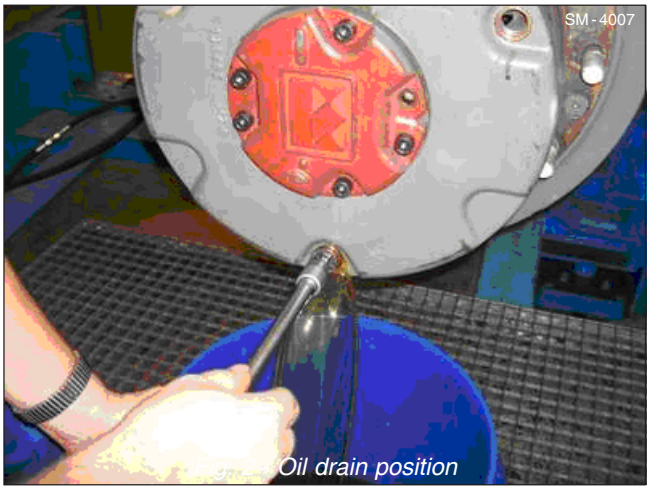
5. Jack up the axle and support with suitably placed stands or timbers.

6. Support tyre and rim assembly with a suitable sling and lifting device. Remove wheel nuts (64) and remove tyre and rim assembly from the machine. Remove opposite road wheel in the same way.

7. Place suitable containers under the differential and both hubs (26). Remove differential drain plug and drain oil from the differential.

8. Rotate hubs (26) until drain plug (45) is at its lowest point. Remove plug (45) and seal ring (44) and drain oil from hub.Refer to fig.2

⚠ WARNING
Be careful during oil drain when oil is at working temperature and therfore is a scald risk



Oil drain position

9. Index mark planet carrier (6) and hub (26) to aid in installation.

10. Loosen screws (1) then remove prise cover (2) from planet carrier (6), removing o-ring (3) in the process.Refer to fig.3

Fig. 3 - Loosen allen screws

11. Using a suitable threaded stud locate into threaded centre on the end of sun gear shaft (63) to remove shaft. Refer to Fig. 4

Fig. 4 - Remove Sungear shaft using threaded stud

12. Pull shaft (9) from the assembly and remove to a suitable bench area for inspection at a later stage.

13. Using a suitable lifting device, secure to planet carrier (6).

14. Remove remaining Bolts (5) from planet carrier (6). Secure carrier and constituent parts i.e. planet gear assembly and remove from the wheel hub assembly.

Fig. 5 - Securing Wheel Hub

15. Locate 2-off fabricated tool (Fig. 5) over bolts securing hub carrier (50) to the axle housing and secure into the 2-off locating holes which are capped on the rear face of the wheel hub (41).

16. Prior to removal of slotted nut (19) it will be necessary to heat the nut to 200°c to release the loctite bond. Using a special tool (15503031) or suitable powered tool, remove slotted nut (19). Refer to Fig 6 & 7

17. Locate fabricated tool onto bolts (25) and screw wheel hub (26) away from the wheel hub (41). Refer to Fig 8. Bearing (24) should come out during this step.

18. Cylinder (27), piston (29), seal ring (28), o-ring (34) , seal ring (30), disc springs (31), thrust washers (32) and snap ring (33) can now be removed from the assembly.

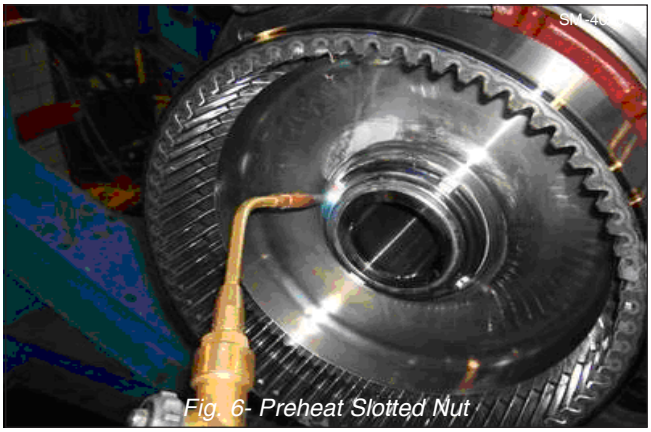


Fig. 6- Preheat Slotted Nut

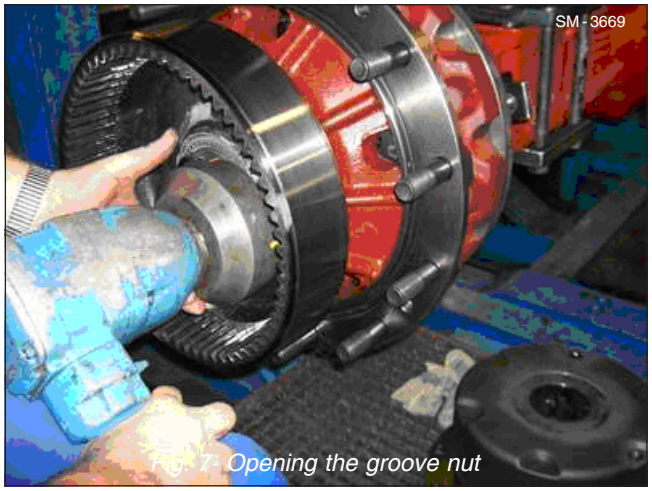


Fig. 7- Opening the groove nut

19. Remove steel discs and inner discs (36 & 37) from the assembly. Pins (35) can also be removed once the discs have been removed.

20. Seal ring (39) should be removed from the bore of the wheel hub (41) as should o-ring (40).

21. Fit locating studs into threaded holes of the axle housing, into the wheel hub (41). This ensures the wheel hub (41) will not drop down , which could damage the valve (shown in yellow). Refer to Fig.9

Fig. 8- Removal of Sun Gear Shaft

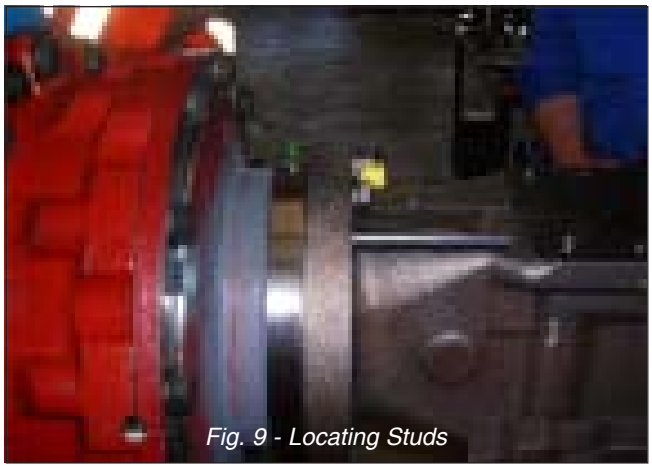


Fig. 9 - Locating Studs

22. Wheel hub (41) can now be removed by removal of fabricated tools which were securing it in place.

23. All other components can now be removed from the assembly. Including Intermediate ring (46) and seal rings (48 & 49).

24. Remove cover (56), seal rings (58 & 59), o-ring (60) and flange(60) from the hub carrier (50).

INSPECTION

Numbers in parentheses refer to Fig. 1.

Thoroughly clean all parts with a suitable solvent and dry with compressed air. Inspect all parts for damage or excessive wear and replace where necessary. Inspect thrust washers (32) to make sure they are free of burrs and are absolutely flat. Replace all 'O' rings.

ASSEMBLY AND INSTALLATION

Numbers in parentheses refer to Fig. 1 unless otherwise stated**.**

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, AXLE 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.

1. Install brass bushing into bore of Hub carrier (50). Ensure oil groove on the bush is at the bottom of the assembly location i.e. at the opposite end from the flat face which is on the outer diameter of the hub carrier (50). Refer to Fig. 10.
Note: Oil groove on bush is a cross groove.

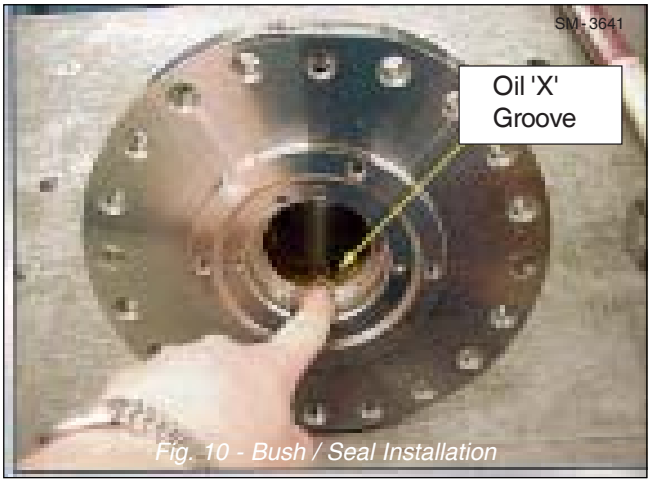


Fig. 10 - Bush / Seal Installation

2. Fit sealrings (58 & 59) and o-ring (61). Secure the caradan flange (60).

3. Secure hub carrier (50) on a suitable table. Fit NBR seal (49) and spindle ring (48). Ensure each is fully home without causing damage to the components.

Note: Bearing (24) should be preheated, prior to fitting onto the hub carrier (50).

4. Secure roller bearing (47) inner race to the hub carrier (50), again ensure it is fully home. Refer to Fig.11.

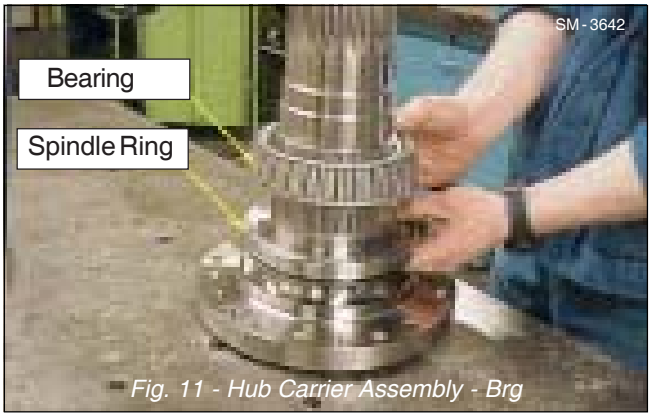


Fig. 11 - Hub Carrier Assembly - Brg

5. Grease o-ring (40) with a thin layer of grease to aid installation. Fit o-ring (40) on hub carrier (50) as shown in Fig. 12.

Fig. 12- Hub Carrier Assembly - O-ring

6. Mount intermediate ring (46) onto carrier (50), using suitable tools, carefully 'punch' ring twice on opposite sides to seat it home onto the carrier. Refer to Fig. 13.

7. Insert bearing (47) outer race into hub (41), use punch tool (15503033). Fit cartridge seal (39) to hub (41) at this stage using punch tool (15503034). Refer to Fig. 14.

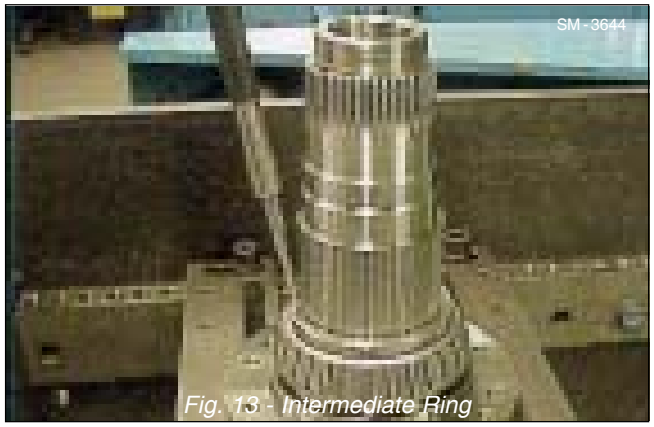


Fig. 13 - Intermediate Ring

Fig. 14 - Brg Outer Race Install

8. Fill the tapered cavity within wheel hub (41) with grease (SKF LGEP 2/18 spec). Ensure an even film is distributed around the bore.

9. Lower wheel hub (41) onto hub carrier (50) until bearing (47) race seats firmly.

Note: Observe that the oil seal slides onto intermediate ring without damage to seal. Refer to Fig. 15.

10. Fit o-ring (38) then locate pins (35) and dowel pins (55) into mating holes on the hub carrier (50). Refer to Fig. 16.

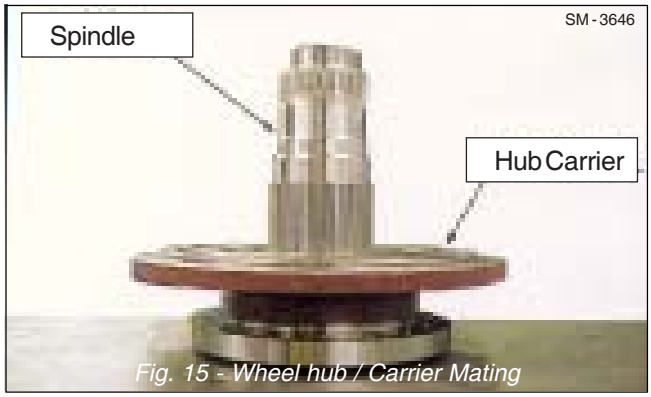


Fig. 15 - Wheel hub / Carrier Mating

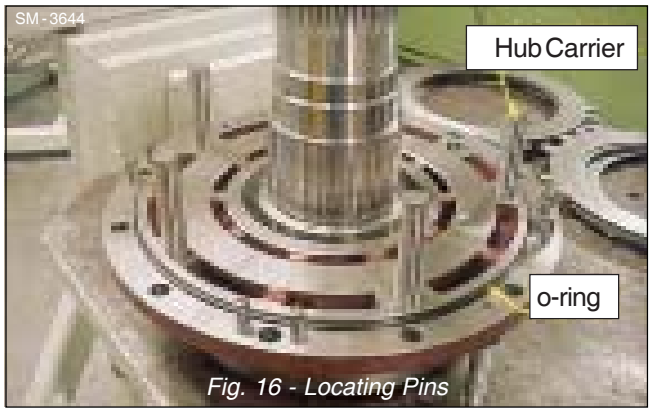


Fig. 16 - Locating Pins

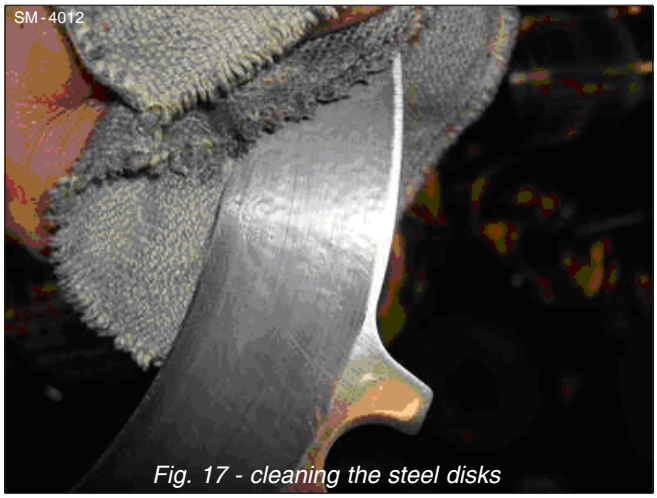


Fig. 17 - cleaning the steel disks

11. Clean the steel discs (36) of oil.Refer to fig.17

12. Assemble alternately; inner discs (37) with steel discs (36). Ensure that all oil channel holes line up and that one of the oil channels is in the top position. Refer to Fig. 18

Fig. 18- Locating Brake Discs

Note: Top steel disc must lie with its measuring tang over the wheel hub opening position. The measuring tang of the lower steel disc must line up with the other position. Refer to Fig. 19.

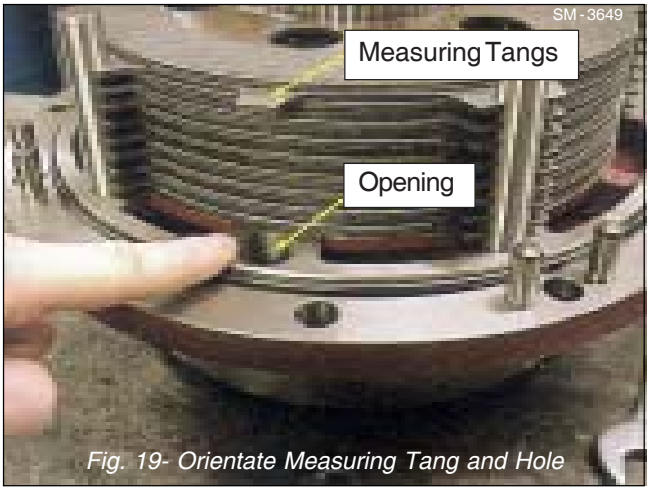


Fig. 19- Orientate Measuring Tang and Hole

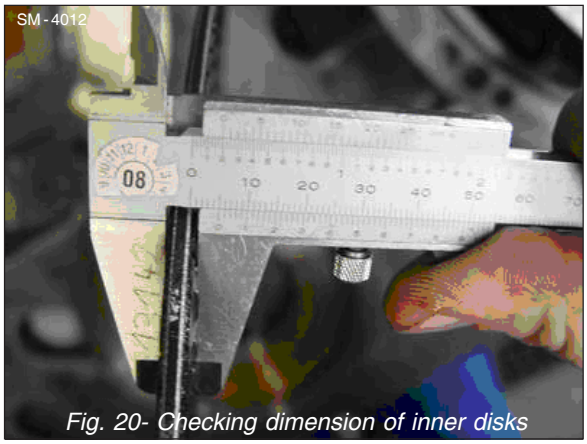


Fig. 20- Checking dimension of inner disks

13. All inner coated disks must be checked dimensionally. The complete thickness for coating disks in new condition is 5mm. If the coating disks thickness is less than 4.65mm, the disks must be replaced.Refer to Fig. 20 & 21

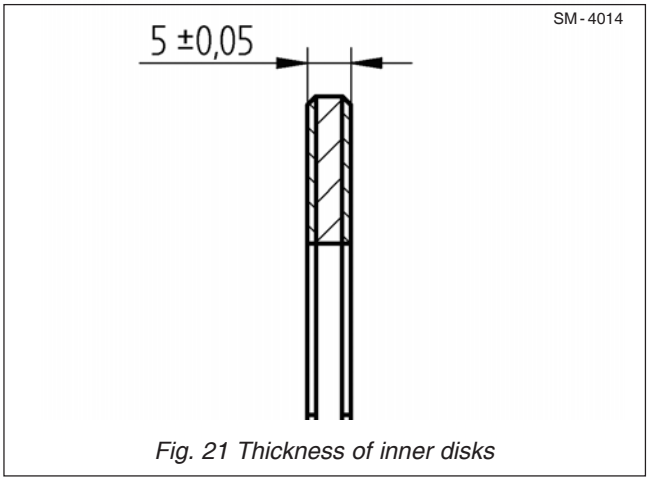


Fig. 21 Thickness of inner disks

14. Check also the depth of the oil groove in the coating area. the depth has to be 0.7mm. If the dept is less than 0.3mm, the disks must be replaced. Refer to Fig. 22

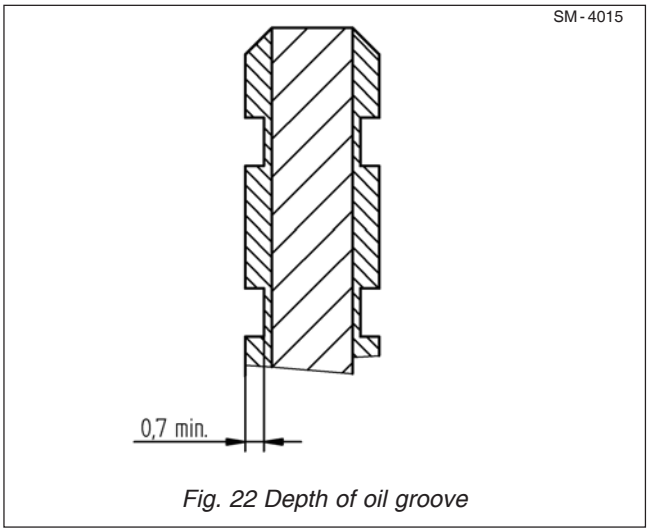


Fig. 22 Depth of oil groove

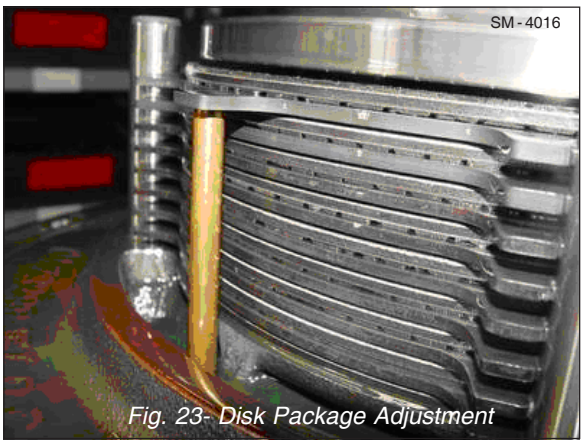


Fig. 23- Disk Package Adjustment

15. Install the checkout disk package again and make a new adjustment.Refer to fig.23

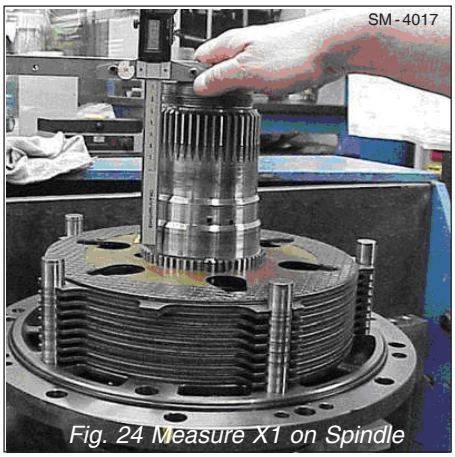


Fig. 24 Measure X1 on Spindle

16. Measure X_1 on spindle(48).
Distance from spindle face to the profile step for coated disks. Refer to fig.24

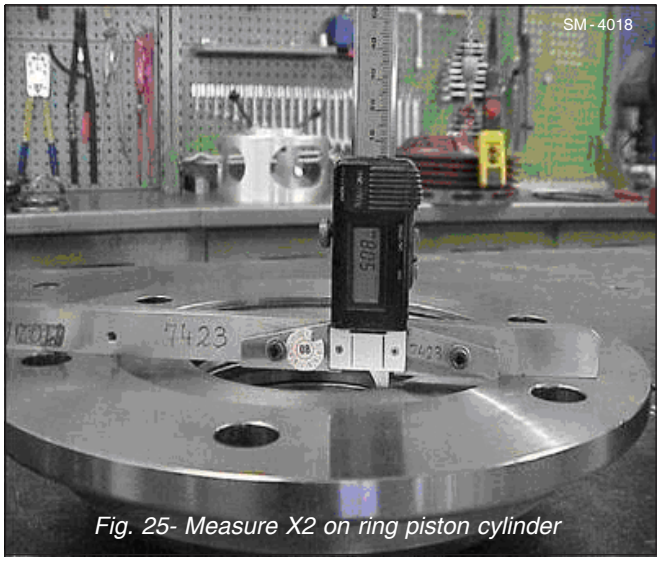


Fig. 25- Measure X2 on ring piston cylinder

17.Measure X2 on ring piston cylinder(29).
Distance from piston face to the inner washer. Measure the distance on the inside diameter.Refer to fig.25

18.Special device WZ 873 for X3 distance
For X3 measurement, set on the special device WZ 873.Screw on the centre nut and tighten by hand. Simultaneous turn constant the wheel hub, to align the wheel hub.

19.Load both lever of the device, so that multi disks set in working condition and becomes pressure.

20.Measure X3 to disks.
Distance from spindle face to the face of coated disk and directly near the stamp. Refer to fig.25

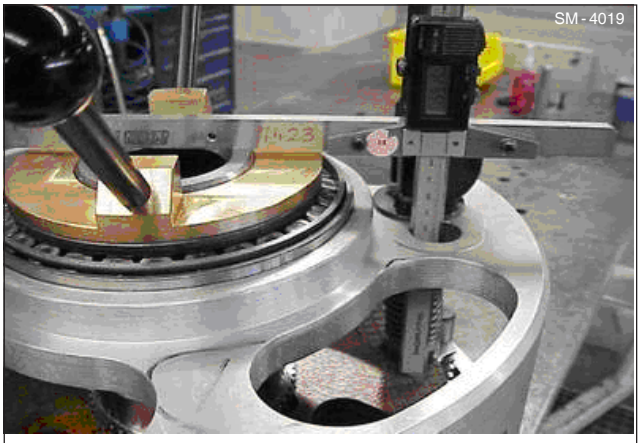


Fig. 25- Measure X3 on ring piston cylinder

21.The release gap “S” is following calculated:
S=X3-(X1+X2)
The setting value is 1.0 – 1.4 mm.
Is the value “S” > 1.4 mm replace so much standard steel disks through steel disks with 0.5 mm thicker size till the setting value is reached.

22.Start to reinstall the disk package with a lined disk. Install the disk with middle groove on top.Refer to fig.26

23.Set the lower steel disks (36) out of measuring line

24.Set the top steel disks in direct measuring line. Then remove the protecting tape.

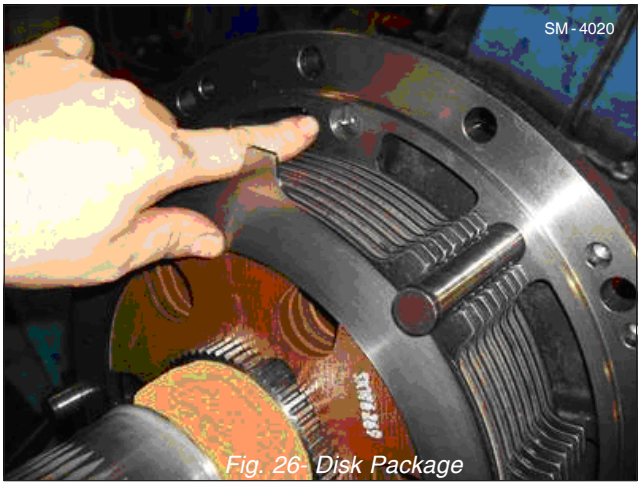


Fig. 26- Disk Package

25. Spray hub carrier with 'Wolfrakote' Paste prior to assembly of the piston (29) and cylinder (27) to the hub carrier (50) assembly. Refer to Fig. 27.

Fig. 27- Coating Hub

26. Locate seal ring (30) to brake piston (29). Ensure correct orientation of seal ring (30).

27. Assemble brake piston (29) to the pack. The Ø20mm oil holes of the brake cylinder must be placed over the oil channel of the multi-discs. Refer to Fig. 28.

28. Fit o-ring (34) to cylinder (27) then locate cylinder on brake assembly. Ensure the Ø5mm bore is on the top as this stage. Refer to Fig. 29.

Fig. 28- Piston Assembly

Fig. 29- Cylinder Assembly

29. Assemble wheel hub (26) onto wheel hub (41) and fit bearing (24) onto carrier (50). Ensure that punched assembly marks on outer diameter of both wheel hubs (26 & 41) line up. Refer to Figs. 30& 31.

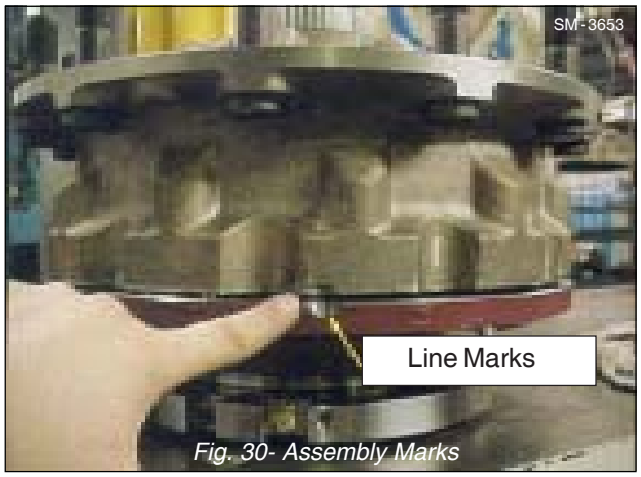


Fig. 30- Assembly Marks

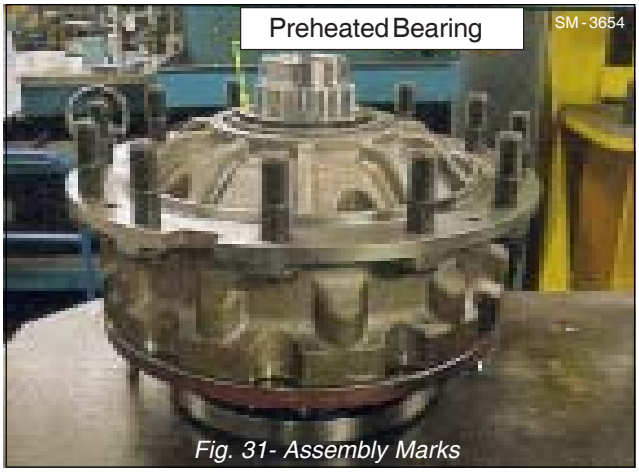


Fig. 31- Assembly Marks

30. Assemble ring gear and ring gear carrier (27 & 28), spray the face of the ring gear carrier (22) with 'Wolfakote paste'. Refer to Fig. 32.

31. Take ring gear assembly and locate over the hub carrier (50). Refer to Fig. 32.

Fig. 32 - Coated Ring Gear Carrier

32. A number of measurements must be made to determine the correct selection of shim (20) size. Follow the procedure listed.

33. Measure dimension 'X1' from the top face of the hub carrier (50) to the face at the end of thread engagement. Refer to Fig. 33.

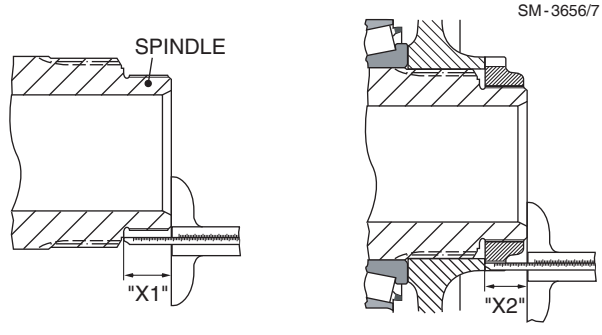


Fig. 33 - Shim Measurement

34. The second measurement should be with the ring gear carrier (22) fixed in place. This should be noted as dimension 'X2'

35. Shim (20) thickness 'd' should fall within the following dimensions , refer to Fig34. :

'd' Max = X1 - X2
'd' Min = (X1 - X2) - 0.12

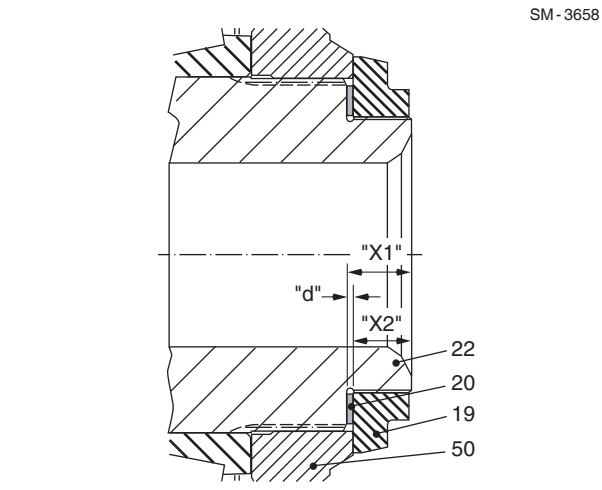


Fig. 34 - Shim Measurement

36. Once the shim (20) has been determined, this should be installed, with the slotted nut (19). The assembly should be mounted suitably in the horizontal position to allow the bearing preload to be checked.

37. Bearing (24) preload should be 50 Nm (36.9 lbf ft) and must be measured in the horizontal position. Refer to Fig. 35.

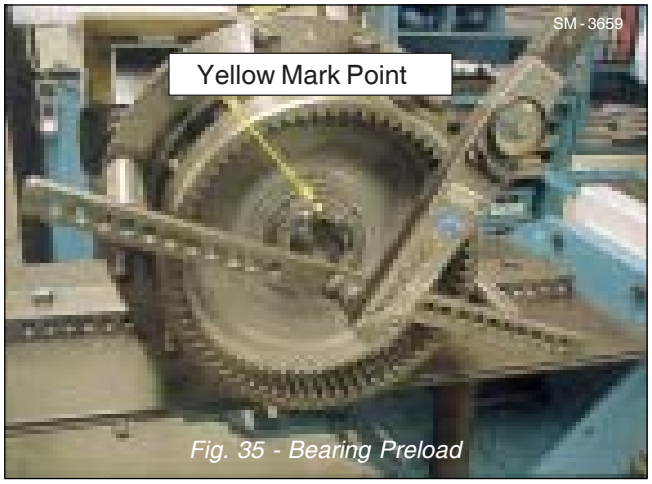


Fig. 35 - Bearing Preload

38. Once the preload has been confirmed, re-install shim (20) and slotted nut (19) , coat engagement face of nut with loctite 262.

39. Taking special tool (15503031) torque slotted nut (19) to a value of 2000 ± 120Nm (1475 ±88 lbf ft). Refer to Fig. 36 &37.

40. Once the slotted nut (19) has been secured. Mark the position of the nut with a yellow colour point. Refer to Fig. 35.

Fig. 36 - Slotted Nut Socket

Fig. 37 - Torque Tool

41. Assemble constituent elements of the carrier (6). Ensure o-ring (14) is fitted prior to planet gears (11), washers (10), pins (13) and bearings (12).

42. Secure elements with planet carrier (15), washers (17) and bolts (18).

43. Locate cover (2) onto planet carrier (6) and secure with screw (1). Torque screw (1) to 67Nm (49 lbf ft) Refer to Fig. 38.

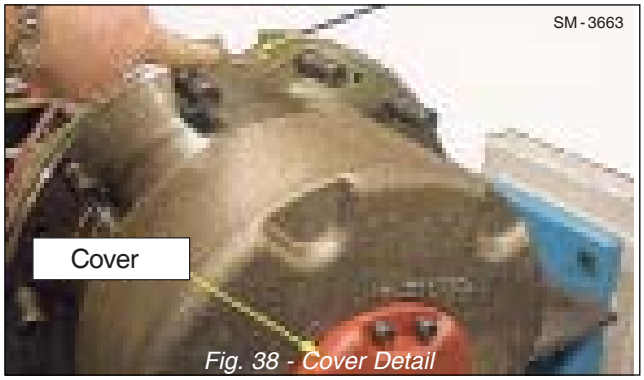


Fig. 38 - Cover Detail

44. Insert sun gear shaft (9) into the planetary cage assembly. Refer to Fig. 39.

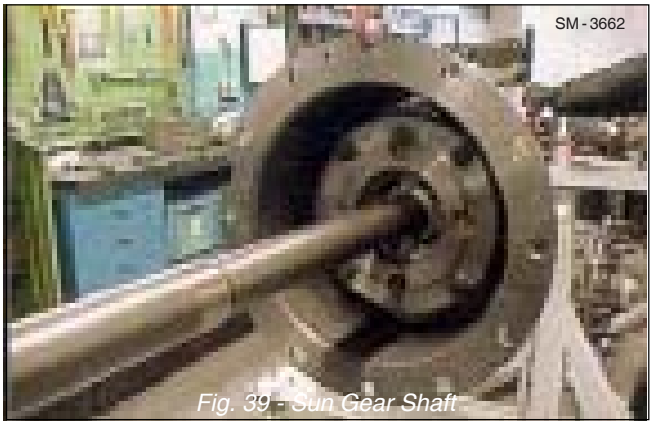


Fig. 39 - Sun Gear Shaft

45. Using suitable lifting tackle mount the complete planetary unit into the wheel hub assembly. Refer to Fig. 40.

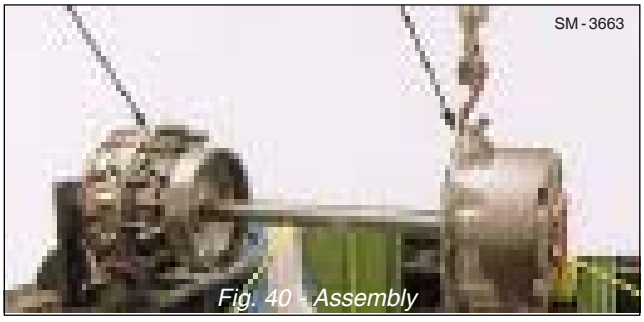


Fig. 40 - Assembly

46. Observe that recesses on outer diameters of carrier (6) and wheel hub (26) are lined up correctly. Refer to Fig. 38.

47. Using suitable lifting device (15503032), secure planetary assemblies to the axle housing with washers (42) and bolts (55). Torque bolts (55) to 290Nm (213 lb-ft).

48. Install differential drain plug. Add gear oil of the type specified in Section 300-0020, LUBRICATION SYSTEM, through the differential filler/level hole until the oil is level with the bottom of the filler/level hole.

49. Fill the planetary assemblies up to the 'Oil Level Check Line' with gear oil of the type specified in Section 300-0020, LUBRICATION SYSTEM.

50. Refit road wheels, securing with wheel nuts (64). Remove stands or timber supports and lower the machine to the ground. Fully tighten wheel nuts to a torque of 600 Nm (442 lbf ft). Remove blocks from the wheels.

Note: Wheel nuts should be checked and tightened if necessary, after the first 10 hours of operation. Check torque every 50 hours (weekly) thereafter.

MAINTENANCE

Proper lubrication of the axle group is essential if axles are to deliver the service intended. Section 300-0020, LUBRICATION SYSTEM gives full information on the proper lubrication intervals and the lubricant which should be used.

The wheel hub - planetary drive and tandem housing have a common oil chamber. The oil chambers are not separated from each other, and due to the narrow oil channels and therefore relatively slow passage of oil, the oil must be filled or added into the correct openings provided.

Numbers in parentheses refer to Fig.41 & 42 unless otherwise stated.

Note: Perform the planetary oil change when the oil is warm, simultaneously with the differential.
1. Planetary drive - Turn the wheel hub until the oil drain plug (1) is at the lowest point to the middle axle. Clean oil drain plug (1). Remove oil drain plug (1) and drain oil. Torque oil drain plug (1) to 45 Nm (33 lbf ft).

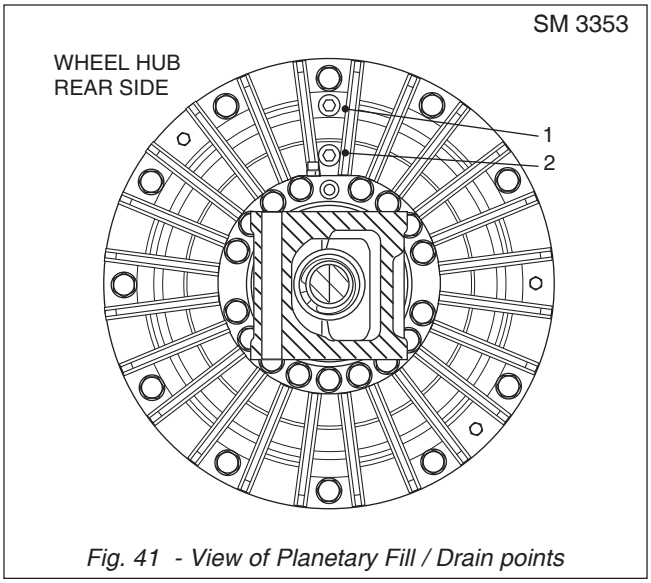


Fig. 41 - View of Planetary Fill / Drain points

2. Turn wheel hubs back by 90 deg. then remove oil fill plug (2). Rest oil Drain plugs (1, Fig. 42) on back side of planetary. Fill system with oil specified in Section 300-0020, LUBRICATION SYSTEM, to the bottom edge of the thread of plug (1, Fig. 42). Torque plug (2) to a value of 45 Nm (33 lbf ft).

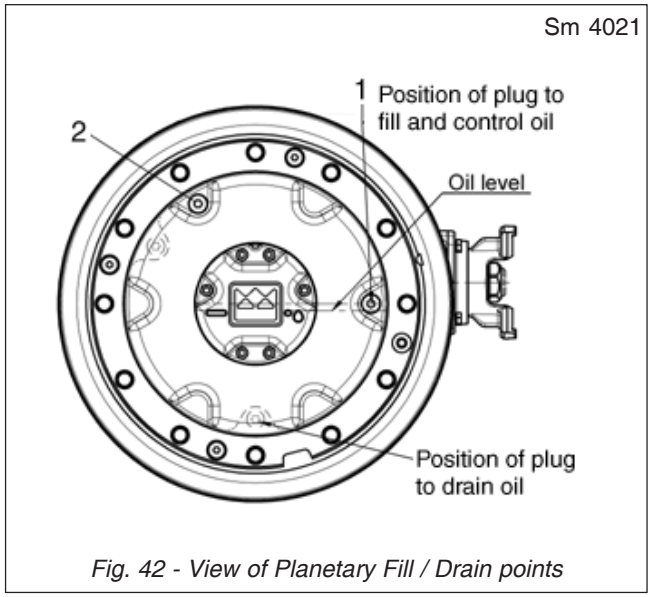


Fig. 42 - View of Planetary Fill / Drain points

3. Refit road wheels, securing with wheel nuts (64). Remove stands or timber supports and lower the machine to the ground. Fully tighten wheel nuts to a torque of 600 Nm (442 lbf ft). Remove blocks from the wheels.

Note: Wheel nuts should be checked and tightened if necessary, at initial inspection and after the first 10 hours of operation. Check torque every 250 hours (monthly) thereafter.

2000 Hours

The multi-discs should be checked for wear. Refer to Fig. 33 for detail. Should brake wear depth measured be 100mm or less i.e. brake wear across disc set of 3mm or greater, then the discs should be replaced. Brake wear should be measured with the brake applied. Measurement is made by removing plug (1, Fig 41) and inserting depth gauge through. Replace and torque plug when measurement is completed.

SPECIAL TOOLS

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

For fabricated tools, refer to the end of this section for dimensions.

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.

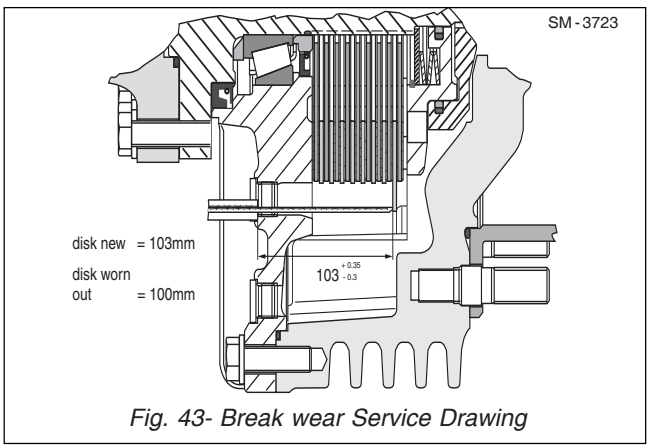


Fig. 43- Break wear Service Drawing

AXLE DIAGNOSIS CHART		
CONDITION	REASON	REMEDY
Noises	Insufficient or incorrect lubricant	Check level. Fill with proper type and grade of lubricant.
	Wheel bearings scored or rough	Replace wheel bearings
	Gear teeth in planetary chipped	Replace gear
Loss of lubricant	Lubricant foams excessively	Drain and fill with proper type and grade of lubricant
	Worn or broken oil seal	Replace oil seal
	Loose nuts or bolts	Tighten nuts or bolts
Gain of lubricant	Incorrect lubricant	Drain and fill with proper type and grade of lubricant
Planetaries running hot	Bearings seized	Replace bearings

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	1	Capscrew	67	49
1	43	Bolt	290	214
1	45	Drain Plug	55	40.5
1	51	Breather	18	32
1	52	Breather	10	7.4
1	57	Plug Screw	15	11
1	64	Wheel Nuts	600	442

FABRICATED TOOLS

The following tools are necessary to aid in removal / assembly of the axle group.

Sm 3670

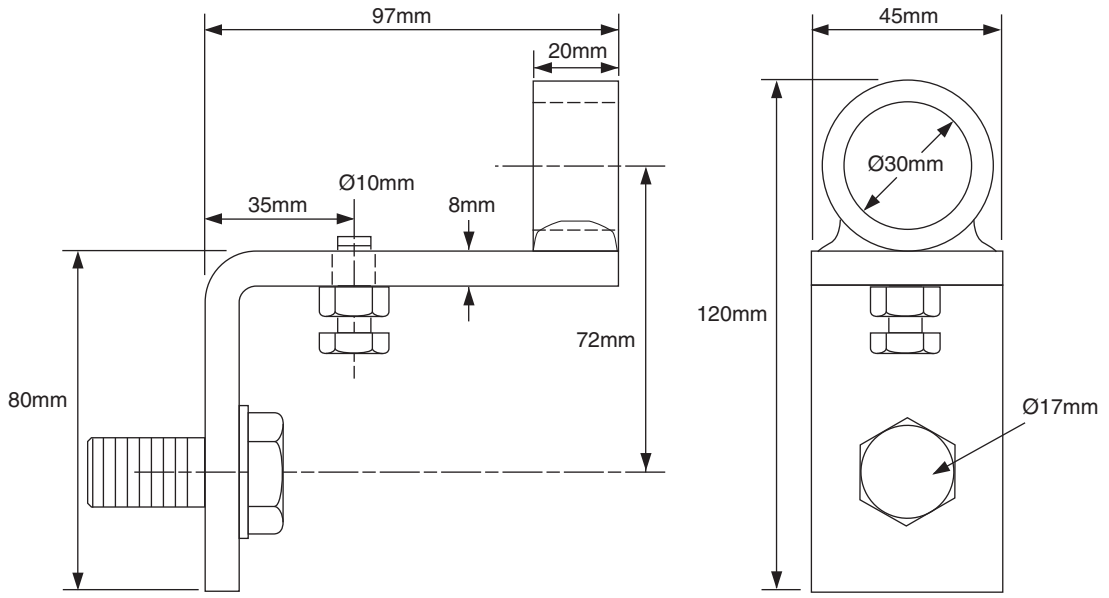


Fig. 33 - Wheel Head Support Bracket Dimensions

Sm 3671

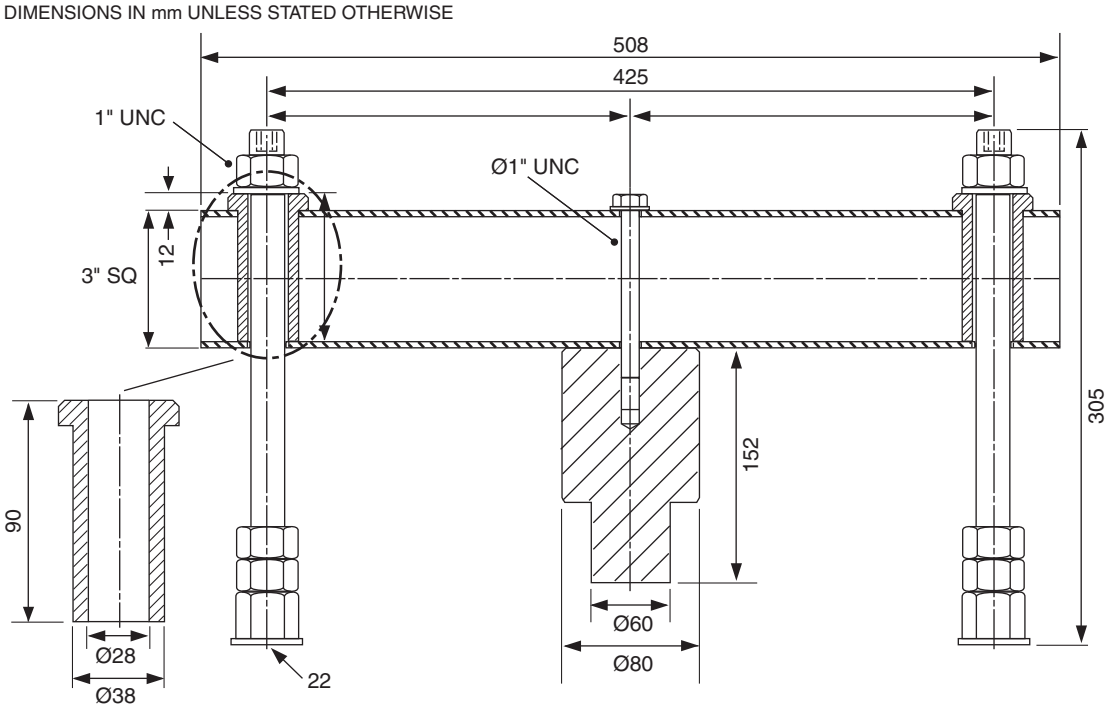


Fig. 34 - Bearing Puller

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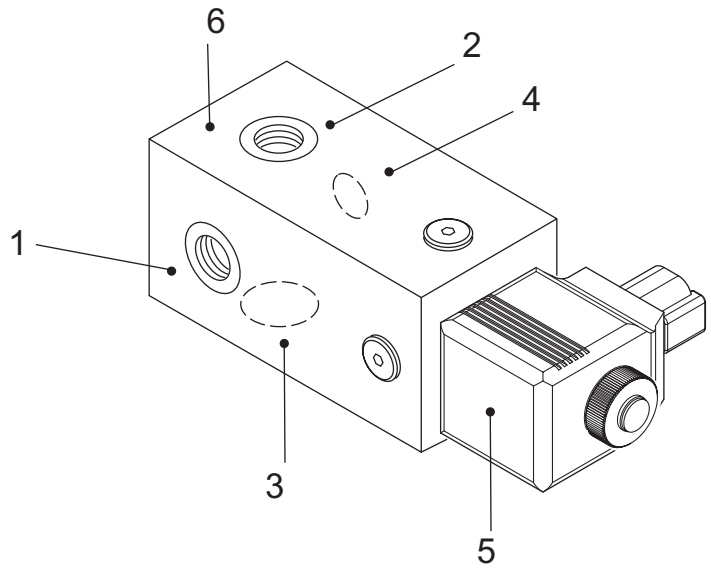

1 - Port 'P'
2 - Port 'B'
3 - Port 'A' (Plugged)
4 - Port 'T' (Tank return)
5 - Solenoid (CT1)
6 - Valve Block

Fig. 1 - Differential Lock Valve Assembly (Typical)

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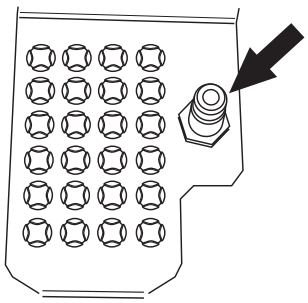


Fig. 2 - Cross-Axle Differential Lock Request Switch

DESCRIPTION & OPERATION

Numbers and letters in parentheses refer to Figure 1.

The Differential Lock Valve is mounted on a bracket at the rear of the remote-mounted transmission filters.

The purpose of the valve is to, when actuated, allow hydraulic pressure to flow to each axle to activate the cross axle differential locks. This is achieved by the operator requesting the differential lock via the foot mounted switch (Figure 2).

Two valve configurations are permissible on the vehicle. This is dependant on whether the vehicle has the standard set up (Figure 4) or an optional transmission retarder (Figure 5) installed. In any case the cross axle differential lock works in the same way. Differential lock application pressure is 42 bar (609 lbf/in²).

For units fitted with the optional transmission retarder, requesting the transmission retarder via the switch (Figure 3) will energize the appropriate solenoid 'CT3' (Figure 5) in the block to send pressure from the transmission through port 'P1' on the valve, via limiting valve 'CT2' which limits the pressure to 5.5 bar (80 lbf/in²) to the transmission retarder. Refer to Figures 5,6 and 7.

SM3718

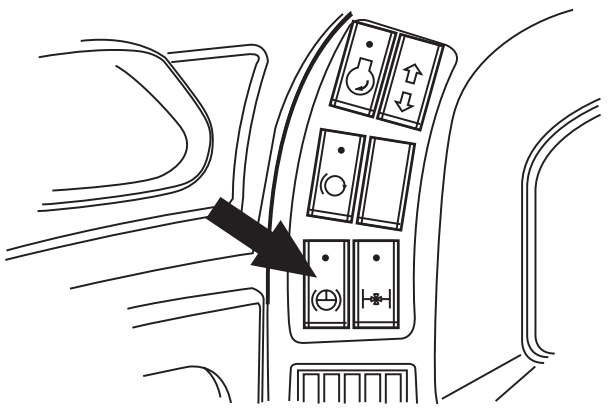


Fig. 3 - Transmission Retarder Request Switch

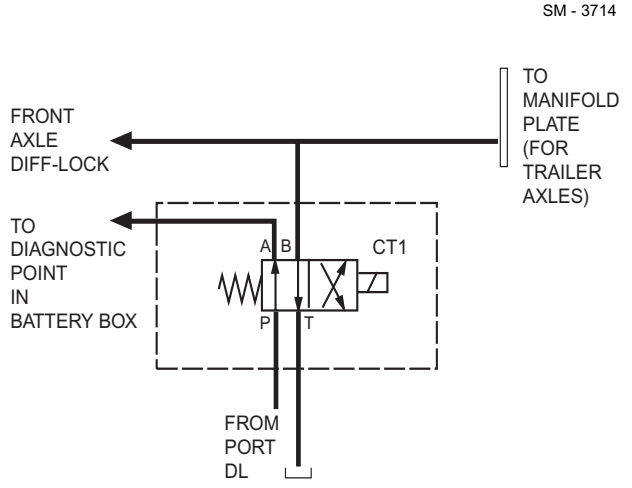


Fig. 4 - Differential Lock Schematic (non-retarder)

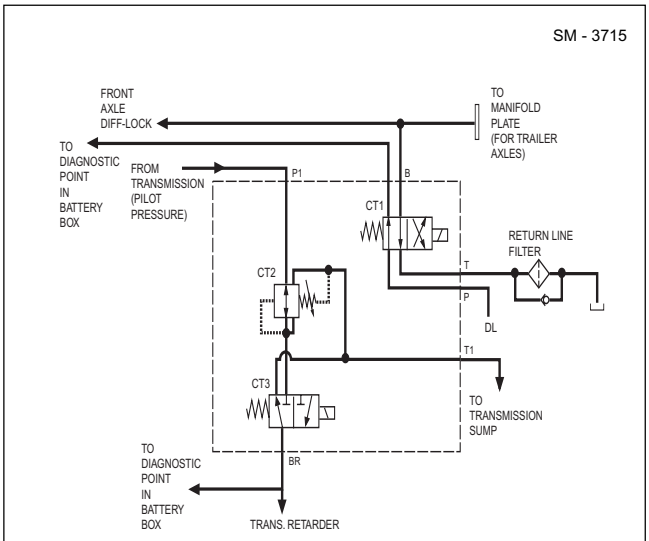


Fig. 5 - Differential Lock Schematic (retarder)

REMOVAL AND DISASSEMBLY

Numbers in parentheses refer to Figure 1

Note: On dismantling, clean all parts in paraffin or suitable cleaner, 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 perform the task safely.

⚠ To prevent personal injury and property damage, the procedure for removing tyre and rim assembly described in Section 160-0050, Wheel, Rim and Tyre, must be strictly followed.

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

1. Apply the parking brake and switch off the engine.

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

4. Remove hoses required to remove the valve from the vehicle.

5. Ensure all hoses are capped and valve ports are plugged.

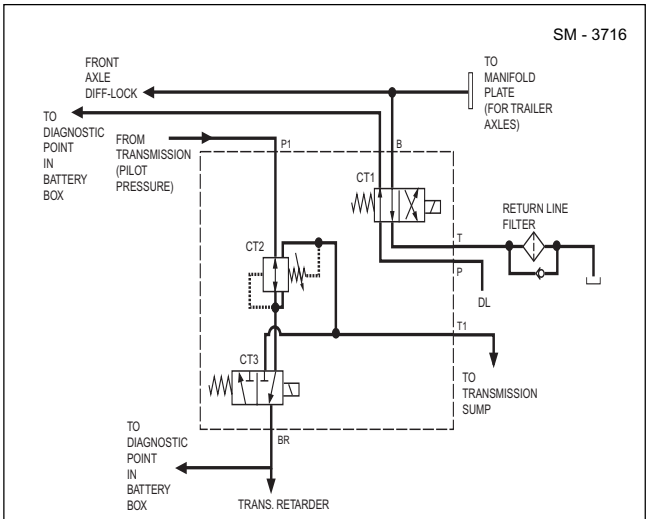


Fig. 6 - Differential Lock Schematic (Retarder Applied)

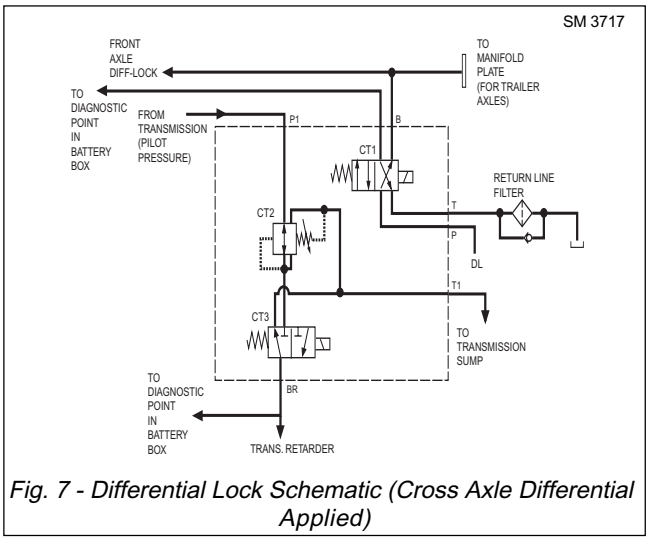


Fig. 7 - Differential Lock Schematic (Cross Axle Differential Applied)

6. Note the orientation of the valve on the vehicle and the corresponding hose/elbow connections to aid in installation.

7. Thoroughly clean all parts with a suitable solvent and dry with compressed air. Inspect all parts for damage or excessive wear and replace where necessary.

8. O-rings should be replaced with new when reinstalling the valve block to the vehicle

ASSEMBLY AND INSTALLATION

Numbers in parentheses refer to Figure 1 unless otherwise stated.

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, Axle 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 perform the task safely.

1. Reinstall the valve block in reverse order from that carried out at the disassembly stage.

2. Ensure all hoses are connected to the correct ports and that appropriate O-rings are fitted correctly.

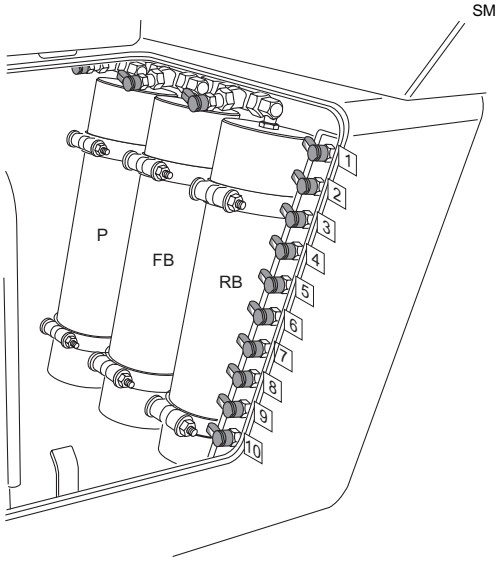
3. Once installed, check the integrity of the circuit, ensuring that there are no leaks or problems.

4. Ensure the system is working to the correct pressures. Where appropriate, carry out pressure adjustments.

Pressure Checks

The differential lock actuation pressure, 35-42 bar (500-609 lbf/in^2), is set by pressure reducing valve CT9 on the main hydraulic valve. Refer to Section 215-0050, Main Hydraulic Valve Assembly.

Differential lock pressure can be checked at the diagnostic check point located inside the battery box (refer to Figure 8). Install a pressure gauge capable of reading at least 240 bar (3500 lbf/in^2) to the correct diagnostic check point.



1 - Differential Lock Pressure
2 - Pump LS Pressure
3 - Front Brake Pressure
4 - Rear Brake Pressure
5 - Park Brake Pressure
6 - Steering Pressure
7 - Trans. Retarder Press.
8 - Trans. Converter Press.
9 - Body System Press.
10 - Trans. System Pressure
P - Primary Accumulator
FB - Front Brake Accumulator
RB - Rear Brake Accumulator

Fig. 8 - Diagnostic Pressure Check Points (Battery Box)

Note: Differential lock pressure can only be checked with the differential lock NOT actuated. While the differential lock is actuated, the diagnostic point is vented to tank via the via the differential lock valve (CT1 on Figures 4, 5, 6 and 7).

MAINTENANCE

Limited maintenance of the valve block is available. Ensure pressures are set correctly periodically and in guidance with those listed.

SPECIAL TOOLS

The special tools referenced throughout this section are available from your dealer. Refer to Section 300-0070, Service Tools, for part numbers of general service tools and sealants required.

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DESCRIPTION

The differential assembly is mounted to the axle housing. It comprises of a differential for the normal cross-axle drive function.

REMOVAL AND INSTALLATION

Numbers in parentheses refer to Figure 1 unless otherwise stated..

> ⚠ **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 performthe task safely.**

1. Position the vehicle in a level work area, raise the body and install the body safety prop to secure the body in the partially raised position.

2. Apply the parking brake and switch off the engine.

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

4. Drain the gear oil out of the axle housing and both planetaries into a suitable container from the oil drain plug (62)on the differential.

5. Remove the planetary assemblies and axle shafts from the axle housing. Note from which side the long and short axle shafts are removed. Refer to Section 160-0030, Axle Group (Hub).

6. Identify the relationship of the front and rear driveline flanges and differential flanges (6 and 72) with punch marks.

7. Disconnect the drivelines from the differential flanges (6 and 72). The drivelines can be removed if it is convenient to do so.

8. Support the weight of the countershaft case assembly with suitable lifting equipment. Remove the bolts (61) securing the countershaft case (60) to the differential housing (35), and carefully remove the countershaft case (60) assembly clear of the differential housing (35).

9. Support the weight of the differential housing (35) assembly with suitable lifting equipment. Remove the bolts (38 and 45) and washers (39 and 46) securing the differential housing (35) to the axle housing (1). Thread in three puller bolts to break the seal between the differential and axle housing and to partially pull the differential assembly out of the axle housing. Carefully remove the differential housing (35) assembly clear of the axle housing.

INSTALLATION

Installation is the reversal of the Removal procedure, described above.

Note: Use sealing compound between the axle housing and differential housing mounting faces.

Note: Tighten all fasteners to standard torques listed in Section 300-0080, Axle Bolt and Nut Torque Specifications.

Add gear oil of the type specified in Section 300-0020, Lubrication System, through the oil filler/level hole, until the oil is level with the bottom of the filler/level hole. Fit Plug (3) and O-ring (4). Fill the planetary assemblies up to the 'Oil Level Check Line'.

DISASSEMBLY

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

1. Remove the nut (56) to allow for removal of the flange (72) from the end of the countercase (60).

2. If not done so previously, remove the bolts (61) which attach the countershaft case (60) to the differential housing (35), then lift off the countershaft

Centre Axle - Differential Drive Head

Section 150-0020

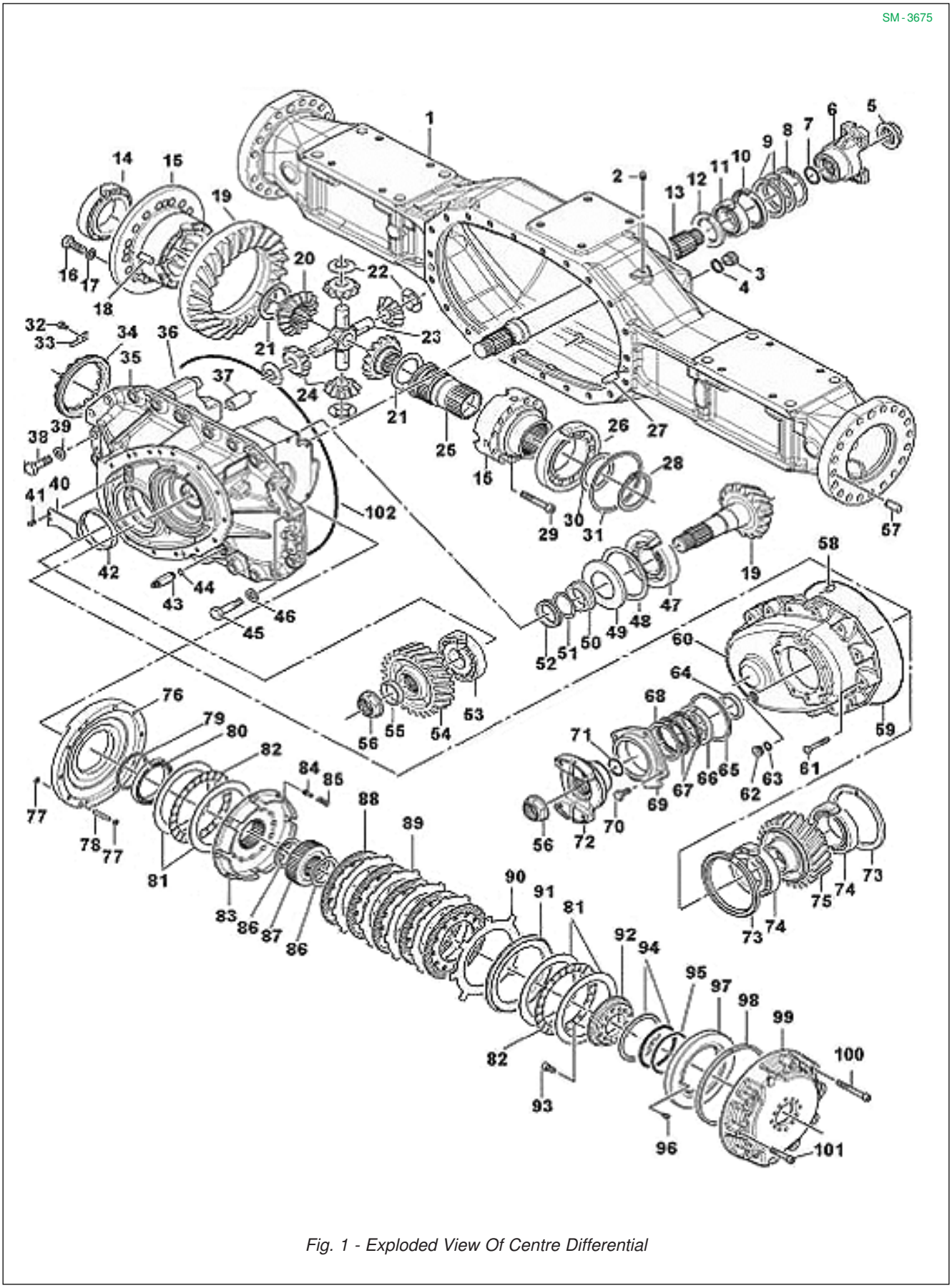


Fig. 1 - Exploded View Of Centre Differential

LEGEND FOR FIGURE 1

1 - Banjo / Axle housing
2 - Breather
3 - Plug
4 - Seal Ring
5 - Nut
6 - Flange
7 - O-ring
8 - Ring
9 - Seal
10 - Radial Seal
11 - Cylinder Roller Brg
12 - Radial Seal
13 - Through Shaft
14 - Ball Bearing
15 - Diff Housing Assembly
16 - Bolt
17 - Washer
18 - Dowel Pin
19 - Crown Wheel/ Pinion
20 - Side Gear
21 - Shim
22 - Thrust Washer
23 - Cross Shaft
24 - Pinion Gear
25 - Clutch Sleeve
26 - Roller Bearing
27 - Dowel Pin
28 - Snap Ring
29 - Screw
30 - Washer
31 - Shim
32 - Bolt
33 - Locking Plate
34 - Nut
35 - Differential Housing
36 - Bearing Cap
37 - Bushing
38 - Bolt
39 - Washer
40 - Baffle Plate
41 - Bolt
42 - Bushing
43 - Stud
44 - Seal Ring
45 - Bolt
46 - Washer
47 - Ball Bearing
48 - Adjusting Washer
49 - Cover
50 - Bushing
51 - Adjusting Washer
52 - Bushing
53 - Ball Bearing
54 - Spur Gear
55 - Intermediate Ring
56 - Nut
57 - Dowel Pin
58 - Dowel Pin
59 - O-ring
60 - Countershaft case
61 - Bolt
62 - Screw
63 - Seal Ring
64 - Centering Ring
65 - Disc
66 - Radial Seal
67 - Seal
68 - Washer
69 - Cover
70 - Bolt
71 - O-ring
72 - Flange
73 - Radial Seal
74 - Ball Bearing
75 - Gear
76 - Flange
77 - Seal
78 - Bushing
79 - Ball Bearing
80 - Grooved Ball Bearing
81 - Disc
82 - Axial Needle Bearing
83 - Carrier
84 - Screw
85 - Compression Ring
86 - Disc
87 - Carrier
88 - Lining Disc
89 - Disc
90 - Disc
91 - Disc
92 - Piston
93 - Cap Screw
94 - Glyd Ring
95 - O-ring
96 - Cap Screw
97 - Piston
98 - Rod Seal
99 - Flange
100 - Cap Screw
101 - Cap Screw
102 - O-ring

case assembly.

3. Remove the bolts (70) and the cover (69). As necessary remove the washer (68), seal (67), radial seal (66), disc (65) and centering ring (64) from the assembled unit.

4. Using suitable lifting equipment, remove the complete differential assembly from the axle housing (1).

5. Index mark the bearing cap (36) and the differential housing (35). Remove the bushing (37), and bolts from the bearing cap (36).

6. Remove the disc lock assembly, items 77 to 100 inclusive from the end of the differential housing (15).

6. Remove the tapered bearing (74), seal (73) and spur gear (75) from the assembly.

7. Remove the bolt (32) and locking plate (33) from the nut (34).

8. Remove the differential assembly from the differential housing (35).

9. Remove the snap ring (28) from the differential assembly.

10. Remove the shim (31), washer (30) and bearing (26) from the housing (15).

11. Similarly, remove the bearing (14) from the opposite end of the housing (15).

12. Remove the bolts (16) and washers (17) . Now separate both halves of the housing (15) to allow for disassembly of the gears.

13. Remove the clutch sleeve (25) from the housing (15), this should allow removal of the washer (21).

14. Fully disassemble the pinion and side gears (24 and 20) from the cross shaft (23).

15. The crown wheel (19) should be removed from the housing (15), along with the adjusting washer (21).

16. If not already done so, remove the nut (56) to allow the pinion (19) and elements to be removed from the differential housing (35). All components should be retained for inspection/replacement where necessary.

17. Through shaft (13) can be removed from the axle housing (1), along with all other elements.

INSPECTION

The importance of careful and thorough inspection cannot be overstressed. Thorough inspection, and necessary replacement of parts now, may eliminate costly and avoidable trouble later.

1. Clean all parts in petroleum base solvent.

2. Immediately after cleaning, dry all parts, except bearings, with compressed air, or with a soft, clean lint free wiping cloth. Compressed air has a corrosive effect on bearings, therefore, they must be wiped dry with a cloth.

3. Coat cleaned, dried parts immediately with light oil to prevent corrosion. If parts are not to be assembled immediately, treat them with a good rust preventive and wrap them with treated paper or other suitable material designed to prevent corrosion.

4. Before installing the differential assembly to the machine, clean the inside and outside of the axle housing to remove any foreign material.

5. Inspect all gears, pinions, and splines for cracked or broken teeth, excessive wear, and pitted or scored surfaces. Repair or replace as necessary.

Note: If either ring gear or pinion gear is defective, both gears must be replaced, because they are serviced only as a matched set. Make sure the ring gear and pinion gear have the same mating numbers.

6. Check for pitted, scored or worn thrust surfaces of differential case halves.

ASSEMBLY

Numbers in parentheses refer to Figure 1 unless specified otherwise.

Note: Tighten all fasteners without special torques specified to torques listed in Section 300-0080, Axle Bolt and Nut Torque Specifications.

Note: During assembly and installation, make sure that mated, punch marked, or otherwise identified parts are returned to their original positions, if still serviceable.

1. Secure the differential housing (35) on a suitable table. Refer to Figure 2.

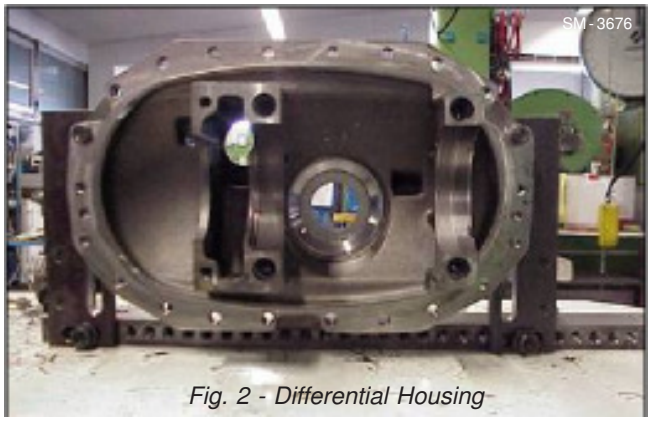
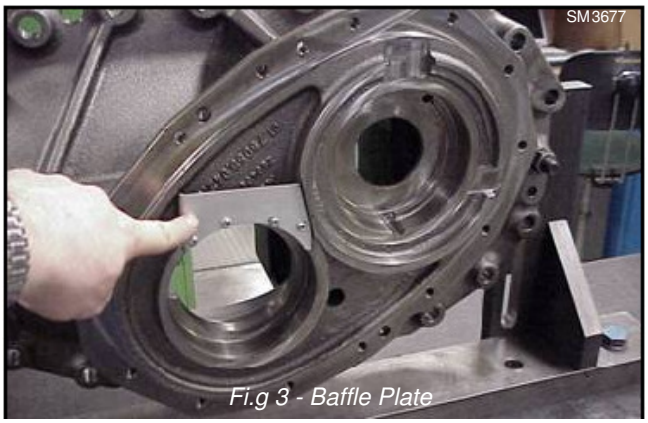


Fig. 2 - Differential Housing

2. Assemble the baffle plate (40) to the differential housing (35). Refer to Figure 3.



Fi.g 3 - Baffle Plate

3. Secure the bushing (42) in place using 15503090 or a suitable driver tool.

Note: Rivets are provided for locking the position. Refer to Figure 4.

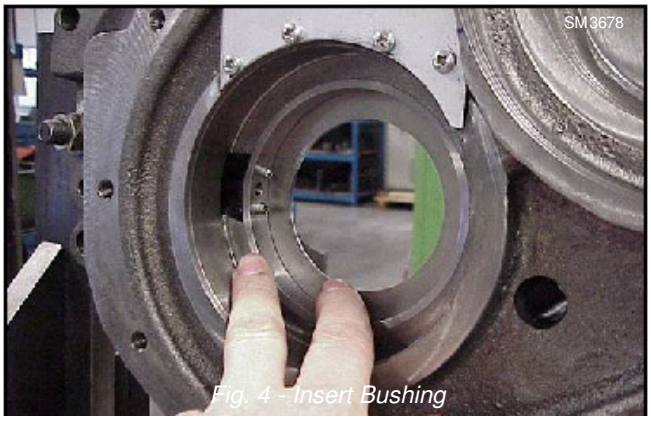


Fig. 4 - Insert Bushing

Selection of adjusting washer for pinion contact pattern.

4. To determine the correct thickness of adjusting washer (48) to be used to attain the correct pinion (19) gear backlash, the following measurements must be made. Refer to Figures 5 and 6.

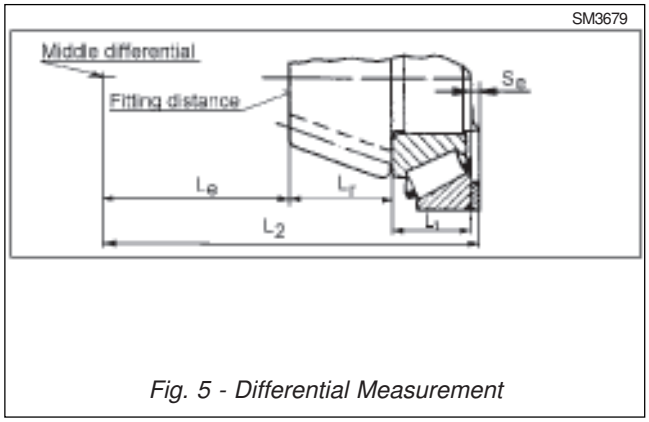


Fig. 5 - Differential Measurement

Se = L2 - Le - Lr - L1

where,

Se = Adjusting washer (48)

L2 = Given distance between bearing (47) seat and middle of differential housing (35).

Le = Fitting distance (engraved on pinion [19] face)

Lr = Recorded measurement of pinion gear (19) head height

L1 = Recorded measurement of the actual thickness of the new bearing (47).

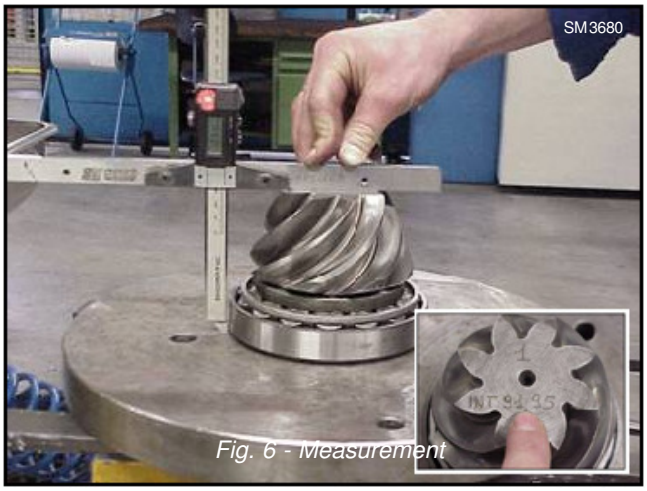


Fig. 6 - Measurement

Pinion bearing assembly and washer selection

5. Assemble the pinion (19) and put it in the measuring device to determine the thickness of the adjusting washer (48). On the pinion head surface, the distance from the middle of the differential cage to the pinion head is engraved. Refer to Figures 6 and 7.

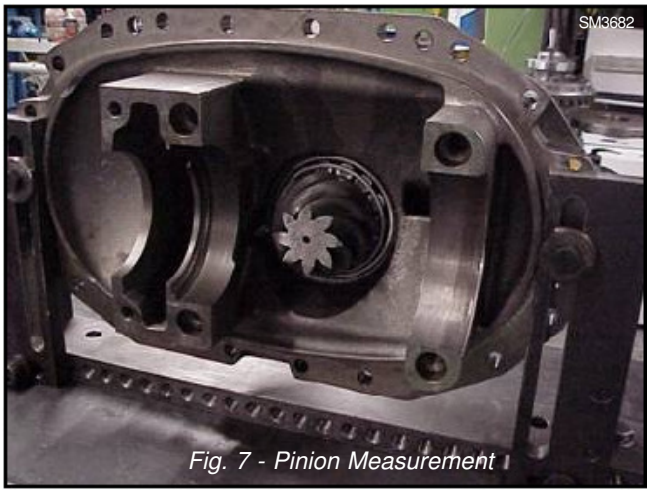


Fig. 7 - Pinion Measurement

6. Insert the selected adjusting washer (48) with its chamfered side (colour marked) down against the housing (35). Ensure that it is flat in the bore. Refer to Figure 8.

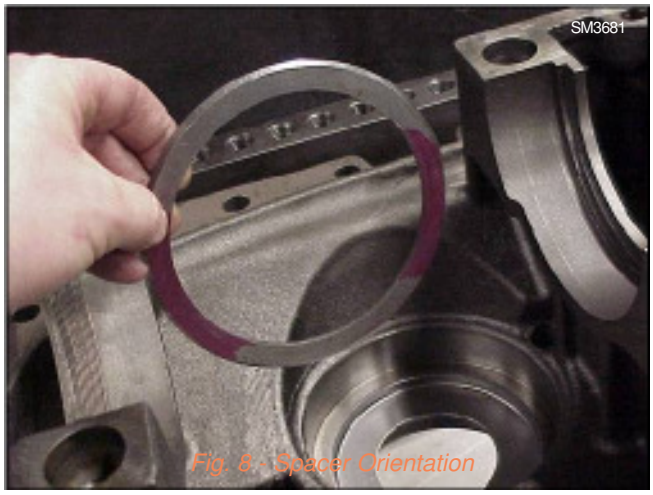


Fig. 8 - Spacer Orientation

7. Assemble the pinion bearing (19) and its constituent elements to allow the bearing preload to be adjusted.

8. The preload should be 0.5-6 Nm without oil seal . Try various washers till a suitable size is found to achieve a preload value in the given range.

9. Loosen pinion nut (56) to remove preload. This is necessary for later adjustment of the crown wheel bearing preload.

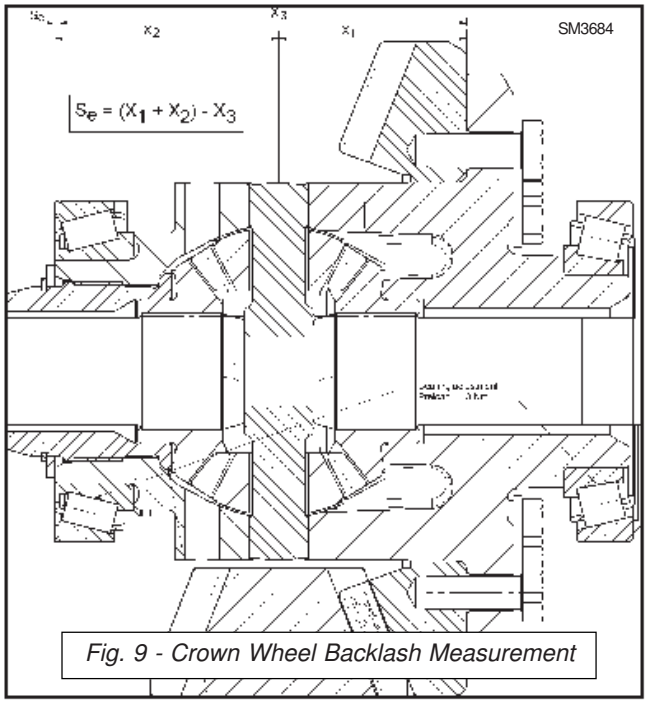


Fig. 9 - Crown Wheel Backlash Measurement

Selection of Adjusting Washer for Crown Wheel Backlash.

10. The following measurement should be made:

Se = (X1 + X2) - X3

where;

Se = Adjusting washer

X1 = Fitting distance on crown wheel

X2 = Given distance of housing (105 mm)

X3 = Actual distance measured

11. Determine adjusting washer (21) thickness for correct gear backlash. The required backlash should be in the range of 0.15 - 0.25 mm.

Fig. 10 - Fitting Distance

12. Fitting distance 'X1' is engraved on the crown wheel (19). Measure actual distance 'X3' Refer to Figures 9, 10 and 13.

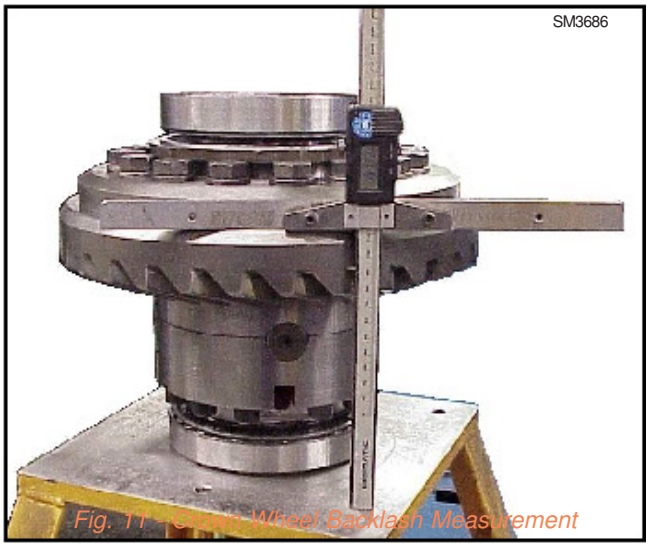


Fig. 11 - Crown Wheel Backlash Measurement

13. Using 15503093 or suitable lifting equipment , lift the differential housing assembly (15) complete with the bearing (26) and adjusting washer (21).

14. Lift the assembly into the differential housing (35). Refer to Figure 12.

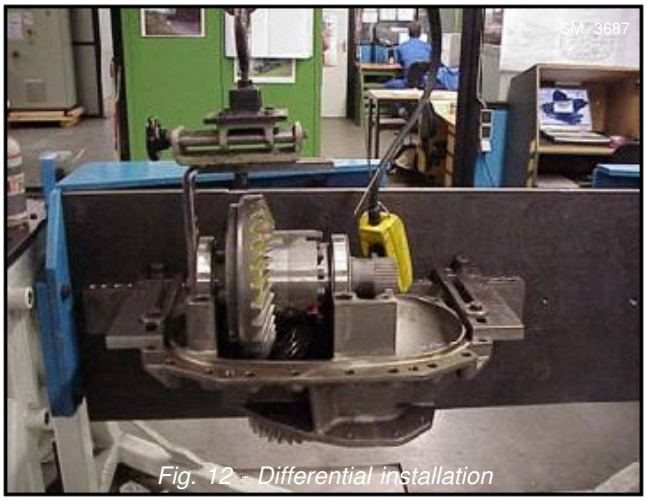


Fig. 12 - Differential installation

15. Assemble both half shells and adjust the bearing preload. Refer to Figure 13.

Fig. 13 - Assembly of half shells

16. Check bearing preload. Preload should be 1 - 3Nm. Refer to Figure 14.

Fig. 14 - Bearing Preload Check

17. Using a suitable dial gauge indicator, inspect gear backlash and contact pattern. Backlash should be 0.15 - 0.25 mm. Refer to Figures 15 and 16.

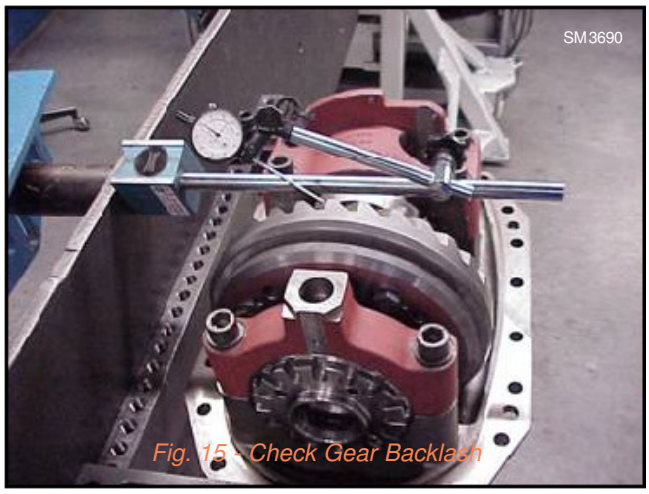


Fig. 15 - Check Gear Backlash

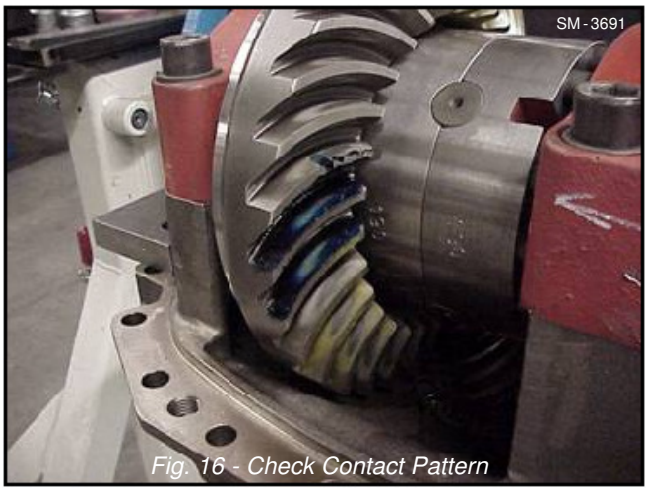


Fig. 16 - Check Contact Pattern

The following should be used as a guide for the correct gear contact. In each case, follow the recommended guidelines.

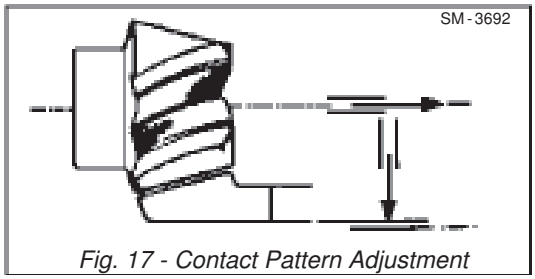


Fig. 17 - Contact Pattern Adjustment

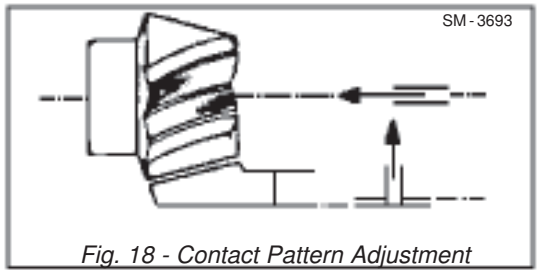


Fig. 18 - Contact Pattern Adjustment

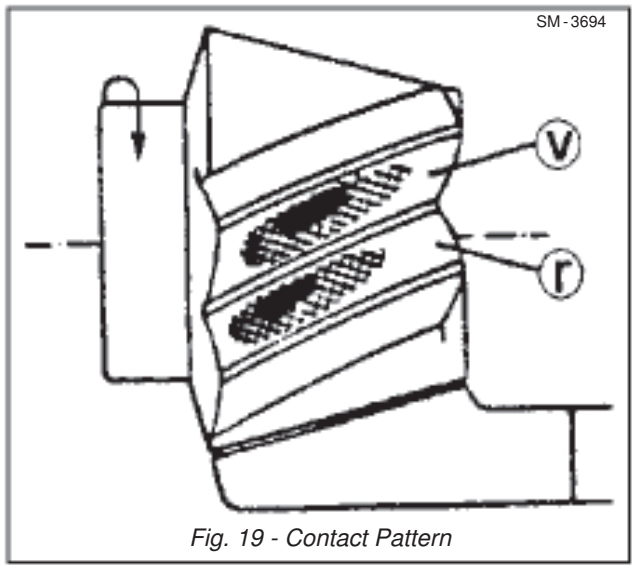


Fig. 19 - Contact Pattern

Spur Gear Assembly

18. Assemble the oil seal (55), the spur gear (54) and the tapered roller bearing (53). Refer to Figure 20.

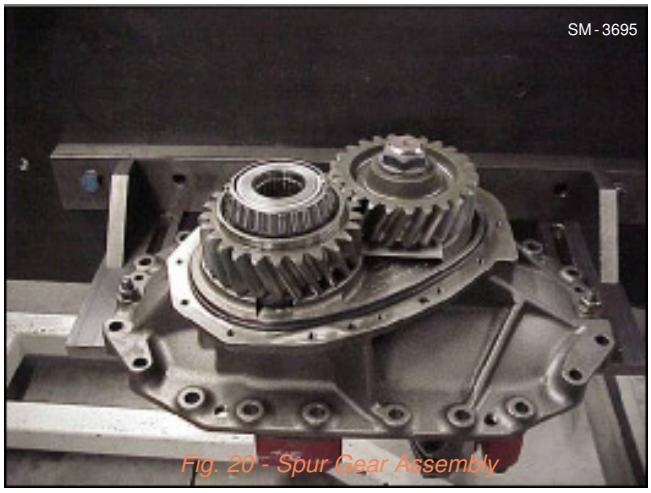


Fig. 20 - Spur Gear Assembly

19. Clean the threads and coat them with Loctite™ 262. Tighten the nut (56), within 5 minutes of applying the Loctite™262.

20. Mount the housing cover (69) [Figure 21].

Fig. 21 - Housing Cover Assembly

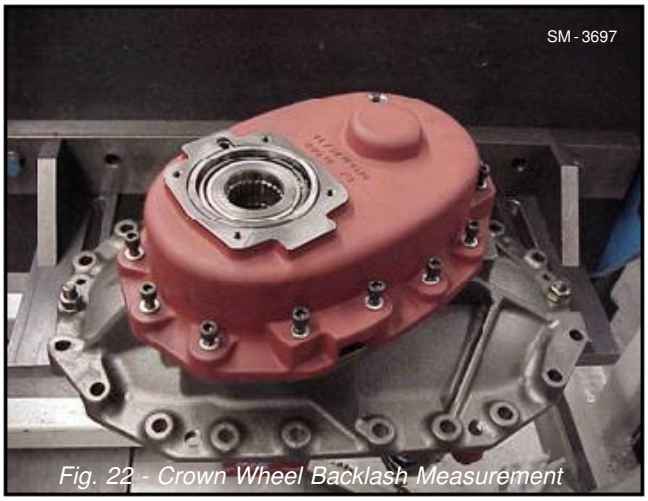


Fig. 22 - Crown Wheel Backlash Measurement

21 Tighten the screws (70), then adjust the axial gap for the tapered roller bearing (74 [outer]). Refer to Fig. 22.

Selection of Adjusting Washer for Axial Gap

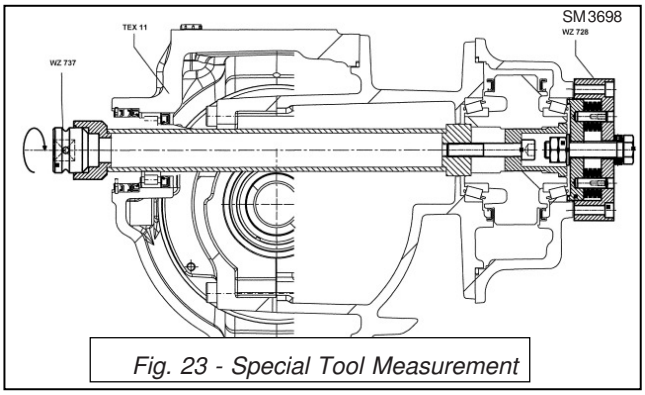


Fig. 23 - Special Tool Measurement

22. Install tool 15503094 to turn the bearing. Then install tool 1503095 and press the tapered roller bearing race until it seats firmly on the bearing. Refer to Figure 23.

23. Measure to determine the thickness of adjusting washer.

24. Insert an adjusting washer of a suitable thickness (48) and mount the top cover (69) and oil seals (66 and 67). Refer to Figure 24.

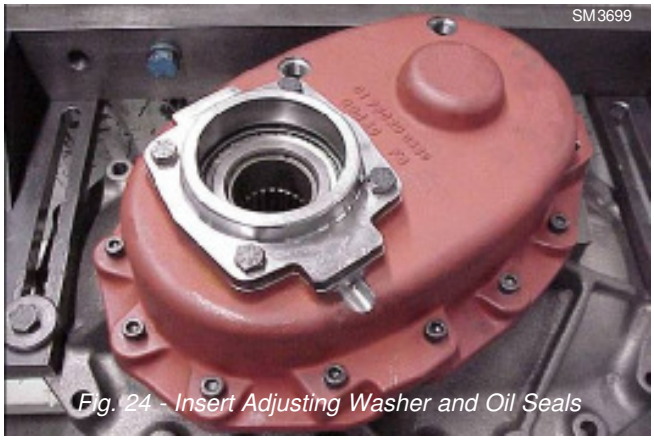


Fig. 24 - Insert Adjusting Washer and Oil Seals

25. Turn the differential assembly over to allow the through shaft (13) to be inserted.

Multiplate Disc Lock Assembly

26. Assemble the elements of the disc assembly, items 77 to 100 inclusive.

27. Using 15503093 or suitable lifting device, lift the assembly and slide it on to the differential shaft(13). Refer to Figure 25.

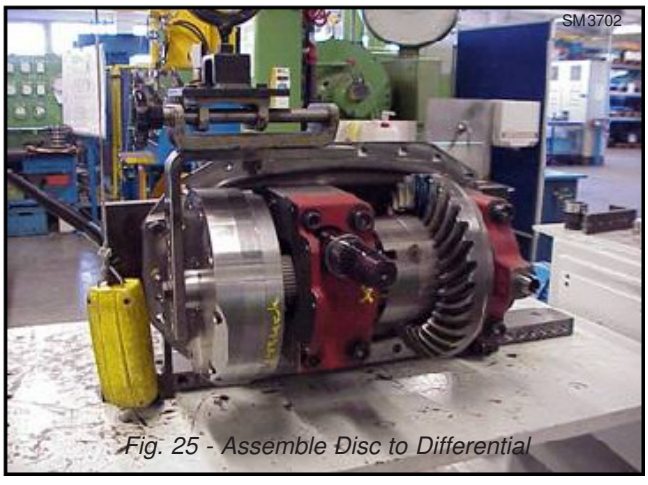


Fig. 25 - Assemble Disc to Differential

28. Taking the axle housing (1), using a suitable fixture, secure the axle in place. Refer to Figure 26.

Differential Assembly to Axle Housing

29. Take axle housing (1) and position it to allow for the final assembly stages.

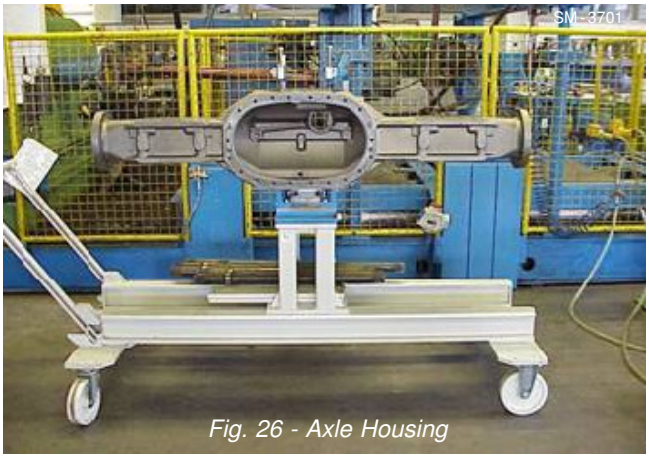


Fig. 26 - Axle Housing

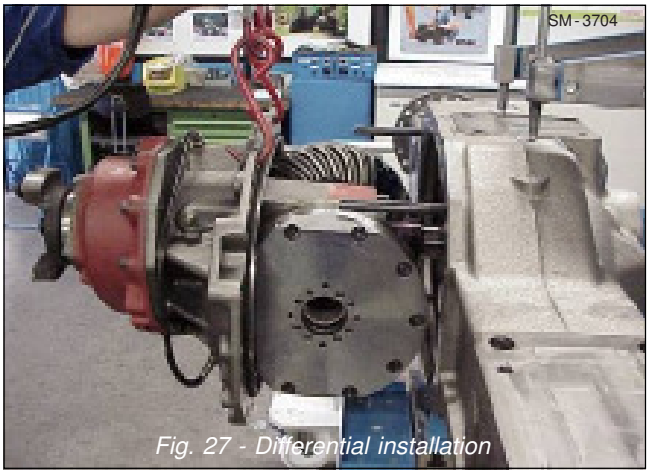


Fig. 27 - Differential installation

30. Mount the complete pre-assembled differential using the lifting device, 15503096, or using a suitable tool, into the axle housing (1). Refer to Figure 27.

31. The unit must be evenly pulled on to the two dowel pins (27) and one shear sleeve using threaded bolts and nuts.

MAINTENANCE

Proper lubrication of the differential assembly is essential if the differentials are to deliver the service intended. Section 300-0020, LUBRICATION SYSTEM gives full information on the proper lubrication intervals and the lubricant which should be used.

SPECIAL TOOLS

The special tools referenced in this section are available from your dealer. Refer to Section 300-0070, Service Tools, for part numbers of general service tools and sealants required.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	PART NAME	TORQUE	
			Nm	lbf ft
1	3	Plug	70	51.6
1	5	Nut	800 (+ Loctite 262)	590 (+ Loctite 262)
1	29	Screw	115	84.8
1	32	Bolt	34	25
1	43	Stud	120	88.5
1	56	Nut	800 (+ Loctite 262)	590 (+ Loctite 262)
1	84	Screw	9.6	7.1
1	93	Screw	46	34.0
1	96	Screw	9.6	7.1
1	100	Screw	67	49.4
1	101	Screw	67	49.4

DIFFERENTIAL DIAGNOSIS

Noises and vibrations originating in the tyres, transmission, planetaries and drivelines are easily transmitted and may be erroneously attributed to the differential. Therefore, all possible sources of noise should be investigated before the differential is taken apart.

Whenever noises such as a grating or rattle are heard coming from the differential, stop the unit immediately. One tooth from a gear can cause damage to all gears and bearings. When the differential is definitely at fault, remove the axle shafts and disconnect the driveline before moving the vehicle.

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

⚠ WARNING
Removing the axle shafts or drivelines will make the parking brake ineffective.

DIAGNOSIS CHART

CONDITION	REASON	REMEDY
Vibration	Broken gear teeth, worn bearings	Replace gear or bearings
Continual noise	Worn gear or bearings	Replace gear or bearings
Noise on drive	Ring or pinion gear adjustment tight	Adjust
Noise on coast	Bearings damaged	Replace bearings
	Ring and pinion gear adjustment loose	Adjust
	Excessive pinion gear end play	Adjust
Noise on turns	Normal limited slip differential operation	Use an EP oil with limited slip additives. Refer to Section 300-0020, Lubrication System
	Worn pinion gears or side gears	Replace gears
	Worn or damaged axles (spiders)	Replace axles (spiders)
Loss of lubricant	Oil seals worn	Replace seals
	Loose nuts or bolts	Tighten nuts or bolts to correct torque
	Cracked housing/case	Repair or replace housing/case

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DESCRIPTION

The differential assembly is mounted to the axle housing. It comprises of a differential for the normal cross-axle drive function.

REMOVAL AND INSTALLATION

Numbers in parentheses refer to Fig. 1 unless otherwise stated..

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

1. Position the vehicle in a level work area, raise the body and install the body safety prop to secure the body in the partially raised position.

2. Apply the parking brake and switch off the engine.

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

4. Drain the gear oil out of the axle housing and both planetaries into a suitable container from the oil drain plug (23)on the differential.

5. Remove the planetary assemblies and axle shafts from the axle housing. Note from which side the long and short axle shafts are removed. Refer to Section 160-0030, AXLE GROUP (HUB).

6. Identify the relationship of the driveline flanges and differential flanges (44) with punch marks.

7. Disconnect the drivelines from the differential flanges . The drivelines can be removed if it is convenient to do so.

8. Remove bolts (21 & 22) securing differential housing (19) assembly to the axle housing.

9. Thread in three puller bolts to break the seal between the differential and axle housing and pull the differential assembly out of the axle housing. Carefully remove differential housing (19) assembly clear of axle housing.

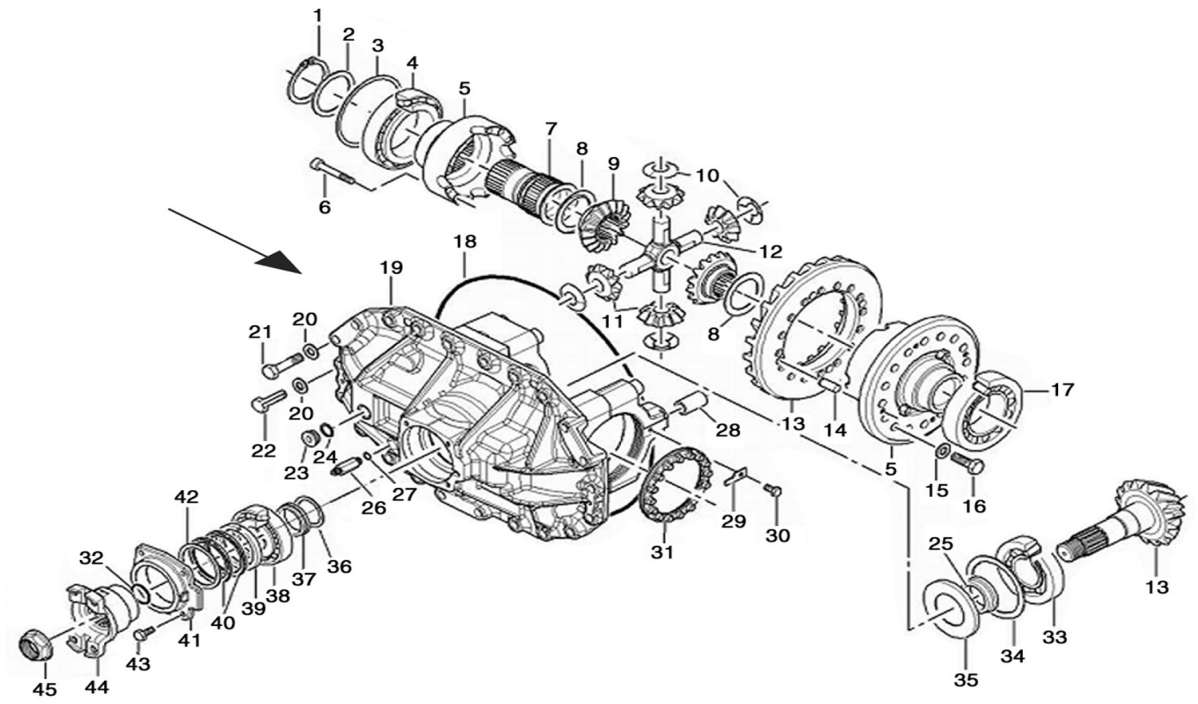
INSTALLATION

is the reversal of the 'Removal' procedure.

Note: Use sealing compound between the axle housing and differential housing mounting faces.

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

Add gear oil of the type specified in Section 300-0020, LUBRICATION SYSTEM, through the oil fill level hole, until the oil is level with the bottom of the filler/level hole. Fit Plug (23) and o-ring (20). Fill the planetary assemblies up to the 'Oil Level Check Line'.



1 - Snap Ring
2 - Washer
3 - Shim
4 - Bearing
5 - Housing
6 - Screw
7 - Clutch Sleeve
8 - Shim
9 - Side Gear
10 - Thrust Washer
11 - Pinion Gear
12 - Shaft
13 - Crown Wheel
14 - Dowel Pin
15 - Washer
16 - Bolt
17 - Ball Bearing
18 - O-ring
19 - Differential Housing
20 - Washer
21 - Bolt
22 - Bolt
23 - Seal Screw
24 - Seal Ring
25 - Bushing
26 - Stud
27 - Seal Ring
28 - Bushing
29 - Locking Plate
30 - Bolt
31 - Nut
32 - O-ring
33 - Ball Bearing
34 - Adjusting Washer
35 - Cover
36 - Adjusting Washer
37 - Bushing
38 - Ball Bearing
39 - Radial Seal
40 - Seal
41 - Cover
42 - Washer
43 - Bolt
44 - Flange
45 - Nut

Fig. 1 - Exploded View Of Front / Rear Differential

DISASSEMBLY

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

Note: Procedure for disassembly is largely the same as that for the centre differential. If required refer to section 150-0020 DIFFERENTIAL DRIVE HEAD for additional information.

Note: Arrow Fig. 1 shows location of Multi lock assembly.

1. Remove bolt (30) and locking pin (29).

2. Index mark bearing cap, and differential housing (19). Remove bushing (28), and bolts from the bearing cap.

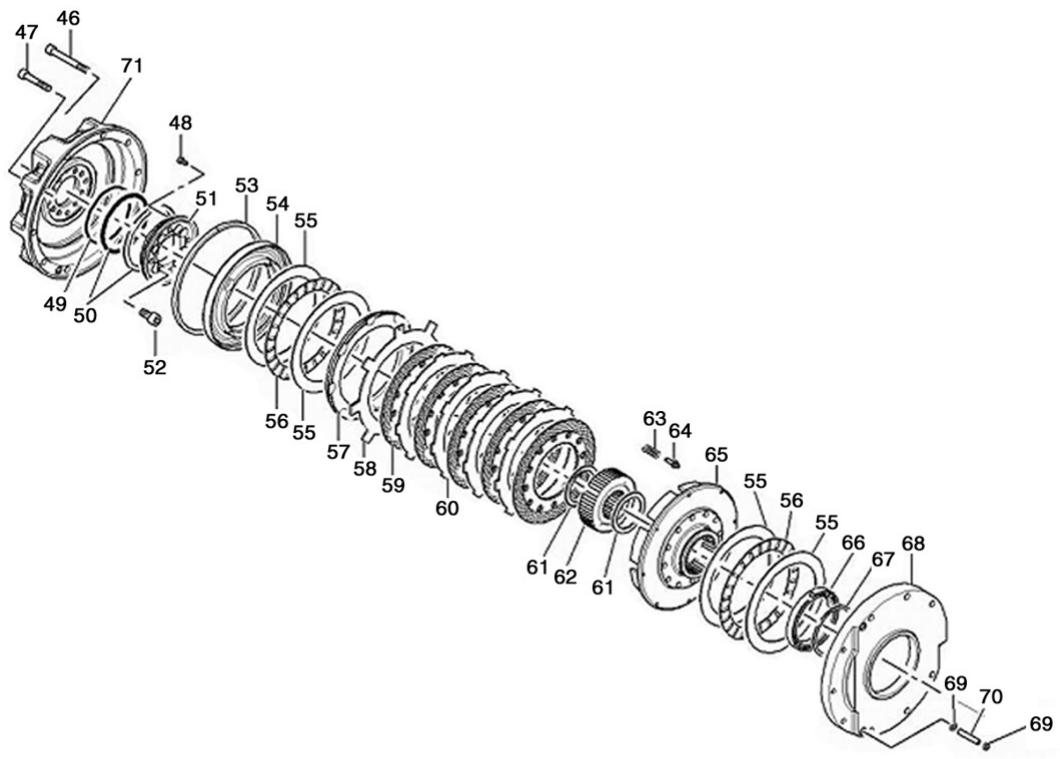
3. Remove disc lock assembly (Fig. 2) items 46 to 71 inclusive from the end of diff housing (19).

4. Remove nut (45) flange (44) and cover (41).

5. Remove Pinion gear (13) and constituent elements from the assembly.

6. If necessary, disassemble the differential assembly as follows.

7. Remove Snap ring (1), washer (2), shim (3) and



46 - Screw
47 - Screw
48 - Screw
49 - O-ring
50 - Glyd Ring
51 - Piston
52 - Screw
53 - Seal ring
54 - Piston
55 - Washer
56 - Thrust needle Cage
57 - Thrust Washer
58 - Disc
59 - Inner Disc
60 - Disc
61 - Washer
62 - Carrier
63 - Compression Spring
64 - Screw
65 - Disc Carrier
66 - Ball Bearing
67 - Snap Ring
68 - Flange
69 - Seal
70 - Bushing
71 - Flange

Fig. 1 - Exploded View Of Multi-Disc Lock Assembly (All Axles)

bearing (4) from the housing (5).

8. Remove bearing (17) from housing (5).
9. Remove bolt (16) washers (15) which secures Housing (5) and crown wheel (13).

10. Remove screws (6) securing both housings (5).
11. Separate housings (5) to allow for removal of pinion/ side gear assembly.

12. Remove remaining elements of assembly for inspection.

INSPECTION

The importance of careful and thorough inspection cannot be over stressed. Thorough inspection and necessary replacement of parts now may eliminate costly and avoidable trouble later.

1. Clean all parts in petroleum base solvent.

2. Immediately after cleaning, dry all parts, except bearings, with compressed air, or with a soft, clean lint free wiping cloth. Compressed air has a corrosive effect on bearings, therefore, they must be wiped dry with a cloth.

3. Coat cleaned, dried parts immediately with light oil to prevent corrosion. If parts are not to be assembled immediately, treat them with a good rust preventive and wrap them with treated paper or other suitable material designed to prevent corrosion.

4. Before installing the differential assembly to the machine, clean the inside and outside of the axle

ASSEMBLY

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

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

Note: During assembly and installation, make sure that mated, punch marked, or otherwise identified parts are returned to their original positions, if still serviceable.

Assembly is the main is the reverse of disassembly. For specific measurements and steps required for shim selection. Refer to Section 150-0020 DIFFERENTIAL DRIVE HEAD.

MAINTENANCE

Proper lubrication of the differential assembly is essential if the differentials are to deliver the service intended. Section 300-0020, LUBRICATION SYSTEM gives full information on the proper lubrication intervals and the lubricant which should be used.

SPECIAL TOOLS

The special tools referenced in this section are available from your dealer. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools and sealants required. Housing to remove any foreign material.

5. Inspect all gears, pinions, and splines for cracked or broken teeth, excessive wear, and pitted or scored surfaces. Repair or replace as necessary.

Note: If either ring gear or pinion gear is defective, both gears must be replaced, because they are serviced only as a matched set. Make sure the ring gear and pinion gear have the same mating numbers.

6. Check for pitted, scored or worn thrust surfaces of differential case halves.

DIFFERENTIAL DIAGNOSIS

Noises and vibrations originating in the tyres, transmission, planetaries and drivelines are easily transmitted and may be erroneously attributed to the differential. Therefore, all possible sources of noise should be investigated before the differential is taken apart.

Whenever noises such as a grating or rattle are heard coming from the differential, stop the unit immediately. One tooth from a gear can cause damage to all gears and bearings. When the differential is definitely at fault, remove the axle shafts and disconnect the driveline before moving the vehicle.

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

⚠ WARNING
Removing the axle shafts or drivelines will make the parking brake ineffective.

DIAGNOSIS CHART		
CONDITION	REASON	REMEDY
Vibration	Broken gear teeth, worn bearings	Replace gear or bearings
Continual noise	Worn gear or bearings	Replace gear or bearings
Noise on drive	Ring or pinion gear adjustment tight	Adjust
Noise on coast	Bearings damaged	Replace bearings
	Ring and pinion gear adjustment loose	Adjust
	Excessive pinion gear end play	Adjust
Noise on turns	Normal limited slip differential operation	Use an EP oil with limited slip additives. Refer to Section 300-0020, LUBRICATION SYSTEM
	Worn pinion gears or side gears Worn or damaged axles (spiders)	Replace gears Replace axles (spiders)
Loss of lubricant	Oil seals worn	Replace seals
	Loose nuts or bolts	Tighten nuts or bolts to correct torque
	Cracked housing/case	Repair or replace housing/case

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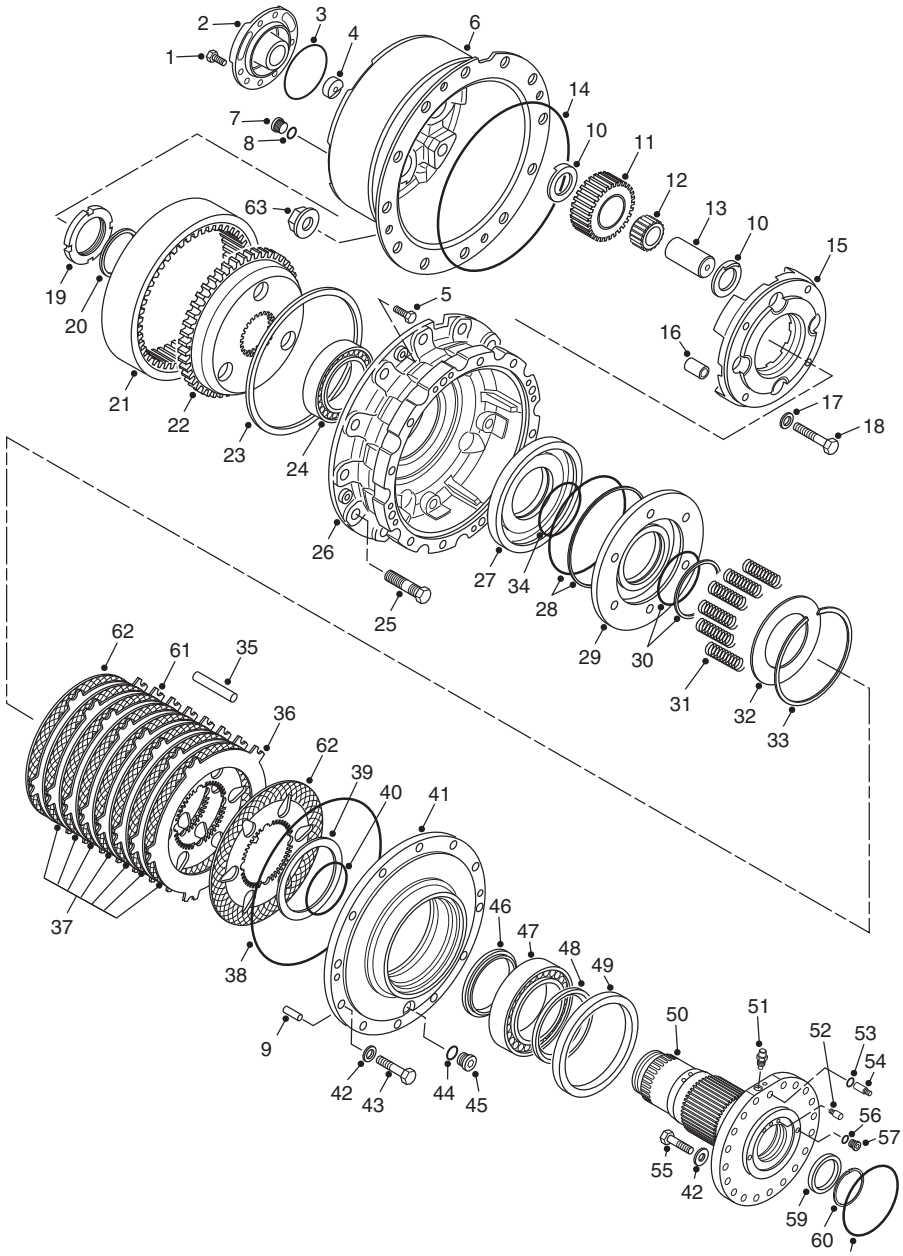

1 - Capscrew
2 - Cover
3 - O-ring
4 - Pin
5 - Bolt
6 - Planet Carrier
7 - Plug
8 - Seal ring
9 - Dowel Pin
10 - Washer
11 - Planet Gear
12 - Caged Needle Brg
13 - Planet Pin
14 - O-ring
15 - Planet Carrier
16 - Shear Pin
17 - Washer
18 - Bolt
19 - Slotted Nut
20 - Shim
21 - Ring Gear
22 - Ring Gear Carrier
23 - Snap Ring
24 - Roller Brg
25 - Wheel Bolt
26 - Wheel Hub
27 - Cylinder
28 - Seal rings
29 - Piston
30 - Seal rings
31 - Pressure Spring
32 - Thrust Washer
33 - Snap Ring
34 - O-ring
35 - Pin
36 - Steel Disc
37 - Inner Disc
38 - O-ring
39 - Radial Seal
40 - O-ring
41 - Wheel Hub
42 - Washer
43 - Bolt
44 - Seal ring
45 - Drain Plug
46 - Intermediate ring
47 - Roller Brg
48- Spindle
49- Seal
50- Hub Carrier
51- Breather
52- Breather
53- Seal ring
54- Threaded Stud
55- Bolt
56- Seal ring
57- Plug
58- O-ring
59- Seal ring
60- Snap ring
61- Steel Disc
62 - Inner Disc
63- Wheel Nut

Fig. 1 - Exploded View of Planetary and Wheel

OPERATION

Numbers and letters in parentheses refer to Fig. 1.

Power from the differential is transmitted through a fully floating axle sun gear shaft . As sun gear shaft rotates in a clockwise direction, 4-off planet gears (11) meshed with sun gear shaft rotate anticlockwise. Ring gear (21) is splined to hub carrier (50) and does not rotate but causes planet gears (11), which are meshed with ring gear (21), to move around it in a clockwise direction. As planet carrier (6) is bolted to wheel hub (26) the wheel then rotates in a clockwise direction.

REMOVAL AND DISASSEMBLY

Numbers in parentheses refer to Fig. 1**.**
Note: On dismantling, clean all parts in paraffin or suitable cleaner, place on a clean work surface.

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

⚠ To prevent personal injury and property damage, the procedure for removing tyre and rim assembly described in Section 160-0050, WHEEL, RIM AND TYRE, must be strictly followed.

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

1. Before attempting to remove the road wheels, drive the vehicle onto a level, solid concrete floor, preferably after a short run to warm the oil.

2. Apply the parking brake and switch off the engine.

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

4. Whilst road wheels are still on the ground, loosen wheel nuts (64).

5. Jack up the axle and support with suitably placed stands or timbers.

6. Support tyre and rim assembly with a suitable sling and lifting device. Remove wheel nuts (64) and remove tyre and rim assembly from the machine. Remove opposite road wheel in the same way.

7. Place suitable containers under the differential and both hubs (26). Remove differential drain plug and drain oil from the differential.

8. Rotate hubs (26) until drain plug (45) is at its lowest point. Remove plug (45) and seal ring (44) and drain oil from hub.

9. Index mark planet carrier (6) and hub (26) to aid in installation.

10. Loosen screws (1) then prise cover (2) from planet carrier (6), removing o-ring (3) and pin (4) in the process.

11. Using a suitable threaded stud locate into threaded centre on the end of sun gear shaft to remove shaft. Refer to Fig. 2

12. Pull shaft from the assembly and remove to a suitable bench area for inspection at a later stage.

13. Using a suitable lifting device, secure to planet carrier (6).

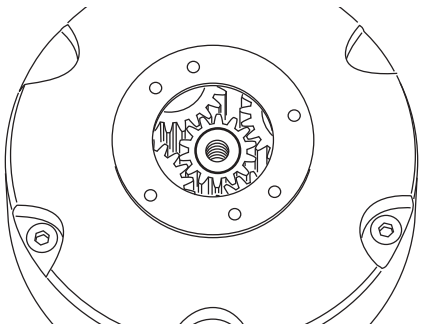

Fig. 2 - Removal of Sun Gear Shaft

14. Remove remaining Bolts (5) from planet carrier (6). Secure carrier and constituent parts i.e. planet gear assembly and remove from the wheel hub assembly.

15. Locate 2-off fabricated tool (Fig. 3) over bolts securing hub carrier (50) to the axle housing 62) and secure into the 2-off locating holes which are capped on the rear face of the wheel hub (41).

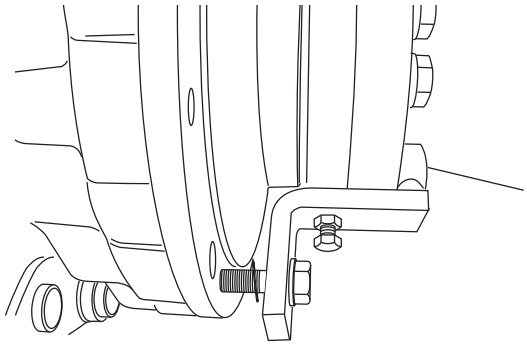

Fig. 3 - Securing Wheel Hub

16. Prior to removal of slotted nut (19) it will be necessary to heat the nut to 200°c to release the loctite bond. Using a special tool (15503031) or suitable powered tool, remove slotted nut (19). Refer to Figures 4 and 5.

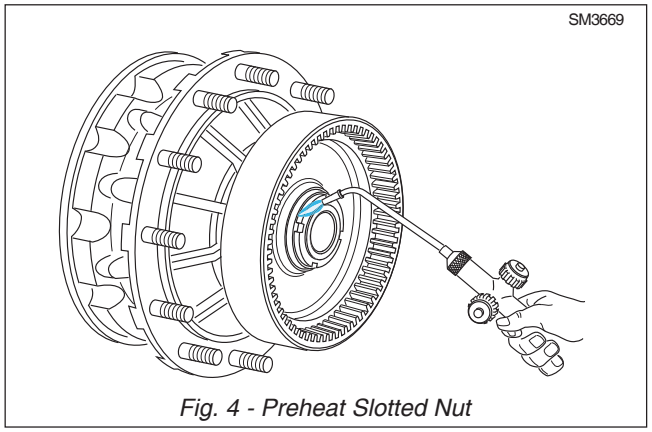

Fig. 4 - Preheat Slotted Nut

17. Locate fabricated tool onto bolts (25) and screw wheel hub (26) away from the wheel hub (41). Refer to Fig. 6. Bearing (24) should come out during this step.

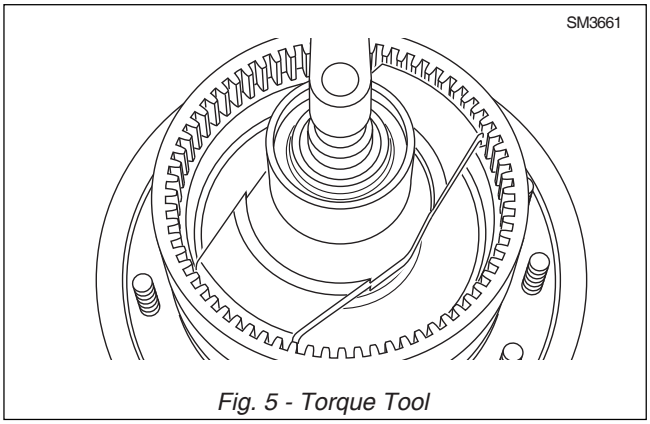

Fig. 5 - Torque Tool

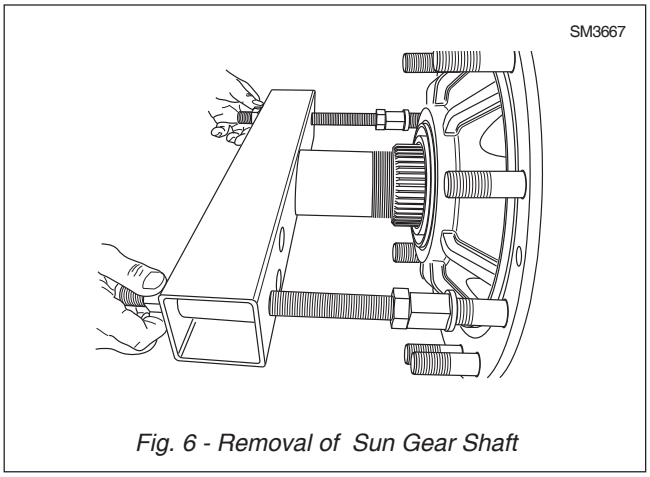

Fig. 6 - Removal of Sun Gear Shaft

18. Cylinder (27), piston (29), seal ring (28), o-ring (34) , seal ring (30), disc springs (31), thrust washers (32) and snap ring (33) ca n now be removed from the assembly.

19. Remove steel discs and inner discs (36 & 37) from the assembly. Pins (35) can also be removed once the discs have been removed.

20. Seal ring (39) should be removed from the bore of the wheel hub (41) as should o-ring (40).

21. Fit locating studs into threaded holes of the axle housing, into the wheel hub (41). This ensures the wheel hub (41) will not drop down , which could damage the valve (shown in yellow). Refer to Fig. 7.

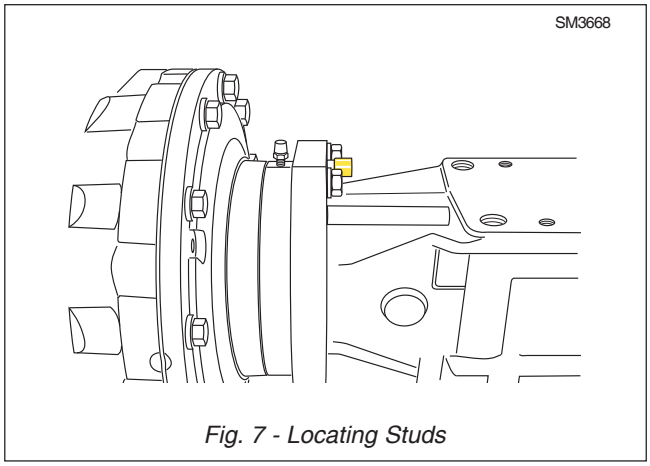

Fig. 7 - Locating Studs

22. Wheel hub (41) can now be removed by removal of fabricated tools which were securing it in place.

23. All other components can now be removed from the assembly. Including Intermediate ring (46)and seal rings (48and49).

24. Bolts (55) securing hub carrier (50) to the axle housing can be removed, along with washers (42).

25. Remove seal ring (59), o-ring (60) and o-ring (61) from the hub carrier (50).

INSPECTION

Numbers in parentheses refer to Fig. 1.

Thoroughly clean all parts with a suitable solvent and dry with compressed air. Inspect all parts for damage or excessive wear and replace where necessary. Inspect thrust washers (32) to make sure they are free of burrs and are absolutely flat. Replace all 'O' rings.

ASSEMBLY AND INSTALLATION

Numbers in parentheses refer to Fig. 1 unless otherwise stated**.**

Note: Tighten all fasteners without special torques specified to standard torques listed in Section 300-0080, AXLE 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.

1. Install brass bushing into bore of Hub carrier (50). Ensure oil groove on the bush is at the bottom of the assembly location i.e. at the opposite end from the flat face which is on the outer diameter of the hub carrier (50). Refer to Fig. 8.
Note: Oil groove on bush is a cross groove.

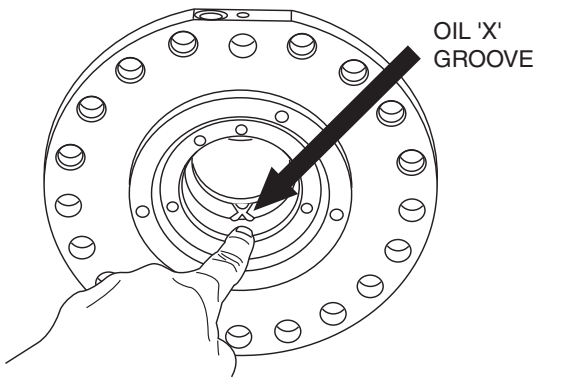

Fig. 8 - Bush / Seal Installation

2. Fit sealring (58 & 59) and o-ring (61). Secure caradan flange(60).

3. Secure hub carrier (50) on a suitable table. Fit NBR seal (49) and spindle ring (48). Ensure each is fully home without causing damage to the components.

Note: Bearing (24) should be preheated, prior to fitting onto the hub carrier (50).

4. Secure roller bearing (47) inner race to the hub carrier (50), again ensure it is fully home. Refer to Fig.9.

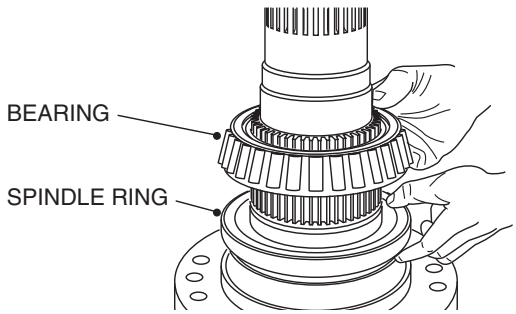

Fig. 9 - Hub Carrier Assembly - Bearing

5. Grease o-ring (40) with a thin layer of grease to aid installation. Fit o-ring (40) on hub carrier (50) as shown in Fig. 10.

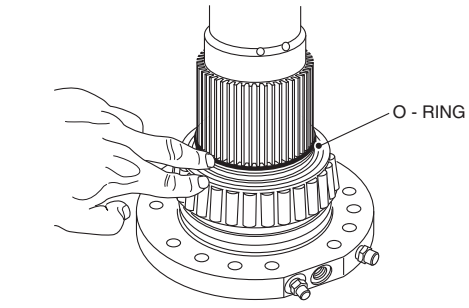

Fig. 10 - Hub Carrier Assembly - O-ring

6. Mount intermediate ring (46) onto carrier (50), using suitable tools, carefully 'punch' ring twice on opposite sides to seat it home onto the carrier. Refer to Fig. 11.

7. Insert bearing (47) outer race into hub (41), use punch tool (15503033). Fit cartridge seal (39) to hub (41) at this stage using punch tool (15503034). Refer to Fig. 12.

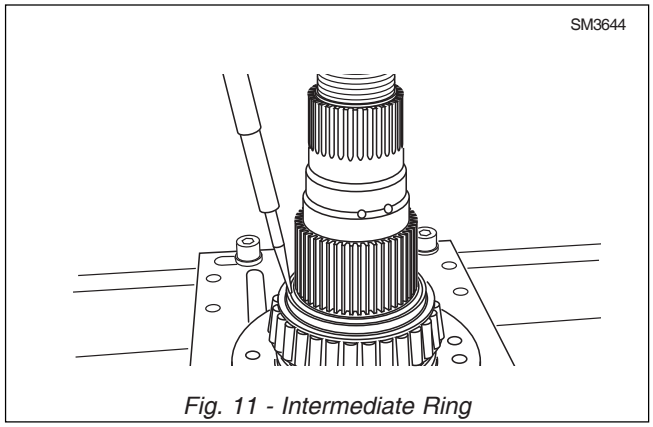

Fig. 11 - Intermediate Ring

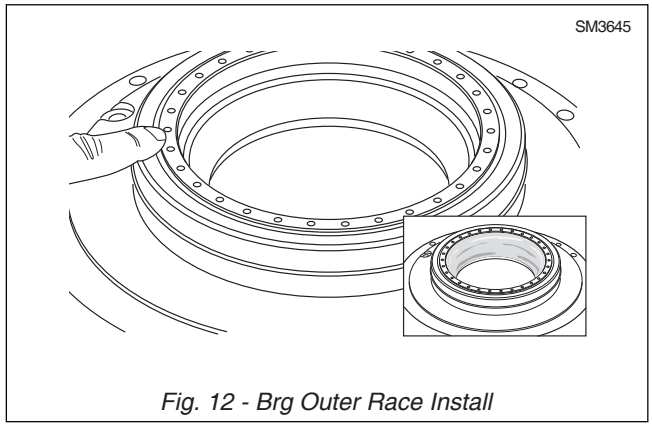

Fig. 12 - Brg Outer Race Install

8. Fill the tapered cavity within wheel hub (41) with grease (SKF LGEP 2/18 spec). Ensure an even film is distributed around the bore.

9. Lower wheel hub (41) onto hub carrier (50) until bearing (47) race seats firmly. **Note:** Observe that the oil seal slides onto intermediate ring without damage to seal. Refer to Fig. 13.

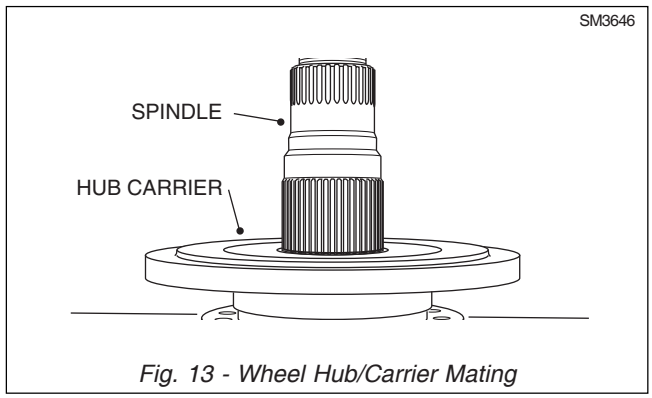

Fig. 13 - Wheel Hub/Carrier Mating

10. Fit o-ring (38) then locate pins (35) and dowel pins (9) into mating holes on the hub carrier (50). Refer to Fig. 14.

11. Clean the steel discs (36 and 61)of oil.

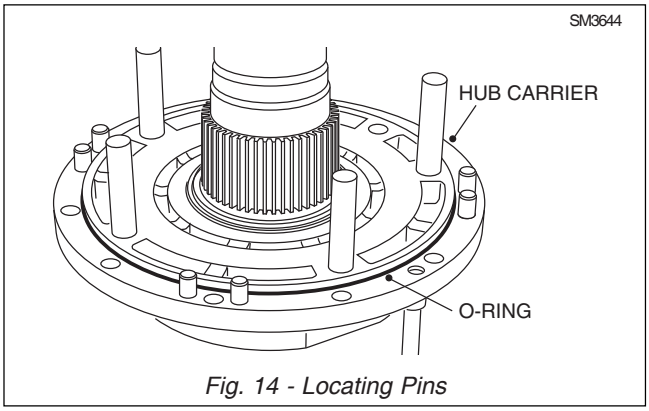

Fig. 14 - Locating Pins

12. Assemble alternately; inner discs (37) with steel discs (36). Ensure that all oil channel holes line up and that one of the oil channels is in the top position. Refer to Fig. 15

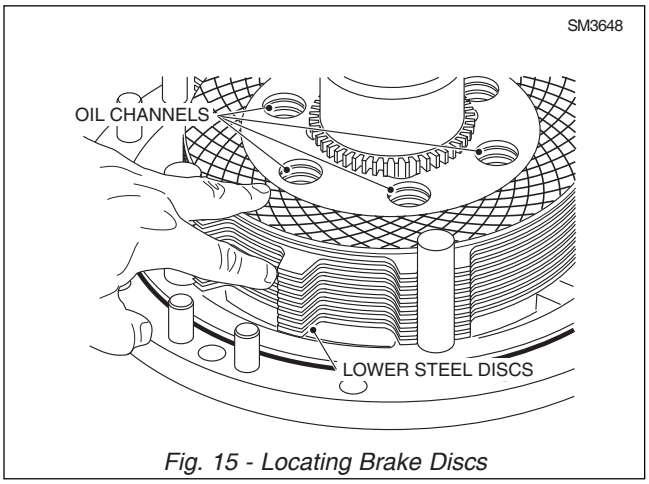

Fig. 15 - Locating Brake Discs

Note: Top steel disc must lie with its measuring tang over the wheel hub opening position. The measuring tang of the lower steel disc must line up with the other position. Refer to Fig. 16.

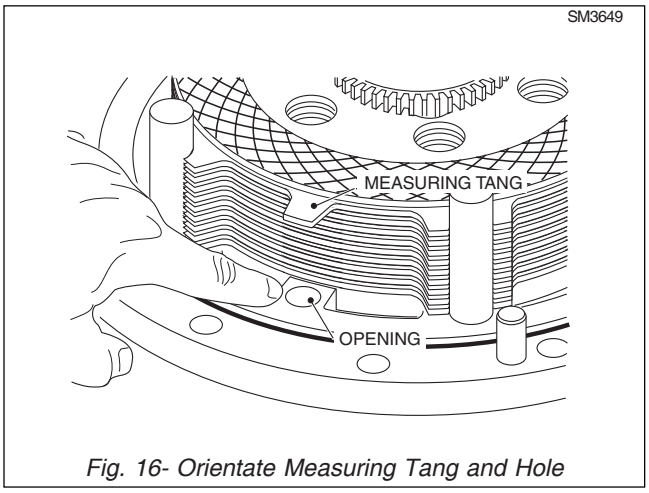

Fig. 16- Orientate Measuring Tang and Hole

13. All inner coated disks must be checked dimensionally. The complete thickness for coating disks in new condition is 5mm. If the coating disks thickness is less than 4.65mm, the disks must be replaced.Refer to Fig. 36 & 37

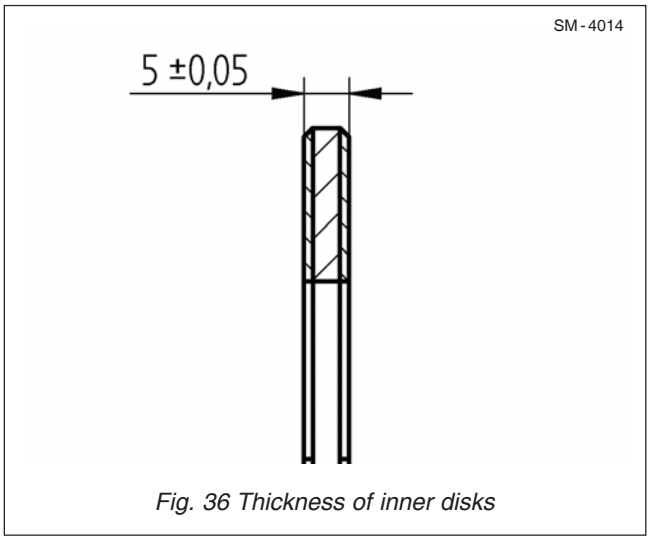

Fig. 36 Thickness of inner disks

14. Check also the depth of the oil groove in the coating area. the depth has to be 0.7mm. If the dept is less than 0.3mm, the disks must be replaced. Refer to Fig. 37

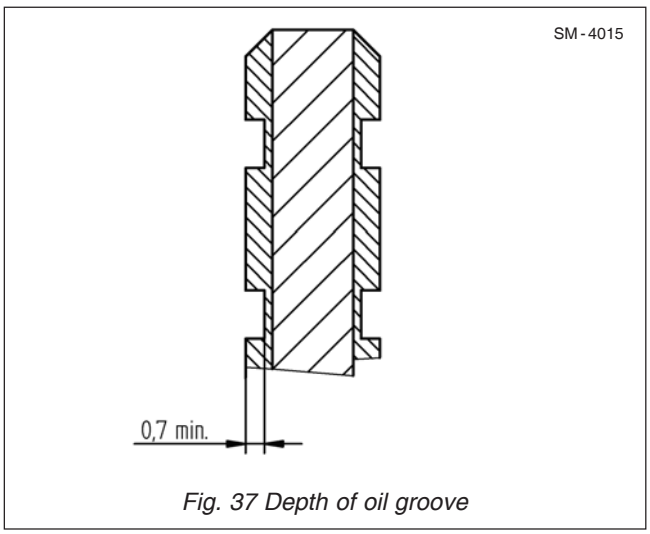

Fig. 37 Depth of oil groove

15. Install the checkout disk package again and make a new adjustment.

16. Measure X_1 on spindle(48).
Distance from spindle face to the profile step for coated disks.

17.Measure X2 on ring piston cylinder(29).
Distance from piston face to the inner washer. Measure the distance on the inside diameter.

18.Special device WZ 873 for X3 distance
For X3 measurement, set on the special device WZ 873.Screw on the centre nut and tighten by hand. Simultaneous turn constant the wheel hub, to align the wheel hub.

19.Load both lever of the device, so that multi disks set in working condition and becomes pressure.

20.Measure X3 to disks.
Distance from spindle face to the face of coated disk and directly near the stamp.

21.The release gap “S” is following calculated:
S=X3-(X1+X2)
The setting value is 1.0 – 1.4 mm.
Is the value “S” > 1.4 mm replace so much standard steel disks through steel disks with 0.5 mm thicker size till the setting value is reached.

Available disks:
Steel disk 03.73440.034.0 has 3.0mm thickness.
Steel disk 03.73440.056.0 has 3.5mm thickness

22.Start to reinstall the disk package with a lined disk. Install the disk with middle groove on top.

23.Set the lower steel disks (36) out of measuring line

24.Set the top steel disks in direct measuring line. Then remove the protecting tape.

25. Spray hub carrier with 'Wolfrakote' Paste prior to assembly of the piston (29) and cylinder (27) to the hub carrier (50) assembly. Refer to Fig. 17.

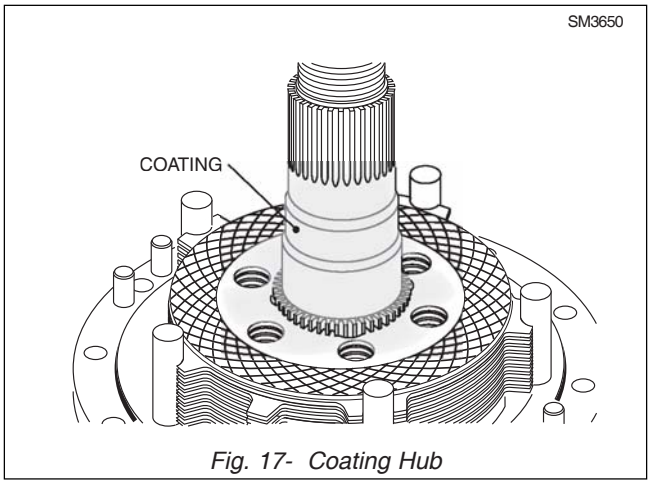

Fig. 17- Coating Hub

13. Locate seal ring (30) to brake piston (29). Ensure correct orientation of seal ring (30).

14. Assemble brake piston (29) to the pack. Ensure that the Ø5mm bleed bore is at the top. The Ø20mm oil holes of the brake cylinder must be placed over the oil channel of the multi-discs. Refer to Fig. 18.

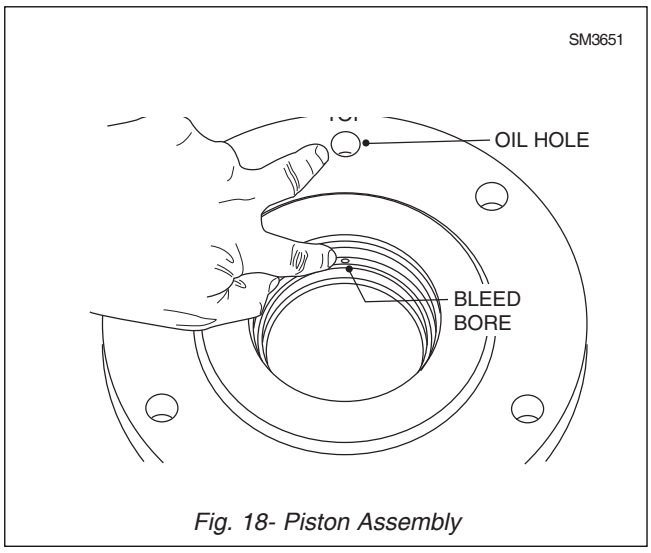

Fig. 18- Piston Assembly

15. Fit o-ring (34) to cylinder (27) then locate cylinder on brake assembly. Ensure the Ø5mm bore is on the top as this stage. Refer to Fig. 19.

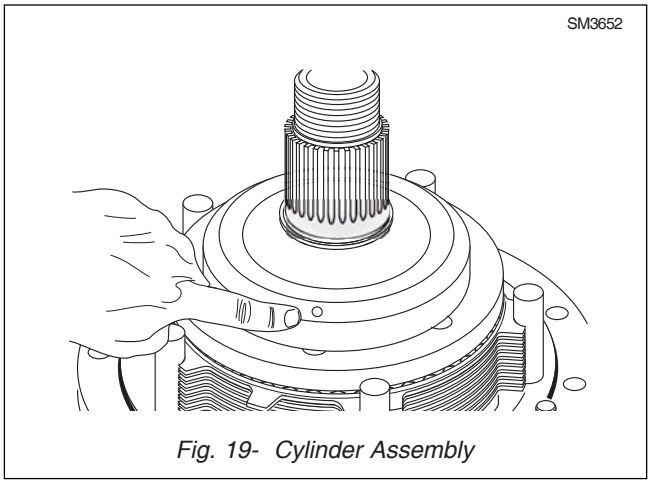

Fig. 19- Cylinder Assembly

16. Assemble wheel hub (26) onto wheel hub (41) and fit bearing (24) onto carrier (50). Ensure that punched assembly marks on outer diameter of both wheel hubs (26 & 41) line up. Refer to Figs. 20 & 21.

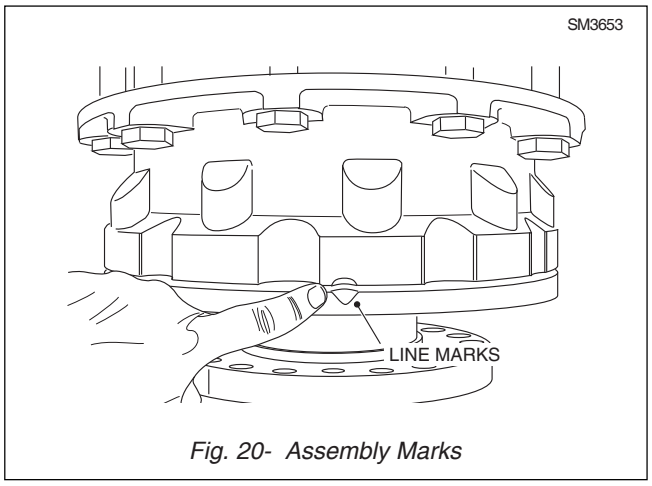

Fig. 20- Assembly Marks

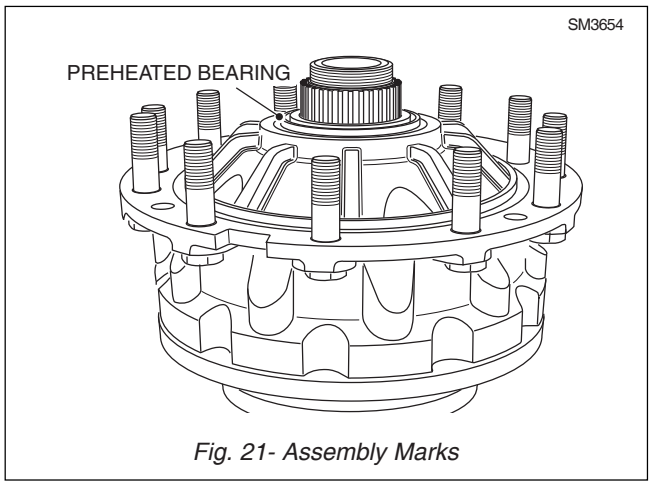

Fig. 21- Assembly Marks

17. Assemble ring gear and ring gear carrier (21 & 22), spray the face of the ring gear carrier (22) with 'Wolfakote paste'. Refer to Fig. 22.

18. Take ring gear assembly and locate over the hub carrier (50). Refer to Fig. 22.

20. A number of measurements must be made to determine the correct selection of shim (20) size. Follow the procedure listed.

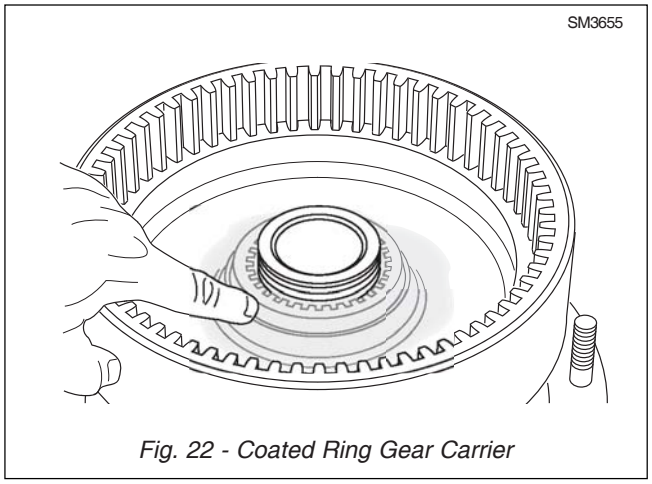

Fig. 22 - Coated Ring Gear Carrier

21. Measure dimension 'X1' from the top face of the hub carrier (50) to the face at the end of thread engagement. Refer to Fig. 23.

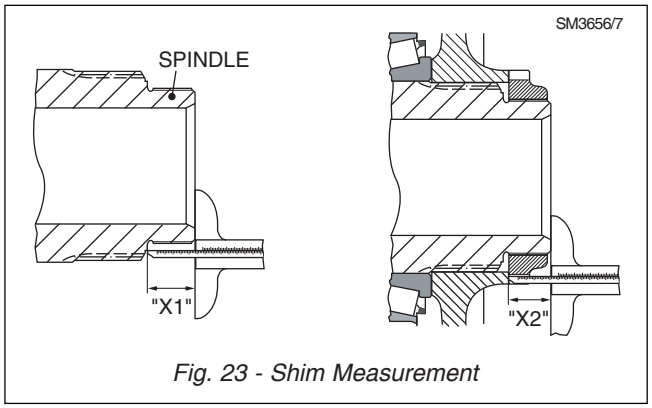

Fig. 23 - Shim Measurement

22. The second measurement should be with the ring gear carrier (22) fixed in place. This should be noted as dimension 'X2'

23. Shim (20) thickness 'd' should fall within the following dimensions , refer to Fig 24. :

'd' Max = X1 - X2
'd' Min = (X1 - X2) - 0.12

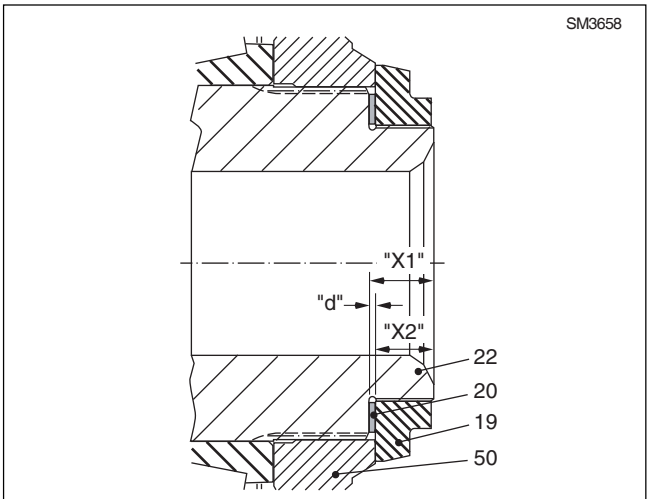

Fig. 24 - Shim Measurement

24. Once the shim (20) has been determined, this should be installed, with the slotted nut (19). The assembly should be mounted suitably in the horizontal position to allow the bearing preload to be checked.

25. Bearing (24) preload should be 50 Nm (36.9 lbf ft) and must be measured in the horizontal position. Refer to Fig. 25.

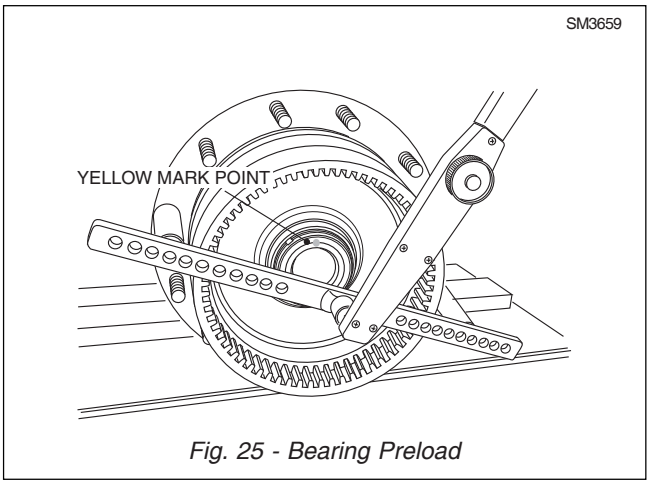

Fig. 25 - Bearing Preload

26. Once the preload has been confirmed, re-install shim (20) and slotted nut (19) , coat engagement face of nut with loctite 262.

27. Taking special tool (15503031) torque slotted nut (19) to a value of 2000 ± 120Nm (1475 ±88 lbf ft). Refer to Fig. 26 & 27.

28. Once the slotted nut (19) has been secured. Mark the position of the nut with a yellow colour point. Refer to Fig. 25.

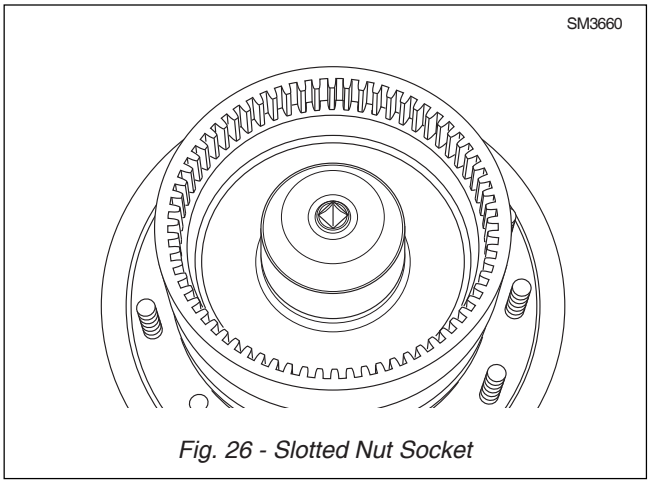

Fig. 26 - Slotted Nut Socket

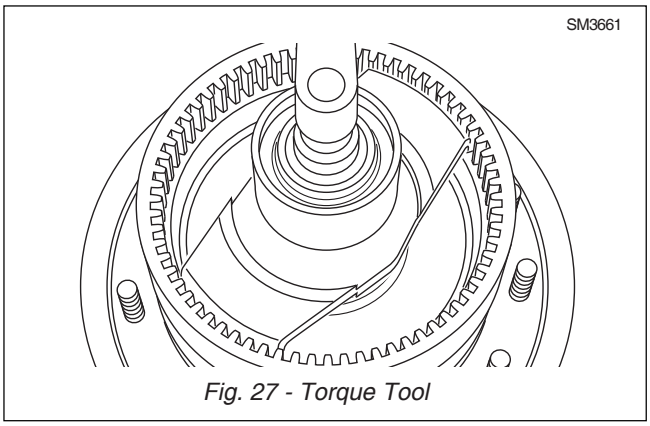

Fig. 27 - Torque Tool

29. Assemble constituent elements of the carrier (6). Ensure o-ring (14) is fitted prior to planet gears (11), washers (10), pins (13) and bearings (12).

30. Secure elements with planet carrier (15), washers (17) and bolts (18).

31. Locate cover (2) onto planet carrier (6) and secure with bolts (1). Torque bolts (1) to 67Nm (49 lbf ft) Refer to Fig. 28.

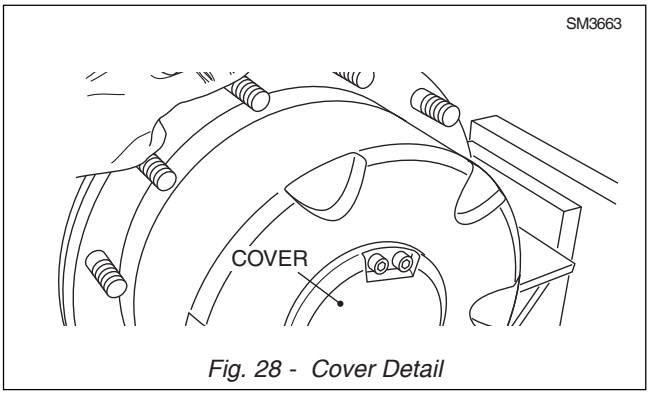

Fig. 28 - Cover Detail

32. Insert sun gear shaft (63) into the planetary cage assembly. Refer to Fig. 29.

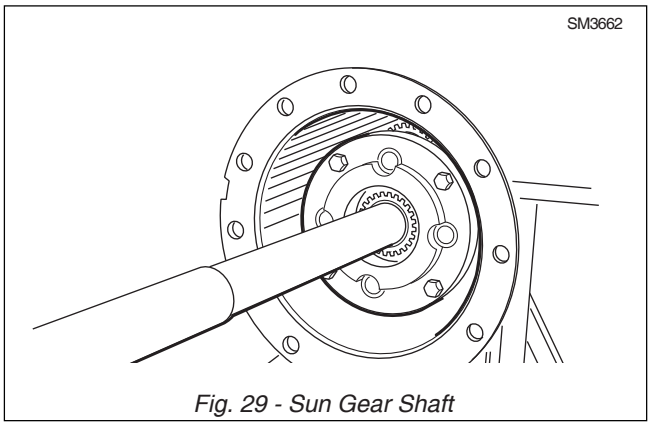

Fig. 29 - Sun Gear Shaft

33. Using suitable lifting tackle mount the complete planetary unit into the wheel hub assembly. Refer to Fig. 30.

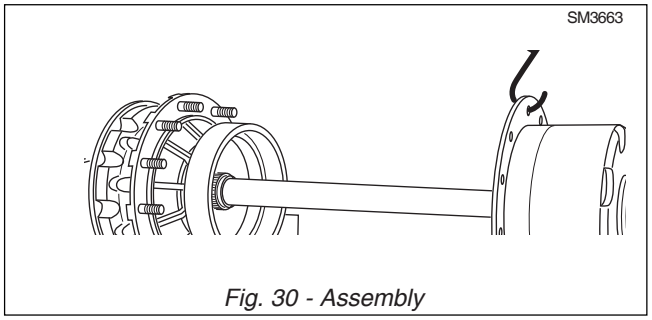

Fig. 30 - Assembly

34. Observe that recesses on outer diameters of carrier (6) and wheel hub (26) are lined up correctly. Refer to Fig. 28.

35. Using suitable lifting device (15503032), secure planetary assemblies to the axle housing (63) with washers (42) and bolts (55). Torque bolts (55) to 290 Nm (213lb-ft).

36. Install differential drain plug. Add gear oil of the type specified in Section 300-0020, Lubrication System, through the differential filler/level hole until the oil is level with the bottom of the filler/level hole.

23. Fill the planetary assemblies up to the 'Oil Level Check Line' with gear oil of the type specified in Section 300-0020, Lubrication System.

24. Refit road wheels, securing with wheel nuts (64). Remove stands or timber supports and lower the machine to the ground. Fully tighten wheel nuts to a torque of 600 Nm (442 lbf ft). Remove blocks from the wheels.

Note: Wheel nuts should be checked and tightened if necessary, after the first 10 hours of operation. Check torque every 50 hours (weekly) thereafter.

MAINTENANCE

Proper lubrication of the axle group is essential if axles are to deliver the service intended. Section 300-0020, Lubrication System gives full information on the proper lubrication intervals and the lubricant which should be used.

The wheel hub - planetary drive and tandem housing have a common oil chamber. The oil chambers are not separated from each other, and due to the narrow oil channels and therefore relatively slow passage of oil, the oil must be filled or added into the correct openings provided.

Numbers in parentheses refer to Fig. 31 & 32 unless otherwise stated.

Note: Perform the planetary oil change when the oil is warm, simultaneously with the differential.
1. Planetary drive - Turn the wheel hub until the oil drain plug (1) is at the lowest point to the middle axle. Clean oil drain plug (1). Remove oil drain plug (1) and drain oil. Torque oil drain plug (1) to 45 Nm (33 lbf ft).

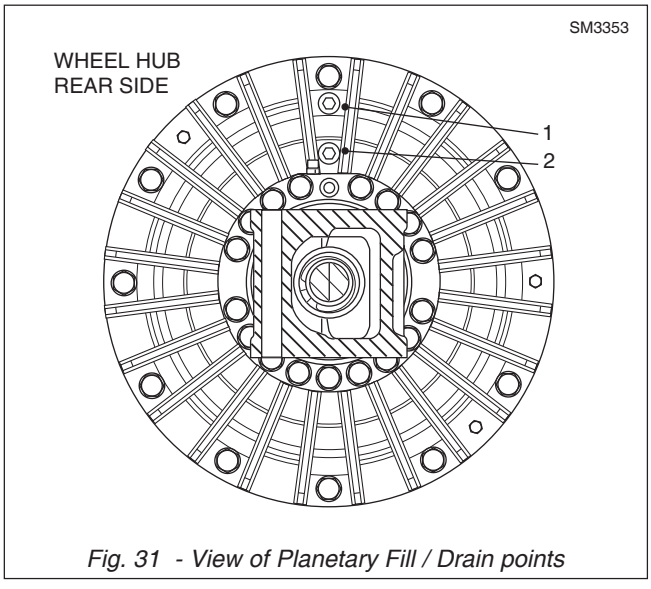

Fig. 31 - View of Planetary Fill / Drain points

Numbers in parentheses refer to Fig. 32 unless otherwise stated.

2. Turn wheel hubs back by 90 deg. then remove oil fill plug (2). Rest oil Drain plugs (1, Fig. 31 & 32) on back side of planetary. Fill system with oil specified in Section 300-0020, Lubrication System, to the bottom edge of the thread of plug (1, Fig. 31 & 32). Torque plugs (1 & 2) to a value of 45 Nm (33 lbf ft).

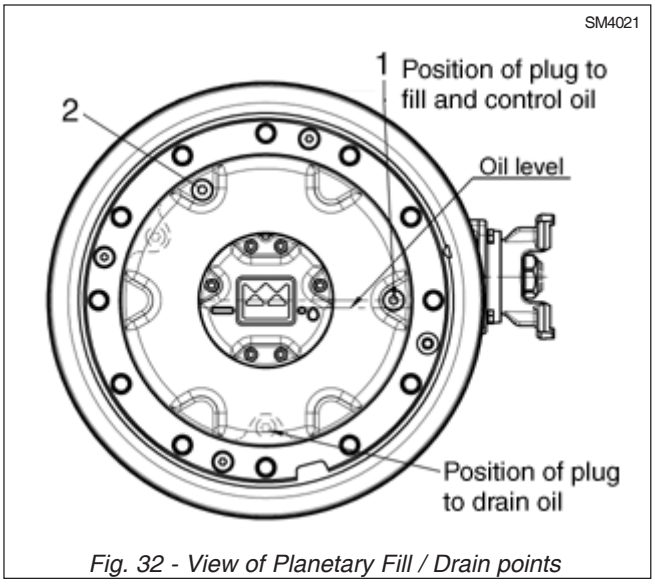

Fig. 32 - View of Planetary Fill / Drain points

3. Refit road wheels, securing with wheel nuts (64). Remove stands or timber supports and lower the machine to the ground. Fully tighten wheel nuts to a torque of 600 Nm (442 lbf ft). Remove blocks from the wheels.

Note: Wheel nuts should be checked and tightened if necessary, at initial inspection and after the first 10 hours of operation. Check torque every 250 hours (monthly) thereafter.

BLEEDING THE BRAKES

Numbers in parentheses refer to Figure 1 unless otherwise stated.

1. Fit a clear hose to the bleed nipple (51) of the rear axle left-hand wheel hub, and submerge the other end of the hose in a bucket of clean oil.

2. Start the truck. While the operator is operating the parking brake or foot pedal, undo the bleed nipple (51) using a suitable ring spanner or a special socket..

3. Allow oil to flow through the hose and into the bucket until it runs clear (NOT AERATED).

4. Close the bleed nipple (51).

5. Deactivate the parking brake or foot pedal.

6. Repeat steps 2 to 5 a further eight times until NO air is visible when the nipple is opened.

7. Remove the hose from the bleed nipple (51) and tighten the bleed nipple to a torque of 18 Nm (32 lbf ft).

8. Transfer the hose to the bleed nipple (51) of the rear axle right-hand wheel hub, and submerge the other end of the hose in a bucket of clean oil.

9. Start the truck. While the operator is operating the parking brake or foot pedal, undo the bleed nipple (51) using a suitable ring spanner or a special socket..

10. Allow oil to flow through the hose and into the bucket until it runs clear (NOT AERATED).

11. Close the bleed nipple (51).

12. Deactivate the parking brake or foot pedal.

13. Repeat steps 2 to 5 a further eight times until NO air is visible when the nipple is opened.

14. Remove the hose from the bleed nipple (51) and tighten the bleed nipple to a torque of 18 Nm (32 lbf ft).

15. Transfer the hose to the bleed nipple (51) of the centre axle left-hand wheel hub, and submerge the other end of the hose in a bucket of clean oil.

16. Start the truck. While the operator is operating the parking brake or foot pedal, undo the bleed nipple (51) using a suitable ring spanner or a special socket..

17. Allow oil to flow through the hose and into the bucket until it runs clear (NOT AERATED).

18. Close the bleed nipple (51).

19. Deactivate the parking brake or foot pedal.

20. Repeat steps 2 to 5 a further eight times until NO air is visible when the nipple is opened.

21. Remove the hose from the bleed nipple (51) and tighten the bleed nipple to a torque of 18 Nm (32 lbf ft).

22. Transfer the hose to the bleed nipple (51) of the centre axle right-hand wheel hub, and submerge the other end of the hose in a bucket of clean oil.

23. Start the truck. While the operator is operating the parking brake or foot pedal, undo the bleed nipple (51) using a suitable ring spanner or a special socket..

24. Allow oil to flow through the hose and into the bucket until it runs clear (NOT AERATED).

25. Close the bleed nipple (51).

26. Deactivate the parking brake or foot pedal.

27. Repeat steps 2 to 5 a further eight times until NO air is visible when the nipple is opened.

28. Remove the hose from the bleed nipple (51) and tighten the bleed nipple to a torque of 18 Nm (32 lbf ft).

29. Transfer the hose to the bleed nipple (51) of the front axle left-hand wheel hub, and submerge the other end of the hose in a bucket of clean oil.

30. Start the truck. While the operator is operating the parking braske or foot pedal, undo the bleed nipple (51) using a suitable ring spanner or a special socket..

31. Allow oil to flow through the hose and into the bucket until it runs clear (NOT AERATED).

32. Close the bleed nipple (51).

33. Deactivate the parking brake or foot pedal.

34. Repeat steps 2 to 5 a further three times until NO air is visible when the nipple is opened.

35. Remove the hose from the bleed nipple (51) and tighten the bleed nipple to a torque of 18 Nm (32 lbf ft).

36. Transfer the hose to the bleed nipple (51) of the centre axle right-hand wheel hub, and submerge the other end of the hose in a bucket of clean oil.

37. Start the truck. While the operator is operating the parking brake or foot pedal, undo the bleed nipple (51) using a suitable ring spanner or a special socket..

38. Allow oil to flow through the hose and into the bucket until it runs clear (NOT AERATED).

39. Close the bleed nipple (51).

40. Deactivate the parking brake or foot pedal.

41. Repeat steps 2 to 5 a further three times until NO air is visible when the nipple is opened.

42. Remove the hose from the bleed nipple (51) and tighten the bleed nipple to a torque of 18 Nm (32 lbf ft).

43. Transfer the hose to the bleed nipple (51) of the rear axle right-hand wheel hub, and submerge the other end of the hose in a bucket of clean oil.

44. Start the truck. While the operator is operating the parking brake or foot pedal, undo the bleed nipple (51) using a suitable ring spanner or a special socket..

45. Allow oil to flow through the hose and into the bucket until it runs clear (NOT AERATED).

46. Close the bleed nipple (51).

47. Deactivate the parking brake or foot pedal.

48. Remove the hose from the bleed nipple (51) and tighten the bleed nipple to a torque of 18 Nm (32 lbf ft).

49. Transfer the hose to the bleed nipple (51) of the rear axle left-hand wheel hub, and submerge the other end of the hose in a bucket of clean oil.

50. Start the truck. While the operator is operating the parking brake or foot pedal, undo the bleed nipple (51) using a suitable ring spanner or a special socket..

51. Allow oil to flow through the hose and into the bucket until it runs clear (NOT AERATED).

52. Close the bleed nipple (51).

53. Deactivate the parking brake or foot pedal.

54. Remove the hose from the bleed nipple (51) and tighten the bleed nipple to a torque of 18 Nm (32 lbf ft).

55. Transfer the hose to the bleed nipple (51) of the centre axle right-hand wheel hub, and submerge the other end of the hose in a bucket of clean oil.

56. Start the truck. While the operator is operating the parking brake or foot pedal, undo the bleed nipple (51) using a suitable ring spanner or a special socket..

57. Allow oil to flow through the hose and into the bucket until it runs clear (NOT AERATED).

58. Close the bleed nipple (51).

59. Deactivate the parking brake or foot pedal.

60. Remove the hose from the bleed nipple (51) and tighten the bleed nipple to a torque of 18 Nm (32 lbf ft).

61. Transfer the hose to the bleed nipple (51) of the centre axle left-hand wheel hub, and submerge the other end of the hose in a bucket of clean oil.

62. Start the truck. While the operator is operating the parking brake or foot pedal, undo the bleed nipple using a suitable ring spanner or special socket.

63. Allow oil to flow through the hose and into the bucket until it runs clear (NOT AERATED).

64. Close the bleed nipple.

65. Deactivate the parking brake or foot pedal.

66. Remove the hose from the bleed nipple and tighten the bleed nipple to a torque of18 Nm (32 lbf ft).

67. Locate the bucket underneath the parking brake assembly.

68. Activate the parking brake.

69. Loosen the hose on the parking brake. Allow oil to escape from the parking brake hose until it runs clear (NOT AERATED).

70. Refit the hose to the parking brake.

71. Deactivate the parking brake.

72. Repeat steps 67-72 a further twice.

73. Check that the hose is correctly tightened to the parking brake on completion.

74. Stop the truck.

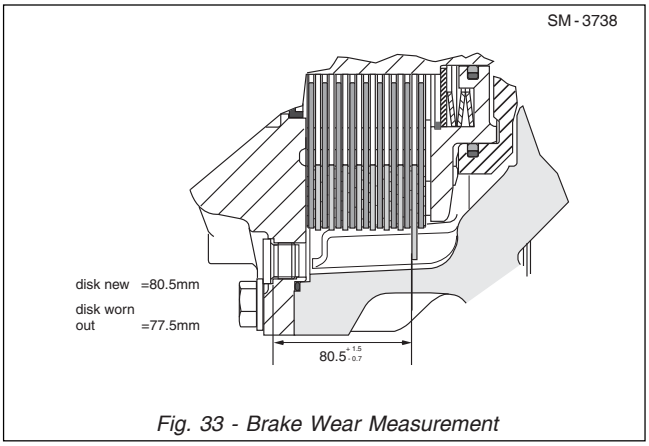

Fig. 33 - Brake Wear Measurement

2000 Hours

The multi-discs should be checked for wear. Refer to Fig. 33 for detail. Should brake wear depth measured be 77.5mm or less i.e. brake wear across disc set of 3mm or greater, then the discs should be replaced.

Brake wear should be measured with the brake applied. Measurement is made by removing plug (1, Fig 31) and inserting depth gauge through. Replace and torque plug when measurement is completed.

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.True axle noises may be located by lifting or jacking the machine up until all tyres are clear of the floor or ground. Securely block the machine in this position. Run power train at moderate speed. Be certain all tyres are off the ground to prevent damage to the differential and make sure that there is no brake drag.

AXLE DIAGNOSIS CHART

CONDITION	REASON	REMEDY
Noises	Insufficient or incorrect lubricant	Check level. Fill with proper type and grade of lubricant.
	Wheel bearings scored or rough	Replace wheel bearings
	Gear teeth in planetary chipped	Replace gear
Loss of lubricant	Lubricant foams excessively	Drain and fill with proper type and grade of lubricant
	Worn or broken oil seal	Replace oil seal
	Loose nuts or bolts	Tighten nuts or bolts
Gain of lubricant	Incorrect lubricant	Drain and fill with proper type and grade of lubricant
Planetaries running hot	Bearings seized	Replace bearings

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	1	Capscrew	67	49
1	43	Bolt	290	214
1	45	Drain Plug	55	40.5
1	51	Breather	18	32
1	52	Breather	10	7.4
1	57	Plug Screw	15	11
1	64	Wheel Nuts	600	442

⚠ 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.

SPECIAL TOOLS

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

For fabricated tools, refer to the end of this section for dimensions.

FABRICATED TOOLS

The following tools are necessary to aid in removal / assembly of the axle group.

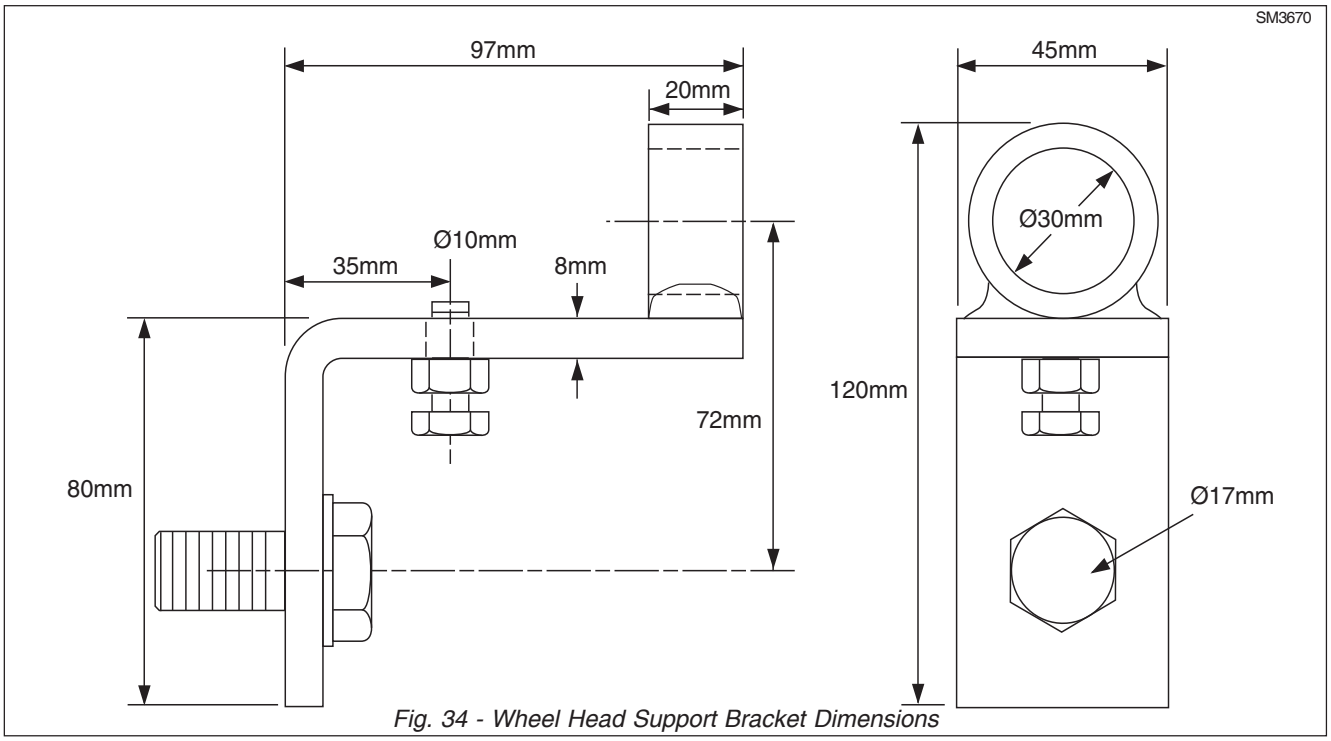

Fig. 34 - Wheel Head Support Bracket Dimensions

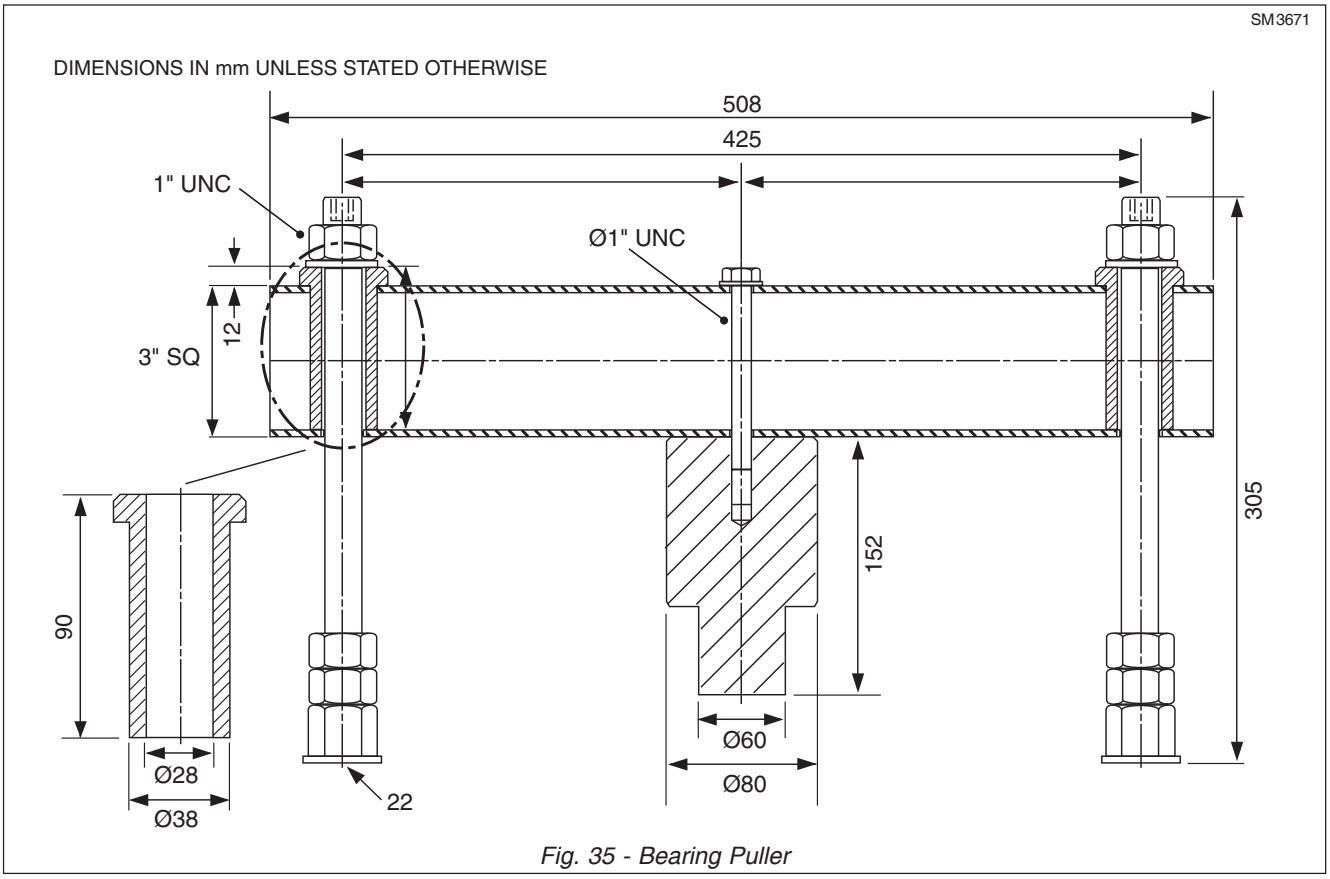

Fig. 35 - Bearing Puller

* * * * *

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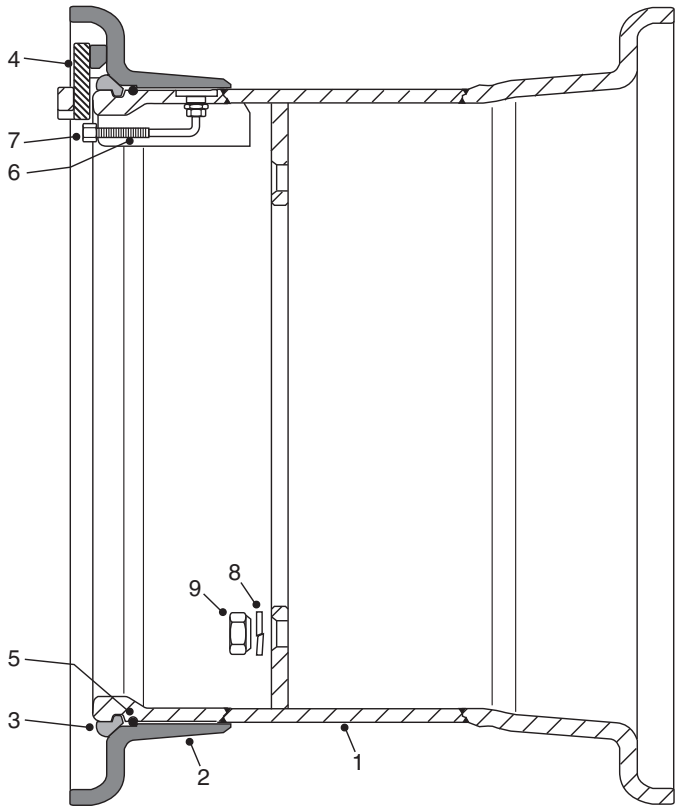


1 - Weel Rim
2 - Flange assembly
3 - Lockring
4 - Key / Driver
5 - O-ring
6 - Valve Assembly
7 - Valve Cap
8 - Lock Washer
9 - Wheel Nut

Fig. 1 - Cutaway View of Wheel Rim

DESCRIPTION AND OPERATION

The rim and wheel assembly are designed to allow the tyre and rim assembly to be replaced with a pre-assembled tyre and rim. The tyre and rim may be removed from the machine as an assembly and transported to a more suitable location for removing the tyre from the rim.

Procedures for removing tyre and rim assembly from machine, and dismounting tyre from rim, the use of hand, hydraulic, and special tools, are described in this section.

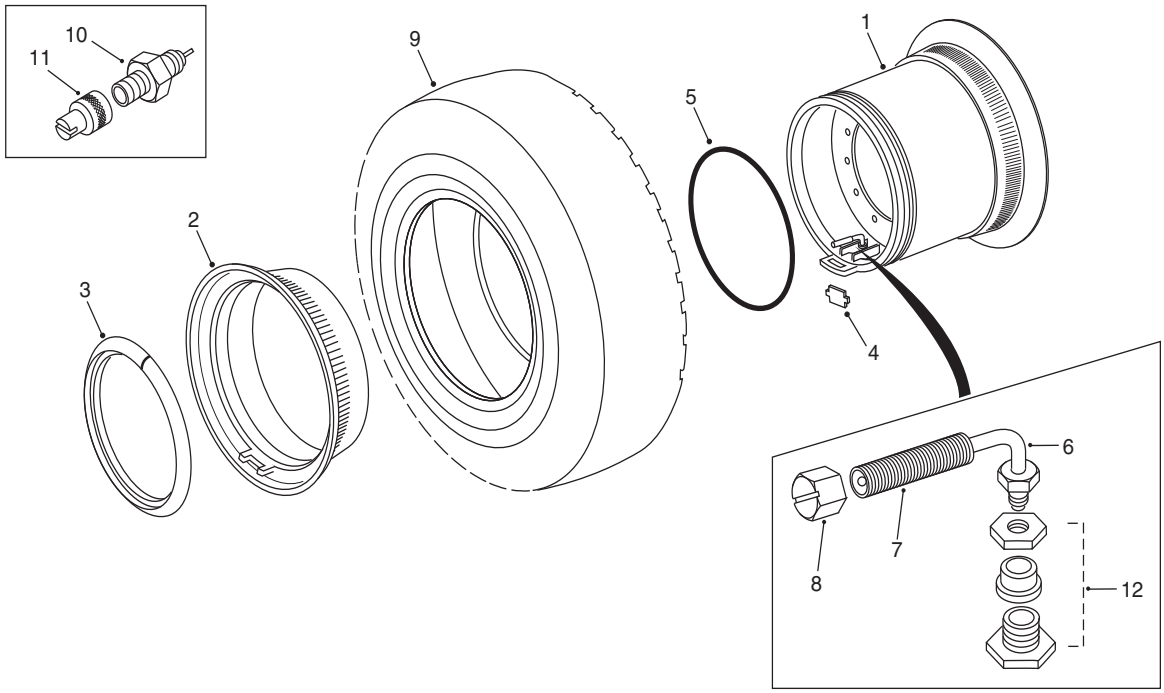
The rim assembly consists of the following components which are illustrated in Fig. 1: Wheel Rim , Flange assembly, Lock ring, 'O'-ring and Driver

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.



1 - Wheel Rim
2 - Flange assembly
3 - Lockring
4 - Key / Driver
5 - O-ring
6 - Valve assembly
7 - Valve Core
8 - Cap
9 - Tyre
10 - Adaptor
11 - Cap
12 - Spud

Fig. 2 - Typical Tyre & Rim Assembly

REMOVING TYRE AND RIM ASSEMBLY FROM MACHINE

Numbers in parentheses refer to Fig. 1.

Note: If tyre and rim assembly is to be replaced pre-assembled, it is not necessary to remove the tyre from the rim. It may be removed as an assembly.

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

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

2. Block all road wheels, except the one to be raised, and place the battery master switch in the 'Off' position.

3. Break wheel nuts (9) loose with tyre still on the ground, but do not remove from wheel studs.

Fig. 3 - Pry Bar

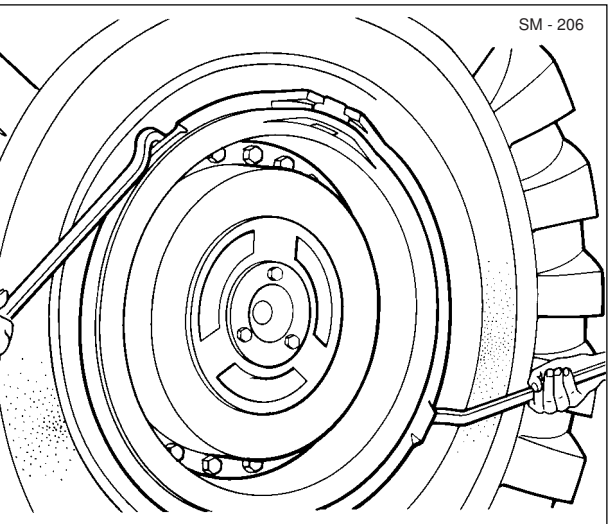


Fig. 4 - Breaking Typical Tyre Bead

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) and lock washers (8) securing wheel rim base assembly (1) to the wheel.

8. With lifting device, remove tyre and rim assembly from the wheel and lift clear of the vehicle.

DISMOUNTING TYRE FROM RIM

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

Note: The following instructions apply to use of hand tools. For procedures and tooling required to dismount the tyre from the rim using hydraulic tools, contact the relevant tyre manufacturer.

> ⚠ **WARNING**
> **When lifting tyre from the rim, be sure the equipment is of sufficient capacity and properly secured to do the job safely.**

1. Remove valve cap (8) and valve core (7) and leave valve open to prevent trapping of air in tyre. Tape valve threads for protection.

2. Remove driver (4) from flange (2) and wheel rim (1).

3. Insert flat hooked end of pry bar into groove of flange (2) betweeen lock ring (3) and flange (2).

4. Prying up with the pry bar. Using two pry bars, work completely around wheel rim (1).breaking lock ring (3) and outer flange (2) apart.

See Fig. 4. A pipe over the straight end of the pry bar will increase leverage.

6. A second pry bar may be inserted in the space between lockring (3) and flange (2). Twist the second pry bar to maintain the space gained by the first pry bar.

7. Move the first pry bar around wheel rim (1), twisting and following with the second pry bar, until the outer tyre bead is loose.

9. Pry lock ring (3) out in the same manner by starting at prying notch in wheel rim (1) assembly, and work all the way around wheel rim (1) with two pry bars.

10. Remove and discard 'O' ring (5).

11. Remove lock ring (3).

12. Breaking slots are provided inside the rims. The inner bead may be broken as described in Steps 4 through 8. If the tyre and rim assembly is on the vehicle, the following procedure may be used for breaking the inner bead.

13. Place jack between inner flange and vehicle frame. Extend jack until tyre bead is broken. Continue around the rim until tyre bead is broken at all points.

14. Using suitable lifting equipment, remove tyre from rim. This completes the removal of the tubeless tyre.

Note: If tyre rim is on the vehicle, and no tyre lifting equipment is available, 'walk' the tyre off the rim as follows:

Force bottom of tyre outward as far as possible; lower jack enough to allow weight of tyre to rest on ground; force top of tyre out as far as possible; raise jack to original height and repeat the above until the tyre is off the rim.

INSPECTION

Tyre

Check the interior surface of the tyre to determine its condition. Inspect for cuts or fabric breaks that have penetrated the tyre body. The casing should be inspected closely for any sharp , pointed object that may have penetrated the tyre body but is invisible from the outside. All dust, dirt, water or other foreign matter should be cleaned from the inside of tyre.

Rim Assembly

Overloading, improper tyre inflation, rough terrain, high speed, accidents, dirt accumulation, and corrosion all tend to reduce the service life of rims and rim components. It is recommended that rims be inspected, as below, not less often than at every tyre change and that, as the warranty limit approaches, consideration be given to periodic replacement.

The rim and its components are designed with built-in safety factors, to prevent the components from flying off with killing force during inflation. Check components

for cracks, bends, distortion, or other damage. If damage is found, the component must be replaced.

⚠ WARNING
Never mix components of one manufacturer's rims with those of another. Using the rim base of one manufacturer with the lock ring of another or vice versa is dangerous. The lock ring of one may not fully engage with the lock ring groove of the other. Always consult the rim manufacturer for proper matching and assembly instructions.

⚠ WARNING (cont.)
Also, use and servicing of damaged, worn out, or improperly assembled rim assemblies is a very dangerous practice. Failure to comply with the above warnings could result in explosions from tyre pressure causing serious personal injury and property damage.

Clean all rust and dirt from the rim parts and wheel and apply a coat of good grade primer paint. Allow the paint to dry thoroughly before remounting tyre.

The rim parts used with tubeless tyres form an important part of the air chamber. Therefore, they should be carefully checked for distortion or mutilation that would prevent an effective air seal when the tyre and rim are reassembled.

Rubber 'O' rings are air seals for tubeless tyre and rim assemblies and therefore should be carefully handled to provide an airtight seal when the tyre is remounted on the rim. Always use new 'O' rings when mounting a tubeless tyre.

Note: Handle 'O' rings carefully, as damage will prevent an airtight seal for tyre inflation.

MOUNTING TYRE ON RIM

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

For mounting a tyre with rim on or off machine, the procedure is basically the same.

⚠ WARNING
When lifting tyre onto the rim, be sure the equipment is of sufficient capacity and properly secured to do the job safely.

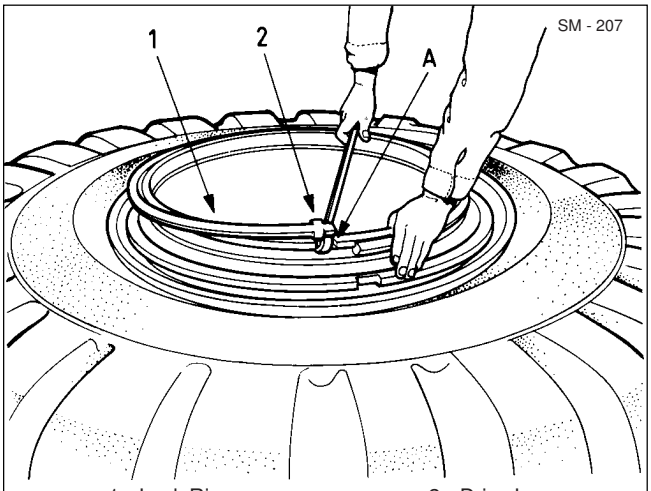


Fig. 5 - Installing Typical Lock Ring

1. For off-machine installation, lay wheel rim (1) on blocks or mounting stand with 'O' ring groove up. Wheel rim (1) should be off the floor enough to allow tyre to rest on rim and not the floor. Blocks are not to extend more than 13 mm (0.50 in) beyond rim base.

2. Lubricate groove and 'O' ring, with a thin solution of vegetable base soap and water. Insert new O-ring (5) in groove on wheel rim (1).

4. Using suitable lifting equipment, lower tyre onto wheel rim (1). Seat tyre firmly against inner flange.

5. Install outer flange (2) on wheel rim (1).

6. Align driver notch in wheel rim (1) with notch in flange (2), and install flange (2) on rim.

7. Install lock ring (3) in groove of wheel rim (1) so that lock ring lug engages both notches. Notches and lock ring lug must line up correctly. If necessary, use only a soft hammer to rotate the lug. Use pry bar for installing lock ring (3), as shown in Fig. 5.

8. Make sure all rim components are correctly assembled.

11. Lift the tyre upwards to effect a seal between flange (2) and 'O' ring (5). In some cases the tyre will automatically spring out, making this step unnecessary.

12. Refer to heading, 'Tyre Inflation' in this section for the proper procedure for inflating the tyre.

MOUNTING TYRE AND RIM ASSEMBLY ON MACHINE

Numbers in parentheses refer to Fig. 1.

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

1. Support tyre and rim assembly with a suitable chain, or rope sling. Attach sling to overhead lifting device. Slide assembly onto wheel of the vehicle, with lock ring (4) and bead seat band (3) facing outward.

2. Install lock washers (9) and wheel nuts (10) on wheel studs. Gradually tighten wheel nuts opposite each other until all wheel nuts are snug. Tighten wheel nuts (10) to a torque of 590 Nm (435 lbf ft). Tighten wheel nuts (10) again, after 10 hours of operation.

TYRE INFLATION

⚠ WARNING
To prevent personal injury and property damage, the tyre and rim assembly should be placed in a safety cage before inflating. If no safety cage is available or tyre is on the machine, the tyre and rim assembly should be wrapped with safety chains or with lash cables before inflating.

Even with these precautions remember that air-blast is a potential hazard. Tyre inflation should be carried out away from busy working areas.

⚠ WARNING
To avoid personal injury and property damage, never stand or sit in front of a mounted tyre during tyre inflation. Use a clip-on air chuck with a long hose and stand to one side while the tyre is being inflated.

⚠ WARNING
To prevent personal injury and property damage, always prevent flammable vapours that could produce tyre explosions, from being pumped into tyres during inflation, by observing the following precautions:

A.
Use an air compressor and reservoir located inside a heated building, when available, so that alcohol, methanol, or other flammable antifreeze liquids are not needed in the air tanks to prevent moisture freezing in the tank and lines in subfreezing outside temperatures.

B.
Make sure that paints, lacquers, paint thinners, or similar materials that produce volatile, flammable vapours are not used or stored near the air intake of the compressor that supplies the air for inflating tyres. The compressor should be isolated from all such sources of flammable vapours.

C.
Be sure to thoroughly flush and blow off all flammable solvents used for cleaning the air compressor inlet screen before using the compressor for tyre inflation, or any other purpose.

D.
Do not charge batteries, either in or out of a machine, near the air inlet of a compressor used for inflating tyres. Charging batteries produces highly explosive hydrogen gas which can be readily drawn into a nearby compressor inlet and pumped into the tyre.

E.
Never exceed the specified concentration of alcohol when adjusting the alcohol vaporizer, or adding alcohol to the auxiliary air tank, used on machine air systems to prevent freezing or moisture condensate in below-freezing temperatures. Excessive alcohol, added to the machines air tanks in this manner can produce flammable vapours that will be pumped into a tyre when this air supply is used for tyre inflation if the tyre inflation kit is not equipped with a moisture filter. Alcohol added to machine air systems in recommended concentration to prevent condensate freezing are below hazardous levels for tyre inflation.

F.
Another source of hazardous flammable vapours in tyres is the tyre bead lubricant. Always use bead lubricants that do not introduce flammable vapours into the tyre.

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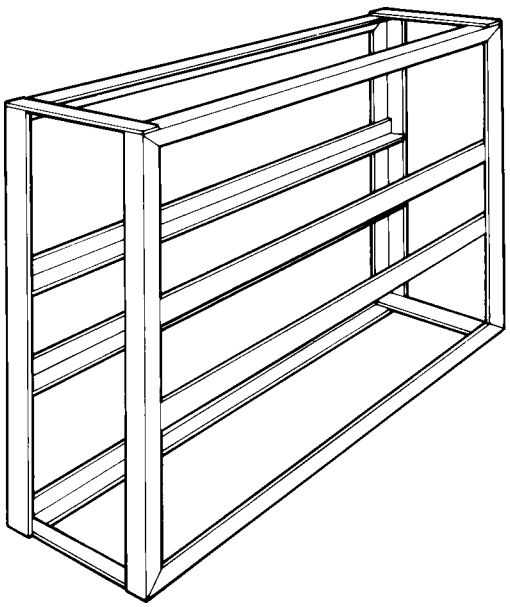

Fig. 6 - Typical Safety Cage

Inflation

Note: Always use tyre inflation equipment with an air filter that removes moisture from the air supply, when available, to prevent moisture corrosion of internal rim parts.

1. Inflate tyre to 1 bar (15 lbf/in²) initially to seat components and tap lock ring lightly to ensure correct seating. Visually check that all components are in place, then continue inflation observing all safety precautions. (See Step 2).

2. If the tyre is off the machine, place it in a safety cage after initially inflating to 1 bar (15 lbf/in²) to seat components. See Fig. 6.

3. Inflate tyres to 5.2 bar (75 lbf/in²) to seat beads and seal the 'O' ring, then adjust to the recommended inflation pressure.

4. For recommended operating air pressure, refer to the 'Tyre Inflation Pressures' table.

NITROGEN TYRE INFLATION

Note: All Warnings and procedures under 'Tyre Inflation' will apply, except for differences covered by this passage.

In certain environments it is recommended that tyres be inflated with dry nitrogen gas, and that the resulting oxygen content of the inflation does not exceed 5%.

All machines whose tyres are factory inflated with dry nitrogen gas will be identified by a decal on the body or frame.

Nitrogen gas improves tyre pressure retention, increases tyre life by reducing carcass oxidation from within, minimizes rim rust and has no detrimental effects on the tyre. It also reduces the potential of a tyre explosion because it is an inert gas and will not support combustion inside the tyre.

The same tyre inflation pressure used for air inflation should be used for nitrogen inflation. Tyre valves formerly used with air inflation are entirely satisfactory for use with nitrogen gas.

Nitrogen Tyre Inflation Kit

⚠ WARNINGS

DO NOT USE charging assembly, Part No. 9359489, for tyre inflation because this assembly does not include a pressure regulator, safety relief valve, and adequate pressure gauging which is mandatory for tyre inflation purposes. Tyre volume is as much as 90 times greater than the average accumulator volume and hence it takes very much longer to inflate a tyre - up to 40 minutes or more for very large tyres.

⚠ Nitrogen gas cylinders used to inflate tyres are generally charged to approximately 152 bar (2 200 lbf/in²). A tyre blowout and/or rim failure could occur if inflation equipment is not properly used. Proper nitrogen charging equipment and personnel training for its use is a must to avoid over inflation.

1. A nitrogen tyre inflation kit is available from your dealer and consists of the following. Refer to Fig. 7.

a. Pressure regulator, 0 - 13 bar (0 - 200 lbf/in²), with two dual pressure gauges.

b. Safety relief valve, 8.6 bar (125 lbf/in²), that will assure an upper limit to the pressure available for tyre inflation.

c. A 15.2 m (50 ft) length of flexible hose with interconnecting fittings. On the tyre end of the hose is a large bore quick connect/disconnect clip-on chuck.

2. The pressure regulator is connected to a nitrogen compressed gas cylinder available from local suppliers.

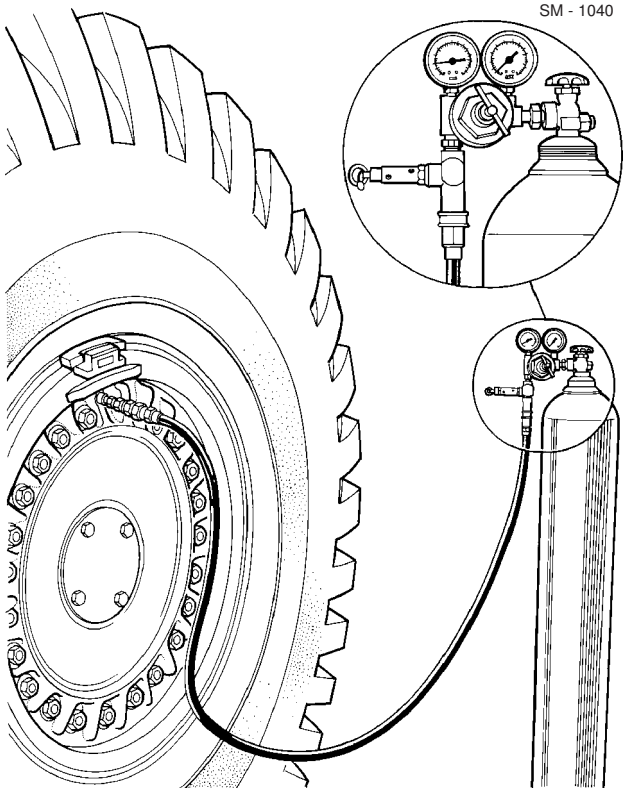

Fig. 7 - Nitrogen Tyre Inflation Kit

3. The usual procedure for using this type of equipment is as follows:

a. Connect nitrogen tyre inflation kit to nitrogen compressed gas supply. DO NOT connect clip-on chuck to the tyre valve at this time.

b. Open valve on nitrogen supply.

c. With flexible hose and clip-on chuck connected to nitrogen tyre inflation kit assembly but not connected to the tyre, adjust pressure regulator so that its output pressure is not more than 1.4 bar (20 lbf/in²) higher than the desired tyre inflation pressure.

d. Connect clip-on chuck to the tyre valve. The tyre will now inflate. Tyre pressure can be monitored by observing the gauge at the pressure regulator. STAY AWAY FROM THE TYRE.

e. When desired inflation pressure has been achieved, back off the regulator or close the valve on the compressed gas cylinder.

f. Remove the clip-on chuck and adjust the tyre pressure with the tyre gauge in the usual manner.

Re-inflation of a Mounted Tyre

To re-inflate a tyre with dry nitrogen gas which is now inflated with air, proceed as follows:

1. Exhaust the tyre until only air at atmospheric pressure remains in the tyre.

2. Re-inflate the tyre using only dry nitrogen gas to 4.15 bar (60 lbf/in²) gauge as a minimum, or to bead-seating pressure as a maximum.

3. Adjust to the service inflation pressure required:

a. If the required service inflation pressure is LESS than 4.1 bar (60 lbf/in²), remove the clip-on chuck and adjust the pressure with the tyre gauge in the usual manner.

b. If the required service inflation pressure is greater than 4.1 bar (60 lbf/in²), further inflate, with dry nitrogen gas only, to the pressure level required. Then remove the clip-on chuck and adjust the pressure with the tyre gauge in the usual manner.

New Tyre Mounts and Remounts

To newly mount or remount a tyre to its rim, use only dry nitrogen gas; this includes the pressure required to seat the beads. After seating the tyre beads, remove the clip-on chuck and adjust the pressure with the tyre gauge in the usual manner.

Note: Although a little more nitrogen gas is used to seat beads than that used for re-inflation of a mounted tyre, refer to 'Re-inflation of a Mounted Tyre', its cost is generally negligible in comparison to the time and labour saving and, longer tyre life achievable with the reduced oxygen content which results.

TYRE EXPLOSION HAZARD

⚠ WARNING
Whenever a machines tyre(s) is (are) exposed to excessive heat such as a machine fire or extremely hot brakes the hazard of a subsequent violent tyre explosion must be recognized. All persons must avoid approaching the machine so as not to be physically endangered in the event of an explosion of the tyre and rim parts.

⚠ WARNING (cont.)
The machine should be moved to a remote area, but only when this can be done with complete safety to the operator operating or towing the machine. All other persons should stay clear of the machine. The fire or overheated brakes, wheel, etc. should be extinguished or cooled from a safe distance. Do not attempt to extinguish the fire or cool the machine by use of hand-held fire extinguishers.

⚠ If it is absolutely necessary to approach a machine with a suspect tyre, approach only from the front or the back. Stay at least 15 m (50 ft) from the tread area. Keep observers out of the area and at least 460 m (1 500 ft) from the tyre sidewall. Refer to Fig. 8. The tyre(s) should be allowed at least eight (8) hours cooling time after the machine is shut down or the fire extinguished before approaching closer.

⚠ There is always a possibility of a tyre explosion whenever the smell of burning rubber or excessively hot brakes is detected. The danger is also present when a fire on the machine reaches the tyre and wheel area. Under such conditions, all personnel must avoid approaching the machine in a manner that could result in injury should an explosion actually occur. Move the machine to a remote area only if it can be done without endangering the operator or other personnel in the area.

⚠ WARNING
DO NOT WELD ON OR HEAT RIM COMPONENTS. For several years the company and tyre and rim manufacturers have warned users never to weld rim components with the tyre mounted on the rim. The gases that build up inside the tyre during arc welding or heating on rim components can ignite, resulting in one of these explosive-like failures of the tyre and rim. This warning also applies to nitrogen inflated tyres. Ignition will not occur in the nitrogen atmosphere, but the pressure buildup from the heat of welding may be sufficient to cause a blowout severe enough to injure or kill. It is recommended to scrap the part if heat is necessary to repair any rim component.

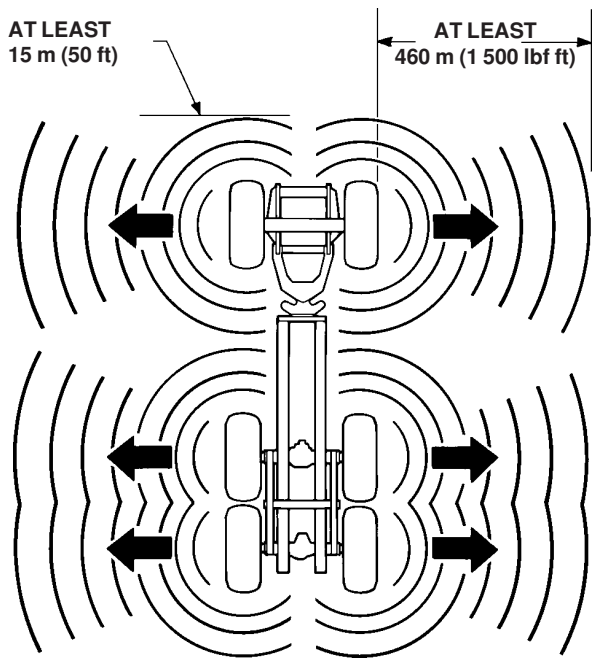

Fig. 8 - APPROACH AREA.
Do Not Approach Tyre in Shaded Area

TYRE AND WHEEL RIM MAINTENANCE

Tyre Repairs

Prompt repair of tyre injuries will prevent small injuries from enlarging and causing tyre failure. Use the best tyre facilities available. If good repair facilities are not available, have the nearest dealer make the necessary repairs.

Minor cuts, snags, or punctures should be repaired upon discovery. Skive with a sharp pointed knife around any cut in the tyre tread area that is of sufficient depth or shape to hold pebbles or dirt. The angle of the skive should be no more than sufficient to expel all foreign material and should extend no deeper than the breaker. The skive should go to the bottom of the hole. Tyres with shallow cuts, if treated promptly, may be allowed to continue in service. If the cut extends deeper into the tyre carcass, the tyre should be removed for repair.

The tyre must be removed from the rim to repair larger punctures or cuts. Irregular shaped punctures or cuts less than 13 mm (0.50 in) in size can be repaired with a plug and hot patch. Insert a repair plug into the hole to keep out moisture and to back up the hot patch. Trim the plug off flush with the inside of the casing, buff, and apply the hot patch according to the instructions supplied with the hot patch equipment.

Punctures 13 mm (0.50 in) or larger, large cuts, or bruise breaks require sectional or reinforced vulcanized repair. Cover the repair patch with a layer of cushion gum after application to the tubeless tyre to ensure an airtight repair. Any cords of the inside ply that are exposed in buffing and are not covered with repair patch must be coated with cushion gum to prevent air leakage into the carcass plies on tubeless tyres.

Recapping and Retreading

There are two general methods employed in restoring the tread surface of off-the-highway tyres: recapping and retreading.

A recapped tyre has a new tread cured right over the old tread surface.

A retreaded tyre has the old tread removed entirely and a new tread cured directly onto the body of the tyre. A tyre can be recapped or retreaded if the cord body is free of cuts, bruises and separation, and is thoroughly sound, including previous repairs.

TYRE CARE

To obtain maximum service from off-highway tyres, the following common-sense precautions should be followed.

Maintain Correct Inflation

The most common cause of tyre damage is improper inflation. Both over-inflation and under-inflation are detrimental to tyre life. Tyre pressure should be checked daily, preferably before the machine is placed in operation. Refer to 'Tyre Inflation Pressures' table.

The valve cores should be checked for leaks. Keep in mind that valve cores are delicate mechanisms that wear out in service; therefore, they should be replaced with new ones when they become worn. Each tyre should be equipped with a valve cap to prevent dirt from damaging the valve core and causing air leakage.

Maintain Good Haul Roads

Because haul roads are considered temporary roads they are frequently neglected. The better the haul road, the longer the tyre and machine life of off-highway machines.

Although it takes time and effort to maintain good haul roads, the delay and cost of tyres and machine breakdowns caused by poor haul roads is many times greater.

Inspect Tyres Regularly

A systematic plan for tyre inspection will more than pay for itself in lowered tyre costs per hour of operation. All tyres should be checked regularly for cuts, bruises, ply material breaks, excessive or uneven wear, embedded foreign matter, and any other damage which can be repaired. A considerable increase in tyre service can be realized if tyre injuries are repaired before they have progressed to the irreparable stage.

The rim mounting nuts should also be checked periodically and tightened to the torque specified.

Prevent Overloading

Off-highway machines are designed to carry a maximum allowable payload. Excessive loading will overstress both the machine and tyres and shorten the life of both.

Prevent Contact with Oil

Prevent tyre contact with petroleum products. Rubber that is exposed to oil, gasoline, or grease becomes soft and spongy and deteriorates rapidly. Always avoid driving machine through a puddle of gasoline, fuel oil, lubricating oil, or grease. Never let a tyre stand in an oil or grease spot overnight.

Store Tyres Properly

The best of care given to tyres in service by operators and maintenance personnel can be completely nullified by careless storage. Time is not the only contributing factor to the deterioration of rubber products. Therefore, tyres that are to be stored must be protected from light, heat, oils, dirt, moisture, and ozone. Stored tyres should be carefully covered with a tarpaulin or some other suitable material, such as opaque plastic sheeting, to prevent contact with the contaminants listed above.

Proper Handling of Tyres and Wheel Rim Parts

Tyres should be stored vertically. Horizontal stacking may compress the tyre walls, making inflation difficult. If tyres are stored in racks, the lower supporting members should provide as broad a surface as possible to the tyre tread to avoid a concentration of load.

The beads of tubeless tyres must be protected from damage or a faulty air seal will result. Do not use hooks, cables, or chains in contact with the tyre beads when lifting these tyres. If forklift trucks are used for handling, they should be equipped with broad, well-

rounded arms to distribute the load and prevent damage to the tyre bead. When handling tyres with the fork truck do not scrape the fork across the bead.

Tubeless tyre rims perform an important function as part of the assembly air seal. Proper care, therefore, must be taken not to distort or mutilate the rim parts because they must mate properly to form part of the basic air chamber. Since the rim base and bead seat band are mating surfaces, distortion may prevent easy assembly as well as possibly resulting in no seal.

Never drop, tumble, or roll rim parts.

If rim parts are stored outdoors, they should be given a protective coat of a good commercial primer.

Similar parts should be stacked neatly to prevent distortion.

Babbit or lead hammers, not sledge hammers, should be used in assembling rim parts.

'O' rings are seals and should be carefully stored in a cool, dry place where they will not be injured or damaged.

Valve cores should also be stored in a cool, dry and clean place.

MAINTENANCE

Check tyre pressures daily, preferably before the machine is placed in operation. Refer to 'Tyre Inflation Pressures' table.

Every 50 hours of operation (weekly), torque tighten wheel rim nuts to 590 Nm (435 lbf ft).

Check tyres regularly and replace or repair if required.

SERVICE TOOLS

The nitrogen tyre inflation kit shown in Fig. 7 is available from your dealer. Refer to Section 300-0070, SERVICE TOOLS for part numbers of general service tools required.

TUBELESS TYRE LEAK DIAGNOSIS

Occasionally a tubeless off highway tyre/rim assembly may leak in field service. To determine cause of leakage, the entire assembly including valve hardware, multi-piece rim assembly, 'O' ring and tyre should be checked using a soap solution.

This table lists various causes of air loss and possible remedy.

CAUSE	REMEDY
Defective valve	Tighten parts. Replace defective parts. Use valve caps.
Cracked rim or weld	Replace defective part ⚠ **WARNING** **Do not attempt repair of wheel components.**
Twisted or damaged 'O' ring	Replace 'O' ring (lubricate)
Tyre cuts and snags	Repair tyre damage
Bead area awl holes	Repair inner liner (preferred)
Leakage between tyre bead trim	With tyre removed from rim: Clean tyre beads in rim contact area Clean rim with wire brush Inspect 5 degree tapered bead seat band and the rim base in the bead seating area to determine if the transverse weld trims are flat or concave. Replace defective part(s). **Note:** Weld trim should follow rim contour. Mount tyre using a lubricant such as Murphy's Tyre and tube Mounting Compound, or equivalent, on tyre beads and rim bead seat area.

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	10	Wheel Nut	590	435

TYRE PRESSURES

Tyre pressures on this pages apply to the truck serial number range specified only, Gross Vehicle Weight (G.V.W.) and axle weights may vary between truck derivatives. Tyre pressure should be recalculated if not shown for a particular truck. Contact TEREX for assistance.

The tyre inflation pressures listed are manufacturers recommendations for G.V.W. travelling at maximum speed. TEREX Advise that operators check tyre inflation pressures with tyre manufactures to ensure correct setting for each particular application.

				Front		Centre		Rear	
Truck	Brand	Size	Pattern	b	lbs/in^2	b	lbs/in^2	b	lbs/in^2
TA27	Bridgestone	23.5 R25	VLT	4.4	64	4.4	64	4.4	64
A889	Bridgestone	23.5 R25	VMT	4.4	64	4.4	64	4.4	64
A892	Bridgestone	23.5 R25	VKT	4.4	64	4.4	64	4.4	64
	Michelin	23.5 R25	XADT	3.8	55	3.4	50	3.8	55
	Double Coin	23.5 R25	REM2	4.5	65	4.5	65	4.5	55
	Triangle	23.5 R25	TB516	5.2	76	5.2	76	5.2	76
	Triangle	23.5 R25	TM518	5.2	76	5.2	76	5.2	76
	Triangle	23.5 R25	TL528	5.2	76	5.2	76	5.2	76
	Bridgestone	30/65 R25	VLT	3	43	3	43	3	43
	Michelin	30/65 R25	XADN	3.1	45	2.8	40	2.8	40
	Michelin	750/65 R25	XAD 65	3.1	45	2.8	40	2.8	40
TA30	Bridgestone	23.5 R25	VLT	4.8	69	4.8	69	4.8	69
A894	Bridgestone	23.5 R25	VMT	4.8	69	4.8	69	4.8	69
A908	Bridgestone	23.5 R25	VKT	4.8	69	4.8	69	4.8	69
A897	Michelin	23.5 R25	XADT	4.1	60	4.1	60	4.1	60
A911	Double Coin	23.5 R25	REM2	4.5	65	4.5	65	4.5	65
	Triangle	23.5 R25	TB516	5.2	76	7.2	76	5.2	76
	Triangle	23.5 R25	TM518	5.2	76	5.2	76	5.2	76
	Triangle	23.5 R25	TL528	5.2	76	5.2	76	5.2	76
	Bridgestone	30/65 R25	VLT	3.2	46	3.2	46	3.2	46
	Michelin	30/65 R25	XADN	3.1	45	3.1	45	3.1	45
	Michelin	750/65 R25	XAD 65	3.1	45	3.1	45	3.1	45

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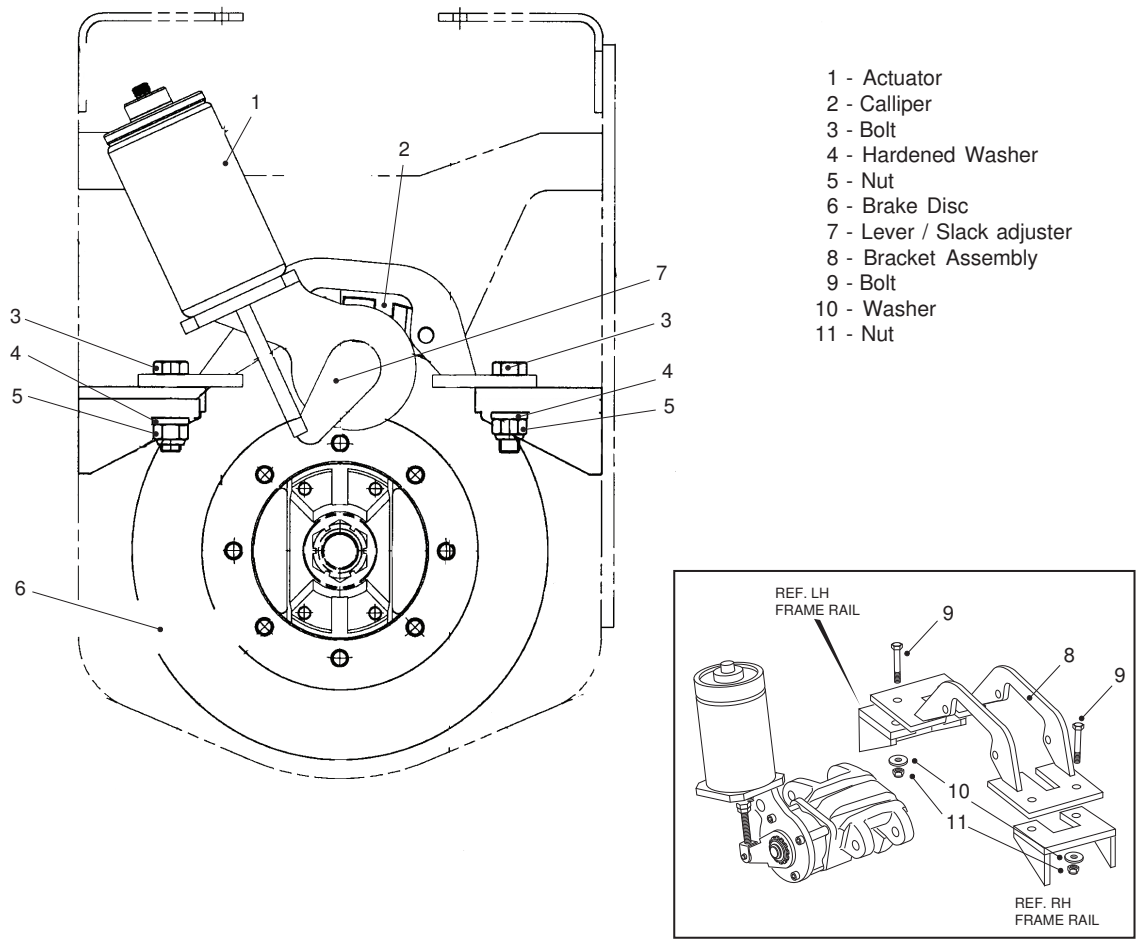


1 - Actuator
2 - Calliper
3 - Bolt
4 - Hardened Washer
5 - Nut
6 - Brake Disc
7 - Lever / Slack adjuster
8 - Bracket Assembly
9 - Bolt
10 - Washer
11 - Nut

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.

DESCRIPTION AND OPERATION

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

The parking brake consists of a sliding calliper (2) acting on a brake disc (6) on a rear drive line. The parking brake is of 'Inverted Design', meaning that it requires pressure to hold the parking brake off.

Operation is by a spring applied/hydraulically released actuator (1). Actuator (1) is connected to lever & slack adjuster (7) via clevis rod and pin (3 and 4 Figure 2). Lever (10, Figure 2), is mated to slack adjuster (12, Figure 2) rotor end. This in turn mates to the piston (14, Figure 2). Slack adjuster and lever automatically maintain brake clearance after each application.

A push control on the dash panel activates the park brake solenoid in the main hydraulic valve, controlling oil pressure from the accumulators to actuator (1). Application of the push control releases oil from actuator (1) allowing internal springs in the actuator to apply the parking brake. Pulling out the push control directs oil pressure from the accumulators to actuator (1), compressing internal springs, to release the parking brake.

Note: The parking brake is automatically applied when the ignition is switched off or the Transmission is in neutral and the transmission output speed is less than 60 RPM ~ 1MPH

REMOVAL

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

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

⚠ 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. Remove storage box under the Instructor seat by referring to operator compartment - Instructor seat and Mountng, Removal and Disassembly Section 260-0110

4. Undo and remove the bolts(3) securing the park brake service switch cover plate(4) . (Refer to fig. 3)

5.Press the bottom of the parkbrake service switch(1) to release the park brake.

Note: The park brake service alarm (2) will remain on continously while the auto park brake system is disabled. (Refer to fig. 3)

6. Pull out push control to release the parking brake.

7. Remove 4-off cotter pins (18) from mounting pins (19).

8. The calliper (17) and constituent parts should be held in place by bracket (8, Figure 1), which the mounting pins (19) are located through.

9. Disconnect the clevis rod (3) end from the lever (10) by removing cotter pin (5) and clevis pin (4).

10. Push park brake button in, releasing hydraulic pressure. This should cause the clevis rod (3) and clevis pin (4) end to retract away from the lever (10).

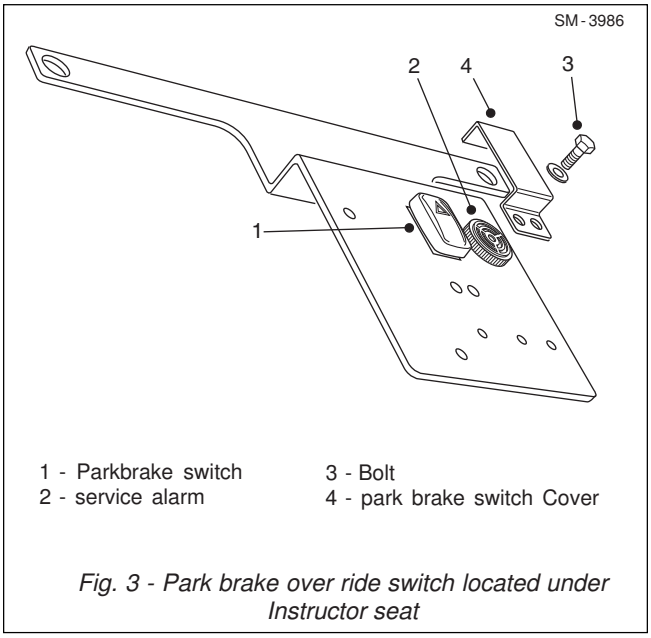
Note: The parking brake will automatically apply on engine shutdown or when the transmission is in neutral and output speed is less than 60RPM~1MPH. Ensure there is sufficient clearance for actuator rod travel.

11. Switch off the engine and place the battery master switch in the 'Off' position.

12. Disconnect and plug hydraulic line from actuator (1). Cap actuator (1) to prevent ingress of dirt.

13. Remove nuts (7) and washers (6) securing actuator (1) to arm (20).

14. Actuator (1) can be removed from the arm (20).



1 - Parkbrake switch
2 - service alarm
3 - Bolt
4 - park brake switch Cover

Fig. 3 - Park brake over ride switch located under Instructor seat

DISASSEMBLY

Numbers in parentheses refer to Figure 2.

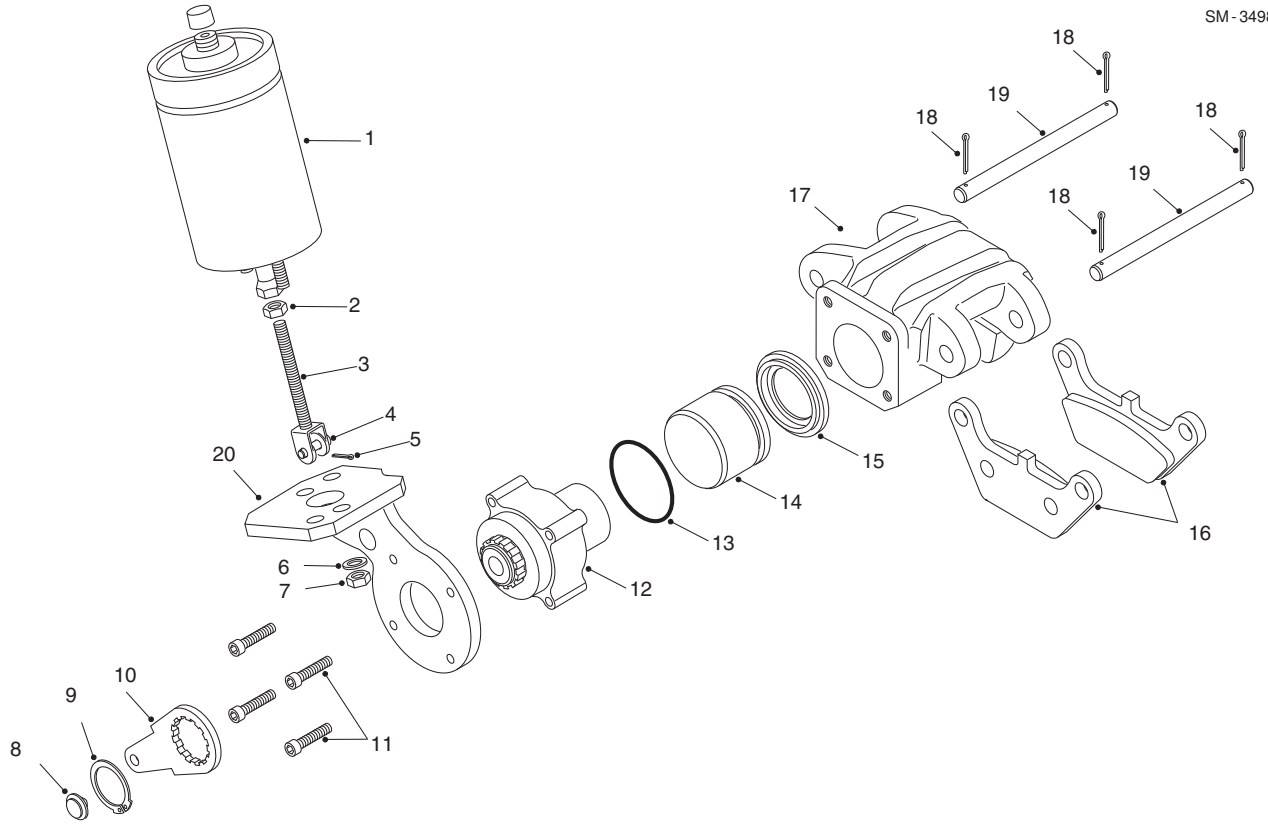
1. Remove cap plug (8), and insert a 3/8" hex socket onto the shaft and rotate in the opposite direction of actuation until you feel a positive stop. Do not over torque.

2. Remove the retaining ring (9) and lever (10) from the slack adjuster (12) rotor end.

3. Remove the four bolts (11) and arm (20).

4. The slack adjuster (12) can now be removed from the calliper (17) mounting face .

5. The O-ring (13), piston (14) and seal (15) should be removed when removing the calliper (17).



1 - Actuator
2 - Jam Nut
3 - Clevis Rod
4 - Clevis Pin
5 - Cotter Pin
6 - Washer
7 - Nut
8 - Cap Plug
9 - Retaining Ring
10 - Lever
11 - Bolt
12 - Slack Adjuster
13 - O-ring
14 - Piston
15 - Dust Seal
16 - Brake Pad /Holder
17 - Calliper
18 - Cotter Pin
19 - Mounting Pin
20 - Arm

Fig. 2 - Exploded View of Parking Brake Assembly

Note: Ensure that the piston (14) and seal (15) are pushed through the calliper at removal, thus away from slack adjuster end.

6. Remove seal (15), piston (14) and O-ring (13) from the slack adjuster (12) and calliper (17) bore.

7. Ensure that the calliper housing (17) is held in place. Remove the mounting pins (19), this should enable the calliper (17) to be removed from the chassis frame.

8. Should it be necessary to aid in the removal of the calliper (17), remove the bolts (9, Figure 1), washers (10, Figure 1) and nuts (11, Figure 1) securing the bracket (8, Figure 1) to the frame rail. Remove the bracket (8, Figure 1) and the calliper (17).

INSPECTION

Numbers in parentheses refer to Figure 2.

Note: Polish any discoloured or stained areas with crocus cloth only. Use finger pressure and rotate the crocus cloth in the bore. Do not use any other kind of abrasive cloth.

1. Examine all parts carefully. Parts showing signs of excessive wear, damage or corrosion should be replaced.

2. Clean all parts with denatured alcohol and either wipe dry with a clean lint free cloth or blow dry with an air hose.

3. Inspect the calliper housing (17) bore for scoring, pitting or corrosion. According to the severity of wear or damage, light scores and stains may be removed. For more severe damage renew as necessary.

4. Similarly, inspect items whose surfaces may be considered 'critical', for example the piston (14) outer diameter and mating elements. Any such components whose damage will affect operational performance or integrity of the system should be replaced where applicable.

5. Check to see that the brake disc (9, Figure 1) is not bent of misshapen.

6. Inspect the lever (10) for wear and renew it if necessary.

7. Check to make sure that the mounting pins (19) slide freely through the mating holes of the calliper (17).

8. Check to make sure that the slack adjuster (12) is still functioning properly. To do this, rotate the lever (10) while it is mated to the rotor end of the slack adjuster (12), in the direction of actuation. The coloured shaft that is extending through the spring cup should rotate and extend while the rotor is turning.

9. If the coloured shaft rotated and extended out while the rotor was rotated, it should not rotate but only retract inwards when the rotor is rotated back to its home position.

Repeating this procedure several times will show the coloured shaft properly adjusting outwards, simulating adjustment due to pad wear.

10. To return the sub-assembly back to its original starting position, remove the plastic cap plug (8) from the rotor end of the slack adjuster (12) , and insert a 3/8" socket into the rotor until it seats on the shaft. Turn the socket the opposite direction of the brake unit (Counter clockwise for a CW unit, or clockwise for a CCW unit), until you feel a positive stop. **Do not** over torque.
11. Inspect the actuator (1) and bracket (20) for damage or cracks. Renew the entire actuator (1), if the outer housing, pull rod or hydraulic fitting are damaged, or if there is any leakage from the unit.

ASSEMBLY

Numbers in parentheses refer to Figure 2.

1. Take the actuator (1) assembly, which includes the clevis rod (3) and pin end, secure it in place to the mating surface of the arm (20), using the four washers (6) with nuts (7).

Note: Ensure that all parts are clean and are suitable for use prior to assembly. When reinstalling the piston (14), ensure that it is fitted from the slack adjuster (12) mounting face end of the calliper (17).

2. Coat the bore of the calliper (17) with silicon grease.

3. Insert a new seal (15) into the calliper (17) bore. Make sure that the seal is not damaged or torn during this process.

Note: Care should be exercised when inserting the piston (14), so as to not damage the piston or other components during this assembly stage.

4. Install the piston (14) into the bore from the same end as the seal. Push the piston (14) through the seal (15) until the seal (15) is seated fully into the piston (14) groove.

5. Lubricate and install the O-ring (13) into the end cover groove .

6. Install the slack adjuster (12) sub-assembly into the calliper (17) and place the arm (20), with actuator (1) attached into the rotor end of the slack adjuster (12).

7. Secure it in place using the four bolts (11). Torque the bolts (11) to a value of 40 - 60 lbf ft (54 - 81 Nm).

8. Place the lever (10) on the spline of the rotor end of the slack adjuster (12) in the correct orientation, and install the retaining ring (9) in the groove.

9. Insert a new cap plug (8) into the end of the slack adjuster (12) rotor.

INSTALLATION

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

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

Do not pressurize the actuator until the following instruction has been carried out. Pressurizing the actuator beforehand can result in serious brake damage.

1. Examine the brake pads (16) for wear or damage. If pad thickness is less than 1/32" (0.79mm), new pads should be fitted. If the pads are within lthe imit, they can be reused.

2. Ensure that the pads are installed in their original position.

Note: The thinner pad should be orientated nearest the actuator side of the calliper. This maintains the thicker pad on the carrier side of the calliper. which is necessary for wear reasons, in operation.

3. Ensure any new pads have the same friction material type as the old ones as determined by the code stamped on the pads.

4. Should the bracket assembly (8, Figure 1) have been removed, reinstall it to the frame rail, securing it in place using the bolts, washers and nuts (9,10 and 11 Figure 1).

5. Remount the calliper (17) and brake pads (16) in place, by locating the mounting pin (19) through the bracket (8, Figure 1) and the calliper (17).

6. Secure the calliper (17) in place between the bracket (8, Figure 1) support arms, by inserting the four cotter pins (18) in the mounting pins (19).

7. Remove the cap fitted to the actuator (1), to prevent dirt ingress at removal.

8. Connect the hydraulic line to the actuator (1). Start the vehicle. Ensure the park brake service switch is ON and pull the park brake button out.Thus, applying oil pressure into the actuator (1).

9. Install the clevis pin (4) through the clevis (rod (3) and lever (10). If the pin does not assemble freely, push the park brake button in, thus releasing the oil pressure from the actuator. At this stage, readjust the clevis rod (3) using the jam nut.

10. Reapply oil pressure to the actuator (1), by pulling the park brake button out.

Note: Ensure Parkbrake service switch is in the ON Position.

11. Repeat steps 8 to 10 until the pin (4) can be freely assembled. Install the cotter pin (5) and the torque clevis jam nut (2), hand tight plus ¼ turn, without causing the clevis to turn and bind the clevis pin (4) in the lever (10).

12. Actuate the brake several times to allow the slack adjuster (12) to fully adjust the brake to the proper pad gap, 0.025"-0.030" (0.635 - 0.762mm)

13.Switch OFF Parkbrake service switch and refit Cover and storage Box. (Refer to fig.3)

14. Remove the wheel blocks and place the steering lock bar in the 'Stowed' position.

MAINTENANCE

Every 250 hours

Test the park brake for proper operation. Check the brake pads and disc for wear.

> ⚠ **WARNING**
> **This time interval should only be used as a guide to maintenance, assuming 'normal' operating conditions, under hard use, checks should be carried out more frequently, at the discretion of the operator/serviceman.**

1. Check that floating parts move freely and that there is adequate freedom of movement for positive brake operation.

2. Check the actuator (1) linkage and verify that there is adequate freedom of movement for positive brake operation.

3. Check the brake disc (9, Figure 1) surface condition. Replace if it is badly warped, pitted or below the minimum recommended thickness. Check for loose mounting bolts (11) or cracks.

4. Check to see if the brake pads are worn to less than 1/32" (0.79mm) thick. Replace them if they are. In normal service, pads will need replacing only after prolonged use.

Brake Pad Replacement

⚠ WARNINGS
To replace the brake pads it is necessary to release the park brake by applying hydraulic pressure to the actuator chamber and rotating the actuator shaft in the opposite direction from where the lever is actuated. Replace the brake pads in pairs only!

To prevent personal injury and property damage, be sure that wheel blocks, blocking materials and lifting equipment are properly secured and of adequate capacity to perform the task safely.

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 the body safety prop, to secure it in the partially raised position.

3. Remove storage box under the Instructor seat by referring to operator compartment - Instructor seat and Mounting, Removal and Disassembly Section 260-0110

4. Undo and remove the bolts(3) securing the park brake service switch cover plate(4) . (Refer to fig. 3)

5.Press the bottom of the parkbrake service switch(1) to release the park brake.

Note: The park brake service alarm (2) will remain on continously while the auto park brake system is disabled. (Refer to fig. 3)

6. Pull out the park brake button to release the parking brake.

7. Remove the cap plug (8) from the end of the slack adjuster (12).

8. Insert a 3/8" socket into the rotor until it seats on the shaft. Turn the socket the opposite direction from the brake unit (counter-clockwise for a clockwise unit, or clockwise for a counter-clockwise unit), until you feel a positive stop. Do not over torque.

9. Using a hard wood dowel or flat edge of a large screwdriver, work the piston (14) back into the bore of calliper (17), by carefully prying against old pads and the brake disc.

10. Remove a cotter pin (18) from one end of each pin (19) and remove the pad pins and worn brake pads (16).

Note: To replace the pads it may be necessary to slide the calliper in its floating mount and not to remove or disassemble it.

Note: Stamped on the front of each pad is a code. The first character is a number that specifies the friction material type. Ensure new pads are the same type as the worn pads that were removed.

11. Install new brake pads (16) and secure them in place by reinstalling the pins.

12. After assembly, insert a 3/8" hex socket on to the shaft and rotate the shaft in the same direction as the actuation, until a clearance of 0.030" (0.762mm) is obtained between the pad and the disc.

13. Reinstall the cap plug (8). With the unit assembled and clearances correctly set, apply and release the park brake 10 times to allow the slack adjuster to find its position.

14.Switch off parkbrake switch(1), Refit cover and storage box.(Refer to fig. 3)

15.Remove wheel blocks and palce the steering lock bar in the 'STOWED' Position.

16. Apply the brakes lightly several times, allowing cooling time in between to burnish the new pads. Always burnish new pads since preburnished pads will have reduced braking power.

SPECIAL TOOLS

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

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
2	11	Bolt	54 - 81	40 - 60

* * * *

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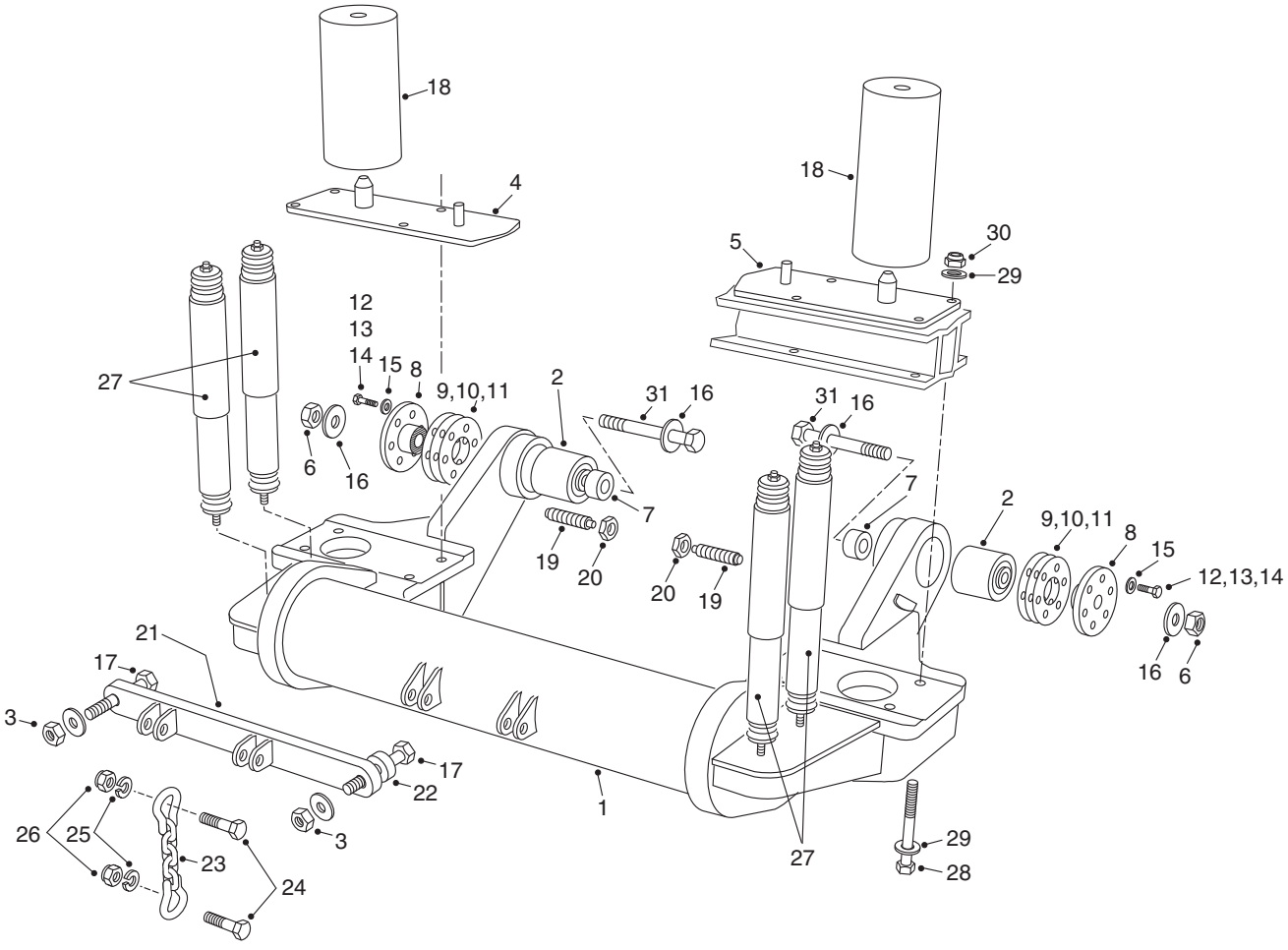


1 - Suspension Frame
2 - Spherilastic Bush
3 - Nut
4 - Axle Plate
5 - Axle Plate
6 - Locknut
7 - Inner Bush
8 - Outer Bush
9 - Shim
10 - Shim
11 - Shim
12 - Bolt
13 - Bolt
14 - Bolt
15 - Washer
16 - Hardened Washer
17 - Bolt
18 - Rubber Mounts
19 - Stop Screw
20 - Locknut
21 - Link Assy
22 - Spacer
23 - Chain & Shackle
24 - Bolt
25 - Lockwasher
26 - Nut
27 - Shock Absorber
28 - Bolt
29 - Hardened Washer
30 - Nut
31 - Bolt

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) which pivots on the front frame.

Suspension is provided by two heavy duty rubber suspension mounts (18) mounted between axle plates (4 & 5) and front frame. In addition, there are four heavy duty double acting shock absorbers (27) (two off each side) to smooth out the ride. Two chain and shackle assemblies (23) provide extra retention on rebound.

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 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 front 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. Disconnect hydraulic brake line at tee on front axle assembly. Disconnect differential breather line. Cap lines and fittings to prevent ingress of dirt.

8. Jack up suspension frame (1) and remove nuts (26), lockwashers (25) and bolts (24) securing chain and shackle assemblies (23) to suspension frame (1) and link assembly (21).

9. Support driveline and remove bolts securing driveline to front axle. Refer to Section 130-0010, FRONT AND REAR DRIVELINES.

10. Remove thread caps and mounting hardware securing shock absorbers (27) to suspension frame (1).

11. Using jack, lower suspension frame (1) onto a suitable trolley until rubber suspension mounts (18) are free of compression.

12. Remove thread caps and mounting hardware securing shock absorbers (27) to front frame. Remove shock absorbers (27), and remove rubber suspension mounts (18).

13. Support the rear end of suspension frame (1) using suitable equipment. Loosen and remove locknuts (20) securing stop screw (19) in front frame. Remove stop screw (19) from front frame.

14. Using torque multiplier (see Special Tools), loosen nuts (6) securing suspension frame (1) to front frame.

15. Remove nuts (6), hardened washers (16) and bolts (31) securing suspension frame (1) to front frame.

16. Remove bolts (12 - 14) and washers (15) securing outer bushes (8) to front frame. Remove inner bushes (7), outer bushes (8) and shims (9 - 11).

17. Carefully lower suspension frame (1) assembly onto the trolley and remove from under the vehicle.

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 nuts (30), hardened washers (29) and bolts (28) securing front axle assembly and axle plates (4 & 5) to suspension frame (1). Using suitable lifting equipment, remove front axle assembly from suspension frame (1).

2. If required, press spherilastic bushes (2) from suspension frame (1) using press tool and power press (See Special Tools).

3. If required, remove bolts (17), spacer (22), washers and nuts (3) securing link assembly (21) to front frame.

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. If spherilastic bushes (2) were removed during disassembly, install new spherilastic bushes as follows:

a. Coat bores in suspension frame (1) with a water based lubricant.

b. Using press tool and power press (See Special Tools), install spherilastic bushes (2) in suspension frame (1).

2. Using suitable lifting equipment, position front axle assembly on suspension frame (1). Position axle plates (4 & 5) and secure with bolts (28), hardened washers (29) and locknuts (30). Tighten locknuts (30) to a torque of 680 Nm (501 lbf ft).

3. If removed, install link assembly (21) to front frame using bolts (17), spacer (22), washers and nuts (3).

INSTALLATION

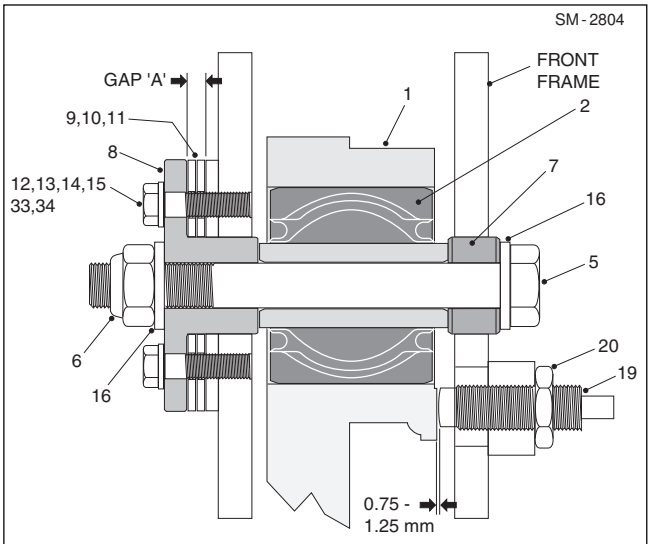
Numbers in parentheses refer to Figs. 1 & 2.

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

1. Position suspension frame (1) assembly and trolley under the front frame with spherilastic bushes (2) to the rear.

2. Using suitable lifting equipment, lift suspension frame (1) assembly and locate inner bushes (7) and outer bushes (8) in front frame.

3. Install bolts (31), hardened washers (16) and nuts (6) through spherilastic bearings (2). Hand tighten nuts (6) at this stage.



1 - Suspension Frame	12 - Bolt
2 - Spherilastic Bush	13 - Bolt
5 - Bolt	14 - Bolt
6 - Locknut	15 - Washer
7 - Inner Bush	16 - Hardened Washer
8 - Outer Bush	19 - Stop Screw
9 - Shim	20 - Locknut
10 - Shim	33 - Loctite Primer T
11 - Shim	34 - Loctite 648

Fig. 2 - Sectional View of Suspension Pivot

4. Position suspension frame (1) completely to one side and take a measurement of the gap between boss on front frame and inside face of outer bush (8). Half this size to obtain the thickness of shim (9 - 11) pack required for Gap 'A' (Fig. 2) at both sides.

Note: Do not overshim, it is important to leave some clearance.

5. Remove outer bushes (8) and shim Gap 'A' at both sides with shims (9 - 11) calculated at Step 4.

6. Reinstall outer bushes (8), bolts (12 - 14) and washers (15). Hand tighten bolts at this stage.

7. Install rubber suspension mounts (18) between axle plates (4 & 5) and front frame.

8. Mount two hydraulic jacks (see Special Tools) below suspension frame. Using hydraulic pump to operate hydraulic jacks, compress rubber suspension mounts (18) to 300mm (11.8").

9. Using torque multiplier (see Special Tools), tighten nuts (6) to a torque of 1 835 Nm (1 325 lbf ft).

10. Remove bolts (12 - 14) and washers (15). Apply

Loctite Primer T (33) and Loctite 648 (34) to threads of bolts and reinstall bolts (12 - 14) and washers (15). Tighten bolts (12 - 14) to a torque of 170 Nm (125 lbf ft).

11. Connect chain and shackle assemblies (23) between link assembly (21) and suspension frame (1) and secure with bolts (24), lockwashers (25) and nuts (26).

12. Install shock absorbers (27) to the front frame and secure with locknuts. Tighten upper locknuts to a torque of 103 Nm (74 lbf ft). Refit thread caps.

13. Align bottom of shock absorbers (27) with mounting holes on suspension frame (1) and secure with locknuts. Tighten lower locknuts to a torque of 103 Nm (74 lbf ft). Refit thread caps.

14. Install and adjust stop screw (19) to achieve 0.75 - 1.25 mm clearance (Fig. 2) between suspension frame (1) and stop screw (19).

15. Once clearance is obtained, install and tighten locknut (20).

16. Remove trolley from underneath tractor frame.

17. Install driveline between axle and transmission and secure with bolts removed previously. Refer to Section 130-0010, FRONT AND REAR DRIVELINES.

18. Reconnect hydraulic brake line at tee on front axle assembly. Reconnect differential breather line. Cap lines and fittings to prevent ingress of dirt.

19. 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 590 Nm (435 lbf ft).

20. Using suitable lifting equipment, position opposite tyre and rim assembly on the opposite front wheel and secure with wheel nuts.

21. Using suitable lifting equipment, raise front frame sufficiently to remove stands and blocking from the front frame and articulation pivot. Lower vehicle to the ground and remove lifting equipment. Tighten all wheel nuts to a torque of 590 Nm (435 lbf ft).

22. Remove wheel blocks from rear road wheels and place the steering lock bar in the 'Stowed' position.

23. Bleed all air from hydraulic brake lines. Refer to Section 165-0010, BRAKE PARTS - REAR.

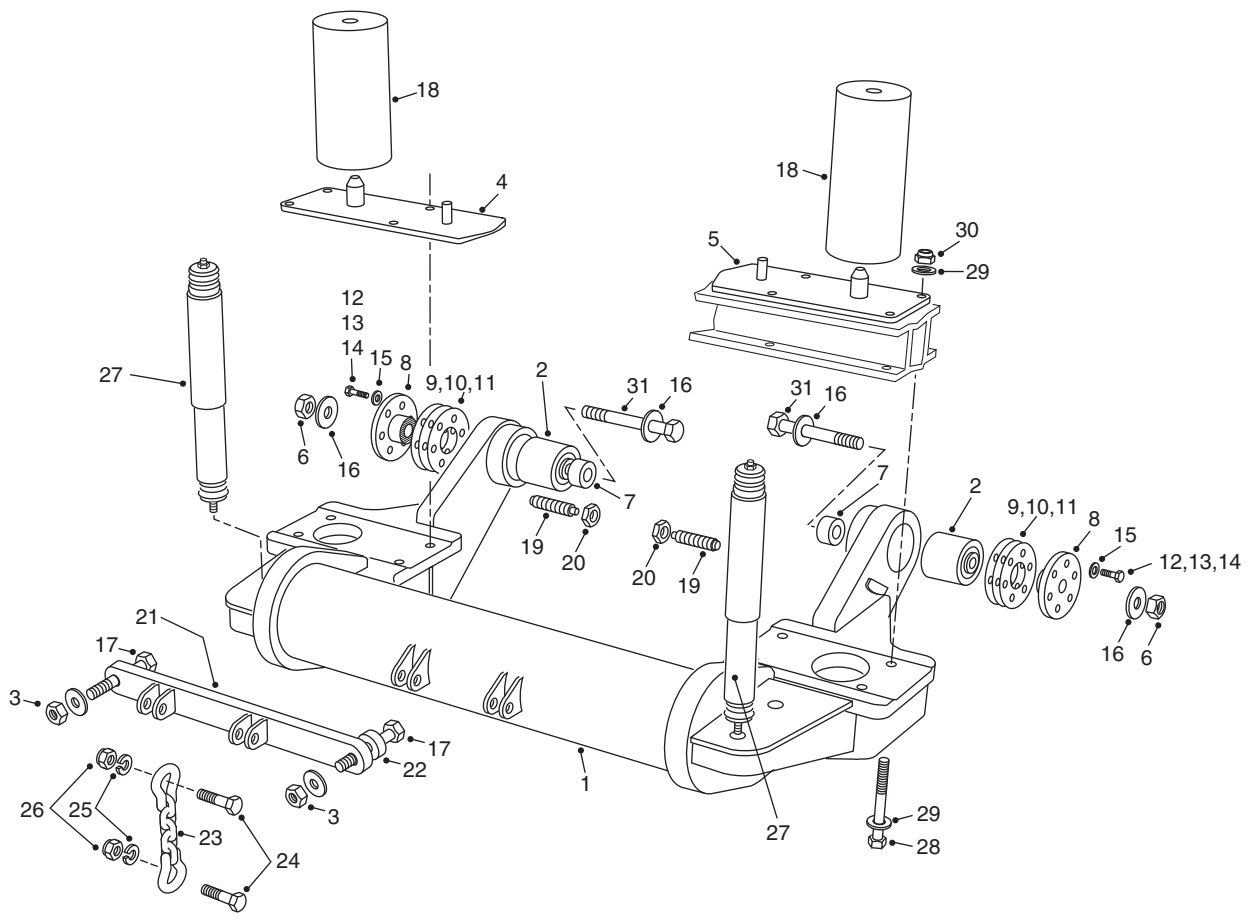
SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of torque multiplier, 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	lbf ft
1	6	Nut	1835	1325
1	12 - 14	Bolt	170	125
1	30	Locknut	680	501
1	27	Shock Absorber Nut (Upper)	103	74
1	27	Shock Absorber Nut (Lower)	103	74
-	-	Wheel Nut	590	435

* * * *



1 - Suspension Frame
2 - Spherilastic Bush
3 - Nut
4 - Axle Plate
5 - Axle Plate
6 - Locknut
7 - Inner Bush
8 - Outer Bush
9 - Shim
10 - Shim
11 - Shim
12 - Bolt
13 - Bolt
14 - Bolt
15 - Washer
16 - Hardened Washer
17 - Bolt
18 - Rubber Mounts
19 - Stop Screw
20 - Locknut
21 - Link Assy
22 - Spacer
23 - Chain & Shackle
24 - Bolt
25 - Lockwasher
26 - Nut
27 - Shock Absorber
28 - Bolt
29 - Hardened Washer
30 - Nut
31 - Bolt

Fig. 1 - Exploded View of Front Suspension

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

This Section applies to new build trucks from the serial numbers identified on Table 1 below.

TA27 G7 - from Serial No. A8891011
TA30 G7 - from Serial No. A8941011
TA30 G7 (RS) - from Serial No. A9081011

Table 1 - Models from which this Section is Effective

The front axle assembly is mounted on the leading arms of suspension frame (1) which pivots on the front frame.

Suspension is provided by two heavy duty rubber suspension mounts (18) mounted between axle plates (4 & 5) and front frame. In addition, there are two heavy duty double acting shock absorbers (27) (one on each side) to smooth out the ride. Two chain and shackle assemblies (23) provide extra retention on rebound.

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 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 front 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. Disconnect hydraulic brake line at tee on front axle assembly. Disconnect differential breather line. Cap lines and fittings to prevent ingress of dirt.

8. Jack up suspension frame (1) and remove nuts (26), lockwashers (25) and bolts (24) securing chain and shackle assemblies (23) to suspension frame (1) and link assembly (21).

9. Support driveline and remove bolts securing driveline to front axle. Refer to Section 130-0010, FRONT AND REAR DRIVELINES.

10. Remove thread caps and mounting hardware securing shock absorbers (27) to suspension frame (1).

11. Using jack, lower suspension frame (1) onto a suitable trolley until rubber suspension mounts (18) are free of compression.

12. Remove thread caps and mounting hardware securing shock absorbers (27) to front frame. Remove shock absorbers (27), and remove rubber suspension mounts (18).

13. Support the rear end of suspension frame (1) using suitable equipment. Loosen and remove locknuts (20) securing stop screw (19) in front frame. Remove stop screw (19) from front frame.

14. Using torque multiplier (see Special Tools), loosen nuts (6) securing suspension frame (1) to front frame.

15. Remove nuts (6), hardened washers (16) and bolts (31) securing suspension frame (1) to front frame.

16. Remove bolts (12 - 14) and washers (15) securing outer bushes (8) to front frame. Remove inner bushes (7), outer bushes (8) and shims (9 - 11).

17. Carefully lower suspension frame (1) assembly onto the trolley and remove from under the vehicle.

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 nuts (30), hardened washers (29) and bolts (28) securing front axle assembly and axle plates (4 & 5) to suspension frame (1). Using suitable lifting equipment, remove front axle assembly from suspension frame (1).

2. If required, press spherilastic bushes (2) from suspension frame (1) using press tool and power press (See Special Tools).

3. If required, remove bolts (17), spacer (22), washers and nuts (3) securing link assembly (21) to front frame.

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. If spherilastic bushes (2) were removed during disassembly, install new spherilastic bushes as follows:

a. Coat bores in suspension frame (1) with a water based lubricant.

b. Using press tool and power press (See Special Tools), install spherilastic bushes (2) in suspension frame (1).

2. Using suitable lifting equipment, position front axle assembly on suspension frame (1). Position axle plates (4 & 5) and secure with bolts (28), hardened washers (29) and locknuts (30). Tighten locknuts (30) to a torque of 680 Nm (501 lbf ft).

3. If removed, install link assembly (21) to front frame using bolts (17), spacer (22), washers and nuts (3).

INSTALLATION

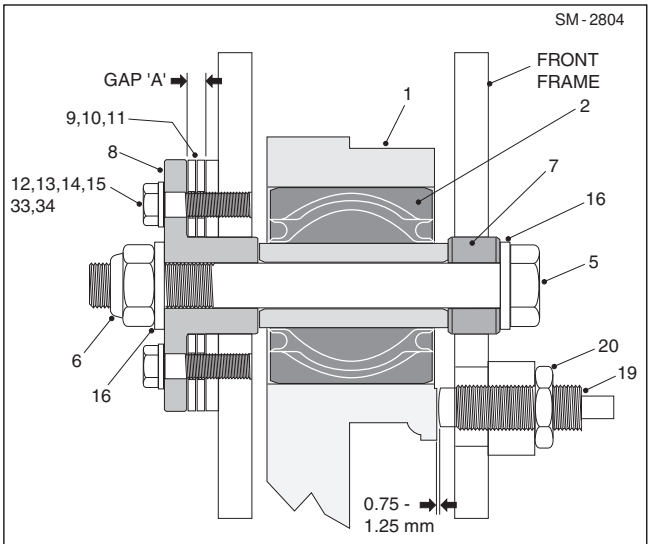
Numbers in parentheses refer to Figs. 1 & 2.

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

1. Position suspension frame (1) assembly and trolley under the front frame with spherilastic bushes (2) to the rear.

2. Using suitable lifting equipment, lift suspension frame (1) assembly and locate inner bushes (7) and outer bushes (8) in front frame.

3. Install bolts (31), hardened washers (16) and nuts (6) through spherilastic bearings (2). Hand tighten nuts (6) at this stage.



1 - Suspension Frame	12 - Bolt
2 - Spherilastic Bush	13 - Bolt
5 - Bolt	14 - Bolt
6 - Locknut	15 - Washer
7 - Inner Bush	16 - Hardened Washer
8 - Outer Bush	19 - Stop Screw
9 - Shim	20 - Locknut
10 - Shim	33 - Loctite Primer T
11 - Shim	34 - Loctite 648

Fig. 2 - Sectional View of Suspension Pivot

4. Position suspension frame (1) completely to one side and take a measurement of the gap between boss on front frame and inside face of outer bush (8). Half this size to obtain the thickness of shim (9 - 11) pack required for Gap 'A' (Fig. 2) at both sides.

Note: Do not overshim, it is important to leave some clearance.

5. Remove outer bushes (8) and shim Gap 'A' at both sides with shims (9 - 11) calculated at Step 4.

6. Reinstall outer bushes (8), bolts (12 - 14) and washers (15). Hand tighten bolts at this stage.

7. Install rubber suspension mounts (18) between axle plates (4 & 5) and front frame.

8. Mount two hydraulic jacks (see Special Tools) below suspension frame. Using hydraulic pump to operate hydraulic jacks, compress rubber suspension mounts (18) to 300mm (11.8").

9. Using torque multiplier (see Special Tools), tighten

nuts (6) to a torque of 1 835 Nm (1 325 lbf ft).

10. Remove bolts (12 - 14) and washers (15). Apply Loctite Primer T (33) and Loctite 648 (34) to threads of bolts and reinstall bolts (12 - 14) and washers (15). Tighten bolts (12 - 14) to a torque of 170 Nm (125 lbf ft).

11. Connect chain and shackle assemblies (23) between link assembly (21) and suspension frame (1) and secure with bolts (24), lockwashers (25) and nuts (26).

12. Install shock absorbers (27) to the front frame and secure with locknuts. Tighten upper locknuts to a torque of 103 Nm (74 lbf ft). Refit thread caps.

13. Align bottom of shock absorbers (27) with mounting holes on suspension frame (1) and secure with locknuts. Tighten lower locknuts to a torque of 103 Nm (74 lbf ft). Refit thread caps.

14. Install and adjust stop screw (19) to achieve 0.75 - 1.25 mm clearance (Fig. 2) between suspension frame (1) and stop screw (19).

15. Once clearance is obtained, install and tighten locknut (20).

16. Remove trolley from underneath tractor frame.

17. Install driveline between axle and transmission and secure with bolts removed previously. Refer to Section 130-0010, FRONT AND REAR DRIVELINES.

18. Reconnect hydraulic brake line at tee on front axle assembly. Reconnect differential breather line. Cap lines and fittings to prevent ingress of dirt.

19. 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 590 Nm (435 lbf ft).

20. Using suitable lifting equipment, position opposite tyre and rim assembly on the opposite front wheel and secure with wheel nuts.

21. Using suitable lifting equipment, raise front frame sufficiently to remove stands and blocking from the front frame and articulation pivot. Lower vehicle to the ground and remove lifting equipment. Tighten all wheel nuts to a torque of 590 Nm (435 lbf ft).

22. Remove wheel blocks from rear road wheels and place the steering lock bar in the 'Stowed' position.

23. Bleed all air from hydraulic brake lines. Refer to Section 165-0010, BRAKE PARTS - REAR.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of torque multiplier, 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

			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	6	Nut	1835	1325
1	12 - 14	Bolt	170	125
1	30	Locknut	680	501
1	27	Shock Absorber Nut (Upper)	103	74
1	27	Shock Absorber Nut (Lower)	103	74
-	-	Wheel Nut	590	435

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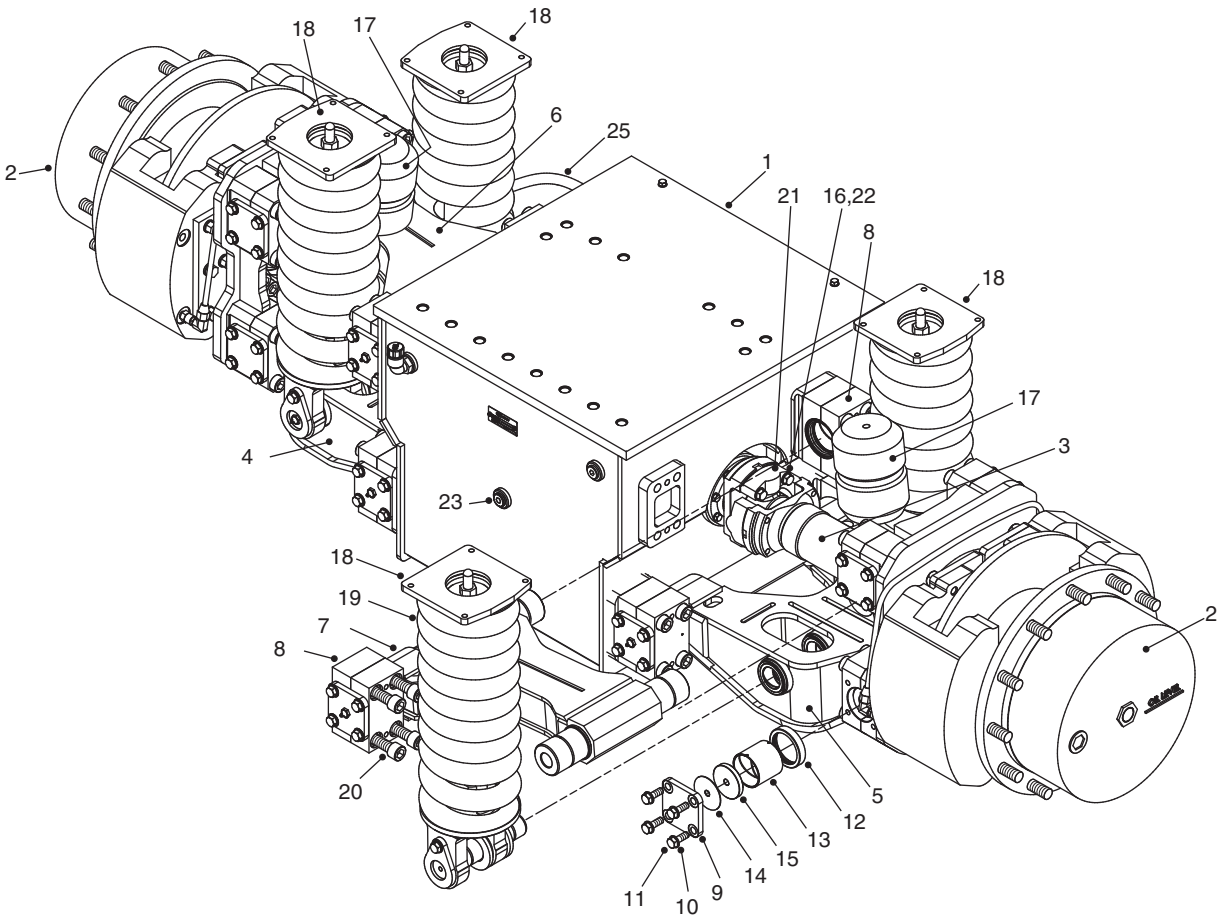


1 - Axle Housing
2 - Knuckle & Wheel Head Assembly
3 - Driveshaft
4 - Lower RH Wishbone
5 - Lower LH Wishbone
6 - Upper RH Wishbone
7 - Upper LH Wishbone
8 - Wishbone Pivot Block
9 - End Cap
10 - Washer
11 - Bolt
12 - Seal Assembly
13 - Bush
14 - Shim
15 - Washer
16 - Washer
17 - Bumpstop
18 - Spring Mount
19 - Spring
20 - Bolts
21 - Axle Half Shaft
22 - Bolt
23 - Oil Plug

Fig. 1 - Front Suspension Assembly Detail

DESCRIPTION

Numbers in parentheses refer to Fig. 1 unless otherwise stated.

The front axle assembly is mounted to the front chassis frame, through the top plate of the front axle housing (1). The complete unit is pivoted through the front frame. Suspension is provided by four spring and damper assemblies (2-off each side) which are linked to lower wishbones (4 & 5) and are secured at their tops to the front frame through spring mounts (18).

Bumpstops are provided to limit the travel of the suspension assemblies during fully loaded conditions.

REMOVAL AND 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.

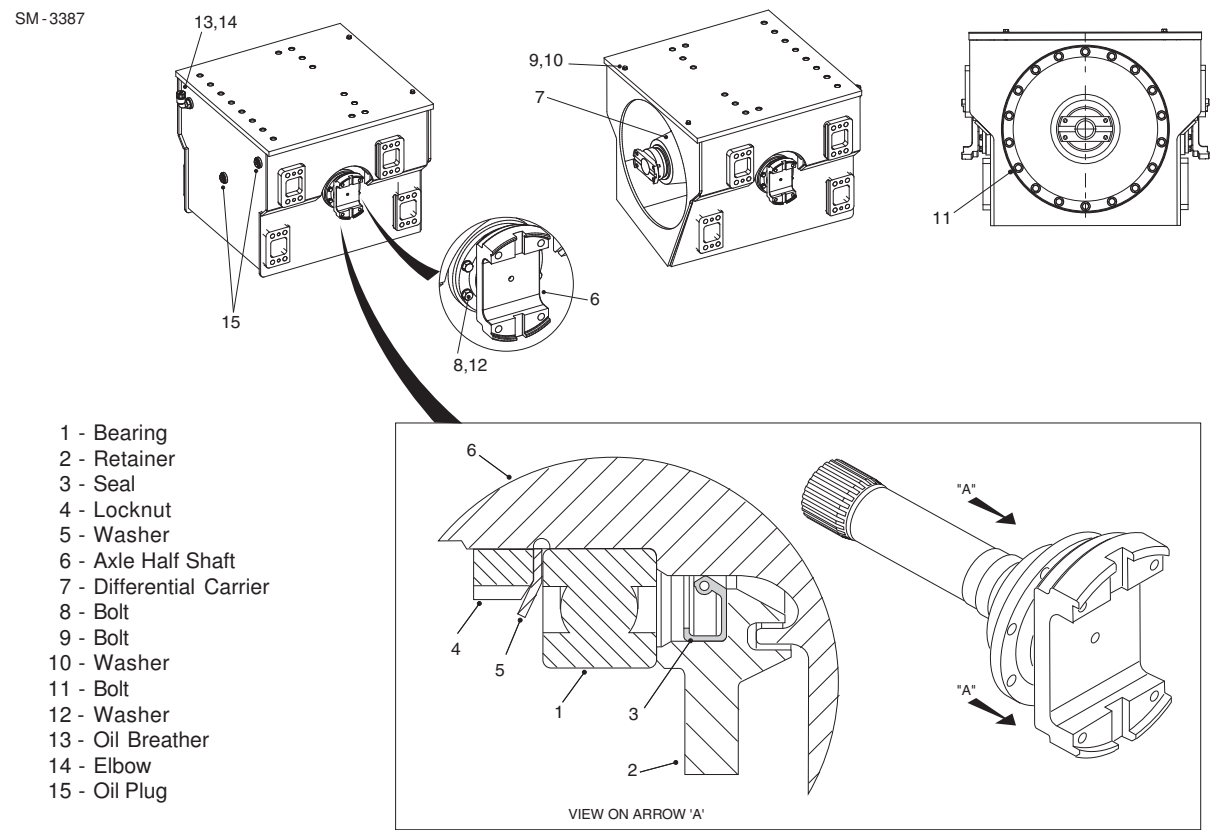


Fig. 2 - Axle Housing / Differential Assembly Detail

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. Disconnect hydraulic brake line at tee on front axle assembly. Dissconnect differential breather line. Cap lines and fittings to prevent ingress of dirt.

8. Remove all dirt and debris from critical access areas around the suspension assembly and unit. Ensure suitable lifting equipment is used to support components which may be a danger to service personnel due to increased weight caused by foreign objects / debris build up during normal operation of the vehicle.

9. Remove clamped steering hoses and guard to allow access to axle housing screws which secure the suspension assembly to the front of the chassis frame.

10.Support driveline and remove bolts securing driveline to front axle. Refer to Section 130-0010, FRONT DRIVELINES.

11. Loosen bolts securing Transmission mounts to frame, to allow transmission to be jacked up enough to gain access to bolts securing front suspension assembly to the chassis frame. Refer to Section 120-0010 TRANSMISSION AND MOUNTING.

12. Using fabricated tools (Fig. 13) to allow access to axle housing screws. Remove screws securing suspension assembly to the frame.

13. Carefully lower front suspension assembly onto a

suitable trolley and remove it from under the vehicle.

Numbers in parentheses refer to Fig. 1 unless otherwise stated.

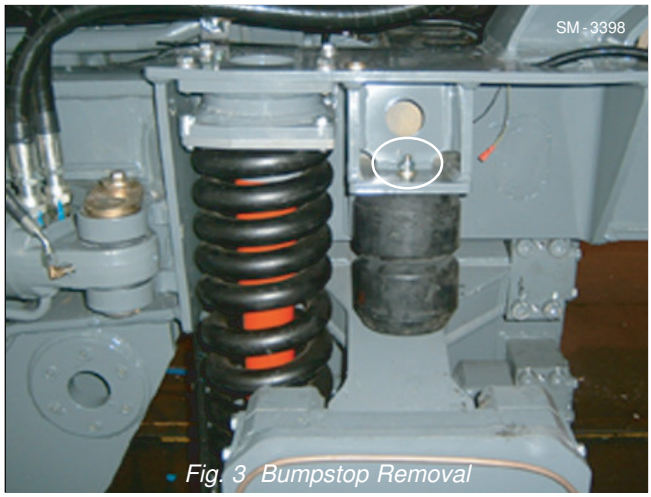


Fig. 3 Bumpstop Removal

14. Remove locknuts, washers (Fig. 3) and bump stops (17) from chassis frame.

Numbers in Parentheses refer to Fig. 4 unless otherwise stated.

15. Using special tool (15502116) and a suitable torque wrench, untorque bolts (1) securing brake callipers (3) to the calliper carrier plate (4).

16. Carefully remove bolts (1), washers (2) and brake callipers (3) from wheel head (5) assembly.

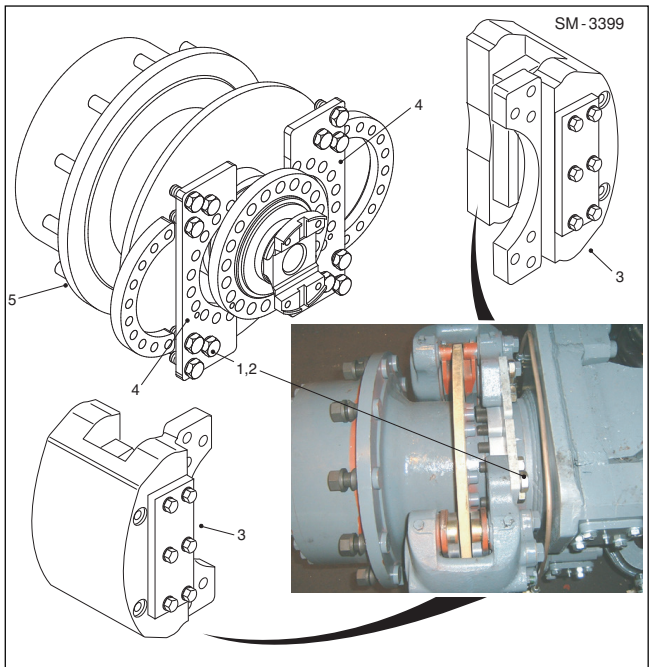


Fig. 4 Brake Calliper Removal.

Numbers in parentheses refer to Fig.5 & 11 unless otherwise stated.
17. Remove locknuts and bolts securing suspension damper upper spring mount (1) to chassis frame mounting bracket.

18. Remove bolts (7) and washers (6). Carefully release mounting pins (5) from the lower spring mounts (2). This should allow for complete removal of spring damper assemblies. Use suitable equipment to prise dampers from the suspension assembly.

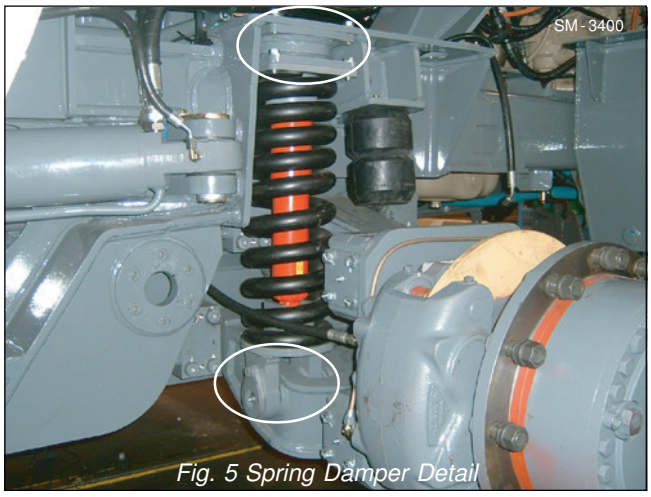


Fig. 5 Spring Damper Detail

19. If necessary, fully disassembly the suspension damper assemblies into individual parts as shown in Fig. 12.

Numbers in parentheses refer to Fig. 1 unless otherwise stated.

20. Remove bolts (16) and washers (22) securing driveshafts (3) to axle half shafts (21) and wheel head (1) flange shaft. Remove driveshafts (3).

21. With suitable supports in place, remove bolts (20) from lower pivot block (8) assemblies. Now remove bolts (11), washers (10) and end caps (9) from pivot blocks (8). This should allow for removal/ rotation of the lower wishbone (4 & 5) assemblies from the housing.

22. Carefully remove the screws (20) from upper pivot blocks (8), this should allow complete removal of upper wishbone (6) assemblies.

Numbers in parentheses refer to Fig's 1 & 6 unless otherwise stated.

23. Place wishbones (4,5 & 6), knuckle and wheel head assemblies (2) onto a suitable surface for complete removal of constituent parts of the assembly.

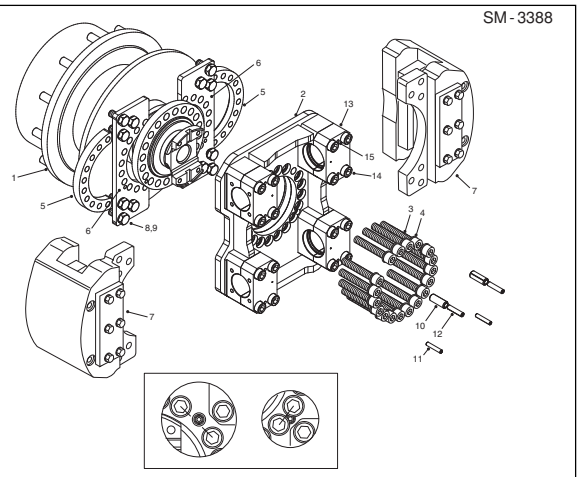


Fig. 6 Knuckle & Wheel Head Detail.

24. Place wheel knuckle and wheel head assembvly (1, Fig. 6) into a suitable jig. Untorque bolts (3, Fig. 6), remove bolts (3) and washers (4) from the knuckle (2).

25. Remove slot pins (10, 11 & 12) from the knuckle (2). Separate knuckle from wheel head assembly.

26. Refer to section 140-0020 AXLE GROUP HUB for disassembly of the wheel head and planetary group.

ASSEMBLY AND INSTALLATION

Numbers in parentheses refer to Fig. 1 unless otherwise stated.

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.

Note: Assembly of knuckle and wheel head (2) is largely the reverse of the steps outlined in disassemly. Although the following details highlight critical steps in this sub-assembly.

Numbers in parentheses refer to Fig. 6 unless otherwise stated.

1. Place wheel head (1) on table with flange facing upwards.

2. Insert bolts (8) and washers (9) into brake calliper carrier plate (6).
3. Drop knuckle (2) onto wheel head, taking care to align 4 slot pin holes.

4. Apply loctite (9029849) to screws (3) and pass them complete with washers (4) through knuckle (2) and wheel head (1).

5. Insert brake calliper carrier plate (7) complete with bolts (8) and washers (9) into position.

6. Insert half rings (5) into position, take care to ensure chamfer is on brake disc side.

7. Hand tighten screws (3). Repeat steps 5 to 7 for other side.

8. Insert 6-off slot pins (10,11 & 12) through knuckle (2), wheel head (1) and brake calliper carrier plate (6).

Note: Rotate pins to ensure they are parallel win the line shown (refer to Fig. 6), ensure pins are 180 degree to eahc other. Slot pin should be 7mm below knucle face for correct engagement with brake calliper plate.

9. Torque screws (3) to a value of 620 Nm (457 lbf ft).

10. Flip the assembly so that the wheel head (1) points upwards. The heads of brake calliper retaining bolts (8) should now be resting against the knuckle.

11. Apply loctite (9029849) to one set of brake calliper retaining bolts (8).

12. Slide brake calliper (7) into position and hand tighten retaining bolts (8).

13. Using special tool (15502116) torque bolts (8) to 515 Nm (380 lbf ft). **Note:** Since special tool ins 150mm in length. Torque wrench should be set at 448 Nm (330.5 lbf ft) to develop the 515 Nm needed. Ensure torque wrench is aligned with special tool whilst tightening.

14. Refer to section 140-0060, DIFFERENTIAL DRIVE HEAD, for detailed assembly of the front differential group.

Numbers in parentheses refer to Fig. 1 unless otherwise stated.

15. Using suitable lifting equipment, position axle housing (1) on bench with differential carrier mounting face in the upwards position.

16. Clean axle housing (1) mounting face and corresponding

face on the differential carrier (7, Fig. 2) with loctite (15269108).

17. Completely cover these faces in loctite sealant 576.

18. Using suitable lifting equipment, lift differential carrier assembly (7, Fig. 2) by input flange and drop into axle housing (1). Take care to ensure that crown wheel is on the correct side.

19. Clean mounting surfaces with loctite (15269108) and apply flange sealant 510.

20. Insert and torque 18-off, bolts (11, Fig. 2) to 250Nm (184 lbf ft).

21. Clean the threads of bolts (8, Fig. 2) with loctite (15269108) and apply loctite (9029849) . Insert bolts with washers (12, Fig. 2) and torque to a value of 27Nm (20 lbf ft).

22. Clean threads of all fittings; elbow, oil breather and oil plugs (13, 14 & 15, Fig. 2) with loctite (15269108) and apply loctite 577 thread sealant and secure.

23. **Note:** Check for correct rotation of driving head- anti clockwise rotation of input flange should cause forward motion.

24. Using suitable lifting equipment, position front axle housing (1) to the front frame assembly.

25. Secure axle housing / differential assembly to the chassis frame using 16-off M20 X 2.5 grade 10.9, min 20mm thread engagement cap screws. The correct torque value should be applied in two stages and the following sequence:

Note: Fabricated tools may be needed to gain adequate access to screws. Refer to Special Tools at the end of this section for details.

A. Torque screws in correct order (Fig. 7) to a value of 225Nm (166 lbf ft).

B. Repeat sequence for final torque value of 450Nm (336 lbf ft).

26. Move LH lower wishbone (5) into position using suitable lifting equipment. Remove end caps (9) from wishbone pivot blocks (8) and apply thermo-paul 1 grease liberally to wishbone pivot pins (2 & 3, Fig 8.) and the inside of pivot blocks (8).

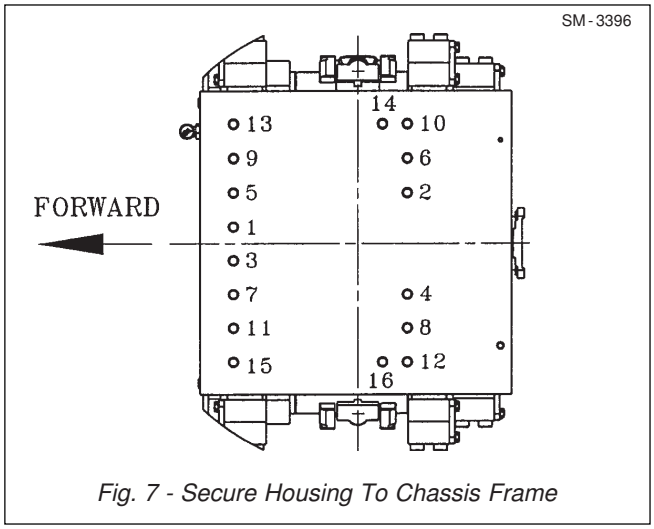


Fig. 7 - Secure Housing To Chassis Frame

27. Clean bolts (20) with loctite (15269108). Apply loctite (09029849) and torque bolts (20) to a value of 455 Nm (336 lbf ft).

28. Replace pivot block washers (15) and secure special tool 15502108 at each end with bolts (11) torqued to a value of 94Nm (69 lbf ft).

29. Measure the gap between each tool and pivot block (8) to determine shim (14) thicknessrequired to achieve an end float of 0.1-0.2mm (0.004"-0.008").

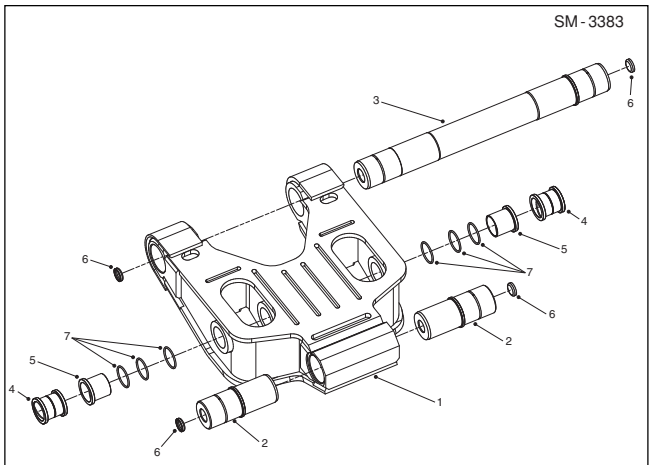


Fig. 8 - Exploded View - Lower Wishbone

30. Remove special tools 15502108, replace end caps (9) with the appropriate shims (14). Clean bolts (11) with loctite (15269108) and torque to a value of 94Nm (69 lbf ft).

31. Repeat steps 26 to 30 with RH lower wishbone (4) assembly.

Numbers in parentheses refer to Fig. 9 unless otherwise stated.

32. Sub-assembly of the upper wishbones, should be carried out as follows:

33. Ensure all surfaces and internal diameters of wishbone (1) are cleaned with loctite (15269108) or equivalent. Apply loctite (09029849) around pins (2 & 3) and inner faces of wishbone (1) ensuring all faces are covered.

34. Press pins (2 & 3) into bush until shoulde contact with wishbone (1). Note ensure chamfer on pin (3) coincides with chamfer on wishbone (1).

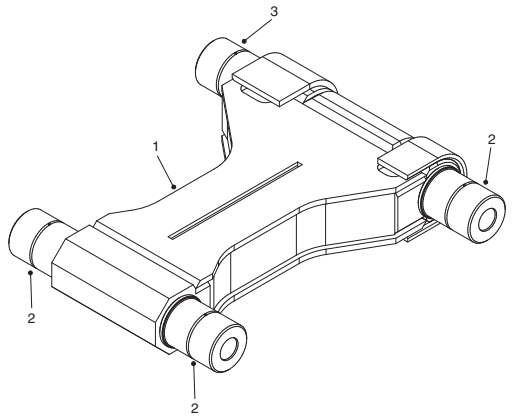


Fig. 9 - Exploded View - Upper Wishbone

Numbers in parentheses refer to Fig.1 unless otherwise stated.

35. Move LH upper wishbone (7) into position and repeat steps 13 to 17.

36. Identify top of knuckle and wheelhead assembly (2) as that with the large 20mm diameter spring pins.

37. Remove lower pivot block (8) end caps, pivot blocks, bushes, seals, shims, washers (9, 8,13,12,14,15) and dowels (refer to 8 Fig. 10) from knuckle assembly (2).

38. Apply thermo paul 1 grease liberally to wishbone pivot pins, bushes and seals (2 & 3,4 & 5, 10, Fig. 10).

39. Slide seal assemblies (12) and bushes (13) into position on LH lower wishbone (5) ensure correct orientation of seal assemblies, Refer Fig.10.

40.Offer knuckle and wheel head assembly (2) up to lower LH wishbone (5) and replace pivot blocks and dowels (8 & 9 Fig. 10).

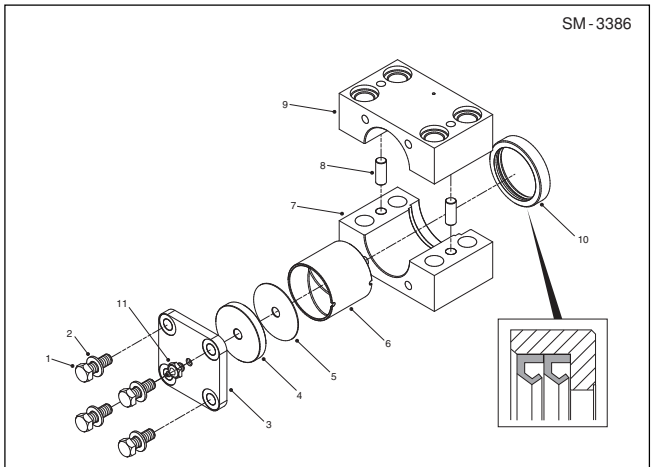


Fig. 10 Exploded View - Pivot Block Assembly

41. Clean bolts (20) with loctite (15269108). Apply loctite (09029849) and torque to a value of 455Nm (336 lbf ft).

42. Repeat steps 32 to 41 for the right hand side.

43. Move driveshaft (3) into position. Take care to ensure the shaft seal points downwards when the suspension is rebounded.

44. Clean bolts (22) and washers (16). Coat bolts (22) with loctite (090209849) then secure input flange to wheel head (2) using bolts (22) with washers (16). Torque bolts (22) to a value of 94Nm (69 lbf ft).

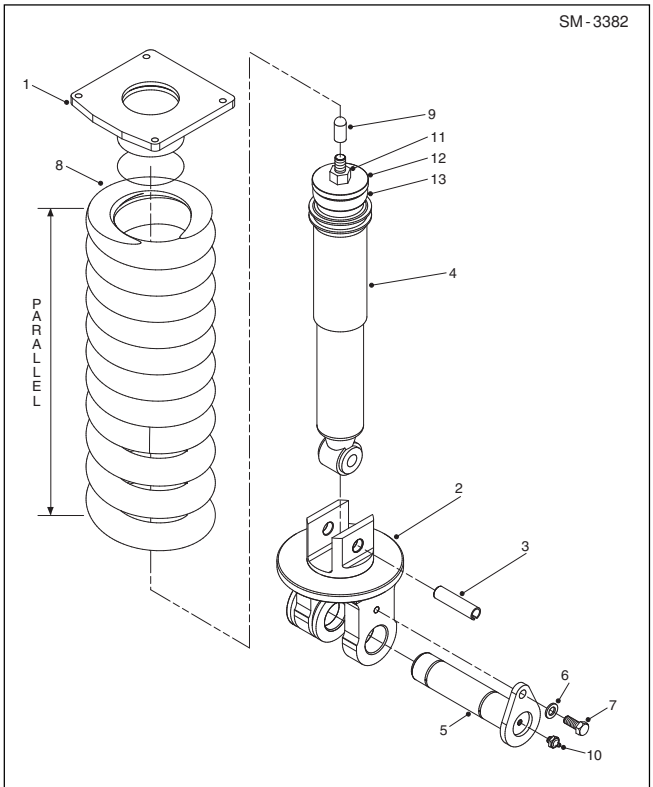


Fig. 11 Suspension Damper Assembly .

45. Clean bolts (22) and washers (16). Coat bolts (22) with loctite (09029849) then secure output flange using bolts (22) and washers (16). Torque to a value 94Nm (69 lbf ft).

46. Repeat steps 43 to 45 for right hand driveshaft.

47. Check that the hubs and driveshafts are free to rotate at the full "bump and rebound angles". Refer to Fig. 12.

48. Check that turning the input flange at the rear of the axle, anti-clickwise, the wheel hubs turn to move the axle in the forward direction.

49. Remove lower spring pin (5, Fig 11) from spring assemblies and remove half caps from lower spring mount (2, Fig. 11).

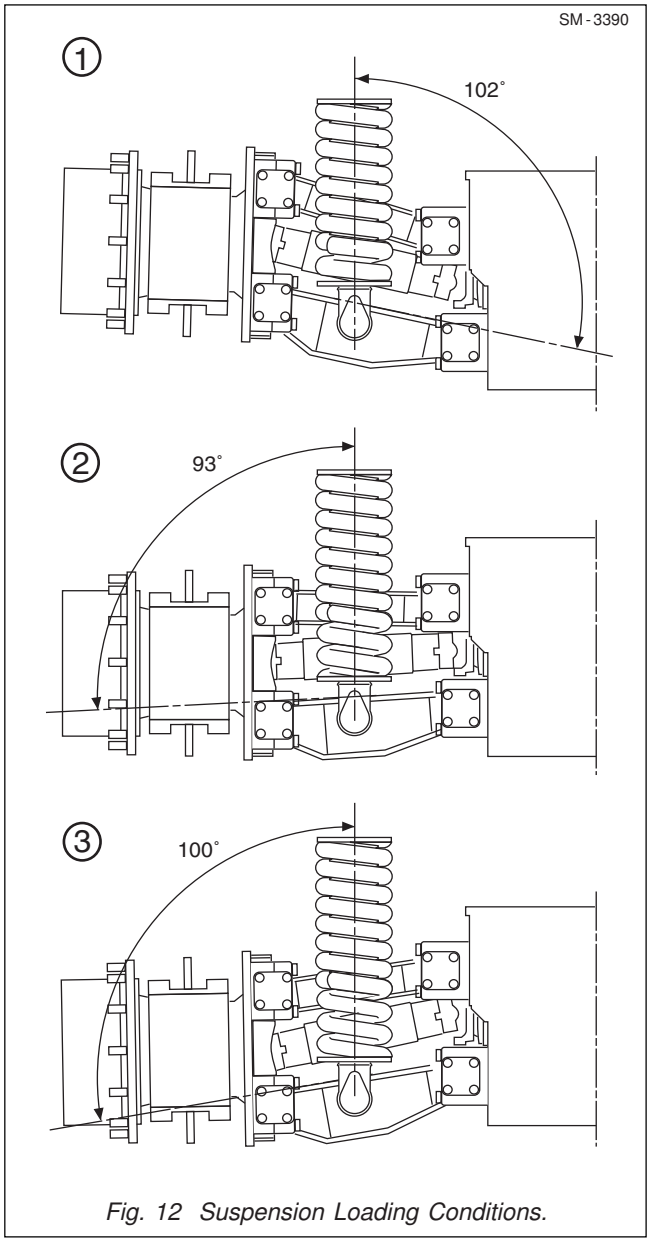


Fig. 12 Suspension Loading Conditions.

50. Completely cover spring pivot bused in lower wishbone (4 & 5) with thermo paul 1 grease.

51. Position lower spring pin (5) in lower wishbone and drop sring assembly into position. Clean pivot block (8) bolts (20) with loctite (15269108) and apply locitite (09029849) to bolts. Torque to a value of 455Nm (336 lbf ft).

52. Ensure that lower spring mount (2) clears the lower wishbone in the full "bump and full" rebound position. Refer to Fig. 12.

53. Repeat steps 49 to 52 for remaining spring assemblies.

54. Remove lug (23) at front of axle housing (1) and fill to level of this plug with SAE grade 80W-90LS oil. Note the volume of oil to fill the differential housing should be 21 Litres.

55. Rotate hub until oil level line is horizontal, remove oil filler plug and fill hub to level of plug with SAE grade 80W-90LS oil.

56. Repeat steps 54 to 55 for opposite hub.

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

57. Position suspension frame (1) assembly and trolley uine.

58. 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).

59. Using suitable lifting equipment, position opposite tyre and rim assembly on the opposite front wheel and secure with wheel nuts.

60. 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).

61. Remove wheel blocks from rear road wheels and place the steering lock bar in the 'Stowed' position.

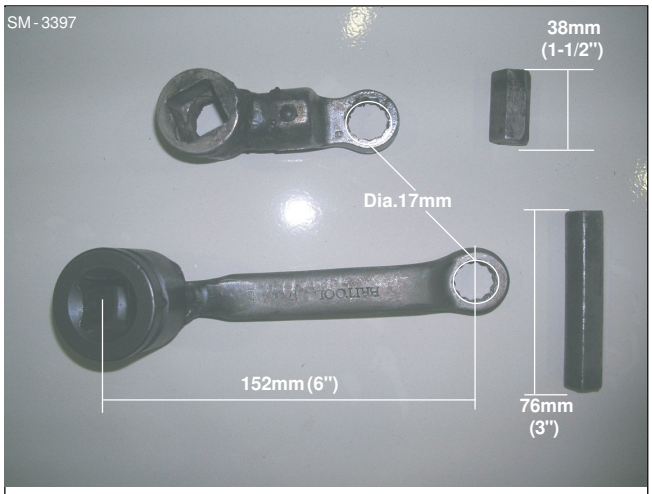
62. Bleed all air from hydraulic brake lines. Refer to Section 165-0010, BRAKE PARTS.

MAINTENANCE

Proper maintenance of the axle / differential and wheel hub elements of the front suspension assembly is essential if the unit is to function properly. Section 300-0020, LUBRICATION SYSTEM gives full information on the proper lubrication intervals and lubricants which should be used. The relevant section within the manual should be referred to should greater detail on individual element service requirements be necessary.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools, special tools and sealants which may be required during routine maintenance. Fabricated tools (Fig. 13) which are shown may need to be created to aid in the overhaul procedure of the unit.



Note: Hex Bar used on conjuction with fabricated tools to allow access to Cap Screws which secure the axle housing to the chassis frame.

Fig. 13 Screws- Fabricated Axle Housing Tool

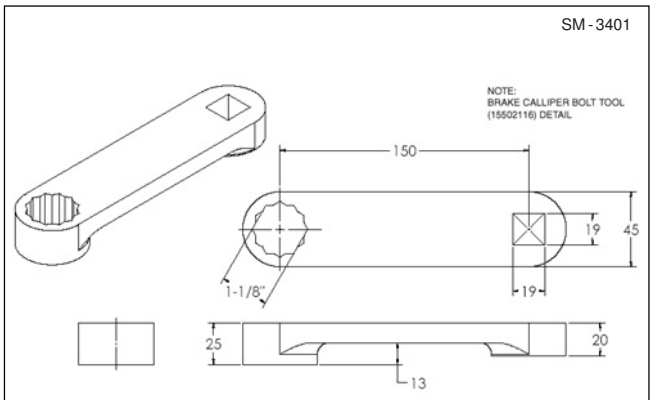
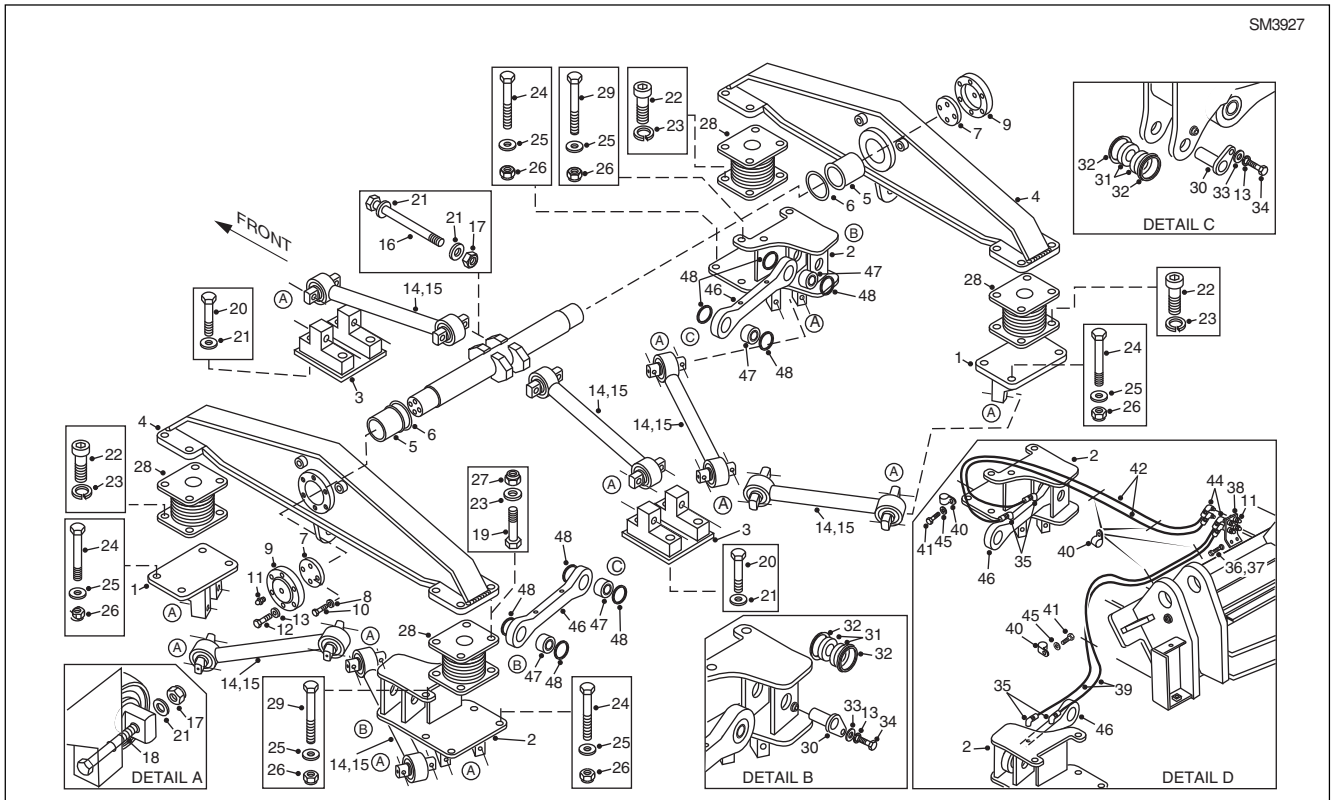


Fig. 14 Special Tool

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
-	-	Cap Screw	450	332
1	11	Bolt	94	69
1	20	Bolt (PIVOT BLOCKS)	455	336
2	8	Bolt	27	20
2	11	Bolt	250	184
-	-	Wheel Nuts	540	400

* * * *



1 - Suspension Link Bracket
2 - Suspension Link Bracket
3 - SuspensionLink Bracket
4 - Machined Beam Assembly
5 - Bushing
6 - V-seal
7 - Retainer
8 - Lockwasher
9 - End Cap
10 - Bolt
11 - Grease Fitting
12 - Bolt
13 - Lockwasher
14 - Control Link
15 - Bushing
16 - Bolt
17 - Locknut
18 - Bolt
19 - Bolt
20 - Bolt
21 - Hardened Washer
22 - Bolt
23 - Lockwasher
24 - Bolt
25 - Hardened Washer
26 - Nut
27 - Locknut
28 - Interleaf Mount
29 - Bolt
30 - Pin Assembly
31 - Retainer
32 - V-seal Ring
33 - Washer
34 - Bolt
35 - Elbow
36 - Bolt
37 - Washer
38 - Manifold Plate Assembly
39 - Hose Assembly
40 - P-clip
41 - Screw
42 - Hose Assembly
43 - Spacer Plate
44 - Elbow
45 - Washer
46 - Panhard Rod Assembly
47 - Bearing
48 - Internal Snap Ring

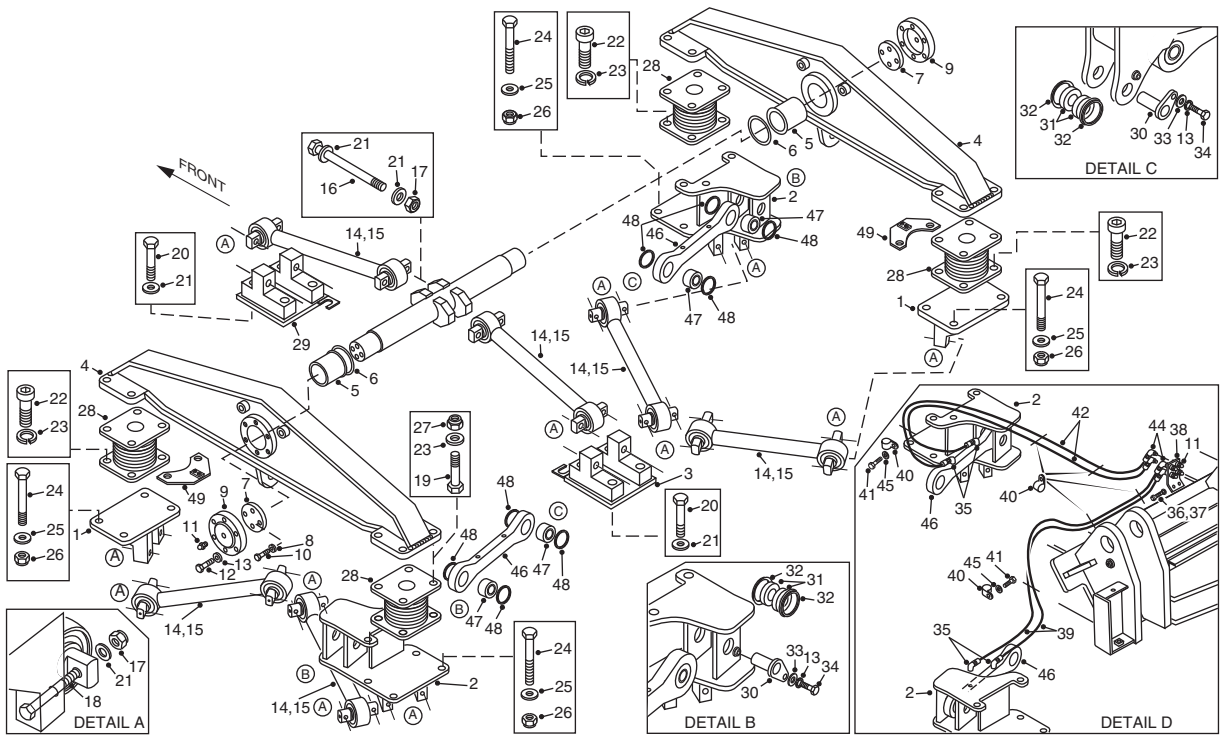
Fig. 1 - Exploded View of Rear Suspension, Earlier Serial Numbers

DESCRIPTION

Numbers in parentheses refer to Figure 1 or Figure 2, depending on the Serial Number of the vehicle, as identified below.

Vehicle Type	Effective Serial Number	Figure
TA27 (889)	From A8891011 to A8891167	1
TA27 (889)	From A8891168	2
TA27, IFS (892)	From A8921011 to A8921012	1
TA27, IFS (892)	From A8921013	2

Vehicle Type	Effective Serial Number	Figure
TA30 (894)	From A8941011 to A8941635	1
TA30 (894)	From A8941636	2
TA30, IFS (897)	From A8971011 to A8971068	1
TA30, IFS (897)	From A8981069	2
TA30, RS (908)	From A9081011 to A9081029	1
TA30, RS (908)	From A9081030	2



1 - Suspension Link Bracket
2 - Suspension Link Bracket
3 - Suspension Link Bracket
4 - Machined Beam Assembly
5 - Bushing
6 - V-seal
7 - Retainer
8 - Lockwasher
9 - End Cap
10 - Bolt
11 - Grease Fitting
12 - Bolt
13 - Lockwasher
14 - Control Link
15 - Bushing
16 - Bolt
17 - Locknut
18 - Bolt
19 - Bolt
20 - Bolt
21 - Hardened Washer
22 - Bolt
23 - Lockwasher
24 - Bolt
25 - Hardened Washer
26 - Nut
27 - Locknut
28 - Interleaf Mount
29 - Suspension Link Bracket
30 - Pin Assembly
31 - Retainer
32 - V-seal Ring
33 - Washer
34 - Bolt
35 - Elbow
36 - Bolt
37 - Washer
38 - Manifold Plate Assembly
39 - Hose Assembly
40 - P-clip
41 - Screw
42 - Hose Assembly
43 - Spacer Plate
44 - Elbow
45 - Washer
46 - Panhard Rod Assembly
47 - Bearing
48 - Internal Snap Ring
49 - Mounting Plate

Fig. 2 - Exploded View of Rear Suspension, Later Serial Numbers

Each axle is coupled to the chassis by three rubber bushed control links (14) which provide longitudinal location and control torque reactions. Lateral location is by means of two Panhard rod links (46). The centre and rear axles are linked by longitudinal equaliser beams (4) which pivot on either side of the chassis.

Loads which act on the axles are balanced by the equaliser beams (4), with bonded rubber/metal laminated interleaf mounts (28) located between the axles and beam ends providing the cushioning medium.

The rear suspension system requires minimal maintenance due to the use of rubber bushings (15) being used in the control links (14). Lubrication of the spherical bearings (47) in the Panhard rods (46) is through lube fittings (11). Similarly, lubrication of the bushings (5) in the equaliser beams (4) is through lube fittings (11).

REMOVAL

Numbers in parentheses refer to Figures 1 and 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 perform the task safely.

⚠ WARNING
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 in a level work area, raise the body and install the body safety prop to secure the body in the partially raised position.

2. Apply the parking brake and switch off the engine. Turn steering wheel several times to relieve any pressure in the steering system.

3. Block the front road wheels, place the steering lock bar and oscillation lock pin in the 'Locked' position and the battery master switch in the 'Off' position.

4. Using suitable blocking equipment, block the equaliser beams (4) to prevent movement when raising the trailer frame.

5. While the rear road wheels are still on the ground, loosen the wheel nuts.

6. Using suitable lifting equipment, raise the trailer frame until the rear wheels are off the ground. Support the vehicle with suitable stands and blocking equipment at the trailer frame, articulation pivot area and centre and rear axles.

7. Support one tyre and rim assembly with suitable lifting equipment and remove the wheel nuts and lockwashers securing the rim to the axle. Remove the tyre and rim assembly.

8. Repeat Step 7 for the remaining rear tyre and rim assemblies.

9. With a suitable container in position, disconnect the hydraulic brake lines from the tee pieces at the centre and rear axle assemblies. Cap the lines and fittings to prevent the ingress of contaminants.

10. Remove the blocking materials from the equaliser beams (4). Remove the locknuts (27), washers (23) and bolts (19) securing the interleaf mounts (28) to the equaliser beams (4).

11. Remove the bolts (22) and lockwashers (23) securing the interleaf mounts (28) to the centre and rear axles. Remove the interleaf mounts (28).

12. Remove the bolts (12) and lockwashers (13) securing the end cap (9) to the equaliser beam (4). Remove the end cap (9).

13. Remove the bolts (10) and lockwashers (8) securing the retainer (7) to the spindle on the frame. Remove the retainer (7).

14. Using suitable lifting equipment, support the equaliser beam (4) and withdraw it from the spindle on the frame.

15. Remove and discard the V-seal (6) from the bushing (5). If required, remove the bushing (5) from the spindle on the frame.

16. Repeat steps 12 to15 inclusive to remove the opposite equaliser beam (4).

17. Remove the locknuts (17), hardened washers (21) and bolts (16) securing the centre control links (14) to the cross shaft mounting brackets.

18. Remove the locknuts (17), hardened washers (21) and bolts (16) securing the centre control links (14) to the suspension link brackets (3 [and 29, Figure 2]). Remove the centre control links (14).

19. Remove locknuts (17), hardened washers (21) and bolts (18) securing the control link (14) to the bracket assembly (2) on the rear axle and left-hand frame mounting bracket. Remove the control link (14).

20. Remove the locknuts (17), hardened washers (21) and bolts (18) securing the control link (14) to the bracket assembly (1) on the centre axle and left-hand frame mounting bracket. Remove the control link (14).

21. Remove locknuts (17), hardened washers (21) and bolts (18) securing the control link (14) to the bracket assembly (2) on the rear axle and right-hand frame mounting bracket. Remove the control link (14).

22. Remove the locknuts (17), hardened washers (21) and bolts (20) securing control link (14) to bracket assembly (2) on the centre axle and the right-hand frame mounting bracket. Remove control link (14).

23. Refer to Detail D of Figure 1 or 2 respectively: Remove the hose assemblies (39) and elbows (35) from the Panhard rods (46).

24. Remove the hose assemblies and elbows (39 and 44) from the manifold bracket (38). Remove the remote lube fittings (11) if necessary.

25. Remove the bolts (41) securing the P-clips (40) and hoses (39) in place. Carefully remove the hose assemblies and elbows (39 and 35) from the Panhard rods (46).

26. If necessary remove the manifold bracket (38) from the frame, by removing the bolts (36) and washers (37).

27. Refer to details B and C of Figure 1 or 2 respectively: Remove bolts (34), washers (33) and lockwashers (13) from the suspension link brackets (2) and frame assembly. Remove the pins (30).

28. Remove the V-ring seals (32), spacers (31) and Panhard rods (46) from the suspension link brackets (2) and frame assembly.

29. Remove the locknuts (26), hardened washers (25) and bolts (24) securing the suspension link bracket (2) on the rear axle. Remove the suspension link bracket (2).

30. Remove the locknuts (26), hardened washers (25) and bolts (24) securing the suspension link bracket (1) on the rear axle. Remove the suspension link bracket (1).

31. Remove the bolts (20) and hardened washers (21) securing the suspension link bracket (3) on the rear axle. Remove the suspension link bracket (3).

32. Remove the locknuts (26), hardened washers (25) and bolts (24) securing the suspension link bracket (1) on the centre axle. Remove the suspension link bracket (1).

33. Remove the locknuts (26), hardened washers (25) and bolts (24) securing the suspension link bracket (2) on the centre axle. Remove the suspension link bracket (2).

34. Remove the bolts (20) and hardened washers (21) securing the suspension link bracket (3, Figure 1or 29, Figure 2 respectively) on the centre axle. Remove the suspension link bracket (3, Figure 1or 29, Figure 2 respectively).

35. If either axle assembly requires to be removed from under the vehicle; raise the axle assembly with suitable lifting equipment, remove the blocking from under the axle assembly, and lower the axle assembly on to a suitable trolley. Slide the axle assembly from under the vehicle to a suitable work area.

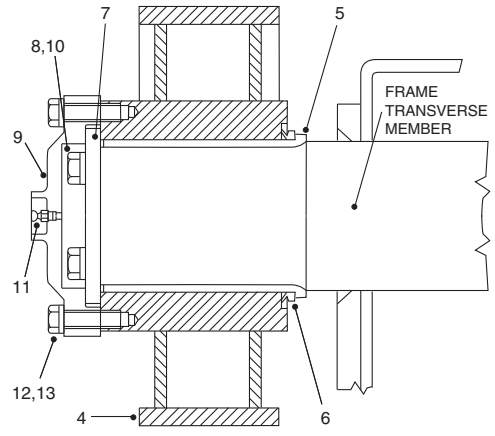
INSTALLATION

Numbers in parentheses refer to Figures 1, 2, 3 and 4.

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

1. Ensure that the centre and rear axle assemblies are correctly positioned and securely blocked below the frame.

2. Install suspension link bracket (3, Figure 1or 29, Figure 2 respectively) on the centre axle. Apply Loctite 270 to the bolts (20) and secure the suspension link bracket (3, Figure 1or 29, Figure 2 respectively) to the centre axle with the bolts (20) and washers (21).



4 - Equaliser Beam
5 - Bushing
6 - V-seal
7 - Retainer
8 - Lockwasher
9 - End Cap
10 - Bolt
11 - Lubrication Fitting
12 - Bolt
13 - Lockwasher

Fig. 3 - Sectional View of Equaliser Beam Installation

Tighten the bolts (20) to a torque of 447 Nm (330 lbf ft).

3. Install the suspension link bracket (2) on the right-hand side of the centre axle. Apply Loctite 243 to the bolts (24) and secure the suspension link bracket (2) to the centre axle with bolts (24), hardened washers (25) and locknuts (26). Tighten the bolts (24) to a torque of:

- 671 Nm (495 lbf ft), Figure 1 or
- 745 Nm (550 lbf ft), Figure 2.

4. Install the suspension link bracket (1) on the left-hand side of the centre axle. Apply Loctite 243 to the bolts (24) and secure the suspension link bracket (1) to the centre axle with the bolts (24), hardened washers (25) and locknuts (26). Tighten the bolts (24) to a torque of:

- 671 Nm (495 lbf ft), Figure 1 or
- 745 Nm (550 lbf ft), Figure 2.

5. Apply Loctite 243 to the bolts (22) and secure the interleaf mounts (28) to the centre axle with the bolts (22) and lockwashers (23). Tighten the bolts (22) to a torque of 165 Nm (122 lbf ft).

6. Install the suspension link bracket (3) on the rear axle. Apply Loctite 270 to the bolts (20) and secure the suspension link bracket (3) to the rear axle with the bolts (20) and washers (21). Tighten the bolts (20) to a torque of 447 Nm (330 lbf ft).

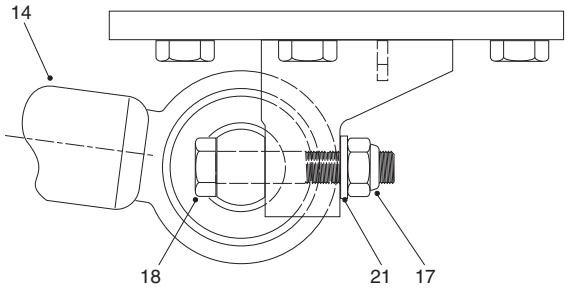
7. Install the suspension link bracket (2) on the left-hand side of the rear axle. Apply Loctite 243 to the bolts (24) and secure the suspension link bracket (2) to the rear axle with bolts (24), hardened washers (25) and locknuts (26). Tighten the bolts (24) to a torque of:

- 671 Nm (495 lbf ft), Figure 1 or
- 745 Nm (550 lbf ft), Figure 2.

8. Install the suspension link bracket (1) on the right-hand side of the rear axle. Apply Loctite 243 to the bolts (24) and secure the suspension link bracket (1) to the rear axle with the bolts (24), hardened washers (25) and locknuts (26). Tighten bolts (24) to a torque of:

- 671 Nm (495 lbf ft), Figure 1 or
- 745 Nm (550 lbf ft), Figure 2.

9. Apply Loctite 243 to the bolts (22) and secure the interleaf mounts (28) to the rear axle with the bolts (22) and lockwashers (23). Tighten the bolts (22) to a torque of 165 Nm (122 lbf ft).



14 - Control Link
17 - Locknut
18 - Bolt
21 - Hardened Washer

Fig. 4 - Sectional View of Typical Control Link Mounting

10. If the bushings (5) were removed from spindle (transverse member) on the frame, thoroughly clean spindle ends with Loctite activator 'N' and allow them to dry. Apply Loctite 648 retaining compound all over the bushing (5) contact area of the spindle ends and install the bushings (5) on the spindle ends. Ensure that the paint dot on each bushing (5) is at TDC, and that one of the grease channels lines up with the channel on the spindle end face (both grease channels should be at the bottom). Once installed, the end face of spindle should protrude by 3mm.

Note: A curing time of fifteen minutes is required for acceptable handling strength.

11. Install new V-seals (6) over bushings (5) with the lip to the outside, as shown in Figure 3.

12. Clean the bores of the equalising beams (4) and, using suitable lifting equipment, install the beams on the bushings (5). Apply Loctite 243 to the bolts (10) and secure the retainers (7) to the spindle ends with the bolts (10) and lockwashers (8). Tighten the bolts (10) to a torque of 149 Nm (110 lbf ft).

13. Apply Loctite 243 to the bolts (12) and Loctite 574 gasket eliminator to the mounting face of the end caps (9). Secure the end caps (9) to the equalising beams (4) with the bolts (12) and lockwashers (13). Tighten the bolts (12) to a torque of 75 Nm (55 lbf ft).

14. If removed, install the lubrication fittings (11) in the end caps (9). Lubricate with grease specified in Section 300-0020, Lubrication System, until excess lubricant is seen.

15. Apply Loctite 243 to the bolts (19) and secure the interleaf mounts (28) to the equaliser beams (4) using the bolts (19), lockwashers (23) and locknuts (27). Tighten the bolts (19) to a torque of 160 Nm (118 lbf ft).

16. Install the centre control links (14) between the suspension link brackets (3, Figure 1or 3 and 29, Figure 2 respectively) and the frame cross member mounting brackets. Secure the control links (14) at the cross member mounting brackets with the bolts (18), hardened washers (21) and locknuts (17). Tighten the bolts (18) to a torque of 556 Nm (410 lbf ft).

17. Secure the centre control links (14) at the suspension link brackets (3, Figure 1or 3 and 29, Figure 2 respectively) with bolts (18), hardened washers (21) and locknuts (17). Tighten bolts (18) to a torque of 556 Nm (410 lbf ft).

18. Install the control links (14) between the rear and centre axle suspension link brackets (1 and 2) and the frame mounting brackets and secure them with the bolts (18), hardened washers (21) and locknuts (17). Tighten the bolts (18) to a torque of 556 Nm (410 lbf ft).

19. Pre-assemble the Panhard rods (46), spherical bearings (47) and retainers (48).

20. Refer to Detail B, Figures 1 and 2 respectively: Install both left-hand and right-hand Panhard rod assemblies (46) between the suspension link brackets (2) and the frame by taking Panhard rods (46) and locating them into the mating slot of the suspension link bracket (2), between the spacers (31) and the V-ring seals (48). Secure them in place by locating the pins (30) and securing them in place with washers (33), lockwashers (13) and bolts (34). Tighten the bolts (34) to a torque of 75 Nm (55 lbf ft).

21. Refer to Detail C, Figures 1 and 2 respectively: Perform the same procedure stated in step 20 for securing the Panhard rods (46) in place at the axle.

22. Refer to Detail D, Figures 1 and 2 respectively: Install the manifold bracket (38) on to the frame and secure it in place using the washers (37) and bolts (36).

23. Fit the elbows (44) and grease nipples (11) to the manifold bracket (38). Now fit the elbows (35) to the Panhard rods (46).

24. Fit the hose assemblies (39) to the elbows (35) and run the hoses using the P-clips (40) and the bolts (41) with washers (45) to secure them in place.

25. If removed, install the lubrication fittings (11) in the bracket (38). Lubricate with grease specified in Section 300-0020, Lubrication System, until excess lubricant is seen.

26. Remove the caps and connect the hydraulic brake lines to the tee pieces at the centre and rear axle assemblies. Clip the brake lines with the clips removed during removal.

27. Using suitable blocking equipment, block the equaliser beams (4) to prevent movement when installing the rear tyre and rim assemblies.

28. Using suitable lifting equipment, position one tyre and rim assembly on one rear wheel and secure it with the wheel nuts and lockwashers.

29. Repeat step 28 for remaining tyre and rim assemblies.

30. Using suitable lifting equipment, raise the trailer frame sufficiently to remove the stands and blocking equipment from the centre and rear axles, articulation pivot area and trailer frame. Lower the vehicle to the ground and remove the lifting equipment.

31. With the vehicle lowered to the ground, tighten all wheel nuts to a torque of 590 Nm (435 lbf ft).

32. Place the battery master switch in the 'On' position, start the engine and check hydraulic brake lines for leaks. Bleed all air from the hydraulic brake lines as described in Section 165-0020, Hydraulic Braking System Schematic.

33. Remove the wheel blocks from the front road wheels and place the steering lock bar and oscillation lock pin in the 'Stowed' position.

MAINTENANCE

Numbers in parentheses refer to Figure 1 or Figure 2 respectively.

Pre-Starting Inspection: Visually check the condition and mounting of the equaliser beams (4), interleaf mounts (28) and control links (14).

Every 50 Hours: Lubricate the spherical bearings (47) in the Panhard rods (46) through the remote lubrication fittings (11), with grease specified in Section 300-0020, Lubrication System, until excess lubricant is seen.

Every 250 Hours: Lubricate the bushings (5) in the

equaliser beams (4) through the lubrication fittings (11), with grease specified in Section 300-0020, Lubrication System, until excess lubricant is seen.

SERVICE TOOLS

There are no special tools required for the procedures outlined in this section. Refer to Section 300-0070, Service Tools, for part numbers of general service tools and adhesives required during the removal and installation of the rear suspension. These tools and adhesives are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	10	Bolt	149	110
1	12	Bolt	75	55
1	16	Bolt	556	410
1	18	Bolt	556	410
1	19	Bolt	160	
1	20	Bolt	447	239
1	22	Bolt	165	800
1	24	Bolt	671	495
1	29	Bolt	671	495
1	34	Bolt	75	55
2	10	Bolt	149	110
2	12	Bolt	75	55
2	16	Bolt	556	410
2	18	Bolt	556	410
2	19	Bolt	160	118
2	20	Bolt	447	330
2	22	Bolt	165	122
2	24	Bolt	745	550
2	34	Bolt	75	55
-	-	Wheel Nut	590	435

* * * *

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COMPONENT DESIGNATIONS

A4 - 12V Radio/Cassette
A5 - Radio/Cassette Speaker

B7 - Coolant Level Sensor
B8 - Fuel Level Sender
B13 - Rotational Speed Sensor
B19 - Throttle Position Sensor
B21 - Trans Oil Temp Sender
B32 - Trans Oil retarder Temp Sender
B35 - Trans Oil Cooler Fan Temp Sender
B39 - Air-con Potentiometer

E3 - Interior Light
E5 - Reverse Light
E7 - Instrument Panel Light
E11 - Side Marker Light, L
E12 - Taillight, L
E13 - Side Marker Light, R
E14 - Taillight, R
E15 - High/Low Beam H'lamp, L
E16 - High/Low Beam H'lamp, R
E19 - Rear Fog Lamp
E21 - Rotating Beacon
E23 - Work Light
E26 - High Beam H'lamp, L
E27 - High Beam H'lamp, R
E34 - Flashing Reverse light
E35 - Heated Mirror

G1 - Generator/Alternator
G2 - Battery

H6 - Direction Indicator; F, L
H7 - Direction Indicator; B, L
H8 - Direction Indicator; F, R
H9 - Direction Indicator; B, R
H10 - Brake Light, L
H11 - Brake Light, R
H29 - Work Socket Illumination
H33 - Autolube Hih Pressure W/L
H34 - Autolube Override W/L

K5 - A/C Comp Clutch/Relay
K21 - Trans Shift Clutch
K22 - Lockup Clutch
K40 - Engine Cooling Fan Clutch

L3 - Reverse Alarm
L4 - Warning Buzzer
L5 - Electric Horn
L6 - Reverse Camera
L7 - Reverse Camera Monitor
L8 - Body Raise/lower Joystick
L9 - Transmission shift lever
L11- Transmission Visual Display Unit
L12- Brake service Warning Buzzer

M1 - Starter Motor
M3 - Starter Motor
M4 - Washer Motor, F
M5 - Wiper Motor, F
M6 - Wiper Motor, B
M7 - Washer Motor, B
M13 - Air Seat Compressor
M16 - Autolube Pump

N3- Voltage Convertor
N8- Camera Module
N9- Autolube Control Module

R10 - Rkr Switch 'Locating' LED
R11 - Rkr Switch 'Function' LED
R12 - 12V Work Socket
R13 - 24V Work Socket

S1 - Battery Master Switch
S2 - Starter Keyswitch
S7 - Emerg/Park Brake Switch
S8 - Emerg/Park Brake 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
S18 - Lights Switch
S19 - Dipswitch
S20 - Headlamp Flash Switch
S22 - Body Proximity Switch
S31 - Park Brake w/l Switch
S41 - Auxiliary Lights Switch
S42 - Air-con temperature Switch
S48 - Acc Press Switch (Tractor)
S49 - Acc Press Switch (Trailer)
S57 - Steering Press Switch
S60 - Difflock Request Switch
S68 - Eng Diag/Request Switch
S69 - Accel Idle Validation Switch
S74 - Kickdown Switch
S78 - Body Lower Emergency Switch
S79 - Heated Mirror Switch
S80 - Engine Compression brake Low/High Switch
S82 - Engine Compression Brake request
S90 - Trans Oil Filter Restriction Switch
S91 - Air - Commpressor Pressure Switch
S97 - Interior Light Door Switch
S106 - Brake Pedal Position Switch
S107 - Cross Axle Diff Lock Request Switch
S111 - Diagnostic inc/dec Switch
S112 - Air-Con Fresh/recirc Switch
S113 - Air-Con Defrot Mode Switch
S114- Air-Con On/Off Switch
S115- Autolube High Pressure Switch
S116- Autolube Override Switch
S117- Parkbrake Service Switch

Y3- Transmission retarder Solenoid
Y4- Emerg/Park Brake Solenoid
Y7- Difflock Solenoid (mid-axle)
Y11- Fresh/Recirc Actuator
Y26- Body Raise Solenoid
Y27- Body Lower Solenoid
Y32- Trans radiator fan solenoid
Y33- System Hyd Unloader Valve
Y34- System Hyd Float Valve
Y36- Trans oil cooler fan isolation
Y48- Defrost Actuator
Y49- Water valve Actuator

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

FUSES

Location	Fuse No.	Circuit	Current Rating
Fuse/Relay Box	2	Keyswitch	15A
	3	Hazard Warning Lights	7.5A
	4	Rear Wash/Wipe	10A
	5	Horn Relay Coil, Front Wash/Wipe	10A
	6	Air Seat Compressor	10A
	7	Dipped Beam Lights Supply	10A
	8	Main Beam/Flash	10A
	9	Wiper Park Front	7.5A
	10	Transmission TCU Battery	7.5A
	11	Transmission TCU Ignition	10A
	12	Reverse System	7.5A
	13	TOC8 Controler Ignition	30A
Fuse/Relay Box	14	Interior Light	5A
	15	Direction Indicators	5A
	16	Emergency/Park Brake	3A
	17	Instrument Cluster/CPU Ignition	7.5A
	18	Heated Mirrors	15A
	19	Ignition Sensed Relays	3A
	20	24V Work Socket Battery	15A
	21	Neutral Start	3A
	22	Front Washer Pump	3A
	23	Rear Washer Pump	3A
	24	Horns	10A
	25	Ignition Sensed Equipment	30A
Fuse/Relay Box	26	Air Cond/Heater/Ventilation System	15A
	27	Reverse Camera	10A
	28	Front Working Lights	15A
	29	Rear Working Lights	15A
	30	Rotating Beacon	5A
	31	Engine ECU Ignition	5A
	32	Engine ECU Battery	10A
	33	Proximity Switch	10A
	34	Sound Power Relay Supply	3A
	35	Brake Pedals Control	5A
	36	12V Work Socket	15A
Fuse/Relay Box	FA	Auxiliary Body Down Supply	5A
	FK	Voltage Convertor Battery Supply	20A
Battery Box	FL	Engine Battery Supply	10A
	FM	Instrument Panel/CPU Battery Supply	10A
	FJ	Autolube System	5A
	61	Alternator Charge Cable (Power Fuse)	100A
	62	Cab Busbar Supply Cable (Power Fuse)	100A
Passenger seat compartment	66	Alternator Charge Cable (Power Fuse)	3A

RELAYS		
Location	Relay	Circuit
Fuse/Relay Box Column A	K58	Sound Power 1st / Rev Gear
	K57	Sound Power Body Up
Fuse/Relay Box Column B	K23	Ignition Sensed - A/C / Heater / Hyd. ECU Ignition
	K23	Wiper Ignition
	K34	Horns
	K15	Headlights
Fuse/Relay Box Column C	K17	Reverse Alarm / Lights
	K14	Neutral Start
Fuse/Relay Box - Column D	K50	Brake Lights Control
	K23	Ignition Sensed - Engine ECU Ignition
	K33	Engine Cooling Fan
	K4	Indicator Flasher Unit
Fuse/Relay Box - Column E	K32	Engine Brake
	K52	Body Proximity Switch
	K27	Differential Lock
	K23	Ignition Sensed - Radio

SM - 3725

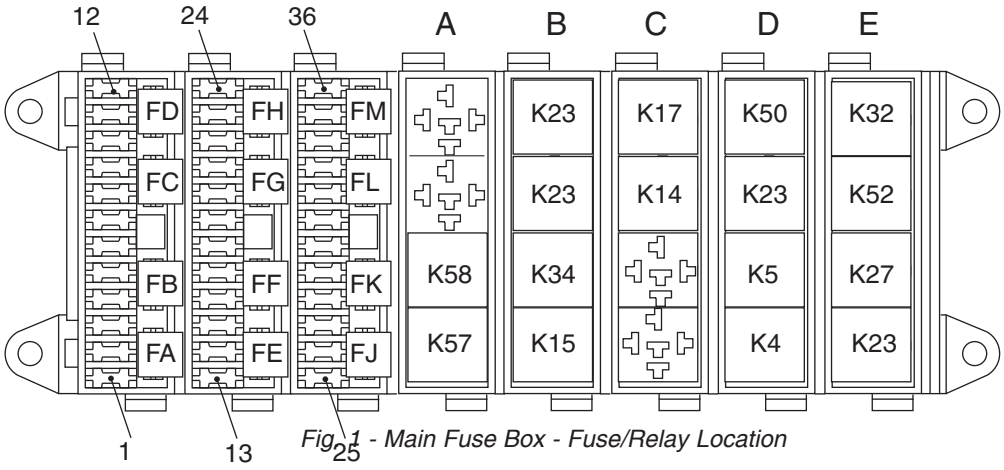
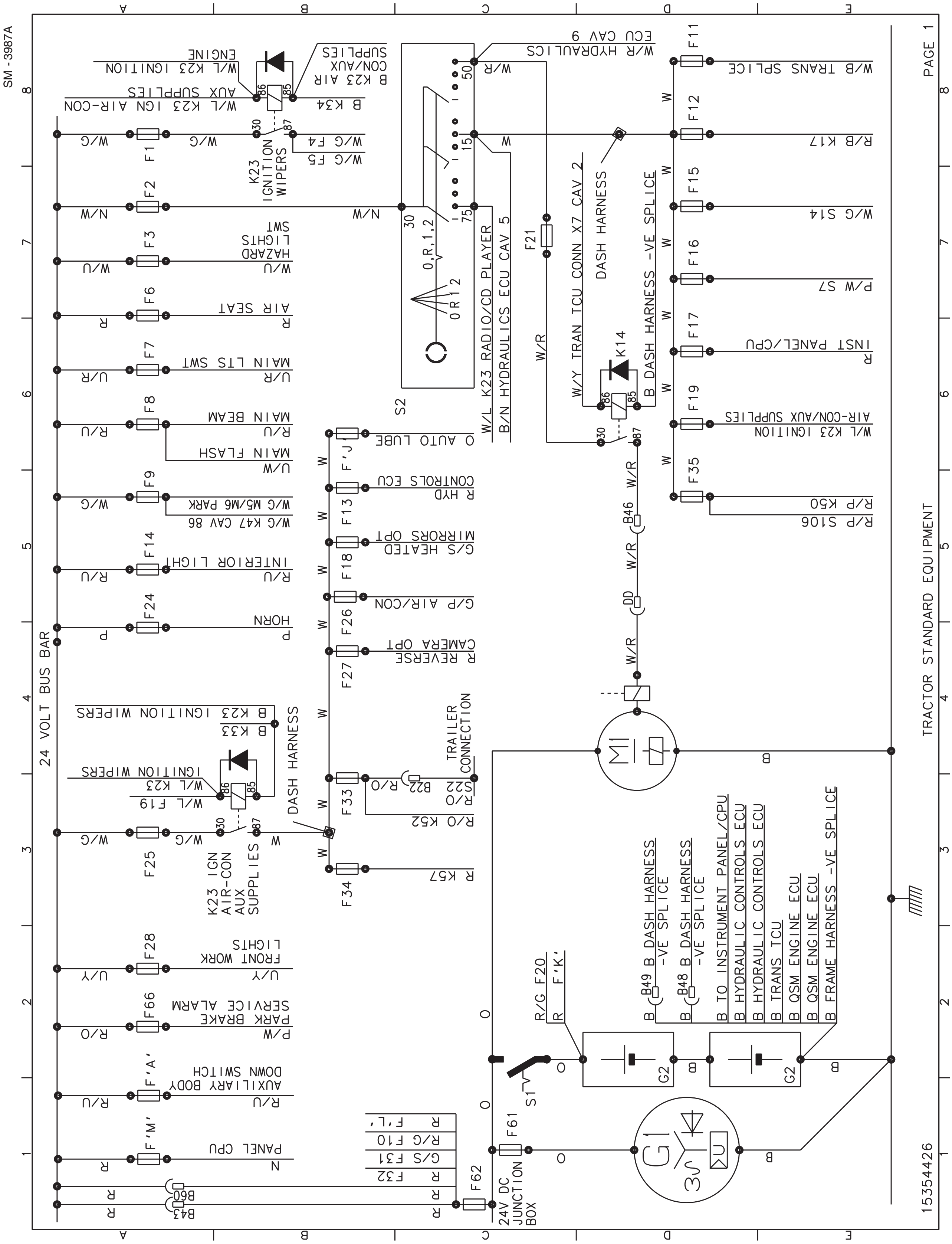


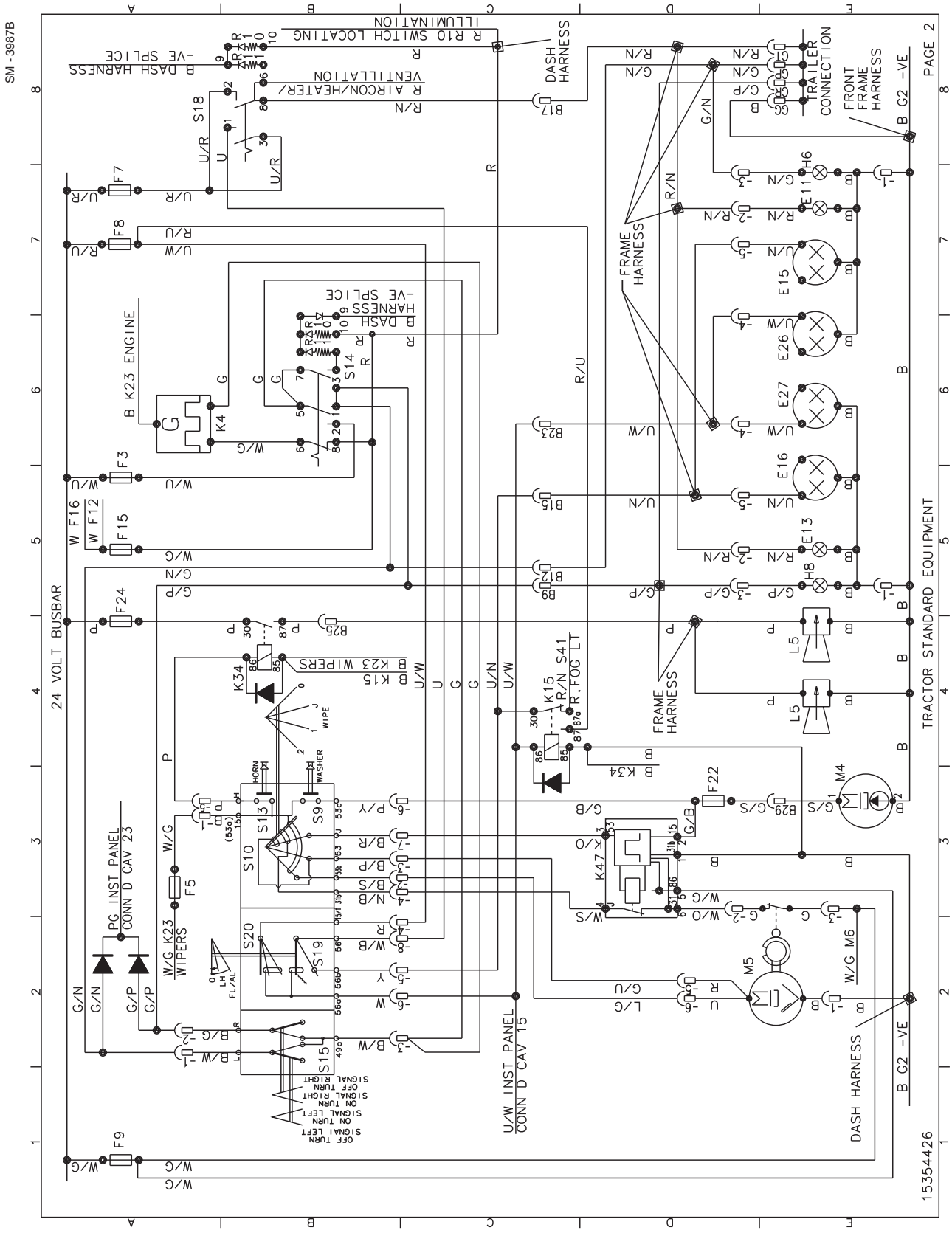
Fig. 1 - Main Fuse Box - Fuse/Relay Location

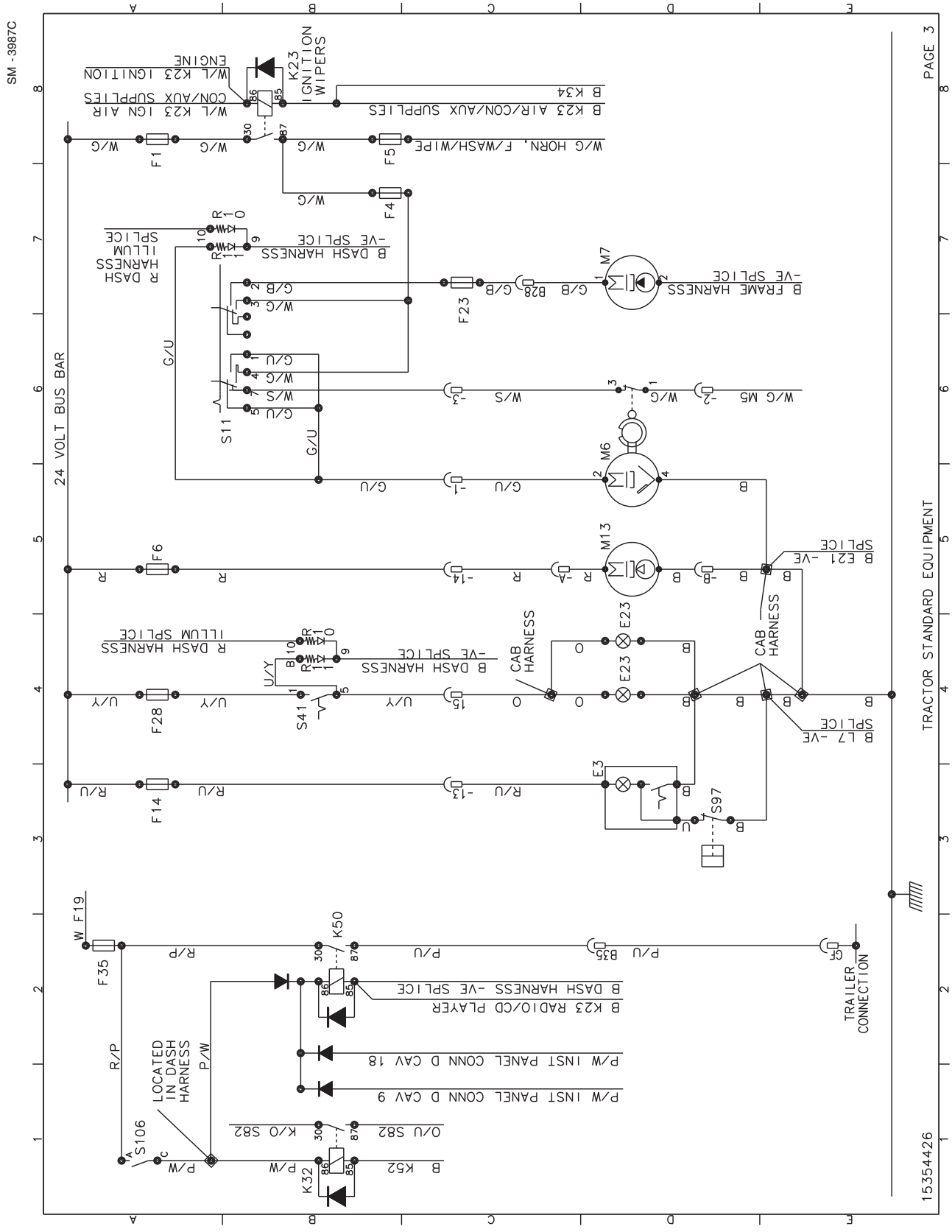
References

- A Harness interface - Dash Harness and Main Chassis Harness (48 way connector)
- B Harness interface - Dash Harness and Main Chassis Harrness (102 way connector)
- C Harness interface - Main Chassis Harness and Engine Harness (23 way socket housing on Frame section)
- D Harness interface - Main Chassis Harness and Engine Harness (23 way pin housing on Frame section)
- E Harness interface - Main Chassis Harness and Transmission Interface Harness
- F Harness interface - Main Chassis Harness and Hydraulic Valve Harness
- G Harness interface - Main Chassis Harness and Rear Frame Harness
- H Harness Auxilliary Components Connection, Only Cavity Nuber Shown I.E. -1.
- All stated dash Harness splices are located in the controls area underneath the instructor seat

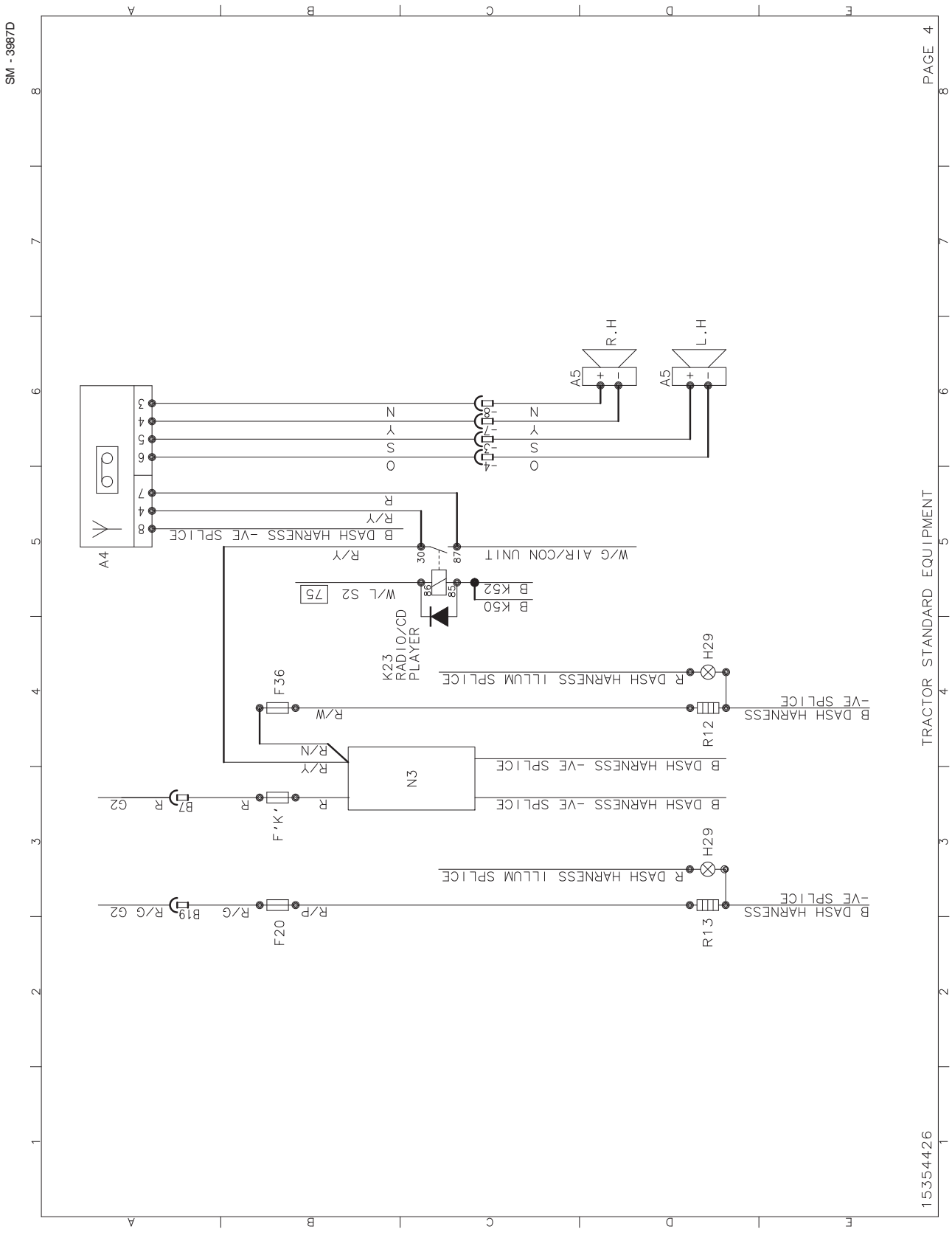


SM - 3987A
PAGE 1
TRACTOR STANDARD EQUIPMENT
15354426
24 VOLT BUS BAR
F1
F2
F3
F6
F7
F8
F9
F14
F24
F25
F28
F66
F'A'
F'M'
W/G
N/W
W/U
R
U/R
R/U
P
U/Y
R/O
K23 IGNITION WIPERS
HAZARD LIGHTS SWT
AIR SEAT
MAIN LTS SWT
MAIN BEAM
MAIN FLASH
W/G M5/M6 PARK
W/G K47 CAV 86
INTERIOR LIGHT
HORN
FRONT WORK LIGHTS
PARK BRAKE SERVICE ALARM
AUXILIARY BODY DOWN SWITCH
PANEL CPU
W/L K23 IGN AIR-CON AUX SUPPLIES
W/L K23 IGNITION ENGINE
B K23 AIR CON/AUX SUPPLIES
B K34
W/G F4
W/G F5
K23 IGN AIR-CON AUX SUPPLIES
DASH HARNESS
B K23 IGNITION WIPERS
B K33
W/L K23 IGNITION WIPERS
W/L F19
S2
W/L K23 RADIO/CD PLAYER
B/N HYDRAULICS ECU CAV 5
O AUTO LUBE
R HYD CONTROLS ECU
G/S HEATED MIRRORS OPT
G/P AIR/CON
R REVERSE CAMERA OPT
TRAILER CONNECTION
R/O S22
R/O K52
R K57
F'J'
F13
F18
F26
F27
F33
F34
B22
F61
F62
24V DC JUNCTION BOX
B60
B43
G/S F31
F32
R/G F10
F'L'
R/G F20
F'K'
S1
G1
G2
M1
F21
W/R
K14
B46
W/Y TRAN TCU CONN X7 CAV 2
B DASH HARNESS -VE SPLICE
ECU CAV 9
W/R HYDRAULICS
F11
F12
F15
F16
F17
F19
F35
W/B TRANS SPLICE
R/B K17
W/G S14
P/W S7
INST PANEL/CPU
W/L K23 IGNITION AIR-CON/AUX SUPPLIES
R/P K50
R/P S106
B49
B48
B TO INSTRUMENT PANEL/CPU
B HYDRAULIC CONTROLS ECU
B TRANS TCU
B QSM ENGINE ECU
B FRAME HARNESS -VE SPLICE


SM - 3987B
24 VOLT BUSBAR
TRACTOR STANDARD EQUIPMENT
PAGE 2
15354426
DASH HARNESS
FRAME HARNESS
TRAILER CONNECTION
FRONT FRAME HARNESS
B G2 -VE
R R10 SWITCH LOCATING ILLUMINATION
R AIRCON/HEATER/ VENTILLATION
B DASH HARNESS -VE SPLICE
B K23 ENGINE
B K23 WIPERS
B K15
R/N S41 R.FOG LT
PG INST PANEL CONN D CAV 23
W/G K23 WIPERS
U/W INST PANEL CONN D CAV 15
OFF TURN SIGNAL LEFT
ON TURN SIGNAL LEFT
OFF TURN SIGNAL RIGHT
ON TURN SIGNAL RIGHT
HORN
WASHER
WIPE
LH FL/AL
F3
F5
F7
F8
F9
F15
F16
F22
F24
F12
S13
S9
S10
S14
S15
S18
S19
S20
K4
K15
K34
K47
M4
M5
M6
E11
E13
E15
E16
E26
E27
H6
H8
L5



SM -3987C
PAGE 3
TRACTOR STANDARD EQUIPMENT
24 VOLT BUS BAR
W/L K23 IGNITION ENGINE
W/L K23 IGN AIR CON/AUX SUPPLIES
K23 IGNITION WIPERS
B K34
B K23 AIR/CON/AUX SUPPLIES
W/G HORN, F/WASH/WIPE
F1
F5
F4
R DASH HARNESS ILLUM SPLICE
B DASH HARNESS -VE SPLICE
F23
B28
M7
B FRAME HARNESS -VE SPLICE
S11
W/G M5
M6
M13
F6
B E21 -VE SPLICE
CAB HARNESS
E23
F28
S41
B L7 -VE SPLICE
F14
E3
S97
F19
F35
K50
B35
TRAILER CONNECTION
B K23 RADIO/CD PLAYER
P/W INST PANEL CONN D CAV 18
P/W INST PANEL CONN D CAV 9
LOCATED IN DASH HARNESS
S106
K/O S82
O/U S82
K32
B K52
15354426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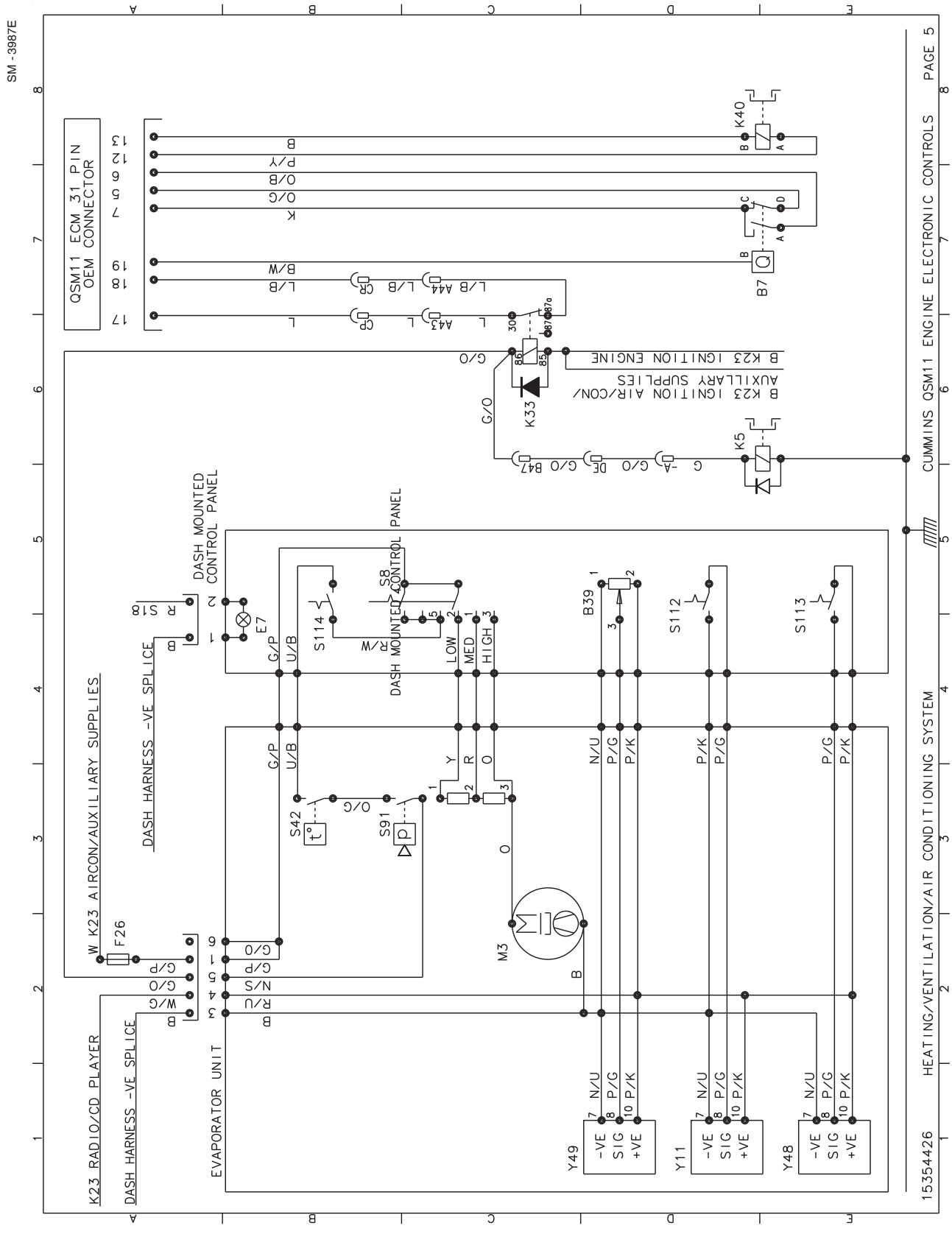
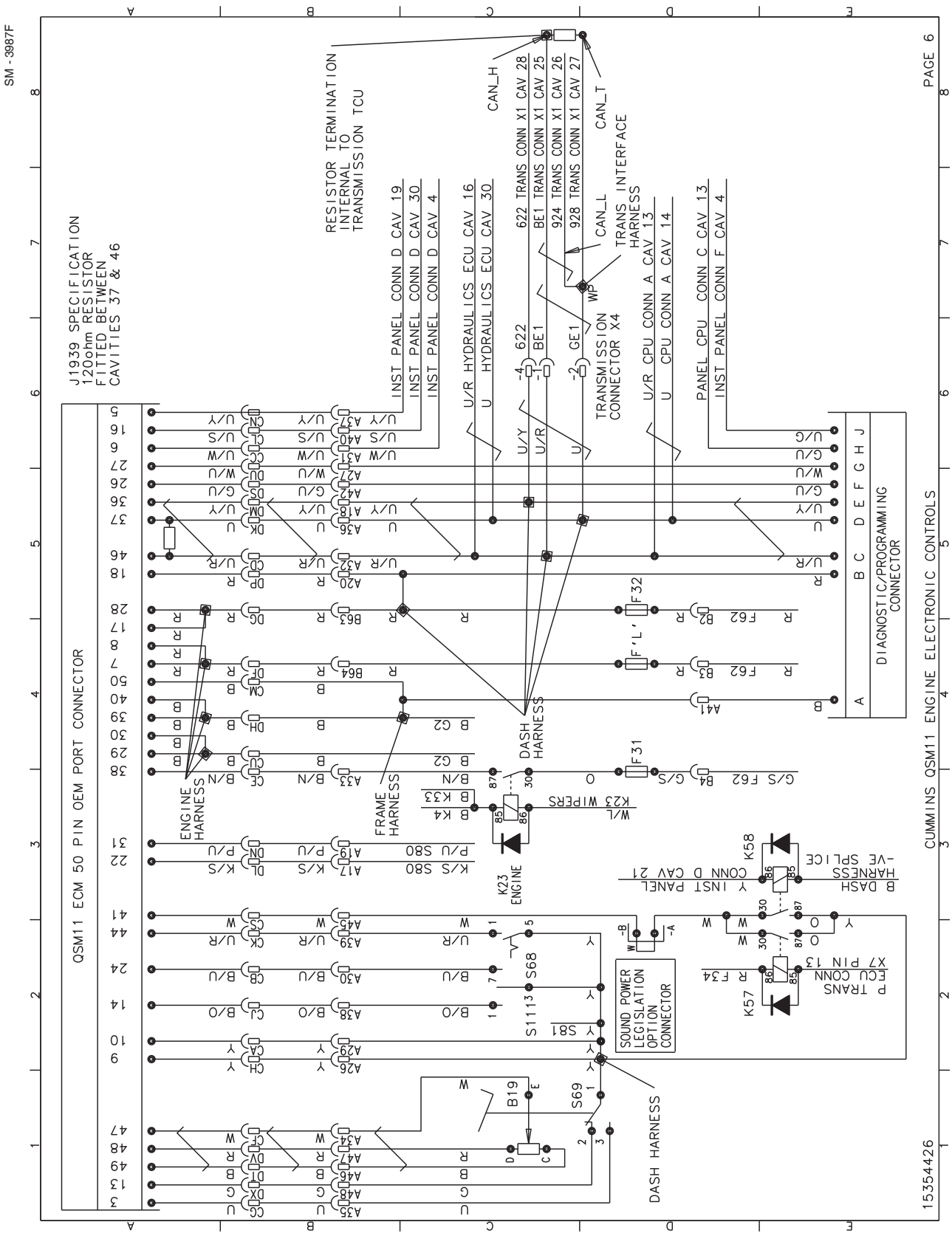
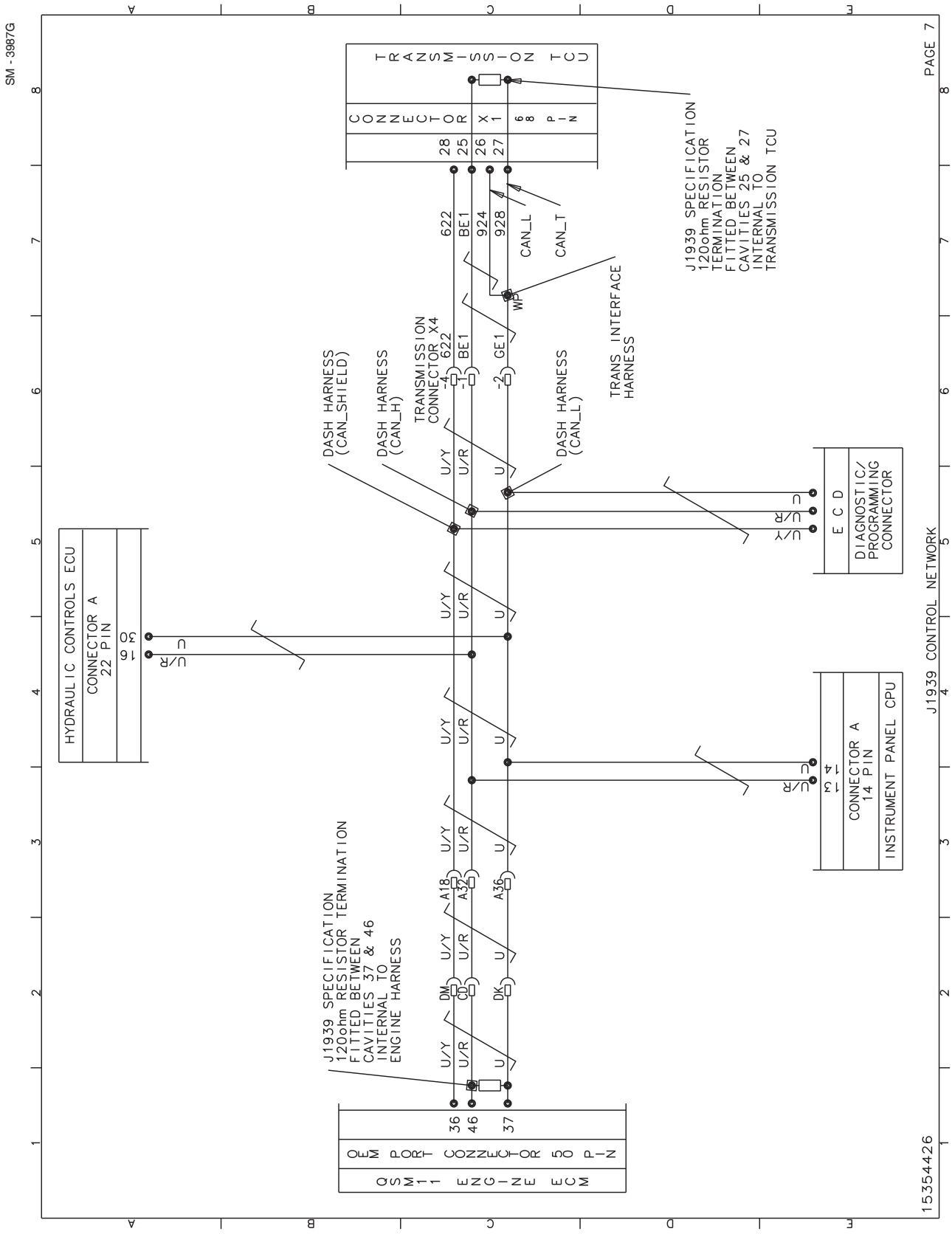
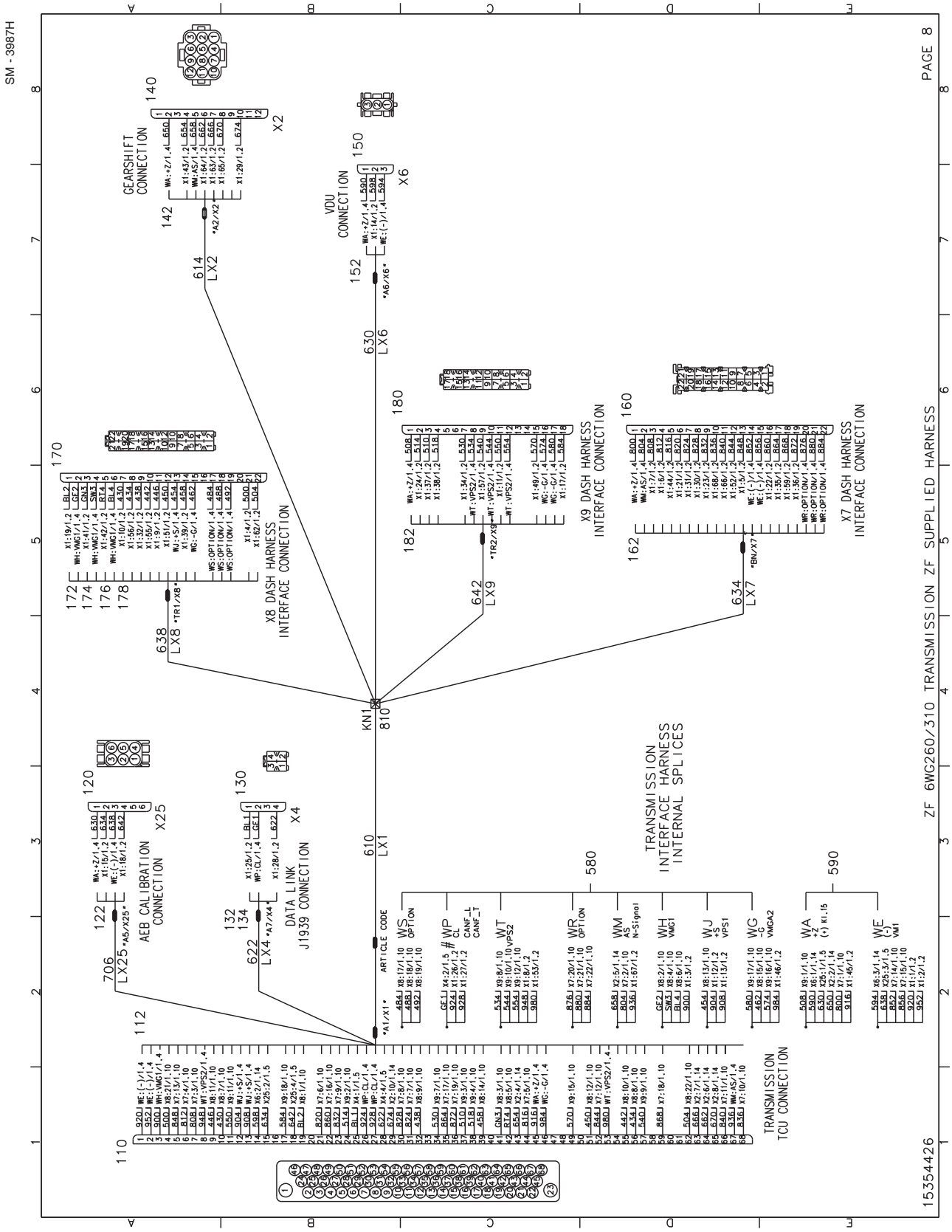
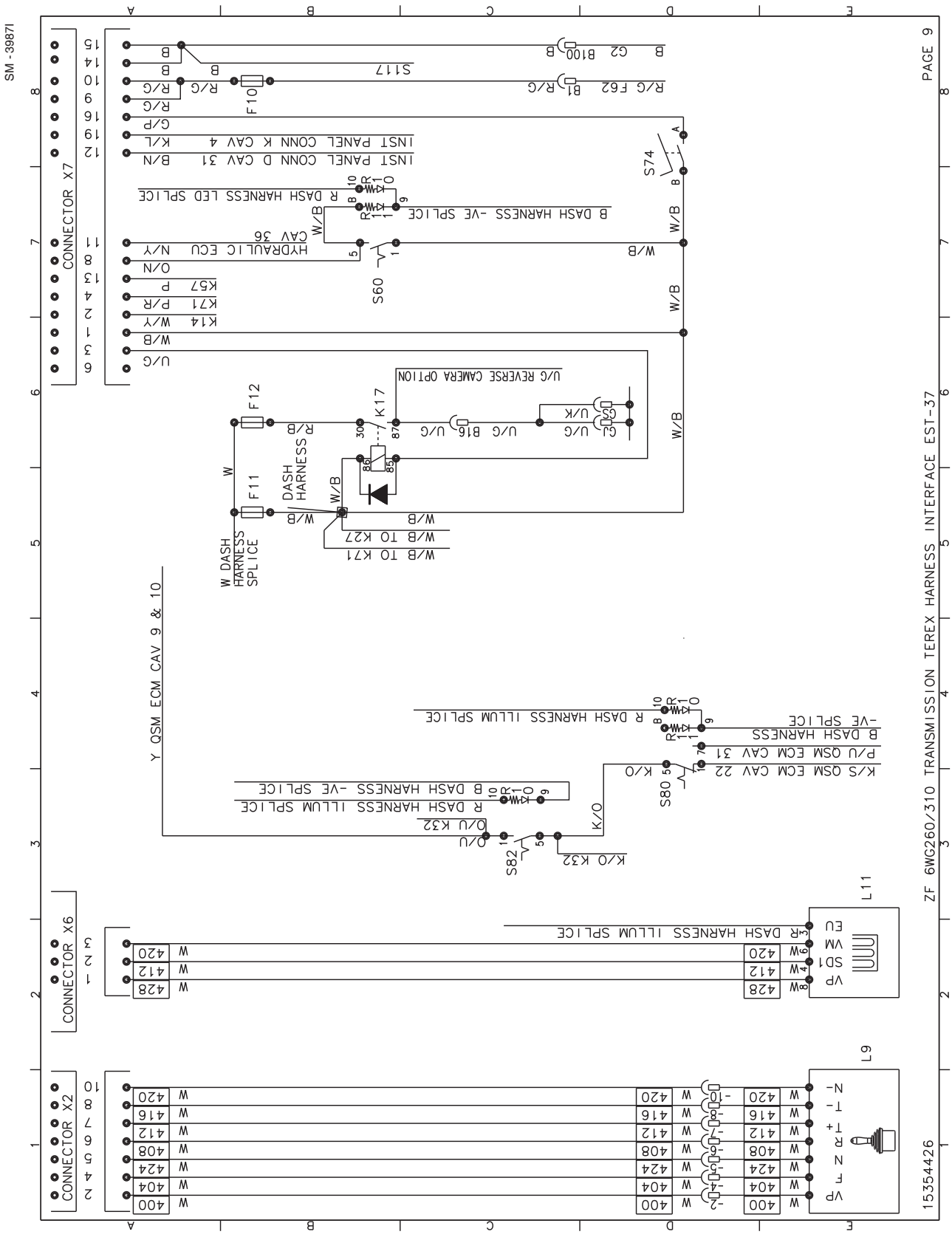
PAGE 4
TRACTOR STANDARD EQUIPMENT
15354426
A4
A5
R.H
L.H
N
Y
S
O
R
R/Y
B DASH HARNESS -VE SPLICE
W/G AIR/CON UNIT
W/L S2
75
B K52
B K50
K23
RADIO/CD
PLAYER
F36
R/W
R/N
N3
F'K'
B7
G2
R/G
B19
F20
R/P
R DASH HARNESS ILLUM SPLICE
H29
R12
R13


SM - 3987E
QSM11 ECM 31 PIN OEM CONNECTOR
K40
B7
K33
B K23 IGNITION AIR/CON/ AUXILLARY SUPPLIES
B K23 IGNITION ENGINE
K5
CUMMINS QSM11 ENGINE ELECTRONIC CONTROLS PAGE 5
DASH MOUNTED CONTROL PANEL
DASH MOUNTED CONTROL PANEL
S8
S114
E7
B39
S112
S113
LOW
MED
HIGH
DASH HARNESS -VE SPLICE
S42
S91
M3
W K23 AIRCON/AUXILIARY SUPPLIES
F26
K23 RADIO/CD PLAYER
DASH HARNESS -VE SPLICE
EVAPORATOR UNIT
Y49
Y11
Y48
-VE
SIG
+VE
HEATING/VENTILATION/AIR CONDITIONING SYSTEM
15354426

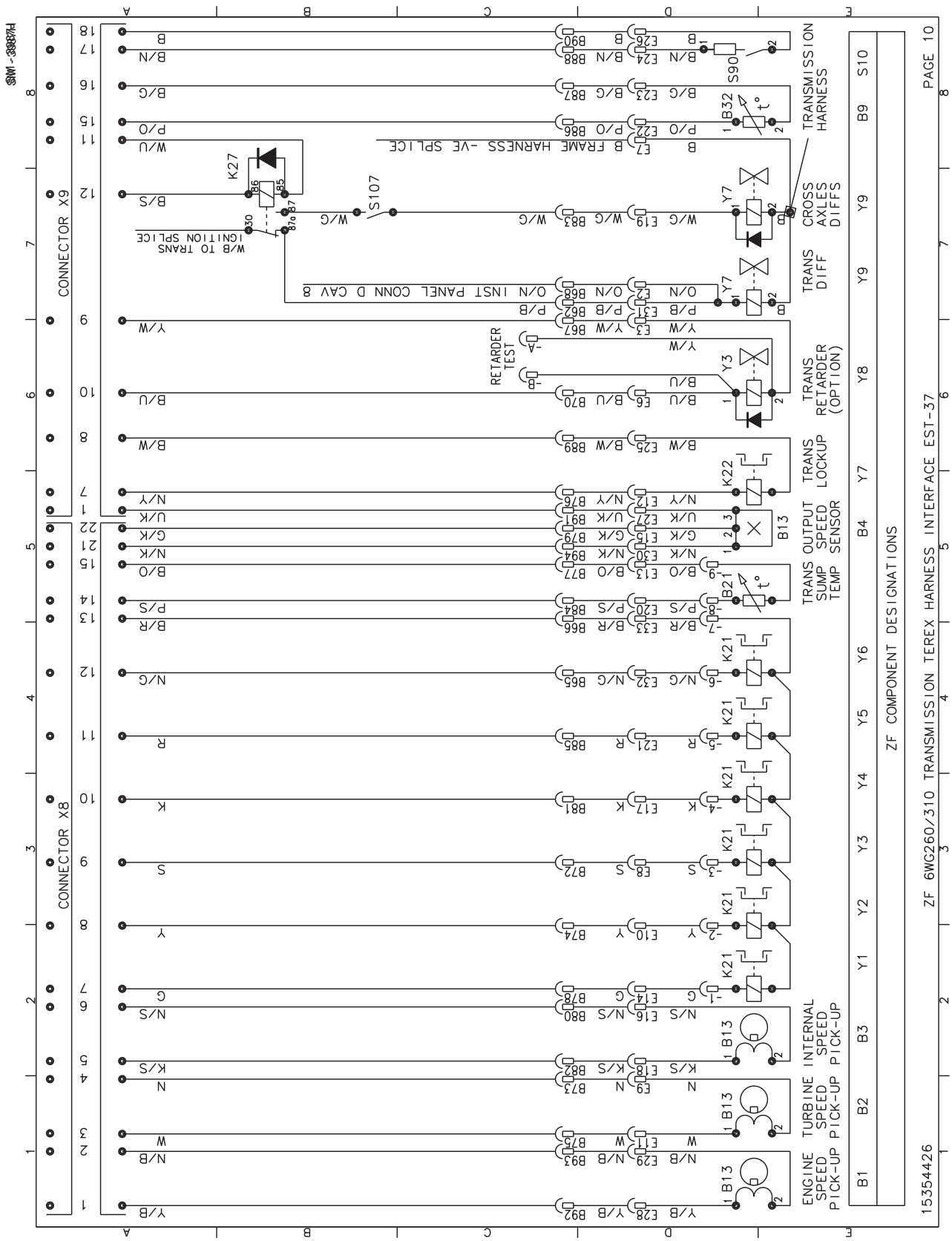

SM - 3987F
PAGE 6
CUMMINS QSM11 ENGINE ELECTRONIC CONTROLS
15354426
QSM11 ECM 50 PIN OEM PORT CONNECTOR
J1939 SPECIFICATION
120ohm RESISTOR
FITTED BETWEEN
CAVITIES 37 & 46
RESISTOR TERMINATION
INTERNAL TO
TRANSMISSION TCU
INST PANEL CONN D CAV 19
INST PANEL CONN D CAV 30
INST PANEL CONN D CAV 4
U/R HYDRAULICS ECU CAV 16
U HYDRAULICS ECU CAV 30
CAN_H
622 TRANS CONN X1 CAV 28
BE1 TRANS CONN X1 CAV 25
924 TRANS CONN X1 CAV 26
928 TRANS CONN X1 CAV 27
CAN_L
CAN_T
TRANS INTERFACE
HARNESS
TRANSMISSION
CONNECTOR X4
U/R CPU CONN A CAV 13
U CPU CONN A CAV 14
PANEL CPU CONN C CAV 13
INST PANEL CONN F CAV 4
DIAGNOSTIC/PROGRAMMING
CONNECTOR
ENGINE
HARNESS
FRAME
HARNESS
DASH
HARNESS
K23 WIPERS
K23
ENGINE
K58
B DASH
HARNESS
-VE SPLICE
Y INST PANEL
CONN D CAV 21
K57
P TRANS
FCU CONN
X7 PIN 13
SOUND POWER
LEGISLATION
OPTION
CONNECTOR
S68
S69
S81
B19
F31
F32
DASH HARNESS

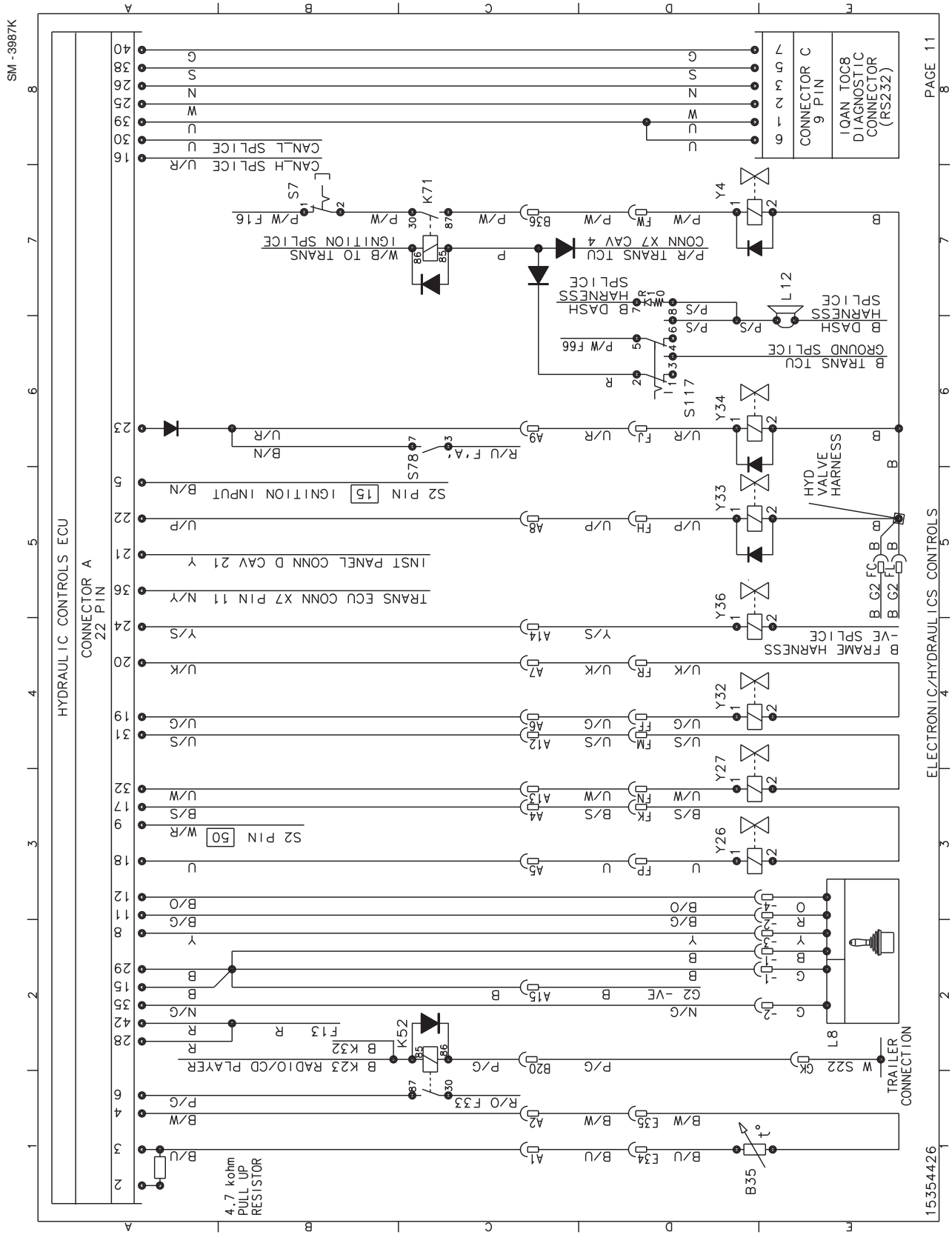

SM - 3987G
PAGE 7
J1939 CONTROL NETWORK
15354426
TRANSMISSION TCU CONNECTOR X1 68 PIN
28 25 26 27
622 BE1 924 928
CAN_L
CAN_T
WP
J1939 SPECIFICATION 120ohm RESISTOR TERMINATION FITTED BETWEEN CAVITIES 25 & 27 INTERNAL TO TRANSMISSION TCU
TRANS INTERFACE HARNESS
TRANSMISSION CONNECTOR X4
-4 -1 -2
622 BE1 GE1
DASH HARNESS (CAN_SHIELD)
DASH HARNESS (CAN_H)
DASH HARNESS (CAN_L)
U/Y U/R U
HYDRAULIC CONTROLS ECU
CONNECTOR A 22 PIN
36 1
R/U
ECD
DIAGNOSTIC/ PROGRAMMING CONNECTOR
R/Y R/U
CONNECTOR A 14 PIN
14 3
INSTRUMENT PANEL CPU
R/U
J1939 SPECIFICATION 120ohm RESISTOR TERMINATION FITTED BETWEEN CAVITIES 37 & 46 INTERNAL TO ENGINE HARNESS
A18 A32 A36
DM CB DK
QSM11 ENGINE ECM 50 PIN
QSM11 CONNECTOR
36 46 37


SM - 3987H
PAGE 8
ZF 6WG260/310 TRANSMISSION ZF SUPPLIED HARNESS
15354426
TRANSMISSION TCU CONNECTION
AEB CALIBRATION CONNECTION X25
DATA LINK J1939 CONNECTION X4
GEARSHIFT CONNECTION X2
VDU CONNECTION X6
X8 DASH HARNESS INTERFACE CONNECTION
X9 DASH HARNESS INTERFACE CONNECTION
X7 DASH HARNESS INTERFACE CONNECTION
TRANSMISSION INTERFACE HARNESS INTERNAL SPLICES
KN1
LX1
LX2
LX4
LX6
LX7
LX8
LX9
LX25
WS OPTION
WP CANF_L CANF_T
WT VPS2
WR OPTION
WM AS N-Signal
WH VMG1
WJ +5 VPS1
WG -G VMGA2
WA +Z (+) KL.15
WE (-) VM1

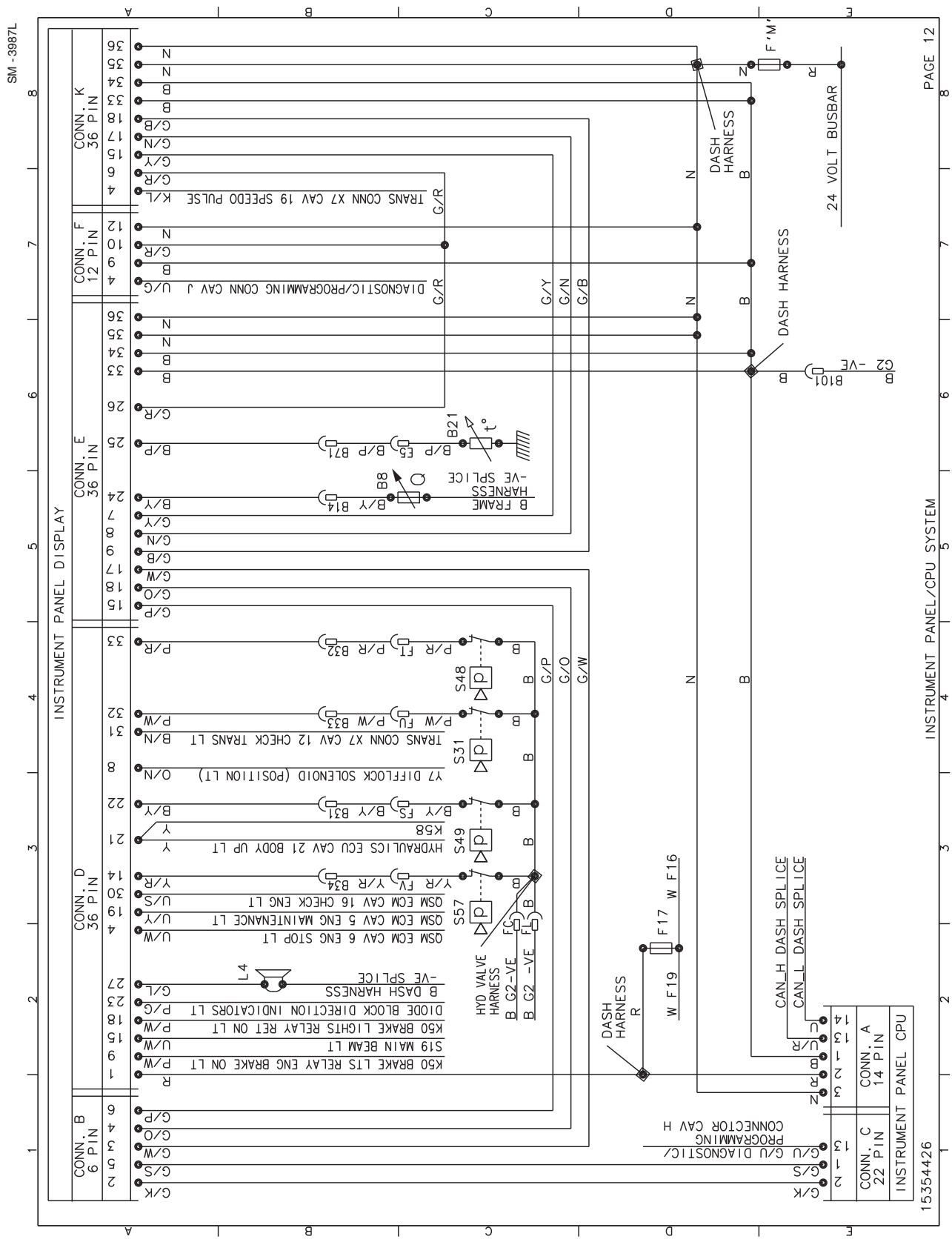


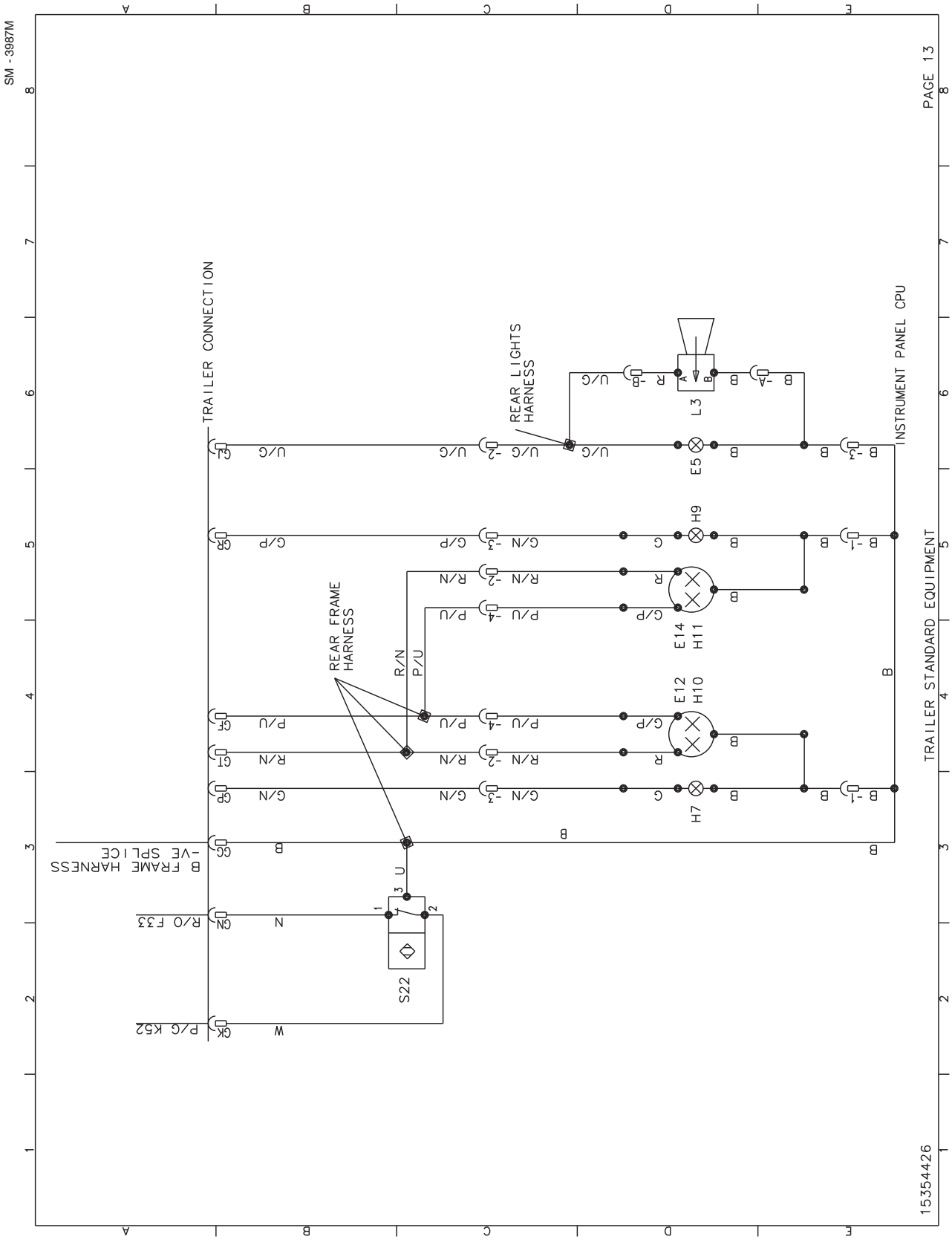
SM - 39871
PAGE 9
ZF 6WG260/310 TRANSMISSION TEREX HARNESS INTERFACE EST-37
15354426
CONNECTOR X7
CONNECTOR X6
CONNECTOR X2
INST PANEL CONN K CAV 4
INST PANEL CONN D CAV 31
R DASH HARNESS LED SPLICE
B DASH HARNESS -VE SPLICE
HYDRAULIC ECU CAV 36
U/G REVERSE CAMERA OPTION
DASH HARNESS
W DASH HARNESS SPLICE
W/B TO K27
W/B TO K71
Y QSM ECM CAV 9 & 10
R DASH HARNESS ILLUM SPLICE
B DASH HARNESS -VE SPLICE
P/U QSM ECM CAV 31
K/S QSM ECM CAV 22
R DASH HARNESS ILLUM SPLICE
B DASH HARNESS -VE SPLICE
R DASH HARNESS ILLUM SPLICE
S117
S74
S60
S80
S82
F10
F11
F12
K17
L11
L9

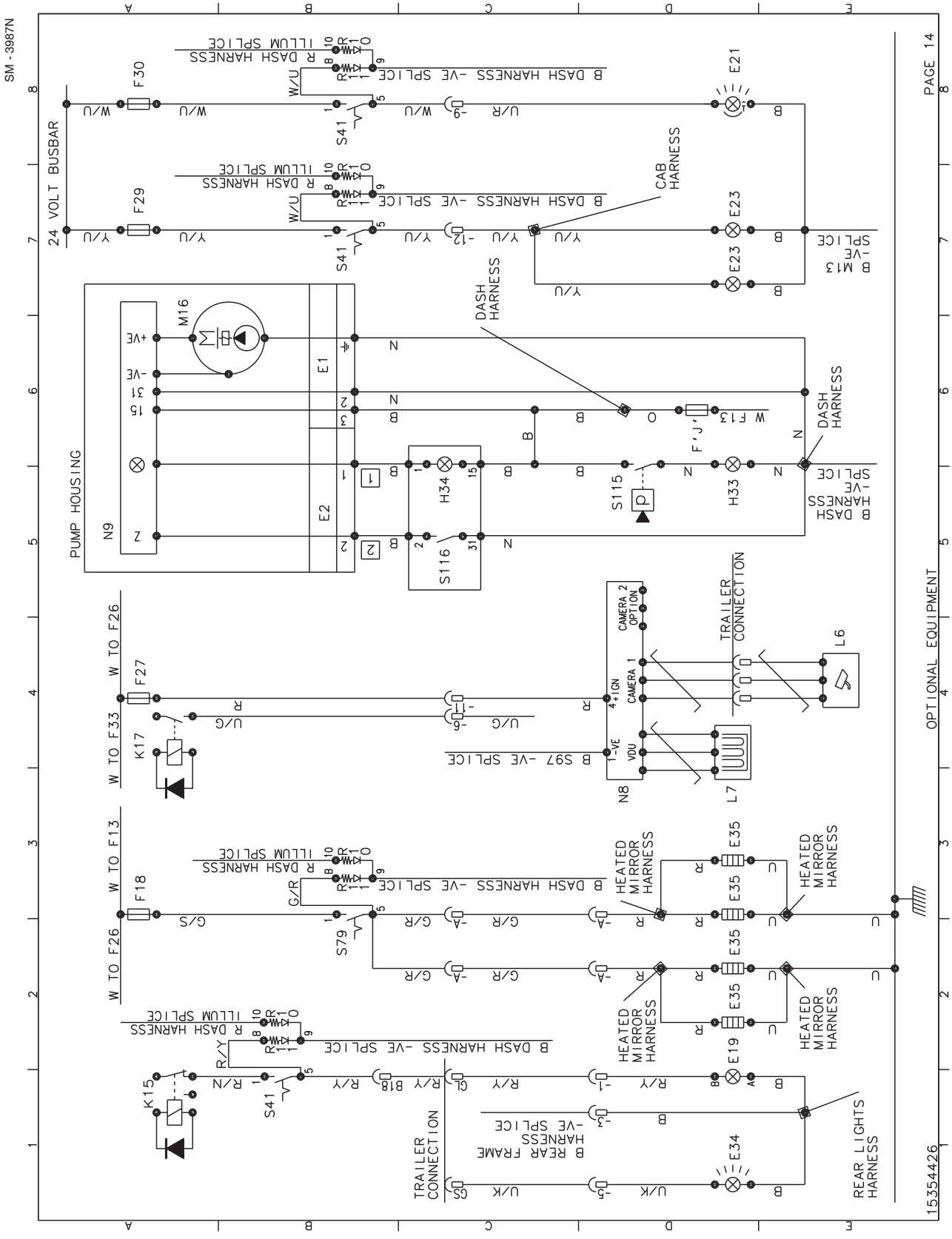

ZF 6WG260/310 TRANSMISSION TEREX HARNESS INTERFACE EST-37
15354426
PAGE 10
ZF COMPONENT DESIGNATIONS
CONNECTOR X9
CONNECTOR X8
TRANSMISSION HARNESS
CROSS AXLES DIFFS
TRANS DIFF
TRANS RETARDER (OPTION)
TRANS LOCKUP
TRANS OUTPUT SPEED SENSOR
TRANS SUMP TEMP
INTERNAL SPEED PICK-UP
TURBINE SPEED PICK-UP
ENGINE SPEED PICK-UP
B FRAME HARNESS -VE SPLICE
W/B TO TRANS IGNITION SPLICE
O/N INST PANEL CONN D CAV 8
RETARDER TEST
S90
S107
K27
K21
K22
B13
B21
B32
Y3
Y7



SM - 3987K
HYDRAULIC CONTROLS ECU
CONNECTOR A
22 PIN
CONNECTOR C
9 PIN
IQAN TOC8
DIAGNOSTIC
CONNECTOR
(RS232)
PAGE 11
ELECTRONIC/HYDRAULICS CONTROLS
HYD
VALVE
HARNESS
TRAILER
CONNECTION
4.7 kohm
PULL UP
RESISTOR
15354426


SM - 3987L
INSTRUMENT PANEL DISPLAY
INSTRUMENT PANEL/CPU SYSTEM
PAGE 12
CONN. K 36 PIN
CONN. F 12 PIN
CONN. E 36 PIN
CONN. D 36 PIN
CONN. B 6 PIN
CONN. C 22 PIN
CONN. A 14 PIN
INSTRUMENT PANEL CPU
15354426
DASH HARNESS
24 VOLT BUSBAR
F 'M'
B101
G2 -VE
B FRAME HARNESS -VE SPLICE
B21
B8
TRANS CONN X7 CAV 19 SPEEDO PULSE
DIAGNOSTIC/PROGRAMMING CONN CAV J
OSM ECM CAV 6 ENG STOP LT
OSM ECM CAV 5 ENG MAINTENANCE LT
OSM ECM CAV 16 CHECK ENG LT
HYDRAULICS ECU CAV 21 BODY UP LT
X7 DIFFLOCK SOLENOID (POSITION LT)
TRANS CONN X7 CAV 12 CHECK TRANS LT
K50 BRAKE LTS RELAY ENG BRAKE ON LT
S19 MAIN BEAM LT
K50 BRAKE LIGHTS RELAY RET ON LT
DIODE BLOCK DIRECTION INDICATORS LT
B DASH HARNESS -VE SPLICE
L4
S48
S31
S49
S57
K58
HYD VALVE HARNESS
B G2-VE
B G2 -VE
F17
W F16
W F19
DASH HARNESS R
CAN_H DASH SPLICE
CAN_L DASH SPLICE
PROGRAMMING CONNECTOR CAV H
G/U G/U DIAGNOSTIC/


SM - 3987M
PAGE 13
TRAILER CONNECTION
REAR LIGHTS HARNESS
INSTRUMENT PANEL CPU
TRAILER STANDARD EQUIPMENT
REAR FRAME HARNESS
B FRAME HARNESS -VE SPLICE
R/O F33
P/G K52
S22
L3
E5
H9
E14
H11
E12
H10
H7
15354426


SM - 3987N
24 VOLT BUSBAR
PUMP HOUSING
OPTIONAL EQUIPMENT
PAGE 14
15354426
CAB HARNESS
DASH HARNESS
TRAILER CONNECTION
HEATED MIRROR HARNESS
REAR LIGHTS HARNESS
B DASH HARNESS -VE SPLICE
R DASH HARNESS ILLUM SPLICE
B M13 -VE SPLICE
B S97 -VE SPLICE
B REAR FRAME HARNESS -VE SPLICE
W TO F26
W TO F33
W TO F13
F30
F29
F27
F18
F13
K17
K15
S41
S79
S115
S116
M16
N9
N8
H33
H34
E1
E2
E19
E21
E23
E34
E35
L6
L7
CAMERA 2 OPTION
CAMERA 1
IGN
VDU
-VE
+VE
-VE
31
15
Z

SM - 3987O

COMPONENT DESIGNATIONS

No	Description	REF	No
A4	12V Radio/CD player	P4 -A5	L3
A5	Radio/cassette speaker	P4 -D6	L4
			L5
B7	Coolant level sensor	P5 -E7	L6
B8	Fuel level sender	P12-C5	L7
B13	Rotational speed sensor	P10-D1	L8
		P10-D2	L9
B19	Throttle position sensor	P6 -C1	L11
B21	Trans oil temp sender	P10-D5	L12
		P12-C6	
B32	Trans oil retarder temp sender	P10-D8	M1
B35	Trans oil cooler fan temp sender	P11-D1	M3
B39	Air-con potentimeter (temp)	P5 -D5	M4
			M5
E3	Interior light	P3 -D3	M6
E5	Reverse light	P13-D6	M7
E7	Instrument panel lights	P5 -B4	M13
E11	Side marker light, Left	P2 -E7	M16
E12	Taillight, Left	P13-D4	N3
E13	Side marker light, Right	P2 -E5	N8
E14	Taillight, Right	P13-D4	N9
E15	High/low beam h'lamp, Left	P2 -E7	R10
E16	High/low beam h'lamp, Right	P2 -E5	
E19	Rear fog lamp	P14-D2	
E21	Rotating beacon	P14-D8	
E23	Work light	P3 -D4	
		P14-D7	
E26	High beam headlamp, Left	P2 -E6	
E27	High beam headlamp, Right	P2 -E6	
E34	Flashing reverse light	P14-D1	
E35	Heated mirror	P14-D2	
		P14-D3	
G1	Generator/Alternator	P1 -D1	
G2	Battery	P1 -D2	R11
		P1 -E2	
H6	Direction indicator, F.L	P2 -E8	
H7	Direction indicator, B.L	P13-D3	
H8	Direction indicator, F.R	P2 -E5	
H9	Direction indicator, B.R	P13-D5	
H10	Brake light, Left	P13-D4	
H11	Brake light, Right	P13-D4	
H29	Work socket illumination	P4 -D3	
		P4 -D4	
H33	Autolube high pressure w/l	P14-D5	R12
H34	Autolube override w/l	P14-C5	R13
K5	Air-con compressor clutch	P5 -D6	S1
K21	Trans shift/actuator clutch	P10-D2	S2
		P10-D3	S7
		P10-D4	S8
		P10-D5	S9
K22	Trans lock-up clutch/solenoid	P10-D6	S10
K40	Engine cooling fan clutch	P5 -D8	S11

No	Description	REF
A4	Reverse/back alarm	P13-D6
A5	Warning buzzer	P12-B2
	Electric horn	P2 -E4
B7	Reverse camera	P14-E4
B8	Reverse camera monitor	P14-D3
B13	Body raise/lower joystick	P11-E2
	Transmission shift lever	P9 -E2
B19	Transmission visual display unit	P9 -E3
B21	Brake service warning buzzer	P11-D7
B32	Starter motor	P1 -C4
B35	Blower motor	P5 -C2
B39	Washer motor, Front	P2 -E3
	Wiper motor, Front	P2 -D2
E3	Wiper motor, Rear	P3 -D6
E5	Washer motor, Rear	P3 -D7
E7	Air seat compressor	P3 -D5
E11	Autolube pump	P14-A6
E12	Voltage converter	P4 -C3
E13	Camera module	P14-D3
E14	Autolube control module	P14-A5
E15	Rocker switch 'locating' LED	P2 -B6
E16		P2 -B8
E19		P3 -B4
E21		P3 -B7
E23		P9 -B7
E26		P9 -C3
E27		P9 -C5
E34		P9 -D4
E35		P11-D7
		P14-B2
		P14-B3
G1		P14-B7
G2		P14-B8
	Rocker switch 'function' LED	P2 -B6
H6		P2 -B8
H7		P3 -B4
H8		P3 -B7
H9		P9 -C5
H10		P9 -D4
H11		P14-B2
H29		P14-B3
		P14-B7
H33		P14-B8
H34	12V work socket	P4 -D4
	24V work socket	P4 -D2
K5	Battery master switch	P1 -C1
K21	Starter keyswitch	P1 -C6
	Emergency/park brake switch	P11-B7
	Blower three speed switch	P5 -B5
K22	Washer switch, Front	P2 -B3
K40	Wiper switch, Front	P2 -B3
	Rear wash/wipe switch	P3 -B6

No	Description	REF
S13	Horn button	P2 -B3
S14	Hazard w/l switch	P2 -B6
S15	Direction ind switch	P2 -B2
S18	Lights switch	P2 -A8
S19	Dipswitch	P2 -B2
S20	Headlamp flash switch	P2 -B2
S22	Body position proximity switch	P13-C2
S31	Park brake w/l switch	P12-C4
S41	Auxiliary lights switch	P3 -B4
		P14-B1
		P14-B7
		P14-B8
S42	Air-con temperature switch	P5 -B3
S48	Accum press swt tractor circuit	P12-C4
S49	Accum press swt trailer circuit	P12-C3
S57	Steering pressure swt	P12-C3
S60	Difflock request switch	P9 -B7
S68	Engine diag/request on/off switch	P6 -C2
S69	Accelerator idle validation switch	P6 -D1
S74	Trans kickdown/hold in range switch	P9 -D7
S78	Auxillary body lower switch	P11-C6
S79	Heated mirror switch	P14-B2
S80	Engine compression brake low/high	P9 -D4
S82	Engine compression brake request	P9 -C3
S90	Trans oil filter restriction switch	P10-D8
S91	Air compressor pressure switch	P5 -B3
S97	Interior light door switch	P3 -D3
S106	Brake pedal position switch	P3 -A1
S107	Foot operated difflock switch	P10-B7
S111	Diagnostic inc/dec switch	P6 -C2
S112	Air-con fresh/recirc switch	P5 -D5
S113	Air-con defrost mode switch	P5 -E5
S114	Air-con on/off switch	P5 -B4
S115	Autolube high pressure switch	P14-D5
S116	Autolube override switch	P14-C5
S117	Park brake service switch	P11-D6
Y3	Transmission retarder solenoid	P10-D6
Y4	Emergency/park brake solenoid	P11-D7
Y7	Difflock solenoid	P10-D7
Y11	Fresh/Recirc actuator	P5 -D1
Y26	Body raise solenoid	P11-D3
Y27	Body lower solenoid	P11-D3
Y32	Trans oil cooler proportional solenoid	P11-D4
Y33	System hydraulics un-loader valve	P11-D5
Y34	System Hydraulics float valve	P11-D6
Y36	Trans oil cooler fan isolation solenoid	P11-D5
Y48	Defrost actuator	P5 -E1
Y49	Water valve actuator	P5 -D1

REF = PAGE NUMBER-GRID REFERENCE I.E. P2 -D3 = K47)

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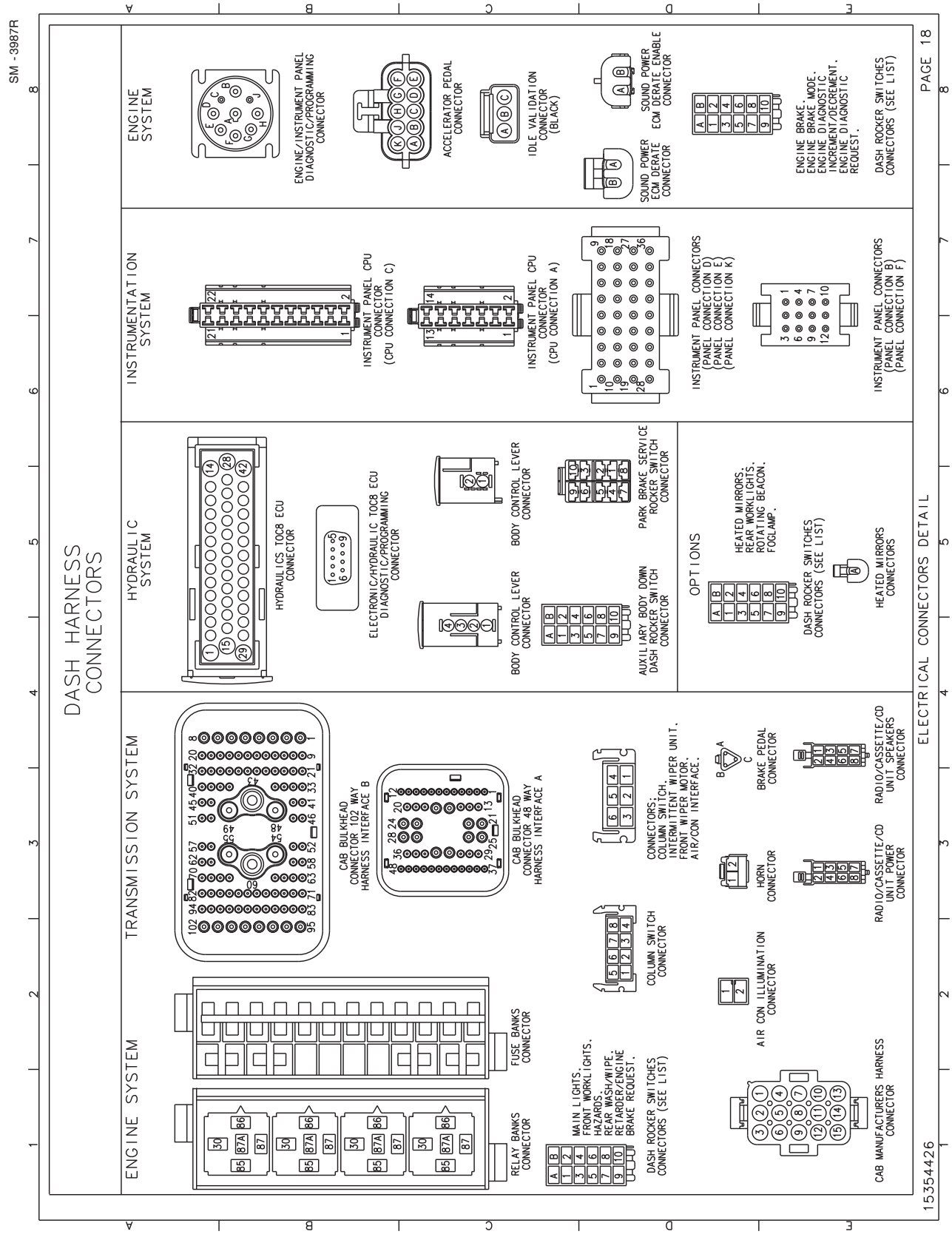
SM - 3987R
DASH HARNESS CONNECTORS
ENGINE SYSTEM
TRANSMISSION SYSTEM
HYDRAULIC SYSTEM
INSTRUMENTATION SYSTEM
ENGINE SYSTEM
ENGINE/INSTRUMENT PANEL DIAGNOSTIC/PROGRAMMING CONNECTOR
ACCELERATOR PEDAL CONNECTOR
IDLE VALIDATION CONNECTOR (BLACK)
SOUND POWER ECM DERATE CONNECTOR
SOUND POWER ECM DERATE ENABLE CONNECTOR
ENGINE BRAKE, ENGINE BRAKE MODE, ENGINE DIAGNOSTIC INCREMENT/DECREMENT, ENGINE DIAGNOSTIC REQUEST.
DASH ROCKER SWITCHES CONNECTORS (SEE LIST)
INSTRUMENT PANEL CPU CONNECTOR (CPU CONNECTION C)
INSTRUMENT PANEL CPU CONNECTOR (CPU CONNECTION A)
INSTRUMENT PANEL CONNECTORS (PANEL CONNECTION D) (PANEL CONNECTION E) (PANEL CONNECTION K)
INSTRUMENT PANEL CONNECTORS (PANEL CONNECTION B) (PANEL CONNECTION F)
HYDRAULICS TOC8 ECU CONNECTOR
ELECTRONIC/HYDRAULIC TOC8 ECU DIAGNOSTIC/PROGRAMMING CONNECTOR
BODY CONTROL LEVER CONNECTOR
BODY CONTROL LEVER CONNECTOR
PARK BRAKE SERVICE ROCKER SWITCH CONNECTOR
AUXILIARY BODY DOWN DASH ROCKER SWITCH CONNECTOR
OPTIONS
HEATED MIRRORS, REAR WORKLIGHTS, ROTATING BEACON, FOGLAMP.
DASH ROCKER SWITCHES CONNECTORS (SEE LIST)
HEATED MIRRORS CONNECTORS
CAB BULKHEAD CONNECTOR 102 WAY HARNESS INTERFACE B
CAB BULKHEAD CONNECTOR 48 WAY HARNESS INTERFACE A
CONNECTORS; COLUMN SWITCH, INTERMITTENT WIPER UNIT, FRONT WIPER MOTOR, AIR/CON INTERFACE.
BRAKE PEDAL CONNECTOR
RADIO/CASSETTE/CD UNIT SPEAKERS CONNECTOR
FUSE BANKS CONNECTOR
RELAY BANKS CONNECTOR
MAIN LIGHTS, FRONT WORKLIGHTS, HAZARDS, REAR WASH/WIPE, RETARDER/ENGINE BRAKE REQUEST.
DASH ROCKER SWITCHES CONNECTORS (SEE LIST)
COLUMN SWITCH CONNECTOR
AIR CON ILLUMINATION CONNECTOR
HORN CONNECTOR
RADIO/CASSETTE/CD UNIT POWER CONNECTOR
CAB MANUFACTURERS HARNESS CONNECTOR
ELECTRICAL CONNECTORS DETAIL
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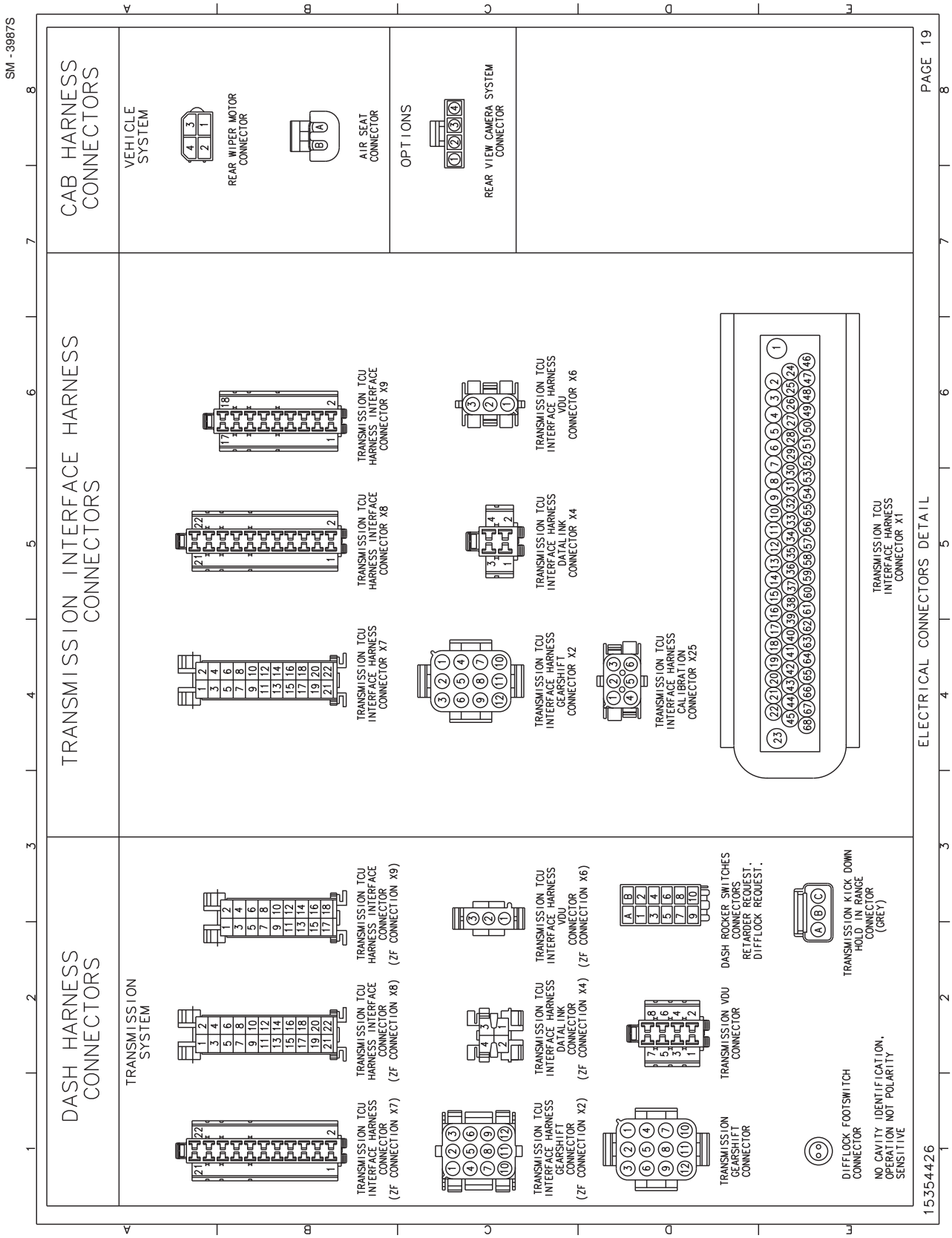
SM - 3987S
DASH HARNESS CONNECTORS
TRANSMISSION SYSTEM
TRANSMISSION INTERFACE HARNESS CONNECTORS
CAB HARNESS CONNECTORS
VEHICLE SYSTEM
OPTIONS
REAR WIPER MOTOR CONNECTOR
AIR SEAT CONNECTOR
REAR VIEW CAMERA SYSTEM CONNECTOR
TRANSMISSION TCU INTERFACE HARNESS CONNECTOR X7 (ZF CONNECTION X7)
TRANSMISSION TCU HARNESS INTERFACE CONNECTOR (ZF CONNECTION X8)
TRANSMISSION TCU HARNESS INTERFACE CONNECTOR (ZF CONNECTION X9)
TRANSMISSION TCU INTERFACE HARNESS GEARSHIFT CONNECTOR (ZF CONNECTION X2)
TRANSMISSION TCU INTERFACE HARNESS DATALINK CONNECTOR (ZF CONNECTION X4)
TRANSMISSION TCU INTERFACE HARNESS VDU CONNECTOR (ZF CONNECTION X6)
TRANSMISSION GEARSHIFT CONNECTOR
TRANSMISSION VDU CONNECTOR
DASH ROCKER SWITCHES CONNECTORS RETARDER REQUEST. DIFFLOCK REQUEST.
DIFFLOCK FOOTSWITCH CONNECTOR
TRANSMISSION KICK DOWN HOLD IN RANGE CONNECTOR (GREY)
NO CAVITY IDENTIFICATION, OPERATION NOT POLARITY SENSITIVE
TRANSMISSION TCU HARNESS INTERFACE CONNECTOR X8
TRANSMISSION TCU HARNESS INTERFACE CONNECTOR X9
TRANSMISSION TCU INTERFACE HARNESS VDU CONNECTOR X6
TRANSMISSION TCU INTERFACE HARNESS DATALINK CONNECTOR X4
TRANSMISSION TCU INTERFACE HARNESS GEARSHIFT CONNECTOR X2
TRANSMISSION TCU INTERFACE HARNESS CALIBRATION CONNECTOR X25
TRANSMISSION TCU INTERFACE HARNESS CONNECTOR X1
ELECTRICAL CONNECTORS DETAIL
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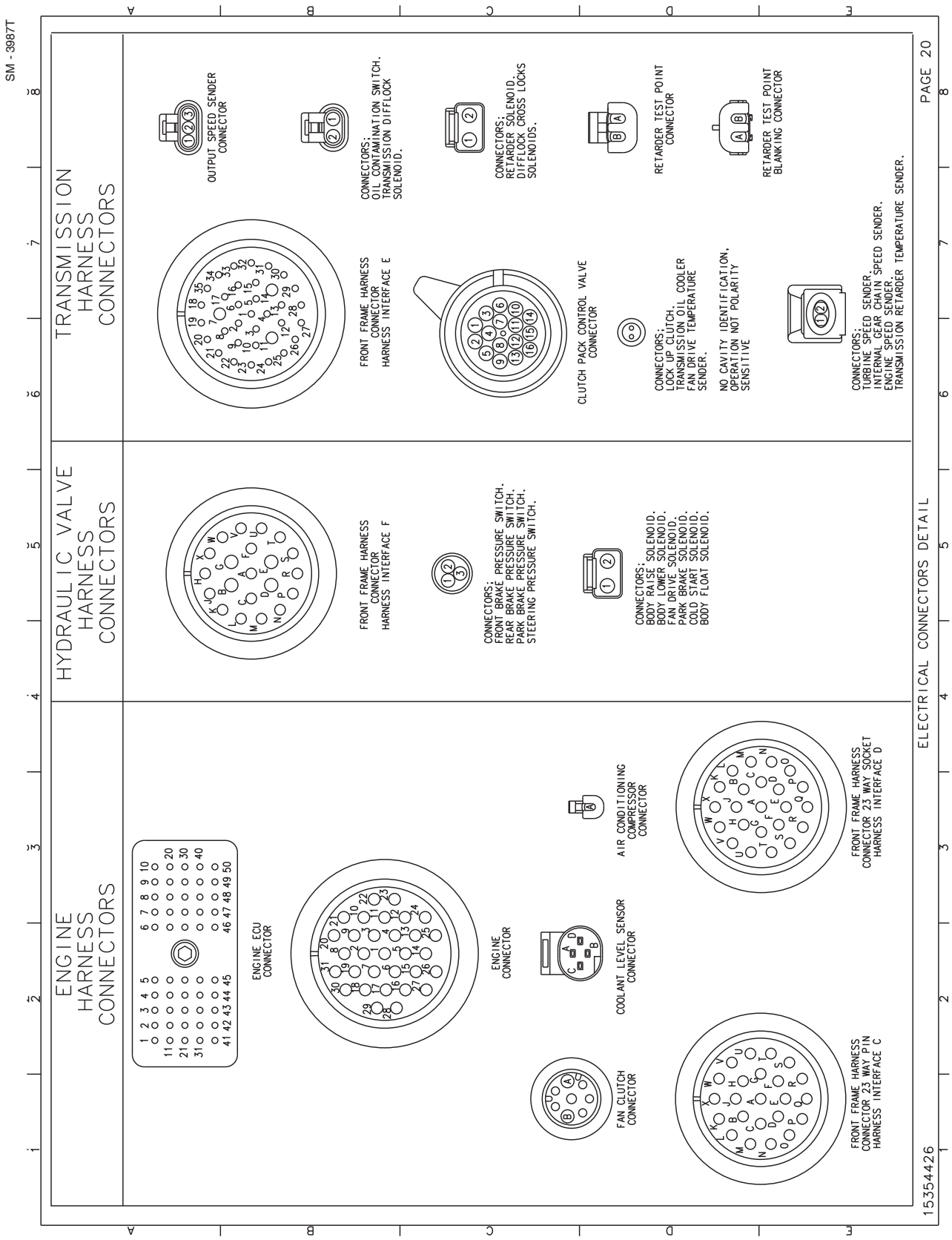
SM - 3987T
ENGINE HARNESS CONNECTORS
HYDRAULIC VALVE HARNESS CONNECTORS
TRANSMISSION HARNESS CONNECTORS
ENGINE ECU CONNECTOR
ENGINE CONNECTOR
COOLANT LEVEL SENSOR CONNECTOR
AIR CONDITIONING COMPRESSOR CONNECTOR
FAN CLUTCH CONNECTOR
FRONT FRAME HARNESS CONNECTOR 23 WAY PIN HARNESS INTERFACE C
FRONT FRAME HARNESS CONNECTOR 23 WAY SOCKET HARNESS INTERFACE D
FRONT FRAME HARNESS CONNECTOR HARNESS INTERFACE F
CONNECTORS; FRONT BRAKE PRESSURE SWITCH. REAR BRAKE PRESSURE SWITCH. PARK BRAKE PRESSURE SWITCH. STEERING PRESSURE SWITCH.
CONNECTORS; BODY RAISE SOLENOID. BODY LOWER SOLENOID. FAN DRIVE SOLENOID. PARK BRAKE SOLENOID. COLD START SOLENOID. BODY FLOAT SOLENOID.
FRONT FRAME HARNESS CONNECTOR HARNESS INTERFACE E
CONNECTORS; OIL CONTAMINATION SWITCH. TRANSMISSION DIFFLOCK SOLENOID.
CONNECTORS; RETARDER SOLENOID. DIFFLOCK CROSS LOCKS SOLENOIDS.
CLUTCH PACK CONTROL VALVE CONNECTOR
CONNECTORS; LOCK UP CLUTCH. TRANSMISSION OIL COOLER FAN DRIVE TEMPERATURE SENDER.
NO CAVITY IDENTIFICATION, OPERATION NOT POLARITY SENSITIVE
CONNECTORS; TURBINE SPEED SENDER. INTERNAL GEAR CHAIN SPEED SENDER. ENGINE SPEED SENDER. TRANSMISSION RETARDER TEMPERATURE SENDER.
OUTPUT SPEED SENDER CONNECTOR
RETARDER TEST POINT CONNECTOR
RETARDER TEST POINT BLANKING CONNECTOR
ELECTRICAL CONNECTORS DETAIL
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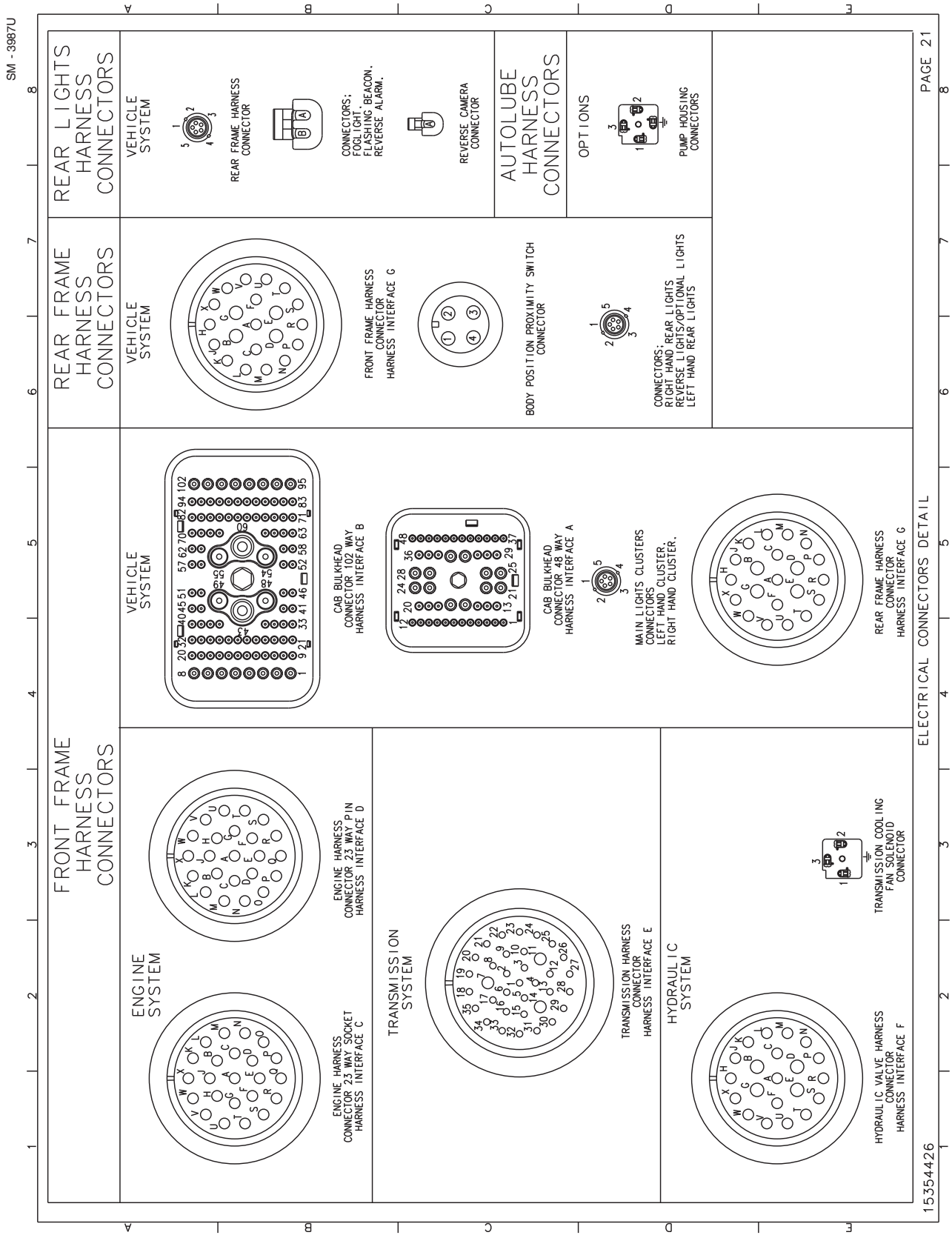
SM - 3987U
FRONT FRAME HARNESS CONNECTORS
REAR FRAME HARNESS CONNECTORS
REAR LIGHTS HARNESS CONNECTORS
AUTOLUBE HARNESS CONNECTORS
OPTIONS
ENGINE SYSTEM
TRANSMISSION SYSTEM
HYDRAULIC SYSTEM
VEHICLE SYSTEM
ENGINE HARNESS CONNECTOR 23 WAY SOCKET HARNESS INTERFACE C
ENGINE HARNESS CONNECTOR 23 WAY PIN HARNESS INTERFACE D
TRANSMISSION HARNESS CONNECTOR HARNESS INTERFACE E
HYDRAULIC VALVE HARNESS CONNECTOR HARNESS INTERFACE F
TRANSMISSION COOLING FAN SOLENOID CONNECTOR
CAB BULKHEAD CONNECTOR 102 WAY HARNESS INTERFACE B
CAB BULKHEAD CONNECTOR 48 WAY HARNESS INTERFACE A
MAIN LIGHTS CLUSTERS CONNECTORS LEFT HAND CLUSTER. RIGHT HAND CLUSTER.
REAR FRAME HARNESS CONNECTOR HARNESS INTERFACE G
FRONT FRAME HARNESS CONNECTOR HARNESS INTERFACE G
BODY POSITION PROXIMITY SWITCH CONNECTOR
CONNECTORS; RIGHT HAND REAR LIGHTS REVERSE LIGHTS/OPTIONAL LIGHTS LEFT HAND REAR LIGHTS
REAR FRAME HARNESS CONNECTOR
CONNECTORS; FOGLIGHT; FLASHING BEACON. REVERSE ALARM.
REVERSE CAMERA CONNECTOR
PUMP HOUSING CONNECTORS
ELECTRICAL CONNECTORS DETAIL
PAGE 21
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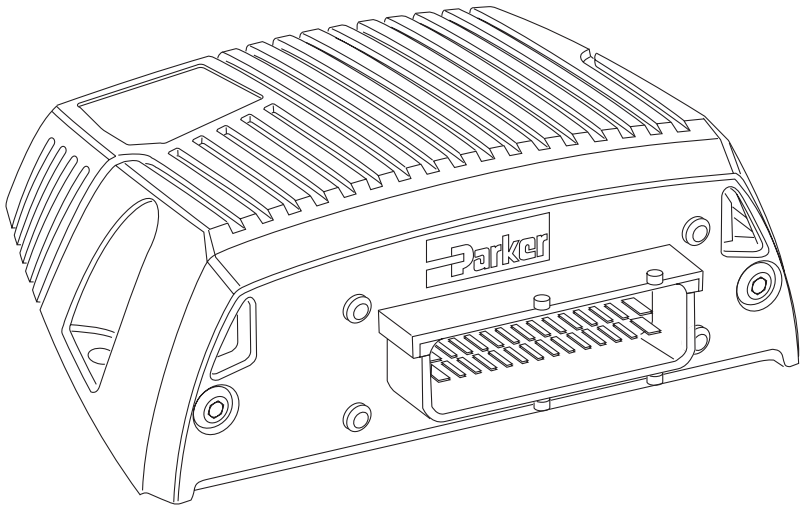

Fig. 1 - IQAN TOC8 Electronic Control Unit

DESCRIPTION

The hydraulic electronic control unit (ECU) (Figure 1) is a stand alone control which controls the machines hydraulic systems, including body hoist and transmission oil cooler fan drive. The IQAN-TOC8 ECU communicates with a variety of input and output devices. It utilises analog/digital inputs, proportional current outputs and digital outputs.

The ECU continuously monitors the system and warns the operator when a fault develops, and also helps diagnose the nature of the fault. ECU is located inside the cab, under the instructor seat (see Figure 2).

⚠ WARNING

Before any welding is carried out on a machine equipped with an IQAN-TOC8 hydraulic system, disconnect the following 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.

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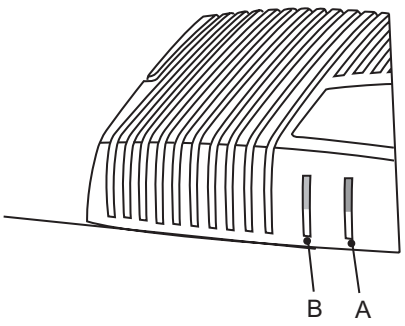

A - Green LED, Power On
B - Yellow/Red LED, Status

Fig. 2 - Hydraulic ECU Location

ECU Inputs

Refer to Figures 3 and 4 and Section 190-0000, Circuit Diagrams.

Ignition Switch - connected to the starter keyswitch, rendering the circuit energized or de-energized.

Starter Motor Relay - when the starter motor relay is activated, a digital signal is fed to the ECU.

Body Control Lever - this three position lever sends analog signals to ECU.

Transmission Cooler Fan Drive Temperature Sensor - sensor at transmission sends analog signal to ECU.

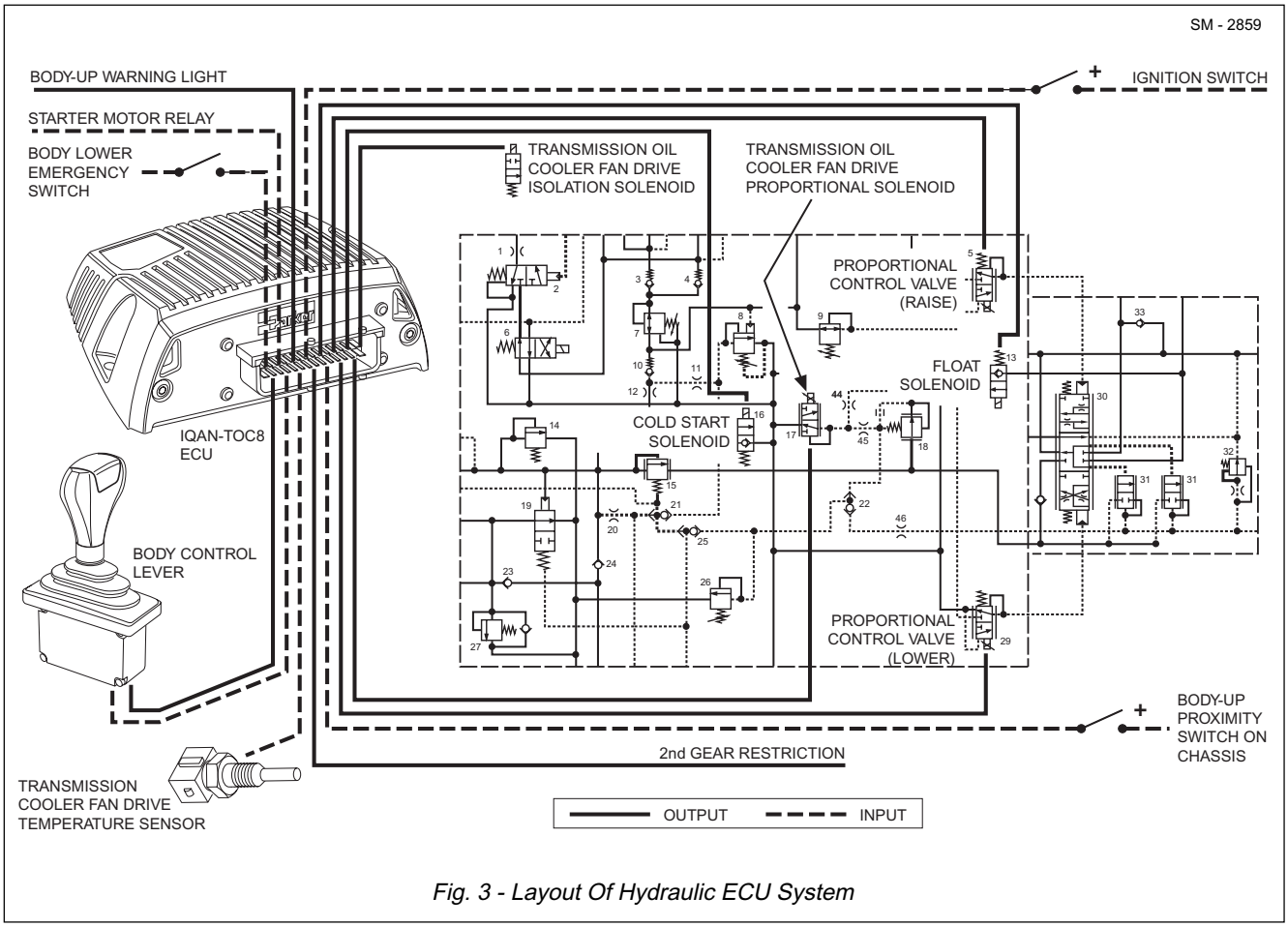

Fig. 3 - Layout Of Hydraulic ECU System

Body Up Proximity Switch - sends a digital signal to the ECU through relay K52 depending on the position of the body. When the body is lowered the proxy switch is made. When the body is in a raised position the proxy switch is open circuit.

Body Lower Emergency Switch - located in the cab, the switch sends a positive battery supply directly to the float solenoid when pressed. This is used to lower the body in the event of system failure.

ECU Outputs

Cold Start Solenoid - when ECU receives input from starter motor relay, the ECU sends an ouput signal to activate cold start solenoid. This prevents the engine starting under hydraulic load.

Body Raise/Lower - when ECU receives signals from body control lever, ECU sends output signals to the raise and lower proportional control valves to shift the main control valve spool accordingly. Typical output from ECU is 250 - 800 mA, providing a delivery pressure between 4 - 25 bar (58 - 363 lbf/in^2) at main control valve spool. For raise proportional control valve, measure current output across pins 17 and 18 on ECU. For lower proportional control valve, measure across pins 31 and 32. When the body proximity switch is closed circuit (body lowered) the lower signal is inhibited.

Transmission Oil Cooler Fan Drive Proportional Solenoid - the transmission cooler fan drive temperature sensor feeds back to the ECU, which outputs a signal to the fan drive proportional solenoid (typically 150-210 mA measured across pins 19 and 20, resulting in a delivery between 38-83 bar (551-1204 lbf/in^2)). This causes the fan speed to increase proportionally. Refer to Section 215-0050, Main Hydraulic Valve Assembly.

Transmission Oil Cooler Fan Drive Isolation Solenoid - the transmission cooler fan drive temperature sensor feeds back to the ECU, which outputs a signal to the fan drive isolation solenoid. Refer to Section 210-0060, Transmission Oil Cooler.

Body-Up Warning Light - the body-up proximity switch sends a signal to the ECU through relay K52, and depending on the body position, the ECU sends a signal to illuminate the warning light in the cab.

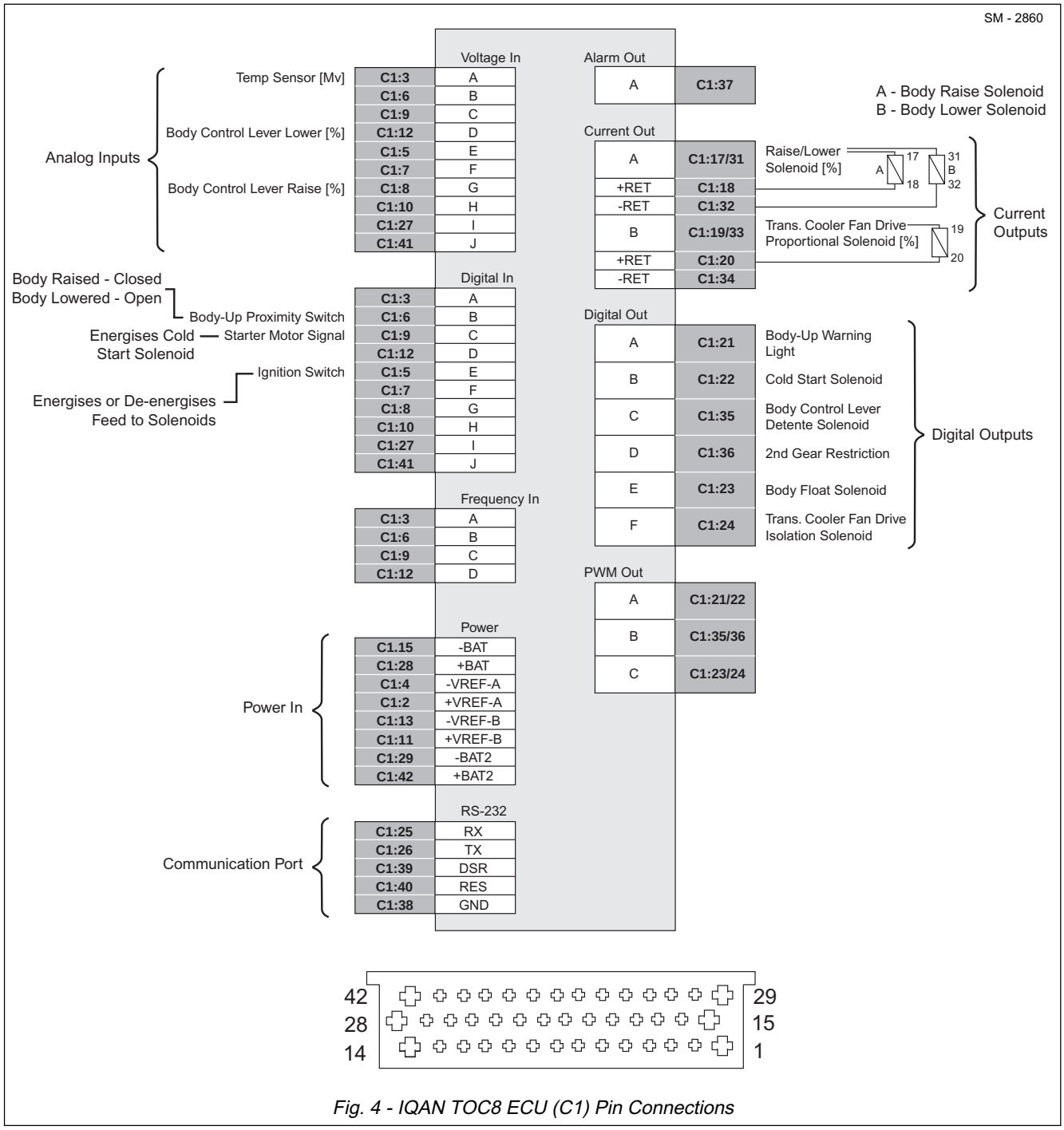

Fig. 4 - IQAN TOC8 ECU (C1) Pin Connections

Body Float Solenoid - the body lower emergency switch sends a positive battery supply to energise the body float solenoid. This ensures that the hoist side of the body cylinders are vented to tank, allowing body to lower onto chassis under it's own weight in the event of system failure.

The body float solenoid is always energised when the body-up proximity switch is open circuit (body lowered). This prevents pressure being trapped in the hoist side of cylinders when travelling, ensuring body is resting on the chassis. If body is not resting on the chassis when travelling, hinge points and cylinders may be damaged, especially when body is laden.

Check the body float solenoid across pin 23 on ECU and vehicle ground. Solenoid is rated at 15 W, 0.6 A, 42 ohms.

Body Control Lever Detent - when the body control lever is pushed fully forward to power down the body,

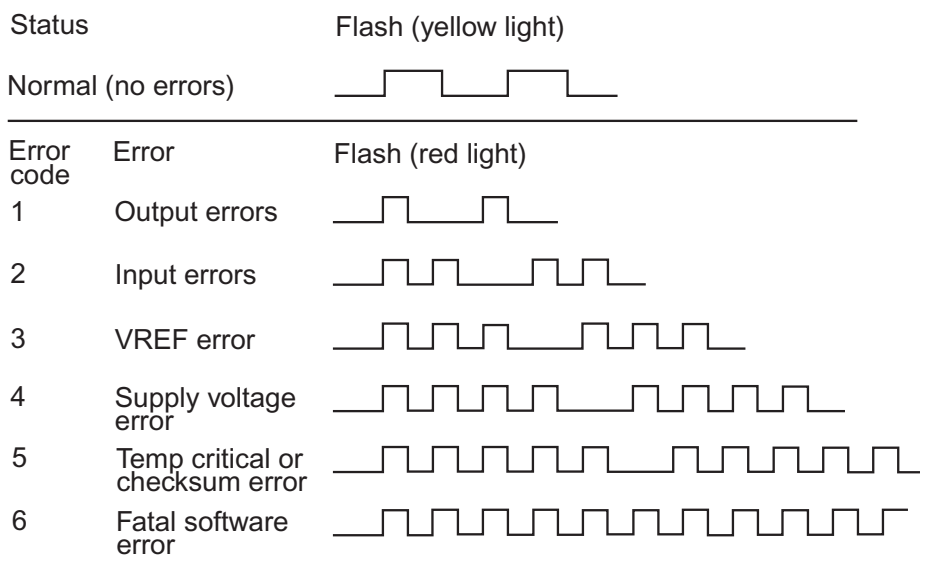

Fig. 5 - LED Indicator Showing Different Modes

the ECU energises a detent solenoid within the lever to hold the lever fully forward. This continues until the body-up proximity switch is open circuit (body lowered), when the ECU de-energizes the detent solenoid so that the lever returns to the neutral position, and the body float solenoid is energized (see Body Float Solenoid).

2nd Gear Restriction - when the body-up proximity switch is made, the ECU sends a signal to the transmission ECU to restrict the transmission to second forward gear. When the body-up proximity switch is open circuit i.e. body is lowered, full gear range is available.

System Safety

Input/Output Protection - all inputs to the ECU are designed to withstand the maximum specified supply voltage. The outputs are protected against short circuit. Additionally, an error on one input/output will not influence other inputs/outputs. External fuse (10A), located in the battery box, will blow if supply exceeds 35 V.

Current Check - for the current outputs, a current check is performed. The ECU compares the return current with the output's set-value. If current deviation occurs, the user will be notified through an appropriate error code on the unit's LED.

If the ECU detects a short circuit to battery supply, the unit will shut off the outputs in order to increase safety.

Memory Test - the ECU will perform a self test during operation to verify the software. The test includes a processor and memory verification, and an internal signal verification. If any software error is detected, appropriate precautions will be taken.

System Diagnosis

Refer to Figures 2 and 5.
The two LEDs on the ECU are used to diagnose basic system errors. The ECU indicates error status through the red blinking LED as shown in Figure 5, giving an immediate diagnosis as to the nature of the error that has occurred.

If there are no errors, the bottom LED flashes yellow to indicate normal status. Some errors will cause the ECU to stop operating or at least shut down the outputs to increase safety. The green LED indicates power on.

> ⚠ **WARNING**
> **Do not use the machine if an error code is present. Shutdown the machine until the problem is resolved.**

Refer to table of error codes for corrective action. The ECU has a RS232 interface under theinstructor seat which plugs directly into a laptop. This allows communication with the ECU using IQAN develop software, and gain more information about the ECU's status.

Error Codes, Messages and Actions

Situation	Error Code	Action ECU	Remarks
ERROR: OUTPUT HIGH			
COUT: Current return low or high	Error 1	Active output shuts off	Check wiring and loads
COUT: Both directions commanded	Error 1	Active output shuts off	Check application
DOUT: Overload	Error 1	Active output shuts off	Check load
PWMOUT: Both directions commanded	Error 1	Active output shuts off	Check application
COUT/DOUT: Internal driver failure	Error 6	Active output shuts off	Replace ECU
ERROR: INPUT			
VIN: > specified max or < specified min	Error 2	Active input goes to error value	Check wiring and sensors
ERROR: VREF			
VREF_< 4.9 V	Error 3	-	Check voltage, replace ECU
VREF_> 5.1 V	Error 3	-	Check voltage, replace ECU
LOW/HIGH SUPPLY VOLTAGE			
+BAT < 8.5 V	Error 4	-	Check voltage supply
+BAT > 34 V	Error 4	-	Check voltage supply
HIGH TEMPERATURE			
Internal temperature > max temp	Error 5	-	Check ambient temperature, allow ECU to cool
Internal temperature sensor error	Error 6	-	Replace ECU
ERROR: PARAMETER			
Parameter error	Error 5	No calibration of signals	Replace ECU
ERROR: SOFTWARE			
Software error	Error 6	Unit stops operating	Replace ECU

REMOVAL

⚠ WARNINGS

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

⚠

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.

2. Operate the treadle valve continuously to discharge the 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 battery ground cable first, then the battery supply cable, before disconnecting harness from IQAN-TOC8 ECU inside cab.

4. Remove bolts securing ECU to support below the right hand console, and remove ECU.

INSTALLATION

1. Secure ECU to support below the right hand console using bolts removed previously.

2. Firstly connect harness to ECU, then connect battery supply cable and battery ground cable in that order.

3. Turn master switch on, start engine and ensure that the top LED is green which indicates voltage is being supplied, and that the bottom LED flashes yellow, indicating normal status.

4. Remove wheel blocks from all road wheels.

SPECIAL TOOLS

There are no special tools required for procedures outlined in this section. To obtain IQAN develop diagnostic software, contact your dealer.

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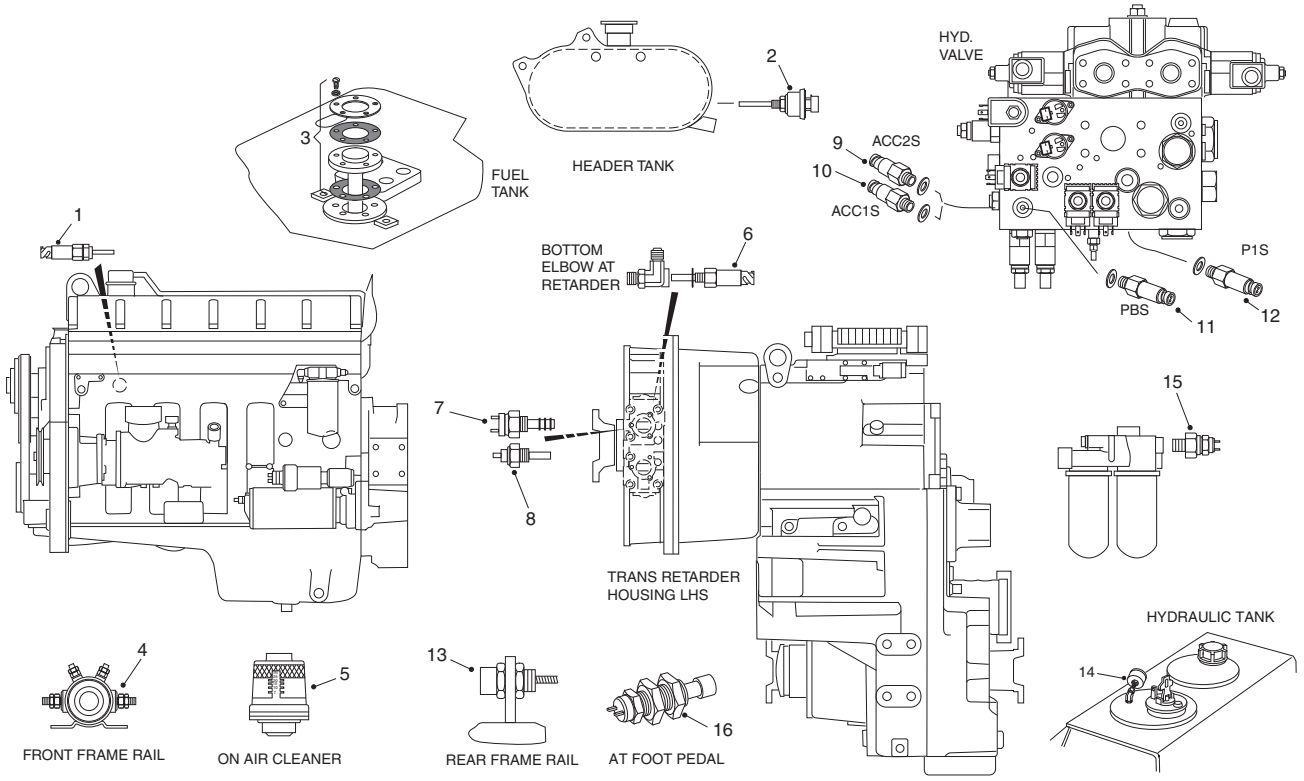


1 - Engine Coolant Temperature Sender
2 - Engine Coolant Level Sensor
3 - Fuel Level Sender
4 - Starter Relay
5 - Air Cleaner Restriction Gauge
6 - Transmission Oil Temp Sender
7 - Trans Oil Cooler Fan Temp Sensor
8 - Retarder Oil Temperature Sensor
9 - Rear Brake Pressure Switch
10 - Front Brake Pressure Switch
11 - Park Brake Pressure Switch
12 - Steering System Pressure Switch
13 - Body Up Proximity Switch
14 - Hydraulic Filter Restriction Gauge
15 - Oil Filter Restriction Switch
16 - Cross Axle Differential Lock Switch

Fig. 1 - Layout View of Switches and Sensors

DESCRIPTION

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

This section describes the location and function of various switches and sensors fitted to the vehicle to monitor all major components and systems. Gauges and warning lights located in the dash panel, relay this information to the operator.

Note: Always make sure all gauges, warning lights and controls are working properly before operating the vehicle.

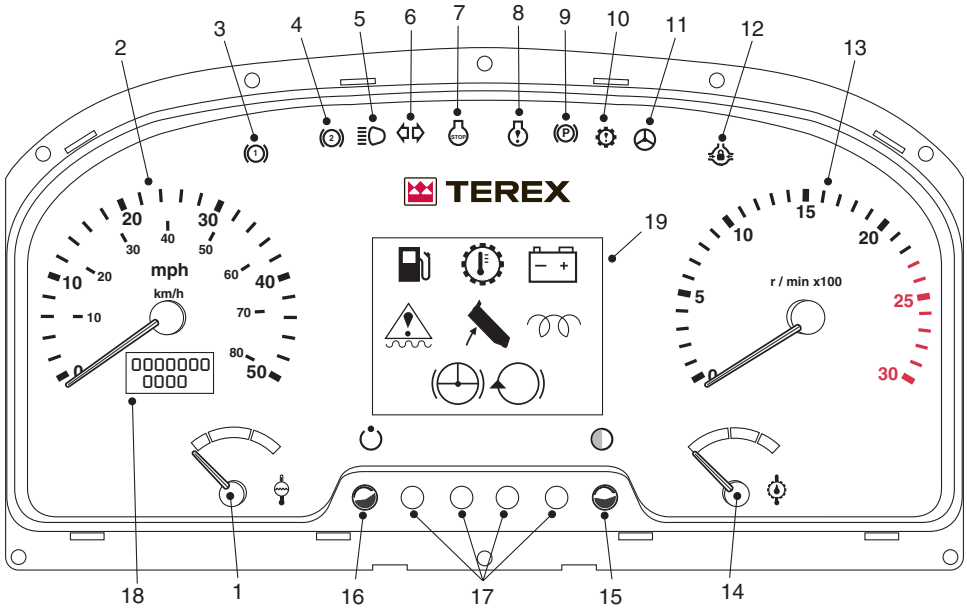
Engine

The Quantum engine management system monitors the engine at all times and sends a signal to the engine check light (8, Fig. 2) and engine stop light (7, 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 Temperature Sender (1) - Located in the right hand side of the engine. Sends a signal indicating engine coolant temperature to engine coolant temperature gauge (1, Fig. 2).

Engine Coolant Level Sensor (2) - Located in the radiator header tank, the sensor sends a signal to engine ECM.

Engine Coolant Temperature Gauge (1, Fig. 2) - Indicates the engine coolant temperature. The gauge should read in the green zone after the engine has warmed. If the gauge reads in the red zone, stop engine and investigate the cause.



1 - Engine Coolant Temperature Gauge
2 - Speedometer
3 - Front Brake Accumulator Pressure W/L
4 - Rear Brake Accumulator Pressure W/L
5 - Headlight Main Beam Ind/L
6 - Direction Indicators Ind/L
7 - Engine Stop W/L
8 - Engine Check W/L
9 - Parking Brake Ind/L
10 - Transmission Check W/L
11 - Emergency Steering W/L
12 - Differential Lock Ind/L
13 - Tachometer
14 - Transmission Sump Oil Temp. Gauge
15 - Dimming Button
16 - Tripmeter Reset Button
17 - Not Used
18 - Digital Odometer
19 - Visual Display Unit (VDU)

Fig. 2 - Layout View of Instruments and Indicator/Warning Lights

Tachometer (13, Fig. 2) - Driven from the engine ECU, the tachometer indicates the number of engine crankshaft revolutions per minute. The needle shows the variations in engine operating speed. Never accelerate the engine to speeds indicated by the red zone on the dial face.

Hourmeter (6, Fig. 4) - Driven from the engine alternator, the hourmeter records the total number of engine hours.

Starter Relay (4) - Mounted on the tractor frame rail, the starter relay powers up the starter motor when the keyswitch is turned.

Transmission

Refer to Section 120-0010, TRANSMISSION AND MOUNTING, for further information on switches and sensors fitted to the transmission.

Speedometer (1, Fig. 2) - Driven by a signal from the transmission ECU, the speedometer indicates travel speed in kilometres per hour and miles per hour.

Transmission Oil Temperature Sender (6) - The sender, located on the elbow at the retarder housing, sends a signal to indicate transmission converter oil temperature on the bar graph gauge displayed on the VDU (3, Fig. 4).

Transmission Oil Cooler Fan Temperature Sensor (7) - Located in the retarder housing, the sensor sends a signal to the hydraulics ECU to operate the transmission oil cooler fan drive at a speed proportional to transmission oil temperature.

Trans. Sump Oil Temperature Sensor (8) - The temperature sensor is located at the retarder housing and records both the retarder and converter oil temperature, which is supplied to the transmission ECU. When either reaches a out of range condition this will cause the tranmission oil temp high warning symbol (2, Fig.3) to be displayed on the VDU.

Oil Filter Restriction Switch (15) - The restriction switch sends a signal to the Transmission TCU to indicate that the Oil filter is restricted, which will in turn send a signal to the check transmission lamp (10, Fig. 2) indicating the need to check for a fault.

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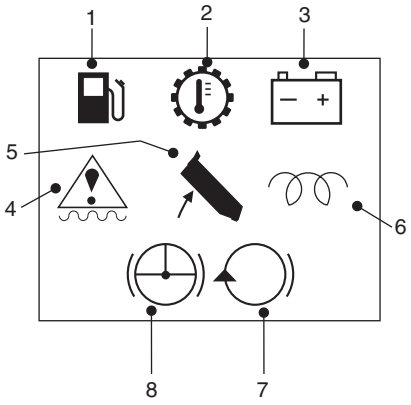

1 - Low Fuel
2 - Trans. Oil Temp High
3 - Alternator Charging
4 - Engine Maintenance Monitor
5 - Body Up
6 - Wait to Start
7 - Engine Brake
8 - Transmission Retarder

Fig. 3 - Warning Symbol Screen

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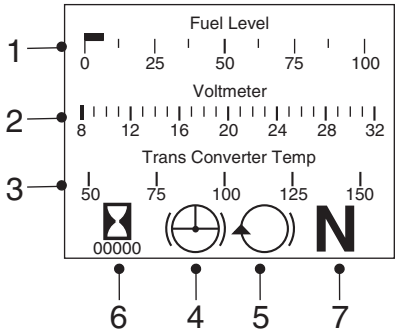


1 - Fuel Level
2 - System Voltage
3 - Transmission Converter Oil Temp.
4 - Transmission Retarder
5 - Engine Brake
6 - Engine Hours Counter
7 - Transmission Gear selected

Fig. 4 - Main Screen Display

Braking System

Rear Brake Pressure Switch (9) - The normally closed (NC) pressure switch, located in port ACC2S of the main hydraulic valve, senses the pressure in the rear brake circuit. The pressure switch sends a signal to illuminate 'Red' rear brake accumulator pressure warning light (20, Fig. 2) when pressure drops to 122 bar (1769 lbf/in^2). An audible buzzer also sounds.

Front Brake Pressure Switch (10) - The normally closed (NC) pressure switch, located in port ACC1S of the main hydraulic valve, senses the pressure in the front brake circuit. The pressure switch sends a signal to illuminate 'Red' front brake accumulator pressure warning light (19, Fig. 2) when pressure drops to 122 bar (1769 lbf/in^2). An audible buzzer also sounds.

Parking Brake Pressure Switch (11) - The normally closed (NC) pressure switch, located in port PBS of the main hydraulic valve, senses pressure in the parking brake circuit. The pressure switch closes at a pressure of 5 bar (70 lbf/in^2) and sends a signal to illuminate 'Green' parking brake indicator light (28, Fig. 2), indicating that the parking brake is applied.

Steering System

Steering System Pressure Switch (12) - The normally closed (NC) pressure switch is located in port P1S of the main hydraulic valve. The pressure switch closes and sends a signal to illuminate 'Red' emergency steering warning light (22, Fig. 2) when steering pressure drops to 5 bar (70 lbf/in^2) or lower. An audible buzzer also sounds.

Hydraulic System

Hydraulic Filter Restriction Gauge (14) - The hydraulic filter restriction gauge is located on top of hydraulic tank. After 1 000 hours or when the needle moves into the red zone, whichever comes first, the hydraulic filter should be changed.

Air Cleaner

Air Cleaner Restriction Gauge (5) - Mounted on the air cleaner, the restriction gauge indicates the degree of air cleaner element restriction as the red panel rises in the gauge window. The filter element(s) should be replaced if the red band locks in place when the engine is shut down. Reset the gauge by pressing the button on the gauge with the engine running.

Fuel Tank

Fuel Level Sender (3) - Located at the rear of the fuel tank, the fuel level sender sends a signal to VDU display which displays fuel level as a graph (1, Fig. 4) to indicate the amount of fuel left in the tank.

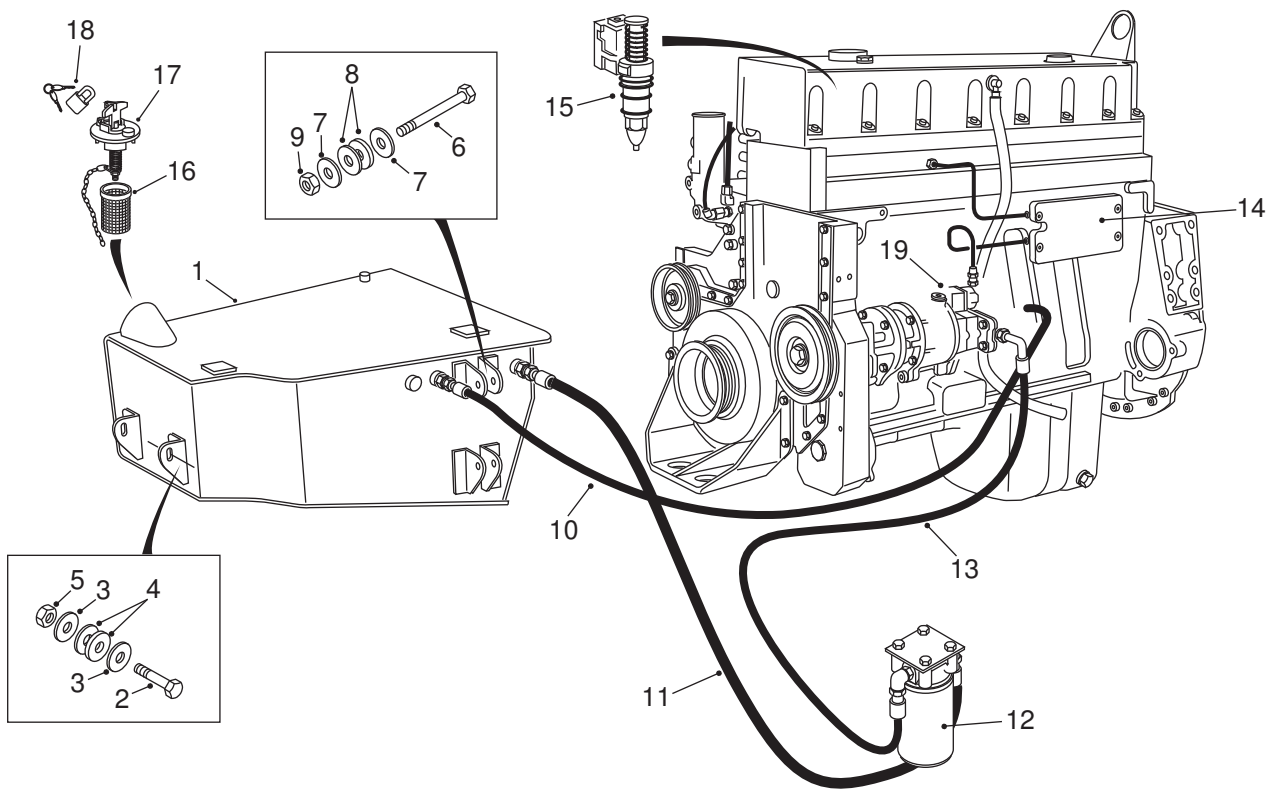
Body

Body Up Proximity Switch (13) - Mounted off 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 body up warning symbol on the VDU panel (5, Fig. 3).

Note: Never move the vehicle until body up warning light (5, Fig. 3) 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 frame. When the proximity switch makes contact, the body control lever detent is de-energised and float solenoid at main hydraulic valve is energised.

* * * *



1 - Fuel Tank
2 - Bolt
3 - Washer
4 - Shims
5 - Nut
6 - Bolt
7 - Washer
8 - Shims
9 - Nut
10 - Fuel Line
11 - Fuel Line
12 - Fuel Filter/Water Separator
13 - Fuel Line
14 - ECM Cooling Plate
15 - Electronic Unit Injector
16 - Strainer
17 - Filler Cap
18 - Padlock
19 - Fuel Pump

Fig. 1 - Fuel Lines and Components

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The fuel system consists of the Quantum Celect Plus electronic fuel system controls, fuel filter (12), fuel pump (19), ECM cooling plate (14), electronic unit injectors (15), fuel tank (1) and the necessary connecting fuel lines.

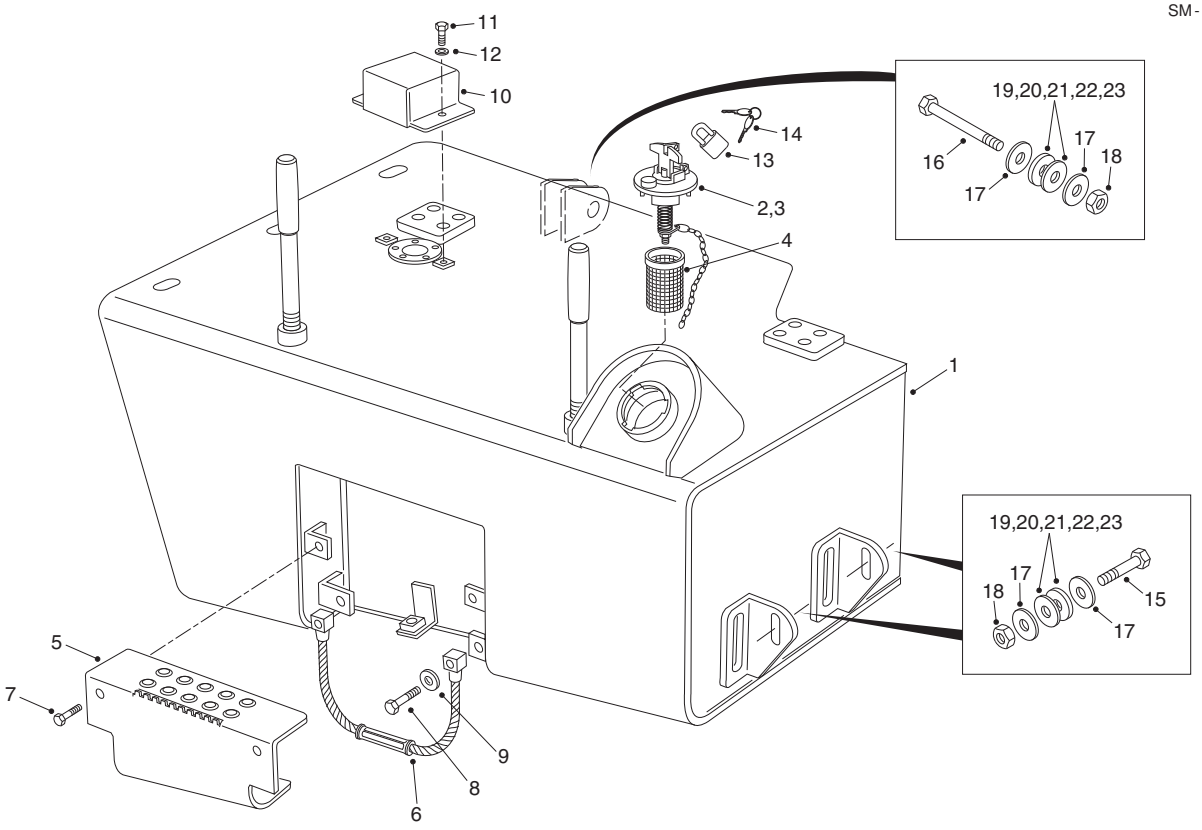
The fuel filter (12) is mounted inside the battery box, alongside the oil filter.

Fuel pump (19) 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), via fuel filter (12), 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 electronic control module (ECM). The ECM sends a command pulse which activates the injector solenoid.

The EUI (15) 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.



1 - Fuel Tank
2 - Filler Cap
3 - Filter Assembly
4 - Strainer
5 - Step Plate
6 - Step Assy
7 - Bolt
8 - Bolt
9 - Washer
10 - Fuel Sender Guard
11 - Bolt
12 - Washer
13 - Padlock
14 - Key
15 - Bolt
16 - Bolt
17 - Hardened Washer
18 - Nut
19 - Shim
20 - Shim
21 - Shim
22 - Shim
23 - Shim

Fig. 2 - Fuel Tank and Mounting

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 (14) is mounted behind the ECM on the LH side of the engine and absorbs heat generated by the ECM. Fuel from fuel pump (19) outlet line flows through ECM cooling plate (14) to absorb this heat.

Flexible fuel lines (10, 11 & 13) 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.

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 (17), 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 fuel filter (12) and enters fuel pump (19). Leaving fuel pump (19) under pressure, the fuel flows through ECM cooling plate (14) 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 the cylinder head and back to fuel tank (1) through fuel line (10).

REMOVAL

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

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

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

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

3. Pull on handle to release hood catch mechanism and raise hood.

4. Remove transmission oil cooler from vehicle. Refer to Section 210-0060, TRANSMISSION OIL COOLER.

5. Remove padlock (13) and remove filler cap (2) from fuel tank (1).

6. Remove fuel strainer (4) from fuel tank (1) and clean with clean diesel fuel.

7. With a suitable container in position, remove drain plug from 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 (10, 11 & 13, Fig. 1) and, with a suitable container available to catch leakage, disconnect fuel lines (10, 11 & 13, Fig. 1). Cap open line ends and adaptors to prevent entry of dirt.

9. Remove hose clamp mounting plate from inside face of fuel tank (1) assembly.

10. Remove bolts (11) and washers (12) securing fuel sender guard (10) to fuel tank (1). Remove fuel sender guard (10). Disconnect electrical harness from fuel sender.

11. Using suitable lifting equipment, support fuel tank (1) assembly. Ensure fender is adequately supported. Remove fasteners securing fender to fuel tank (1) assembly.

12. Remove nuts (18), bolts (16), hardened washers (17) and shims (19 - 23) securing fuel tank (1) assembly to the front frame rail.

13. Remove nuts (18), bolts (15), hardened washers (17) and shims (19 - 23) securing fuel tank (1) assembly to the front frame bumper. Using a suitable lifting device, remove fuel tank (1) assembly from the vehicle.

DISASSEMBLY

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

1. Remove bolts (7) securing step plate (5) to fuel tank (1).

2. Remove bolts (8) and washers (9) securing step assembly (6) to fuel tank (1).

3. Remove grab handles from fuel tank (1).

3. Remove screws and washers securing fuel sender to fuel tank (1). Remove fuel sender.

ASSEMBLY

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

1. Install fuel sender to tank (1) using screws and washers.

2. Install grab handles to fuel tank ().

3. Install step assembly (6) to fuel tank (1) and secure using bolts (8) and washers (9).

4. Install step plate (5) to fuel tank (1) and secure using bolts (7).

INSTALLATION

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

⚠ 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. Using suitable lifting equipment, position fuel tank

(1) assembly to the front frame.

2. Secure the front of fuel tank (1) assembly to the front frame bumper with bolts (15), hardened washers (17), shims (19 - 23) and nuts (18). Use shims (19 - 23) as necessary to improve transverse alignment of fuel tank (1) assembly.

3. Secure the inside of fuel tank (1) assembly to the front frame rail with bolts (16), hardened washers (17), shims (19 - 23) and nuts (18). Use shims (19 - 23) as necessary to improve longitudinal alignment of fuel tank (1) assembly.

4. Secure fender to fuel tank (1) assembly using fasteners previously removed.

5. Reconnect electrical harness to fuel sender. Fit fuel sender guard (10) using bolts (11) and washers (12).

6. Refit hose clamp mounting plate to inside face of fuel tank (1) assembly.

7. Remove blanking caps and secure fuel lines (10, 11 & 13, Fig. 1) to adaptors, as identified at removal.

8. Install fuel strainer (4) in fuel tank (1).

9. Fill fuel tank (1) assembly with clean diesel fuel specified in Section 300-0020, LUBRICATION SYSTEM.

10. Install filler cap (2) assembly on fuel tank filler neck. Tighten filler cap (2) securely and secure in place with padlock (13).

11. Install transmission oil cooler to vehicle. Refer to Section 210-0060, TRANSMISSION OIL COOLER.

12. 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 (10, 11 & 13, Fig. 1) and tighten if required.

13. Remove wheel blocks from all road wheels.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

⚠ 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.

⚠
To prevent personal injury or even death, welding of the fuel tank is strictly prohibited at all times, due to the hazardous flammable liquids and vapours present inside the tank, even when empty.

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 (4, Fig. 2) and filler cap (2, Fig. 2). 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, connections 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.

From time to time, remove fuel sender guard and check condition of electrical connections at fuel level sender.

Fuel Filter/Water Separator (12) - Drain the water and sediment from the separator daily.

Position the vehicle on a level work area, apply the parking brake, shut off the engine and, with a suitable container below the drain valve to catch spillage, open the drain valve by hand. Turn the valve anticlockwise approximately 1.5 to 2 turns until draining occurs. Drain the filter sump until clear fuel is visible. Turn the valve clockwise to close the drain valve.

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

Every 500 Hours:

Check condition of filler cap (2, Fig. 2) and clean fuel strainer (4, Fig. 2) and filler cap with clean fuel.

Every 1 000 Hours:

Fuel Filter/Water Separator (12) - Clean the area around the filter head and replace the fuel filter/water separator.

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

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

Install new fuel filter/water separator on the filter head and tighten by hand until the gasket contacts the filter head surface. Tighten fuel filter/water separator per filter manufacturer's instructions.

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

Fuel Filler Cap
Remove filler cap (2, Fig. 2) from filler neck. With the handle in the up and rotated position, remove the two screws securing the filter assembly (3, Fig. 2) to the cap. Discard 'O' rings. Clean top of filler cap and valve cavity. Install new filter assembly to filler cap using new screws and 'O' rings (supplied with new filter). Tighten screws to 10 - 13 in lbs.

Diesel Fuel Oil

The sulphur content of diesel fuel oil should be as low as possible to avoid premature wear of piston rings and line, excessive deposit formation, and minimise sulphur dioxide exhausted into the atmosphere. Limited amounts can be tolerated, but the amount of sulphur in the fuel and engine operating conditions can influence corrosion and deposit formation tendencies. The use of diesel fuel oil with a MAXIMUM sulphur content of 0.5% is recommended for use. Refer to Section 300-0020, LUBRICATION SYSTEM.

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 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.

3. If the fuel flow is insufficient for satisfactory engine performance then proceed as follows:

a. Replace the fuel filter/water separator, as described under 'Maintenance'. Start the engine and run it at maximum rev/min and recheck for the presence of air. If fuel flow is still unsatisfactory, perform step 'b'.

b. Check the fuel lines for restrictions due to pinching, kinking or other damage. 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. 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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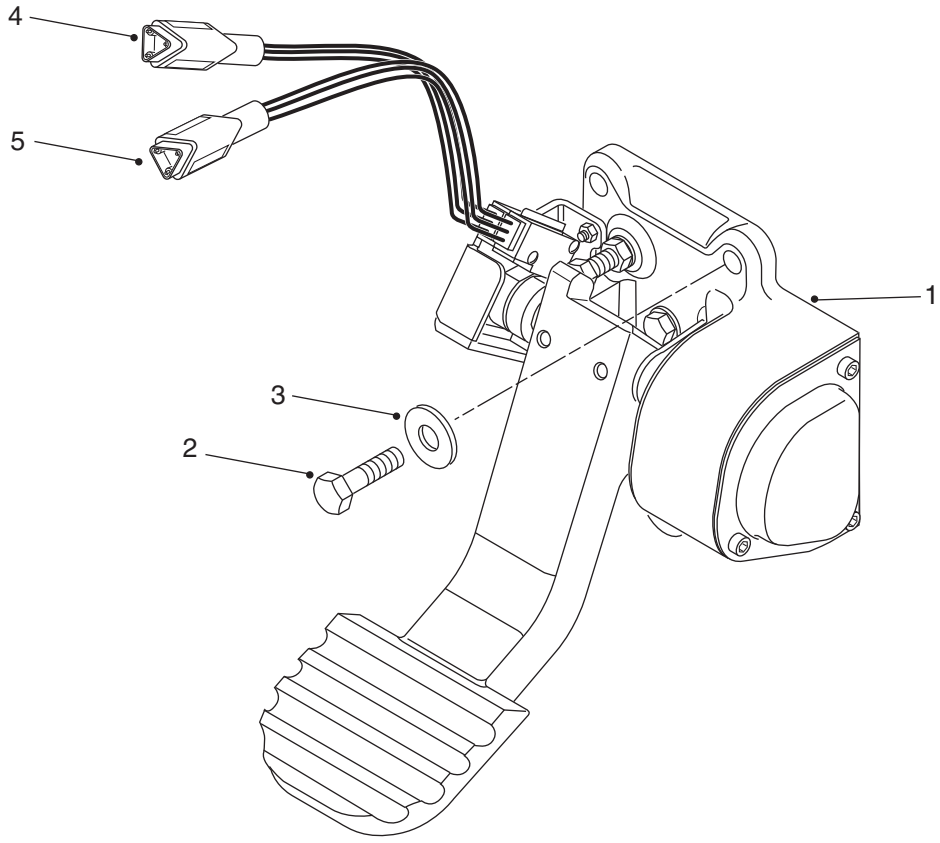

1 - Pedal Assembly
2 - Bolt
3 - Washer
4 - Transmission Kickdown Switch
5 - Idle Validation Switch

Fig. 1 - Electronic Foot Pedal 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.

The pedal incorporates an idle validation switch (5) which informs the engine ECM that the pedal is in the idle position. Kickdown switch(4) , which can be used when automatic range is selected, allows for the possibility of selecting a lower gear by pressing down fully on pedal and holding (see Fig. 2). 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, release the pedal and allow it to return to a light throttle 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.

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

3. Disconnect electrical harness from dash harness.

4. Remove bolts (2) and washers (3) securing pedal assembly to cab wall. Remove pedal assembly.

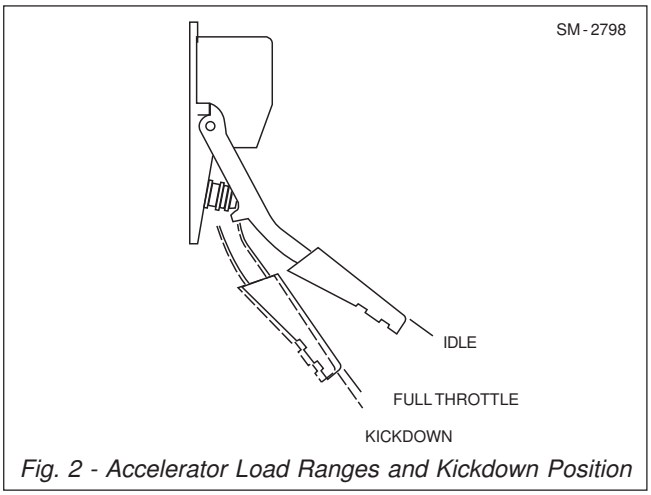

Fig. 2 - Accelerator Load Ranges and Kickdown Position

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 on cab wall and secure with bolts (2) and washers (3). Ensure that pedal assembly (1) is free to operate.

2. Connect electrical harness to dash harness. Pedal must be calibrated before the machine is operated. See 'Pedal Calibration'.

3. Place the battery master switch in the 'On' position, remove wheel blocks and start the engine. Ensure that pedal (2) assembly operates correctly.

Note: The engine should be started with the foot 'OFF' pedal (2) assembly.

PEDAL CALIBRATION

The pedal calibration must be checked if the harness is disconnected or the pedal replaced. Using Cummins INSITE diagnostic reader, the pedal can be checked as follows:

1. With engine off, turn keyswitch to position '1', and connect diagnostic reader.

Note: With the pedal at idle position, the diagnostic reader should show 0%.

3. Press pedal fully to full throttle position (before kickdown, ref. Fig. 2) and release three times.

Note: The diagnostic reader should show 100% at full throttle position.

4. If these figures are achieved, the pedal is correctly calibrated. Turn keyswitch off and remove diagnostic reader.

5. If figures are not realised, the pedal will have to be re-calibrated. This can only be done by authorised Cummins personnel. Please contact your local Cummins dealer.

TROUBLESHOOTING

The pedal can be checked by measuring the voltage signal across the pedal harness.

Voltage Ref:	Measure voltage across red and black wires - reading should be 5V.
Pedal at Idle:	Measure voltage across white and black wires - reading should be less than 0.8V.
Pedal at Full Throttle:	Measure voltage across white and black wires - reading should be greater than 3.1V.

MAINTENANCE

Limited repair of the electronic foot pedal assembly is by replacement of parts only. Refer to vehicle Parts Book for part numbers.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of Cummins engine INSITE diagnostic tools which can be used to check pedal calibration. These tools are available from your dealer.

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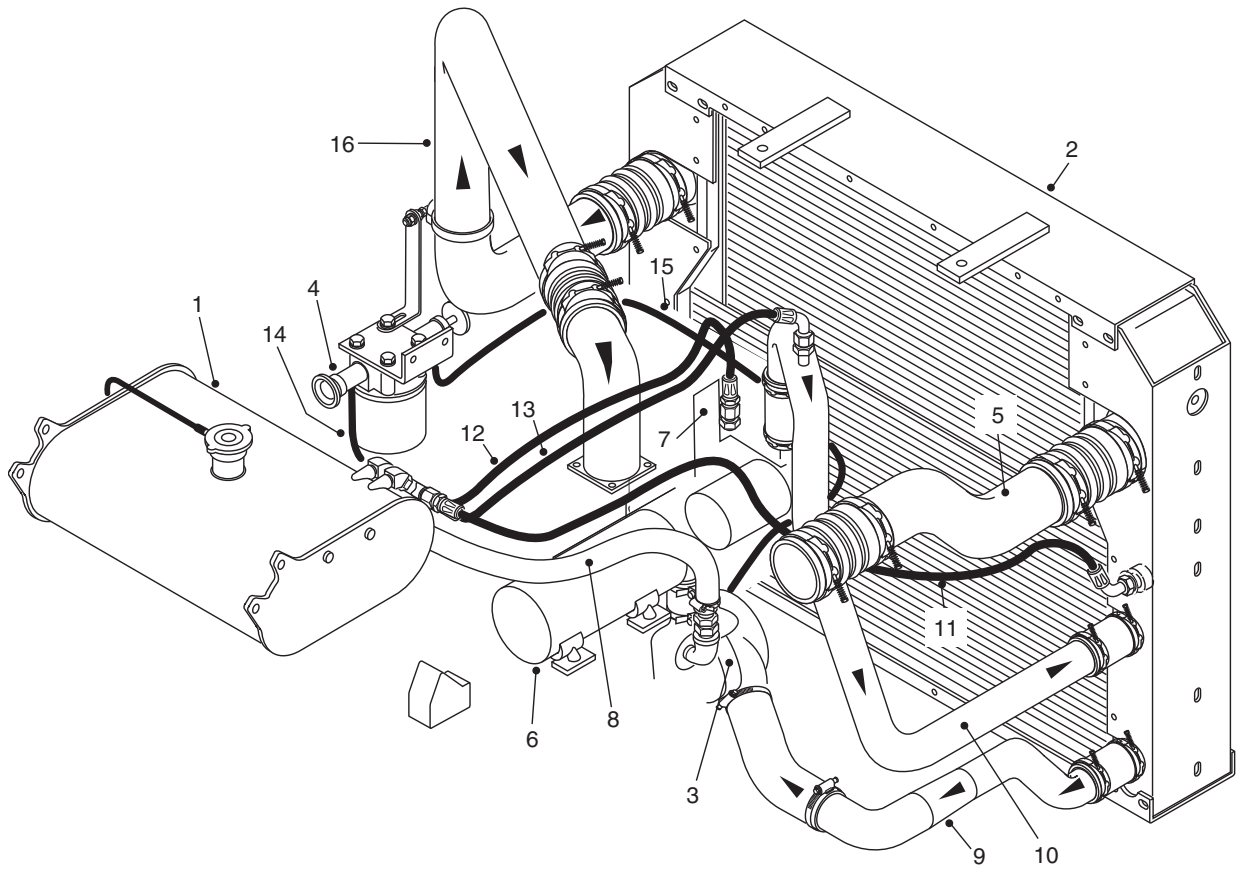


1 - Header Tank
2 - Radiator Assembly
3 - Engine Water Pump
4 - Coolant Filter
5 - Charge Air Inlet Pipe
6 - Engine Oil Cooler
7 - Thermostat Housing
8 - Make-up Line
9 - Radiator Outlet Pipe
10 - Radiator Inlet Pipe
11 - Deaeration Line
12 - Deaeration Line
13 - Deaeration Line
14 - Filter Outlet Line
15 - Filter Inlet Line
16 - Charge Air Outlet Pipe

Fig. 1 - Cooling Lines and Flow

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

A radiator and fan cooling system is used on the Quantum engines installed in these vehicles. This system has a centrifugal type water pump (3) to circulate coolant throughout the system. A full blocking type thermostat located in thermostat housing (7), attached to the right hand side of the cylinder head, controls the flow of coolant.

The main components of the cooling system are; header tank (1), radiator assembly (2), engine water pump (3), DCA4 coolant filter (4), engine oil cooler (6) and thermostat housing (7).

The radiator assembly (2) consists of an air-to-air charge cooler mounted on top of a radiator, with an air conditioning condenser and a hydraulic oil cooler mounted on the front.

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 provides water circulation within the engine during the warm-up period.

Note: The engine coolant thermostat starts to open at 82° C (180° F) and is fully open at 93° C (199° F).

Engine water pump (3) draws coolant from the radiator through radiator outlet pipe (9). Engine water pump (3) then pumps coolant through engine oil cooler (6) and engine block and passes up through the cylinder head to the thermostat housing (7).

When the coolant reaches operating temperature, the thermostat opens, allowing coolant to flow into the radiator through radiator inlet pipe (10). The coolant passes through a series of tubes in the 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 and engine through the deaeration lines (11,12 and13).

The use of antifreeze is mandatory with the cooling system. Refer to 'Recommended Coolants'. 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

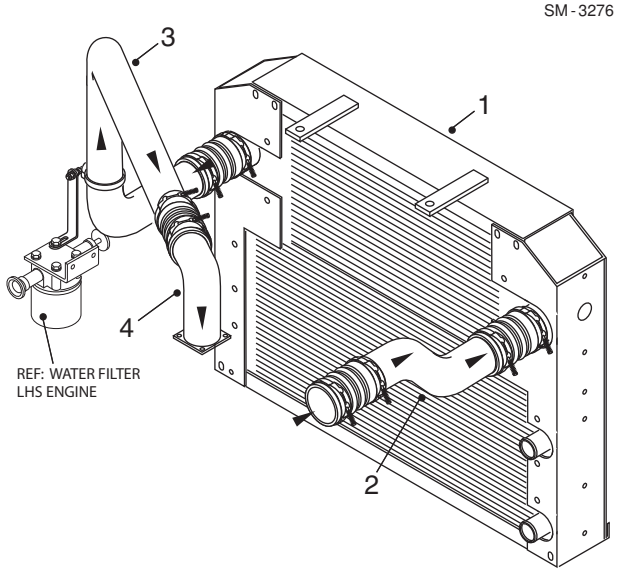
The cooling system is protected by a replaceable spin-on type coolant filter (4) mounted on the left hand side of the engine. The filter provides mechanical filtration by means of a closely packed element through which the coolant passes. Any impurities such as sand and rust particles suspended in the 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 thermostat.

Coolant flows from the engine block (3) through filter inlet line (15) and into coolant filter (4). Coolant flows through the filter element and exits through filter outlet line (14) and back into the engine block. Shut-off cocks on both filter lines allow coolant filter (4) to be replaced with the minimum loss of coolant.

Air-To-Air Charge Cooling

Numbers in parentheses refer to Fig. 2.

In the air system used on the Quantum engines, outside air is 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



1 - Air-to-Air Charge Cooler
2 - Inlet Pipe
3 - Outlet Pipe
4 - Inlet Pipe

Fig. 2 - Air-to-Air Charge Cooler Lines and Flow

then exits the turbocharger through the inlet pipe (2) and enters air-to-air charge cooler (1). The hot air travels through a series of tubes in air-to-air charge cooler (1) core, where the air temperature is lowered. From here the air flows through outlet pipe (3) and into the engine intake manifold through inlet pipe (4). 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. 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 recommended coolant if low. Fill the radiator header tank with coolant until coolant reaches the bottom of the filler neck and holds at that level.

Note: Any time a significant amount of coolant is added, the DCA4 coolant concentration MUST be checked. Failure to use recommended coolant and to maintain mixture at sufficient concentration levels can result in damage to the cooling system and its related components. Always maintain concentrations at recommended levels. Refer to 'Recommended Coolants'.

Check cooling fan for cracks and damage. Check fan mounting and tighten if required. Replace cooling fan if damaged.

Check coolant lines, pipes and components for leaks and wear. Check drive belts for damage.

Every 250 Hours

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 500 Hours

Check and replenish the DCA4 concentrations as described under 'Coolant Recommendations' in this section.

The DCA4 coolant filter must be replaced. When testing the DCA4 concentration, the level of DCA4 determines which coolant should be installed. Refer to instructions under 'Coolant Recommendations' in this section.

Note: Under concentration of DCA4 coolant additive can result in liner pitting and system corrosion. Over concentration can result in water pump seal leakage. Always maintain DCA4 concentration at recommended levels.

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

WARNING
Do not remove the pressure cap from a hot engine. Wait until the coolant temperature is below 50° C (120° F) before removing the pressure cap. Heated coolant spray or steam can cause personal injury.

1. Remove the cooling system pressure cap from header tank.

2. Close shut off valves at coolant filter inlet and outlet lines and, using filter wrench, remove and discard coolant filter from engine.

WARNING
A small amount of coolant can leak when servicing the coolant filter with the shut off valves in the closed position. To avoid personal injury, avoid contact with hot coolant.

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

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

5. Start coolant filter on the filter adaptor and tighten it by hand until the seal touches the adaptor filter head. Tighten an additional 1/2 to 3/4 of a turn after contact, or as specified by the filter manufacturer.

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

6. Open shut off valves at coolant filter inlet and outlet lines, and install pressure cap on header tank.

7. Start the engine and check for leaks. If any leaks are noted, have them corrected. Add recommended coolant

as required.

Note: Any time a significant amount of coolant is added, the coolant concentration MUST be checked.

Every 4 000 Hours (or two years)

Whichever interval arrives first: Drain and flush the cooling system as described under 'Cleaning the Cooling System' in this section. Fill the cooling system with the correct mixture of antifreeze, water and DCA4 liquid as described under 'Coolant Recommendations' in this section.

Cleaning The Cooling System

⚠ 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.

Note: It is recommended to use a cleaner such as Fleetguard RESTORE, or equivalent, when cleaning the cooling system.

1. Drain the cooling system. Do not allow the cooling system to dry out or remove the DCA4 coolant filter.

2. Add 3.8 litres (1 US gal) of cleaner for each 38 - 57 litres (10 - 15 US gal) of cooling system capacity, and fill the system with clean water.

Note: Fleetguard RESTORE contains no antifreeze and the cooling system should not be allowed to freeze during the cleaning operation.

3. Slide the heater temperature control to high to allow maximum coolant flow through the heater core. The blower switch does not have to be on.

4. Operate the engine at normal operating temperature, at least 85° C (185° F) for 1 - 1.5 hours.

⚠ WARNING
Do not remove the filler cap from the radiator header tank or attempt to drain the coolant until the engine has cooled to below 50° C (120° F).

5. Shut off the engine and drain the cooling system.

6. Fill the cooling system with clean water and operate the engine at high idle for 5 minutes with the coolant temperature above 85° C (185° F).

⚠ WARNING
Do not remove the filler cap from the radiator header tank or attempt to drain the coolant until the engine has cooled to below 50° C (120° F).

7. Shut off the engine and drain the cooling system.

Note: If the water being drained is still dirty, the system must be flushed again until the water is clean.

8. Refill the cooling system with the proper mix of coolant and water and install new DCA4 coolant filter. Refer to instructions under 'Recommended Coolants'.

9. Install filler cap on the radiator header tank, operate the engine and check for coolant leaks.

RECOMMENDED COOLANTS

⚠ WARNING
Hazardous substance. To prevent personal injury, wear appropriate personal protective equipment when there is a risk of contact or inhalation of fumes. Always work in a well ventilated area.

⚠ WARNING
If substance gets into your eyes, immediately flush eyes gently with water for at least 15 minutes. Seek immediate medical attention.
If substance contacts skin, immediately flush with water for at least 15 minutes. Remove contaminated clothing. Wash affected area with soap and water and seek immediate medical attention.
If substance is swallowed or inhaled, seek immediate medical attention.

Heavy duty diesel engines installed in these vehicles require a heavy duty coolant for optimum performance. Heavy duty coolant is defined as a correct mixture of good quality water, low silicate antifreeze and supplemental coolant additives (SCA's).

Water quality is important for cooling system performance. Excessive levels of calcium and

magnesium contribute to scaling problems, and excessive levels of chlorides and sulphates cause cooling system corrosion.

It is recommended to use a low silicate antifreeze concentrate that meets ASTM D4985 specifications (less than 0.1% silicate). Low silicate antifreeze must be mixed with quality water at a 50/50 ratio (40 to 60% working range). A 50/50 mixture of antifreeze and water gives a -37° C (-34° F) freeze point and a boiling point of 109° C (228° F). The actual lowest freeze point of ethylene glycol antifreeze is at 68%. Using higher concentrations of antifreeze will raise the freeze point of the solution and increase the possibility of a silicate gel problem. A refractometer must be used to accurately measure the freeze point of the coolant. Refer to 'Special Tool and Test Kit'.

Supplemental coolant additives (DCA4), or equivalent, are used in conjunction with water and antifreeze to prevent liner pitting, corrosion and scale deposits in the cooling system. The cooling system must be precharged with the correct concentration of DCA4. Refer to the relevant 'Precharge Chart' in this section. When coolant is replaced in the field, it must be replaced with heavy duty coolant precharged with DCA4. In addition, a service coolant filter must be installed. Together, this will result in a total precharge of approximately 0.33 DCA4 units per litre of coolant.

Proper blending of heavy duty coolant is achieved as follows:

a. Pour water into a suitable clean container.

b. Add the same quantity of low silicate antifreeze to the water.

c. Add the correct quantity of DCA4 liquid for the cooling system capacity required. Refer to the relevant 'Precharge Chart' in this section for DCA4 quantities. Refer to Section 300-0020, LUBRICATION SYSTEM for cooling system capacity.

d. Thoroughly blend all components.

Note: Following the correct order for mixing the heavy duty coolant will prevent additive dropout during the mixing process.

Note: The cooling system must be clean before adding DCA4 liquid.

Note: Do not use soluble oils in the cooling system. The use of soluble oils will lead to cylinder lining pitting, corrode brass and copper, damage heat transfer surfaces and damage seals and hoses.

DCA4 Test Kit

The test kit must be used:

1. When excessive coolant loss occurs.

2. After every 250 hours of operation.

3. If the concentration is known to be above the high limit of 0.8 units per litre. Test at each subsequent oil change until the concentration decreases below the high limit.

Note: Do not use the test kit to omit or extend the service intervals unless the concentration is above 0.8 units per litre.

The test strip container is marked with an expiration date and the plastic container must be securely tightened to protect the moisture sensitive strips. Discard the strips if there is any doubt about the test strip quality.

Test Instructions

1. Collect coolant sample from the radiator or pet cock. DO NOT collect from the coolant recovery or overflow system. Coolant must be between 10° C and 54° C when tested.

2. Remove one strip from the bottle and replace cap immediately. DO NOT touch the pads on the end of the strip.

Note: Discard kit if unused strips have turned light brown or pink.

3. Dip strip in coolant sample for one second, remove, and shake strip briskly to remove excess liquid.

4. **45 seconds** after dipping strip compare and record results in the following order:

a. Compare **Freeze Point** (end pad) to colour chart and record the result.

b. Next, compare **Sodium Molybdate** (middle pad) to colour chart and record the result.

c. Finally, compare **Sodium Nitrate** test to colour chart and record the result.

5. All three readings must be completed **no later than**

75 seconds after dipping the strip.

6. It is okay to estimate a value between colour blocks, but if uncertain about the colour match, pick the lower numbered block.

7. Determine where the Sodium Molybdate level intersects the Sodium Nitrite level on the chart. The amount of SCA units per litre in the cooling system is given where the Sodium Molybdate row intersects the Sodium Nitrite column.

Note: For best results follow test times carefully. Use a stopwatch or clock with a sweep second hand. Comparing the test strip to the colour chart too soon before, or too late after, the required test time will result in incorrect readings and improper treatment, and could result in liner pitting and engine damage.

8. All readings should be recorded on the truck maintenance record for future reference.

Treatment Instructions

If the concentration is:

Below 0.3 units per litre - Add both the normal amount of DCA4 liquid as specified in the respective service chart' and the amount specified in the respective 'Precharge Chart'. Replace the DCA4 coolant filter.

Between 0.3 and 0.8 units per litre - Add the normal amount of DCA4 liquid as specified in the respective 'Service Chart'. Replace the DCA4 coolant filter.

Above 0.8 units per litre - Do not replace the DCA4 filter or add liquid DCA4 until the concentration drops below 0.8 units per litre. The concentration must be tested at every subsequent 250 hour service interval until concentration decreases below 0.8 units per litre.

SPECIAL TOOL AND TEST KIT

Refer to Section 300-0070, SERVICE TOOLS, for part numbers of the refractometer and coolant test kit referenced in this section. These items are available from your dealer.

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		
Engine coolant temperature too high	Low coolant level	Fill coolant 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 belt broken or slipping	Adjust or replace fan belt
	Thermostat not opening	Replace thermostat
	Restricted cooling system passages	Flush cooling system
	Faulty engine water pump	Repair or replace engine water pump
Engine coolant temperature too low	Thermostat remains open or open at too low a temperature	Replace thermostat
	Leakage around thermostat seal	Replace thermostat seal
	Extremely cold weather	Cover radiator or install radiator shutters

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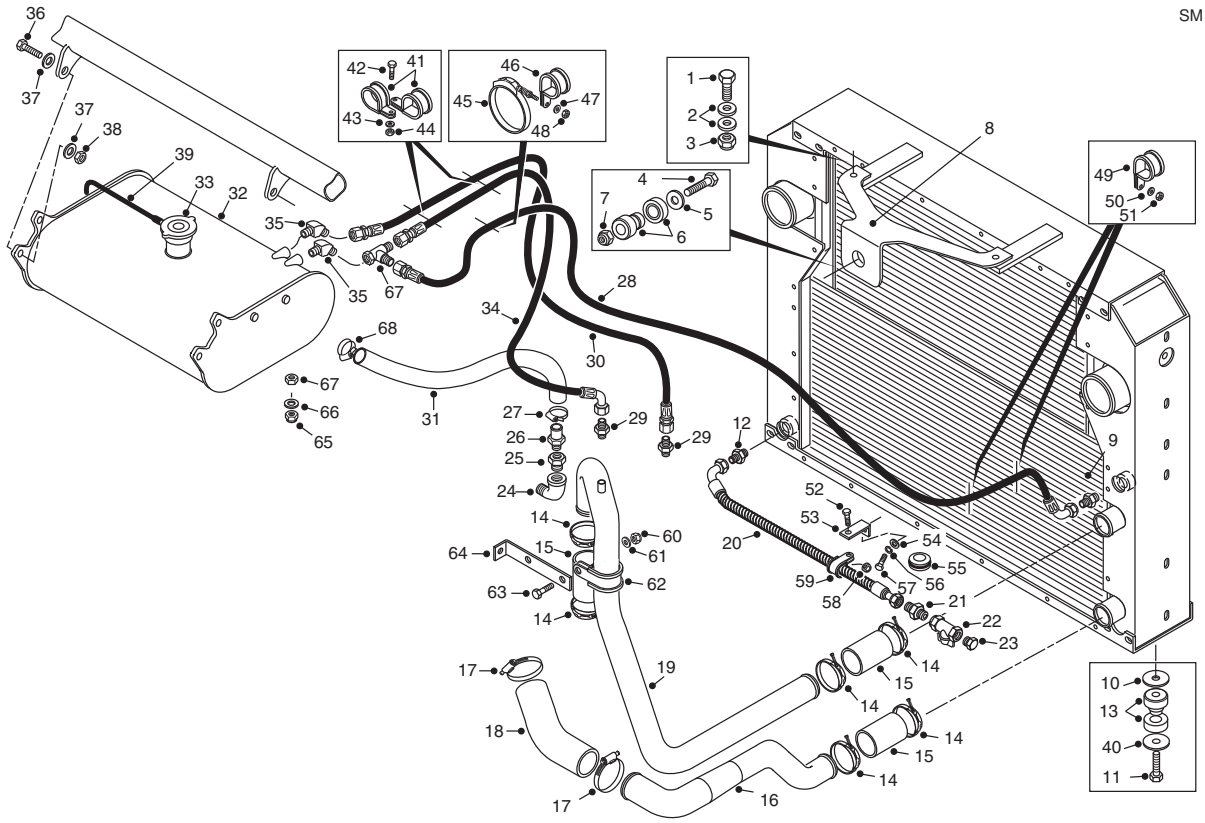


1 - Bolt
2 - Washer
3 - Nut
4 - Bolt
5 - Snubbing Washer
6 - Rubber Mounting
7 - Nut
8 - Support Bracket
9 - Connector
10 - Snubbing Washer
11 - Bolt
12 - Connector
13 - Rubber Mounting
14 - Clamp
15 - Hose
16 - Coolant Outlet Pipe
17 - Clamp
18 - Hose
19 - Coolant Inlet Pipe
20 - Hose Assy
21 - Connector
22 - Shut-Off Valve
23 - Plug
24 - Elbow
25 - Reducer
26 - Connector
27 - Clamp
28 - Deaeration Line
29 - Connector
30 - Deaeration Line
31 - Make-up Line
32 - Header Tank
33 - Filler Cap
34 - Deaeration Line
35 - Connector
36 - Bolt
37 - Washer
38 - Nut
39 - Bracket Assembly
40 - Snubbing Washer
41 - Clip
42 - bolt
43 - Washer
44 - Nut
45 - Spring Loaded Clamp
46 - Clip
47 - Washer
48 - Nut
49 - Clip
50 - Washer
51 - Nut
52 - Bolt
53 - Plate Bent
54 - Washer
55 - Grommet
56 - Lockwasher
57 - Bolt
58 - Nut
59 - Clip
60 - Nut
61 - Washer
62 - Clip
63 - Bolt
64 - Plate Bent
65 - LockNut
66 - Washer
67 - Tee
68 - Clamp

Fig. 1 - Exploded View of Radiator Mounting and Hoses

DESCRIPTION

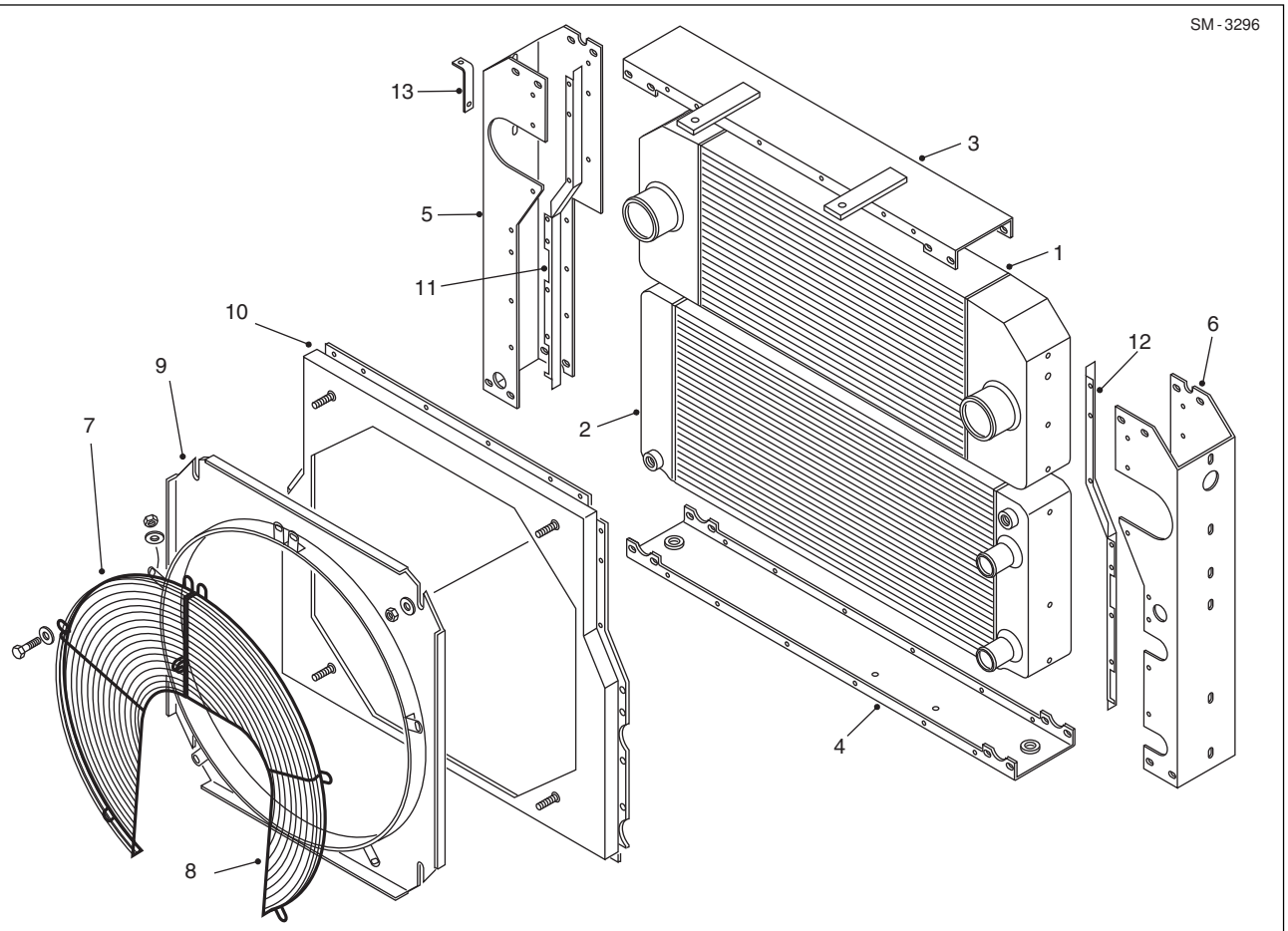
Numbers in parentheses refer to Fig. 1, unless otherwise specified.

Radiator assembly is mounted in front of the engine cooling fan at the front end of the vehicle. It is fed from header tank (32) located in front of the operators compartment and mounted to the goalpost arrangement.

The radiator assembly consists of an air-to-air charge cooler mounted on top of a radiator, with an air conditioning condenser and a hydraulic oil cooler mounted on the front. Refer to Section 210-0000, COOLING SYSTEM.

Fan plate assembly (9, Fig. 2) improves the engine cooling fan efficiency, provides a more uniform distribution of air over charge air cooler core (1, Fig. 2) and radiator core (2, Fig. 2) and helps restrict recirculation of air within the engine compartment.

Recirculation baffles (11 &12), incorporated in the hood assembly prevent hot air from the engine cooling fan being reintroduced into the cooling air circuit.



1 - Charge Air Cooler Core
2 - Radiator Core
3 - Top Column
4 - Bottom Column
5 - LH Column
6 - RH Column
7 - LH Fan Guard
8 - RH Fan Guard
9 - Fan Plate Assy
10 - Fan Cowl Assy
11 - LH Baffle Plate
12 - RH Baffle Plate
13 - Bent Plate

Fig. 2 - Exploded View of Radiator Assembly

REMOVAL

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

⚠ 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.

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

3. Pull on handle to release hood catch mechanism and raise hood.

4. Remove hood assembly from the vehicle. Refer to Section 100-0040, HOOD AND MOUNTING.

5. Disconnect electrical harness from horns, and remove horns and mounting from front of radiator. Disconnect electrical harness from engine cooling fan.

6. Remove filler cap (33) carefully from header tank (32).

7. Remove plug (23) and open shut-off valve (22) at the bottom of radiator assembly and drain coolant into a suitable container. Close shut-off valve (22) when coolant is completely drained and refit plug (23).

8. Remove bolt (4), snubbing washer (5) and nut (7) securing support bracket (8) to the engine bracket.

9. Remove bolts (1), washers (2) and nuts (3) securing support bracket (8) to mounting brackets on radiator assembly. Remove support bracket (8).

10. Ensure air conditioning lines from condenser mounted on front of charge air cooler (1, Fig. 2), and from receiver drier mounted at rear left hand side of radiator assembly are identified for ease of installation. Disconnect air conditioning lines. Fit blanking caps to open lines and ports.

Note: Refer to Section 260-0130, AIR CONDITIONING before disturbing the air conditioning circuit.

11. Ensure hydraulic lines connected to hydraulic oil cooler mounted on front of radiator (2, Fig. 2) 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.

12. Disconnect deaeration line (28) from connector (9) in radiator and deaeration lines (30 & 34) from elbows (29) in engine and pipe (19). Identify lines for ease of installation and cap open lines and elbows.

13. Disconnect all clips and clamps securing air conditioning lines, hydraulic lines and deaeration lines to radiator assembly. Move all lines away from radiator assembly to prevent fouling on removal of radiator assembly.

14. Remove bolts, washers and nuts securing fan guards (7 & 8, Fig. 2) to radiator assembly. Remove fan guards (7 & 8, Fig. 2) from radiator assembly.

15. Slacken clamps securing cooler hoses to air inlet pipe (2, Fig. 3) and remove air inlet pipe from charge air cooler (1, Fig. 3) and engine turbocharger.

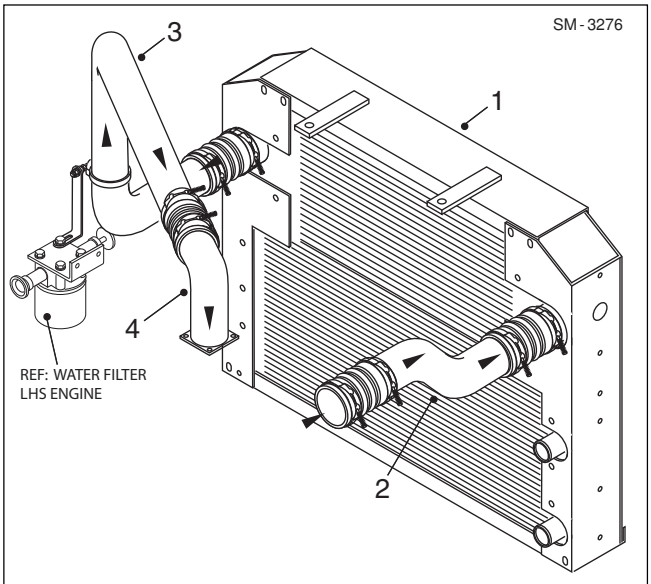


Fig. 3 - Air-To-Air Charge Cooler Piping

16. Remove nut, washers and clamp securing air outlet pipe (3, Fig. 3).

17. Slacken clamps securing cooler hoses to air outlet pipe (3, Fig. 3) and remove air outlet pipe (3, Fig. 3) from charge air cooler (1, Fig. 3) and inlet pipe (4, Fig. 3).

18. Slacken clamps (14) and remove coolant inlet pipe (19), hoses (15) and clamps (14) from radiator assembly and engine thermostat housing.

19. Slacken clamps (14 & 17) and remove coolant outlet pipe (16), hoses (15 & 18) and clamps (14 & 17) from bottom of radiator assembly and engine water pump inlet.

20. Install two eye bolts in lifting bosses on side of radiator assembly. Using suitable lifting equipment support radiator assembly.

21. Remove bolts (11), washers (10), snubbing washers (40) and mounts (13) securing radiator assembly to the frame.

22. 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.

Note: If Header Tank (32**)** requires to be removed, follow steps 23 through 28.

23. Disconnect electrical harness from coolant level sensor at bottom of header tank (32).

24. With a suitable container available to catch leakage, remove drain plug from radiator header tank (32) and drain coolant. Apply Loctite 225 to drain plug and reinstall in header tank.

25. Ensure all cooling lines connected to header tank are identified for ease of installation and with suitable containers available to catch leakage, disconnect deaeration lines (28 & 30) and overflow line (34). Fit blanking caps to all open lines.

26. Slacken clamp (27) and disconnect make-up line (31) from header tank (32). Blank off open line end.

27. Following removal instructions in Section 100-0040, HOOD AND MOUNTING, remove goalpost and header tank (32) as an assembly from the vehicle.

28. Remove bolts (36), nuts (38) and washers (37) securing header tank (32) to goalpost. Remove header tank (32) from goalpost.

DISASSEMBLY

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

Note: Take care not to damage charge air cooler core (1), radiator core (2), condenser core and hydraulic oil cooler core during disassembly.

1. Remove nut (58), bolt (52) and clip (59) from bracket (53) allowing removal of drain cock assembly (12, 20 & 23, Fig. 1) from bottom of radiator core (2). Remove connector (9, Fig. 1) from radiator core (2).

2. Remove receiver drier and mounting from rear of radiator assembly.

3. Remove mounting hardware securing hydraulic oil cooler to radiator assembly. Remove hydraulic oil cooler from radiator assembly.

4. Remove mounting hardware securing air conditioning condenser to radiator assembly. Remove condenser from radiator assembly.

5. Remove bolts, washers and nuts securing fan plate assembly (9) to radiator assembly. Remove fan plate assembly (9) from radiator assembly.

6. Remove bolts and washers securing fan cowl assembly (10) to radiator assembly.

Remove fan cowl assembly (10) from radiator assembly.

7. Remove remaining bolts and washers securing top column (3), LH column (5), RH column (6) and bottom column (4) to charge air cooler core (1) and radiator core (2).

INSPECTION

Numbers in parentheses refer to Fig. 2.

1. Steam clean all parts thoroughly with a suitable solvent.

2. Examine charge air cooler core (1), radiator core (2), condenser 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.

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. Fit RH column (6) and LH column (5) to charge air cooler core (1) and radiator core (2) using fasteners removed during 'Disassembly'. If baffle plates (11 & 12) were removed during disassembly; refit accordingly.

2. Secure mounts (7) to bottom column (4) with bolts removed during 'Disassembly'.

3. Fit top column (3) and bottom column (4) to radiator assembly using fasteners removed during 'Disassembly'.

4. Position fan cowl assembly (10) to radiator assembly and secure with fasteners removed during 'Disassembly'.

5. Position fan plate assembly (9) to radiator assembly and secure with fasteners removed during 'Disassembly'.

Note: When installing radiator, ensure clearance around cooling fan tips to plate assembly is of equal dimension all round.

6. Install air conditioning condenser and hydraulic oil cooler to radiator assembly picking up mounting locations and hardware as identified at 'Disassembly'.

7. Fit connector (9, Fig. 1) to radiator core (2), torque connector (9) to 35 Nm (26 lbf ft).

8. Fit drain cock assembly (12, 20 & 23, Fig. 1) to bottom of radiator core (2). Secure in place using clip (59), bolts (52) nut (58) located on plate (53).

9. Install receiver drier to rear of radiator assembly picking up mounting locations and hardware as identified at '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 300-0020, 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. Using suitable lifting equipment, position radiator assembly on the frame and secure with bolts (11), washers (10), mounts (13) and snubbing washers (40).

2. Position support bracket (8) on mounting brackets at top of radiator assembly and secure in place with bolts (1), washers (2) and nuts (3).

3. Secure support bracket (8) to engine bracket with bolt (4), snubbing washer (5), rubber mounts (6) and nut (7).

4. Install coolant outlet pipe (16) between radiator outlet port and engine water pump inlet, and secure with hoses (15 & 18) and clamps (14 & 17).

5. Install coolant inlet pipe (19) between radiator inlet port and engine thermostat housing, and secure with hoses (15) and clamps (14).

6. Install air outlet pipe (3, Fig. 3) between engine inlet pipe (4, Fig. 3) and charge air cooler (1, Fig. 3) and secure with hoses and clamps.

7. Secure air outlet pipe (3, Fig. 3) with clamp, nut and washers removed during 'Removal'.

8. Install air inlet pipe (2, Fig. 3) between engine turbocharger and charge air cooler (1, Fig. 3) and secure with hoses and clamps.

9. Feed electrical harness from engine cooling fan through hole in fan plate assembly (9, Fig. 2). Fit grommet if previously removed.

10. Connect engine cooling fan electrical harness to main electrical harness.

11. Install LH and RH fan guards (7 & 8, Fig. 2) to radiator assembly with bolts, washers and nuts removed during 'Removal'.

12. Remove blanking caps from deaeration lines (28 , 30 & 34) and connect deaeration line (28) to connector (9) in radiator assembly, deaeration line (30) to connector (29) in engine and deaeration line (34) to pipe (19). Do not clip lines at this point.

13. Remove blanking caps from hydraulic oil cooler lines and fittings. Connect all hydraulic lines to hydraulic oil cooler as identified at removal.

14. Remove blanking caps from air conditioning lines and fittings. Connect air conditioning lines to condenser and receiver drier. Refer to Section 260-0130, AIR CONDITIONING for procedure on charging the system.

15. 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.

16. Ensure fittings, lines and pipes are securely tightened to prevent leaks at initial fill and start up.

Note: If **Header Tank (32)** was removed and has not yet been installed, proceed from step 17, however, if header tank (32) was not removed or has been reinstalled, proceed from step 24.

17. Fit header tank (32) to goalpost and secure using bolts (36), nuts (38) and washers (37).

18. Following installation instructions in Section 100-0040, HOOD AND MOUNTING, install header tank (32) and goalpost assembly on the vehicle.

19. Remove blanking from make-up line (31) and connect to header tank (32). Secure with clamp (27).

20. Remove blanking caps from deaeration lines (28 & 30) and connect to appropriate fittings on header tank (32), as noted on removal.

21. 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.

22. Connect electrical harness to coolant level sensor at bottom of header tank (32).

23. Refer to Section 210-0000, COOLING SYSTEM for correct selection of coolant. Fill the cooling system through filler in header tank (32) with coolant until coolant level stabilizes at the bottom of filler neck.

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

25. 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.

26. Install filler cap (33) on header tank (32) after the coolant level has stabilized at the bottom of filler neck.

27. Following installation instructions in Section 100-0040, HOOD AND MOUNTING, install hood assembly on the vehicle.

28. 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.

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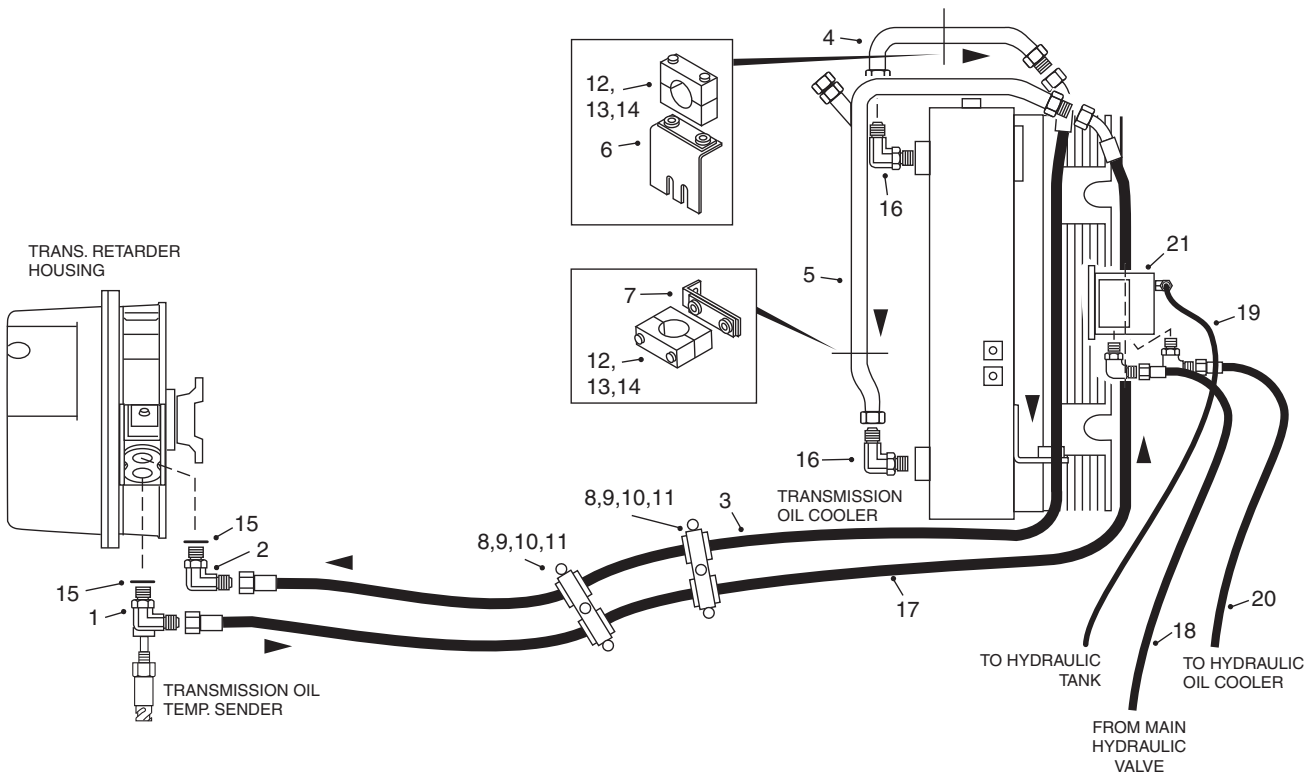


1 - Elbow
2 - Elbow
3 - Hose
4 - Tube Assy
5 - Tube Assy
6 - Bracket
7 - Bracket
8 - Clamp
9 - Bushing
10 - Stacking Nut
11 - Bolt
12 - Clamp
13 - Plate
14 - Screw
15 - 'O' Ring
16 - Elbow
17 - Hose
18 - Hose
19 - Hose
20 - Hose
21 - Motor

Fig. 1 - Transmission Oil Cooler Lines

DESCRIPTION AND OPERATION

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

The transmission oil cooler (1, Fig. 2) is mounted on the right hand side of the tractor, on top of the fuel tank. The transmission oil cooler is an air blast cooler, using hydraulic oil from the main hydraulic circuit to supply the fan motor (21).

Transmission oil to be cooled exits from the bottom port of transmission retarder housing and flows through hose (17) and tube assembly (5) into bottom of cooler (1, Fig. 2). Transmission oil flows through the crossflow core and is cooled by air flow produced by the rotation of fan (4, Fig. 2), which is driven by motor (21). Cooled transmission oil then exits the top of cooler (1, Fig. 2) and flows through tube assembly (4) and hose (3) and into the top port of transmission retarder housing.

The fan motor (21) is proportionally controlled by the hydraulic ECU. The higher the transmission temperature, the more hydraulic oil is supplied to the fan motor (21) through hose (18). Refer to Section 215-0050, MAIN HYDRAULIC VALVE. Hydraulic oil leaving the fan motor (21) returns through hose (20) to the hydraulic tank via the hydraulic oil cooler.

An isolation solenoid valve also controls flow to the fan motor (21), preventing hydraulic oil being supplied to the motor (21) until the transmission oil temperature increases to 90° C (194° F). This prevents the transmission oil being overcooled. Refer to Section 215-0050, MAIN HYDRAULIC VALVE.

The isolation solenoid valve, mounted on the right hand fender, is failsafe i.e. if the solenoid fails, the valve will default to an open position, allowing hydraulic oil to the motor (21). The solenoid valve is controlled by the hydraulic ECU (refer to Section 190-0085, HYDRAULIC SYSTEM ECU).

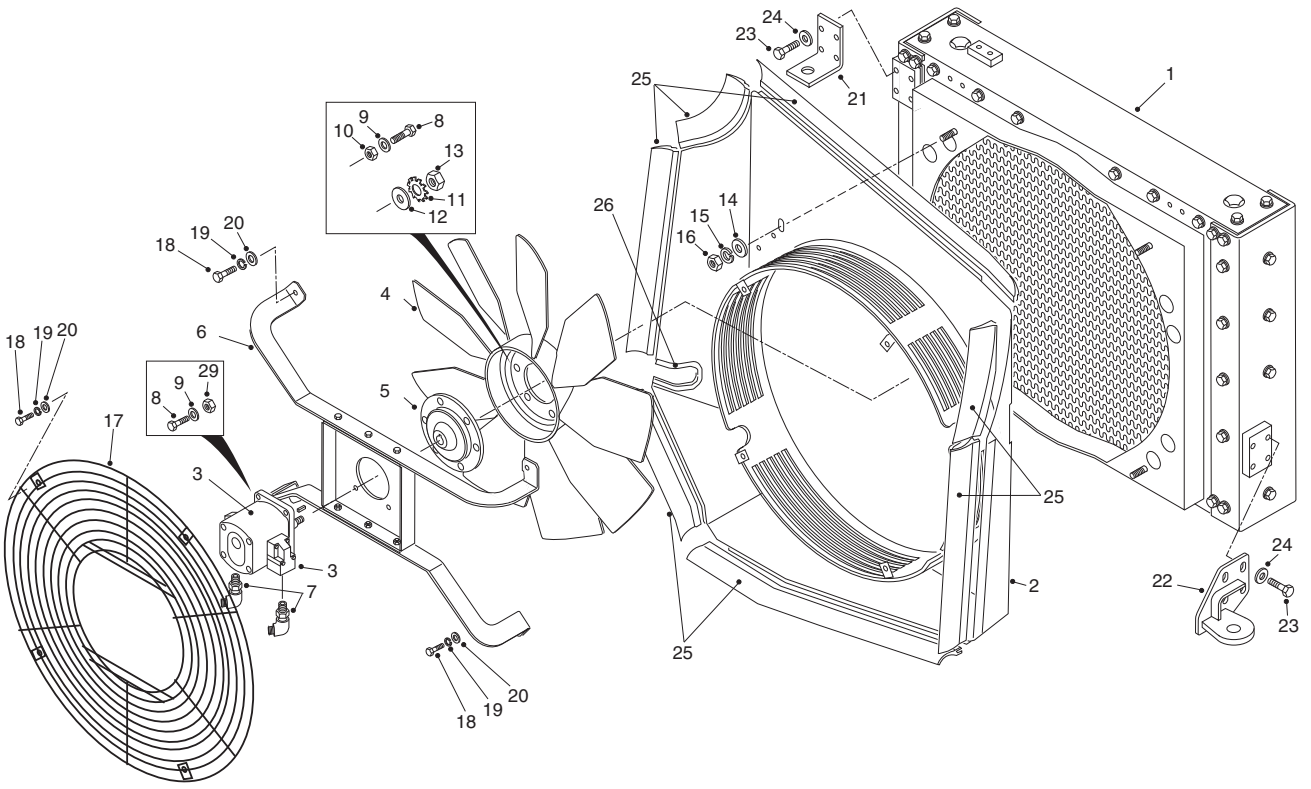


Fig. 2 - Exploded View of Transmission Oil Cooler Assembly

REMOVAL

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

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

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

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

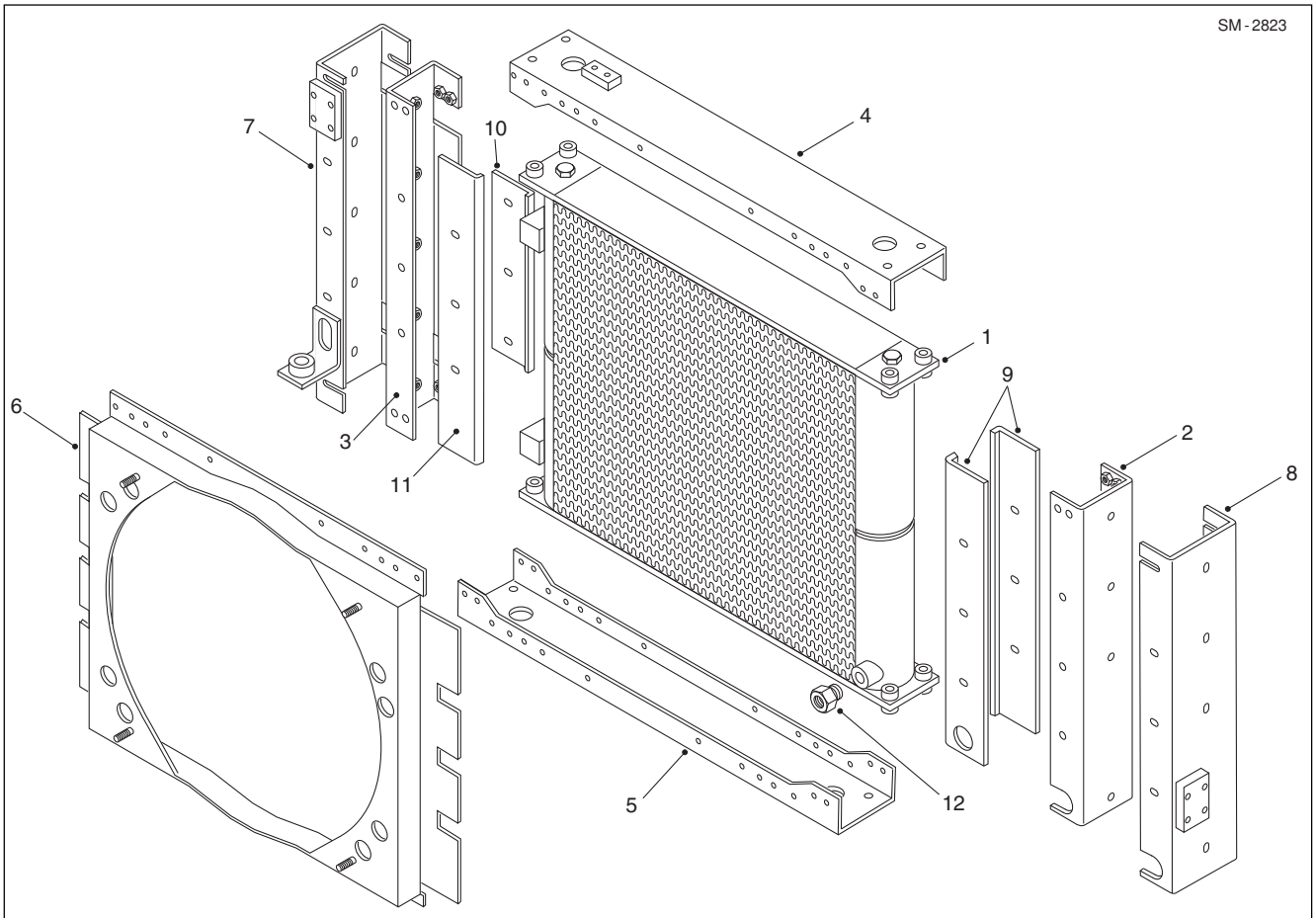
3. Pull on handle to release hood catch and raise hood.

4. Remove hood assembly from the vehicle. Refer to Section 100-0040, HOOD AND MOUNTING.

5. Open drain valve (14) at the bottom of the cooler assembly and drain transmission oil into a suitable container. Close drain valve when oil is completely drained.

6. Remove bracket from rear of cooler. It may be possible to remove bracket without disturbing hoses.

7. With a suitable container available to catch leakage, disconnect supply hose (18, Fig. 1), case drain hose (19, Fig. 1) and return hose (20, Fig. 1) from fan motor (21, Fig. 1) and secure clear of transmission oil cooler.



1 - Cooler Core
2 - Side Column
3 - Side Column
4 - Top Channel
5 - Bottom Channel
6 - Cowl Assy
7 - End Column
8 - End Column
9 - Baffle
10 - Baffle
11 - Baffle
12 - Adaptor

Fig. 3 - Exploded View of Transmission Oil Cooler

Fit blanking caps to open lines and ports.

8. With a suitable container available to catch leakage, disconnect transmission hoses (3 & 17, Fig. 1) from tube assemblies (4 & 5, Fig. 1). Fit blanking caps to open lines and ports.

9. Support transmission oil cooler assembly with suitable lifting equipment.

10. Remove nuts (11), bolts (1), hardened washers (8 & 9), isolators (5) and washers (10) from cooler brackets (2) and support plate (6).

11. Using suitable lifting equipment, remove transmission oil cooler from machine to a clean area for disassembly.

DISASSEMBLY

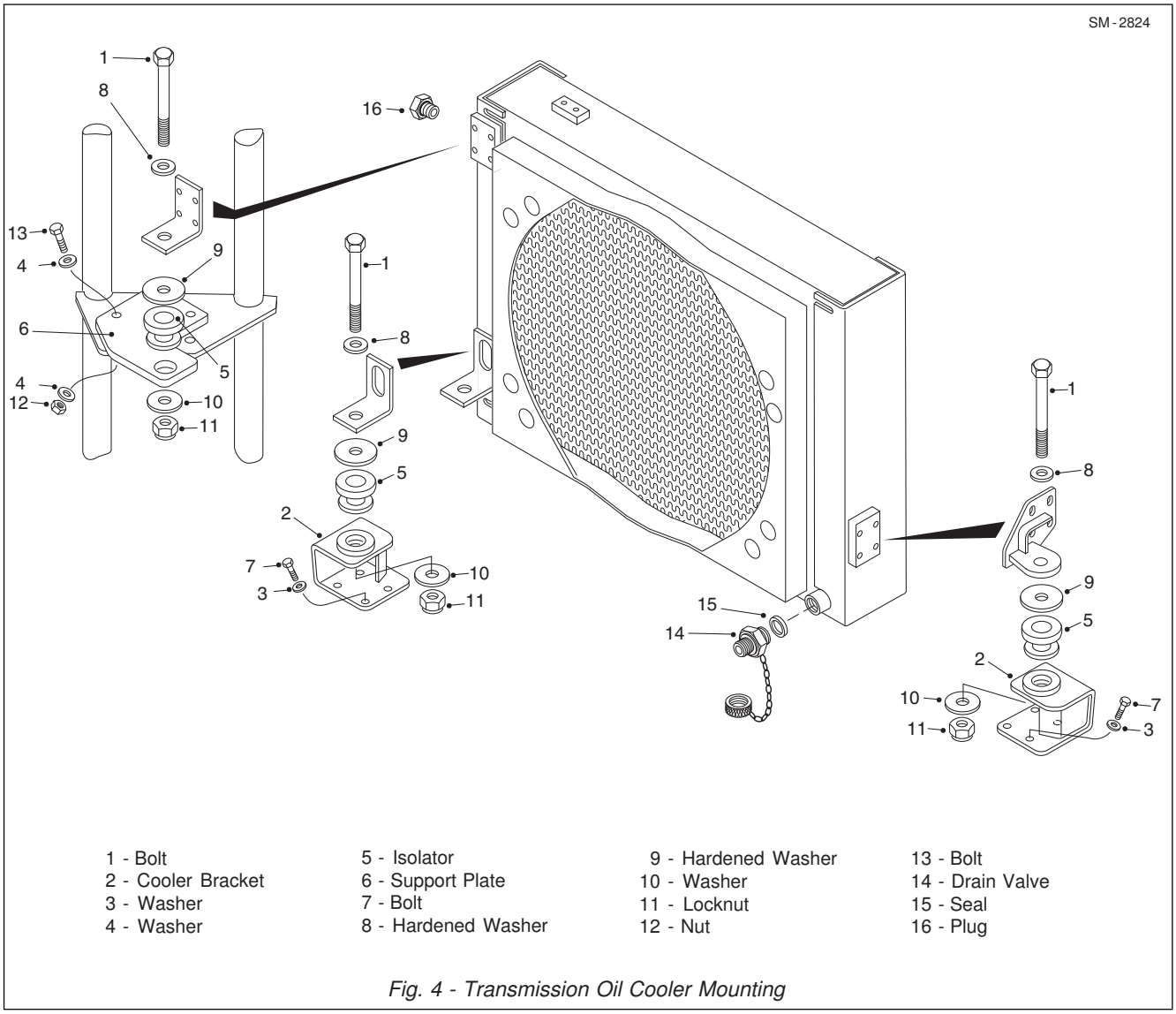
Numbers in parentheses refer to Fig. 2, unless otherwise stated.

Note: Take care not to damage cooler core during disassembly.

1. Remove clamp (6, Fig. 1) and mounting hardware (12 - 14, Fig. 1) securing tube assembly (4, Fig. 1) to cooler (1).

2. Disconnect tube assembly (4, Fig. 1) from elbow (16, Fig. 1) and remove. Remove elbow (16, Fig. 1) from cooler (1), noting orientation.

3. Remove clamp (7, Fig. 1) and mounting hardware (12 - 14, Fig. 1) securing tube assembly (5, Fig. 1) to cooler (1).



1 - Bolt
2 - Cooler Bracket
3 - Washer
4 - Washer
5 - Isolator
6 - Support Plate
7 - Bolt
8 - Hardened Washer
9 - Hardened Washer
10 - Washer
11 - Locknut
12 - Nut
13 - Bolt
14 - Drain Valve
15 - Seal
16 - Plug

Fig. 4 - Transmission Oil Cooler Mounting

4. Disconnect tube assembly (5, Fig. 1) from elbow (16, Fig. 1) and remove. Remove elbow (16, Fig. 1) from cooler (1), noting orientation.

5. Remove bolts (18), lockwashers (19) and washers (20) securing fan guard (17) to fan ring assembly (2), and remove fan guard (17).

6. Remove bolts (18), lockwashers (19) and washers (20) securing mounting (6) to cooler (1). Remove mounting (6) complete with motor (3), fan (4) and adaptor (5).

7. Remove nut (13), toothed washer (11) and washer (12) securing fan (4) and adaptor (5) to motor (3) shaft. Pull fan (4) and adaptor (5) from motor (3) shaft.

8. Remove bolts (8), washers (9) and nuts (10) securing fan (4) to adaptor (5).

9. Remove bolts (8) and washers (9) securing motor (3) to mounting (6), and remove motor (3).

10. Remove nuts (16), lockwashers (15) and washers (14) securing fan ring assembly (2) to cooler (1). Remove fan ring assembly (2) from cooler (1).

11. Remove bolts (23) and washers (24) securing brackets (21 & 22) to cooler (1).

12. Remove mounting hardware securing cowl assembly (6, Fig. 3) to cooler (1), and remove cowl assembly (6, Fig. 3).

13. Remove mounting hardware securing end columns (7 & 8, Fig. 3) to top and bottom channels (4 & 5, Fig. 3).

14. Remove remaining mounting hardware to allow end

columns (7 & 8, Fig. 3), side columns (2 & 3, Fig. 3) and baffles (9 - 11, Fig. 3) to be removed.

15. Remove mounting hardware securing top and bottom channels (4 & 5, Fig. 3) to cooler core (1, Fig. 3), and remove channels (4 & 5, Fig. 3).

ASSEMBLY

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

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

1. Secure top and bottom channels (4 & 5, Fig. 3) to cooler core (1, Fig. 3) using mounting hardware removed previously.

2. Fit end columns (7 & 8, Fig. 3), side columns (2 & 3, Fig. 3) and baffles (9 - 11, Fig. 3) to cooler core (1, Fig. 3) and secure using mounting hardware removed previously.

3. Secure cowl assembly (6, Fig. 3) to cooler (1) using mounting hardware removed previously.

4. Secure brackets (21 & 22) to cooler (1) using bolts (23) and washers (24).

5. Secure fan ring assembly (2) to cooler (1) using nuts (16), lockwashers (15) and washers (14).

6. Fit motor (3) to mounting (6) using bolts (8) and washers (9).

7. Assemble fan (4) to adaptor (5) using bolts (8), washers (9) and nuts (10).

8. Press fan (4) and adaptor (5) onto motor (3) shaft, ensuring key is fitted.

9. Secure fan (4) and adaptor (5) using washer (12), toothed washer (11) and nut (13).

10. Install mounting (6) complete with motor (3), fan (4) and adaptor (5) to cooler (1).

Note: When installing mounting, ensure clearance around fan (4) tips to fan ring assembly (2) is of equal dimension all round.

11. Secure fan guard (17) to fan ring assembly (2) using bolts (18), lockwashers (19) and washers (20).

12. Fit elbows (16, Fig. 1) to cooler (1) in correct orientation.

13. Fit bracket (6, Fig. 1) to cooler. Fit tube assembly (4, Fig. 1) to top elbow (16, Fig.1) and secure with clamp (12, Fig. 1), plate (13, Fig. 1) and screws (14, Fig. 1).

14. Fit bracket (7, Fig. 1) to cooler. Fit tube assembly (5, Fig. 1) to bottom elbow (16, Fig.1) and secure with clamp (12, Fig. 1), plate (13, Fig. 1) and screws (14, Fig. 1).

INSTALLATION

Numbers in parentheses refer to Fig. 4, 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 transmission oil cooler assembly on machine and secure to cooler brackets (2) and support plate (6) with nuts (11), bolts (1), hardened washers (8 & 9), isolators (5) and washers (10).

2. Connect transmission hoses (3 & 17, Fig. 1) to tube assemblies (4 & 5, Fig. 1).

3. Fit bracket to rear of cooler, using fasteners removed previously.

4. Connect supply hose (18, Fig. 1), case drain hose (19, Fig. 1) and return hose (20, Fig. 1) to fan motor (21, Fig. 1).

5. Following installation instructions in Section 100-0040, HOOD AND MOUNTING, install hood assembly on the vehicle.

6. Fill transmission oil cooler with transmission oil specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 120-0010, TRANSMISSION AND MOUNTING, for filling procedure and level check.

7. Top up hydraulic tank as necessary with hydraulic

oil specified in Section 300-0020, LUBRICATION SYSTEM.

8. Check all line and pipe connections for noticeable leaks prior to starting the vehicle.

9. 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.

10. Lower hood assembly and remove wheel blocks.

MAINTENANCE

Motor Overhaul

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.

Every 10 Hours

Check cooling fan for cracks and damage. Check fan mounting and tighten if required. Replace cooling fan if damaged.

Check lines and components for leaks and damage.

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

Every 250 Hours

Inspect the transmission oil cooler fins and, if necessary, clean with a quality detergent (see Cleaning).

Note: Fuel oil, kerosene or gasoline should not be used to clean fins.

Note: It may be necessary to clean cooler fins more frequently if the machine is being operated in extremely dusty or dirty areas.

CLEANING

External Cleaning

Numbers in parentheses refer to Fig. 2.

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 cooler core (1).

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 cooler core (1).

Note: In the case of grossly fouled surfaces which are not cleaned adequately in steps 1 through 3, the following procedure may be used.

4. Ensure that the cooler core (1) is dry.

5. Liberally brush on to both sides of the cooler core (1) an emulsifying cleaner such as 'Gunk', or equivalent, and leave to soak for at least 1 hour.

6. 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 core.

7. For surfaces with stubborn deposits, it may be necessary to repeat steps 4 through 6, brushing the surfaces between stages using a stiff bristle brush.

Internal Cleaning - Tubes

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.

SERVICE 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 are available from your dealer.

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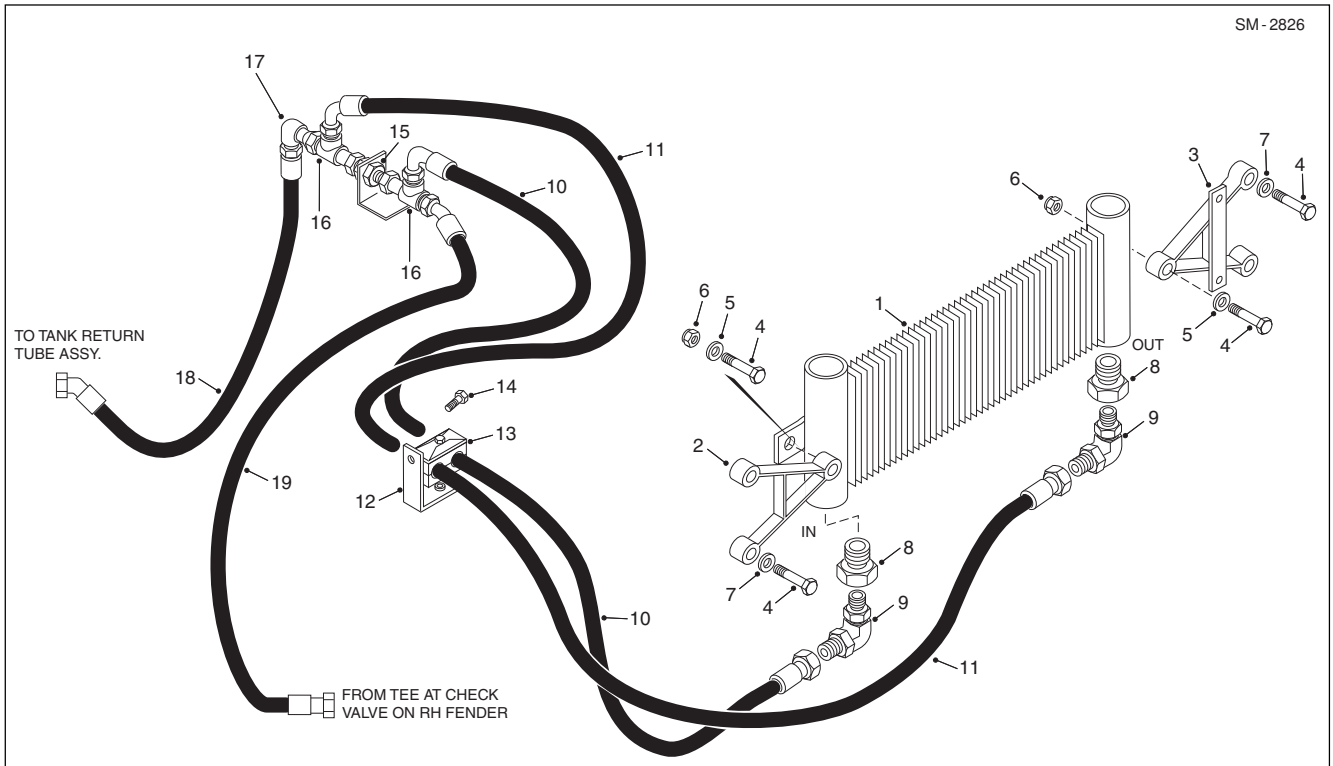

1 - Hydraulic Oil Cooler
2 - Bracket Assembly
3 - Bracket Assembly
4 - Bolt
5 - Washer
6 - Locknut
7 - Washer
8 - Adaptor
9 - Elbow
10 - Hose
11 - Hose
12 - Bracket
13 - Clamp
14 - Bolt
15 - Adaptor
16 - Tee
17 - Elbow
18 - Hose
19 - Hose

Fig. 1 - Exploded View of Hydraulic Oil Cooler and Mounting

DESCRIPTION AND OPERATION

Numbers and letters in parentheses refer to Fig. 1.

The air cooled hydraulic oil cooler is mounted on the front of the radiator assembly, with the purpose of cooling hydraulic oil circulating through the hydraulic tank.

Hydraulic oil from the transmission oil cooler motor enters hydraulic oil cooler (1) through inlet line (10).

The hydraulic oil is cooled by the air flow through the fins and exits through outlet line (11) and flows back to the hydraulic tank.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNING

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

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Turn steering wheel several times to relieve any pressure in the steering circuit. Operate brake pedal 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 drain plug from hydraulic tank remote drain fitting. Drain oil in the hydraulic tank into a suitable container and re-install drain plug.

4. Remove mounting hardware securing front grille on the hood assembly. Remove front grille from the hood.

5. Remove inlet line (10) from elbow (9) and connector (8) in hydraulic oil cooler (1). Drain oil from inlet line (10) into a suitable container. Plug inlet line and cap port to prevent ingress of dirt.

6. Remove outlet line (11) from elbow (9) and connector (8) in hydraulic oil cooler (1). Drain oil from outlet line (11) into a suitable container. Plug outlet line and cap port to prevent ingress of dirt.

7. Remove mounting hardware securing hydraulic oil cooler (1) to bracket assemblies (2 & 3). Remove hydraulic oil cooler (1) from its mounting.

8. If required, remove horns along with bolts (4) and washers (7) securing bracket assemblies (2 & 3) to the radiator assembly.

CLEANING AND INSPECTION

1. Inspect fins on hydraulic oil cooler carefully, for trapped debris and damage. If hydraulic oil cooler fins show signs of leakage or are excessively damaged, it must be replaced as an assembly.

2. Check connectors in hydraulic oil cooler ports for damaged threads. Replace if required.

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 listed in Section 300-0080, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 220-0000, STEERING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

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

1. If removed, secure bracket assemblies (2 & 3) to the radiator assembly with bolts (4) and hardened washers (5), and install horns.

2. Secure hydraulic oil cooler (1) to bracket assemblies (2 & 3) with mounting hardware, as removed at 'Removal'.

3. Install inlet line (10) and outlet line (11) in their respective ports, as removed at 'Removal'.

4. Fill hydraulic tank with oil. Refer to Section 230-0040, HYDRAULIC TANK, for correct fill level and Section 300-0020, LUBRICATION SYSTEM for specifications of oil to be used.

5. Place the battery master switch in the 'On' position, start engine and operate the body hydraulics several times to circulate the oil. Check hydraulic oil cooler (1) and lines for leaks. Tighten fittings as required.

6. Install front grille assembly to the hood with mounting hardware, as removed at 'Removal'.

7. Remove wheel blocks from all road wheels.

MAINTENANCE

Check and clean hydraulic oil cooler every 4 000 hours, or more frequently, if required. Debris in the cooling fins can restrict the flow of air through the cooler which significantly reduces the cooling effect.

Note: In the event of a hydraulic failure, hydraulic oil cooler should be removed and cleaned to prevent clogging.

SERVICE 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 are available from your dealer.

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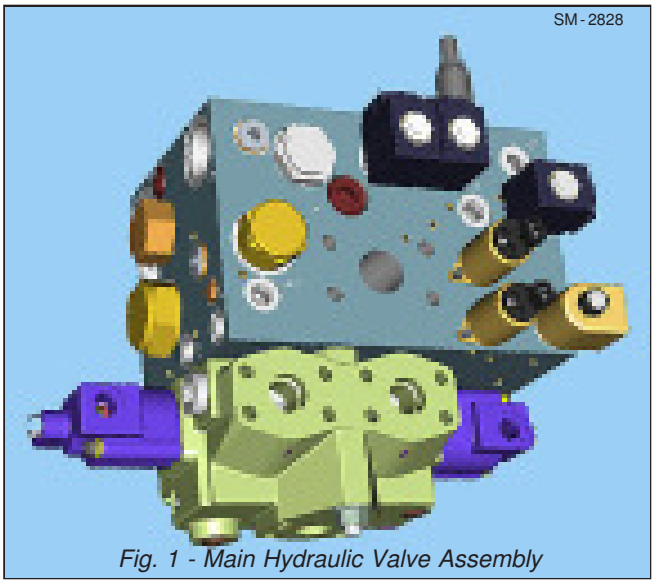


Fig. 1 - Main Hydraulic Valve Assembly

DESCRIPTION

Numbers in parentheses refer to Fig. 2

The Main Hydraulic Valve Assembly is mounted on the left hand side of the tractor frame next to the transmission.

The Main Hydraulic Valve Assembly controls the following functions;

(a) System relief protection for main pump.
(b) Priority function
(c) Steering function.
(d) Brake charging function.
(e) Park/emergency function.
(f) Body control function.
(g) Transmission cooler fan drive.
(h) Cold start function.

Valves that control all the above functions are integrated into the Main Hydraulic Valve Assembly and are identified in Figs. 2 through 7.

System Relief

The system relief valve (14) protects the main hydraulic valve assembly components against pressure spikes. This system relief valve is pre-set at 265 bar (3850 lbf/in^2) and is non-adjustable.

Priority Function

This function automatically ensures that the steering and brake charging circuits are given preference over the fan and body tipping functions.

When the pump is not running, the priority valve (15) is closed. As the main pump starts rotating it builds up residual pressure and the priority valve opens, feeding the main pump pressure through to the fan drive (17 & 18) & body tipping (5 & 29) valves.

During the body tipping operations and whilst the fan is running, if the demand pressure at the brake charging or the steering circuit is less than these functions, the priority valve (15) remains open, but the oil takes the path of the least resistance and the requirements of the charging or steering circuits are met.

If the demand pressure for charging or steering is higher than that demanded by the fan drive or body tipping function, this higher pressure will be fed to the main pump load sense line via the shuttle valves (21 & 25) and therefore enable the main pump to meet the charging or steering pressure requirements. At the same time the higher load sense pressure assists the spring in the priority valve (15), the priority valve will then close to reduce the flow to the fan or body tipping circuit and therefore making sure the brake charging & steering always has priority over the other functions.

Steering Function

Refer to Section 220-0000, STEERING SYSTEM

Steering actuation pressure is controlled by steering load sense orifice (20).The steering load sense orifice (20) controls main pump pressure in the steering load sense line. As pressure increases through steering load sense orifice (20), main pump pressure increases lifting steering check valve (24) allowing steering actuation pressure to access the steering orbitrol control valve.

Emergency Steering

Refer to Section 220-0000, STEERING SYSTEM.

The emergency valve (19) forms part of the emergency steering system. It is connected to the main output line of the wheel driven Emergency Steering Pump mounted on the transmission.

Brake Charging Function

Refer to Section 250-0000, BRAKE SYSTEM.

Brake charge valve (8) and brake pressure reducer valve (7) are integral valves that form part of the brake charging function. Brake charge valve (8) ensures that there is sufficient load sense pressure to the main pump to allow the charge pressure to be generated. Brake pressure reducer valve (7) maintains a safe

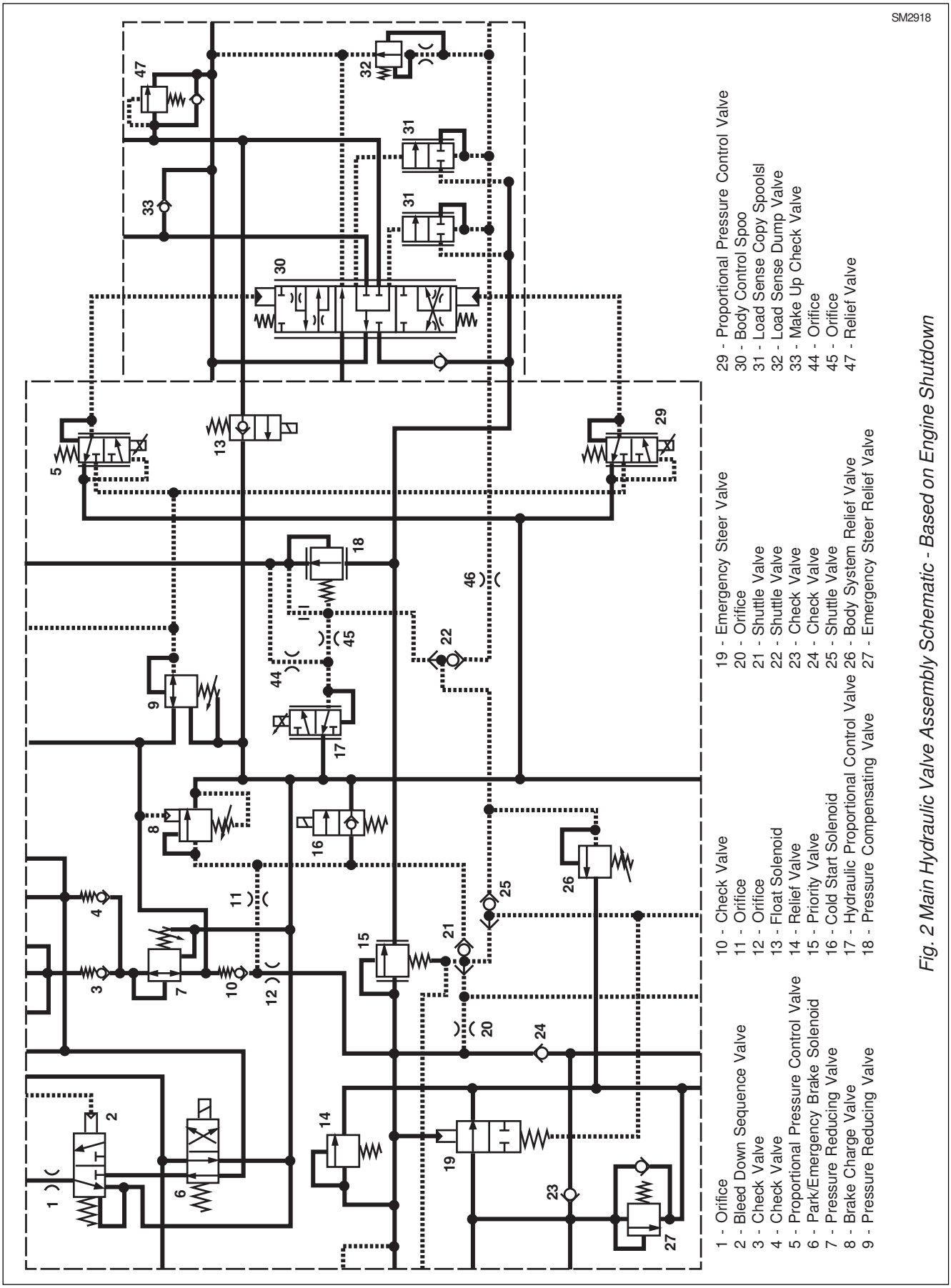


Fig. 2 Main Hydraulic Valve Assembly Schematic - Based on Engine Shutdown

operating pressure within the front and rear brake accumulators.

Park/Emergency Brake Function

Refer to Section 250-0000, BRAKE SYSTEM.

Park/Emergency brake solenoid (6) is the integral valve that controls hydraulic pressure to the park and emergency brake function of the truck.

Body Control Function

Refer to Section 230-0000, BODY SYSTEM

Proportional pressure control valve (5) is the integral valve that controls the body tipping function. This valve is operated via the body control lever located in the operators cab. The body control lever sends an electrical signal to the hydraulic ECU. (Refer to Section 190-0085). The hydraulic ECU processes this signal and delivers an actuating electrical signal to the proportional pressure control valve (5). The proportional pressure control valve (5) converts this electrical signal into a pilot pressure, that then is allowed to stroke the body control spool to the lift position.

Proportional pressure control valve (29) is the integral valve that controls the body lower function. This valve is operated via the body control lever located in the operators cab. The body control lever sends an electrical signal to the hydraulic ECU (Refer to Section 190-0085). The hydraulic ECU processes this signal and delivers an actuating electrical signal to the proportional pressure control valve (29). The proportional pressure control valve (29) converts this electrical signal into a pilot pressure, that then is allowed to stroke the body control spool to the lower position.

Body relief valve (47) is located on the raise side of the circuit and prevents pressure spikes at maximum extension of the cylinders when the body is raised at maximum engine speed. Relief valve (47) is set at 230 bar (3 335 lbf/in^2).

Transmission Cooler Fan Drive

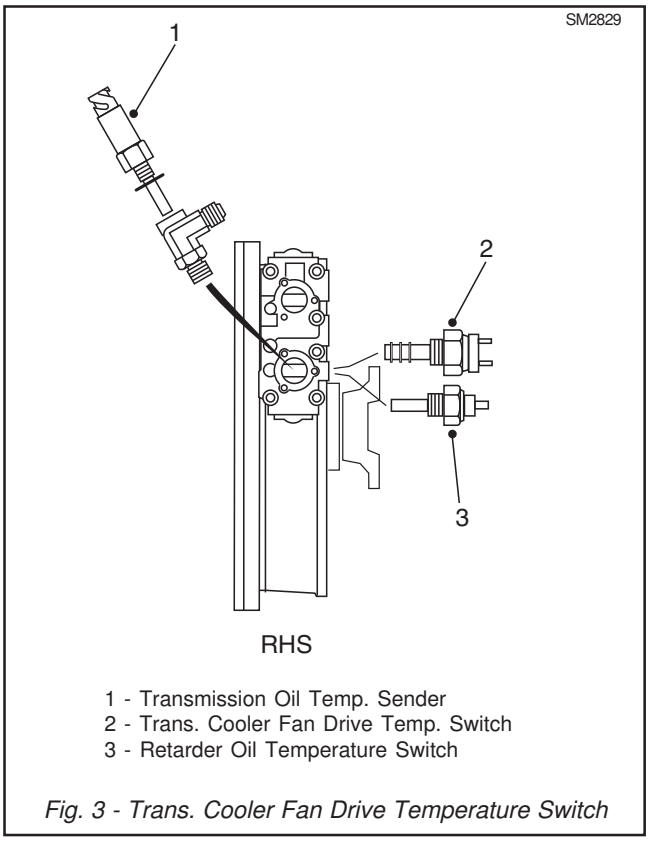
The transmission cooler fan speed is modulated by proportionally controlling the pressure at the fan motor. Fan speed is a function of the pressure at the fan motor.

On a cold start, the transmission cooler fan will not rotate. A fan drive solenoid valve, mounted on the right hand fender next to the transmission cooler, will remain closed, blocking actuating pressure until the transmission oil temperature reaches 90°C (195°F).

The hydraulic ECU receives an electrical signal from the transmission cooler fan drive temperature switch, mounted on the transmission retarder housing. Once an electrical signal reflecting a transmission oil temperature of 90°C (195°F) has been received, the hydraulic ECU sends a signal to de-energise the fan drive solenoid valve, allowing actuation pressure to access the fan drive circuit. This fan drive solenoid valve is a fail safe system. If power or connection is lost the fan drive solenoid valve will de-fault to the open (de-energised) condition.

The hydraulic ECU (Refer to Section 190-0085) sends an electrical signal from Pin C1:24 to the fan drive solenoid valve. This signal de-energises the fan drive solenoid, opening the transmission cooler fan drive circuit.

The transmission cooler fan speed pressure is controlled by the Electro-Hydraulic Proportional Control Valve (17). A varying current input into this valve of between 150 to 210 mA controls the pressure between 34 bar (490 psi) and 87 bar (1260 psi). This pressure then acts upon the Shuttle Valve (22) and onto the main pump load sense connection via Shuttle Valve (25). This pressure acts upon the spring chamber of the Logic Valve (18) that controls the pressure at the fan.



1 - Transmission Oil Temp. Sender
2 - Trans. Cooler Fan Drive Temp. Switch
3 - Retarder Oil Temperature Switch

Fig. 3 - Trans. Cooler Fan Drive Temperature Switch

Trans. Cooler Fan Drive Temperature Switch - Typical Analog Outputs (Mv) Vs' Oil Temperature (°C)										
Temp.(°C)	20	25	35	50	70	**90**	95	120	140	150
Mv.	900	780	760	330	170	**95**	80	40	35	0

The hydraulic ECU receives an analog input from the Transmission Cooler Fan Drive Temperature Switch at Pin C1:3. The temperature sensor output is calibrated against actual temperature within the hydraulic ECU. The hydraulic ECU converts the analog signal into a varying current output. This varying current output, from Pin C1:19, controls Electro-Hydraulic Proportional Control Valve (17) increasing and decreasing pressure at the fan motor. The fan speed increases and decreases proportionally between transmission oil temperatures of 90 to 140°C (195 to 285°F).

The Fan Drive Solenoid will remain de-energised until the transmission oil temperature falls to 87°C (188°F). At this point the oil flow to the transmission cooling fan will stop.

Refer to troubleshooting charts.

Cold Start Function

Cold Start Solenoid (16) is the integral valve that controls the cold start function of the Main hydraulic valve assembly

Cold start solenoid (16) energises when starter motor signal is high, this dumps all load sense pressure from the main hydraulic pump, rendering the pump off-load. This reduces parasitic losses during engine cranking procedure.

There is about a 2 second delay before de-energising cold start solenoid (16) (starter motor signal low). This function prevents brake charging during engine start up, which is particularly important in cold climates.

A starter motor high signal is received by the hydraulic ECU at Pin C1:9. The hydraulic ECU converts this high signal into digital output signal at Pin C1:22, energising the cold start solenoid (16). The signal to energise the cold start solenoid (16) will remain on until a starter motor low signal is received by the hydraulic E.C.U. at Pin C1:9, this will negate the digital output signal from Pin C1:22.
(Refer to section 190-0085 for full Hydraulic E.C.U. detail.)

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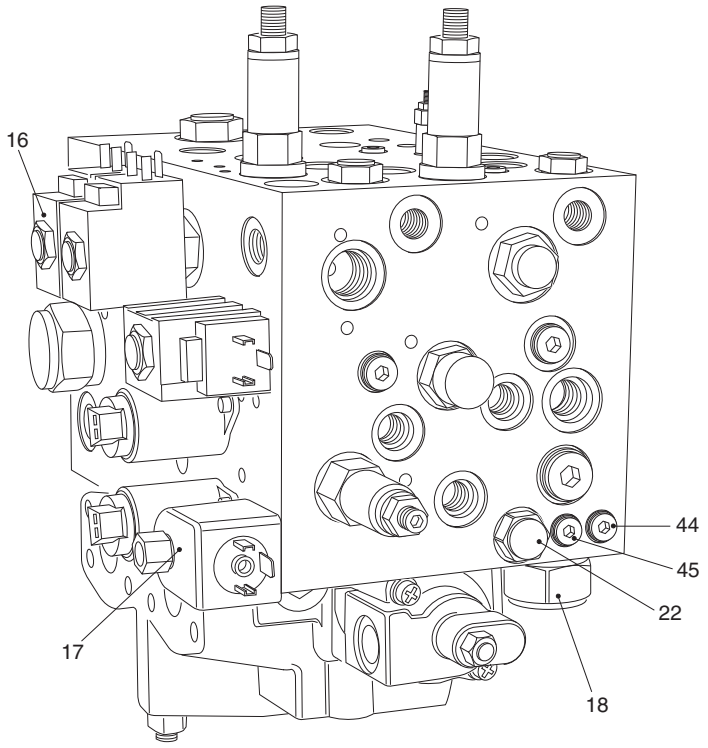


16 - Cold Start Solenoid
17 - Hydraulic Proportional Control Valve
18 - Pressure Compensating Valve
22 - Shuttle Valve
44 - Orifice
45 - Orifice

Valve (16) Coil Rating		
Ohms	Amps	Watts
42	0.6	15
Voltage: 24V		

Valve (17) Coil Rating		
Ohms	Amps	Watts
25	0.9	21
Voltage: 24V		

Fig. 4 - Main Hydraulic Valve Assembly - Transmission Cooler Fan Valves/Cold Start Solenoid

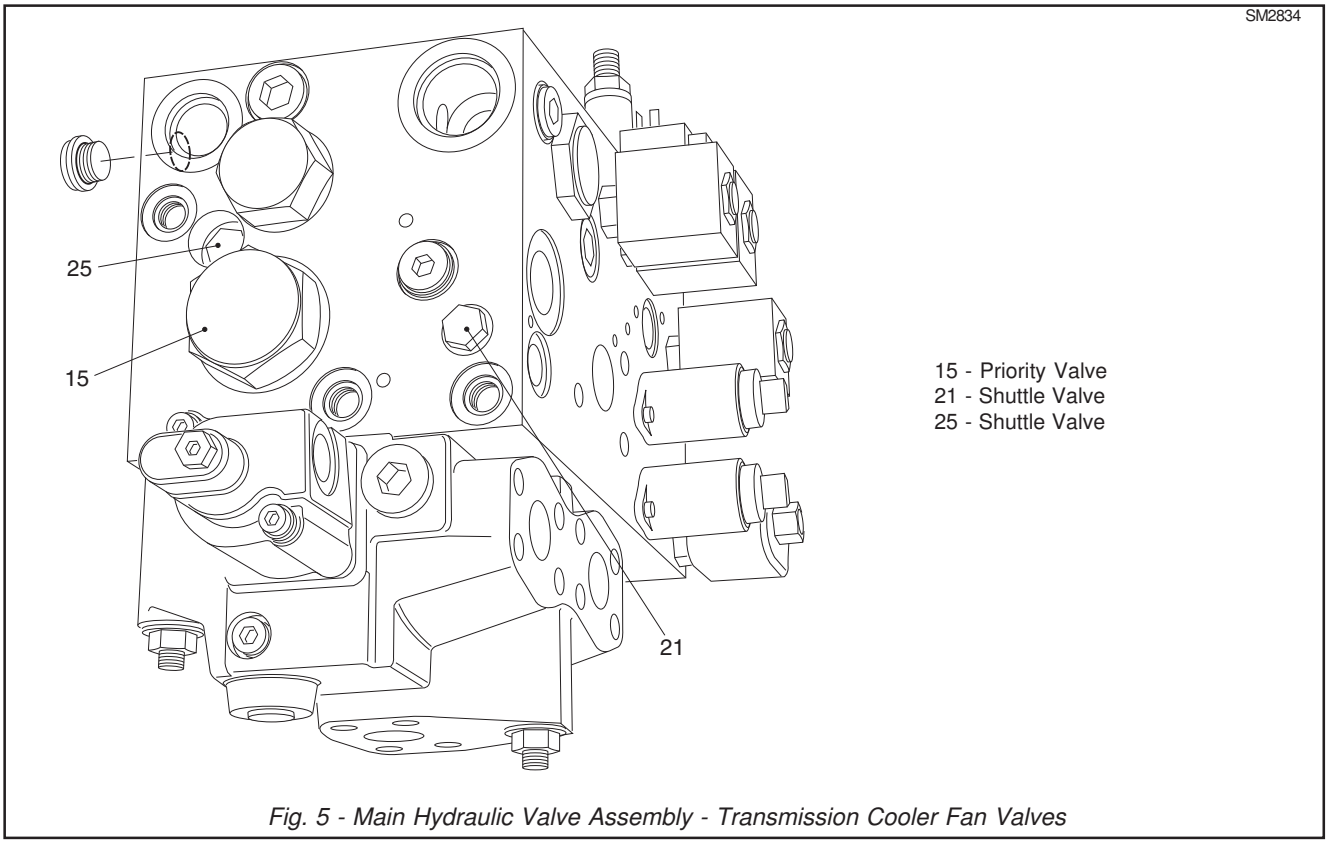


Fig. 5 - Main Hydraulic Valve Assembly - Transmission Cooler Fan Valves

Transmission Cooler Fan Drive Trouble Shooting

Symptom	Possible Cause	Remedy
Fan will not rotate once transmission oil temperature is >90°C (195°F).	Hydraulic E.C.U. no receiving appropriate signal from transmission cooler fan drive temperature switch, when transmission oil is >90°C (195°F).	Replace transmission cooler fan drive temperature switch. (Ref. Fig. 3)
	Fan drive solenoid, located on right hand fender remains closed.	(a) Check signal from hydraulic E.C.U. - Pin C1:24. Should be low signal. (b) Check electrical connections. (c) Replace fan drive solenoid.
	Check for output fault at hydraulic E.C.U.	Ref. Output from Pin C1:19. Ref. Section 190-0085 Hydraulic E.C.U.
	Fan control logic valve (18) sticking in the open position.	Replace fan control logic valve (18).
	Contamination in load sense orifices (44 &45) and/or shuttle valves (22 & 25).	Disconnect fan at main hydraulic valve assembly and plug port DF. Raise and lower the body several times to flush out system. If this is unsuccessful, replace main hydraulic valve assembly.

Transmission Cooler Fan Drive Trouble Shooting		
Symptom	**Possible Cause**	**Remedy**
Fan will not modulate its speed over the desired temperature range.	Residual current at hydraulic proportional valve (17).	Check current at valve (17).
	No voltage at hydraulic proportional valve (17).	(a) Check electric connections at valve (17). (b) Check annalog signal from Trans. Cooler Fan Drive Temperature Switch. (c) Check output signal from Hydraulic E.C.U. Pin C1:19.
	Fan Proportional Solenoid Valve(17) Faulty.	Replace Valve(17).
	Contamination or Air in Load Sense Drillings or Shuttle Valves (22 & 25)	Disconnect the fan and plug port DF. Raise and lower the body several times to flush out the system. If this does not work change the whole manifold block.
	Fan Pressure Modulating Valve(18) Faulty	Replace valve(18).
	Contamination in Orifices(44 & 45)	Clean Orifices (44 & 45).
Fan Speed too low.	Fan Proportional Solenoid(17) Faulty.	Replace Valve(17).
	Faulty Fan Motor.	Replace Fan Motor. Ref. Section 210-0060 Transmission Oil Cooler
Fan unstable over the speed range when another function is selected.	Orifices(44 or 45) Blocked.	Clean Orifices
	Fan Proportional Pressure Solenoid (17) Faulty.	Replace Valve(17)
	Fan Pressure Modulating Logic Valve(18) Faulty.	Replace Valve(18)
		Check Main Pump setting. Ref. Section 230-0050 Main Hydraulic Pump

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 battery master switch to the 'off' position. Relieve stored pressure in accumulators (x3). This is achieved by pressing and releasing foot brake pedal continuously until all accumulator pressure is relieved.

⚠ WARNING
Accumulators are charged with Nitrogen. The service pressure is 95 bar (1380 lbf/in²) at 20° C (68° F). To prevent personal injury and property damage do not attempt to remove any valves or fittings until all nitrogen pressure is completely relieved.

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. Main hydraulic valve assembly is accessed by raising the operator cab. (Refer to Section 260-0010, CAB AND MOUNTING.)

⚠ WARNING
Never work under or near an unsupported raised operator cab assembly. Always ensure cab safety prop is in correct position.

5. Clean outer area of the main hydraulic valve assembly with a suitable cleaning solvent. Ensure all hydraulic lines connected to the main hydraulic valve assembly are identified for ease of installation. With suitable containers catch any oil leakage when disconnecting hydraulic lines. Install blanking caps to all open lines and fittings.

6. Install M10 eye bolt into clamp mounting hole at port 'T' located on top of main hydraulic valve assembly. Support main hydraulic valve assembly with suitable lifting equipment, using eye bolt.

7. Disconnect mounting hardware securing main hydraulic valve assembly to vehicle.

DISASSEMBLY

All integral valves on the main hydraulic valve assembly can easily be removed. On removal of all integral valve assemblies, clean and examine for wear or damage.

If integral valve is badly damaged, inpect bore of main hydraulic valve housing. If the main hydraulic valve housing is damaged, the main hydraulic valve assembly will have to be completely replaced.

Always replace all o-rings and seals after inspection.

ASSEMBLY

All integral valves must be re-installed into correct locations on the main hydraulic valve assembly. All integral valves must be torqued to correct value.

1. Re-install O.R.F.S. connectors into correct ports. Replace o-rings and seals. Ref. Fig. 6

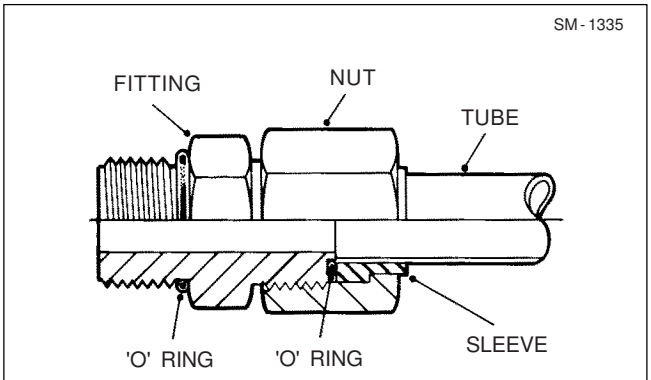


Fig. 6 - Assembly of Typical ORFS Connector

2. Install M10 eye bolt into clamp mounting hole at port 'T' located on top of main hydraulic valve assembly. Support main hydraulic valve assembly with suitable lifting equipment, using eye bolt.

3. Manoeuvre main hydraulic valve assembly into position and secure to vehicle with mounting hardware.

4. Remove blanking caps from all hydraulic lines and fittings. Re-connect hydraulic lines to correct fittings astagged at removal.

5. Lower operator cab and secure. Ref. Section 260-0010, CAB AND MOUNTING.

6. Fill hydraulic tank with hydraulic oil as described in Section 300-0020, LUBRICATION SYSTEM. Ensure

arear around fill area is clean. Install filler cap on hydraulic tank.

7. Turn battery master switch to 'on' position, remove any wheel blocks, start engine. Operate body and steering systems. Check hydraulic lines and fittings for leaks. Tighten where required.

8. Check hydraulic tank oil level and replenish if required.

9. Bleed brake system after main hydraulic valve removal. Ref. Section 165-0010 BRAKE PARTS.

Main Hydraulic Valve Assembly - Integral Valve Tightening Torques

Valve No.	Description	Qty.	Tighten Torque Nm
2	Directional Control Bleed Down Valve	1	50
3	Check Valve	1	30
4	Check Valve	1	30
5	Body Raise Solenoid Valve	1	3
6	Park Brake Valve	1	30
	24 Volt Coil	1	3.5
	Coil Nut	1	3.5
7	Brake Accumulator Pressure Valve	1	60
8	Brake Pressure Low Setting	1	60
9	Servo Pressure Reducing Valve	1	60
10	Check Valve	1	30
11	M6 Orifice Screw	1	3
12	M6 Orifice Screw	1	3
13	Float Solenoid Valve	1	30
	24 Volt Coil	1	3
	Coil Nut	1	3
14	Shock Relief Valve (265 Bar)	1	60
15	System Press. Generating Logic Valve	1	40
16	Cold Start Solenoid Valve	1	30
	24 Volt Coil	1	3
	Coil Nut	1	3

Main Hydraulic Valve Assembly - Integral Valve Tightening Torques			
Valve No.	Description	Qty.	Tighten Torque Nm
17	Fan Proportional Press. Control Valve	1	60
	CoilNut	1	3.5
18	Fan Control Logic Valve	1	115
19	Emergency Steering Valve	1	100
20	Steering Pressure LS Orifice	1	115
21	Shuttle Valve	1	10
22	Shuttle Valve	1	10
23	Check Valve	1	100
24	Check Valve	1	100
25	Shuttle Valve	1	10
26	Body Raise LS – Relief Valve	1	10
27	Emergency Steering Relief Valve	1	60
29	Body Lower Solenoid Valve	1	3
31	Plug – G1/8”	3	15
32	Plug – G1/4”	1	30
33	Plug – G3/8”	3	45
34	Plug 9/16 UNF	1	30
35	Plug – G1/4”	1	30
40	Nut – M12	3	80
44	M6 Orifice Screw	1	3
45	M6 Orifice Screw	1	3
46	M6 Orifice Screw	1	3
47	Relief Valve	1	80

1 - Orifice
2 - Bleed Down Sequence Valve
3 - Check Valve
4 - Check Valve
5 - Proportional Pressure Control Valve
6 - Park/Emergency Brake Solenoid
7 - Pressure Reducing Valve
8 - Brake Charge Valve
9 - Pressure Reducing Valve
10 - Check Valve
11 - Orifice
12 - Orifice
13 - Float Solenoid
14 - Relief Valve
15 - Priority Valve
16 - Cold Start Solenoid
17 - Hydraulic Proportional Control Valve
18 - Pressure Compensating Valve
19 - Emergency Steer Valve
20 - Orifice
21 - Shuttle Valve
22 - Shuttle Valve
23 - Check Valve
24 - Check Valve
25 - Shuttle Valve
26 - Body System Relief Valve
27 - Emergency Steer Relief Valve
29 - Proportional Pressure Control Valve
44 - Orifice
45 - Orifice
47 - Relief Valve

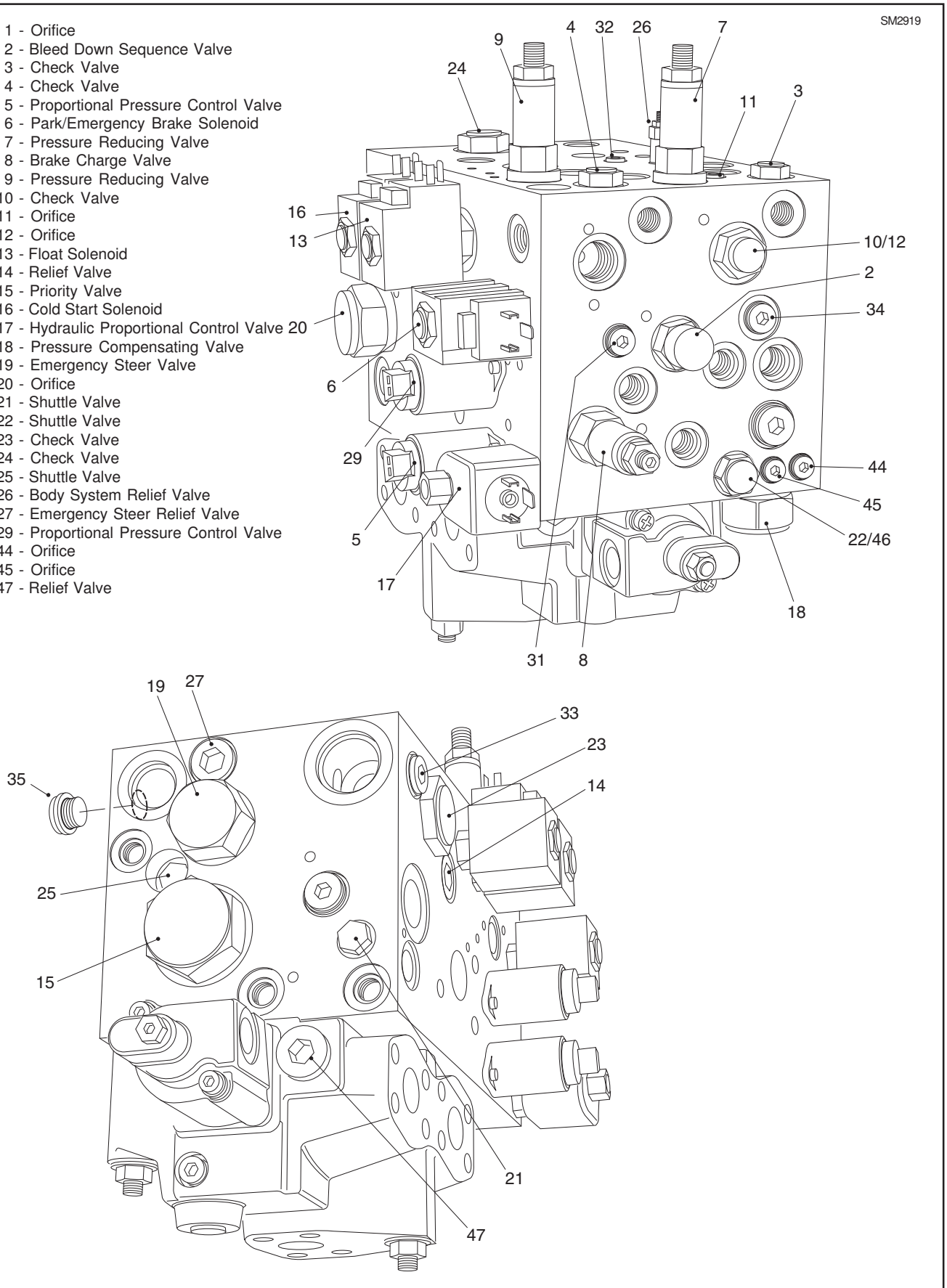


Fig. 7 - Main Hydraulic Valve Assembly - Integral Valve Positions

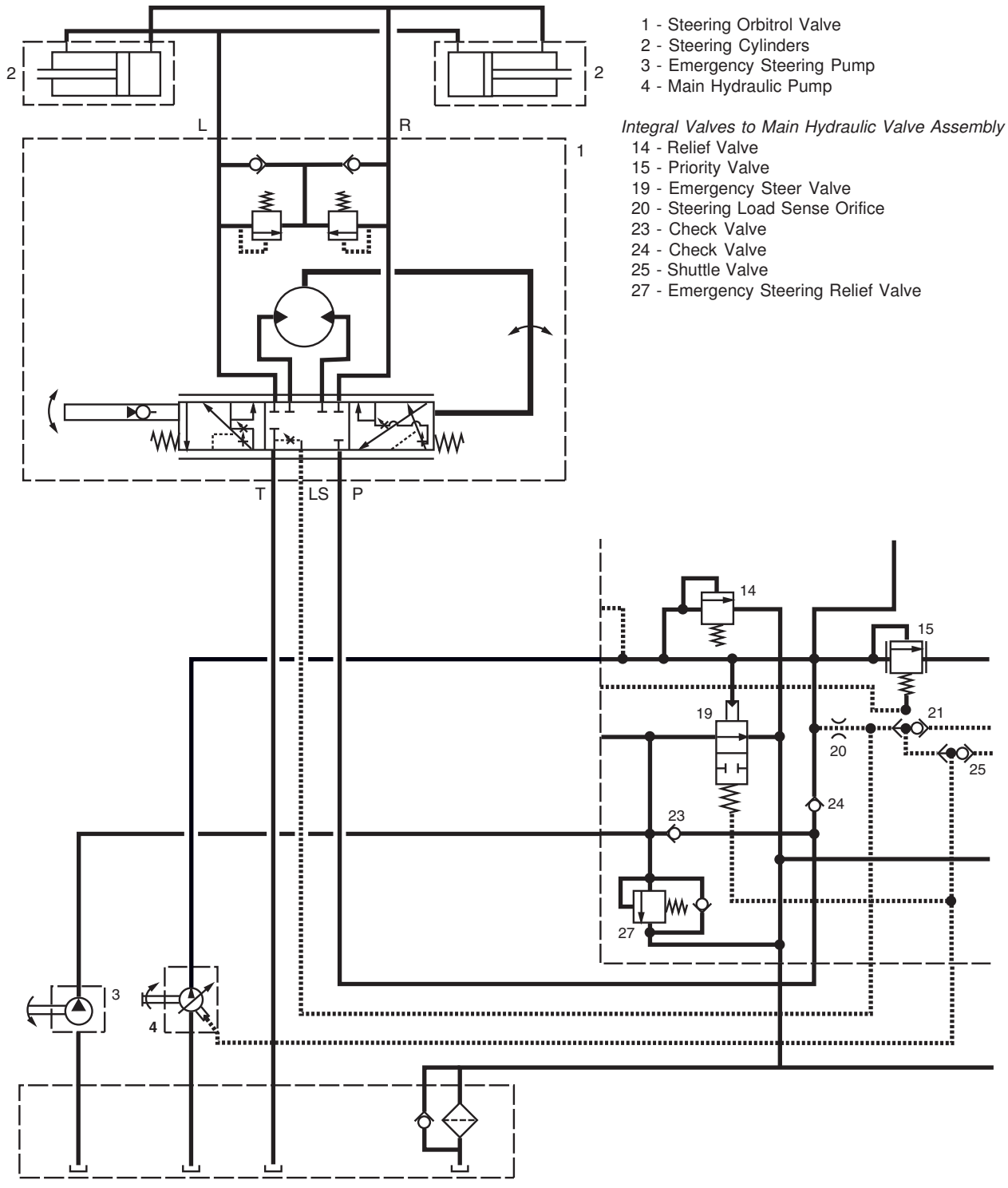


Fig. 1 - Steering System Schematic

DESCRIPTION

Numbers in parentheses refer to Figure 1.

Steering Orbitrol Valve (1)

Refer to Section 220-0090, Steering Valve.

The steering valve, which is mounted on the underside of the cab floor, is connected to the steering column and controls hydraulic oil flow to the steering cylinders.

The steering valve is of a closed centre design, indicating oil is 'dead headed' at the valve until it is operated.

Steering Cylinders (2)

Refer to Section 220-0120, Steering Cylinder.

There are two single stage, double acting cushioned steering cylinders on the machine. The cylinder base end is connected to the front frame, and the piston rod end is connected to the articulation and oscillation pivot. Single stage double acting means that the piston rod can have oil applied to either side, extending or retracting the piston rod.

Cylinder mounting is by pins, spacers, seals and, spherical bearings secured with circlips. Spherical bearings permit a limited amount of cylinder misalignment when travelling over rough terrain.

Emergency Steering Pump (3)

The emergency steering ground driven pump, mounted on the transmission, provides flow to the steering circuit in the event that the main pump (4) can no longer function effectively.

Main Hydraulic Pump (4)

Refer to Section 230-0050, Main Hydraulic Pump.

The main hydraulic pump, mounted on the transmission power take off (PTO), supplies hydraulic oil for operating the steering, body, brakes and transmission cooler fan drive circuits.

The main hydraulic pump is an axial piston, variable displacement type, with load sense and pressure regulator.

Valves 14, 15, 19, 20, 23, 24, 25 and 27

These valves for part of the steering and emergency steering circuit and are an integral part of the main hydraulic valve assembly, mounted on the left hand side of the tractor frame. Refer to Section 215-0050, Main Hydraulic Valve Assembly.

Diagnostic Test Point

Steering and load sense pressures can be checked at the diagnostic check points located inside the battery box. Refer to Figure 2.

The steering system pressure is set at 240 bar (3500 lbf/in^2)

Load Sense (LS) pressure is set 25 bar (360 lbf/in^2) below steering system pressure, therefore at maximum setting, LS pressure will be 215 bar (3120 lbf/in^2).

OPERATION

PRIORITY FUNCTION

Numbers in parentheses refer to Figure 1

The priority function automatically ensures that the steering and brake charging circuits are given preference over the transmission cooler fan and tipping functions.

When the main pump (4) is not running, the priority valve (15) is closed. As the main pump (4) starts rotating it builds up residual pressure entering the main hydraulic valve assembly at port P1. The pressure opens priority valve (15), feeding the main pump pressure through to the transmission cooler fan drive the lift valve.

During the tipping operations and while the transmission cooler fan is running, if the demand pressure at the brake charging or the steering circuit is less than these functions, the priority valve (15) remains open, but the oil takes the path of the least resistance and the requirements of the brake charging or steering circuits are met.

If the demand pressure for brake charging or steering circuit is higher than that demanded by the transmission cooler fan drive or tipping function, this higher pressure will be fed to the main pump load sense line via the shuttle valves (21 and 25) and therefore enables the main pump (4) to meet the brake charging or steering circuit pressure requirements. At the same time the higher load sense pressure assists the spring in the priority valve (15). The priority valve (15) will then close to reduce the flow to the transmission cooler fan or tipping circuit and therefore making sure the brake charging and steering circuit always has priority over the other vehicle functions.

PRIORITY FLOW CONTROL TO STEERING

This function ensures that the flow from the steering valve (1) is maintained at all times regardless of the other pressure demand within the system.

To achieve this function the pressure at the steering valve (1) has to be at a level equal to that demanded by the steering plus the differential control pressure set by the steering valve.

The pressure demanded by the steering is fed back to the main pump (4) and the priority valve (15) via the

shuttle valve (21). The priority valve (15) will close and the main pump will increase its displacement to make sure there is enough flow and pressure available to meet that demanded by the steering.

The steering load sense orifice (20) feeds oil from the main pump supply, to boost the load sense pressure back to the main pump during the steering operation. This is to make sure an adequate flow is always available from the main pump (4) to meet that demanded by the steering. This is commonly known as a dynamic load sense system.

Note: The maximum steer pressure is set by the pressure cut off (compensator) on the main hydraulic pump (240 bar [3500 lbf/in^2]). Refer to Section 230-0050 Main Hydraulic Pump.

EMERGENCY STEERING

The emergency steering ground driven pump (3) provides flow to the steering circuit in the event that the main pump (4) can no longer function effectively.

Engine failure, transmission failure or internal failure of the main pump (4) could cause ineffective performance.

The emergency steering pump (3) will also assist with flow from the main pump to articulate the vehicle if the main pump cannot deliver the flow required by the steering circuit. This can happen at low engine speed when the vehicle is moving and the operator attempts to articulate the vehicle rapidly.

To protect the ground driven emergency steering pump (3) the maximum pressure at the pump is set by the relief valve (27) to 179 bar (2600 lbf/in^2).

The emergency steering valve (19) is sensing the main pump (4) pressure and the load sense pressure at the spring end of the valve (19). During normal operation the differential pressure between the main pump (4) outlet and the load sense line will be approximately 25 bar (360 lbf/in^2) and the emergency steering valve (19) will stroke against its spring dumping the emergency steer pump (3) flow to tank.

In the event of the main pump (4) not been able to supply sufficient flow for the steering, the differential pressure between the main pump (4) outlet and the load sense line will be reduced. As soon as the differential pressure drops below 8.5 bar (125 lbf/in^2) the emergency steering valve (19) will close and the ground driven pump (3) flow will be diverted across check valve (23) and supply the steering system.

The check valve (24) prevents the emergency steer flow going towards the main pump (4), which may already have failed.

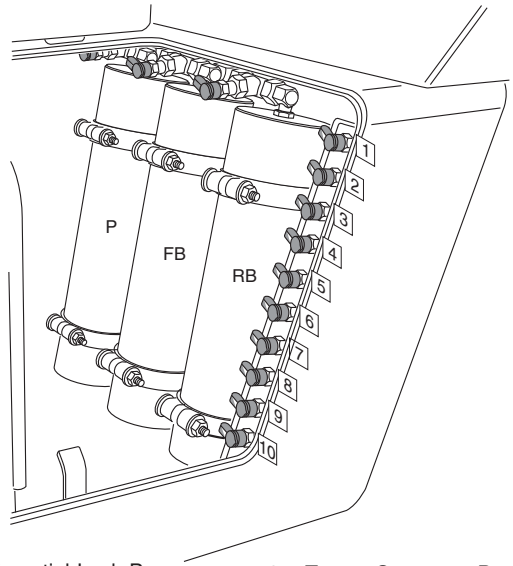
STEERING PRESSURE SETTING

⚠ WARNING
The machine has to fully articulate to set the steering pressure, therefore the steering lock bar cannot be 'Locked'. To prevent personal injury and property damage, exercise extreme caution while working around articulation and oscillation pivot area.

The maximum steer pressure is set by the pressure cut off (compensator) on the main pump (240 bar [3500 lbf/in^2]). Refer to Section 230-0050, Main Hydraulic Pump.

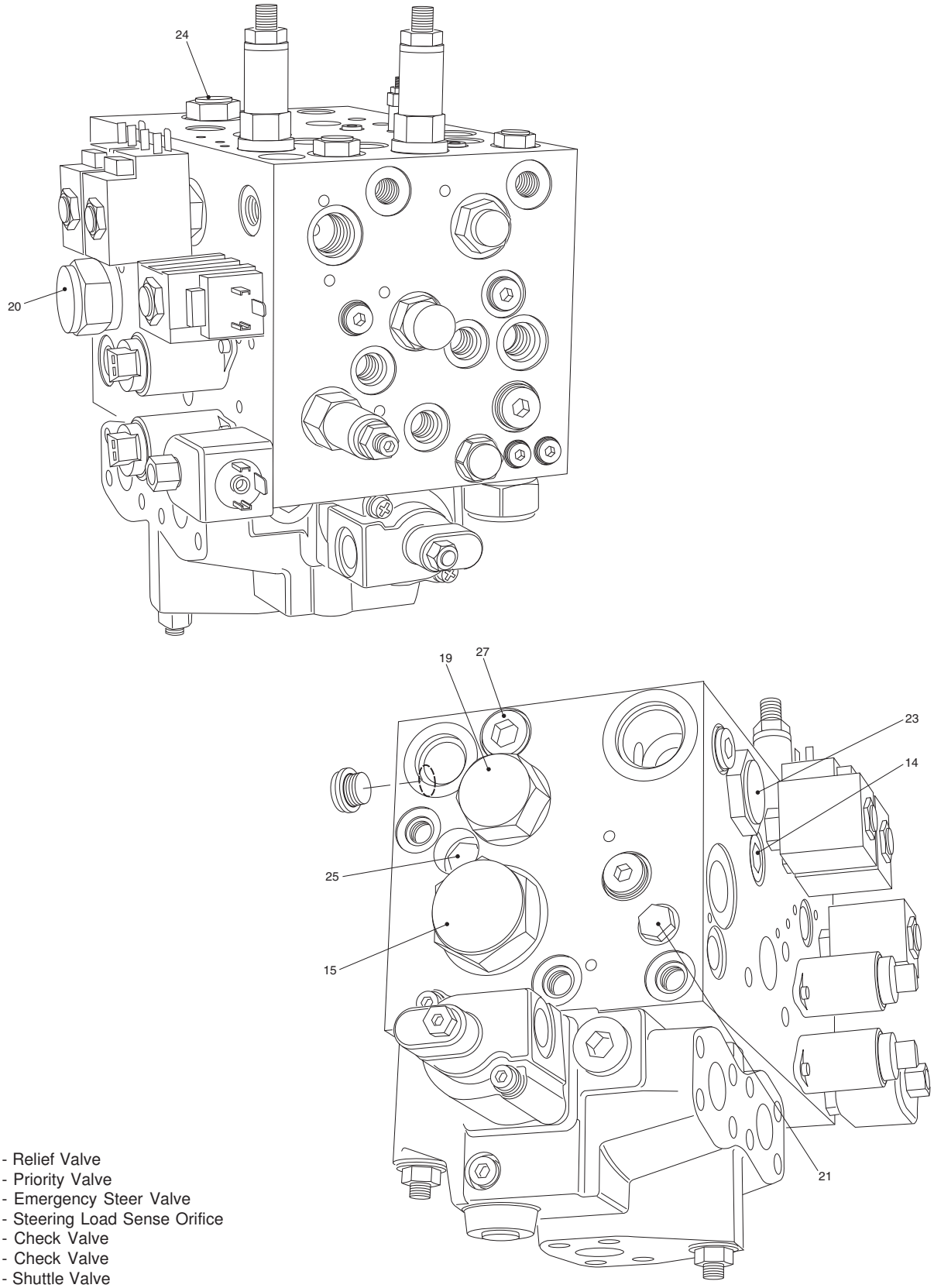
Steering pressure can be checked at the diagnostic check point located inside the battery box (refer to Figure 2). Install pressure gauge capable of reading at least 240 bar (3500 lbf/in^2) to the correct diagnostic check point.

Steer the truck over the relief (against the steering stops) to observe the maximum cut-off pressure of 240 bar (3500 lbf/in^2). Adjust pressure cut-off screw on main pump (4) if necessary. Refer to Section 230-0050, Main Hydraulic Pump.



1 - Differential Lock Pressure
2 - Pump LS Pressure
3 - Front Brake Pressure
4 - Rear Brake Pressure
5 - Park Brake Pressure
6 - Steering Pressure
7 - Trans. Retarder Press.
8 - Trans. Converter Press.
9 - Body System Press.
10 - Trans. System Pressure
P - Primary Accumulator
FB - Front Brake Accumulator
RB - Rear Brake Accumulator

Fig. 2 - Diagnostic Pressure Check Points (Battery Box)



14 - Relief Valve
15 - Priority Valve
19 - Emergency Steer Valve
20 - Steering Load Sense Orifice
23 - Check Valve
24 - Check Valve
25 - Shuttle Valve
27 - Emergency Steering Relief Valve

Fig. 3 - Steering System Valves Integral to Main Hydraulic Valve Assembly

O-RING FACE SEALS (ORFS)

Where hydraulic lines are fitted with ORFS connections, the following procedure should be carried out during 'Installation'. Refer to Figure 4.

a. Ensure that the O-ring/seal is in place and that the joining surfaces are clean. If necessary, retain the O-ring/seal in place with a light coating of grease or vaseline.

b. Initially, the nuts should be tightened by hand.

c. Where a hose is fitted, ensure that it is not twisted or kinked when the nuts are tightened so that it is allowed to adopt a natural position.

d. Where a tube is fitted, ensure that the connection is aligned correctly.

e. Tighten the nut a further 1/4 to 1/2 a turn using the correct size spanner (wrench).

f. Check that a satisfactory hose or tube routing has been achieved.

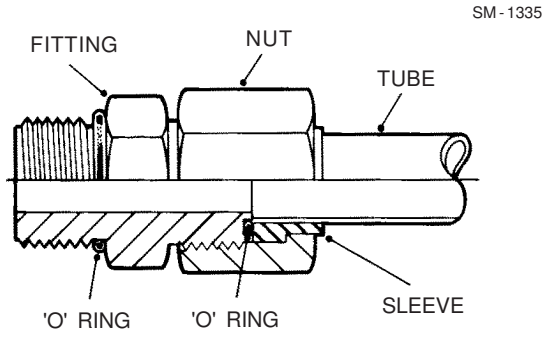


Fig. 4 - Assembly of Typical ORFS Connector

FILLING AND BLEEDING THE STEERING SYSTEM

1. Fill hydraulic tank to maximum level. Be ready to add oil when the engine is started. Do not let oil drop below the pump suction line to prevent air entering the system.

2. Start engine and let it idle. Immediately add oil to the tank as required. When no more oil can be added and oil is clear, proceed as follows:

a. Turn the steering wheel from lock to lock to bleed the air in the steering cylinders and lines.

Note: Immediately upon valve spool actuation oil must be added to the hydraulic tank to replenish the oil moving into the circuit.

⚠ WARNING
Do not operate the machine until all air is bled from the oil.

b. When the oil in the tank is clear (not cloudy or creamy), the system is free of air.

Note: Slight creep or drift of the steering wheel is normal.

c. Fill the hydraulic tank to the recommended level and install the filler cap.

Hydraulic Oil

The steering system should be kept filled with hydraulic oil as listed in Section 300-0020, Lubrication System.

MAINTENANCE

Maintenance instructions, intervals and warnings, in the individual steering and body hydraulic component Sections of this manual, should be adhered to at all times.

SERVICE TOOLS

It is recommended that the following service tools are used when carrying out pressure and temperature checks during maintenance procedures. These tools, along with other general service tools, are available from your dealer. Refer to Section 300-0070, Service Tools, for part numbers of these tools.

Multi-Gauge

The multi-gauge, 15269784, is basically four pressure gauges in one. Continuous system pressure readings are indicated on one of three simultaneously reading gauges through a pressure range of 30 in of vacuum to 5 000 lbf/in².

The following items should be added to the multi-gauge to enable the gauge to be used on the diagnostic pressure check points;

15018226	Diagnostic Coupling
00118748	Connector (2 off)
15004085	Hose Assembly (-04 HP, 2130 mm long)

Non-contact Infrared Thermometer

The infrared thermometer, 15269785, 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.

O-ring Face Seals (ORFS) - Seal Kit

The steering system utilizes 'O' Ring Face Seal (ORFS) connectors. An ORFS kit, 15271082, is available. This kit contains a minimum stock requirement of all sizes of ORFS type seal.

Steering System Trouble Shooting

Symptom	Possible Cause	Remedy
System does not reach the maximum operating pressure	Fault with main pump or pressure cut-off incorrectly set	Refer to Section 230-0050, Main Hydraulic Pump
	Faulty relief valve (14)	Replace valve (14)
	Priority valve (15) sticking open or wrong spring setting	Replace valve (15)
	Fault in LS orifice (20)	Replace/clean orifice (20)
Heavy steering due to not enough flow being available at the steering valve but differential pressure between the main pump outlet and the load sense port is between 15 - 22 bar (218 - 319 lbf/in^2)	Fault with main pump or standby pressure incorrectly set	Refer to Section 230-0050, Main Hydraulic Pump
	Faulty steer valve	Refer to Section 220-0090, Steering Valve
	Priority valve (15) - sticking open or wrong spring setting	Replace valve (15)
	Fault in LS orifice (20)	Replace/clean (20)
	Leaking shuttle valve (21)	Replace valve (21)
No steering flow available whilst the vehicle is still travelling and engine is switched off	Ground driven pump faulty	Replace ground driven pump at transmission.
	Emergency steer valve (19) sticking open	Replace valve (19)
	Emergency steer relief valve (27) pressure setting too low.	Replace valve (27)
With no functions operated pressure at ground driven pump too high.	Emergency steer valve (19) spool sticking closed.	Replace valve (19)

* * * *

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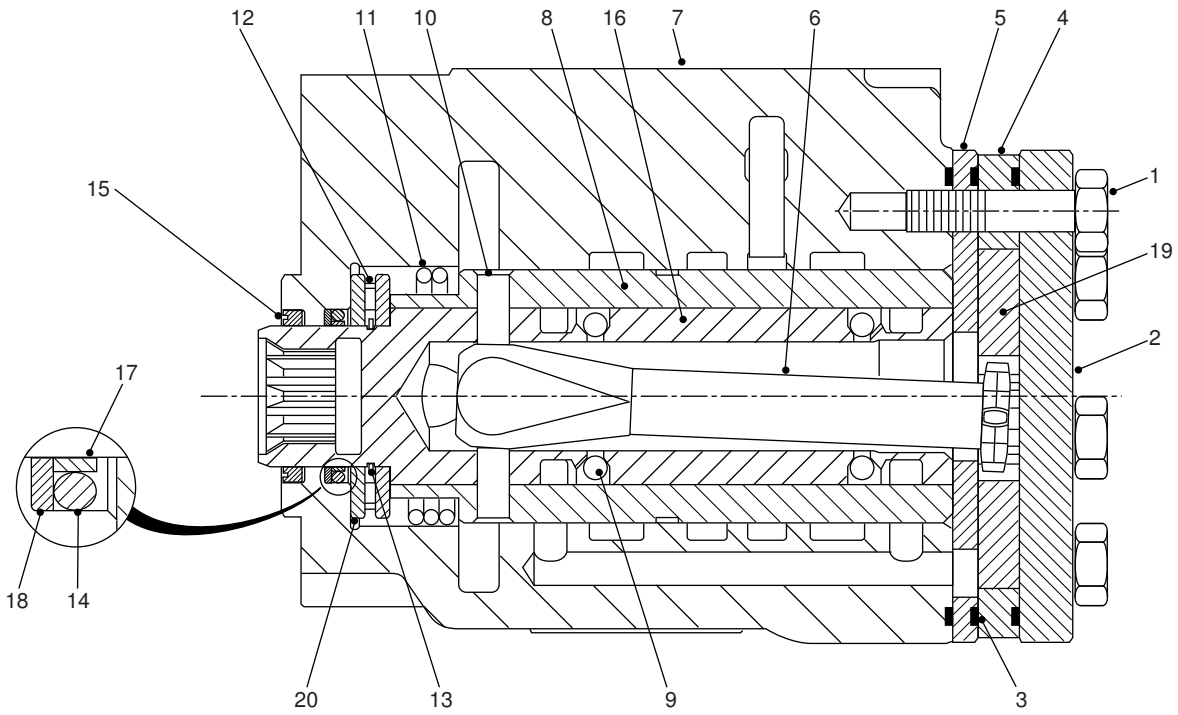


1 - Capscrew
2 - End Cap
3 - 'O' Ring
4 - Gerotor Housing
5 - Spacer Plate
6 - Driveshaft
7 - Valve Housing
8 - Sleeve
9 - Ball - Check
10 - Pin
11 - Centring Springs
12 - Needle Bearing
13 - Bearing Race
14 - 'O' Ring
15 - Dust Seal
16 - Spool
17 - Seal
18 - Backup Ring
19 - Gerotor Gear
20 - Retainer
21 - 'O' Ring
22 - 'O' Ring
23 - Roll Pin
24 - Ball valve

Fig. 1 - Sectional View of Steering Valve

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The steering valve can be identified as item 1 in Section 220-0000, STEERING SYSTEM SCHEMATIC.

The steering valve, mounted off the underside of the cab floor and connected to the steering column, controls hydraulic flow in the steering system. The steering valve is of a closed centre design, which means that the valve does not have any flow through it when it is in the neutral or no steering position. The steering valve has integral cylinder relief valves which relieve shock loads on the steering cylinders by transferring excessive pressure applied to the oil by the road shock, to the opposite end of the cylinders. This shock, if left unchecked, might damage steering linkage components.

The main components of the steering valve are valve housing (7), gerotor housing (4), gerotor gear (19), driveshaft (6), sleeve (8) and spool (16).

There are five ports on valve housing (7) as follows:

Port 'P' - Supply from main hydraulic valve
Port 'T' - Return to tank
Port 'R' - Cylinder supply for right hand turn
Port 'L' - Cylinder supply for left hand turn
Port 'LS' - Load Sensing to main hydraulic valve

Turning action of the steering wheel is transmitted through the steering column to sleeve (8) and driveshaft (6), which is fastened to the sleeve with centring pin (10). Rotation of driveshaft (6) causes gerotor gear (19) to rotate in gerotor housing (4). When gerotor gear (19) rotates, oil in gerotor housing (4) pockets (see Fig. 2) is forced out and flows through spool (16) and sleeve (8) to the steering cylinder port.

Spool (16) contains porting matched to sleeve (8) and rotates within sleeve (8) to provide directional control of the oil. See Fig. 3.

OPERATION

Numbers in parentheses refer to Fig. 1.

When the operator turns the steering wheel a certain number of degrees for either a left or right hand turn, the movement is transmitted through the steering column to spool (16). After a minimum rotation of 2.5 degrees, the ports in spool (16) start to align with ports in sleeve (8). When the steering wheel is rotated to a maximum of 10 degrees the ports are fully aligned allowing full oil flow. After 10 degrees of travel in either direction the spool and sleeve rotate as an assembly through centring pin (10).

Oil from the priority valve flows into valve housing (7) at port 'P' and is channelled through sleeve (8) and spool (16) to gerotor housing (4). Porting in gerotor housing (4) permits oil to flow into pockets formed by gerotor housing (4) and gerotor gear (19). As spool (16) rotates, driveshaft (6) also rotates which, in turn, rotates gerotor gear (19) to which it is splined. When gerotor gear (19) rotates it progressively forces oil out of the pockets (see Fig. 2) of gerotor housing (4). The oil is channelled through sleeve (8) and spool (16) and exits valve housing (7) through port 'R' for a right hand turn, or port 'L' for a left hand turn. Oil then travels through steering lines to the steering cylinders.

As the steering cylinder pistons move, oil forced out of the steering cylinders returns to valve housing (7). The return oil passes through valve sleeve (8) and spool (16) and exits through port 'T' to tank.

When the steering effort is released, centring spring (11) which was put under tension by the rotation of spool (16), forces sleeve (8) to rotate back to its original position. This puts the ports out of alignment and stops pump oil flow to the steering cylinders. The vehicle stops turning further but will hold the present turning radius until spool (16) is rotated past the 2.5 degree minimum.

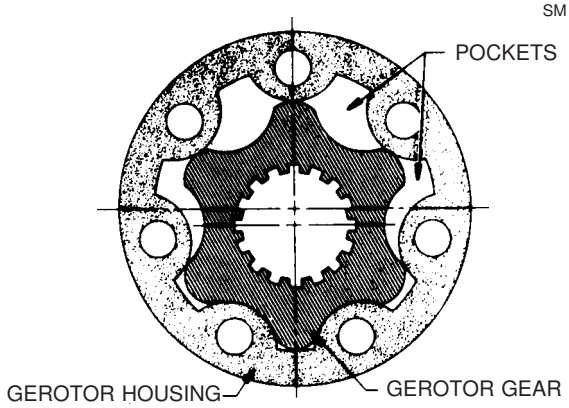


Fig. 2 - Gerotor Gear Set

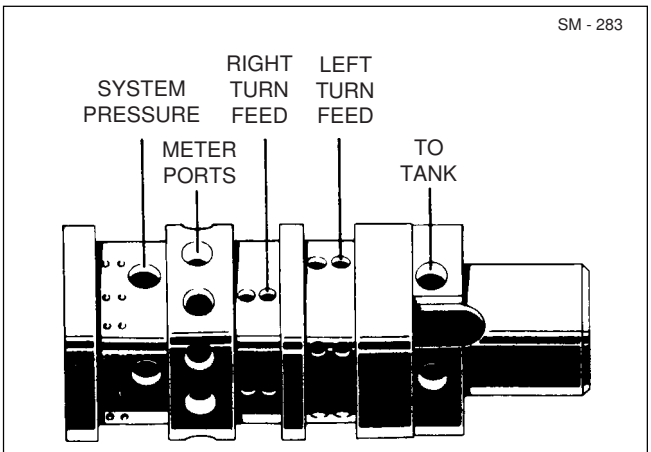


Fig. 3 - Porting of Spool and Sleeve

REMOVAL

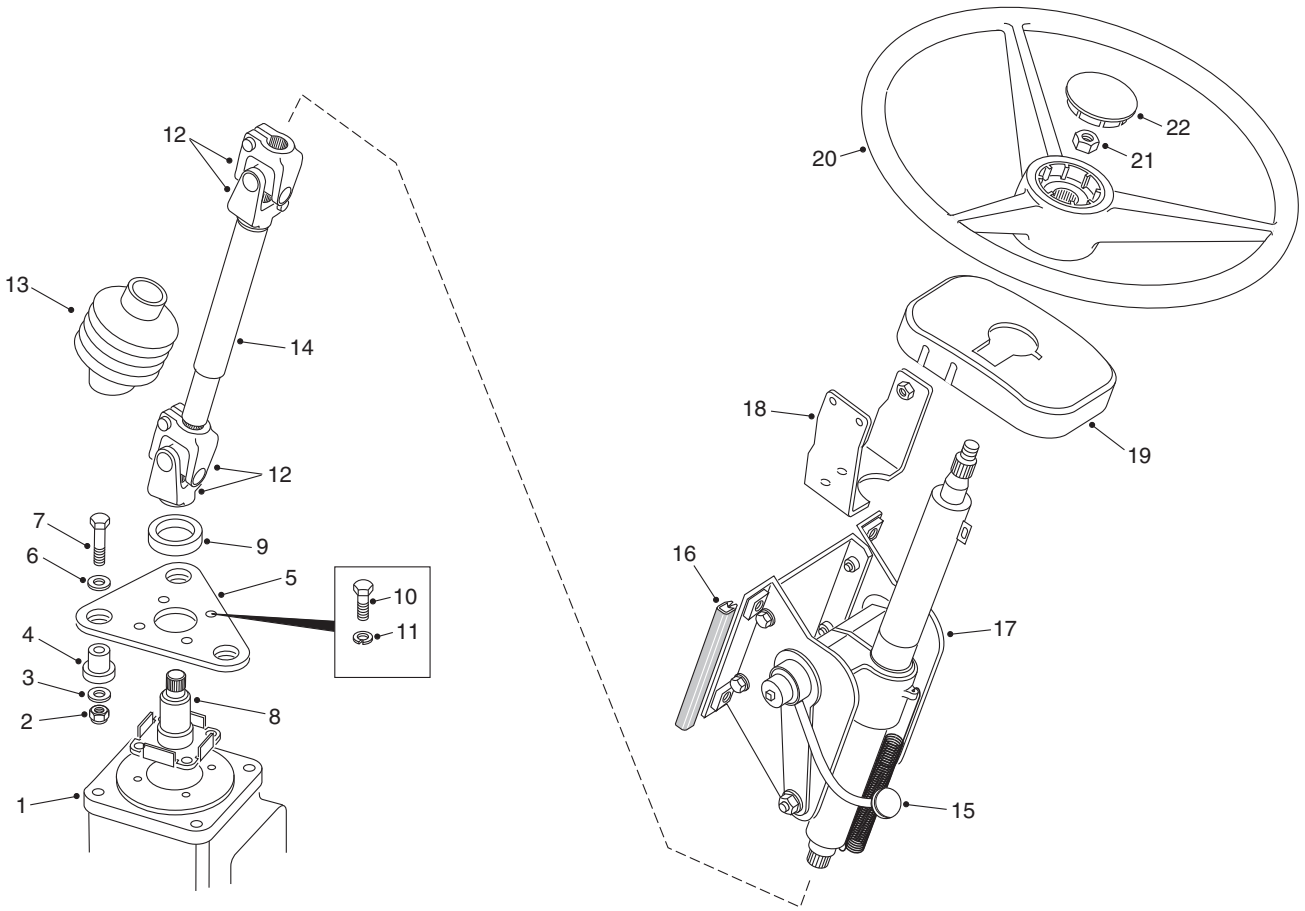
Numbers in parentheses refer to Fig. 4.

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

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Turn steering wheel several times to relieve any pressure in the steering circuit. Operate brake pedal 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 hydraulic tank remote drain plug and drain



1 - Steering Valve
2 - Locknut
3 - Washer
4 - Rubber Mount
5 - Mounting Plate
6 - Washer
7 - Bolt
8 - Stub Shaft
9 - Nitrile Seal
10 - Bolt
11 - Lockwasher
12 - Joint
13 - Bellows
14 - Steering Shaft
15 - Lever
16 - Beading
17 - Steering Column Assy
18 - Bracket
19 - Column Cover
20 - Steering Wheel
21 - Nut
22 - Cap

Fig. 4 - Exploded View of Steering Valve Installation

hydraulic oil into a suitable container. Reinstall drain plug in hydraulic tank remote drain fitting.

4. Pull floor mat back to allow access to bolts (7). Raise cab and secure with prop. Refer to Section 260-0010, CAB AND MOUNTING.

5. Clean outer area of steering valve (1) with a suitable solvent. Ensure all hydraulic lines connected to steering valve (1) are identified for ease of installation and with suitable containers available to catch leakage, disconnect hydraulic lines. Cap all lines and plug all ports to prevent entry of dirt.

6. Slide bellows (13) over steering shaft (14) to gain access to bottom joint (12) and loosen bolt which tightens joint (12) onto stub shaft (8).

7. Support steering valve (1) and remove bolts (7), locknuts (2) and washers (3 & 6) securing mounting plate (5) to cab floor. Remove steering valve (1) and mounting plate (5) to a clean area for disassembly. Remove nitrile seal (9) and discard rubber mounts (4), if damaged.

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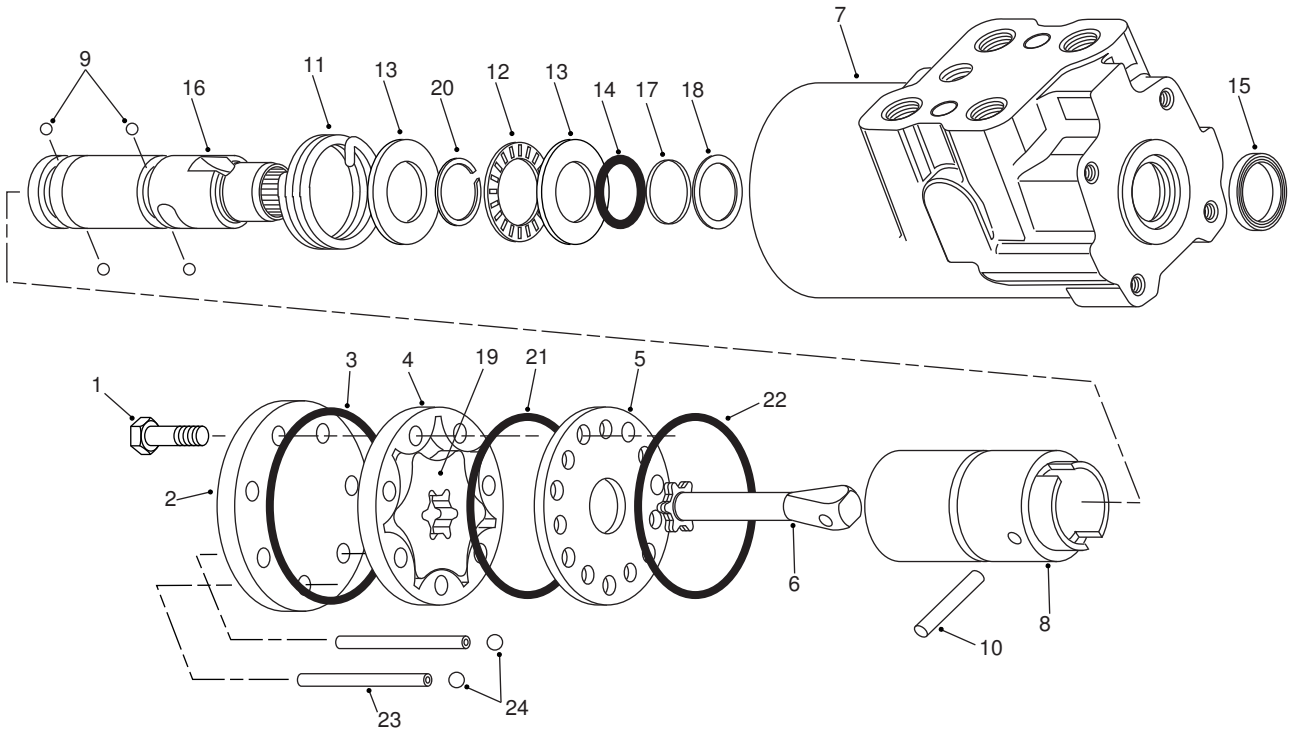

1 - Capscrew
2 - End Cap
3 - 'O' Ring
4 - Gerotor Housing
5 - Spacer Plate
6 - Driveshaft
7 - Valve Housing
8 - Sleeve
9 - Ball - Check
10 - Pin
11 - Centring Springs
12 - Needle Bearing
13 - Bearing Race
14 - 'O' Ring
15 - Dust Seal
16 - Spool
17 - Seal
18 - Backup Ring
19 - Gerotor Gear
20 - Retainer
21 - 'O' Ring
22 - 'O' Ring
23 - Roll Pin
24 - Ball valve

Fig. 5 - Exploded View of Steering Valve

DISASSEMBLY

Numbers in parentheses refer to Fig. 5, unless otherwise specified.

Note: Steering valves fitted with anti-cavitation valves must be disassembled and assembled in the vertical postion to prevent ball valves (24) becoming trapped in the wrong cavities within the valve housing (7).

1. Remove bolts (10, Fig. 4) and washers (11, Fig. 4) securing mounting plate (5, Fig. 4) to steering valve (1, Fig. 4).

2. Clamp steering valve assembly horizontally in a soft jawed vice and break loose the seven capscrews (1). With capscrews (1) loosened, place steering valve

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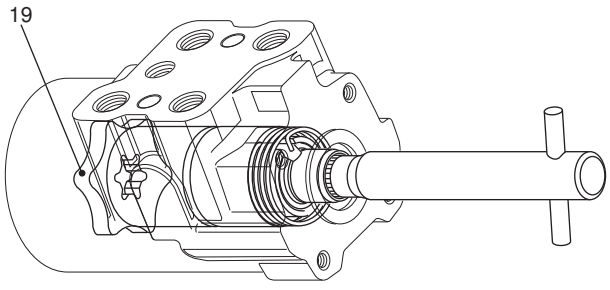
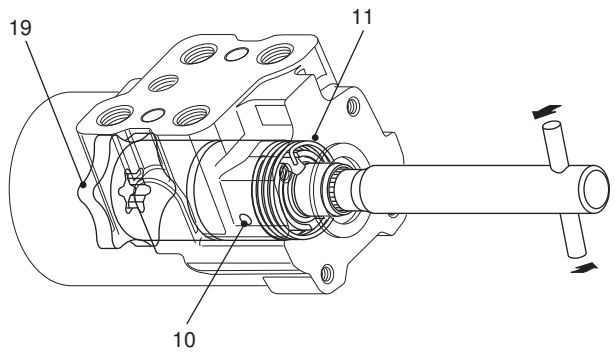


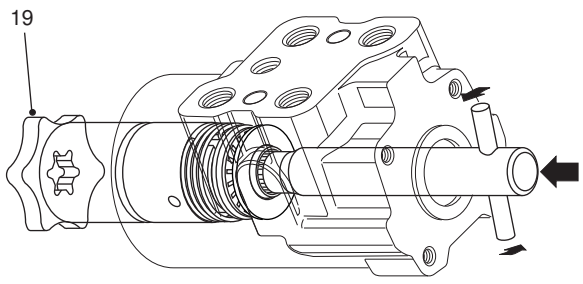
19 - Gerotor Gear

Fig. 6 - Gerotor Gear and Splined Drive Engaged



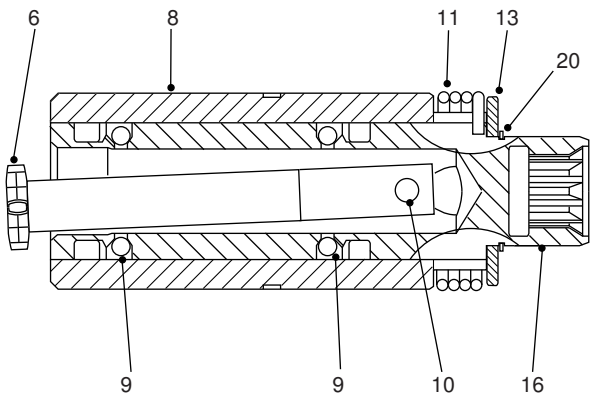
10 - Pin
11 - Centring Springs
19 - Gerotor Gear

Fig. 7 - Compressing Centering Spring



19 - Gerotor Gear

Fig. 8 - Removing Spool and Sleeve Assembly



6 - Driveshaft
8 - Sleeve
9 - Ball - Check
10 - Pin
11 - Centring Springs
13 - Bearing Race
16 - Spool
20 - Retainer

Fig. 9 - Sectional View of Spool and Sleeve Assembly

vertically in vice, end cap (2), up.

Note: Hidden pin. If tension on this pin is released before these parts are fully disengaged and the pin is not horizontal, the pin can drop and lockup can occur.

3. Remove cap screws (1) securing end cap (2), gerotor housing (4) and spacer plate (5) to valve housing (7). Remove end cap (2) from valve housing (7) and discard 'O' ring (3).

4. Remove gerotor housing (4) and gerotor gear (19) from valve housing (7). Remove and discard 'O' ring (21) from gerotor housing (4).

5. Remove spacer plate (5) from valve housing (7).

6. Remove and discard 'O' ring (22) from valve housing (7).

7.Using a cloth to protect the hand, place gerotor gear (19) over end of drive shaft (6) and engage special tool with splined end of spool (16). Refer to Fig. 6.

8. Hold gerotor gear (19) and prevent drive shaft (6) from turning. Twist special tool to compress centering spring (11) radially CW or CCW, decreasing the coil diameter of the centering spring (11) allowing spool and sleeve assembly to be removed. Refer to Fig. 7.

9. With drive held stationary and centering spring (11) compressed, carefully push spool (16), sleeve (8), ball checks (9), drive shaft (6), pin (10), bearing races (13), retainer (20) and needle thrust bearing (12), as a complete assembly, from valve housing (7). Refer to Fig. 8.

10. Remove bearing race (13) and needle thrust bearing (12) from spool and sleeve assembly.

11. Using suitable pliers, remove retainer (20) and bearing race (13) from spool (16) and sleeve (8) assembly. Refer to Fig. 9.

12. Remove centering spring (11) from spool (16) and sleeve (8) assembly. Refer to Fig. 9.

13. Remove pin (10) and slide drive shaft (6) from spool (16) and sleeve (8) assembly. Refer to Fig. 9.

14. Carefully remove spool (16) and ball checks (9) from sleeve (8). Refer to Fig. 9.

15. Use a soda straw as a guide tool to remove the roll pin (23) and ball valve (24) from the anti-cavitation valve ports. Insert two soda straws, one in each anti-cavitation valve bore. Remove valve housing (7) from

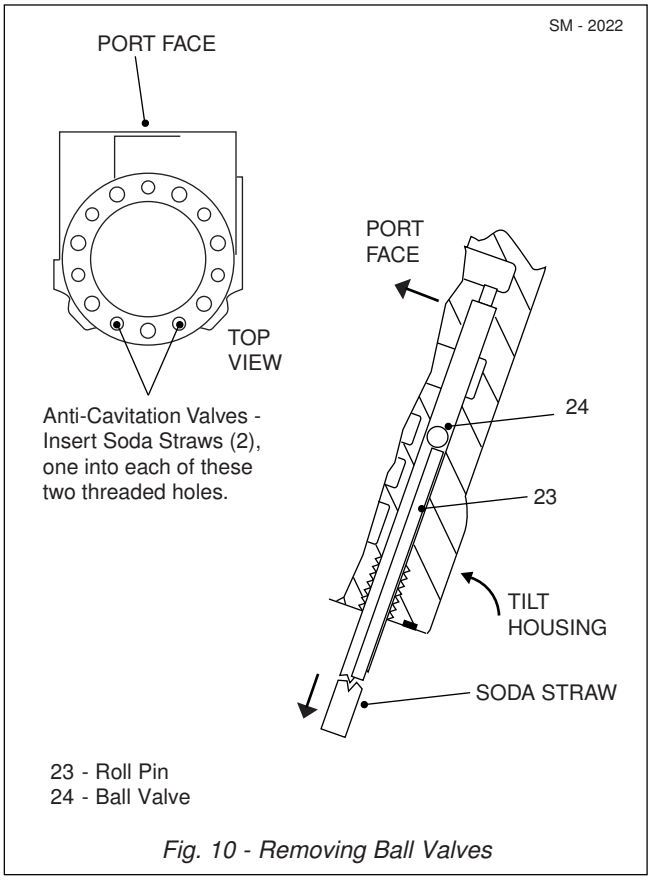


Fig. 10 - Removing Ball Valves

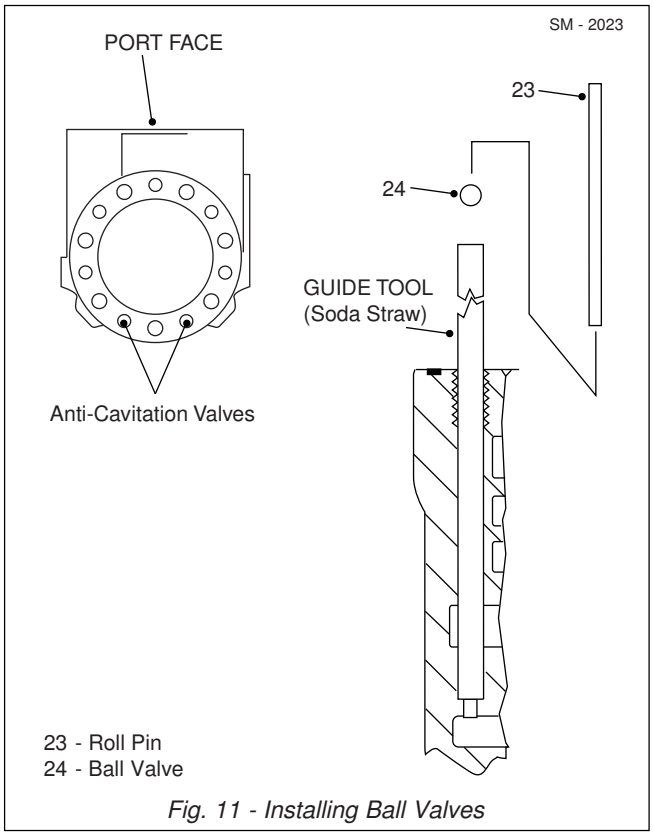


Fig. 11 - Installing Ball Valves

vice and tilt until roll pins (23) and ball valves (24) slide through the straws and out of the valve housing (7). Refer to Fig. 10.

16. Remove and discard 'O' ring (14), seal (17) and backup ring (18) from valve housing (7).

17. Using a thin blade screwdriver, pry dust seal (15) from valve housing (7). Take care not to damage dust seal seat.

INSPECTION

1. Clean all metal parts in a suitable solvent and blow dry with compressed air. Do not wipe dry with cloth or paper towel as lint or other matter may get into the hydraulic system and cause damage.

2. Check all mating surfaces and replace any parts that have scratches or burrs that could cause leakage.

3. Do not use course grit or try to file any metal parts.

Note: Replace all 'O' rings and seals with new 'O' rings and seals at 'Assembly'. Lubricate all 'O' rings and seals with a petroleum jelly.

ASSEMBLY

Numbers in parentheses refer to Fig. 5, unless otherwise specified.

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

Note: Steering valves fitted with anti-cavitation valves must be disassembled and assembled in the vertical postion to prevent ball valves (24) becoming trapped in the wrong cavities within the valve housing (7).

1. Use a soda straw as a guide tool to insert the roll pin (23) and ball valve (24) into the anti-cavitation valve ports. Insert soda straw into anti-cavitation valve bore. Drop ball valve (24) through straw into bore. Remove straw and drop roll pin (23) into bore. Repeat for second anti-cavitation valve bore. Refer to Fig. 11.

2. Apply a light coating of clean hydraulic fluid to spool (16). Slide spool (16) and ball checks (9) into sleeve (8). Refer to Fig. 12.

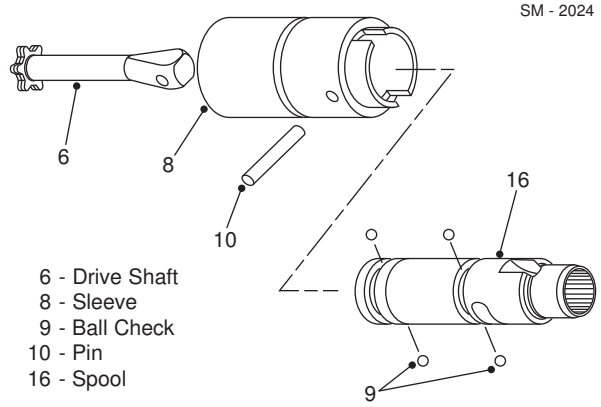


Fig. 12 - Installing Spool and Ball Checks

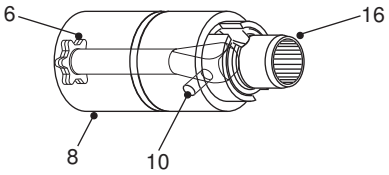


Fig. 13 - Installing Centring Pin and Drive Shaft

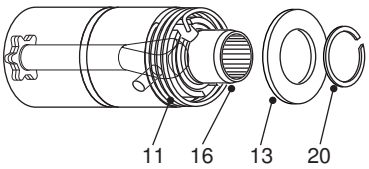


Fig. 14 - Installing Bearing Race and Retainer

3. Insert drive shaft (6) into spool (16) in sleeve (8) carefully so that holes line up. Install pin (10) through sleeve (8), spool (16) and drive shaft (6) assembly until pin (10) becomes flush at both sides of sleeve (8). See Figs. 12 & 13.

4. Position one end of centring spring (11) into slotted end of spool (16). Compress centring spring (11) radially (CCW) and engage free end of spring into slot in spool (16). See Fig. 14.

5. Install bearing race (13) onto spool (16). Using suitable pliers install retainer (20) onto spool (16). See Fig. 14.

6. Apply a light coating of petroleum jelly to the inside diameter of dust seal (15) and install in valve housing (7).

7. Apply a light coating of petroleum jelly to needle thrust bearing (12), bearing race (13), 'O' ring (14), seal ring (17) and backup ring (18). Install each item onto spool (16), as shown in Fig. 15.

Note: Needle thrust bearing is positioned between the two bearing races (13) and must be centered around retainer (20).

Note: Clamp steering valve housing (7) vertically in a soft jawed vice.

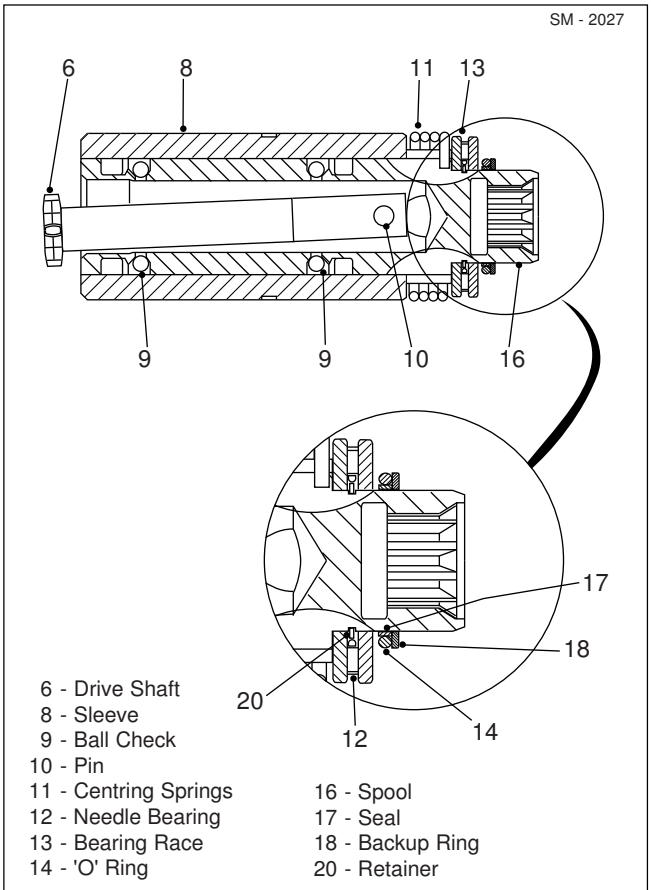


Fig. 15 - Sectional View of Seals and Bearings

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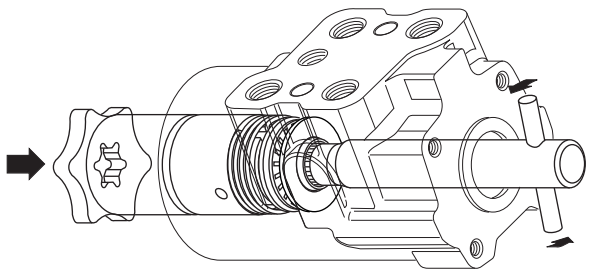

Fig. 16 - Compressing Centering Spring

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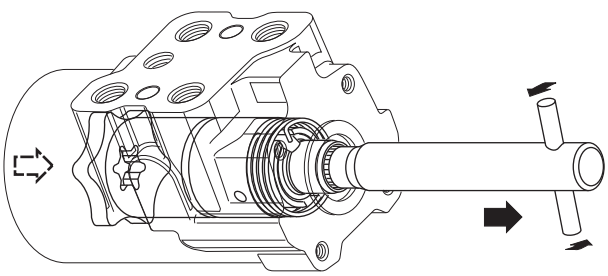

Fig. 17 - Installing Spool and Sleeve Assembly

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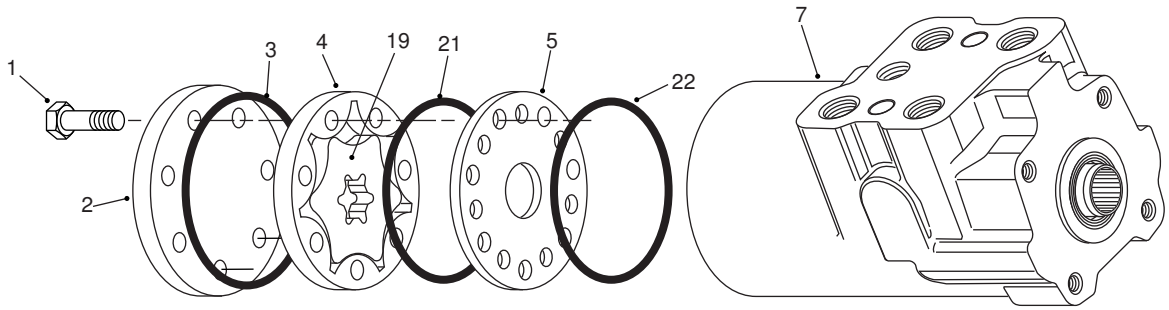


1 - Capscrew
2 - End Cap
3 - 'O' Ring
4 - Gerotor Housing
5 - Spacer Plate
7 - Valve Housing
19 - Gerotor Gear
21 - 'O' Ring
22 - 'O' Ring

Fig. 18 - Installing Seals and Gerotor Assembly

8. Using a cloth to protect the hand, place gerotor gear (19) over end of drive shaft (6). Insert special tool through valve housing (7) and engage with splined end of spool (16) and sleeve (8) assembly. Twist tool to compress centering spring (11) radially CW or CCW. Refer to Fig. 16.

9. Keep centering spring (11) compressed and carefully insert assembled parts into valve housing (7), as shown in Fig. 17.

10. Release tension on centering spring (11) and remove special tool and gerotor gear (19).

11. Lubricate and install new 'O' ring (22) in groove in valve housing (7). Refer to Fig. 18.

12. Install spacer plate (5) with the 'O' ring groove up, on valve housing (7). Align bolt holes in spacer plate (5) with tapped holes in valve housing (7). Refer to Fig. 18.

13. Lubricate and install new 'O' ring (21) in groove in spacer plate (5). Refer to Fig. 18.

14. Install gerotor housing (4) on valve housing (7). Align bolt holes in gerotor housing (4) with tapped holes in valve housing (7). Refer to Fig. 18.

15. Align gerotor gear (19) on driveshaft (6) and gerotor housing (4), as shown in Fig. 18.

16. Lubricate and install new 'O' ring (3) in groove in gerotor housing (4).

17. Install end cap (2) on gerotor housing (4), as shown in Fig. 18.

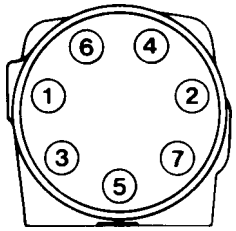


Fig. 19 - Cap Screw Tightening Sequence

18. Align cap screw (1) holes and install seven dry cap screws (1) in end cap (2). Pre-tighten cap screws (1) to 17 Nm (12.5 lbf ft) then tighten to a torque of 34 Nm (25 lbf ft), in the sequence shown in Fig. 19.

19. Using bolts (10, Fig. 4) and washers (11, Fig. 4) secure mounting plate (5, Fig. 4) to steering valve (1, Fig. 4).

INSTALLATION

Numbers in parentheses refer to Fig. 4.

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

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 220-0000, STEERING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

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

1. Make certain area of installation is clean.

2. Install rubber mounts (4) if removed, and secure steering valve (1) and mounting plate (5) to cab floor with bolts (7), washers (3 & 6) and locknuts (2).

3. Install nitrile seal (9) to steering shaft (14).

4. Slide bottom joint (12) of steering shaft (14) over stub shaft (8) and secure by tightening bolt. Slide bellows (13) down over bottom joint (12) and stub shaft (8).

5. Remove plugs from steering valve ports and caps from steering lines and install steering lines to steering valve (1), as identified at removal.

6. Lower cab and secure with pins. Refer to Section 260-0010, CAB AND MOUNTING.

7. Fill hydraulic tank with hydraulic oil, as specified in Section 300-0020, LUBRICATION SYSTEM. Refer to 'Filling and Bleeding The Steering System'.

8. Remove wheel blocks from all road wheels, place the battery master switch in the 'On' position and start the engine. Operate the steering and check hydraulic lines for leaks. Tighten lines and fittings as required.

FILLING AND BLEEDING THE STEERING SYSTEM

1. Fill hydraulic tank to Maximum level. Be ready to add oil when the engine is started. Do not let oil drop below the pump suction line to prevent air entering the system.

2. Start engine and let it idle. Immediately add oil to the hydraulic tank as required. When no more oil can be added and oil is clear, proceed as follows:

a. Turn the steering wheel from lock to lock to bleed the air in the steering cylinders and lines.

Note: Immediately upon valve spool actuation oil must be added to the hydraulic tank to replenish the oil moving into the circuit.

⚠ WARNING
Do not operate the vehicle until all air is bled from the oil.

b. When the oil in the tank is clear (not cloudy or creamy), the system is free of air.

Note: Slight creep or drift of the steering wheel is normal.

c. Fill hydraulic tank with hydraulic oil specified in Section 300-0020, LUBRICATION SYSTEM. Refer to Section 230-0040, HYDRAULIC TANK, for correct fill level. Install filler cap on tank.

SPECIAL TOOLS

Refer to Section 300-0070, SERVICE TOOLS, for details of the centring spring installation tool referenced in this section. This tool is available from your dealer.

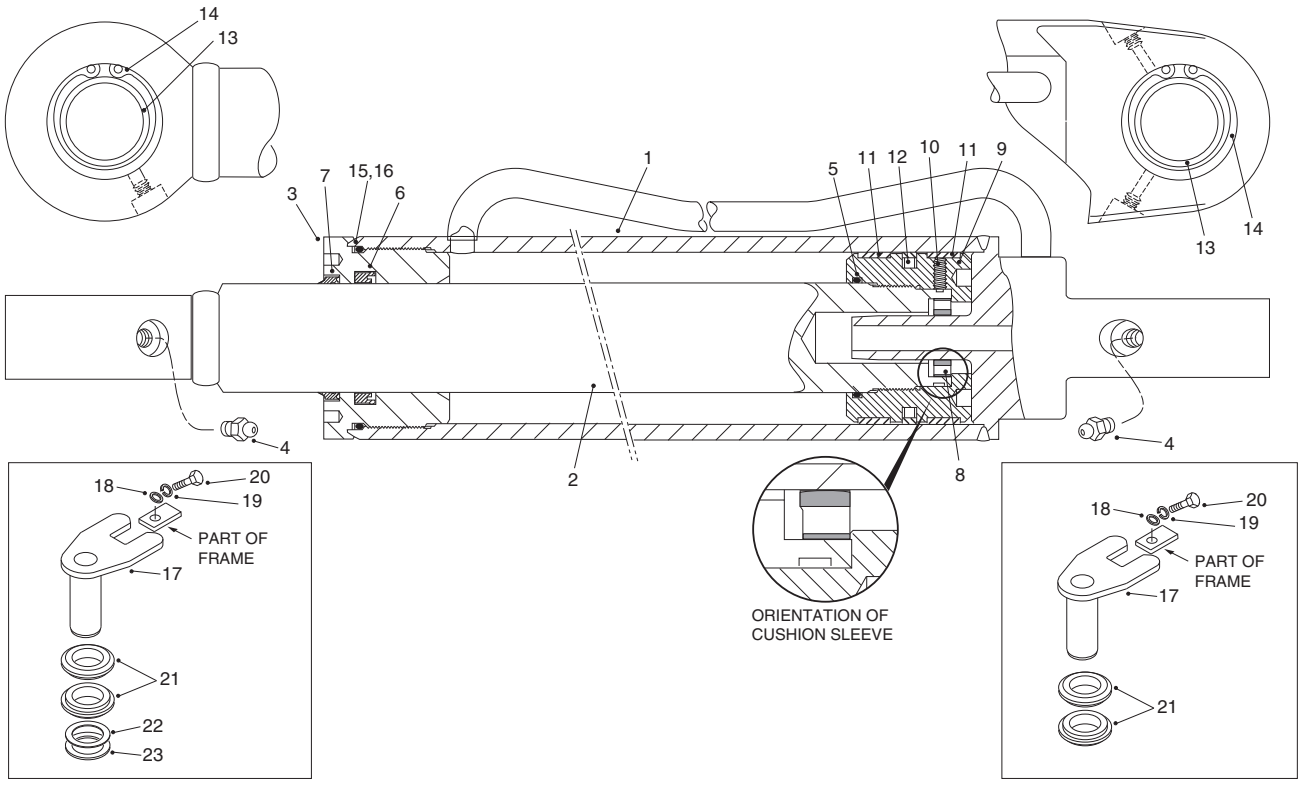
SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
5	1	Capscrew	34	25

STEERING CONTROL DIAGNOSIS

CONDITION	REASON	REMEDY
Steering wheel does not centre	Binding in steering linkage to valve	Align as required
	Worn gerotor	Replace parts
	Broken centring springs	Replace centring springs, drain and flush system
	Burrs on sleeve or spool	Disassemble and repair or replace parts
Apparent inability to steer when wheel is turned slowly	Dirt in system	Drain and flush system. Refill with clean oil
Slow steering	Excessive wear in sleeve and spool	Replace sleeve and spool
	Excessive wear in gerotor	Replace gerotor
Hard steering	See 'Slow Steering'	
Opposite steering	Lines hooked up incorrectly	Reconnect correctly
	Wrong orientation between gerotor and gerotor drive	Realign per instructions
Steering wheel rocking back and forth	See 'Opposite Steering'	
Steering wheel continues to turn	Input linkage binding	Align as required
	Burr on sleeve or spool	Disassemble and repair or replace
	Dirt in system	Drain and flush system. Refill with clean oil
	Broken centring springs	Replace centring springs, drain and flush system
No steering action	Sleeve and spool locked together	Disassemble and repair or replace

* * * *



1 - Cylinder Body
2 - Piston Rod
3 - End Cap
4 - Lube Fitting
5 - 'O' Ring
6 - Rod Seal
7 - Wiper
8 - Cushion Sleeve
9 - Piston
10 - Grub Screw
11 - Wear Ring
12 - Piston Seal
13 - Spherical Bearing
14 - Circlip
15 - Back Up Ring
16 - 'O' Ring
17 - Pin
18 - Hardened Washer
19 - Lockwasher
20 - Bolt
21 - Spacer
22 - Spacer

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 2 in Section 220-0000, STEERING SYSTEM SCHEMATIC.

There are two single stage, double acting cushioned steering cylinders on the machine. The piston rod (2) end is connected to the articulation and oscillation pivot, and, the cylinder base end is connected to the front frame. Single stage double acting means that piston rod (2) can have oil applied to either side, extending or retracting the piston rod.

Rod end cylinder mounting is by pins (17), seals (21), spacers (22) and spherical bearings (13) secured with circlips (14). Base end cylinder mounting is by pins (17), spacerls (21), spacers (22) and spherical bearings (13) secured with circlips (14). Spherical bearings (13) permit a limited amount of cylinder misalignment when travelling over rough terrain.

OPERATION

When the operator turns the steering wheel for a steering operation, movement of the piston rod generates force required to pivot the tractor frame.

In the neutral position, with the steering valve centralized, oil movement between the steering cylinders and the steering valve is stopped. Trapped oil in the system locks both steering cylinders and the angle of steering set by the operator is maintained. Refer to Section 220-0090, STEERING VALVE, for operation of the steering valve.

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 system after engine shutdown. Operate the treadle pedal continuously until the pressure has dissipated before carrying out any work on the hydraulic system or serious injury could result.

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. Operate brake pedal continuously to relieve pressure in the braking system.

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

3. Identify, tag and with a suitable container in position to catch the spillage, disconnect all hydraulic lines on one steering cylinder. Cap all lines and fittings to prevent ingress of dirt.

4. Support steering cylinder with a suitable lifting device.

5. Remove bolt (20), lockwasher (19) and hardened washer (18) securing pin (17) at base end of the cylinder. Remove pin (17) securing base end to the front frame.

6. Remove bolt (20), lockwasher (19) and hardened washer (18) securing pin (17) at piston rod (2) end of the cylinder. Remove pin (17) securing piston rod (2) end to the articulation and oscillation pivot.

7. Remove cylinder assembly from the machine. Spacers (22 & 21) will come free at this time.

8. Remove cylinder assembly to a clean area for disassembly. Drain oil from cylinder assembly into a suitable container.

9. Repeat steps 3 through 8 for opposite steering cylinder assembly.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

⚠ WARNING

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

1. Ensure clean working conditions, remove any port plugs thus allowing easy entry of air into the cylinder, preventing a vacuum when parts are withdrawn from cylinder body (1).

2. Remove circlips (14) from base end of cylinder body (1) and piston rod (2) end. Press out spherical bearings (13).

3. Using special tool which can be fabricated as shown in Fig. 2, unscrew end cap (3) until thread is disengaged from cylinder body (1).

4. Pull end cap (3) and piston rod (2) out of cylinder body (1) as an assembly.

5. Place piston rod (2) on supports which will not damage the chrome piston rod diameter.

6. Remove and discard piston seal (12) and wear rings (11) from piston (9).

7. Remove grub screw (10) from wear ring groove in piston (9).

8. Provide an anti-torsion device through piston rod (2) eye to allow unscrewing of piston (9). Using special tool which can be fabricated as shown in Fig. 3, unscrew piston (9) from piston rod (2).

9. Remove and discard 'O' ring (5) from piston (9). Remove and retain cushion sleeve (8) from piston rod (2).

10. Pull end cap (3) assembly off piston rod (2). Remove and discard back up ring (15) and 'O' ring (16) from end cap (3) outer grooves. Remove and discard wiper (7) and rod seal (6) from end cap (3) inner grooves.

11. If damaged, remove lube fittings (4) from cylinder body (1) and piston rod (2).

INSPECTION

Numbers in parentheses refer to Fig. 1

1. Clean all parts of the cylinder with a suitable solvent and dry with clean, lint-free cloths. Clean all grooves carefully to remove any foreign material.

2. Check cylinder body (1), end cap (3) grooves and outer diameter of piston (9) 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 (13) for wear and replace if necessary.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

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

1. Press spherical bearings (13) in base end of cylinder body (1) and piston rod (2) end. Secure spherical bearings (13) with circlips (14).

2. Install new rod seal (6) into bore of end cap (3) with the lip pointing towards the internal face of end cap (3). Install new wiper (7) into bore of end cap (3).

3. Install new back up ring (15) and 'O' ring (16) in external groove of end cap (3).

4. Guide end cap (3) assembly onto piston rod (2), taking care not to damage rod seal (6) on the thread.

5. Install cushion sleeve (8) into piston rod (2) counter bore. Note correct orientation, spigot face abuts counter bore face (see Fig. 1).

6. Install new 'O' ring (5) into internal groove of piston (9).

7. Using special tool which can be fabricated as shown in Fig. 3, screw piston (9) on piston rod (2). Tighten piston (9) to a torque of 746 - 813 Nm (550 - 600 lbf ft).

8. Insert piston grub screw (10), through wear ring groove in piston (9), into groove machined in piston rod (2). Tighten grub screw (10) to a torque of 13 - 20 Nm (10 - 15 lbf ft). Ensure the extreme of grub screw (10) is below the level of wear ring groove.

9. Insert new piston seal (12) and new wear rings (11) in piston (9) external grooves.

10. Fully grease piston (9) OD and 'O' ring (16) in end cap (3).

11. Ensure bore of cylinder is well lubricated with hydraulic oil. Carefully insert piston rod (2) and end cap (3) assembly into cylinder body (1).

12. Engage end cap (3)/cylinder body (1) thread and screw up fully. Using special tool which can be fabricated as shown in Fig. 2, tighten end cap (3) to a torque of 542 - 610 Nm (400 - 450 lbf ft).

13. Replace lube fittings (4) if required.

INSTALLATION

Numbers in parentheses refer to Fig. 1.

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

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 220-0000, STEERING SYSTEM SCHEMATIC. Renew all 'O' rings where used.

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

1. Install a suitable strap, or other lifting device, around one cylinder assembly and position cylinder assembly on the vehicle, with piston rod (2) end of cylinder ready for mounting.

2. Install spacers (21) and spacers (22) either side of piston rod (2) end of cylinder and insert pin (17). Secure pin (17) to articulation and oscillation pivot with bolt (20), lockwasher (19) and hardened washer (18).

3. Install spacers (21) and spacers (22) either side of base end of cylinder and insert pin (17). Secure pin (17) to front frame with bolt (20), lockwasher (19) and

hardened washer (18).

4. Connect hydraulic lines to steering cylinder ports, as tagged during removal.

5. Repeat steps 1 through 4 for installation of opposite steering cylinder.

6. Lubricate pins (17) through lube fittings (4) with lubricant, as specified in Section 300-0020, LUBRICATION SYSTEM.

7. Check oil level in hydraulic tank and add oil if low. Refer to Section 230-0040, HYDRAULIC TANK, for correct fill level. Refer to Section 300-0020, LUBRICATION SYSTEM, for the type of oil used.

8. Place the steering lock bar in the 'Stowed' position and remove wheel blocks.

9. Place the battery master switch in the 'On' position, start the engine and operate the steering, from lock to lock several times, to purge air out of the hydraulic lines. Check hydraulic lines and fittings for leaks. Tighten lines and fittings as required.

MAINTENANCE

Inspect steering cylinders regularly for leaks or damage, repair as required. Lubricate cylinder pins every 250 hours, as specified in Section 300-0020, LUBRICATION SYSTEM.

SPECIAL TOOLS

Special tools can be fabricated as shown in Figs. 2 & 3. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

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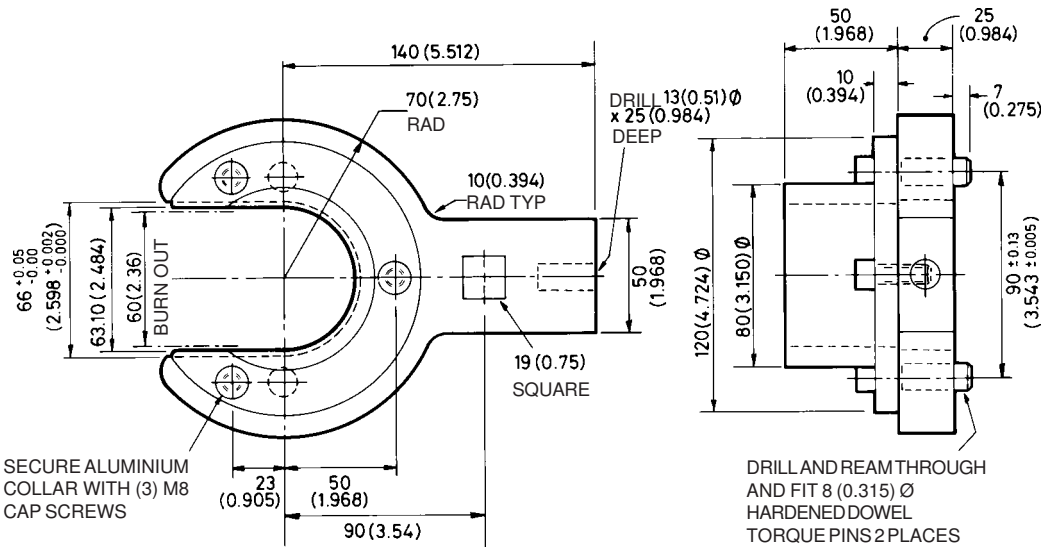

Dimensions in mm (inches)

Fig. 2 - End Cap Torque Tool

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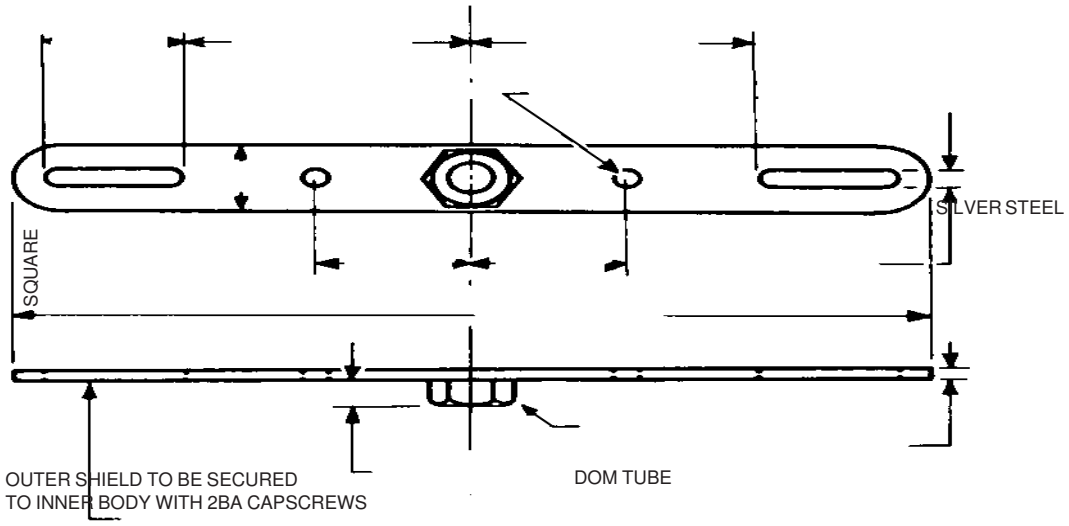

Dimensions in mm (inches)

Fig. 3 - Piston Torque Tool

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	9	Piston	746 - 813	550 - 600
1	3	End Cap	542 - 610	400 - 450
1	10	Grub Screw	13 - 20	10 - 15

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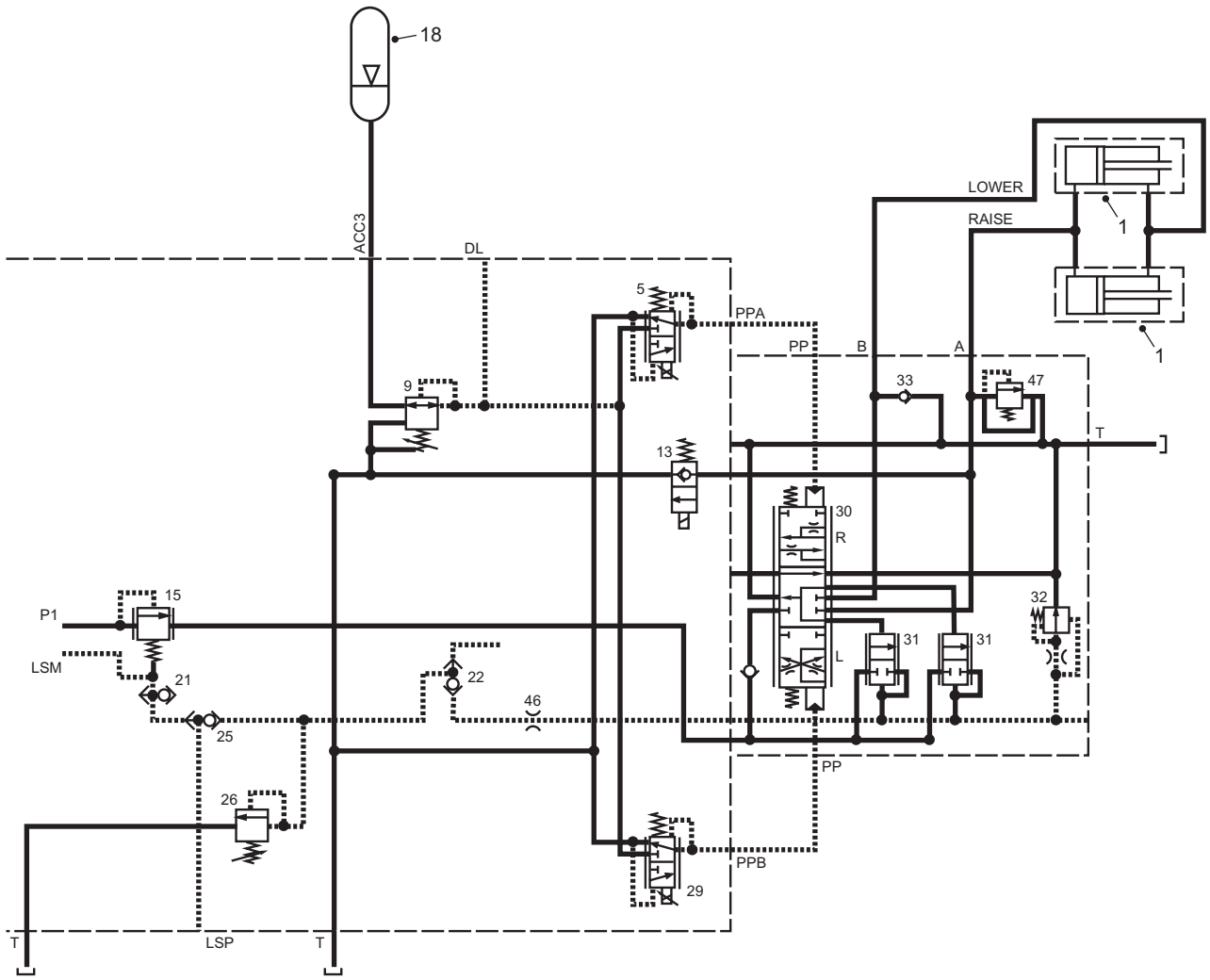


1 - Body Cylinders
5 - Proportional Control Valve (Raise)
9 - Pressure Reducing Valve
13 - Float Solenoid
15 - Priority Valve
18 - Primary Accumulator
21 - Shuttle Valve
22 - Shuttle Valve
25 - Shuttle Valve
26 - Relief Valve
29 - Proportional Control Valve (Lower)
30 - Control Spool
31 - Copy Spool
32 - Load Sense Dump Valve
33 - Make Up Check Valve
46 - Orifice
47 - Relief Valve

Fig. 1 - Body System Schematic

DESCRIPTION

Numbers in parentheses refer to Figures 1 and 4.

Other useful reference reading: Section 190-0000, Circuit Diagrams; Section 215-0050, Main Hydraulic Valve Assembly; Section 230-0081, Body Control Lever.

The body hydraulic system enables the operator to lift and lower the body in a safe manner using an electric output from the body control lever.

A brief description of the individual components used in the body hydraulic system is provided below. Detailed service and operating instructions can be found in the relevant component sections of this manual.

Body Control Lever

Refer to Section 230-0081, Body Control lever.

The body control lever is mounted on the right-hand side dash panel inside the operator's cab. The body control lever is manually operated to control the lift and lower functions of the body assembly.

Body Cylinders (1)

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. Each cylinder base end is connected to the trailer frame and each piston rod eye end is connected to 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.

Accumulators (18)

Refer to Section 250-0060, Accumulator.

The primary accumulators are mounted inside the battery box, which in turn is located on the front left hand side of the tractor. The primary accumulators support the service brake system and the body pilot pressure system. The primary accumulators are of the piston type and are each precharged with nitrogen to a pressure of 95 bar (1380 lbf/in²). Each comprises a charging valve assembly, a cylinder assembly and a piston. The charging valve is equipped with a locking feature which, when the valve is opened, will allow the precharge to be checked or charging of the accumulator to be facilitated.

Each piston acts as a separator, dividing the respective cylinder assembly into two sections. The section nearest the charging valve contains the nitrogen precharge. Hydraulic oil from the accumulator charge valve flows through accumulator check valves in the brake manifold valve and into the other section of the accumulator.

Accumulator pressure is monitored by pressure switches in the brake lines (Ref. Section 250-0000, Braking System).

Valves 5, 9, 13, 15, 21, 22, 25, 26, 29, 30, 31, 32, 33, 46 and 47

These valves form part of the brake circuit and are an intregal part of the main hydraulic valve assembly, mounted on the left hand side of the tractor frame. Refer to Section 215-0050, Main Hydraulic Valve Assembly.

OPERATION

LIFTING THE BODY

Refer also to Sections 190-0000 Circuit Diagrams and 215-0050 Main Hydraulic Valve Assembly.

When the operator pulls back on the body control lever, a voltage between 0 and 5 volts is sent to the hydraulic ECU, Pin C1:8. The hydraulic ECU converts this signal to an output current at Pin C1:17 to between 250 and 800 mA, determined by how far the lever is moved. This current is delivered to the Electro-hydraulic Proportional Pressure Control Valve (5) which converts this current into a pilot pressure.

The primary accumulator (18) pressure is reduced to a 35 bar (508 lbf/in²) pilot control pressure by a pressure reducing valve (9). This pilot control pressure acts on the proportional pressure control valve (5), which in turn reduces the pilot pressure to between 4 bar (58 lbf/in²) and 25 bar (363 lbf/in²), depending on the current output from the hydraulic ECU. This pilot pressure then selects the main spool (30) in the lift valve section of the main hydraulic valve assembly to the raise position.

When the main spool (30) has been stroked to the raise position, oil from the main pump flows through the control spool (30), out of port 'A' on the main hydraulic valve, and on to the tip cylinders (1).

When oil from the main pump flows through the control spool (30), a pressure is created at the head of the copy spool (31). The copy spool (31) strokes down, allowing a 'load sense' pressure to be fed back to the load sense port of the main pump, via shuttle valves (22 and 25). The main pump then increases its displacement and flow passes to port 'A' lifting the body. Returning flow from the tipping cylinders (1) passes to Port 'B', through the control spool (30) back to tank.

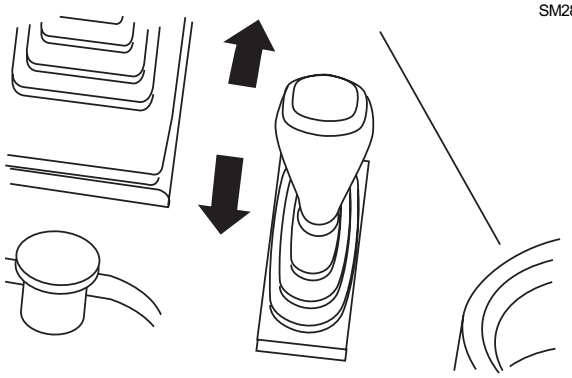


Fig. 2 - Body Control Lever (Operator's Cab)

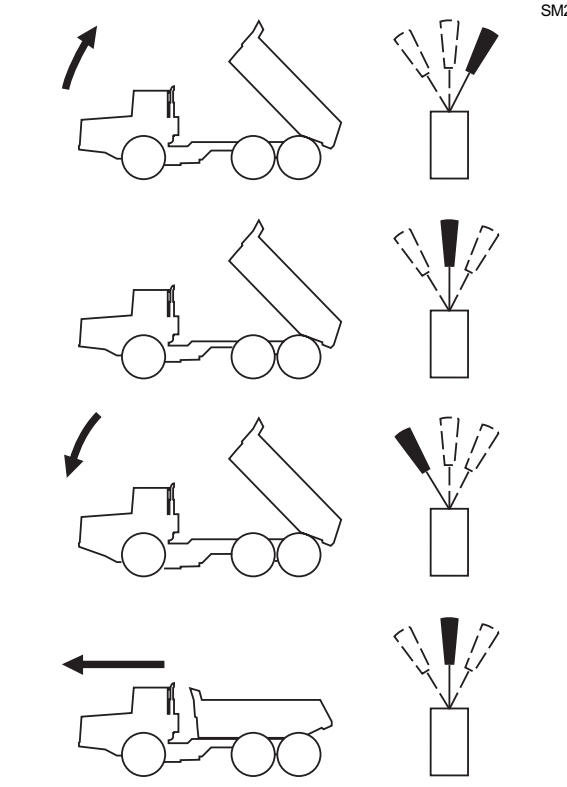


Fig. 3 - Body Control Lever Positions

The load sense pressure created by the copy spool (31) is controlled to a maximum of 195 bar (2830 lbf/in^2) by the relief valve (26). This will result in a maximum main pump delivery pressure for the body raise circuit of 220 bar (3200 lbf/in^2). This is a result of the 195 bar (2830 lbf/in^2) maximum load sense pressure, plus the 25 bar (360 lbf/in^2) stand by pressure of the main pump. Refer to Section 230-0050, Main Hydraulic Pump.

The body relief valve (47) is located on the raise side of the circuit, and prevents pressure spikes at maximum extension of the cylinders when the body is raised at maximum engine speed. The relief valve (47) is set at 230 bar (3 335 lbf/in^2).

LOWERING THE BODY

When the operator pushes forward on the body control lever, a voltage of between 0 and 5 volts is sent to the hydraulic ECU, Pin C1:12. The hydraulic ECU converts this signal to an output current at Pin C1:31 of between 250 and 800 mA, determined by how far the lever is moved. This current is seen at the Electro-hydraulic Proportional Pressure Control Valve (29) that converts this current into a pilot pressure.

The pilot control pressure of 35 bar (508 lbf/in^2), created by pressure reducing valve (9), is reduced by the proportional pressure control valve (29) to between 4 bar (58 lbf/in^2) and 25 bar (363 lbf/in^2), depending on the current output from the hydraulic ECU. This pilot pressure selects the main spool (30) in the lift valve section of the main hydraulic valve assembly to the lower position.

When the main spool (30) has been stroked to the lower position, oil from the main pump flows through the control spool (30) out of port 'B' on the main hydraulic valve, and on to the tip cylinders (1).

When oil from the main pump flows through the control spool (30), a pressure is created at the head of the copy spool (31). The copy spool (31) strokes down allowing a 'load sense' pressure to be fed back to the load sense port of the main pump via shuttle valves (22 and 25). The main pump then increases its displacement and flow passes to port 'B' lowering the body. Returning flow from the tipping cylinders (1) passes to Port 'A', through the control spool (30) back to tank.

During lowering, the operator can fully select the body control lever on to an electric detent within the lever base which is connected to the hydraulic ECU pin C1:35, This detent holds the lever in the power down position, allowing the operator to drive the vehicle whilst the body is still lowering.

A proximity switch is located on the chassis, which supplies a 24 Volt signal to the hydraulic ECU pin C1:6. When the body reaches the proximity switch the 24 Volt signal is switched off, which in turn signals the hydraulic ECU to de-energize the electric detent, allowing the lever to spring back to the mid position. At

SM - 2920

5 - Proportional Control Valve (Raise)
9 - Pressure Reducing Valve - Pilot Pressure
13 - Float Solenoid
15 - Priority Valve
21 - Shuttle Valve
22 - Shuttle Valve
25 - Shuttle Valve
26 - Relief Valve - Body Raise Pressure LS
29 - Proportional Control Valve (Lower)
31 - Copy Spools
32 - Load Sense Dump Valve
46 - Orifice
47 - Relief Valve

Valve (5 & 29) Coil Rating		
Ohms	Amps	Watts
21	1.1	25
Voltage: 24V		

Valve (13) Coil Rating		
Ohms	Amps	Watts
42	0.6	15
Voltage: 24V		

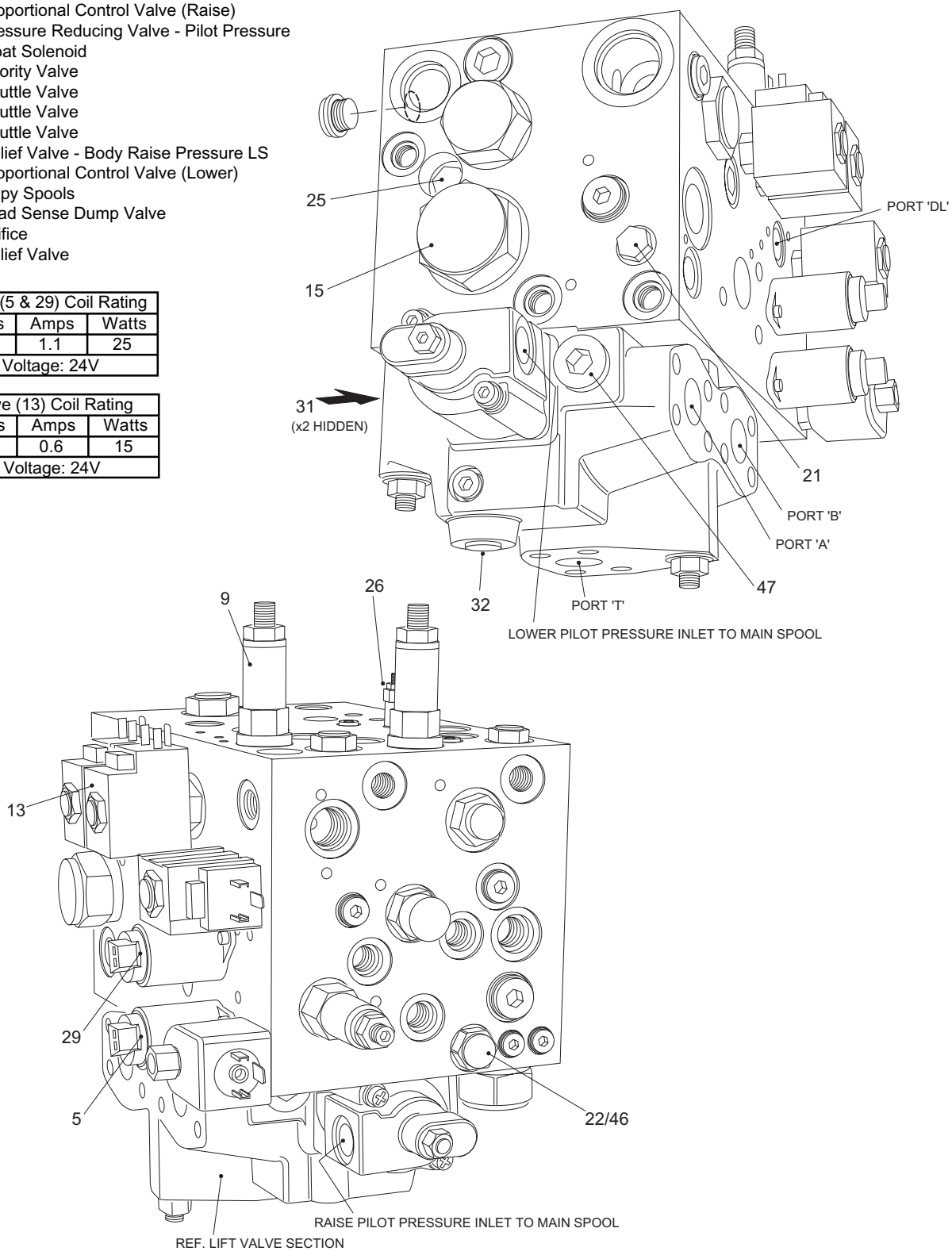


Fig. 4 - Main Hydraulic Valve Assembly - Body Control Valve Locations

the same time the hydraulic ECU ramps back the current to proportional pressure control valve (29) to de-select the main spool (30), and energizes the coil on the float solenoid valve (13), allowing the body to float down to the chassis over the last few centimeters of travel.

To prevent damage to the body hinge points or the tip cylinders (1) the float solenoid valve (13), which is connected to Pin C1:23 on the hydraulic ECU is energized all the time the body is on the chassis and the engine is running. This ensures that the head side of the tip cylinders (1) is always vented to tank and the body is sitting firmly on the chassis.

When the body meets the proximity switch on the chassis, the control spool is de-selected and reverts to the neutral position. This action closes the copy spool (31). The load sense dump valve (32) allows a controlled load sense pressure drain back to the hydraulic tank.

When the control spool (30) moves to the neutral position, oil delivery from the main pump is blocked. To compensate for this over the last few centimetres of travel, make up check valve (33) opens allowing a controlled oil flow via port 'B' to the lower side of the tip cylinders (1). The make up check valve (33) opening safeguards the system against cavitation when the main pump flow is blocked during the lowering procedure of the body.

BODY LOWER EMERGENCY SWITCH

A switch is provided on the console, immediately to the right of the operator's seat, which initiates lowering of the body in the event of an engine, hydraulic or hydraulic ECU failure. The switch (S78 on Page 11 of the Circuit Diagrams [Section 190-0000]), when operated, powers the solenoid of the float switch (13) directly from the batteries. The cause of the failure must be investigated and rectified.

Note: If an electrical fault occurs that results in the main spool (30) defaulting to the Neutral (Hold) position, while the body is raised, lowering can be achieved by pressing the body lower Emergency switch, which will allow it to drop under its own weight. The body must remain lowered with the lever in the Neutral position until it is necessary to operate the body again. Failure to comply with this may result in overheating of the hydraulic oil and failure of the hydraulic system components.

SM 3911

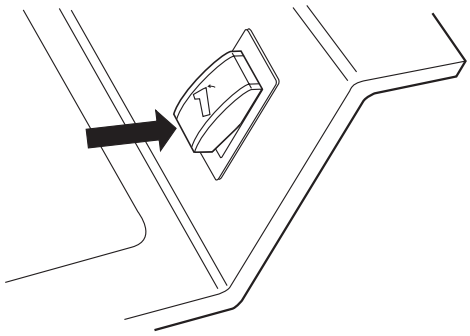
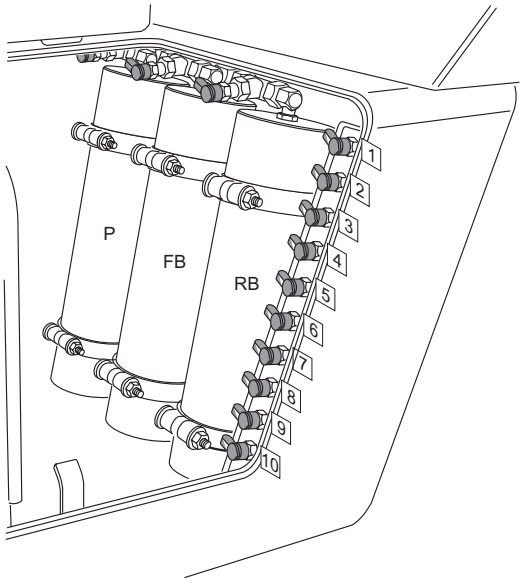


Fig. 5 - Body Lower Emergency Switch

SM 2849



1 - Differential Lock Pressure
2 - Pump LS Pressure
3 - Front Brake Pressure
4 - Rear Brake Pressure
5 - Park Brake Pressure
6 - Steering Pressure
7 - Trans. Retarder Press.
8 - Trans. Converter Press.
9 - Body System Press.
10 - Trans. System Pressure
P - Primary Accumulator
FB - Front Brake Accumulator
RB - Rear Brake Accumulator

Fig. 6 - Diagnostic Pressure Check Points (Battery Box)

⚠ WARNING
Always disconnect the body control lever before welding on the machine.

EMERGENCY BODY LOWERING PROCEDURE, FOLLOWING LOSS OF HYDRAULIC AND ELECTRICAL POWER

If the body is raised and the vehicle has lost electrical AND hydraulic power, it is possible to make adjustments to the threaded end stops at the body spool of the Main Hydraulic Valve, that will force a controlled lowering of the body. The procedure for carrying out this operation is detailed below.

⚠ 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 perform the task safely.

Exercise extreme caution when accessing the Main Hydraulic Valve in order to lower the body. Do not put yourself in any danger from impact with the lowering body.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine. Turn the battery master switch to the 'off' position.

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

3. The Main Hydraulic Valve assembly is accessed by raising the operator's cab. Using the hydraulic hand pump inside the battery box, tilt the cab and secure it. Refer to Section 260-0010, Cab and Mounting.

⚠ WARNING

Never work under or near an unsupported raised operator's cab assembly. Always ensure that the cab safety prop is in the correct position.

4. Locate the spool screws identified as A and B respectively on Figure 7. Measure and record the height of the outer face of each screw from the casing of the Body Section of the Main Hydraulic Valve.

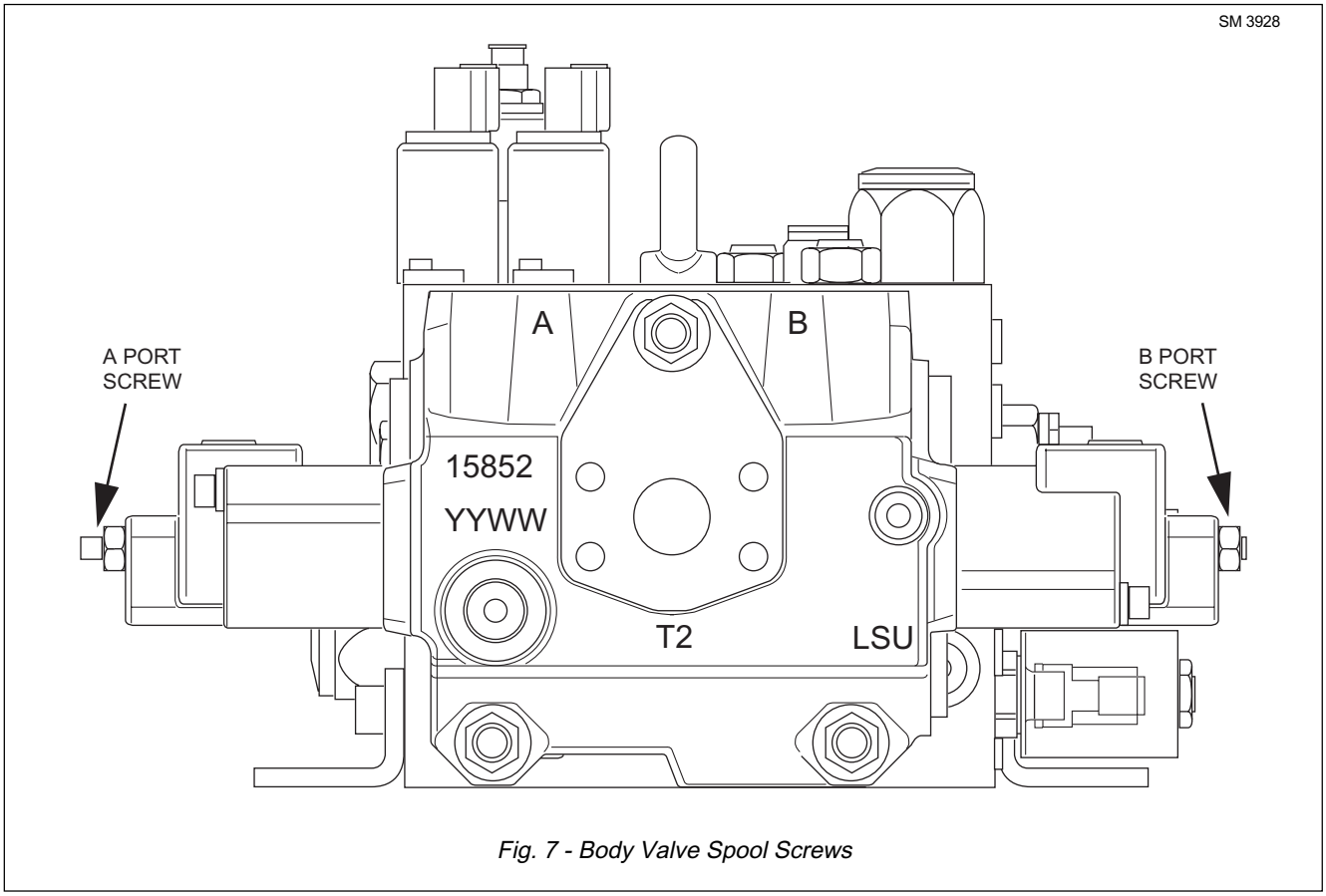


Fig. 7 - Body Valve Spool Screws

5. Loosen the lock nut on spool screw B, then unscrew screw B until the threaded shoulder of the screw is flush with the face of the casing.

6. Loosen the lock nut on spool screw A, then screw in screw A until the body lowers slowly and in a controlled fashion.

⚠ WARNING
Keep well clear of the body as it is lowering.

RESETTING MAIN HYDRAULIC VALVE AFTER HYDRAULIC AND ELECTRICAL POWER IS RESTORED

1. Start the engine.

2. Raise the body until it is 50% raised.

3. Unscrew spool screw A until its outer face is returned to the original height above the casing, measured in Step 4 of the Emergency Lowering procedure given above. Lock the screw in this position using the lock nut.

4. Screw in screw B until its outer face is returned to the original height above the casing, measured in Step 4 of the Emergency Lowering procedure given above. Lock the screw in this position using the lock nut.

5. Using the hydraulic hand pump inside battery box, lower the cab and secure it. Refer to Section 260-0010, Cab and Mounting.

CHECKING SYSTEM PRESSURES

⚠ 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 brake treadle pedal continuously until the pressure has dissipated before carrying out any work on the system or serious injury could result.

CHECKING THE MAIN BODY SYSTEM PRESSURE

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 any pressure in the steering circuit.

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

3. This following procedure will check that the body raise pressure is properly set. Connect a hydraulic gauge, capable of recording a pressure of 0 - 345 bar (0 - 5000 lbf/in²), to the body system pressure diagnostic pressure point inside the battery box (9, Figure 6).

4. Place the battery master switch in the 'On' position, start the engine and allow all systems to be charged normally.

5. Pull back body control lever. Allow body to raise over relief. The pressure observed on the pressure gauge should be 220 bar (3200 lbf/in²).

6. Pressure setting can be adjusted by adjusting relief valve (26) on the main hydraulic valve assembly. Relief valve (26) actually sets the load sense pressure for the body circuit, controlling the load sense to a maximum of 195 bar (2830 lbf/in²). This will result in a maximum main pump delivery pressure for the body raise circuit of 220 bar (3200 lbf/in²). This is due to the 195 bar (2830 lbf/in²) maximum load sense pressure, plus the 25 bar (360 lbf/in²) stand by pressure of the main pump. Refer to Section 230-0050, Main Hydraulic Pump. The operator's cab has to be raised to facilitate access to the relief valve (26). Refer to Section 260-0010, Cab and Mounting.

7. Adjust relief valve (26) until 220 bar (3200 lbf/in²) is observed on the pressure gauge, while raising the body over relief.

8. Shut off the engine and remove the pressure gauge from the diagnostic check point.

9. Remove the wheel blocks, place the steering lock bar in the 'Stowed' position, start the engine and check the body system for proper operation.

CHECKING THE PILOT CONTROL PRESSURE

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 brake treadle valve continuously to relieve pressure in the accumulators. Block all road wheels, place the steering lock bar in the 'Locked' position and the battery master switch in the 'Off' position.

3. Connect a hydraulic gauge, capable of recording a pressure of 0 - 345 bar (0 - 5000 lbf/in^2), into the differential lock diagnostic pressure point inside the battery box (1, Figure 6).

4. Place the battery master switch in the 'On' position, start the engine and allow all systems to be charged normally.

5. A hydraulic pressure of 35-42 bar (500-609 lbf/in^2) should be observed on the pressure gauge.

6. Pressure setting can be adjusted by adjusting pressure reducing valve (9) on the main hydraulic valve. Adjust pressure reducing valve (9) until 35-42 bar (500-609 lbf/in^2) is observed on the pressure gauge.

Note: Differential lock (pilot) pressure can only be tested with the differential lock NOT actuated. When the differential lock is engaged the diagnostic pressure point is vented to tank.

7. Check the body system for proper operation.

8. Shut off the engine and remove the pressure gauge from port 'DL'.

9. The operator's cab should be lowered into the travel position. Check the hydraulic lines for any leakage.

10. Remove wheel blocks, place the steering lock bar in the 'Stowed' position, start the engine and check the body system for proper operation.

O-RING FACE SEALS (ORFS)

Where hydraulic lines are fitted with ORFS connections, the following procedure should be carried out during 'Installation'. Refer to Figure 6.

a. Ensure that the O-ring/seal is in place and that the joining surfaces are clean. If necessary, retain the O-ring/seal in place with a light coating of grease or vaseline.

b. Initially, the nuts should be tightened by hand.

c. Where a hose is fitted, ensure that it is not twisted or kinked when the nuts are tightened so that it is allowed to adopt a natural position.

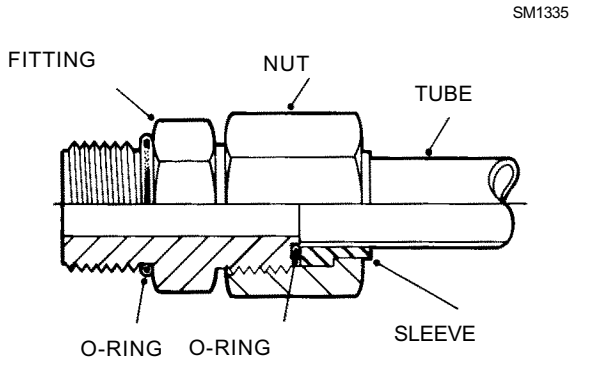


Fig. 8 - Assembly of Typical ORFS Connector

d. Where a tube is fitted, ensure that the connection is aligned correctly.

e. Tighten the nut a further 1/4 to 1/2 a turn using the correct size spanner (wrench).

f. Check that a satisfactory hose or tube routing has been achieved.

HYDRAULIC OIL

The hydraulic 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 service tools are used when carrying out pressure and temperature checks during maintenance procedures. These tools,

along with other general service tools, are available from your dealer. Refer to Section 300-0070, Service Tools, for part numbers of these tools.

Multi-Gauge

The multi-gauge, 15269784, is basically four pressure gauges in one. Continuous system pressure readings are indicated on one of three simultaneously reading gauges through a pressure range of 30 in of vacuum to 5000 lbf/in².

The following items should be added to the multi-gauge to enable the gauge to be used on the diagnostic pressure check points;

15018226	Diagnostic Coupling
00118748	Connector (two)
15004085	Hose Assembly (-04 HP, 2130 mm long)

Non-contact Infrared Thermometer

The infrared thermometer, 15269785, 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.

O-ring Face Seals (ORFS) - Seal Kit

The braking system utilizes O-ring Face Seal (ORFS) connectors. An ORFS kit, 15271082, is available. This kit contains a minimum stock requirement of all sizes of ORFS type seal.

Body System Trouble Shooting		
Symptom	**Possible Cause**	**Remedy**
Body will not lift	Pressure Level in the system is not high enough	Check the pressure at the pump and re-adjust the Relief Valve (26). Refer to Section 230-0050, Main Hydraulic Pump.
		Relief valve (47) stuck open.
	No electric current at the proportional control valve (5)	Check voltage at the electric connector of for Valve (5) when pulling back on the lever in the cab. If no voltage present refer to Sections190-0085 Hydraulic ECU and 230-0081, Body Control Lever
		Replace Valve (5)
	Proportional control valve (5) faulty	
	Control lever in the cab faulty	Check output from lever. Refer to Sections190-0085 Hydraulic ECU and 230-0081, Body Control Lever
	Main control spool (30) in the lift section of the main hydraulic valve assembly sticking	Replace lift section of the main hydraulic valve assembly
	Copy spool (31) sticking	Check condition of copy spool, replace if necessary. Replace Main Hydraulic Valve Assembly
	Contamination in the load sense drillings and the orifice (46)	Clean orifice (46). Replace Main Hydraulic Valve Assembly
	Main pump faulty	Refer to Section 230-0050 Main Hydraulic Pump, for correct setting procedures
Lift function too slow.	Proportional control valve (5) current not high enough	Check output from body control lever. Refer to Sections190-0085 Hydraulic ECU and 230-0081, Body Control Lever
	Main control spool (30) not fully selecting.	Replace lift section of main hydraulic valve assembly.
	Contamination in the load sense drillings and the orifice (46).	Clean orifice (46).
		Replace Main Hydraulic Valve Assembly.
	Main pump faulty.	Refer to Section 230-0050 Main Hydraulic Pump, for correct setting procedures.

Body System Trouble Shooting		
Symptom	**Possible Cause**	**Remedy**
Lift function too slow (cont.)	Control lever in the cab faulty.	Check lever outputs. Refer to Sections 190-0085 Hydraulic ECU and 230-0081 Body Control Lever
	Engine RPM too low.	Can affect pump delivery. Check throttle pedal for correct signals.
Body will not lower.	Supply fuse to hydraulic ECU blown.	Check that the green LED on the hydraulic ECU is illuminated. Replace fuse F48 located inside fuse box. Refer to Section190-0000 Circuit Diagrams
	No electric current at proportional control valve (29)	Check the link between the body control lever and the hydraulic ECU, and between the hydraulic ECU and the proportional control valve (29). Refer to Sections 190-0085 Hydraulic ECU and 230-0081 Body Control Lever
	Proportional control valve (29) faulty.	Check connections. Replace proportional control valve (29).
	Control lever in the cab faulty.	Check for output from control lever. Refer to Sections 190-0085 Hydraulic ECU and 230-0081 Body Control Lever
	Proximity switch on chassis reading LOW (float condition)	Check connections/replace proximity switch.
	Loss of hydraulic and electrical power	Follow the Emergency Body Lower Procedure
Body lowers too slow.	Not enough electric current at the proportional control valve (29)	Check output from body control lever. Refer to Sections 190-0085 Hydraulic ECU and 230-0081 Body Control Lever
	Pilot pressure not high enough	Re-set the pilot pressure at the pressure reducing valve (9). If it cannot be reset, replace the pressure reducing valve (9).
	Main control spool (30) sticking.	Replace the lift section of the main hydraulic valve assembly.
	Faulty main pump.	Refer to Section 230-0050 Main Hydraulic Pump, for correct setting procedures.

Body System Trouble Shooting		
Symptom	**Possible Cause**	**Remedy**
Body lowers too slow.(continued)	Contamination in the load sense drillings and the orifice (46).	Clean the orifice (46). Replace the main hydraulic valve assembly.
Body will not hold	Oil by-passing between control spool (30) and valve body	Replace lift section of main hydraulic valve aseembly
	Oil by-passing body lift cylinders (1)	Repair the lift cylinders (1)
	Control spool (30) not centring	Check that there is zero pilot pressure at both ends of control spool (30). Either of proportional control valves (5/29) could remain active
		Check the body control lever. Should be zero ouput signal from control lever when in the neutral position
		Control spool (30) damaged. Replace control spool (30)
Power down available when body is on the chassis	Faulty proximity switch on chassis	Check connections. Replace proximity switch. Refer to Section 190-0085 Hydraulic ECU, for check tool
Body fails too slow down when reaching the proximity switch on the chassis	Faulty proximity switch on chassis	Check gap between body plate and proximity switch. Max. gap 15mm. Replace proximity switch
	Faulty hydraulic ECU or connections	Refer to Section 190-0085 Hydraulic ECU for check procedure.
	Main spool (30) sticking	Replace main hydraulic valve assembly
	Faulty float solenoid valve (13)	Check connections. Replace valve(13). Refer to Section 190-0085 Hydraulic ECU
Body fails too go into float and stops before it reaches the chassis	No voltage at the float solenoid valve (13)	Check connections at valve (13) and hydraulic ECU. Refer to Section 190-0085 Hydraulic ECU

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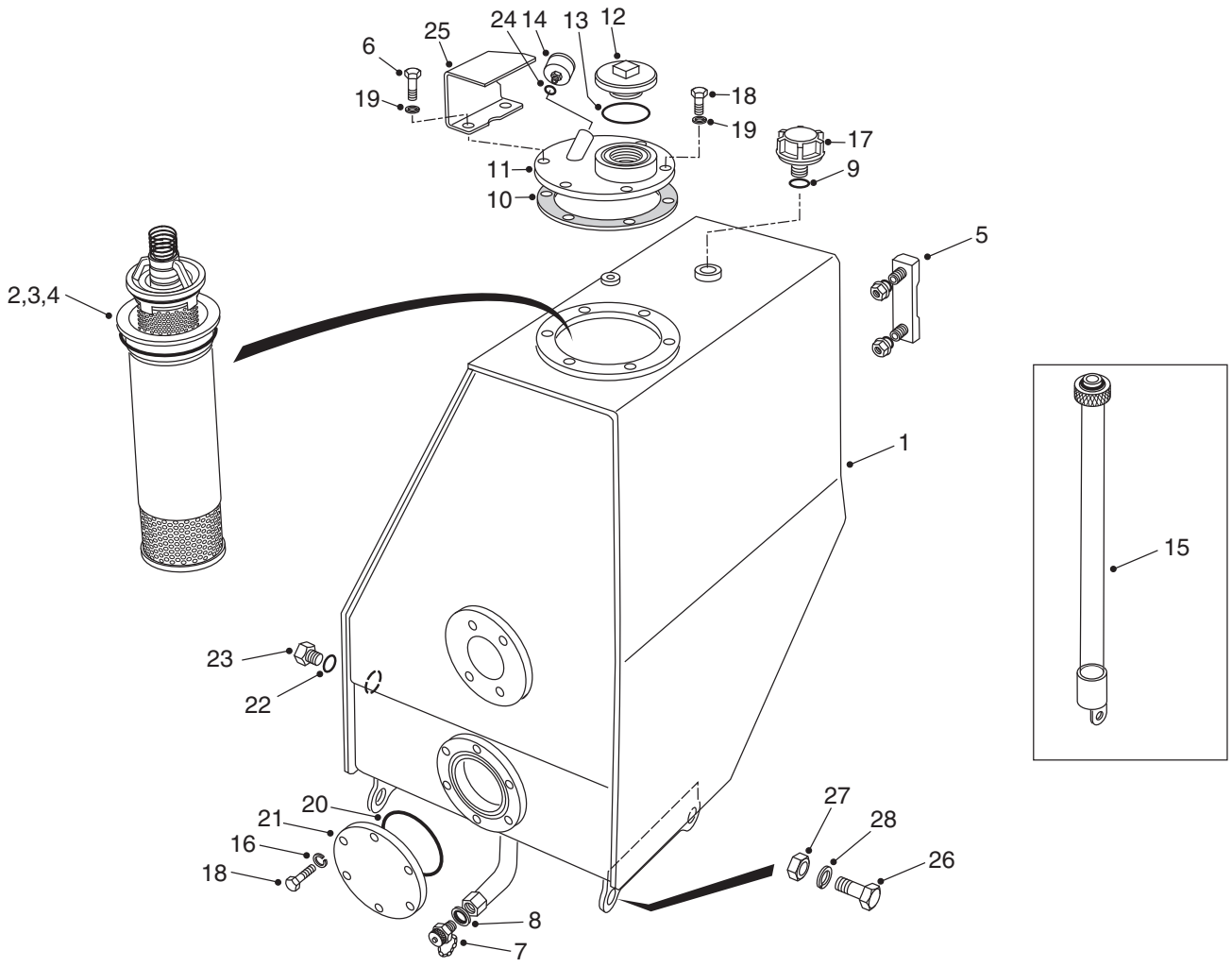

1 - Hydraulic Tank
2 - Filter Assembly
3 - Element
4 - 'O' Ring
5 - Sight Gauge
6 - Bolt
7 - Drain Valve
8 - Seal
9 - 'O' Ring
10 - Gasket
11 - Cover Plate
12 - Cap
13 - 'O' Ring
14 - Filter Restriction Gauge
15 - Drain Adaptor Hose
16 - Lockwasher
17 - Breather
18 - Bolt
19 - Washer
20 - 'O' Ring
21 - Access Cover
22 - 'O' Ring
23 - Plug
24 - 'O'-Ring
25 - Guard
26 - Bolt
27 - Nut
28 - Lockwasher

Fig. 1 - Exploded View of Hydraulic Tank and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The hydraulic tank (1) is the common reservoir for the steering, braking, body hoist and transmission oil cooler fan drive systems. It is mounted off the frame at the rear right hand side of the tractor.

Integral with hydraulic tank (1) assembly are filter assembly (2), oil level sight gauge (5) and access cover (21). Located on top of the tank is filler cap (12), breather (17) and filter restriction gauge (14).

OPERATION

Numbers in parentheses refer to Fig. 2.

Oil is added to the hydraulic tank (4) through filter assembly (2). The hydraulic oil is drawn from hydraulic tank (4) by main hydraulic pump (1) and pumped to the main hydraulic valve to supply the various hydraulic

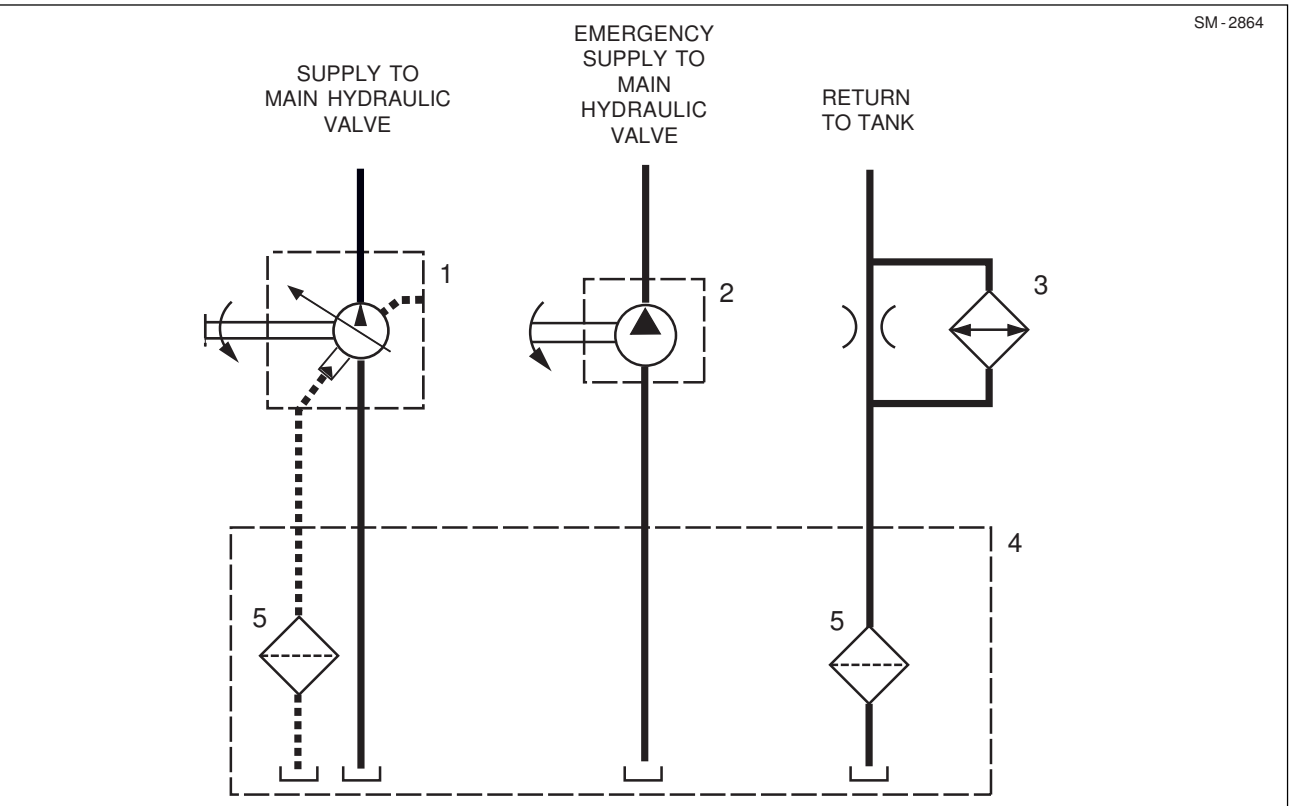

Fig. 2 - Hydraulic Schematic of Hydraulic Tank

systems. Refer to Section 215-0050, MAIN HYDRAULIC VALVE ASSEMBLY.

Emergency steering oil is drawn from hydraulic tank (4) by emergency pump (2), mounted off transmission, and is also pumped to the main hydraulic valve. Should a failure occur at the main hydraulic pump (1) the emergency pump (2) will supply the steering system with oil to enable the vehicle to be brought to a safe halt. Refer to Section 220-0000, STEERING SYSTEM SCHEMATIC.

Return oil from the hydraulic systems flows through hydraulic oil cooler (3) (if fitted) and filter assembly (5) before entering the tank storage area. The filter assembly has a bypass valve which allows oil to bypass element (3, Fig. 1) when it is cold or when the filter element is plugged. The bypass valve opens at a pressure differential of 1.5 bar (22 lbf/in^2). Filter restriction gauge (14, Fig. 1) shows red when element (3, Fig. 1) 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 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. Oil should at least reach the minimum level in the sight gauge (5). If oil is required, remove filler cap (12) from hydraulic tank (1) and fill hydraulic tank with hydraulic oil specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (12) on hydraulic tank (1) and tighten.

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 (3) must be replaced and hydraulic tank (1) cleaned thoroughly using a suitable solvent.

Replacing Breather

Every 1 000 hours of operation, or sooner if the vehicle is being operated in extremely dusty conditions, the hydraulic tank breather should be replaced.

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 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. Unscrew breather (17) and remove from tank (1). Discard 'O' ring (9).

4. Install new 'O' ring (9) and breather (17) to tank (1).

Replacing Filter Element

Every 2 000 hours of operation or when filter restriction gauge (14) shows red, whichever comes first, clean filter assembly (2) and install new element (3).

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 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 valve (7) on the bottom of hydraulic tank (1). Install a hose adaptor (15) 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 valve (7).

4. Remove bolts (6 & 18) and washers (19) securing guard (25) and cover plate (11) to top of hydraulic tank (1). Remove guard (25), cover plates (11) and gasket (10) from hydraulic tank (1). Discard gasket (10).

5. Remove filter assembly (2) from hydraulic tank (1).

6. Remove and discard element (3) from filter assembly (2). Discard 'O' ring (4).

7. Remove bolts (18) and lockwashers (16) securing access cover (21) to tank (1). Remove access cover (21) and discard 'O' ring (20).

⚠ WARNING
Splashing liquid. Wear a suitable face shield when using compressed air to dry hydraulic tank and components.

8. Clean out the inside of hydraulic tank (1) with a suitable solvent and dry with compressed air.

9. Install new element (3) in filter assembly (2).

10. Install filter assembly (2) in tank (1), complete with new 'O' ring (4).

11. Place new gasket (10), cover plate (11) and guard (25) on hydraulic tank (1). Secure with bolts (6 & 18) and washers (19).

12. Install new 'O' ring (20) and secure access cover plate (21) on hydraulic tank (1) with bolts (18) and lockwashers (16).

13. Remove filler cap (12) from hydraulic tank (1) and fill hydraulic tank with hydraulic oil specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (12) on hydraulic tank (1) and tighten.

14. 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.

15. 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 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 valve (7) 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 valve (7).

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. Remove two bolts (18) and washers (19) from top of hydraulic tank (1) and install eyebolts. Attach a suitable lifting device to eyebolts and remove nuts (27), lockwashers (28) and bolts (26) securing hydraulic tank (1) to fender and support bracket.

6. Carefully remove hydraulic tank (1) assembly from the unit to a clean work area for inspection.

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 (17), filter restriction gauge (14) and filter assembly (2) for damage. Replace if required.

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 (26), lockwashers (28) and nuts (27).

2. Remove eyebolts that were installed to lift hydraulic tank (1). Reinstall two bolts (18) and washers (19) on top of tank (1).

3. Install new 'O' rings and install all hydraulic lines and fittings to hydraulic tank (1), as tagged at removal.

4. Remove filler cap (12) and fill hydraulic tank (1) with hydraulic oil specified in Section 300-0020, LUBRICATION SYSTEM. Install filler cap (12) on hydraulic tank (1) and tighten.

5. 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.

6. 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.

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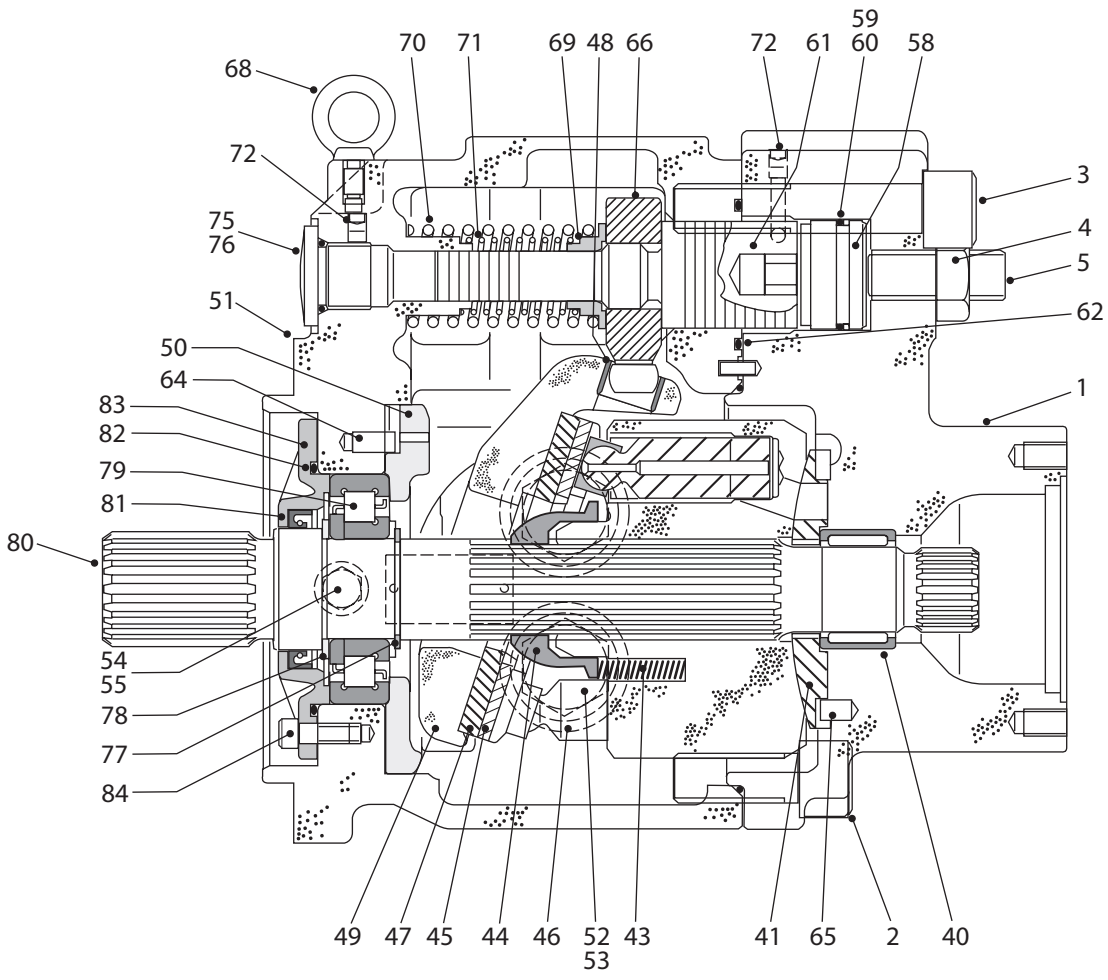

1 - Valve Cover
2 - Bolt
3 - Bolt
4 - Nut
5 - Set Screw
40 - Needle Bearing
41 - Valve Plate
43 - Cylinder Spring
44 - Spherical Bush
45 - Set Plate
46 - Piston & Shoe
47 - Shoe Plate
48 - Tilting Bush
49 - Swash Plate
50 - Swash Plate Support
51 - Pump Casing
52 - O-ring
53 - Plug
54 - O-ring
55 - Plug
58 - Stopper
59 - Back-up Ring
60 - O-ring
61 - Servo Piston
62 - O-ring
64 - Pin
65 - Pin
66 - Tilting Pin
68 - Eye Bolt
69 - Spring Seat
70 - Outer Spring
71 - Inner Spring
72 - Plug
75 - O-ring
76 - Plug
77 - Snap Ring
78 - Bearing Spacer
79 - Roller Bearing
80 - Driveshaft
81 - Oil Seal
82 - 'O' Ring
83 - Seal Cover
84 - Bolt

Fig. 1 - Sectional View Of Hydraulic Pump

DESCRIPTION

Numbers in parentheses refer to Figures 1 and 7.

The Hydraulic Pump can be identified as item 5 in Section 250-0000, Braking System Schematic.

The hydraulic pump is mounted off the rear of the transmission. It is an axial piston, variable displacement pump with load sense and pressure regulator to match the flow and pressure to the demand. The pump displaces 140 cc/rev, and the pressure regulator is set to 240 bar (3500 lbf/in^2).

The pump supplies hydraulic oil for the steering, braking and body hoist systems, as well as the transmission oil cooler fan drive system.

The components of the pump can be divided into three sub-groupings:

Rotating Group - Provides the main rotary pumping action. Consists of the driveshaft (80), cylinder block (42), piston and shoe (46), set plate (45), spherical bush (44) and cylinder springs (43).

Swash Plate Group - Varies the pump's delivery flow

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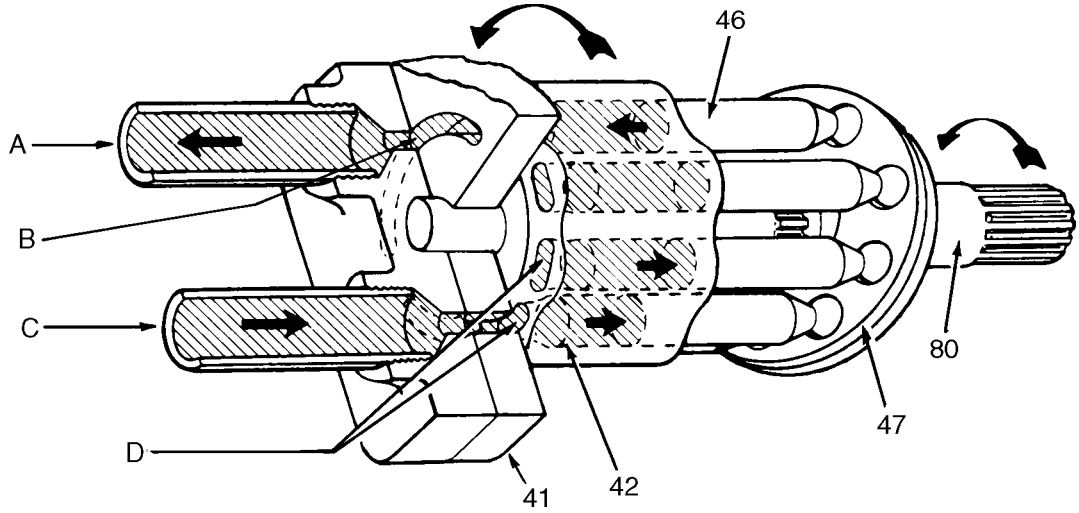

A - Outlet Port
B - Outlet Kidney Slot
C - Inlet Port
D - Inlet Kidney Slot

41 - Valve Plate
42 - Cylinder Block
46 - Piston and Shoe

47 - Shoe Plate
80 - Driveshaft

Fig. 2 - Pump Rotation and Oil Flow

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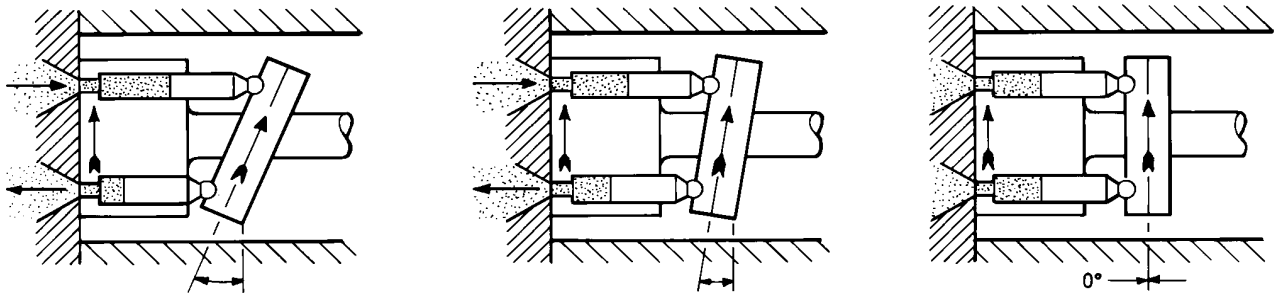


MAXIMUM SHOE PLATE ANGLE (MAXIMUM DISPLACEMENT)
VIEW A

DECREASED SHOE PLATE ANGLE (PARTIAL DISPLACEMENT)
VIEW B

ZERO SHOE PLATE ANGLE (MINIMUM DISPLACEMENT)
VIEW C

Fig. 3 - Variable Displacement Action

rate. Consists of the swash plate (49), shoe plate (47), swash plate support (50), tilting bush (48), tilting pin (66), servo piston (61) and servo assist springs (70 and 71).

Valving Cover Group - Provides the switching of oil between suction and delivery ports. Consists of valve cover (1), valve plate (41) and valve plate pin (65).

OPERATION

Numbers in parentheses refer to Figures 1, 2 and 7. Refer to Figures 4 - 6 for hydraulic schematics of pump.

When the pump's driveshaft (80) rotates, the cylinder block (42), being spline coupled to the shaft, will also rotate. If the swash plate (49) has been tilted, the pistons and shoes (46) arranged in the cylinder block (42) due to the shoes being retained on the shoe plate (47) will both rotate with the cylinder block and reciprocate once per revolution.

Paying attention to one such piston, then it will move away from the valve plate (41) for half a rotation (suction stroke), and move towards the valve plate (41) for the second half of rotation (delivery stroke). The larger the tilt angle of the swash plate (49), the longer the piston (46) stroke and the higher the pump's displacement. As the swash plate (49) tilting angle

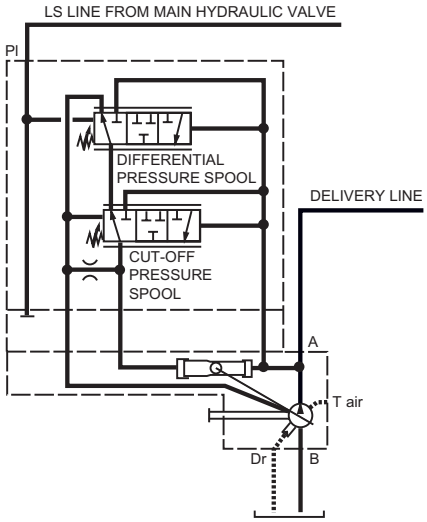


Fig. 4 - Pump Schematic - Unregulated Condition

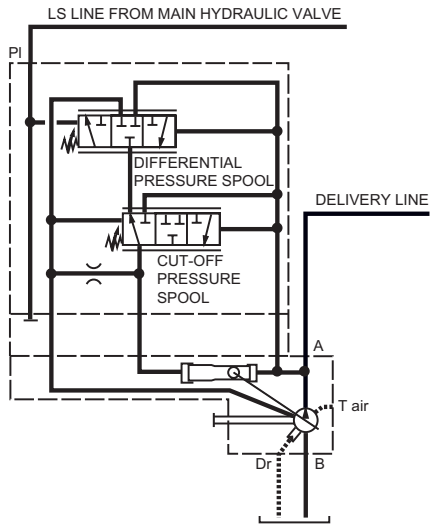


Fig. 5 - Pump Schematic - Regulated Condition

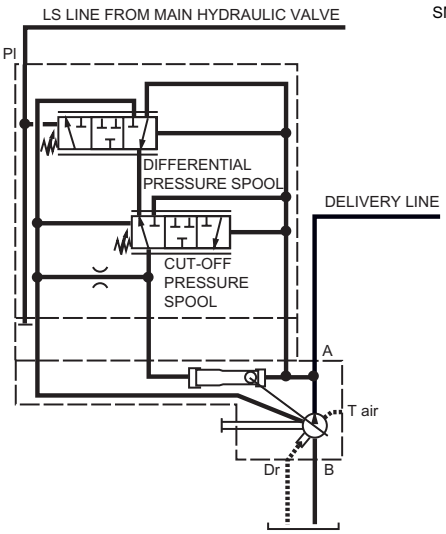


Fig. 6 - Pump Schematic - Standby Condition

approaches zero, the piston (46) does not stroke and therefore delivers minimum displacement. (Refer to Figure 3).

Pressure Regulator

Numbers in parentheses refer to Figures 1 and 7.

Pressure regulator (6) is a pilot operated differential pressure type spool regulator for load sense control. The load sense feedback signal from the main hydraulic valve is fed to load sense port (P_L) on top of the pressure regulator (6) (see Figure 8). This feedback signal acts on the spring chamber end of the spool (23).

Unregulated Condition - Refer to Figure 4. Pump pressure is low and the load sense signal is wide open. The cut-off pressure spool spring (18 and 20) preload shifts the cut-off pressure spool (24) to its extreme right position. Since the pressure drop across the main hydraulic valve is low, both sides of the differential pressure spool (23) see the same pressure and therefore the spool (23) remains in the extreme right position. This condition causes the oil at the servo piston (61) to be vented, causing spring (70 and 71) force to move the servo piston (61) and swash plate (49) to maximum pump displacement.

Regulated Condition - Refer to Figure 5. Pump pressure is still relatively low but the pressure drop across the main hydraulic valve increases. The cut-off pressure spool spring (18 and 20) preload still retains the spool (24) in its extreme right position. However, since the pressure drop is increased, the pressure on the right hand side of the differential pressure spool (23) (pump delivery pressure) overcomes the combination of spring (17 and 19) preload and pressure in the load sense line in the left hand side of the differential pressure spool (23). Therefore the spool (23) moves to the left, blocking the vent line and causing the pressure to the large side of the servo piston (61) to increase, overcoming spring (70 and 71) force. This reduces the swash plate (49) angle and hence the pump displacement.

This will continue until the pump flow across the main hydraulic valve reduces the pressure drop to the value determined by the differential spool spring (17 and 19) preload.

Stand-by Condition - Refer to Figure 6. When no hydraulic operations are required, the pump stand-by condition is reached. The load sense line is vented to tank. The differential pressure spool (23) shifts to the extreme left due to pump outlet pressure. This allows

oil pressure to pass through the cut-off pressure spool (24) and reach the large side of the servo piston (61), overcoming spring (70 and 71) force and reducing the swash plate (49) angle to zero.

The pump also has a pressure limiting function, used for example when steering cylinder reaches the end of it's stroke. In this condition the delivery pressure will rise, and the load sense control will try to raise delivery pressure above the now 'dead head' pressure. This causes differential pressure spool (23) to shift to the extreme left, allowing oil pressure to pass through cut-off pressure spool (24) and reach the large side of the servo piston (61), overcoming spring (70 and 71) force and reducing the swash plate (49) angle to zero.

REMOVAL

Numbers in parentheses refer to Figures 1 and 7.

⚠ 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 perform the task 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 the 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. 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 the drain cock and drain the hydraulic oil into a suitable container. Close the drain cock, remove the hose and reinstall the blanking cap.

4. Clean the pump housing and surrounding area with a suitable solvent. Ensure that all hydraulic lines connected to the pump are identified for ease of installation and, with suitable containers available to catch leakage, disconnect the hydraulic lines. Fit blanking caps to all open lines and fittings.

5. Support the pump assembly with suitable lifting equipment. It is possible to set up a sling arrangement using the exhaust cradle. Remove the bolts (56) and lock-washers (57) securing the pump to the transmission. Remove the pump from the transmission.

6. Remove the O-ring from the pump. Wash the outside of the pump thoroughly with a suitable solvent and move it to a clean work area for disassembly. Discard the O-ring.

DISASSEMBLY

Numbers in parentheses refer to Figures 1 and 7.

Note: Discard and renew all O-rings and seals removed during disassembly.

1. Remove the drain plug (53) and drain the oil from the pump casing (51).

2. Remove the bolts (26) and then remove the regulator casing (25) from the pump casing (51). Ensure that the O-ring does not drop from the gasket surface of the regulator. Fit blanking caps to all open ports.

3. Remove the bolts (2 and 3) securing the valve cover (1) to the pump casing (51).

4. Separate the valve cover (1) from the casing (51). The valve plate (41) may detach from the valve cover. Ensure that the contact faces of the valve cover (1) and casing (51) are not damaged.

5. If necessary, remove the needle bearing (40) and valve plate (41) from the valve cover (1). Only remove the needle bearing (40) if it is nearing the end of its life. Do not loosen the nut (4), as this will influence the delivery flow rate.

6. Pull the cylinder block (42) out from the pump casing (51) straight over the driveshaft (80). Pull out the pistons and shoes (46), set plate (45), spherical bush (44) and cylinder springs (43) at the same time. Be careful not to damage the sliding surfaces of components.

7. Cover the splined end of the shaft with plastic tape to prevent the oil seal (81) being damaged. Remove the bolts (84) and seal cover (83), ensuring that the oil seal (81) is not damaged.

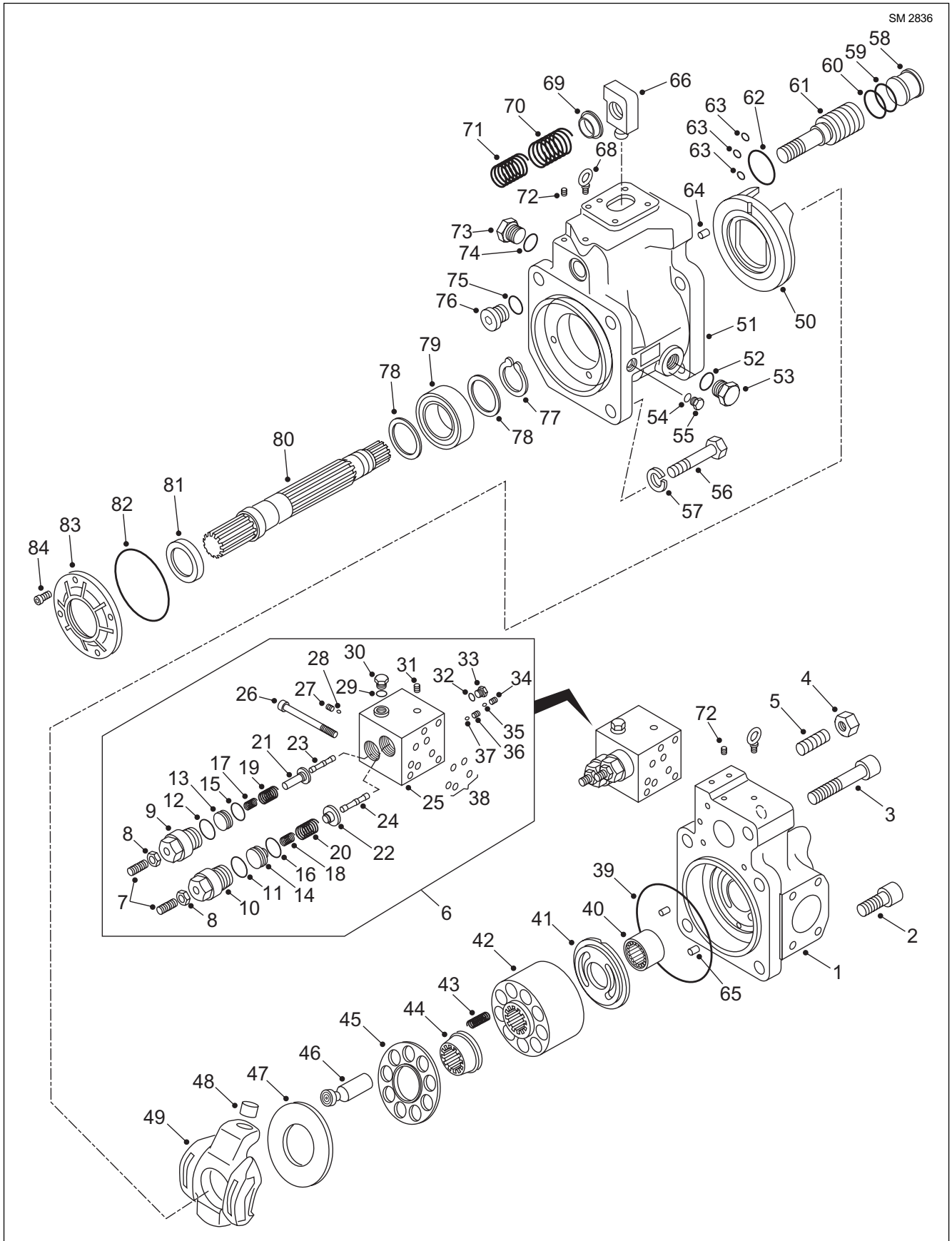


Fig. 7 - Exploded View Of Hydraulic Pump

LEGEND FOR FIG. 7

1 - Valve Cover	22 - Spring Seat	43 - Cylinder Spring	64 - Pin
2 - Bolt	23 - Spool	44 - Spherical Bush	65 - Pin
3 - Bolt	24 - Spool	45 - Set Plate	66 - Tilting Pin
4 - Nut	25 - Casing	46 - Piston & Shoe	68 - Eye Bolt
5 - Set Screw	26 - Bolt	47 - Shoe Plate	69 - Spring Seat
6 - Pressure Regulator	27 - Plug	48 - Tilting Bush	70 - Outer Spring
7 - Set Screw	28 - Orifice	49 - Swash Plate	71 - Inner Spring
8 - Nut	29 - O-ring	50 - Swash Plate Support	72 - Plug
9 - Plug	30 - Plug	51 - Pump Casing	73 - Plug
10 - Plug	31 - Plug	52 - O-ring	74 - O-ring
11 - O-ring	32 - O-ring	53 - Plug	75 - O-ring
12 - O-ring	33 - Plug	54 - O-ring	76 - Plug
13 - Stopper	34 - Plug	55 - Plug	77 - Snap Ring
14 - Stopper	35 - Orifice	56 - Bolt	78 - Bearing Spacer
15 - O-ring	36 - Plug	57 - Lockwasher	79 - Roller Bearing
16 - O-ring	37 - Plug	58 - Stopper	80 - Driveshaft
17 - Spring	38 - O-ring	59 - Back-up Ring	81 - Oil Seal
18 - Spring	39 - O-ring	60 - O-ring	82 - O-ring
19 - Spring	40 - Needle Bearing	61 - Servo Piston	83 - Seal Cover
20 - Spring	41 - Valve Plate	62 - O-ring	84 - Bolt
21 - Spring Seat	42 - Cylinder Block	63 - O-ring	

8. Hold the front of the driveshaft (80), and using a plastic hammer, tap the driveshaft (80) out of the pump casing (51). Do not remove the roller bearing (79) unless it is considered to be near the end of its expected life.

9. Push down the servo piston (61), and remove the shoe plate (47) and swash plate (49).

10. Remove the swash plate support (50) from the pump casing (51).

11. If necessary, remove the servo piston (61), tilting pin (66), outer spring (70), inner spring (71), spring seat (69) and plug (76). Ensure that the servo piston (61) and tilting pin (66) are not damaged when being removed.

Pressure Regulator

1. Remove the plug (9) and then remove the springs (17 and 19) and the spring seat (21). Be careful not to drop the spool (23) after removing the plug (9). Do not remove the nut (8), set screw (7) or stopper (13) unless required.

2. Remove the plug (10) and then remove the springs (18 and 20) and spring seat (22). Be careful not to drop the spool (24) after removing the plug (10). Do not remove the nut (8), set screw (7) or stopper (14) unless required.

3. Loosen the plug (33) and remove the spools (23 and 24).

4. If necessary, remove the plugs (27, 31, 34 and 36) and orifice (28 and 35).

ASSEMBLY

Numbers in parentheses refer to Figures 1 and 7.

This is largely the reverse sequence to disassembly, but note the following:

a) Ensure that all damaged parts are fixed or renewed before assembly.

b) Before assembly wash each part with clean oil and dry them with compressed air. Assemble the pump in a clean work area to prevent contamination.

c) When assembling, apply clean oil on the sliding surfaces and bearings.

d) When assembling parts that easily detach, for example O-rings, apply clean grease to prevent them from being misplaced.

1. Install servo piston (61), tilting pin (66), outer spring (70), inner spring (71), spring seat (69) and plug (76) in pump casing (51). Apply adhesive on the thread of the servo piston (61).

2. Fit the swash plate support (50) in the pump casing (51). Make sure that the pin (64) enters into the slit of the swash plate support (50). Be careful not to install the swash plate support (50) in an angular attitude.

3. Push down the servo piston (61) and insert the tilting pin (66) into the tilting bush (48) of the swash plate (49). Install the swash plate (49) and shoe plate (47) into the groove of the swash plate support (50) correctly.

4. Insert the driveshaft (80) into the pump casing (51), tapping the driveshaft (80) lightly so that the end of the roller bearing (79) is slightly above the surface of the pump casing (51). This prevents the swash plate support (50) from being displaced.

5. Cover the splined end of the driveshaft (80) with plastic tape. Apply grease to the lip of the oil seal (81) installed in the seal cover (83). Insert the seal cover (83) slightly into the pump casing (51). Tighten the bolts (84) uniformly to locate the seal cover (83), then tighten bolts to the standard torque.

6. Sub-assemble the cylinder block (42), pistons and shoes (46), spherical bush (44), set plate (45) and cylinder springs (43).

7. Place the pump casing (51) horizontally with the surface of the regulator downward. Install the piston-cylinder sub-assembly in the pump casing (51).

8. Install the valve plate (41) on the valve cover (1). When installing the valve plate (41), ensure that the pin (65) enters into the slit of the valve plate (41). If the stopper (58), max flow set screw (5) and max flow set screw lock nut (4) have been removed, reinstall these parts on the valve plate (41) beforehand.

9. Install the valve cover (1) on the pump casing (51) and secure it using the bolts (2 and 3).

10. Install regulator casing (25) to pump casing (51) and secure with bolts (26).

Pressure Regulator

1. If removed, install the plugs (27, 31, 34 and 36) and orifice (28 and 35) into the regulator casing (25).

2. Install the plug (33) and insert the spools (23 and 24). When inserting the spools, care should be taken not to damage the sliding surface of the spools.

3. If removed, install the nut (8), set screw (7) and stopper (13). Insert the springs (17 and 19) and spring seat (21) into the plug (9).

4. Install the plug (9) in the regulator casing (25).

5. If removed, install the nut (8), set screw (7) and stopper (14). Insert the springs (18 and 20) and spring seat (22) into the plug (10).

6. Install the plug (10) in the regulator casing (25).

7. Ensure that the O-rings (38) are in place and install the regulator casing (25) on the pump casing (51) using the bolts (26).

INSTALLATION

Numbers in parentheses refer to Figures 1 and 7.

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. Install a new O-ring to the pump.

2. Push the pump inward to engage with the coupling in the transmission. Secure the pump assembly to the transmission with the bolts (56) and lock-washers (57). Tighten the bolts (56) to a torque of 230 Nm (170 lbf ft).

3. Remove the caps and connect the outlet, inlet and load sense lines to the pump. Before connecting the case drain line, fill the pump casing through the drain port with clean hydraulic oil as used in the hydraulic tank. Connect the case drain line to the pump. Fill the hydraulic tank with oil specified in Section 300-0020, Lubrication System.

Note: It is very important that the pump casing is completely filled with hydraulic oil. This will ensure proper lubrication of the internal parts of the pump when it is initially operated. Fill the pump casing through the drain port. Filling only the suction line is totally insufficient.

4. Refer to 'Pump Starting Procedure' for proper start-up procedure.

PUMP STARTING PROCEDURE

1. Be sure the pump case drain line is free from obstructions that restrict the pump case drain flow

back to tank and is a cause of high case drain pressure which can lead to an early pump failure.

2. Ensure that all hydraulic controls are set to a neutral position, the steering lock bar is in the 'Locked' position and the battery master switch is placed in the 'On' position. Start the engine and allow the pump to run unloaded for a period to ensure that all residual air within the system is released.

3. Check for external leakage, abnormal noise and vibrations.

4. Remove the wheel blocks and place the steering lock bar in the 'Stowed' position. Start the engine and check the hydraulic systems for proper operation.

PRESSURE CHECKS

To check pump delivery pressure (cut-off pressure) the steering should be operated full lock against the stops. The pump is checked against the steering system as this is the highest pressure requirement in the hydraulic circuit.

> **⚠ WARNING**
> **The machine has to fully articulate to check the pump pressures, therefore the steering lock bar cannot be 'Locked'. To prevent personal injury and property damage, exercise extreme caution while working around the articulation and oscillation pivot area.**

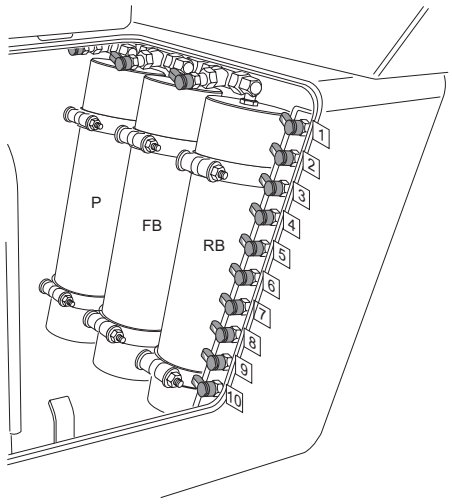
Delivery Pressure (cut-off pressure)
Install a pressure gauge capable of at least 240 bar (3 500 lbf/in^2) into the STR diagnostic checkpoint in the battery box (6, Fig. 8). When steering against the stops, the pressure should be 240 bar (3500 lbf/in^2).

Differential Pressure (load sense pressure)
Install a pressure gauge capable of at least 240 bar (3 500 lbf/in^2) into the STR diagnostic checkpoint in battery box (6, Fig. 8). Install a pressure gauge capable of at least 240 bar (3 500 lbf/in^2) into the LS VAL diagnostic checkpoint in battery box (2, Fig. 8). With the steering in the neutral position, the pressure at the STR gauge should be 25 bar (360 lbf/in^2) greater than the pressure at the LS VAL gauge.

If these pressures are not observed, then pump may need to be reset (refer to Troubleshooting).

TROUBLESHOOTING

If the steering cannot be operated or is excessively heavy, the pump delivery pressure is likely to be low and pump setting should be checked.



1 - Differential Lock Pressure
2 - Pump LS Pressure
3 - Front Brake Pressure
4 - Rear Brake Pressure
5 - Park Brake Pressure
6 - Steering Pressure
7 - Trans. Retarder Press.
8 - Trans. Converter Press.
9 - Body System Press.
10 - Trans. System Pressure
P - Primary Accumulator
FB - Front Brake Accumulator
RB - Rear Brake Accumulator

Fig. 8 - Diagnostic Test Points

If the difference (ΔP) between delivery pressure and load sense pressure is equal to 25 bar (360 lbf/in^2), proceed to the 'Pump Setting Procedure - Pump Delivery Pressure Setting'.

However, if the ΔP is not equal to 25 bar (360 lbf/in^2) carry out the complete 'Pump Setting Procedure'.

PUMP SETTING PROCEDURE

Note: It is very important that the pump casing is completely filled with hydraulic oil before the pump is operated. Fill the pump casing through the drain port. Filling only the suction line is totally insufficient.

Differential Pressure Setting

Numbers in parentheses refer to Figures 1 and 7, unless otherwise stated.

1. Install a pressure gauge capable of at least 240 bar (3500 lbf/in^2) into the STR diagnostic checkpoint in the battery box (6, Figure 8), to measure the pump delivery pressure (cut-off pressure) (Gauge A).

2. Install a pressure gauge capable of at least 240 bar (3500 lbf/in^2) into the LS VAL diagnostic checkpoint in the battery box (2, Figure 8) to measure the load

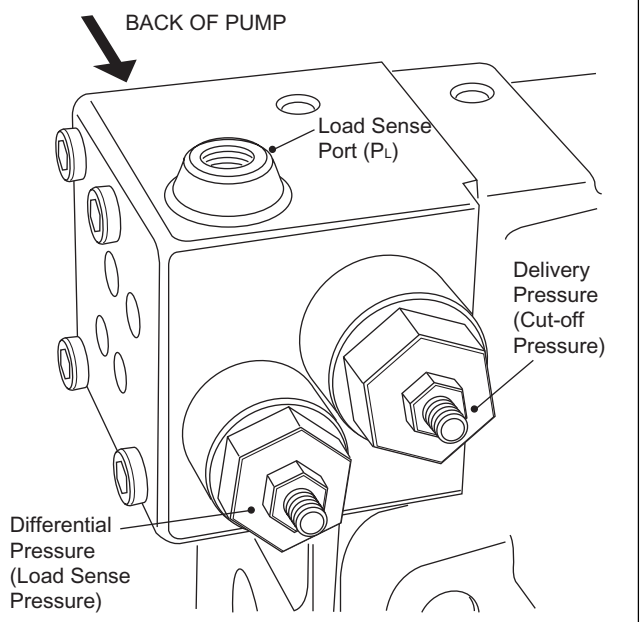


Fig. 9 - Pump Adjustment At Pressure Regulator

sense pressure setting (Gauge B).

3. Ensure that all hydraulic controls are set to a neutral position, the steering lock bar is in the 'Locked' position and place the battery master switch in the 'On' position. Start the engine and allow to run at low idle. This allows the pump to run unloaded for a period to ensure that all residual air within the system is released. Check for external leaks.

4. Check readings on both pressure gauges. Pump delivery pressure (Gauge A) should always be greater than load sense pressure (Gauge B). This differential pressure (ΔP) should be equal to 25 bar (360 lbf/in^2). If the ΔP pressure differs from 25 bar (360 lbf/in^2), then carry out steps 5 through 9.

Note: Typical readings -
STR = 34 - 38 bar (500 - 550 lbf/in^2)
LS Val = 11 - 13 bar (160 - 180 lbf/in^2)

Note: If the pump delivery pressure (Gauge A) is less than 25 bar (360 lbf/in^2), disconnect transmission oil cooler fan solenoid, causing solenoid valve to default to an open position, allowing hydraulic oil to the fan motor. This will place a demand on the pump, causing pump delivery pressure to increase.

5. At the differential pressure (load sense) port (see Figure 9), unlock the nut (8) and turn the set screw (7) clockwise (looking straight at set screw) to increase ΔP pressure, or counter-clockwise to decrease ΔP pressure.

Note: Adjustment of ΔP pressure = 5 bar (70 lbf/in^2) increase per quarter turn of set screw (7). This is a result of an increase of 7 bar (100 lbf/in^2) on the pump delivery pressure and an increase of 2 bar (30 lbf/in^2) on the LS pressure.

Note: Pressure should always be adjusted on the increase. Hence if ΔP pressure is too high, the set screw (7) should be turned counter-clockwise approximately 2 turns, then turn the set screw (7) clockwise to attain 25 bar (360 lbf/in^2).

6. Recheck the readings on both the pressure gauges. The pump delivery pressure (Gauge A) should be 25 bar (360 lbf/in^2) greater than the load sense pressure (Gauge B).

7. Once the correct ΔP is achieved, tighten the nut (8) at the differential pressure (load sense) port to 16 Nm (12 lbf ft).

8. The differential pressure (ΔP) is now set. Switch off the engine and relievethe system pressures as described in 'Removal'.

9. Remove the pressure gauges from the diagnostic pressure points in the battery box.

Pump Delivery Pressure Setting

Numbers in parentheses refer to Figures 1 and 7, unless otherwise stated.

⚠ WARNING
The machine has to fully articulate to set the pump, therefore the steering lock bar cannot be 'Locked'. To prevent personal injury and property damage, exercise extreme caution while working around the articulation and oscillation pivot area.

There should be no requirement to adjust the set screw (7) at the delivery pressure (cut-off pressure) port (see Figure 9) as this is factory set. The cut-off pressure sets the pump delivery pressure. If the set screw (7) or nut (8) has been moved, follow the procedure below to reset the pump delivery pressure :

1. Install a pressure gauge capable of at least 240 bar (3500 lbf/in^2) into the STR diagnostic checkpoint in the battery box to measure the pump delivery pressure (cut-off pressure).

2. Start the engine and run it at full throttle. Steer full lock against the stops. Observe the pressure on the gauge. This cut-off pressure should be 240 bar (3500 lbf/in^2). If the pressure reading differs or the steering is excessively heavy, then carry out steps 3 to 8 inclusive.

Note: The steering has to be operated over relief (against the stops) as this is the maximum pressure the pump must deliver. Setting the pump against any other operation would result in the pump being set at a lower maximum delivery pressure.

3. At the delivery pressure (cut-off pressure) port (see Figure 9), unlock the nut (8) and turn the set screw (7) clockwise to increase the cut-off pressure, or counter-clockwise to decrease the cut-off pressure (adjustment 90 bar [1305 lbf/in^2] per turn).

Note: The pressure should always be adjusted on the increase. Hence if the cut-off pressure is too high, the set screw (7) should be turned counter-clockwise to decrease cut-off pressure below 240 bar (3500 lbf/in^2), then turn the set screw (7) clockwise to attain 240 bar (3500 lbf/in^2).

4. Once the correct cut-off pressure has been attained, revert the steering to the neutral position, then steer full lock against the stops. Observe the gauge to confirm that the cut-off pressure is set to 240 bar (3500 lbf/in^2).

Note: A change in pump tone should be heard when the cut-off pressure is reached, as the pump de-strokes to standby condition.

5. If no change in pump tone is heard, the cut-off pressure is too high. Return to step 3 of the procedure. If the problem persists, refer to Section 220-0000, Steering System Schematic.

6. Tighten the nut (8) at the cut-off pressure port to 16 Nm (12 lbf ft).

7. The differential pressure (load sense) and cut-off pressure are now set. Switch off the engine and relieve the system pressures as described in 'Removal'.

8. Remove the pressure gauge from the diagnostic pressure point in the battery box.

Note: If there are still problems with the pump pressures after completing the 'Pump Setting Procedure', ensure that the set screw (5) has not been adjusted. As a dimensional check, the distance between the end of the set screw (5) to the face of the nut (4) should be 16 mm (0.63").

LUBRICATION

Refer to Section 300-0020, Lubrication System, for the recommended periodic oil change periods and oil specifications.

All pump parts are lubricated by hydraulic oil, and therefore the oil must be kept clean to minimize pump wear. Whenever there is a hydraulic system failure, the oil should be drained, the entire system flushed, oil filter replaced and clean hydraulic oil added to eliminate all metal particles or foreign matter.

PUMP WEAR LIMITS

Before reassembling the pump after disassembly, the Pump Wear Limits table should be consulted to establish which components should be replaced.

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.

PUMP WEAR LIMITS

ITEM	INITIAL VALUE	LIMIT FOR REPLACING	ACTION
Clearance between cylinder (42) bore and piston (46)	0.039 mm	0.067 mm	Replace piston/cylinder
Endplay between piston and shoe (46)	0.1 mm	0.3 mm	Replace piston-shoe assembly
Thickness of shoe	4.9 mm	4.7 mm	Replace piston-shoe assembly
Free height of cylinder spring (43)	39.5 mm	38.8 mm	Replace cylinder spring
Combined height of set plate (45) and spherical bush (44)	23.0 mm	22.0 mm	Replace set plate

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	8	Nut	16	12
1	56	Bolt	230	170

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DESCRIPTION AND OPERATION

The body control lever is mounted on the right hand side dash panel, next to the transmission shift controller.

When the body control lever is operated, a voltage is sent to the hydraulic ECU, which converts voltage to current. This current controls the body raise and lower proportional pressure control valves, producing a pilot pressure to shift the control spool in the main hydraulic valve. This allows the flow of oil to reach the body cylinders, to either raise or lower the body. Refer to Section 230-0000, BODY SYSTEM SCHEMATIC and Section 215-0050, MAIN HYDRAULIC VALVE.

The three operating positions of the joystick from front to rear are as follows:

Power Down - Pushing the lever forward provides hydraulic force to power-down the body. Pushing the lever fully forward will engage the electric detent. When the body reaches the body proximity switch, the lever springs back to 'NEUTRAL' and power down is ramped back to allow the body to float down onto the chassis.

Neutral - If the body is above the body proximity switch, the lever in this position will stop and hold the body at any desired height. If the body is below the proximity switch, the hydraulic ECU defaults the control spool in the main hydraulic valve to the neutral position and energises the float solenoid, allowing the body to float down onto the chassis. The body should be fully lowered and in the 'NEUTRAL' position while the machine is in motion. The lever will remain in the 'NEUTRAL' position when released.

Raise - Pulling the lever back and holding it in this position directs oil to extend the body hoists and raise the body. When released, the lever will spring back to the 'NEUTRAL' position.

A body lower emergency switch in the cab is connected directly to the float solenoid, within the main hydraulic valve, to enable the lowering of the body in the event of an engine, hydraulic or hydraulic ECU failure. The cause of the failure must be investigated and corrected.

Note: The body must remain lowered with lever in the 'NEUTRAL' 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.

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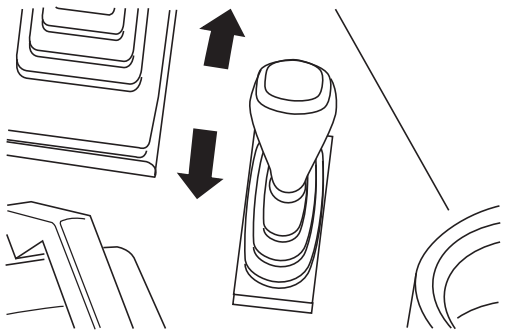

Fig. 1 - Body Control Lever

WARNING

Always disconnect body control lever before welding on the machine.

MAINTENANCE

The body control lever is a non-serviceable item and should be replaced completely, if damaged, as follows:

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

⚠ WARNINGS

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

⚠ Hydraulic fluid pressure will remain within the 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.

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

2. Operate the treadle valve continuously to relieve pressure in the hydraulic system.

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

4. Disconnect body control lever harness from main harness.

5. Support body control lever and remove screws securing body control lever on the right hand dash panel.

6. Remove body control lever from mounting location.

7. Secure new body control lever on the right hand dash panel with screws.

Note: Ensure harness from body control lever is at the front when lever is installed.

8. Reconnect main harness to body control lever harness.

9. Place the battery master switch in the 'On' position, start the engine and bring hydraulic oil to operating temperature. Operate the body control lever to ensure correct operation.

10. Remove wheel blocks and place the steering lock bar in the 'Stowed' position.

TROUBLESHOOTING

A faulty body control lever will cause an input error at the hydraulic ECU. Refer to Section 190-0085, HYDRAULIC SYSTEM ECU.

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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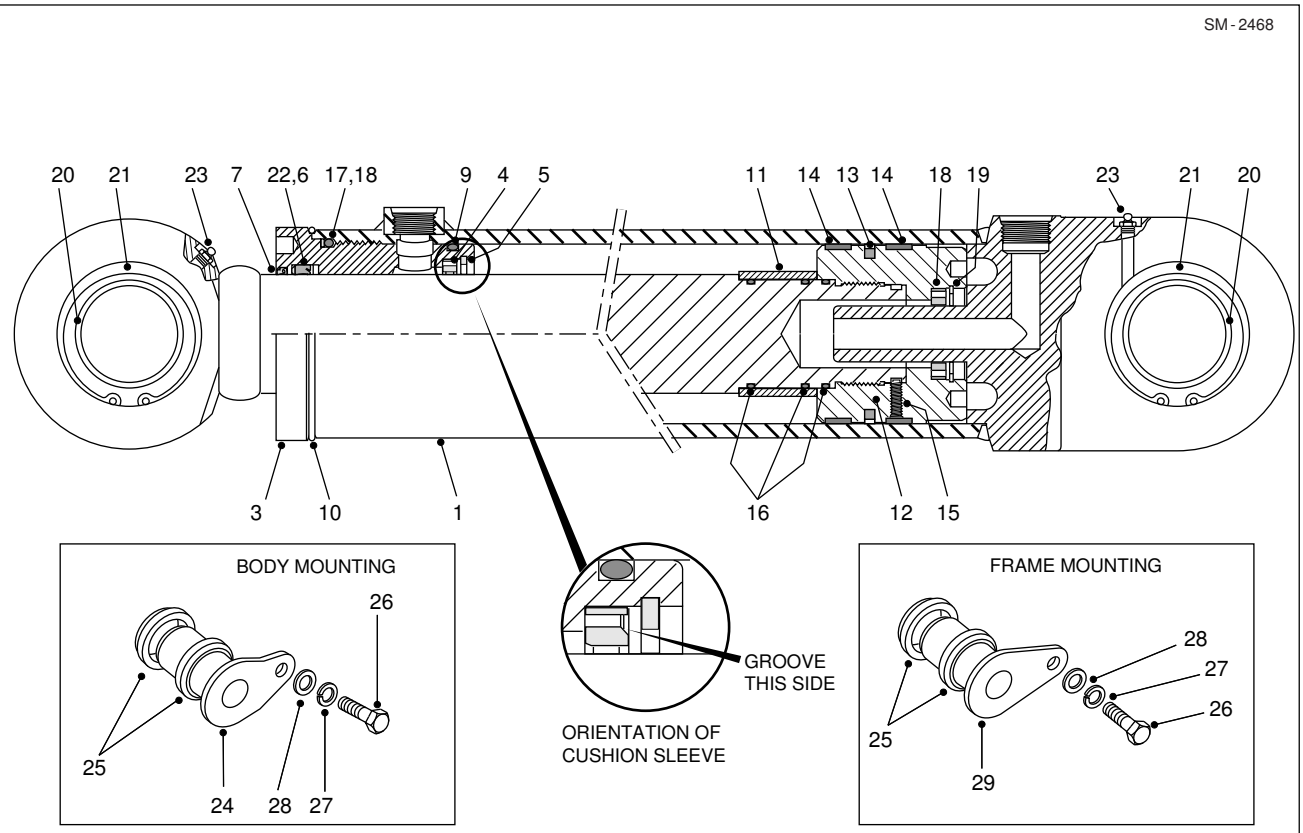

1 - Cylinder Body
2 - Piston Rod
3 - End Cap
4 - Cushion Sleeve
5 - Circlip
6 - Rod Seal
7 - Wiper
8 - 'O' Ring
9 - 'O' Ring
10 - Lock Ring
11 - Cushion Spear
12 - Piston
13 - Piston Seal
14 - Wear Ring
15 - Grub Screw
16 - 'O' Ring
17 - Back Up Ring
18 - Cushion Sleeve
19 - Circlip
20 - Spherical Bearing
21 - Circlip
22 - Nylon Ring
23 - Lube Fitting
24 - Upper Pin
25 - Spacer
26 - Bolt
27 - Lockwasher
28 - Washer
29 - Lower Pin

Fig. 1 - Sectional View Of Body Cylinder and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

There are two single stage, double acting body hoist cylinders, cushioned at both ends of the stroke on the vehicle. The cylinder base end is connected to the trailer frame and piston rod (2) end is connected at the body. Single stage double acting means that piston rod (2) can have oil applied to either side, extending or retracting the piston rod.

Cylinder mounting is by pins (24 & 29), spacers (25) and spherical bearings (20) secured in place with circlips (21). Spherical bearings (20) permit a limited amount of cylinder misalignment.

REMOVAL

Numbers in parentheses refer to Fig. 1.

⚠ WARNINGS

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

⚠ Hydraulic fluid pressure will remain within the body hoist system after engine shutdown. Operate the treadle pedal continuously until the pressure has dissipated before carrying out any work on the hydraulic system or serious injury could result.

⚠ WARNING
Exercise extreme caution when lowering the cylinders from the body. The cylinders will swing out sharply as they leave their mountings.

1. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine.

2. Press and hold down body hoist bleed down switch and operate the body control joystick continually to relieve pressure in the body hoist system.

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

4. Install a suitable strap around the cylinder and attach to a lifting device.

5. Position a suitable container at the base end of one cylinder. Identify and remove the hydraulic lines. Cap hydraulic lines and cylinder ports to prevent entry of dirt.

6. Remove bolt (26), lockwasher (27), washer (28) and upper pin (24) connecting piston rod (2) end of the cylinder to the body. 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.

7. Lower cylinder slowly and remove spacers (25).

Note: Cylinder will swing out sharply as it leaves its mounting.

8. Remove bolt (26), lockwasher (27), washer (28) and lower pin (29) connecting base end of the cylinder to the frame.

9. Remove spacers (25) and remove cylinder assembly to a clean area for disassembly.

10. Repeat steps 4 through 9 for opposite cylinder.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

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

1. Ensure clean working conditions, remove any port plugs thus allowing easy entry of air into cylinder body (1), preventing a vacuum when parts are withdrawn from cylinder body (1).

2. Remove circlips (21) from base end of cylinder body (1) and piston rod (2) end. Press out spherical bearings (20).

3. Remove lock ring (10) from end cap (3).

4. Using special tool which can be fabricated as shown in Fig. 2, unscrew end cap (3) until thread is disengaged from cylinder body (1).

5. Support piston rod (2) at the rod eye and withdraw piston rod (2) from cylinder body (1). Ensure centre lines of piston rod (2) and cylinder body (1) remain coincidental during removal of piston rod (2).

6. Place piston rod (2) on supports which will not damage the piston rod diameter.

7. Remove and discard piston seals (13) and wear rings (14) from piston (12).

8. Remove grub screw (15) from wear ring (14) groove in piston (12).

9. Provide an anti-torsion device through piston rod (2) eye to allow unscrewing of piston (12). Using special tool which can be fabricated as shown in Fig. 3, unscrew piston (12) from piston rod (2).

10. Remove cushion spear (11) and 'O' rings (16) from piston rod (2). Discard 'O' rings (16).

11. Remove cylinder end cap (3) from piston rod (2). Remove and discard cushion sleeve (4), circlip (5), rod seal (6), nylon ring (22), wiper (7), 'O' rings (8 & 9) and back up ring (17).

INSPECTION

Numbers in parentheses refer to Fig. 1

1. Clean all parts of the cylinder with a suitable solvent and dry with clean, lint-free cloths. Clean all grooves carefully to remove any foreign material.

2. Check cylinder body (1) and outer diameter of piston (12) for scratches, cracks or other defects. Remove ridges, nicks and scratches with a fine stone and re-clean. Replace any components which cannot be repaired.

3. Inspect piston rod (2) for distortion, cracks or other defects. Replace piston rod if defective area is irreparable.

4. Check spherical bearing (20) for wear and replace if necessary.

ASSEMBLY

Numbers in parentheses refer to Fig. 1.

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

1. Press spherical bearing (20) in base end of cylinder body (1) and piston rod (2) end. Secure spherical bearings (20) with circlips (21).

2. Install new cushion sleeve (4), circlip (5), rod seals (6), nylon ring (22), 'O' rings (8 & 9) and back up (17) in end cap (3). Load end cap (3) over piston rod (2) thread, taking care not to damage rod seal (6) on the thread.

3. Install new 'O' rings (16) on piston rod (2) and replace cushion spear (11).

4. Apply Loctite 243 to first two threads of piston (12). Using special tool which can be fabricated as shown in Fig. 3, screw on piston (12) and tighten to a torque of 1 356 Nm (1 000 lbf ft).

5. Insert piston grub screw (15) through wear ring (14) groove in piston (12) and into groove machined in piston rod (2). Tighten grub screw (15) to a torque of 49 Nm (36 lbf ft). Ensure the extreme of grub screw (15) is below the level of wear ring (14) groove.

6. Ensure cushion sleeve (18) and circlip (19) are secure in piston (12).

7. Insert new piston seal (13) and new wear rings (14) in piston (12).

8. Fully grease piston (12) OD and 'O' rings (8 & 9) in end cap (3).

9. Sling assembled piston rod (2) in a manner to allow careful leading of the assembled piston rod into cylinder body (1). Take care not to damage piston seal (13) on cylinder body (1) threads.

10. After piston (12) is inserted in cylinder body (1), push the piston rod assembly into cylinder body (1) maintaining coincidental centre lines of piston rod and cylinder body.

11. Before piston rod (2) is fully home and, with slings still taking some of piston rod (2) weight, engage end cap (3) thread and screw home.

12. Push piston rod (2) to the fully retracted position and tighten end cap (3) to a torque of 237 Nm (175 lbf ft).

13. Re-drill end cap (3) for lock ring (10), 3 x 12 mm (0.125 x 0.50 in) deep, if necessary. Insert lock ring (10) in end cap (3).

INSTALLATION

Numbers in parentheses refer to Fig. 1.

Note: Tighten all hydraulic lines fitted with ORFS connections, as described in Section 230-0000, BODY SYSTEM SCHEMATIC. Renew all 'O' rings where used.

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

1. Install a suitable strap around the cylinder and position cylinder on unit with base end of cylinder ready for mounting.

2. Install spacers (25) in base end of cylinder and insert lower pin (23) through mounting bores, spacers (25) and cylinder. Secure lower pin (23) with washer (28), lockwasher (27) and bolt (26). Tighten bolt (26) to a torque of 66 Nm (49 lbf ft).

3. Install spacers (25) in rod end of cylinder, align spherical bearing with bores in body and install upper pin (24) through mounting bores, spacers (25) and cylinder. Secure upper pin (24) with washer (28), lockwasher (27) and bolt (26). Tighten bolt (26) to a torque of 66 Nm (49 lbf ft).

4. Connect the hydraulic oil lines to the cylinder ports as tagged during removal.

5. Lubricate pins at lube fittings (22) with lubricant as specified in Section 300-0020, LUBRICATION SYSTEM.

6. Check oil level in hydraulic tank and add if low. Refer to Section 230-0040, HYDRAULIC TANK, for correct fill level. Refer to Section 300-0020, LUBRICATION SYSTEM, for the type of oil used.

7. Place the battery master switch in the 'On' position, start the engine, operate the body and check cylinder lines for leaks. Tighten lines and fittings as required.

8. Remove wheel blocks from road wheels.

MAINTENANCE

Every 250 hours: Lubricate cylinder pins as described in Section 300-0020, LUBRICATION SYSTEM. Inspect cylinders for leaks, if leaks are found, replace seals with seals contained in the Service Repair Kit, as specified in the parts book.

SPECIAL TOOLS

Special tools can be fabricated as shown in Figs. 2 & 3. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of general service tools required. These tools are available from your dealer.

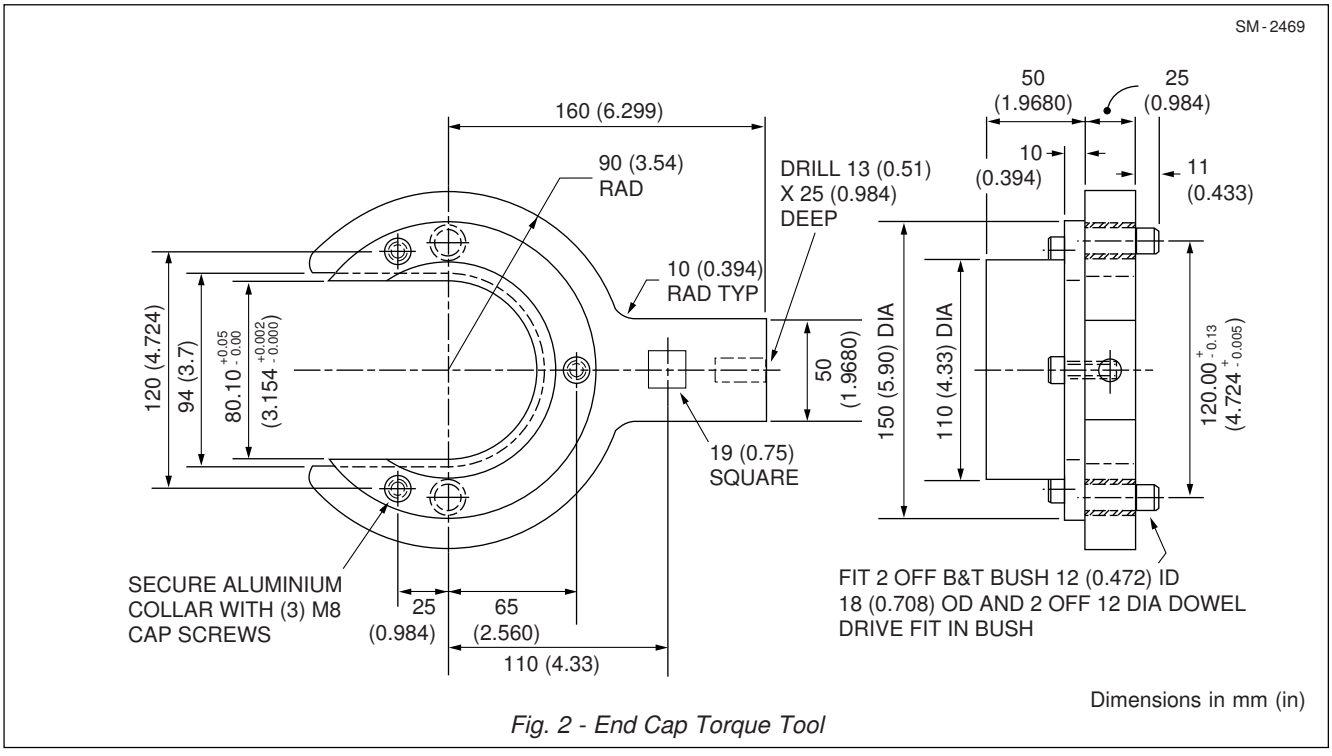

Fig. 2 - End Cap Torque Tool

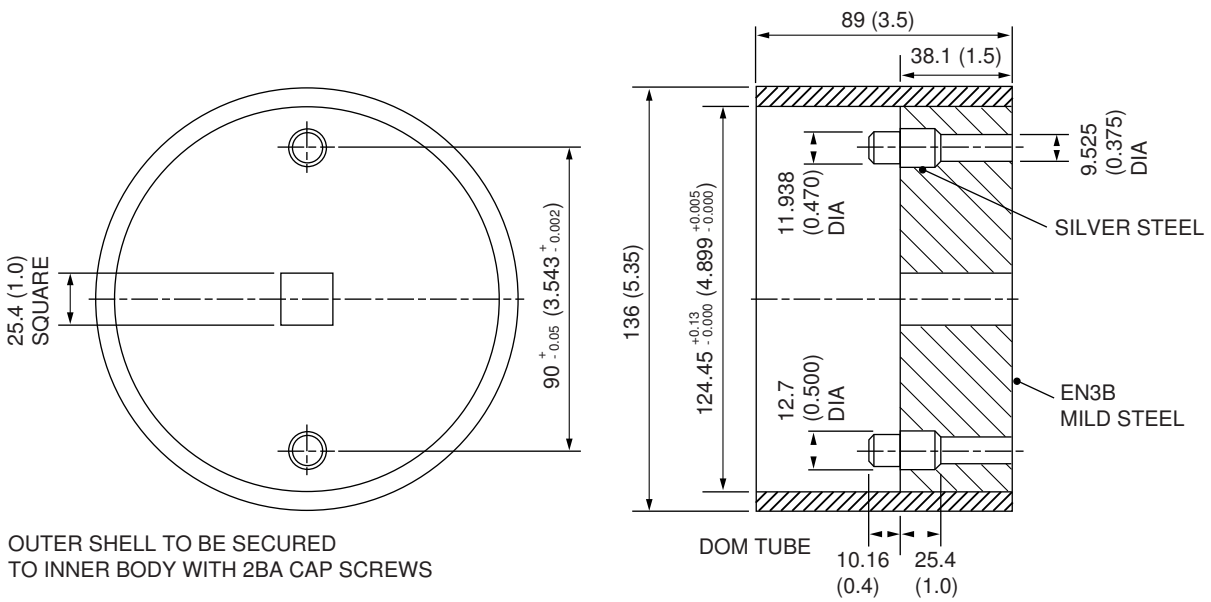

Fig. 3 - Piston Torque Tool

SPECIAL TORQUE SPECIFICATIONS

FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	3	End Cap	237	175
1	12	Piston	1 356	1 000
1	15	Grub Screw	49	36
1	26	Bolt	66	49

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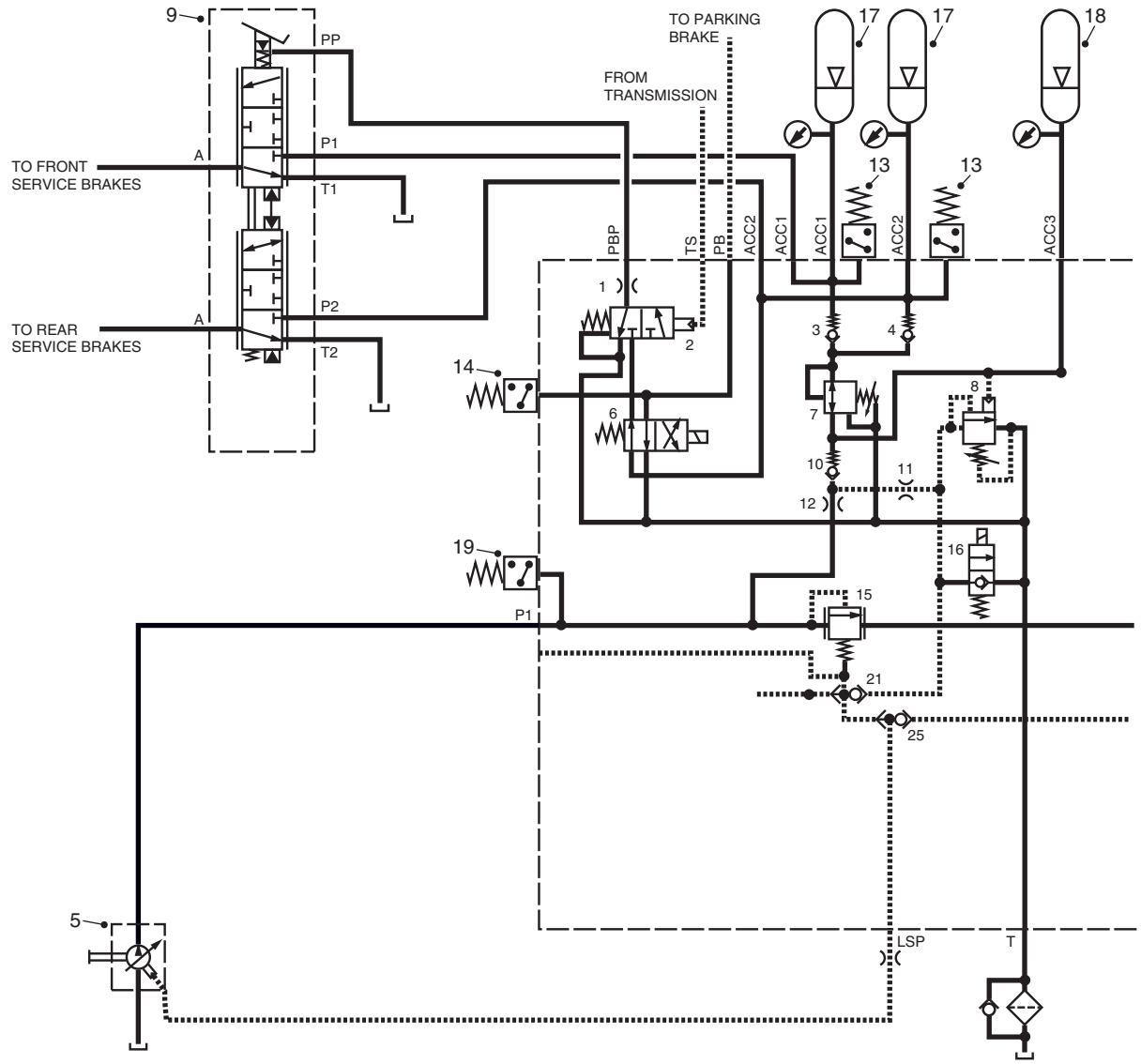


1 - Orifice
2 - Directional Control Valve
3 - Check valve
4 - Check Valve
5 - Main Hydraulic Pump
6 - Park Brake Solenoid Valve
7 - Brake System Relief Valve
8 - Brake System Charge Valve
9 - Brake Treadle Valve
10 - Check Valve
11 - Orifice
12 - Orifice
13 - Pressure Switch
14 - Pressure Switch
15 - Priority Valve
16 - Cold Start Solenoid Valve
17 - Brake Accumulators
18 - Primary Accumulator
19 - Pressure Switch
21 - Shuttle Valve
25 - Shuttle Valve

Fig. 1 - Brake System Schematic

DESCRIPTION

Numbers in parentheses refer to Figures 1, 2 and 9.

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 165-0010, Brake Parts.

The service brakes are of the oil immersed multi disc-type. The service piston is designed for use with hydraulic oil as specified in Section 300-0020, Lubrication System.
DO NOT USE BRAKE FLUID (J 1703).

The brake head is bolted to a mounting plate on the axle housing. There are two brake heads at each of the six road wheels.

When the treadle valve is actuated, hydraulic oil enters the brake head and forces the piston against the brake discs which are in turn forced against each other , locking together and thus preventing the spindle from further movement, 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 'PB' line 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', which means that it requires 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 park brake solenoid valve (6) on the main hydraulic valve assembly, 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 and selecting the transmission gear, directs oil pressure from the rear 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 'PB' line 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, braking and body hoist systems. It is mounted on the frame and fender bracket, on 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.

Main Hydraulic Pump (5)

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, body, brakes and transmission cooler fan drive circuits.

The main hydraulic pump is an axial piston, variable displacement type, with load sense and pressure regulator.

Parking Brake Pressure Switch (14)

Located on the main hydraulic valve assembly it senses pressure in the parking brake (PB) line. The pressure switch closes at a pressure of 5 bar (70 lbf/in^2) and sends a signal to illuminate the parking brake indicator light when the parking brake is applied.

Brake Circuit Pressure Switches (13)

Front and rear brake circuit pressure switches are both located on the main hydraulic valve assembly. The pressure switches sense pressure in the front and rear brake circuits and sends a signal to warning lights on the dash (a buzzer also sounds) when the pressure drops below 122 bar (1770 lbf/in^2). The warning lights will remain illuminated until the pressure rises above 135 bar (1960 lbf/in^2).

Brake Accumulators (17/18)

Refer to Section 250-0060, Accumulator.

There are three accumulators mounted inside the battery box located on the front left-hand side of the tractor; one for the front brake system and one for the rear. The front and rear brake accumulators are supplemented by a third (primary) accumulator (18), also mounted inside the battery box. The primary accumulator supports the service brake system and the body pilot pressure system. All three accumulators are of the piston type and are precharged with nitrogen to 105 bar (1500 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 the

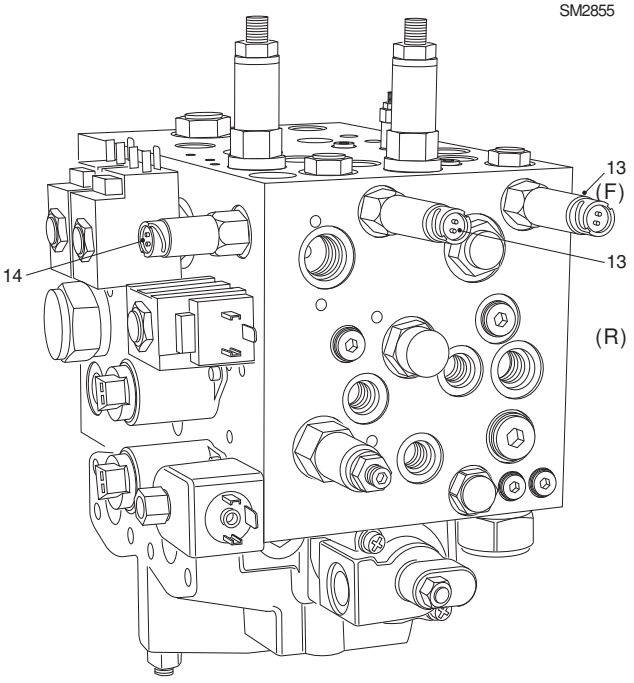
accumulator charged.

The piston acts as a separator dividing the cylinder assembly into two sections. The bottom section nearest the charging valve contains the nitrogen precharge. Hydraulic oil from the main hydraulic pump flows through check valves in the main hydraulic valve and into the top section of the accumulators. Accumulator pressure is monitored by pressure switches (13) in the brake lines.

A diagnostic pressure point is provided local to each brake accumulator, to facilitate the fitting of pressure test apparatus.

Brake Treadle Valve (9)

Refer to Section 250-0070, Treadle Valve.



13 - Service Brake Circuit Pressure Switches
14 - Park Brake Pressure Switch

Fig. 2 - Brake System Pressure Switch Locations

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 operator's cab and, with the engine running, is automatically applied by the park brake solenoid valve (6) on the main hydraulic valve.

Advanced Engine Braking

A microswitch is mounted on the brake treadle valve, which on foot pedal activation sends a signal to the engine ECM requesting the engine brake.

The first 5° (±1°) movement of the brake pedal engages the Engine Brake, provided the transmission is in 'lockup'. Further movement of the brake pedal applies the service brakes in addition to the engine brake. The engine brake will disengage when the brake pedal is released, or when any of the operating conditions become out of range.

Valves 1, 2, 3, 4, 6, 7, 8, 10, 11, 12, 15, 16, 21 and 25

These valves form part of the brake cuircuit and are an intregal part of the main hydraulic valve assembly, mounted on the left hand side of the tractor frame. Ref. Section 215-0050, Main Hydraulic Valve Assembly.

OPERATION

Numbers in parentheses refer to Figures 1, 2 and 9.

Brake Charging

The valves integral of the main hydraulic valve assembly automatically maintain the brake accumulator pressures between a lower and upper limit.

Accumulators (17) are charged from accumulator (18) via brake system relief valve (7), to limit the pressure in these accumulators to 155 bar (2248 lbf/in^2) and then via check valves (3 and 4) respectively.

If the pressure in accumulator (18) is below the lower charge limit of 165 bar (2390 lbf/in^2) the brake system charge valve (8) spring closes the brake system charge valve (8). The pressure then builds up in the load sense line from brake system charge valve (8) to the shuttle valve (21) and on to the priority valve (15) spring chamber where it helps this valve to close, ensuring flow priority is to the brake charging. At the same time it also acts on the main hydraulic pump load sense line via shuttle valve (25) to supply sufficient flow to charge the accumulators.

As soon as the pressure in accumulator (18) reaches the upper charge limit of 185 bar (2680 lbf/in^2) the brake system charge valve (8) opens and unloads the load sense line to tank. This action unloads the main hydraulic pump back to its standby pressure of 25 bar (360 lbf/in^2).

The accumulators (17 and 18) are also automatically charged every time the pressure at the main hydraulic pump rises above the pressure in accumulator (18). It is therefore possible to achieve pressures up to the

main hydraulic pump cut off pressure of 240 bar (3500 lbf/in^2) in this accumulator (18) (for example when steering over the relief). The brake system relief valve (7) will still limit the pressure in accumulators (17) to 155 bar (2248 lbf/in^2).

The orifice (12) is rated at 6 l/min and would protect all three accumulators (17/18) against abnormally high pressure spikes. However, accumulator (18) can see system pressure if any of the main hydraulic functions are held over the relief for a period of time.

Brake Apply

The minimum pressure required at the brake treadle valve is 117 bar (1696 lbf/in^2) and the accumulator pre-charge pressure is 90% of this at 105 bar (1522 lbf/in^2).

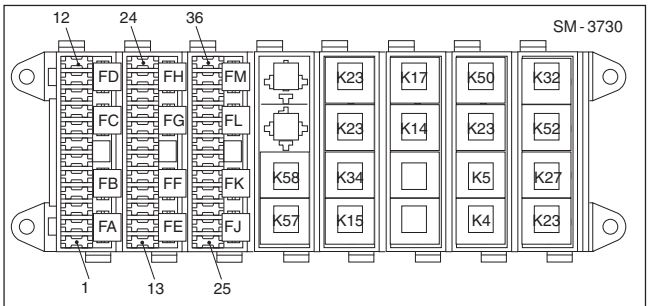


Fig. 3 - Fuse Box Layout (Operator's Cab)

The brake treadle valve controls the level of hydraulic pressure applied to front and rear brakes and the maximum pressure available to these circuits. It is operated by the foot pedal in the operator's cab and in an emergency with the engine running, is automatically applied by the park brake solenoid valve (6) in the main hydraulic valve assembly (Refer to the Park/ Emergency Brake Function description).

Mounted on the the brake treadle valve is a microswitch (S106). This microswitch sends a signal to activate the engine brake and rear brake lamps. The brake pedal microswitch energizes K50, brake lamp relay and K32, engine brake relay. Both relays are located in operator's cab fuse/relay box. When these relays are energized an electrical circuit is completed to energize appropriate lamps and request signals.

The first 5° (±1°) movement of the brake pedal engages the Engine Brake, providing the transmission is in 'lockup'. Further movement of the brake pedal applies the service brakes in addition to the engine brake. The engine brake will disengage when the brake pedal is released, or when any of the operating

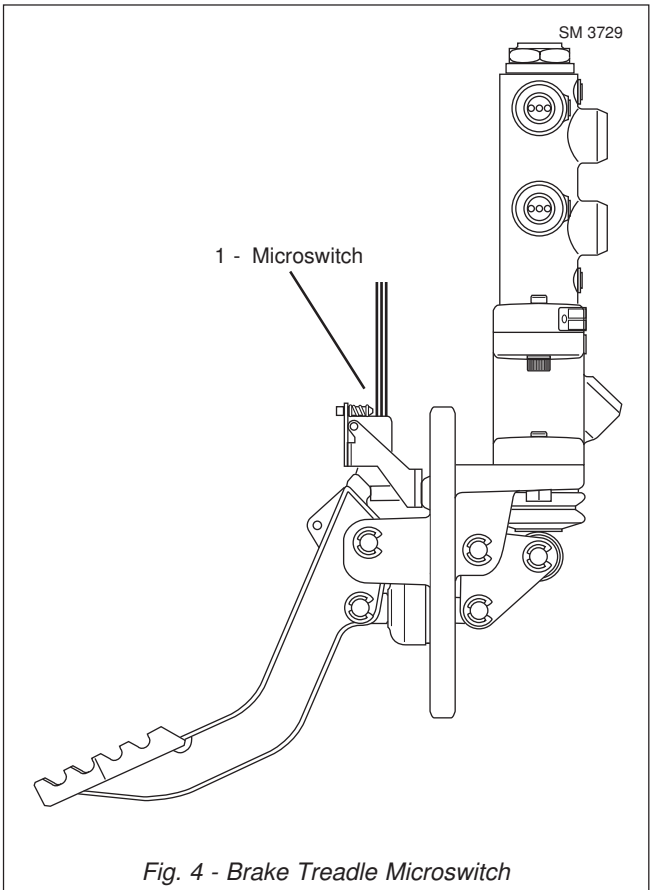


Fig. 4 - Brake Treadle Microswitch (Advanced Engine Brake)

conditions become out of range.

Park/Emergency Brake Function

The park/emergency brake function is designed to electrically operate the park brake and with the engine running automatically actuates the service brakes also during this operation.

When the engine is running, a transmission hydraulic pilot pressure acts against the spring at the directional control valve (2). The directional control valve (2) creates an open circuit between the main hydraulic valve assembly and port 'PP' on the brake treadle valve. This permits a flow of oil to either energize the 'PP' port at the treadle valve, or to exhaust the 'PP' port through the main hydraulic valve assembly to tank, dependant on operation of the park brake solenoid valve (6). The park brake solenoid valve (6) is controlled by the park/emergency control switch inside the operator's cab and also the transmission T.C.U which controls the parkbrake OFF relay.

When the park/emergency control switch is activated (pushed in), the electrical signal between the switch and park brake solenoid valve (6) is opened. This action de-energizes the park brake solenoid valve (6). Oil flows through park brake solenoid valve (6) and

through the directional control valve (2). The oil travels through the directional control valve and into the 'PP' port in the treadle valve for an emergency brake application.

Return oil from the parking brake circuit enters the main hydraulic valve assembly. The oil flows through park brake solenoid valve (6) and exits the main hydraulic valve assembly to the hydraulic tank. With no pressure in the parking brake circuit to hold the parking brake off, the parking brake is applied.

When the emergency brake switch is deactivated (pulled out) and the transmission is in gear, the park brake OFF relay contacts close.The electrical signal between the switch and park brake solenoid valve (6) is closed, energizing the park brake solenoid valve (6). Oil flows through the park brake solenoid valve (6) and exits the main hydraulic valve assembly to the parking brake circuit, to release the parking brake.

Return oil from the 'PP' port on the brake treadle valve flows through the directional control valve (2) through the park brake solenoid cartridge (6) and exits the main hydraulic valve assembly to the hydraulic tank.

When the engine is shut down, transmission pilot pressure at directional control valve (2) is lost, causing the directional control valve (2) to move to the right under the influence of the compressed spring. This movement links the 'PP' port at the brake treadle valve with the hydraulic tank through the main hydraulic valve assembly. This action results in a controlled bleed down of the applied service brakes to the hydraulic tank. This controlled bleed down permits a synchronized service brake release/mechanical park brake application.

When the transmission is in neutral and transmission output speed is less than 60RPM~1MPH, the Parkbrake OFF relay contacts open. Thus, the park brake solenoid valve (6) is automatically de-energized (fail safe). Park brake hold off pressure is allowed to return to tank through the park brake solenoid valve (6), causing the park brake to apply (spring applied). The vehicle is now held with the park brake only.

CHECKING SYSTEM PRESSURES

Numbers in parentheses refer to Figures 1, 2 and 9, unless otherwise stated.

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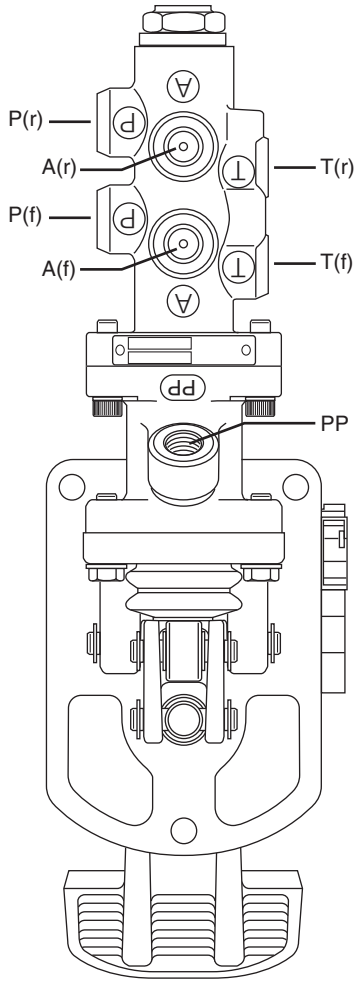


A(f) - Pressure to Front Brakes
A(r) - Pressure to Rear Brakes
P(f) - Pressure from Front Brake Accumulator
P(r) - Pressure from Rear Brake Accumulator
T(f) - Tank Return - Front Brakes
T(r) - Tank Return - Rear Brakes
PP - Emergency/Park Pilot Pressure

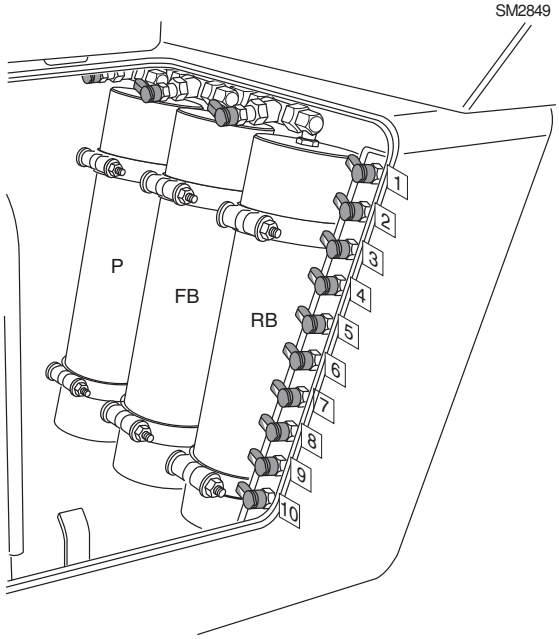
Fig. 6 - Brake Treadle Valve Porting Arrangement

⚠ 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 brake treadle pedal continuously until the pressure has dissipated before carrying out any work on the 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 the



1 - Differential Lock Pressure
2 - Pump LS Pressure
3 - Front Brake Pressure
4 - Rear Brake Pressure
5 - Park Brake Pressure
6 - Steering Pressure
7 - Trans. Retarder Press.
8 - Trans. Converter Press.
9 - Body System Press.
10 - Trans. System Pressure
P - Primary Accumulator
FB - Front Brake Accumulator
RB - Rear Brake Accumulator

Fig. 7 - Diagnostic Pressure Check Points (Battery Box)

steering wheel in both directions several times to relieve any pressure in the steering circuit.

2. Operate the brake 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. Connect a hydraulic gauge, capable of recording a pressure of 0 - 345 bar (0 - 5 000 lbf/in²), to the park brake diagnostic pressure point (5, Figure 7) inside the battery box.

4. Place the battery master switch in the 'On' position, start the engine and release the park/emergency button (pull out), to energize the park brake line. Monitor the system pressure gauge. The pressure setting should be 155 bar (2248 lbf/in²).

5. If necessary, the pressure setting can be adjusted via the brake system relief valve (7) on the main hydraulic valve assembly. The operator's cab will require to be raised to access brake system relief valve (7). Refer to Section 260-0010, Cab and Mounting.

6. Connect a hydraulic gauge, capable of recording a pressure of 0 - 345 bar (0 - 5000 lbf/in²), to the front brake diagnostic pressure point (3, Figure 7) inside the battery box.

7. Place the battery master switch in the 'On' position, start the engine and apply park/emergency brake (push button in), to apply service brakes. Monitor system pressure gauge. Brake actuating pressure for the front brake circuit is 60 ±5.1 bar (870 ±75 lbf/in²).

8. Repeat steps 6 and 7 at the rear brake diagnostic pressure point (4, Figure 7) inside the battery box. The brake actuating pressure for the rear brake circuit is 60 ±5.1 bar (870 ±75 lbf/in²).

Note: When the brakes are released, a residual pressure of 0.5 bar (7 lbf/in²) should remain.

9. If necessary, the pressure setting can be adjusted via the brake system relief valve (7) on the main hydraulic valve assembly. The operator's cab will require to be raised to access the brake system relief valve (7). Refer to Section 260-0010, Cab and Mounting.

10. Shut off the engine and remove the pressure gauge from the diagnostic pressure point.

11. Remove the wheel blocks, place the steering lock bar in the 'Stowed' position, start the engine and check the braking system for proper operation.

BLEEDING THE BRAKING SYSTEM

Refer to Section 165-0010, Brake Parts.

O-RING FACE SEALS (ORFS)

Where hydraulic lines are fitted with ORFS connections, the following procedure should be carried out during 'Installation'. Refer to Figure 8.

a. Ensurethat the O-ring/seal is in place and that the joining surfaces are clean. If necessary, retain the O-ring/seal in place with a light coating of grease or vaseline.

b. Initially, the nuts should be tightened by hand.

c. Where a hose is fitted, ensure that it is not twisted or kinked when the nuts are tightened, so that it is allowed to adopt a natural position.

d. Where a tube is fitted, ensure that the connection is

aligned correctly.

e. Tighten the nut a further 1/4 to 1/2 a turn using the correct size spanner (wrench).

f. Check that a satisfactory hose or tube routing has been achieved.

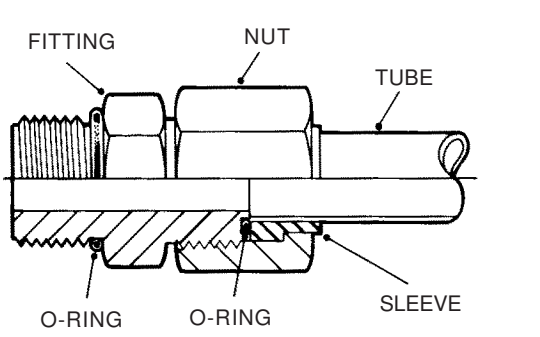


Fig. 8 - Assembly of Typical ORFS Connector

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 service tools are used when carrying out pressure and temperature checks during maintenance procedures. These tools, along with other general service tools, are available from your dealer. Refer to Section 300-0070, Service Tools, for part numbers of these tools.

Multi-Gauge

The multi-gauge, 15269784, is basically four pressure gauges in one. Continuous system pressure readings are indicated on one of three simultaneously reading gauges through a pressure range of 30 in of vacuum to 5 000 lbf/in^2.

The following items should be added to the multi-gauge to enable the gauge to be used on the diagnostic pressure check points:

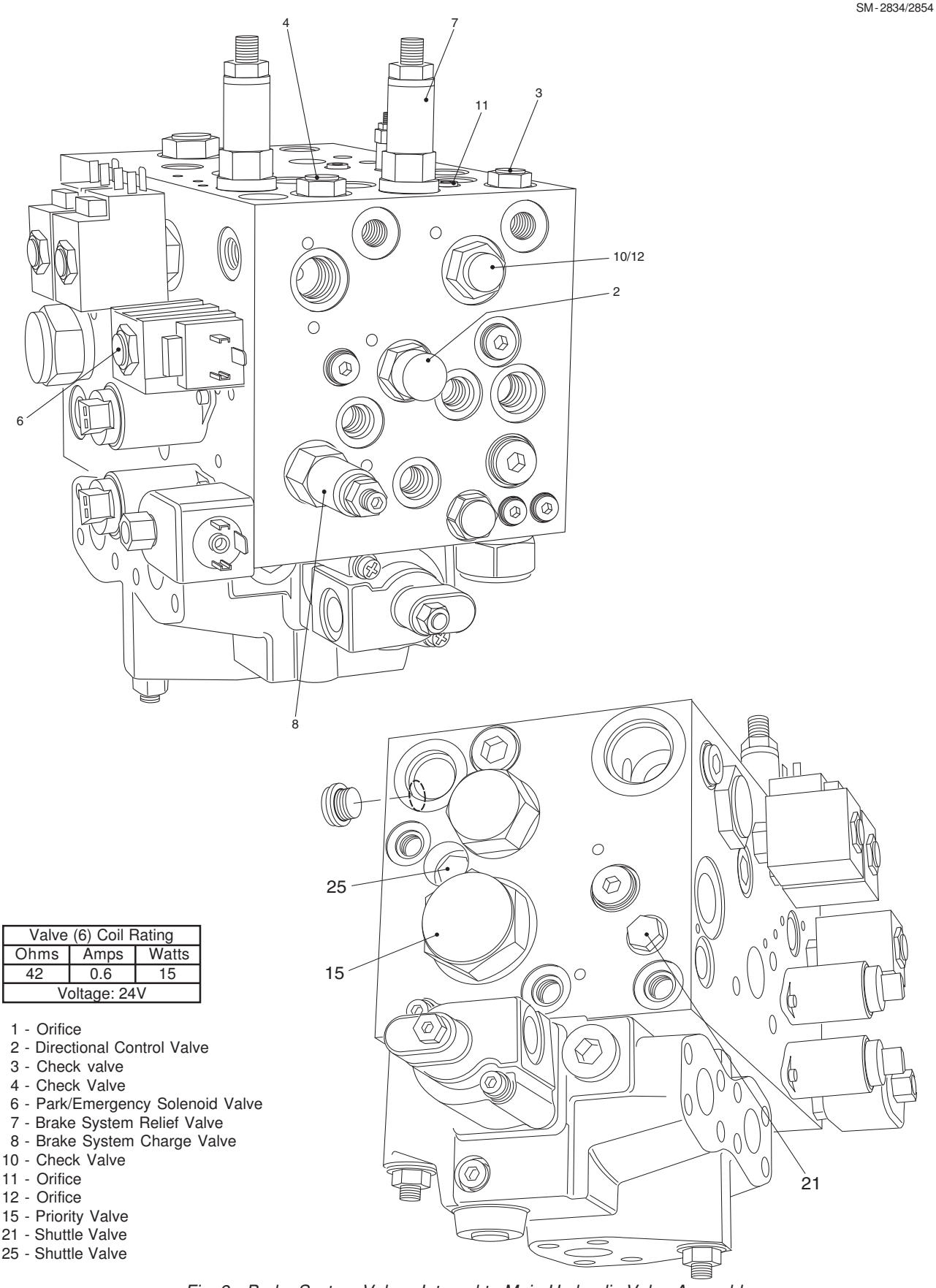
15018226	Diagnostic Coupling
00118748	Connector (2 off)
15004085	Hose Assembly (-04 HP, 2130 mm long)

Non-contact Infrared Thermometer

The infrared thermometer, 15269785, 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.

O' Ring Face Seals (ORFS) - Seal Kit

The braking system utilizes O-ring Face Seal (ORFS) connectors. An ORFS kit, 15271082, is available. This kit contains a minimum stock requirement of all sizes of ORFS type seal.



Valve (6) Coil Rating		
Ohms	Amps	Watts
42	0.6	15
Voltage: 24V		

1 - Orifice
2 - Directional Control Valve
3 - Check valve
4 - Check Valve
6 - Park/Emergency Solenoid Valve
7 - Brake System Relief Valve
8 - Brake System Charge Valve
10 - Check Valve
11 - Orifice
12 - Orifice
15 - Priority Valve
21 - Shuttle Valve
25 - Shuttle Valve

Fig. 9 - Brake System Valves Integral to Main Hydraulic Valve Assembly

Braking System Trouble Shooting		
Symptom	**Possible Cause**	**Remedy**
Front and Rear Brake Accumulators (17) not reaching the correct hydraulic charge pressure	Brake System Relief Valve (7) not set correctly or faulty	Re-set valve (7) to the correct setting or replace if faulty
	Pressure at Primary Accumulator (18) not high enough due to Brake System Charging Valve (8) not being set correctly	Set the Charge Valve (8) to the correct setting. Replace valve (15)
	Pre-charge gas pressure in the accumulator not at the correct level	Check Pre-charge gas pressure in the accumulator. Refer to Section 250-0060, Accumulator
Front and Rear Brake Accumulators (17) do not hold their charge pressure	Check Valves (3) or (4) leaking	Replace Check Valves (3) or (4)
	Pre-charge gas pressure in the accumulator not at the correct level	Check Pre-charge gas pressure in the accumulator. Refer to Section 250-0060, Accumulator
	Faulty seal in the piston of the accumulator	Replace the accumulator/seals.
	Brake Treadle Valve leaking	Refer to Section 250-0070, Treadle Valve
Brake Charging System Fails to charge at initial engine start up	Cold Start Solenoid Valve (16) remains open	Replace Valve (16). Refer to Section 215-0050, Main Hydraulic Valve Assembly
	Faulty Brake System Charge Valve (8)	Replace valve (8)
	Contamination in orifice(11)	Replace orifice (11)
	Air or contamination in the Load Sense System, especially when first running the truck after new main hydraulic valve is fitted.	Lift the body of the truck up and down several times to purge the system.
Primary Accumulator (18) does not hold its charge pressure.	Front and Rear Brake Accumulators (17) are not holding their charge.	See previous symptoms.
	Pre-charge gas pressure in the accumulator not at the correct level	Check Pre-charge gas pressure in the accumulator. Refer to Section 250-0060, Accumulator
	Leakage across the Valves (10, 9, 5 or 29) is too high.	Replace each valve one at a time (in order stated) until the fault is found.
	Accumulator Piston Seal leaking	Replace the accumulator

Braking System Trouble Shooting		
Symptom	**Possible Cause**	**Remedy**
Ineffective Park Brake	Fault with Park Brake caliper	Refer to Section 170-0010, Parking and Mounting
	Park Brake Solenoid Valve (6) not functioning. Sticking in the selected position	Check if there is hydraulic pressure at the Park Brake port. If there is pressure present, replace Valve(6).
Park Brake fails to release.	No voltage at Park Brake Solenoid Valve (6) when the switch is activated in the cab and the park brake OFF relay is energised.	Check park/emergency switch in operators cab. Check wiring between park/ emergency switch and park brake OFF relay and park brake Solenoid (6).
	Park Brake Solenoid Valve(6) fails to operate due to fault.	Check Parkbrake service switch wiring.
	Insufficient hydraulic charge pressure in rear brake accumulator	Replace valve(6). Check warning lights in cab and pressure at the Park Brake diagnostic check point. See trouble-shooting Brake Accumulator Charging
Service brakes fail to come on when Parking Brake is selected when the engine is running.	Faulty Brake Treadle Valve. Spool not stroking when pressure at port 'PP'.	Refer to Section 250-0070, Treadle Valve.
	No transmission pressure at Port TS on main hydraulic valve assembly.	Check piping and see instructions for the transmission.
	Directional Control Valve (2) not selecting.	Replace Valve (2)
	Fault with Park Brake System	See previous trouble-shooting
Service Brakes come on when Parking Brake is selected and Engine is not running.	Directional Control Valve (2) sticking in the selected position.	Replace Valve (2)
Inadequate Braking.	Low system pressure.	Check hydraulic oil level. Check oil condition. Check for major leakage. Check accumulator pressures. Refer to Section 250-0060, Accumulators

Braking System Trouble Shooting		
Symptom	**Possible Cause**	**Remedy**
Inadequate Braking (cont.)	Brake treadle valve delivery pressure below normal setting.	Check front and rear brake pressure Check brake treadle valve operation. Refer to Section 250-0070, Treadle Valve
	Insufficient brake surfaces.	Check brake disc/pads for wear. Refer to Section 165-0010, Brake Parts. Replace seals and pistons as required. Refer to Section 165-0010, Brake Parts.

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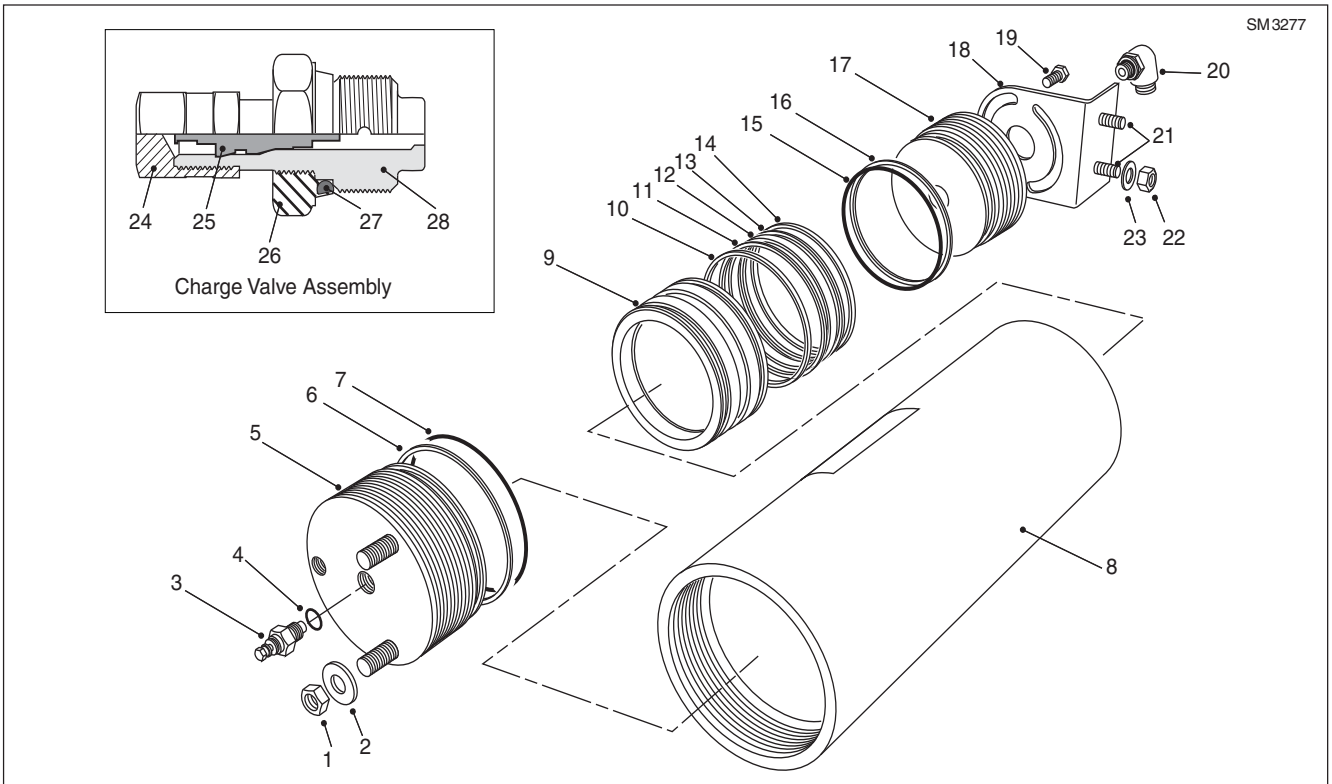


1 - Nut
2 - Washer
3 - Charging valve Assembly
4 - O-ring
5 - Cylinder Cap
6 - Back-up Ring
7 - O-Ring
8 - Cylinder Body
9 - Piston
10 - Seal Ring
11 - Washer
12 - O-Ring
13 - Washer
14 - Seal Ring
15 - O-Ring
16 - Back-up Ring
17 - End Cap
18 - Mounting Bracket
19 - Bolt
20 - Elbow
21 - Bolt
22 - Nut
23 - Washer
24 - Cap
25 - Valve Core
26 - Lock-nut
27 - O-Ring
28 - Valve Body

Fig. 1 - Exploded View of Accumulator Assembly

DESCRIPTION

Numbers in parentheses refer to Figure 1.

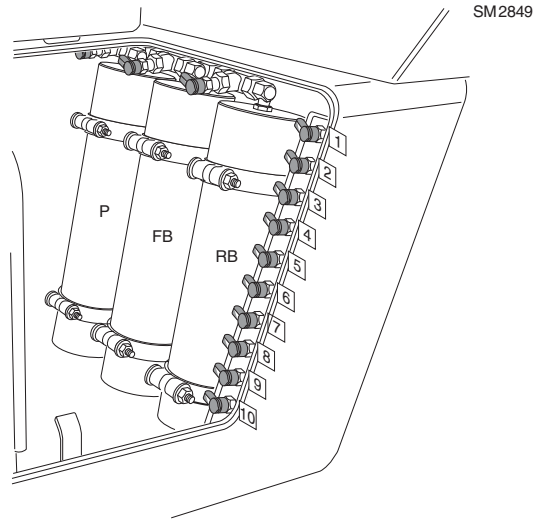
The accumulators can be identified as items 17 and 18, and the pressure switches as items 13 in Section 250-0000, Braking System Schematic.

There are three accumulators mounted inside the battery box located on the front left hand side of the tractor; one for the front brake system and one for the rear. The front and rear brake accumulators are supplemented by a third (primary) accumulator. Refer to Figure 2. The primary accumulator supports the service brake system and the body pilot pressure system. All three accumulators are of the piston type and are precharged with nitrogen to 103 bar (1494 lbf/in²), at 20 °C (68 °F).

Note: The nitrogen pressure in an accumulator is directly influenced 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 on Page 7 of this Section for nitrogen pressures at ambient temperatures of other than 20 °C (68 °F).

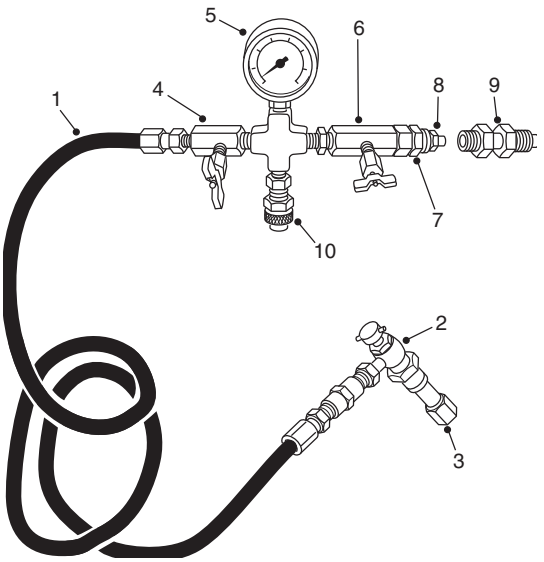
Each accumulator consists of a charging valve assembly (3), end cap (17), cylinder (8) and piston (9). The charging valve (3) is equipped with a locking feature. Loosening locknut (26) will open the valve so that the precharge can be checked or the accumulator charged.

A diagnostic pressure point is provided local to each brake accumulator, to facilitate the fitting of pressure test apparatus.



1 - Differential Lock Pressure
2 - Pump LS Pressure
3 - Front Brake Pressure
4 - Rear Brake Pressure
5 - Park Brake Pressure
6 - Steering Pressure
7 - Trans. Retarder Press.
8 - Trans. Converter Press.
9 - Body System Press.
10 - Trans. System Pressure
P - Primary Accumulator
FB - Front Brake Accumulator
RB - Rear Brake Accumulator

Fig. 2 - Accumulator Mounting



1 - Line
2 - Valve Chuck
3 - Valve Extension
4 - Cylinder Valve
5 - Pressure Gauge
6 - Tank Valve
7 - Gland Fitting
8 - Gland Nut
9 - Cylinder Adaptor
10 - Bleeder Valve

Fig. 3 - Charging Assembly Kit

OPERATION

Numbers in parentheses refer to Figure 1.

Piston (9) acts as a separator dividing cylinder (8) into two sections. The bottom section nearest charging valve (3) contains the nitrogen precharge. Hydraulic oil from the main hydraulic pump flows through check valves in the main hydraulic valve and into the top section of the accumulators.

Accumulator pressure is monitored by pressure switches located in the main hydraulic valve, which send a signal to illuminate warning lights in the dash panel when the pressure drops below 122 bar (1769 lbf/in²). The warning lights will remain illuminated until the pressure rises above 135 bar (1958 lbf/in²).

TESTING

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

⚠ WARNINGS
Accumulators are charged with nitrogen. The service pressure is 105 bar (1523 lbf/in²) at 20 °C (68 °F). To prevent personal injury and property damage do not attempt to remove any valves or fittings until all nitrogen pressure is completely relieved.

⚠
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 Figure 1.

1. Remove the cover plate from the bottom of the battery box.

2. Remove the cap (24) from the charging valve (3) and loosen the locknut (26). Coat the open end of the charging valve (3) with soapy water. Bubbles indicate a leaky valve core (25).

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 the valve core (25). Tighten the locknut (26) to 11 Nm (100 lbf in) and replace the valve cap (24) finger tight.

Testing Precharge Pressure

Numbers in parentheses refer to Figure 3, unless otherwise specified.

Note: The nitrogen pressure in an accumulator is directly influenced 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 on Page 7 of this Section for nitrogen pressures at ambient temperatures of other than 20 °C (68 °F).

To test the accumulator precharge pressure or to charge the accumulator, a charging assembly kit can be used. Refer to Figure 3.

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. Check the accumulator mountings confirm that the accumulator is held tightly in position.

4. Remove the cap (24, Figure 1) from the accumulator charging valve (3, Figure 1). Attach the charging line (1) to the charging valve by rotating the 'T' handle of the valve chuck (2) anticlockwise until it stops, then screw the swivel nut down on the valve. Loosen the locknut (26, Figure 1) by turning it anticlockwise one to two turns.

5. Turn 'T' handle clockwise until the charging valve core is depressed. Be sure that the bleeder valve (10) is tight and does not leak, and the valves (4 and 6) are closed.

6. To read the accumulator precharge pressure, slowly open the cylinder valve (4). The pressure gauge (5) will register the precharge pressure, it should be 103 bar (1494 lbf/in²) at 20 °C (68 °F) ambient temperature. Refer to the table at the end of this section for the nitrogen pressures at ambient temperatures of other than 20 °C (68 °F).

7. Close the cylinder valve (4) and open the bleeder valve (10) to dissipate the gauge pressure. Close the bleeder valve (10) after the pressure is relieved. If the accumulator needs to be charged, leave the line (1) and valve chuck (2) attached to the charging valve (3 , Figure 1). Charge the accumulator as described under 'Charging The Accumulator'.

8. If the precharge pressure is correct, rotate the 'T' handle anticlockwise until it stops. Tighten the locknut (26, Figure 1) on the charging valve (3, Figure 1) to 11 Nm (100 lbf in). Loosen the swivel nut and remove the gauging head.

9. Install the cap (24, Figure 1) on the charging valve (3, Figure 1) and tighten it finger tight.

10. Remove the wheel blocks and place the battery master switch in the 'On' position.

CHARGING THE ACCUMULATOR

Numbers in parentheses refer to Figure 3, 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 the line (1) and the swivel nut to the charging valve (3, Figure 1), as described in steps 1 through 4 under the heading 'Testing Precharge Pressure'. Ensure that the valves (4 and 6) are closed.

2. Attach the gauging head to the nitrogen bottle by screwing down on the gland nut (8).

3. Open the tank valve (6) slowly. The pressure shown on the pressure gauge (5) is tank pressure.

4. Open the cylinder valve (4) slowly and charge the accumulator to 103 bar (1494 lbf/in^2) at 20 °C (68 °F) ambient temperature, closing the valve occasionally. Refer to the table at the end of this Section for nitrogen pressures at ambient temperatures of other than 20 °C (68 °F).

5. To check the accumulator charge, close the tank valve (6), relieve the pressure between the tank and the pressure gauge (5), by opening the bleeder valve (10) momentarily. This will allow the gauge needle to settle, thus giving a correct pressure reading of the accumulator charge.

6. When the correct pressure for the ambient temperature has been reached, close the valves (4 and 6) tightly. Bleed the pressure off the pressure gauge (5) by opening the bleeder valve (10). Close the bleeder valve when all pressure is bled off from the gauge and unscrew the gland nut (8) from the nitrogen bottle.

7. Rotate the 'T' handle of the valve chuck (2) anticlockwise until it stops. Tighten the locknut (26, Figure 1) to 11 Nm (100 lbf in). Loosen the swivel nut and remove the gauge head.

8. Check the charging valve (3, Figure 1) for leakage using soapy water. Reinstall the valve cap (24, Figure 1) and tighten it finger tight.

DISCHARGING NITROGEN

Numbers in parentheses refer to Figure 1.

Make sure that the charging valve (3) is closed internally by turning the locknut (26) clockwise. Remove the cap (24) and the core (25) from the charging valve (3). Slowly turn the locknut (26) anticlockwise to open the charging valve (3).

Do not remove the charging valve (3) until all the gas has been completely evacuated.

⚠ WARNING

Do not try to discharge the accumulator by depressing charging valve core (25).

REMOVAL

⚠ WARNINGS

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

⚠ Accumulators are charged with nitrogen. The service pressure is 103 bar (1494 lbf/in^2) at 20 °C (68 ° 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 the cover plate from the bottom of the battery box.

4. Discharge nitrogen from the accumulators as described under 'Discharging Nitrogen'.

5. Disconnect the hydraulic lines from the top of the accumulators and plug the accumulators to prevent oil spillage. Cap open lines and fittings to prevent the entry of dirt.

6. Support the accumulators with an adequate sling and lifting device. Remove the bolts, nuts, washers and clamps. Remove the accumulators and drain the oil from the top section into a suitable container.

7. Remove the accumulators to a clean area for disassembly.

DISASSEMBLY

Numbers in parentheses refer to Figure 1.

> ⚠ **WARNING**
> **Accumulators are charged with Nitrogen. The service pressure is 103 bar (1494 lbf/in²) at 20 °C (68 ° 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. Ensure that all nitrogen gas has been released before starting to disassemble the accumulator. Refer to 'Discharging Nitrogen'.

2. Remove the charging valve assembly (3) from the end cap (17).

3. With the accumulator lying horizontal, hold the accumulator cylinder (8) with a strap wrench.

4. Install pins in three equally spaced holes in the end cap (17), then use a long bar working against the pins to remove the end cap from the cylinder (8). Remove and discard the back-up ring (6) and the O-ring (7).

5. Grip the cast web of the piston (9) with pliers, and while rotating it, pull the piston from the cylinder (8). Remove and discard the seal rings (10 and 14), washers (11 and 13) and the O-ring (12).

INSPECTION

Numbers in parentheses refer to Figure 1.

1. Wash metal components with a suitable solvent and thoroughly air dry them.

2. Inspect the piston (9) for cracks or burrs. Replace the piston (9) if it is excessively scored or worn.

3. Use an inspection lamp to check the bore of the accumulator cylinder (8) 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. Renew the complete accumulator assembly if the inside of the cylinder (8) is excessively scored or worn.

4. Inspect the threads in the end cap (17) and the threads in the cylinder (8) for damage. Renew all parts worn or damaged beyond repair.

ASSEMBLY

Numbers in parentheses refer to Figure 1.

1. Lubricate the O-rings (7,11 and 15), the back-up rings (6 and 16), the seal rings (10 and14), the washers (11 and 13) and the inside of the cylinder body (8) with hydraulic oil prior to assembly.

2. Install the O-ring (15) and the backup ring (16) on the end cap (17).

3. Install the end cap (17) on the cylinder body (8).

4. Install new seal rings (10 and 14), washers (11and 13) and O-ring (12) on the grooves of the piston (9).

5. Insert the piston (9) into the bore of the cylinder body (8) with the cupped end facing the open end of the cylinder body (8). Taking care not to damage any components on the threads of the Cylinder body (8) on insertion.Use a hammer and wood block to carefully tap the piston (9) into place until the piston (9) is 50.8 mm (2.0 in) below the beginning of the honed bore. Keep pressure against the piston (9) while tapping it into place, to ensure that the piston (9) does not resist movement and force its way back.

6. Install the O-ring (7) and the back-up ring (6) on to the cylinder cap (5), and install the cylinder cap into the bore of the cylinder body (8). Tighten the cap so that it is flush with the end of the cylinder body (8), within 1.6-2.4 mm (0.062 - 0.094 in) above or below.

7. Install the charging valve assembly (3). Torque tighten the locknut (26) clockwise to 11 Nm (100 lbf in) to close the charging valve (3). Insert the valve core (25) and torque it to 0.5 Nm (5 lbf in). Replace the valve cap (24) and tighten it hand tight.

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 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 perform the task safely.**

1. Position the accumulators in the battery box with the oil inlet ports at the top.

2. Attach the clamps securely with the nuts, washers and bolts.

3. Remove the caps installed at removal and install hydraulic lines securely to the oil inlet ports at the top of the accumulators.

4. Charge the accumulator with Nitrogen gas as described under 'Charging the Accumulator' in this section.

5. Install the cover to the bottom of the battery box.

6. Check the oil level in the hydraulic tank and add oil as required. Refer to Section 230-0040, Hydraulic Tank, for the correct fill level and Section 300-0020, Lubrication System, for the oil specification.

7. Place the battery master switch in the 'On' position, start the engine and check for leaks. Tighten the lines and fittings as required. Remove the wheel blocks.

MAINTENANCE

Inspect the accumulator assembly for leaks. If leaks are found, disassemble and replace all O-rings and seals. Inspect all hydraulic lines for wear and leaks. Renew/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 TABLE 017

FIG. No.	ITEM No.	TORQUE		
		Nm	lbf ft	lbf in
1	26	11	8	97

AMBIENT TEMPERATURE - NITROGEN PRE-CHARGE PRESSURE			
AMBIENT TEMPERATURE		NITROGEN PRE-CHARGE PRESSURE	
°C	°F	bar	lbf/in²
-20	-4	88.94	1290
-10	14	92.45	1341
0	32	95.97	1391
10	50	99.48	1443
20	68	103	1494
30	86	106.52	1545
40	104	110.03	1596
50	122	113.55	1647
60	140	117.06	1698
70	158	120.58	1749
80	176	124.09	1800
90	194	127.61	1851
100	212	131.12	1902
110	230	134.64	1953
120	248	138.15	2004

⚠ WARNING
This vehicle is equipped with precharged nitrogen gas cylinders of more than 2.8 bar (40 lbf/in²). 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.

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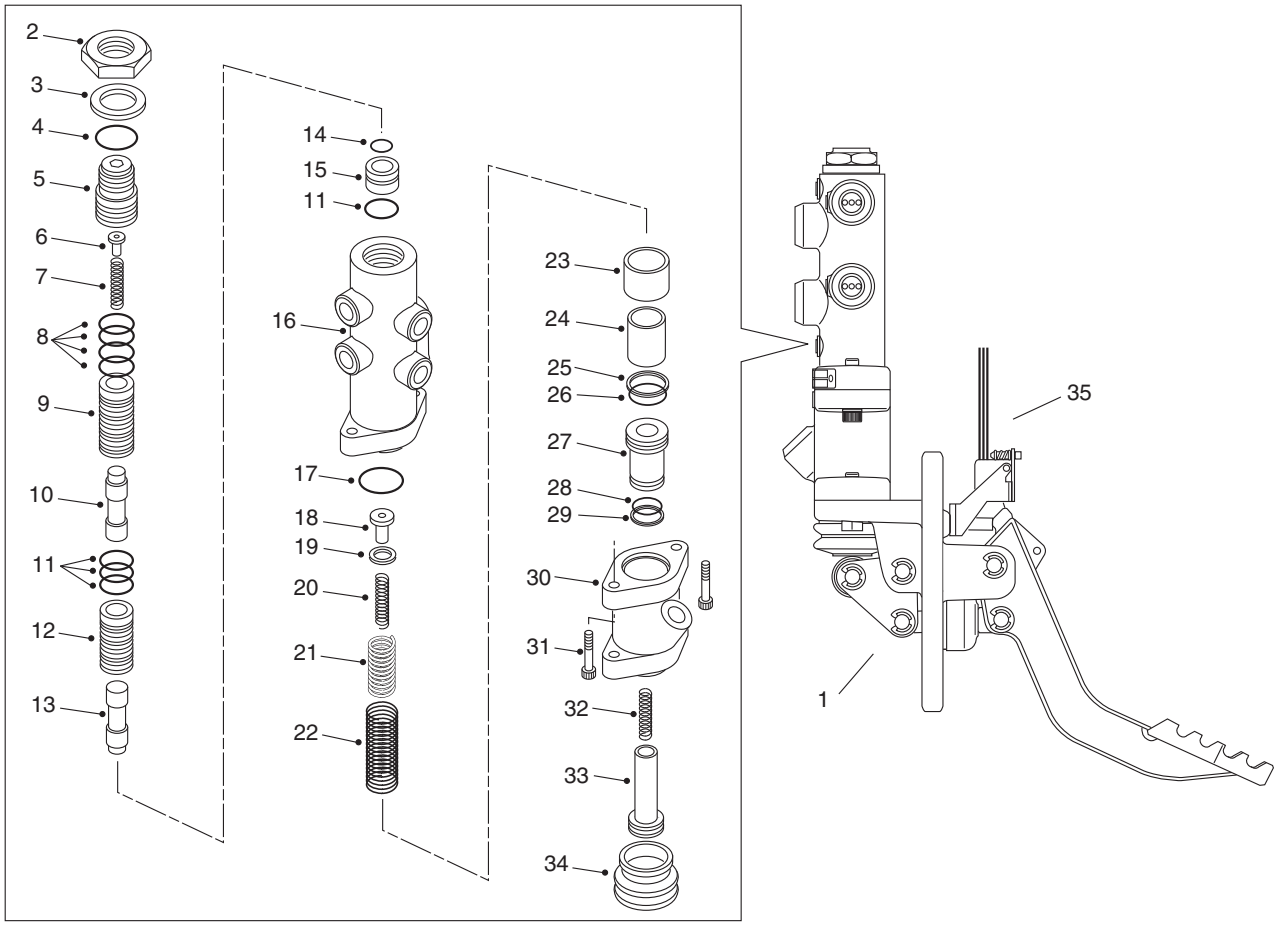


1 - Pedal Assembly
2 - Nut
3 - Washer
4 - O-ring
5 - End Plug
6 - Retainer
7 - Spring
8 - O-ring
9 - Sleeve
10 - Spool
11 - O-ring
12 - Sleeve
13 - Spool
14 - Cup
15 - Spacer
16 - Valve Housing
17 - O-ring
18 - Retainer
19 - Shims
20 - Spring
21 - Spring
22 - Spring
23 - Bearing
24 - Piston
25 - Backup Ring
26 - O-ring
27 - Piston
28 - O-ring
29 - Backup Ring
30 - Pilot Housing
31 - Screw
32 - Spring
33 - Push Rod
34 - Boot
35 - Microswitch

Fig. 1 - Exploded View of Treadle Valve Assembly

DESCRIPTION

Numbers in parentheses refer to Figure 1.

Note: The treadle valve can be identified as item 9 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 operator's cab and with the engine running, is automatically applied by the park brake solenoid valve within the main hydraulic valve. Refer to Section 215-0050, Main Hydraulic Valve Assembly.

In the normal position, brake pedal assembly (1) is in the up position. In this condition the regulated pressure outlet ports of the valve 'A1' and 'A2' are directly linked to the hydraulic tank ports 'T1' and 'T2'. While the pedal is in this position the brakes are released.

A microswitch (35), mounted on the brake treadle valve, sends a signal to activate the rear brake lights and the engine brake when the treadle valve is depressed.

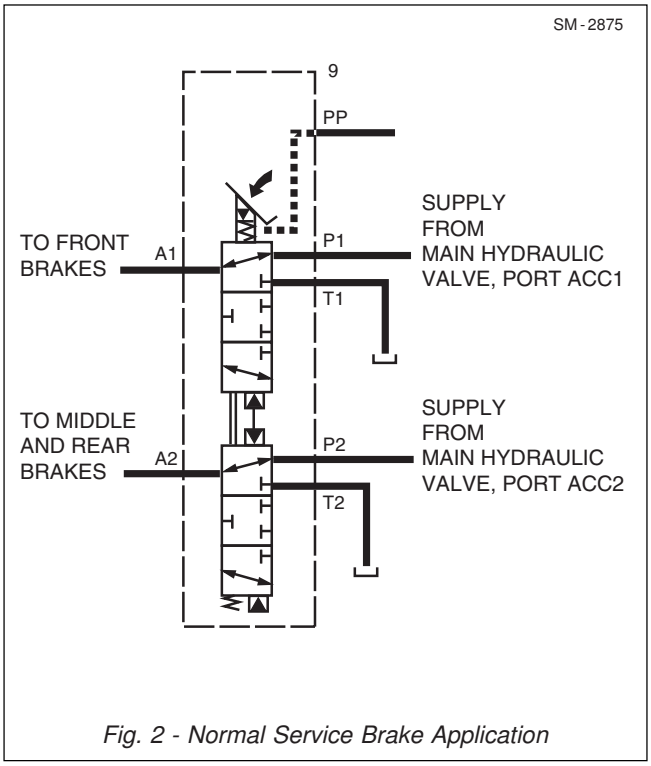


Fig. 2 - Normal Service Brake Application

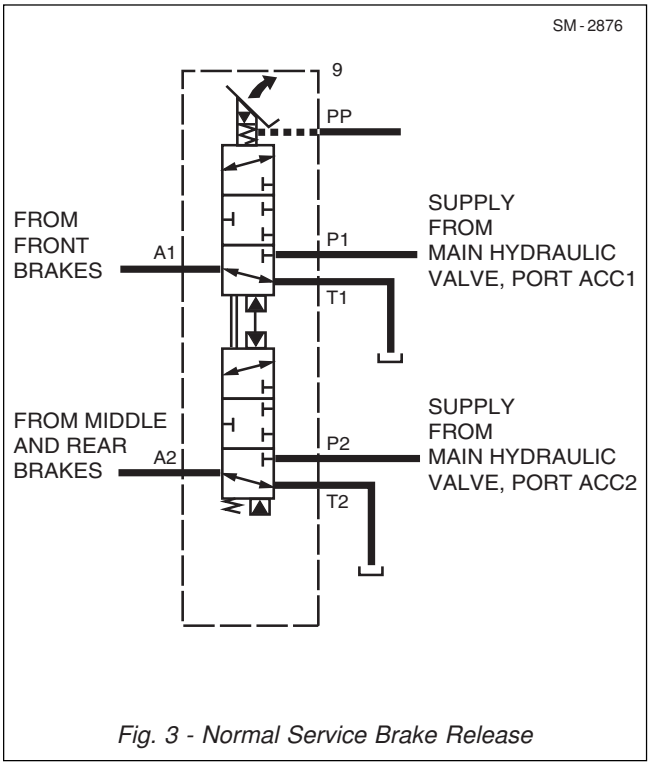


Fig. 3 - Normal Service Brake Release

OPERATION

Numbers in parentheses refer to Figure 1.

Normal Service Brake Application

Refer to Figure 2. When the operator depresses pedal assembly (1), push rod (33) is moved up and pushes on pistons (24 and 27), and in turn pushes spools (10 and 13) up. As spools (10 and 13) move up, the metering notches move out of the tank cavity and close outlet ports 'A1' and 'A2' off to tank ports 'T1' and 'T2'. Spools (10 and 13) continue to move upwards until the metering notches become exposed to the inlet pressure ports. This movement opens inlet ports 'P1' and 'P2' to outlet ports 'A1' and 'A2' respectively. As hydraulic pressure builds in the brake, oil flows through the small orifice in spools (10 and 13) and into the cavities above the spools. As pressure rises in the brake it also rises in the cavities above the spools forcing spools (10 and 13) downwards closing outlet ports 'A1' and 'A2'. Spools (10 and 13) are now balanced between the brake pressure and the pressure of springs (20 - 22) generated by the operator's force on the pedal (1) assembly. Spools (10 and 13) have closed off the inlet ports, outlet ports and the tank ports and will remain in this position as long as pedal (1) assembly is not moved. If the operator further depresses pedal (1) assembly, spools (10 and 13) will move up and build more pressure in the brake until it balances the pedal force.

Normal Service Brake Release

Refer to Figure 3. When the operator releases pedal (1) assembly, spools (10 and 13) will become unbalanced and move downwards, opening outlet ports 'A1' and 'A2' to tank. At this point, oil in the 'A1' and 'A2' lines is released to tank through tank ports 'T1' and 'T2', releasing the brakes.

Emergency Stop Brake Application/ Release

Refer to Figure 4. Pushing in the park/emergency control results in the de-energization of the park brake solenoid valve within the main hydraulic valve. This allows full pressure to enter the 'PP' port in the treadle valve simulating a full and immediate depression of pedal (1) assembly, thus pushing the spools (10 and 13) upwards and thereby applying maximum braking action.

Refer to Figure 5. Pulling out the park/emergency control with park brake OFF Relay energised (i.e transmission in gear) will energize the park brake solenoid valve within the main hydraulic valve, allowing the pressure in the 'PP' line to fall via the return to tank port opened within the park brake solenoid valve. Outlet ports 'A1' and 'A2' are opened to tank ports 'T1' and 'T2' allowing oil in the 'A1' and 'A2' lines to return to tank, releasing the brakes.

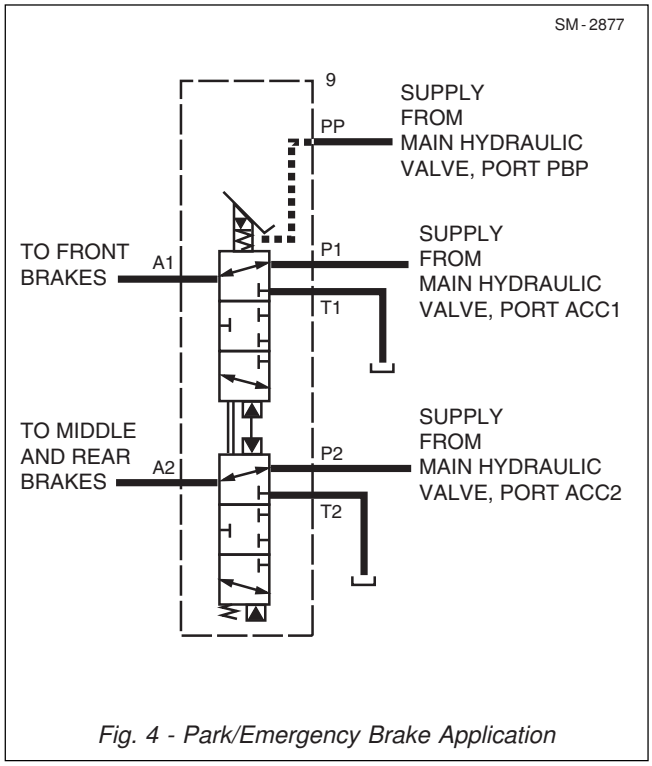


Fig. 4 - Park/Emergency Brake Application

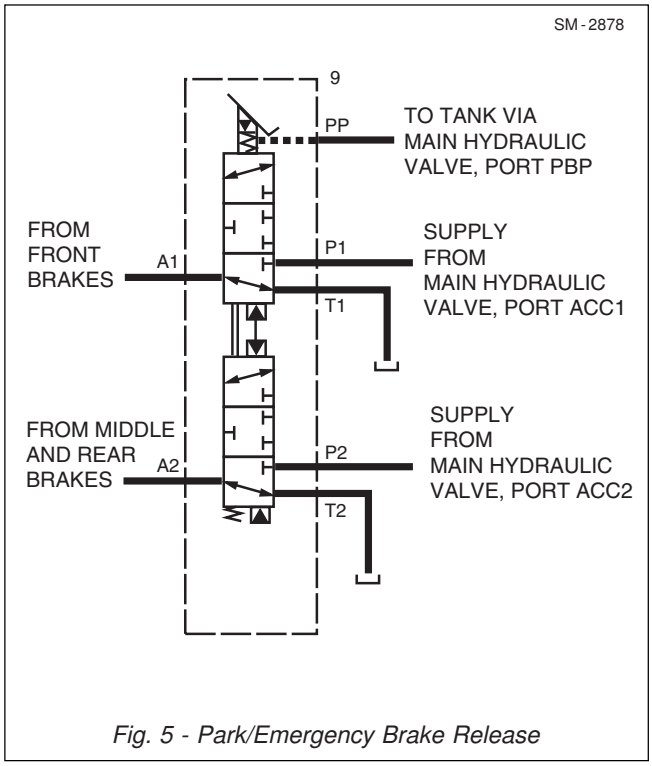


Fig. 5 - Park/Emergency Brake Release

Advanced Engine Braking

Refer to Figure 1. The brake pedal microswitch (35) sends a signal to activate the engine brake and the rear brake lamps. The brake pedal microswitch (35) energizes the brake lamp relay K50, and the engine brake select relay K32. Both relays are located in the operator cab fuse/relay box. Refer to Section 190-0000, Circuit Diagrams. When these relays are energized, the electrical circuit is completed to energize the appropriate lamps and request signals.

The first few degrees of movement of the pedal (1) engages the engine brake, providing that the transmission is in 'lockup'. Further movement of the pedal (1) applies the service brakes in addition to the engine brake. The engine brake will disengage when the pedal (1) is released, or when any of the operating conditions become out of range.

REBUILD CRITERIA

Inspect the valve regularly for any signs of leakage or damage and replace components if necessary.

The treadle valve 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 does not remain constant between circuits.

REMOVAL

⚠ WARNINGS

To prevent personal injury and property damage, be sure wheel blocks are properly secured and of adequate capacity to performthe task 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 area, apply the parking brake, switch off the engine and turn thhe 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 the battery master switch in the 'Off' position.

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

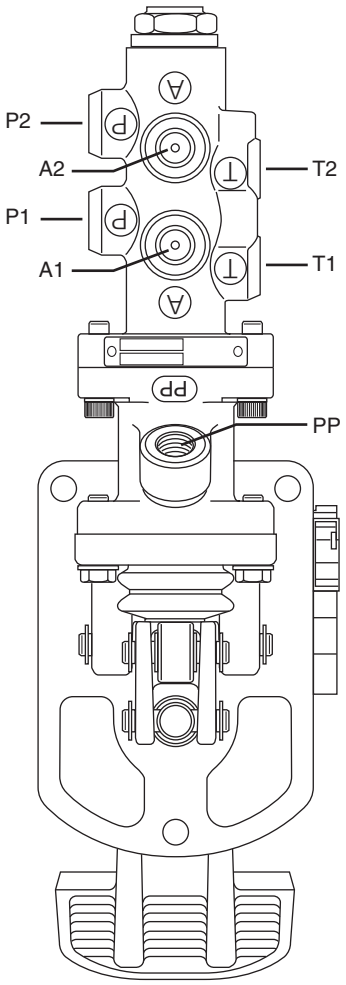
4. Remove the blanking cap from the remote drain line at the bottom of the hydraulic tank. Install a length of hose on remote drain fitting, open drain cock and drain the hydraulic oil into a suitable container. Close the drain cock, remove the hose and reinstall the blanking cap.

5. If necessary remove the engine air intake tube to gain access to the treadle valve on the front of the cab. Alternatively, tilt the cab to gain access. Refer to Section 260-0010, Cab and Mounting.

6. Clean the treadle valve assembly and the surrounding area with a suitable solvent. Ensure that all hydraulic lines connected to the treadle valve are identified for ease of installation and, with suitable containers available to catch leakage, disconnect the hydraulic lines. Fit blanking caps to all open lines and treadle valve ports.

7. Disconnect the electrical connection from the brake pedal microswitch (35).

8. Remove the four bolts securing the treadle valve and mounting plate to the cab. Remove the treadle valve and mounting plate as an assembly from the front of cab to a clean area for 'Disassembly'.



P1 - Pressure from main hydraulic valve, port ACC1
P2 - Pressure from main hydraulic valve, port ACC2
A1 - Pressure to front brakes
A2 - Pressure to rear brakes
T1 - Tank return, front brakes
T2 - Tank return, rear brakes

Fig. 6 - Treadle Valve Porting

DISASSEMBLY

Numbers in parentheses refer to Figure 1.

1. Remove the blanking caps from the treadle valve ports and drain all oil from the valve body ports, by rotating the valve over a suitable container.

2. Remove the treadle valve from the mounting plate and secure the valve assembly upright in a table vice.

3. Remove the circlips to allow the cam assembly to be disassembled.

4. Remove the boot (34) from the push rod (33), then remove the push rod (33) and spring (32) from the pilot housing (30) bore.

5. Separate the pilot housing (30) and valve housing (16) by removing the screws (31). Remove the O-ring (17) from the valve housing (16).

6. Remove the piston (27) from the pilot housing (30).

Note: Be careful not to scratch housing bore.

7. Remove the O-rings (26 and 28) and back-up rings (25 and 29) from the piston (27), being careful not to damage the O-ring and piston grooves.

8. Remove the piston (24), springs (20, 21 and 22) and shims (19) from the valve housing bore.

9. The bearing (23) should not be removed from the housing bore.

Note: Excessive wear in both the bearing (23) and the piston (24) may require replacement.

10. Remove the retainer assembly (18) from the housing bore.

Note: The ball is a press fit in the retainer.

11. Loosen the nut (2) and remove the end plug (5) from the housing. Remove the spring (7), retainer (6), nut (2), washer (3) and O-ring (4) from the end plug (5).

12. Remove the spacer (15), sleeves (9 and 12) and spools (10 and 13) assembly from the housing bore. This assembly must be removed through the end plug (5) end of the housing (16).

Note: Be careful not to scratch the housing bore.

13. Separate the spacer (15) and spools (10 and 13) from the sleeves (9 and 12).

Note: Excessive wear on either the spools (10 and 13) or the sleeves (9 and12) may require replacement. Spool (10)/sleeve (9) and spool (13)/sleeve (12) are matched sets and MUST be replaced as matched sets - DO NOT intermix.

14. Remove the O-ring (11) and cup (14) from the spacer (15). Remove the other O-rings (11) from the sleeve (12) and the O-rings from the sleeve (8).

Note: Be careful not to damage the cup and O-ring grooves and bores.

ASSEMBLY

Numbers in parentheses refer to Figure 1.

Lubricate all new rubber components with clean hydraulic oil used in the braking system. Refer to Section 300-0020, Lubrication System.

1. Clean all parts thoroughly before assembly.

2. Install a new cup (14) in the spacer (15) and one new O-ring (11) on the spacer (15). Note the direction of the cup.

3. Install other new O-rings (11) on the sleeve (12) and new O-rings (8) on the sleeve (9).

4. Lubricate the spool (13) with clean hydraulic oil and carefully insert it into the sleeve (12). Note the direction of the spool.

5. Insert the spacer (15) into the housing bore through the end plug (5) end. Note the direction of the spacer.

6. Lubricate the sleeve (12) and the spool (13) assembly with clean hydraulic oil and carefully insert it into the housing bore using a wooden dowel. Note the direction of the assembly.

7. Carefully insert the sleeve (9) into the housing until it rests against the sleeve (12). Lubricate the spool (10) with clean hydraulic oil and carefully insert it into the sleeve (9). Note the direction of spools and sleeves.

8. Install the spring (7) and retainer (6) in the housing bore.

9. Install the end plug (5) and torque it to 11 - 20 Nm (96 - 180 lbf in) to the seat sleeves. Then turn back the end plug a ¼ turn and torque it to 1 - 7 Nm (10 - 60 lbf in). Install a new O-ring (4), washer (3) and nut (2). Hold the end plug and torque the nut to 68 - 81 Nm (50 - 60 lbf ft).

10. Install a new O-ring (17) on the valve housing (16).

11. Install the retainer assembly (18) in the housing.

Note: Depress the retainer (18) until it bottoms on the spacer (15). Spools (10 and 13) and retainer (18) should return when released. If the spools and retainer do not return when released, the bores of the sleeves (9 and 12) may have been damaged during installation.

12. Install the shims (18), springs (20, 21 and 22) and piston (24) in the valve housing bore.

Note: For proper brake pressure setting, install the same number of shims and spacer(s) that were removed during disassembly. If spools (10 and 13), sleeves (9 and 12), or spring (22) were replaced, shim adjustment may be required.

13. Install new O-rings (26 and 28) and new back-up rings (25 and 29) on the piston (27). Note the order of the back-up rings and O-rings.

14. Lubricate the piston (27) with clean hydraulic oil and insert it into the pilot housing (30) through the valve housing (16) end. Be sure to install the piston (27) as far as it will go into the pilot housing bore.

15. Carefully attach the pilot housing (30) to the valve housing (16) using the screws (31). Torque the screws to 24 - 30 Nm (18 - 22 lbf ft).

16. Install the spring (32) and push rod (33) into the pilot housing (30) bore.

17. Install a new boot (34) on the push rod (33).

18. Assemble the cam assembly and secure it with circlips.

19. Install the mounting plate to the treadle valve.

INSTALLATION

Numbers in parentheses refer to Figure 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 the treadle valve and mounting plate assembly to the front of the cab using the four bolts removed previously.

2. Connect the electrical connection to the brake pedal potentiometer (35).

3. Remove the blanking caps and connect the hydraulic lines to the treadle valve assembly as noted at 'Removal'.

4. If previously removed, install the engine air intake tube, or if applicable, lower the cab. Refer to Section 260-0010, Cab and Mounting.

5. Fill the hydraulic tank with oil specified in Section 300-0020, Lubrication System.

6. Place the battery master switch in the 'On' position, start the engine and bring the hydraulic oil to operating temperature.

7. Apply the brakes and check for oil leaks. Tighten line connections and fittings as necessary.

Note: When performing Step 8, make sure that parking brake applies and releases appropriately.

8. Check brake operations by actuating pedal and park/emergency control and engaging transmission gear. Ensure that the pedal assembly is free to operate.

9. Shut off the engine and check the hydraulic tank oil level. Replenish as necessary.

CHECKING SYSTEM PRESSURES

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

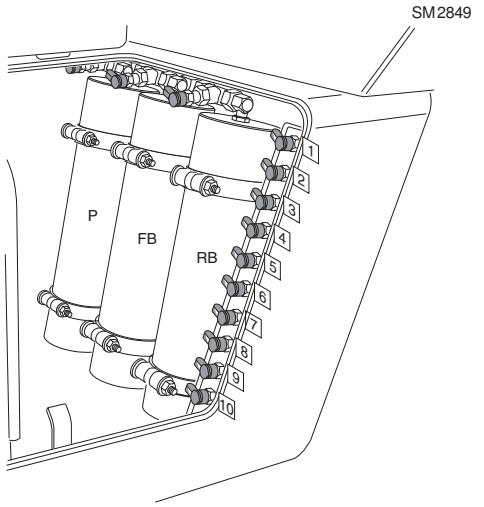
⚠ Hydraulic fluid pressure will remain within the system after engine shut down. Operate the brake treadle pedal continuously until the pressure has dissipated before carrying out any work on the system or serious injury could result.

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. Connect a hydraulic gauge, capable of recording a pressure of 0 - 345 bar (0 - 5000 lbf/in^2), to the front brake diagnostic pressure point (point 3 on Figure 7), inside the battery box.

Truck Serial No.	Pressure	Tolerance
A8891011 to A8891214 A8971011 to A8971149 A9201011 to A9201033	55 bar (795 lbf/in²)	± 5.1 bar (± 75 lbf/in²)
From: A8891215 A8971150 A9201034	57 bar (825 lbf/in²)	± 5.1 bar (± 75 lbf/in²)



1 - Diff-lockPressure
2 - Pump LS Pressure
3 - Front Brake Pressure
4 - Rear Brake Pressure
5 - Park Brake Pressure
6 - Steering Pressure
7 - Trans. Retarder Press.
8 - Trans. Converter Press.
9 - Body System Press.
10 - Trans. System Pressure
P - Primary Accumulator
FB - Front Brake Accumulator
RB - Rear Brake Accumulator

Fig. 7 - Diagnostic Pressure Check Points (Battery Box)

4. Place the battery master switch in the 'On' position, start the engine and apply the park/emergency brake (push button in), to apply the service brakes. Monitor the system pressure gauge. The brake actuating pressure for the front brake circuit is 60 ± 5.1 bar (870 ± 75 lbf/in²).

Note: When brakes are released, a residual pressure of 0.5 bar (7 lbf/in²) should remain.

5. Repeat steps 1 through 4 at the rear brake diagnostic pressure point (point 4 on Figure 7), inside the battery box.

Note: The actuating pressure for the front brake circuit is 60 ±5.1 bar (870 ±75 lbf/in²). The actuating pressure for the rear brake circuit is specific to particular serial numbers, detailed on Page 7. However, the system pressure is 240 bar (3500 lbf/in²) and can be checked at the steering diagnostic pressure point (STR) inside the battery box (point 6 on Figure 7). Front and rear brake pressures are also tested at diagnostic points in the battery box (points 3 and 4 respectively on Figure 7). System pressure is checked against steering pressure as this is the highest pressure requirement in the hydraulic circuit. Refer to Section 230-0050, Main Hydraulic Pump.

6. If the pressures to the brake circuits have been determined as high or low, refer to the Troubleshooting table for the treadle valve and Section 250-0000, Braking System Schematic.

MAINTENANCE

General

Check all hydraulic brake lines and fittings at the treadle valve for leaks and damage. Tighten/replace as required.

Every 1000 Hours

Check the front and rear brake pressures at remote diagnostic test points. If the pressures are not within the specified pressure range, refer to Troubleshooting table for treadle valve and Section 250-0000, Braking System Schematic.

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.

TREADLE VALVE TROUBLESHOOTING		
SYMPTOM	POSSIBLE CAUSE	REMEDY
Brakes slow to apply	No or improper accumulator pre-charge pressure	Check accumulator pre-charge pressure. Refer to Section 250-0060, Accumulator
	Brakes not properly adjusted	Adjust brakes. Refer to Section 165-0010, Brake Parts
	Inoperative brakes	Check brakes. Refer to Section 165-0010, Brake Parts
	Hydraulic lines/fittings leaking	Check for leaks and repair
	Damaged hydraulic brake lines	Check lines for restrictions
	Air in system	Bleed air from system. Refer to Section 165-0010, Brake Parts
Brakes will not release	Pedal angle out of adjustment	Check for proper pedal angle
	Inoperative brakes	Check brakes. Refer to Section 165-0010, Brake Parts
	Inoperative treadle valve. Binding spools (10 and 13), damaged sleeves (9 and 12), piston (24) binding	Replace treadle valve
Insufficient brakes	Low hydraulic oil level	Top up hydraulic oil
	Brakes not properly adjusted	Adjust brakes. Refer to Section 165-0010, Brake Parts
	Oil or grease on brake pads	Clean or replace brake pads. Refer to Section 165-0010, Brake Parts
	Hydraulic lines damaged	Check hydraulic lines
	No or improper accumulator pre-charge pressure	Check accumulator pre-charge pressure. Refer to Section 250-0060, Accumulator
	Inoperative brakes	Check brakes. Refer to Section 165-0010, Brake Parts
	Inoperative treadle valve. Broken spring (21). Boot (34) cut, allowing dirt under piston (24) flange.	Replace treadle valve
Excessive braking	Inoperative brakes	Check brakes. Refer to Section 165-0010, Brake Parts
	Inoperative treadle valve. Excessive shims (19) fitted	Replace treadle valve

TREADLE VALVE TROUBLESHOOTING		
SYMPTOM	POSSIBLE CAUSE	REMEDY
Brakes will not release completely	Brakes not properly adjusted	Adjust brakes. Refer to Section 165-0010, Brake Parts
	Inoperative brakes	Check brakes. Refer to Section 165-0010, Brake Parts
	Pedal angle out of adjustment	Check for proper pedal angle
	Air in system	Bleed air from system. Refer to Section 165-0010, Brake Parts
	Inoperative treadle valve. Piston (24) sticking, spring (7) broken	Replace treadle valve
	Back pressure on return line excessive	Remove restriction
No brakes	No oil in hydraulic system	Add oil to tank
	Broken/damaged hydraulic line	Replace broken/damaged line
	Brakes not properly adjusted	Adjust brakes. Refer to Section 165-0010, Brake Parts
	No accumulator pre-charge pressure	Check accumulator pre-charge pressure. Refer to Section 250-0060, Accumulator
	No pump pressure	Check pump operation
	Worn brakes	Replace brake pads and discs
	Inoperative treadle valve. Piston (24) binding, broken spring (21)	Replace treadle valve
Pedal kickback when brakes are applied	Air in system	Bleed air from system. Refer to Section 165-0010, Brake Parts

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	5	End Plug	1 - 7	10 - 60 lbf in
1	2	Nut	68 - 81	50 - 60
1	31	Screw	24 - 30	18 - 22

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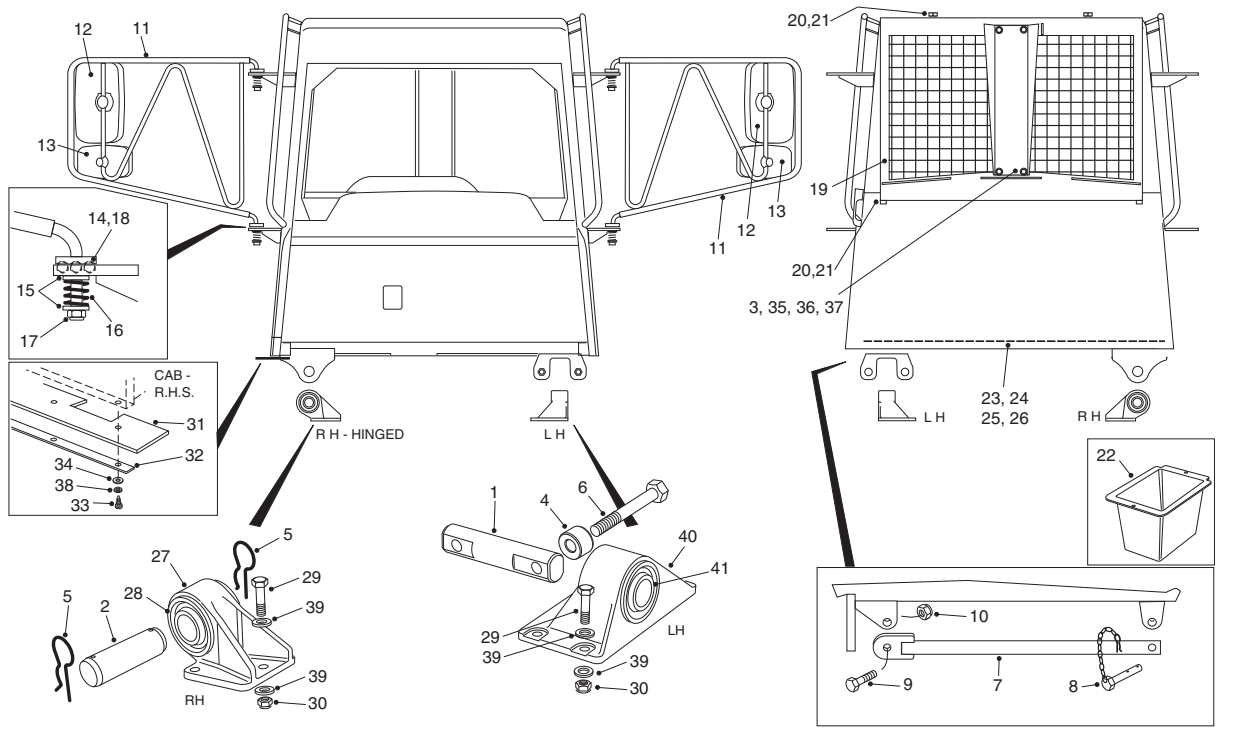


1 - Locating Pin
2 - Hinge Pin
3 - Nut
4 - Bushing
5 - Spring Pin
6 - Bolt
7 - Cab Safety Prop
8 - Pin Assembly
9 - Bolt
10 - Nut
11 - Mirror Arm
12 - Mirror - Exterior
13 - Mirror - Wide Angle
14 - Ball
15 - Washer
16 - Spring
17 - Locknut
18 - Grease (EMS19014)
19 - Window Guard
20 - Bolt
21 - Washer
22 - Storage Box
23 - Mat (front floor)
24 - Mat (left rear)
25 - Mat (right rear)
26 - Mat (under seat)
24 - Cab Pin
25 - Bolt
26 - Locknut
27 - Support Block
28 - Isolation Mount
29 - Bolt
30 - Locknut
31 - Mud flap (cab RHS)
32 - Bolt
33 - Bolt
34 - Washer
35 - Heat Shield
36 - Bolt
37 - Washer
38 - Lockwasher
39 - Washer

Fig. 1 - Cab and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

The cab is fully insulated and mounted on cab supports (23) 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.

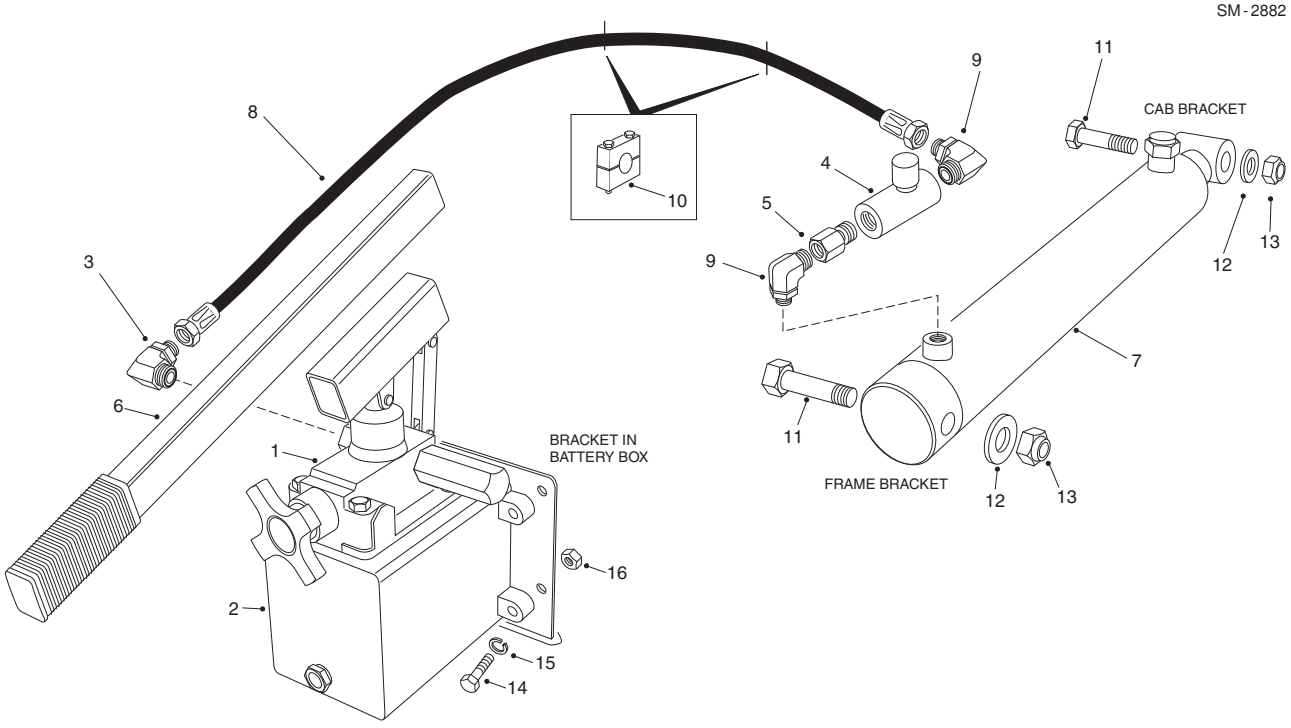
ROPS - ISO 3471, SAE J1040 APR 88
FOPS - ISO 3449, SAE J231

⚠ 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.

The cab assembly can be tilted to improve accessibilty to components below the cab, including transmission and main hydraulic valve. A hydraulic hand pump (1, Fig. 2), located inside the battery box on the left hand side of the tractor frame and a cab raise cylinder (7, Fig. 2) are used to raise the cab.

⚠ WARNING
Never operate the machine while the cab is tilted. Always ensure the cab is fully lowered and properly secured before operating the machine.

Cab assembly is spacious and offers outstanding visibility through large areas of tinted safety glass. Access to cab assembly is from the left hand side with open tread steps, platform and handrail.



1 - Hand Pump
2 - Hydraulic Tank
3 - Elbow
4 - Flow Control Valve
5 - Adaptor
6 - Lever
7 - Cab Raise Cylinder
8 - Hose Assy
9 - Elbow
10 - Clamp
11 - Bolt
12 - Washer
13 - Nut
14 - Bolt
15 - Washer
16 - Nut

Fig. 2 - Cab Tilt Mechanism

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. Air conditioning is fitted as standard. 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 back pillar).

REMOVAL

Numbers in parentheses refer to Fig. 1.

Note: Identify and tag all cables, harnesses, lines and linkages disconnected from cab assembly during removal to aid in installation.

⚠ WARNINGS

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

⚠ Hydraulic fluid pressure will remain within the system after engine shutdown. Operate the brake pedal continuously until the pressure has dissipated before disconnecting any hoses.

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

2. Operate the brake pedal continuously to relieve pressure in the system.

3. Block all road wheels, place the battery master switch in the 'Off' position and lift the hood assembly.

4. Disconnect the electrical cables in the following order to prevent damage to the electrical components:

a. Battery earth cable.
b. Battery supply cable.
c. Alternator earth cables.
d. Alternator supply cables.
e. Electrical harnesses at cab bulkhead.

⚠ WARNING
Before disconnecting any air conditioner lines, refer to Section 260-0130, AIR CONDITIONING. Refrigerant will rapidly freeze all objects with which it comes into contact. It can cause serious and permanent damage to the eyes and skin.

5. Evacuate the refrigerant from the air conditioning system and disconnect the lines. Refer to Section 260-0130, AIR CONDITIONING. Fit blanking caps to all open lines and fittings.

6. Ensure heater lines are identified for ease of installation and with suitable containers available to catch leakage, disconnect heater lines. Fit blanking caps to open line ends and fittings.

7. Remove the front right hand tyre and rim assembly for access. Refer to Section 160-0050, WHEEL RIM AND TYRE.

⚠ WARNINGS
To prevent damage, always ensure hood is raised before tilting or lowering the cab.

⚠ Never work near or under an unblocked or unsupported cab. Always use the cab safety prop.

8. Tilt cab to allow access to steering valve below cab, and secure with cab safety prop (7). Ensure lines are identified for ease of installation and with suitable containers available to catch leakage, disconnect and remove steering valve hoses. Fit blanking caps to open line ends and fittings.

9. Attach suitable slings to the cab lifting points and raise lifting equipment to take up the slack. Disconnect cab raise cylinder (7, Fig. 2) from cab floor by removing bolt (11, Fig. 2), washer (12, Fig. 2) and nut (13, Fig. 2).

10. Tag and disconnect any other harnesses and hoses that may be affected by cab removal.

Disconnect earth strap at rear right hand cab support (40).

11. Lower cab safety prop (7) and place in the stowed position, then using lifting equipment, slowly lower cab until horizontal.

12. Remove spring pins (5) to allow right hand pins (2) to be driven out using a suitable driver.

13. Check to make certain that all necessary disconnections have been made, before lifting cab assembly. Taking care to prevent damaging the insulating material, lift cab assembly 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 cab supports (27 & 40) for damage and replace if necessary.

2. Attach suitable slings to the cab lifting points and raise and position cab on frame.

3. Secure cab assembly to right hand cab supports (23) with pins (2) and spring pins (5), as shown in Fig. 1.

4. Using lifting equipment, raise cab and secure cab raise cylinder (7, Fig. 2) to bracket on cab floor using bolt (11, Fig. 2), washer (12, Fig. 2) and nut (13, Fig. 2). Secure cab in raised position with cab safety prop (7).

5. Install and connect steering valve hoses as noted on removal. Connect earth strap at rear right hand cab support.

6. Connect and secure any other harnesses and hoses that were previously removed.

7. Place cab safety prop (7) in the stowed position.

Using hand pump (1, Fig. 2) to control lowering of cab, gently lower cab until cab brackets align with cab supports (40). Install pins (1) and secure with bushes (4) and bolts (6).

8. Install front right hand tyre and rim assembly. Refer to Section 160-0050, WHEEL RIM AND TYRE.

9. Secure the heater hoses to the front of the cab as identified at removal.

10. Connect air conditioning lines and charge air conditioning system. Refer to Section 260-0130, AIR CONDITIONING.

11. Connect electrical harnesses at cab bulkhead as identified at removal.

12. Connect cables to alternator (earth cable last).

13. Connect cables to battery terminal posts (earth cable last).

14. 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.

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

TILTING THE CAB

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

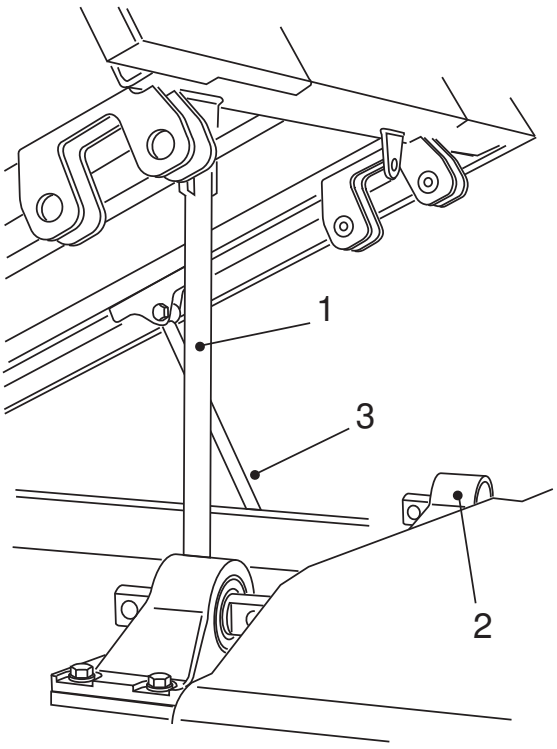
⚠ WARNINGS
To prevent damage, always ensure hood is raised before tilting or lowering the cab.

⚠ Never work near or under an unblocked or unsupported cab. Always use the cab safety prop.

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

2. Operate the brake pedal continuously to relieve pressure in the hydraulic system.

3. Block all road wheels, place the battery master switch in the 'Off' position and lift the hood assembly.



1 - Cab Safety Prop
2 - Cab Support
3 - Cab Raise Cylinder

Fig. 3 - Cab Secured In Raised Position

4. Insert lever (6), located in the battery box on the left hand side of the tractor frame, into cab hand pump (1).

5. Using hand pump (1), charge the cab raise cylinder (7) sufficiently to allow left hand pins (1, Fig. 1) to be removed. Hold cylinder (7) in this position by locking hand valve on hand pump (1).

6. Remove bolts and bushes (6 & 4 Fig. 1), then drive out pins (1, Fig. 1). Carefully raise or lower the cab as necessary to facilitate removal of pins (1, Fig. 1).

7. Once pins (1, Fig. 1) have been safely removed, continue to raise the cab using hand pump (1) until the cab safety prop (1, Fig. 3) can be fitted.

8. Remove pin assembly (8, Fig. 1) to allow cab safety prop (1, Fig. 3) to swing down to a vertical position on top of the front left hand cab leg.

9. Lock the cab safety prop (1, Fig. 3) in position using pin assembly (8, Fig. 1), locating through holes on bracket at front left hand cab leg.

10. Lock off hand valve on hand pump (1). Remove

lever (6) from pump (1) and place in the stowed position.

LOWERING THE CAB

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

⚠ WARNINGS
To prevent damage, always ensure hood is raised before tilting or lowering the cab.

⚠ Never work near or under an unblocked or unsupported cab. Always use the cab safety prop.

1. Remove pin assembly (8, Fig. 1) from bracket at front left hand cab leg. Place cab safety prop (1, Fig. 3) in stowed position by locating pin assembly (8, Fig. 1) in bracket under cab.

2. Slowly open hand valve on hand pump (1) to allow cab to gently lower. Rate of descent is controlled by the hand valve on pump (1).

3. Lower cab until holes in cab brackets line up with holes in cab supports (2, Fig. 3). Hold cylinder (7) in this position by locking hand valve on hand pump (1).

4. Install pins (1, Fig. 1) through cab brackets and cab supports (2, Fig. 3). Secure pins in position with bush (4, Fig. 1) and bolts (6, Fig. 1).

5. Lower the hood and place the battery master switch in the 'On' position before closing the battery box.

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

MIRROR ARMS

Removal

Numbers in parentheses refer to Fig. 1.

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

1. Support mirror arm bracket (11) and remove locknuts (17), hardened washers (15) and springs (16) securing mirror arm assembly to mounting brackets.

2. Remove mirror arm bracket (11) and ball bearings (14) from mounting brackets.

3. Repeat steps 1 and 2 for other mirror arm bracket (11).

MIRROR ARMS

Installation

Numbers in parentheses refer to Fig. 1.

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

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

1. Coat ball bearings (14) with grease (18) and locate in mounting brackets.

2. Locate mirror arm bracket (11) to mounting brackets and install hardened washers (15), springs (16) and locknuts (17) as shown in Fig. 1.

3. Set mirror bracket spring (16) pressure as follows;
   a. rotate mirror arm (11) until ball bearings (14) are out of their detent.
   b. tighten locknut (17) until spring (16) is almost completely compressed (typical two places).
   c. swing arm until it seats in detent.
   d. check the other two detent positions

4. Repeat steps 1, 2 and 3 for other mirror arm bracket (11).

REPLACING GLASS

Note: When replacing broken glass, it is the user's responsibility to ensure that the replacement glass meets the required specifications. Replacement glass can be purchased from your dealer.

The rear glass, left and right hand side glasses and front windscreen are held in place by a bonding adhesive.
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. Manoeuvre 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. Clean the remains of the adhesive from the edge of the panel opening using a suitable solvent.

6. Coat the edge of the replacement glass with primer and apply adhesive around the lip of the window aperture, as per the manufacturers recommendations.

7. Position glass onto panel opening, pressing firmly so that adhesive bonds sufficiently to allow the glass to be moved or straightened up as required.

8. Ensuring the glass is adequately supported, allow the sealing adhesive to set properly.

9. Clean off any excess adhesive using a suitable solvent.

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.

MAINTENANCE

General

Ensure that hand pump hydraulic tank (2, Fig. 2) is filled with clean hydraulic oil as specified in Section 300-0020, LUBRICATION SYSTEM. Capacity is 0.75 litre (0.2 US gallon).

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.

* * * *

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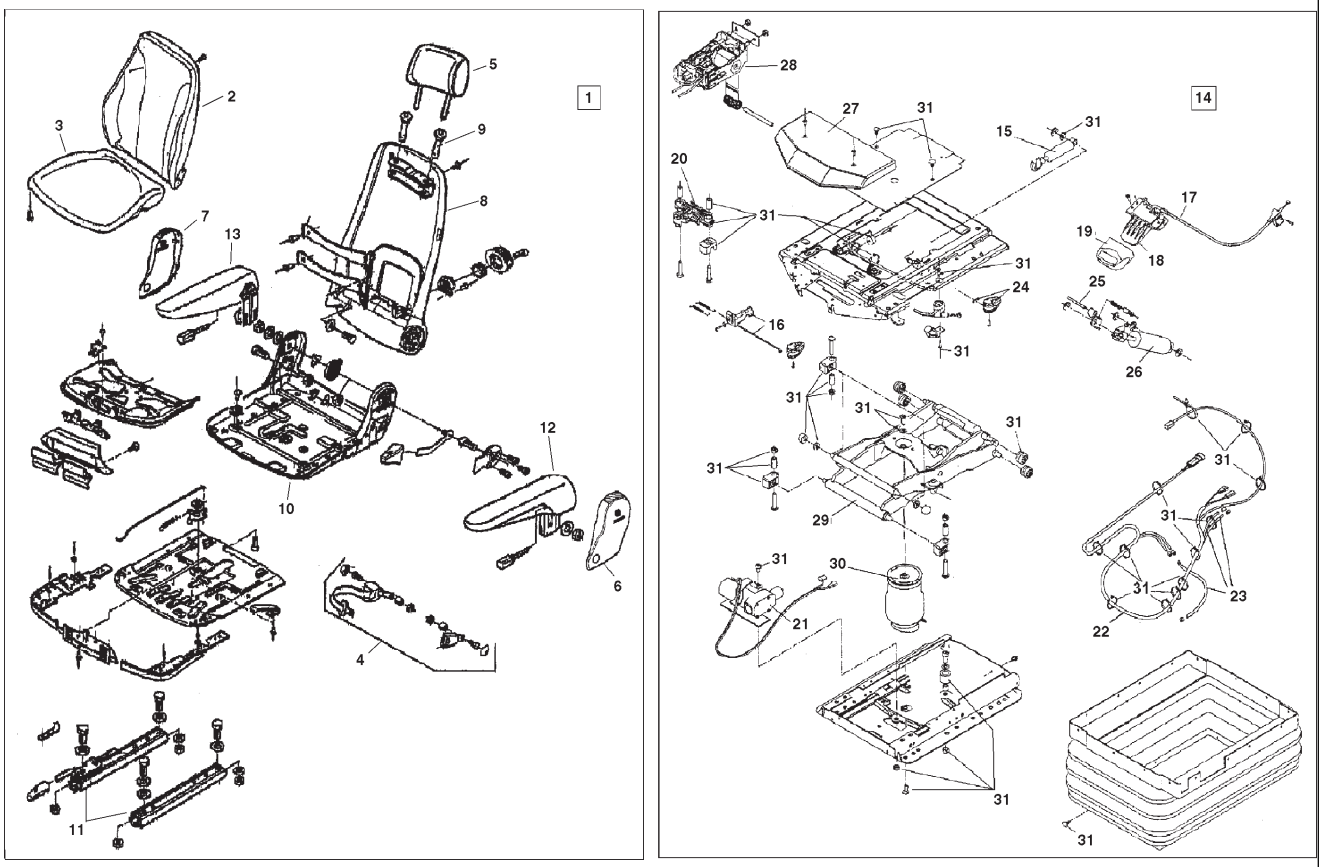

1 - Seat Assembly	12 - Armrest LH	23 - Air Hose
2 - Backrest Cushion	13 - Armrest RH	24 - Lever
3 - Seat Cushion	14 - Suspension Assembly	25 - Cable
4 - Seat Belt	15 - Shock Absorber	26 - Shock Absorber - Vertical
5 - Headrest	16 - Locking Lever Kit	27 - Suspension Kit - Upper
6 - Cover LH	17 - Cable Assembly	28 - Level Controller
7 - Cover RH	18 - Operation Unit	29 - Swing Arm
8 - Backrest	19 - Operation Unit Handle	30 - Air Spring
9 - Bushing	20 - Horizontal Isolator	31 - Wear Kit
10 - Seat Pan	21 - Compressor	32 - Bolt
11 - Adjustment Rails	22 - Connecting Cable	33 - Lock Washer

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 seat assembly consists of a seat cushion (3) and backrest cushion (2) mounted to backrest (8) and seat pan (10). Seat pan (10) is attached to a cab seat base by means of a suspension assembly (14). 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 seat belt (4) is secured to the seat assembly using nuts and spacers. A push button allows quick release of seat belt (4).

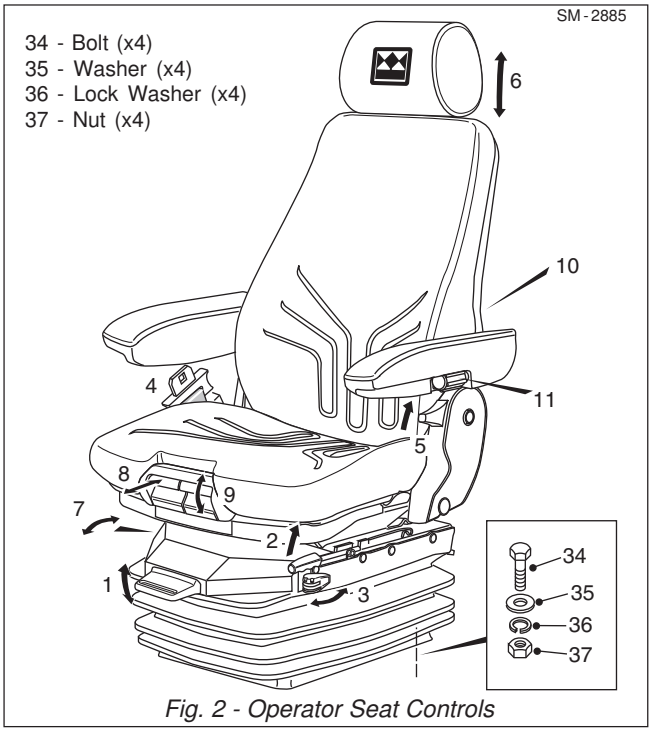

Fig. 2 - Operator Seat Controls

Numbers in parentheses refer to Fig. 2.
The following is the list of controls to adjust the seat:

1. Height and weight adjustment.
2. Horizontal adjustment (sliderails).
3. Fore/aft isolator (forward position - unlocked, rearmost position - locked).
4. Seat belt.
5. Backrest angle adjustment.
6. Backrest height adjustment.
7. Damper adjustment (4 positions; forward position - hardest setting, rearmost position - softest setting).
8. Seat cushion - Fore/aft adjustment.
9. Seat cushion - Rake adjustment
10. Lumber support adjustment
11. Armrest adjustment.

⚠ 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 (1) 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 (2) and move seat forwards or backwards, release handle when required position is achieved.

4. Pull up (or push down) height and weight adjustment (1) 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 handle (8) to adjust seat cushion fore and aft position. Hold and pull handle (8) until desired position is achieved.

6. Pull handle (9) to adjust seat cushion rake angle, hold and pull until desired angle is achieved. Ensure cushion is locked into position. This procedure is better performed when operator is off seat.

7. Pull up handle (5) and adjust backrest to the required angle, release handle when required position is achieved.

8. Pull up (or push down) backrest (6) to the required height.

9. Turn lumber support adjustment (10) until desired pressure if felt on operators back.

10. Set damper adjustment (7) position to suit driving conditions, (4 positions; forward position - hardest setting, rearmost position - softest setting).

11. Set fore/aft isolator (3) position to suit driving conditions, (forward position - unlocked, rearmost position - locked).

12. Turning armrest adjustment (11) alters the height of armrests.

13. Engage seat belt (4).

NOTE: All controls should be set to operators own personal comfort.

REMOVAL

Numbers in parentheses refer to Fig. 2.

⚠ 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 (1) handle to release the air from the seat air suspension system.

5. Remove bolts (34), washers (35), lock washers (36) and nuts (37) securing complete seat assembly to the cab seat base. Remove seat assembly from vehicle using suitable lifting equipment.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

Note: The disassembly and assembly procedures will cover only basic sub-assemblies due to the multitude of parts. If a sub-assembly must be disassembled, use the exploded view in Fig. 1 for reference.

1. Remove covers (6 & 7) from seat assembly. Remove nuts and spacers securing lap belt (4) to seat assembly. Remove lap belt (4).

2. Pull up and remove headrest (5) from seat frame (1).

3. Remove screws securing backrest cushion (2) to seat frame (1). Remove backrest cushion (2).

4. Remove screws securing seat cushion (3) to seat frame (1). Remove seat cushion (3).

5. Pull up horizontal adjustment (2, Fig. 2.) lever and slide seat assembly rearwards. Hold captive nuts using a suitable spanner and remove front allen screws.

6. Pull up horizontal adjustment (2, Fig. 2.) lever and slide seat assembly forwards. Hold captive nuts using a suitable spanner and remove rear allen screws.

7. Remove seat assembly from suspension base.

Horizontal 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. 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.

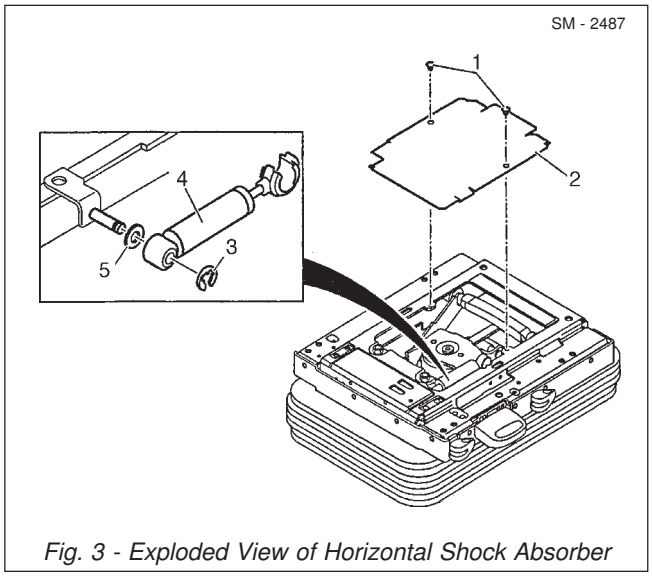

Fig. 3 - Exploded View of Horizontal Shock Absorber

Vertical Shock Absorber

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. 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).

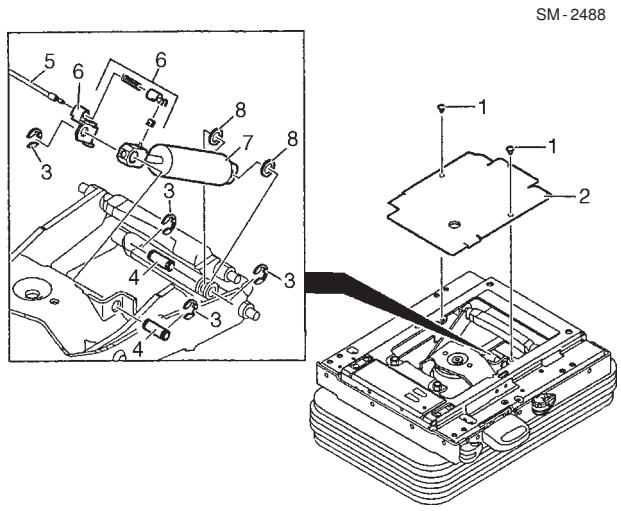

Fig. 4 - Exploded View of Vertical Shock Absorber

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.

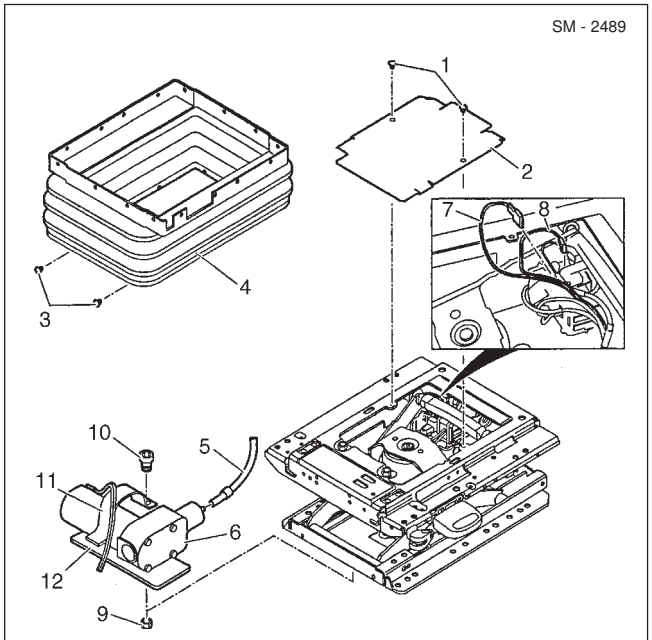

Fig. 5 - Exploded View of Compressor and Mounting

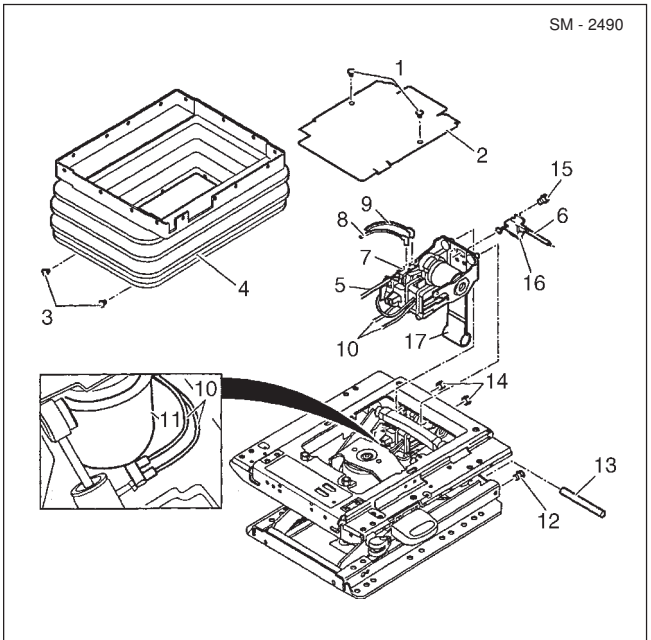

Fig. 6- Exploded View of Level Controller and Mounting

Compressor

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.

Level Controller

Numbers in parentheses refer to Fig. 6.

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).

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. Tighten allen screws to a torque of 25 Nm (18 lbf ft).

2. Pull up horizontal adjustment (2, Fig. 2) lever and slide seat assembly rearwards. Hold captive nuts using a suitable spanner and install front allen screws. Tighten allen screws to a torque of 25 Nm (18 lbf ft).

3. Install seat cushion (3) to seat frame (1) and secure using screws.

4. Install backrest cushion (2) to seat frame (1) and secure using screws.

5. Refit headrest (5) to seat frame (1).

6. Position lap belt (4) to seat assembly and secure using nuts and spacers as removed at 'Disassembly'. Tighten nuts to a torque of 50 Nm (36 lbf ft). Refit covers (6 & 7).

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.

⚠ 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 seat base and secure using bolts (34), washers (35), nuts (37) and lock 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.

SPECIAL TORQUE SPECIFICATIONS				
			TORQUE	
FIG. NO.	ITEM NO.	ITEM NAME	Nm	lbf ft
1	#	Nut	50	36
1	#	Allen Screw	25	18
5	14	Nut	25	18

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 (4) 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 (4) must be removed and replaced at least once every three years.

* * * *

SM3903

1 - Instructor Seat Assembly
2 - Seat Belt
3 - Bolt
4 - Washer
5 - Lockwasher

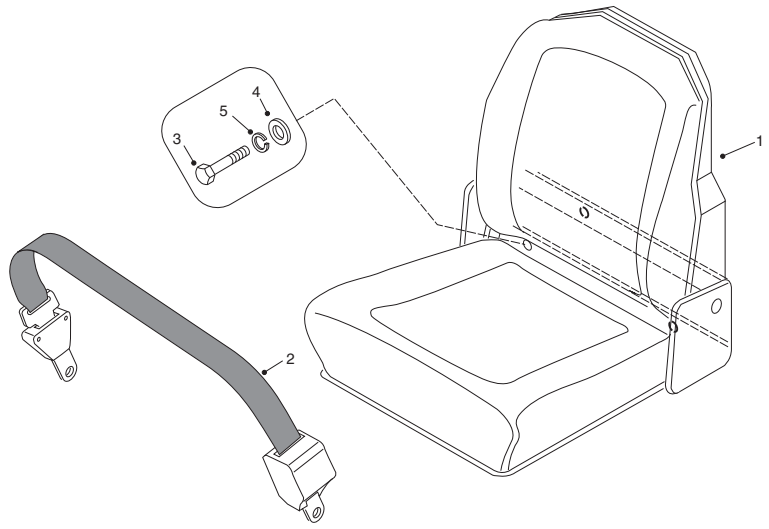

Fig. 1 - Exploded View of Instructor Seat

DESCRIPTION

Numbers in parentheses refer to Figure 1.

> ⚠ **WARNING**
> **By Law, seat belts must be provided. Always wear seat belts when travelling in the vehicle.**

The instructor seat is located adjacent to the left-hand side of the driver's seat, and is secured to tapped bosses on the rear wall of the cab with bolts (3), washers (4) and lockwashers (5). The seat assembly (1) comprises a seat cushion and back cushion mounted to a seat frame. Seat frame (2) is attached to seat base (8) by means of a hinge (9) at the front end and locked at the rear by a spring loaded latch arrangement. Located below the seat base is a storage box, below which is a cavity containing a number of electrical harnesses, the transmission ECU, the Hydraulic ECU, the wash/wipe relay, the CPU and the busbar assembly, all of which are described elsewhere. Access to the equipment below the seat requires pivoting of the base cushion into a vertical attitude, then securing it to the back rest by means of the strap provided, as shown on steps 1 and 2 on Figure 2 below. The back rest can be pivoted to the horizontal position when not in use, by first unlocking the release catch on the right-hand side, then rotating it down as shown on steps 3 and 4 of Figure 2.

The diagnostic interface socket and the hood control switch are both fitted adjacent to the right-hand side of the instructor seat.

A retractable lap seat belt (2) is secured to drilled lugs on the rear wall of the cab. A release button allows quick release of the seat belt (2).

SM3904

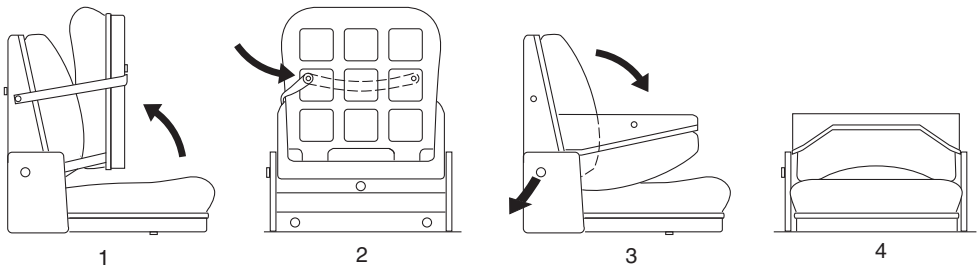

Fig. 2 - Instructor Seat, Hinged Back and Base Operations

REMOVAL AND DISASSEMBLY

Numbers in parentheses refer to Figure 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 perform the task safely.

⚠ WARNINGS
High electrical current. Turn the ignition key switch 'Off' before disconnecting any electrical components. Disconnect electrical connections in the correct order given to prevent damage to the electrical components.

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

2. Turn the steering wheel in both directions several times to relieve any pressure in the steering system. Block all road wheels.

3. Pivot the base cushion to the vetical position, then secure it to the back rest using the strap provided, thus allowing access to the seat mounting hardware.

4. Undo and remove the bolts (3), lockwashers (5) and washers (4) securing the seat assembly to the rear wall of the cab.

5. Lift the entire seat assembly (1) out of the cab and remove it to a prepared area.

6. If access is required to the electrical equipment in the space underneath the seat mounting position, firstly undo and remove the screws securing the storage box, then remove the storage box and the screws to a prepared area.

7. Before working on any of the electrical items beneath the instructor seat, carry out the procedures itemized below in the order given to prevent damage to the electrical components.

a. Turn off the battery master switch
b. Disconnect the battery earth cable
c. Disconnect the battery supply cable
d. Disconnect the alternator earth cable
e. Disconnect the alternator supply cable
f. Disconnect the electrical connections at the engine ECM
g. Disconnect the Transmission TCM
h. Disconnect the body control lever
i. Disconnect the Hydraulic ECU
j. Disconnect the instrument panel (VDU) ECU.

ASSEMBLY AND INSTALLATION

Numbers in parentheses refer to Figure 1.

Note: Tighten all fasteners without special torques specified to torques listed in Section 300-0080, Standard Bolt and Nut Torque Specifications.

1. Carry out the procedures itemized below in the order given to prevent damage to the electrical components.

a. Connect the instrument panel (VDU) ECU
b. Connect the Hydraulic ECU
c. Connect the body control lever
d. Connect the Transmission TCM
e. Connect the electrical connections at the engine ECM
f. Connect the alternator supply cable
g. Connect the alternator earth cable
h. Connect the battery supply cable
i. Connect the battery earth cable
j. Switch on the battery master switch.

2. Position the instructor seat assembly (1) against the internal rear wall of the cab, correctly orientated such that the three holes in the rear of the seat frame align with the tapped holes in the bosses of the rear cab wall.

3. Secure the instructor seat to the rear wall of the cab using the bolts (3), lockwashers (5) and washers (4), tightened evenly and securely.

4. Support the base cushion, then undo the strap holding it in a vertical attitude. Carefully pivot the base cushion to the horizontal position.

5. Remove the wheel chocks from the road wheels.

MAINTENANCE

Numbers in parentheses refer to Fig. 1.

The care of the upholstery on the base cushion and back rest is relatively simple, but an 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 the base cushion and back rest, 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.

The seat belt (2) assembly should be inspected by the user on a regular basis. Replace the seat belt (2) immediately if the hardware is worn or damage, straps are nicked or frayed, release mechanism 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, the seat belt (2) must be removed and replaced at least once every three years.

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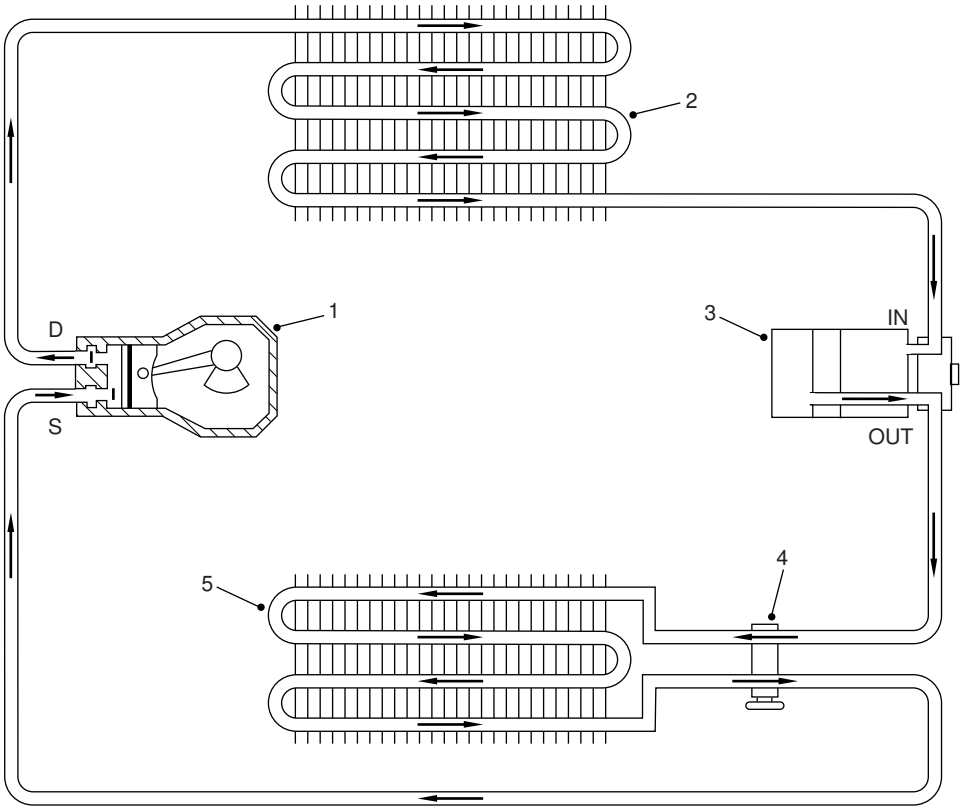


1 - Compressor
2 - Condenser
3 - Receiver Drier
4 - Expansion Valve
5 - Evaporator

Fig. 1 - Typical Air Conditioning Flow Diagram

DESCRIPTION

Temperature Control Switch

A thermostat switch senses the temperature of the evaporator and engages or disengages the compressor clutch. The control for this switch is located in the cab.

Compressor

The compressor is designed to compress vapour and can be damaged by non-compressibles such as dirt, moisture, liquid refrigerant (R-134a), etc. The compressor draws vaporized R-134a from the evaporator (which maintains the low pressure necessary for proper evaporation) and compresses the vapour to a high pressure, which is necessary for condensation. The high pressure vapour then moves into the condenser where heat can be radiated to change the R-134a back to liquid.

Note: R-134a designates the type of refrigerant used in heavy duty vehicle air conditioning systems.

Compressor Drive Clutch

The R-134a compressor systems use an electronically actuated clutch to engage and disengage drive to the compressor. The drive 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.

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

3. Pull on handle (inside battery box) to release hood catch and raise the hood.

4. Discharge the air conditioning system as described under 'Discharging The System'.

5. When satisfied that the system is completely discharged, tag refrigerant hoses (8 & 9) to aid in installation and carefully disconnect hoses from cab firewall. Cap fittings at front of cab and refrigerant hoses (8 & 9) to prevent foreign matter from entering the system.

6. Remove fasteners securing front cover (36, Fig. 3) and end plate (19, Fig. 3) to main weldment (18, Fig. 3).

7. Remove heater hoses from front of cab, which connect to water inlet hose (24, Fig. 3) and water outlet hose (23, Fig. 3). Cap open ports and hoses to prevent foreign matter from entering the system.

8. Unhook control assembly cable (40, Fig. 3) at main weldment (18, Fig. 3).

9. If necessary to remove main weldment (18, Fig. 3) from cab, be sure to disconnect any remaining harnesses, hoses or ducting before withdrawing main weldment (18, Fig. 3) from cab.

Note: The blower assembly mounting (35, Fig. 3), thermostat (21, Fig. 3) and heat exchangers (31,32, Fig. 3) can be accessed without removing the main weldment (18, Fig. 3) from cab.

10. Tag refrigerant hoses (7 & 8) to aid in installation and carefully disconnect hoses from receiver/drier (4). Cap receiver/drier (4) fittings and refrigerant hoses (7 & 8) to prevent foreign matter from entering the system.

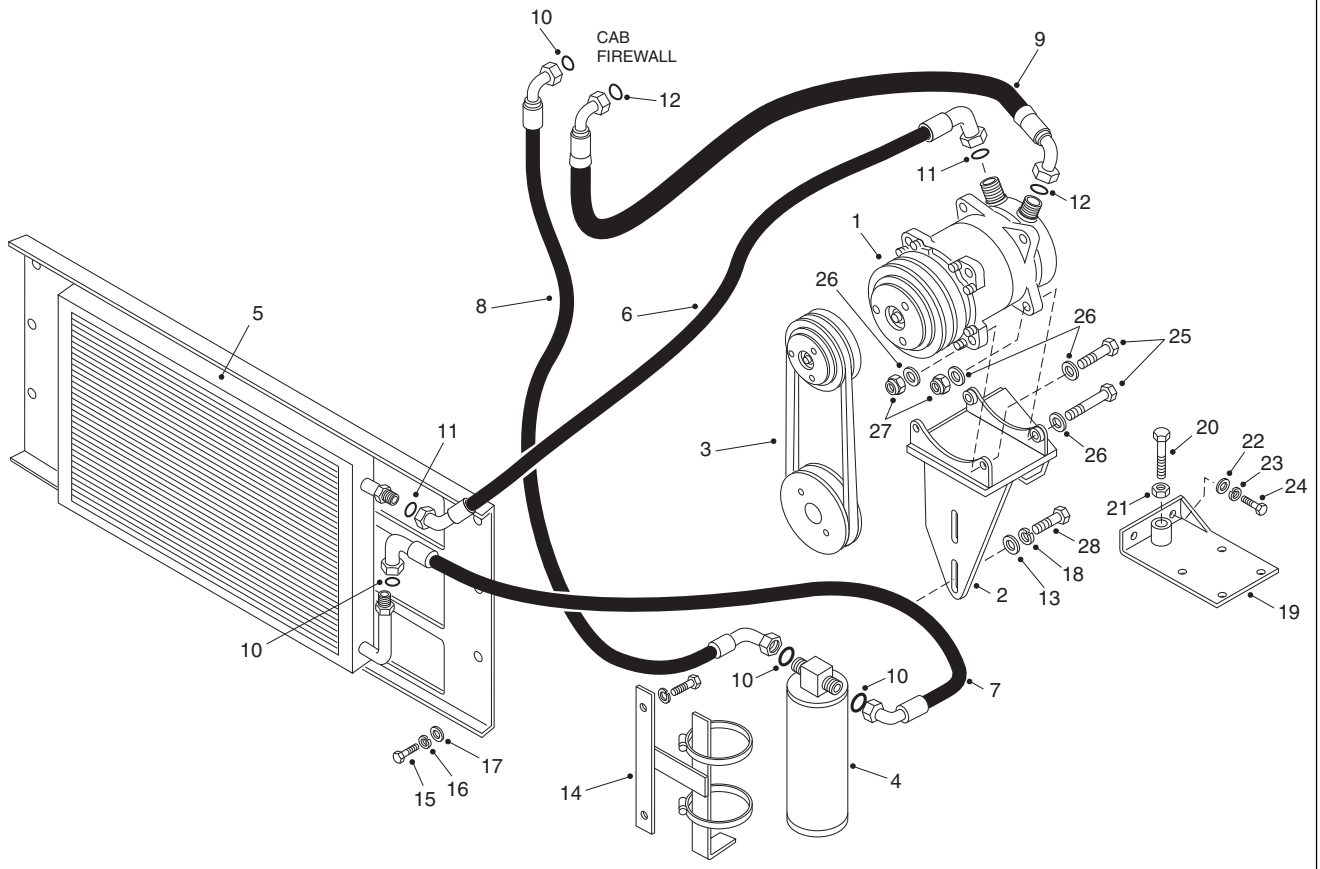
11. Support receiver/drier (4) and remove clamps securing receiver/drier (4) to mounting bracket (14).

12. Tag refrigerant hoses (6 & 7) to aid in installation and carefully disconnect hoses at condenser (5). Cap condenser (5) fittings and refrigerant hoses to prevent ingress of foreign matter.

13. If required, support air conditioner condenser (5) and remove bolts (15), lockwashers (16) and washers (17) securing condenser (5) to radiator assembly. Remove condenser (5) from vehicle.

14. Tag refrigerant hoses (6 & 9) to aid in installation and carefully disconnect hoses from compressor (1). Cap compressor (1) fittings and refrigerant hoses (6 & 9) to prevent foreign matter from entering the system.

15. Disconnect electrical connection from compressor (1) clutch.



1 - Compressor
2 - Compressor Bracket
3 - Drive Belt
4 - Receiver/Drier
5 - Condenser
6 - Refrigerant Hose
7 - Refrigerant Hose
8 - Refrigerant Hose
9 - Refrigerant Hose
10 - 'O' Ring
11 - 'O' Ring
12 - 'O' Ring
13 - Washer
14 - Bracket
15 - Bolt
16 - Lockwasher
17 - Washer
18 - Lockwasher
19 - Adjuster Bracket
20 - Bolt
21 - Nut
22 - Washer
23 - Lockwasher
24 - Bolt
25 - Bolt
26 - Washer
27 - Nut
28 - Bolt

Fig. 2 - Air Conditioner Lines and Mounting

16. Slacken nut (21) and bolt (20). Adjust bolt (20) to release tension on drive belt (3).

17. Drive belt (3) should now be free to slide off the groove in compressor (1).

18. Support compressor (1) and remove bolts (25), washers (26) and nuts (27) securing compressor (1) to bracket (2). Remove compressor (1) from the vehicle.

Note: If drive belt (3) does not require replacement do not remove from engine pulley. If drive belt (3) requires replacement, proceed with steps 19 and 20.

19. If required, remove mounting hardware securing fan guard assembly to radiator assembly. Refer to Section 210-0040, RADIATOR AND MOUNTING.

20. If required, remove bolts (28), lockwashers (18), washers (13) and bracket (2) from engine.

21. If required, remove bolts (24), lockwashers (23), washers (22) and bracket (19).

Note: If fitted, coolant filter will have to be removed.

22. If required, disconnect all clamps and clips securing refrigerant hoses and harnesses to the vehicle. Remove hoses and harnesses from the vehicle.

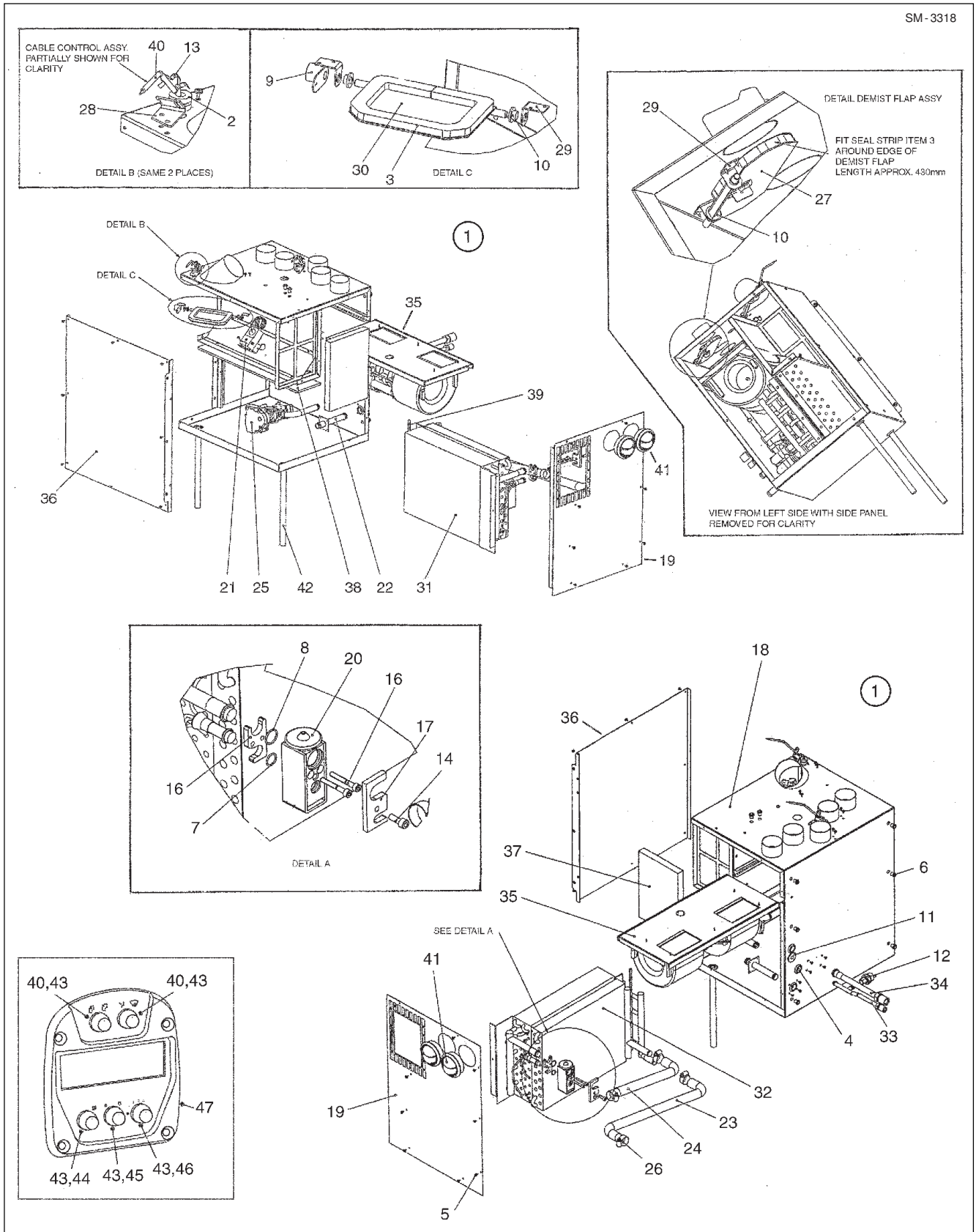


Fig. 3 - Air Conditioner Lines and Mounting

LEGEND FOR FIG. 3

1 - Heater/Air-Con Assy
2 - Grommet
3 - Seal
4 - Grommet
5 - Screw
6 - Grommet
7 - 'O' Ring
8 - 'O' Ring
9 - Control Arm
10 - Control Arm
11 - Nut Insert
12 - Binary Switch
13 - Nut Insert
14 - Allen Screw
15 - Allen Screw
16 - Clamp Plate
17 - Clamp Plate
18 - Main Weldment
19 - End Plate
20 - Valve
21 - Thermostat
22 - Water Outlet Pipe
23 - Water Outlet Hose
24 - Water Inlet Hose
25 - Water Valve Assy
26 - Jubilee Clip
27 - Demist Flap Assy
28 - Cable Bracket
29 - Pivot Bracket
30 - Fresh Air Flap Assy
31 - Evaporator
32 - Heater Coil
33 - Manifold
34 - Manifold
35 - Blower Assy Mounting
36 - Front Panel Assy
37 - Recirculation Filter
38 - Coil Seal
39 - Coil Seal
40 - Control Assy Cable
41 - Louver
42 - Drain Tube Assy
43 - Control Knob
44 - Potentiometer Assy
45 - Air Con Switch
46 - Fan Speed Switch
47 - Control Panel

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.

Note: Renew all 'O' rings where necessary (10, 11 & 12).

⚠ 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 main weldment (18, Fig. 3) was removed, install in cab and reconnect harnesses, hoses and air ducting as noted during removal.

2. Attach control assembly cable (40, Fig. 3) as noted during removal.

3. Reconnect heater hoses to front of cab and connect to water inlet hose (24, Fig. 3) and water outlet hose (23, Fig. 3), as identified at removal.

4. Once all necessary connections have been made, secure front cover (36, Fig. 3) and end plate (19, Fig. 3) to main weldment (18, Fig. 3) using fasteners previously removed.

5. Remove caps from end of refrigerant hoses (8 & 9) and ports at front of cab and connect hoses to ports as tagged at removal.

6. Route refrigerant hoses (8 & 9) along the LH side of the engine securing with clamps removed during removal.

7. If removed, install receiver/drier (4) to mounting bracket (14) and secure with clamps.

8. Remove caps from end of refrigerant hoses (7 & 8) and ports on receiver/drier (4) and connect hoses to ports as tagged at removal.

9. If removed, install condenser (5) to radiator assembly and secure with bolts (15), lockwashers (16) and washers (17).

10. Remove caps and connect refrigerant hoses (6 & 7) to condenser (5) ports as tagged at removal.

11. If removed, install bracket (19) to engine and secure with bolts (24), lockwashers (23) and washers (22). If applicable, install coolant filter to bracket (19).

12. If removed, install compressor bracket (2) to engine and secure using bolts (28), lockwashers (18) and washers (13) as shown in Fig. 2.

13. Fit compressor (1) to compressor bracket (2) and secure with bolts (25), washers (26) and locknuts (27). Do not fully tighten at this stage.

Note: If fan guard and compressor drive belt (3) were removed, proceed with steps 14 & 15.

14. Install new drive belt (3) onto engine pulley and fit to groove on compressor (1).

15. Adjust tension of compressor drive belt with nut (21) on adjuster bolt (20) until there is approximately an inward deflection of 10 mm (0.4 in) at the centre of drive belt (3). Fully tighten all mounting hardware.

16. Remove caps from end of refrigerant hoses (6 & 9) and ports on compressor (1) and connect hoses to ports as tagged at removal.

17. Connect electrical connection to compressor (1) clutch.

18. 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.

19. Charge the air conditioning system as described under 'Charging Procedure'.

20. Switch the battery master switch to the 'On' position, start up the engine and check for correct operation of the air conditioning system.

21. Lower hood and remove wheel blocks from all road wheels.

MAINTENANCE

⚠ WARNINGS

Always wear goggles or glasses to protect your eyes when working around R-134a. R-134a boils at sea level temperatures of -29.8° C (-21.6° F), which means that direct contact with your skin will produce frostbite. Exercise extreme care when handling R-134a. If 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.

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. Check for any air blockages within the system. Clean recirculation filter periodically, by shaking off dust or by washing in soapy water.

9. If the refrigerant system is broken into following gas loss due to mechanical damage or there is any other reason to suspect foreign material ingress, then the receiver/drier should be replaced.

10. Every 4 000 hours, drain, flush and refill the compressor with refrigerant oil specified in Section 300-0020, LUBRICATION SYSTEM. Also see 'Refrigerant Oil'.

Maintenance of drive belts

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 533 N (120 lbf)

dropping to 422 N (95 lbf) after the first 48 hours.
- There should be a freeplay of 10 mm in the belt.
- Do not over tension belts.
- Keep belts free from foreign material that may cause slippage.
- Inspect the 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 drive belt or force it into the sheave groove. Loosen the drive 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 drive 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

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.

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

3. Pull on handle to release hood catch and raise the hood.

4. Connect the service hose (yellow) to the centre access port on the manifold gauge and to the vacuum connection (6) on vacuum pump. Ensure that the system is empty before connecting the vacuum so that refrigerant does not enter the pump.

5. Tighten down (turn clockwise) both high and low side valves on the gauge manifold to the closed position. Remove protective caps from the service ports on the compressor.

6. Connect both service hoses from the two fittings (2 & 3) in the bottom of the manifold to the two service ports on the compressor. High side (red) to compressor discharge valve, low side (blue) to compressor suction valve.

7. Switch vacuum pump on, open vacuum pressure valve (1) until less than 6 mb is reached on vacuum gauge (A). The vacuum gauge (A) should remain at this value when vacuum pressure valve (1) is closed to indicate that there are no leaks.

8. Open the low side hand valve on the manifold and vacuum pressure valve (1) and watch that the gauges start to register that a vacuum is being drawn. If the gauges do not register the vacuum thena blockage is present. Open the high side and pump down until a vacuum of 10 mb is achieved.

9. After 10 - 15 minutes close vacuum pressure valve (1) and allow the system to settle, vacuum gauge (A) should not alter. If the vacuum is held, no leaks or refrigerant contaminated oil is present. If not, open the vacuum pressure valve (1) and continue pumping, checking at regular intervals. If there is a leak, check all fittings and tighten if necessary.

10. Tighten down (turn clockwise) both high and low side valves on the gauge manifold to the closed position, remove the service hose (yellow) from the vacuum connection (6) on vacuum pump and switch the pump 'Off'.

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.

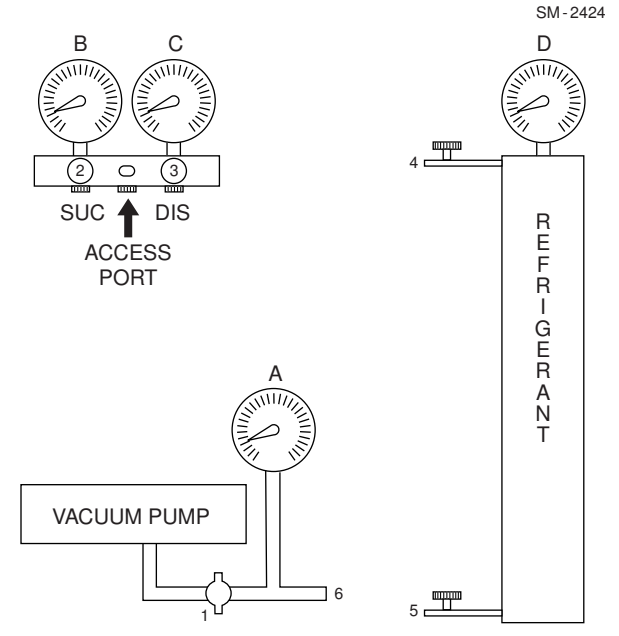
2. Pull on handle to release hood catch and raise the hood.

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.



Gauges:
- A - Vacuum Gauge
- B - Low Pressure Gauge
- C - High Pressure Gauge
- D - Charging Cylinder Pressure Gauge

Valves:
- 1 - Vacuum Pressure
- 2 - Suction Line
- 3 - Discharge Line
- 4 - Refrigerant Gas
- 5 - Refrigerant Liquid

Port:
- 6 - Vacuum Connection

Fig. 4 - Standard Service Manifold

8. Start vacuum pump to evacuate the complete air conditioning system.

9. Run vacuum pump for approximately 30 minutes. Ideal gauge readings should be 29.92 inches of mercury. The pressure will vary with altitude; it will be approximately 0.03 bar (0.5 lbf/in²) less for each 305 m (1 000 ft) of elevation.

10. Before disconnecting power supply from vacuum pump, close both high and low side gauges. Remove yellow hose from vacuum pump and connect to R-134a source.

11. Open R-134a source. Loosen, but do not remove, yellow supply hose at manifold on gauges to remove all air in the yellow supply hose, replacing the air with R-134a. This is done in a few seconds. Tighten yellow supply hose.

12. Open low side of R-134a gauges slowly. When gauge reads zero open both sides completely. Vacuum in the system will draw R-134a gas into the system. Hold until both gauge readings equalize.

Note: Never charge with liquid R-134a. Charge on the low pressure side only.

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. Allow charging to continue until 1.1 kg (2.43 lbs) of refrigerant has been added. The charging process can be speeded up by running the engine at a fast idle.

4. The sight glass on top of the receiver/drier will be substantially free of bubbles.

Note: It is normal for bubbles to increase during clutch cycling or system start-up.

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 suction pressure on the gauge is approx. 20 - 30 psig at 25° C ambient.
b. the correct weight of refrigerant has been added i.e. 1.1 kg (2.43 lbs).
c. 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.

TROUBLESHOOTING

Preliminary Checks

Before any checks are carried out on the refrigerant circuit the following checks should be made:

1. Check the compressor drive belt is serviceable and correctly tensioned.

2. Check the condenser and engine radiator are not blocked by debris. Clean with compressed air or water if necessary.

3. Check that the condenser fins are not flattened or damaged, the fins must allow air to pass freely.

4. Check the cab fresh air inlet filter for blockage.

5. Check that, with the ignition switch on (engine not running), the blower operates over whole speed range

6. Check that, with the ignition switch on (engine not running), the blower and air conditioning switched on, the compressor clutch engages.

Charge level:
Note: It is not possible to check refrigerant charge level with R134a systems. Any bubbles seen at the sight glass on the receiver drier may be bubbles of oil and are perfectly normal.

Fault finding:
Refer to Troubleshooting table
Important: Refer to appropriate removal and installation procedures before working on any system component.

SPECIAL TOOLS

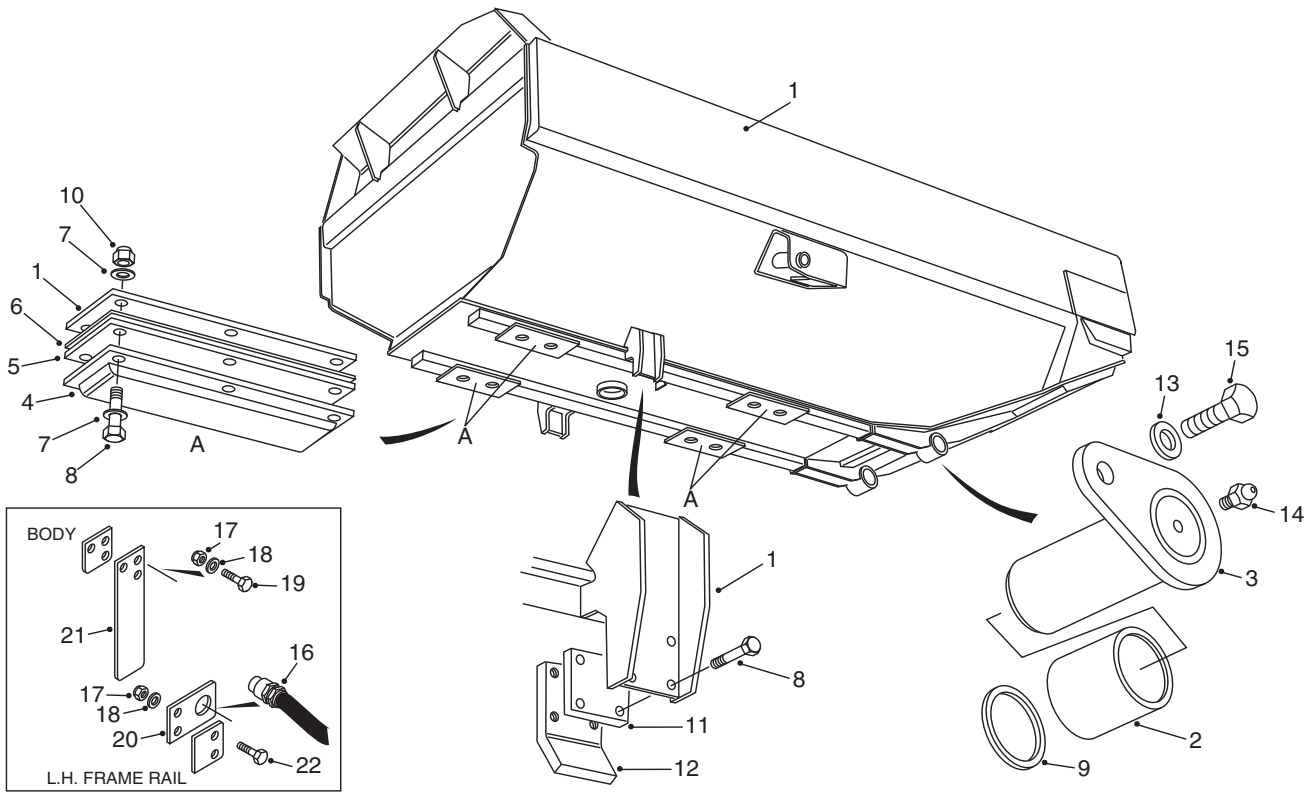
Refer to Section 300-0070, SERVICE TOOLS, for part numbers of special tools referenced in this section and general service tools and sealants required. These tools and sealants are available from your dealer.

AIR CONDITIONING TROUBLESHOOTING		
CONDITION	PROBLEM	REMEDY
1. Belt Trouble		
Slipping	Loose	Adjust belt to 10 mm (0.39 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
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

AIR CONDITIONING TROUBLESHOOTING (CONTINUED)		
CONDITION	PROBLEM	REMEDY
4. Air Conditioning Inadequate After Short Period Of Operation		
Cooling quits	Loss of refrigerant	Charge system/check for leaks
	Moisture in system	Replace drier
	Thermostat	Replace thermostat
	Clutch	Check pull-in of clutch or replace
Cooling intermittent	Moisture in system	Replace drier
5. Electrical Trouble		
Blower motor or condenser fan motor inoperable	Defective circuit breaker or bad wiring connections	Replace. Clean and tighten connections
	Tight motor bearing	Repair or replace motor
	Switch open or shorted	Repair or replace switch
	Blown fuse	Check fuse, replace if necessary
	Motor seized	Check rotors are free to turn
	Loose wire/connection	Check connectors at blower. Check there is power across terminals
	Motor failure	Remove and replace blower
	Faulty control	Check system with replacement
	Module damaged	Check system with replacement module inside main weldment
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 relay	Replace
	Loose connection	Clean and tighten connection
	Broken wire - ground	Repair wire
	Shorted or open field	Replace field
	Blown fuse	Check fuse, replace if necessary
	Faulty freeze protection thermostat	When temperature is above cut-off temp, thermostat should be closed. If faulty, replace thermostat

AIR CONDITIONING TROUBLESHOOTING (CONTINUED)		
CONDITION	PROBLEM	REMEDY
Clutch inoperable (continued)	Faulty compressor	If compressor clutch is being fed power then it should be engaged. If not, check wiring. Replace compressor if faulty
	Faulty pressure switch	If the binary pressure switch detects pressure within range, circuit should be closed. If switch is not closed circuit, indicates incorrect pressure or faulty switch.
6. Air Conditioning System Trouble - Gauges must be connected		
High head pressure	Overcharge of refrigerant	Purge system as necessary
	Air in system	Evacuate and re-charge
	Condenser clogged	Clean condenser
Low head pressure	Undercharge of refrigerant	Complete charge
	Bad compressor valve plate or gasket	Repair or replace
	Restriction in drier	Replace drier
Low suction pressure	Restriction in lines	Clean lines
	Restriction in expansion valve	Replace expansion valve and drier
	Improper expansion valve in charge	Replace expansion valve
	Refrigerant leak	Inspect lines and fittings. Tighten, repair or replace

* * * *



1 - Body	5 - Shim	9 - Shim	13 - Washer	18 - Washer
2 - Bushing	6 - Shim	10 - Locknut	14 - Lube Fitting	19 - Bolt
3 - Hinge Pin	7 - Washer	11 - Spacer	15 - Bolt	20 - Plate
4 - Body Pad	8 - Bolt	12 - Plate	16 - Proximity Switch	21 - Plate
			17 - Locknut	22 - Bolt

Fig. 1 - Exploded View of Body and Mounting

DESCRIPTION

The standard body is an all welded construction with all wear plates fabricated from high hardness (min. 360 BHN) 1000 MPa (145000 lbf/in^2) yield strength steel. Angled lower body sides reduce body impacts when loading and a tail chute angle of 25° provides good retention when travelling without a tailgate. Refer to Section 000-0000, General Information for body capacities.

The body is pivoted at the rear of the trailer frame and is operated by two single stage, double acting hoist cylinders which are cushioned at both ends of the stroke to reduce impact shocks. The hoist cylinders raise the body to a tipping angle of 65° in 12 seconds and power down the body in 7.5 seconds.

OPERATION

The body control lever, mounted on the right hand dash panel, controls the main hydraulic valve assembly.

When the body control lever is operated, a voltage is sent to the hydraulic ECU, which converts voltage to current. This current controls the body raise and lower proportional pressure control valves, producing a pilot pressure to shift the control spool in the main hydraulic valve. This allows the flow of oil to reach the body cylinders, to either raise or lower the body. Refer to Section 230-0000, Body System Schematic and Section 215-0050, Main Hydraulic Valve.

The three operating positions of the joystick from front to rear are as follows:

Power Down - Pushing the lever forward provides hydraulic force to power-down the body. Pushing the

lever fully forward will engage the electric detent. When the body reaches the body proximity switch, the lever springs back to 'NEUTRAL' and power down is ramped back to allow the body to float down on to the chassis.

Neutral - If the body is above the body proximity switch, the lever in this position will stop and hold the body at any desired height. If the body is below the proximity switch, the hydraulic ECU defaults the control spool in the main hydraulic valve to the neutral position and energizes the float solenoid, allowing the body to float down on to the chassis. The body should be fully lowered and in the 'NEUTRAL' position while the machine is in motion. The lever will remain in the 'NEUTRAL' position when released.

Raise - Pulling the lever back and holding it in this position directs oil to extend the body hoists and raise the body. When released, the lever will spring back to the 'NEUTRAL' position.

A **Body Lower** Emergency switch in the cab is connected directly to the float solenoid, within the main hydraulic valve, to enable the lowering of the body in the event of an engine, hydraulic or hydraulic ECU failure. The cause of the failure must be investigated and corrected.

Note: The body must remain lowered with lever in the 'NEUTRAL' position until it is necessary to operate the body again. Failure to comply with 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 on to the chassis. At a predetermined height, the sensor automatically energizes the float solenoid on the main hydraulic valve assembly.

Note: If an electrical failure occurs, the main hydraulic valve assembly will automatically default to the 'HOLD' condition. The cause of the electrical fault must be investigated and corrected.

⚠ WARNING
Never work under or near an unblocked or unsupported raised body. Always use the body safety prop. The body safety prop must only be used when the body is empty.

REMOVAL

Numbers in parentheses refer to Fig. 1.

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

⚠ Hydraulic fluid pressure will remain within the body hoist system after engine shutdown. To prevent personal injury and property damage, press and release the brake treadle valve continuously to relieve pressure in the system.

⚠ WARNING
Exercise extreme caution when lowering the cylinders from the body. The cylinders will swing out sharply as they leave their mountings.

1. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine.

2. Relieve stored hydraulic pressure in accumulators (x3), by pressing and releasing brake treadle valve continuously, until all accumulator pressure is relieved.

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

4. Remove upper pins securing the body cylinders to body (1) assembly and secure body cylinders clear of the body. Refer to Section 230-0130, BODY CYLINDER.

Note: Body lifting lugs can be fabricated as shown in Fig. 2.

5. Secure lifting lugs to body (1) using suitable bolts. Using appropriate lifting equipment, sling body (1) assembly at the four lifting points and take an initial strain.

Note: Approximate weight of body (1) assembly is 4 400 kg (9 700 lb).

6. Remove bolts (15) and washers (13) securing hinge pins (3) in place. Remove hinge pins (3) and shims (9) from body (1).

7. Remove body (1) assembly from the vehicle.

8. Remove bushing (2) from body hinge bores.

INSTALLATION

Numbers in parentheses refer to Fig. 1.

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

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

1. Inspect bushing (2) for damage and replace if necessary. Install bushing (2) in body hinge bores.

Note: Body lifting lugs can be fabricated as shown in Fig. 2.

2. Secure lifting lugs to body (1) using suitable bolts. Using appropriate lifting equipment, sling body (1) assembly and position over the trailer frame.

Note: Approximate weight of body (1) assembly is 4 400 kg (9 700 lb).

3. Align hinge pin bores in body (1) assembly with bores in the trailer frame. Install hinge pins (3) and shims (9) and secure with bolts (15) and washers (17).

4. Secure body cylinders to body (1) assembly with pins and mounting hardware removed during removal. Refer to Section 230-0130, BODY CYLINDER for instructions.

5. Lubricate hinge pins (3) through lube fitting (14) with lubricant specified in Section 300-0020, LUBRICATION SYSTEM. Lubricate slowly until excess lube is seen.

6. Install body pads (4) and body guide plates (12) on body (1) assembly as described under 'Body Shimming Procedure'.

7. Remove lifting equipment from body (1) assembly and blocks from all road wheels.

8. Place the battery master switch in the 'On' position, start the engine and check for correct operation of body (1) assembly.

BODY SHIMMING PROCEDURE

Numbers in parentheses refer to Fig. 1.

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

Note: When it becomes necessary, body pads (4) should be replaced as a set to maintain load distribution along the frame. Existing body pads will have taken a compression 'set' and a new pad, shimmed to match existing pads, will not carry its share of the load, resulting in uneven load distribution along the frame.

1. Raise body (1) clear of the trailer frame and lay body pads (4) (metal face down) roughly in position on the frame.

2. Lower body (1) assembly onto body pads (4).

3. Centralise body (1) assembly to the frame and place shims (5 & 6) under the front two body pads (4) until all other pads are clear of body (1) assembly.

4. Slide shims (5 & 6) under remaining body pads (4) until they just make contact with body (1) assembly.

5. Raise body (1) assembly and install body pads (4) and shim packs (5 & 6) to their relative brackets on body (1) assembly securing with bolts (8), washers (7) and locknuts (10).

6. Lower body (1) assembly to the frame and check the shimming.

7. Install body guide plates (12) with spacers (11) to mounting brackets on body (1) assembly. Set gap between plates (12) and the frame at 5 - 10 mm (0.2 - 0.4 in). Secure plates (12) and spacers (11) to mounting brackets with bolts (8).

MAINTENANCE

Lubricate the body hinge pins and body cylinder pins at the intervals stated and with lubricant specified in Section 300-0020, LUBRICATION SYSTEM. Lubricate slowly until excess lube is seen.

SPECIAL TOOLS

Special tools can be fabricated as shown in Figure 2. Refer to Section 300-0070, Service Tools, for part numbers of the general service tools required. These tools are available from your dealer.

CHAIN OPERATED TAILGATE OPTION

Numbers in parentheses refer to Figure 3.

The chain operated tailgate, when fitted features a rear tail-gate (3), two tailgate side arms (1 and 2), trunnion mounted to the stub shafts (5) on the sides of the body, and side chain assemblies that connect the front ends of the side arms (1 and 2) to outrigger assemblies (23) bolted to the suspension equalization beams. As the body is lifted, the chains rotate the side arms (1 and 2) about the axes of the stub shafts (5), thus maintaining the side arms in an approximately horizontal attitude, and opening up a gap between the tailgate (3) and the rear end of the body.

TAILGATE REMOVAL

> ⚠ **WARNING**
> **To prevent personal injury and property damage, be sure wheel chocks and lifting equipment are properly secured and of adequate capacity to perform the task 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 the 'Off' position.

3. Attach lifting tackle to the attachment point on the top of the tailgate (3) and take up the slack.

4. Undo and remove the bolts (13) with nuts (14) and washers (18) securing the locking plate (4), tailgate side arm (1 or 2) and tailgate (3) together, and remove the locking plate (4), if necessary. The side arm (1 or 2) is applied with a retaining compound (Loctite™ 648) on assembly, and may not readily be separated from the tailgate (3).

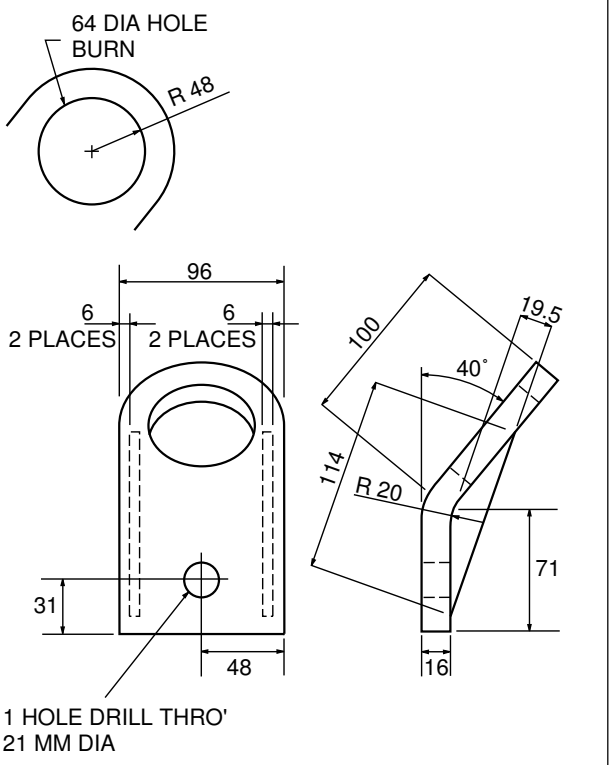


Fig. 2 - Body Lifting Lug

5. Undo and remove the bolts (13) with nuts (14) and washers (18) securing the locking plate (4), tailgate side arm (2 or 1) and tailgate (3) together, and remove the locking plate (4), if necessary.The side arm (2 or 1) is applied with a retaining compound (Loctite™ 648) on assembly, and may not readily be separated from the tailgate (3).

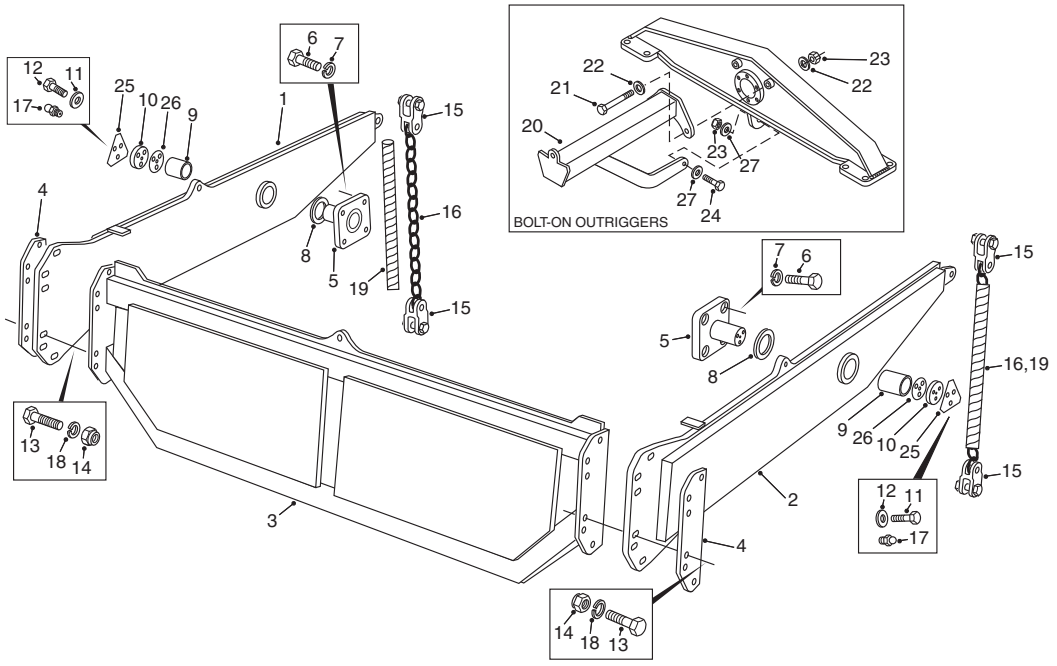
6. Remove the tailgate (3) to a prepared area.

7. Transfer the lifting tackle to one of the tailgate side arms (1 or 2) and take up the slack.

8. Disconnect the shackle (15) at the lower end of the respective chain (16) from the location on the respective outrigger (20).

9. Bend down the corners of the locking plate (28) to allow the bolts (11) and washers (12) to be removed. Undo and remove the bolts (11), washers (12), locking plate (28), thrust plate (10) and the shim (26), if fitted.

10. Carefully manipulate the tailgate side arm (1 or 2)



1 - Left-hand Tailgate Arm Assembly
2 - Right-hand Tailgate Arm Assembly
3 - Tailgate
4 - Locking Plate
5 - Stub Shaft
6 - Bolt
7 - Lockwasher
8 - Shim
9 - Bush
10 - Thrust Plate
11 - Bolt
12 - Washer
13 - Bolt
14 - Locknut
15 - Shackle
16 - Chain
17 - Grease Fitting
18 - Washer
19 - Spiral Wrap
20 - Outrigger Assembly
21 - Bolt
22 - Washer
23 - Nut
24 - Bolt
25 - Locking Plate
26 - Shim
27 - Washer

Fig. 3 - Chain Operated Tailgate Assembly (Option)

off the stub shaft (5), and remove it to a prepared area.

11. Remove the bush (9) from the aperture of the tailgate side arm (1 or 2), if required. The bush is an interference fit in the arm and therefore it will be necessary to use a bearing puller to assist in the removal process.

12. Transfer the lifting tackle to the other tailgate side arm (2 or 1) and take up the slack.

13. Disconnect the shackle (15) at the lower end of the respective chain (16) from the location on the respective outrigger (20).

14. Bend down the corners of the locking plate (28) to allow the bolts (11) and washers (12) to be removed. Undo and remove the bolts (11), washers (12), locking plate (25), thrust plate (10) and the shim (26), if fitted.

15. Carefully manipulate the tailgate side arm (2 or 1) off the stub shaft (5), and remove it to a prepared area.

16. Remove the bush (9) from the aperture of the tailgate side arm (2 or 1), if required. The bush is an interference fit in the arm and therefore it will be necessary to use a bearing puller to assist in the removal process.

17. Support the weight of one of the outrigger assemblies (20), then undo and remove the bolt (24), washers (27) and nut (23) securing the outrigger assembly lower arm to the respective equalization beam lower lug. Similarly, undo and remove the bolts (21), washers (22) and nuts (23) securing the outrigger assembly main beam to the body of the equalization beam. Remove the outrigger assembly to a prepared area. Repeat this step for the other outrigger assembly.

18. Undo and remove the four bolts (6) with lockwashers (7) securing one of the stub shafts (5) to the side of the body. Remove the stub shaft to a prepared area. Repeat this step for the stub shaft on the other side arm (2 or 1 respectively).

TAILGATE INSTALLATION

Numbers in parentheses refer to Figure 2.

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. Apply Loctite™ 243 (anaerobic threadlock) to bolts (6), then secure both stub shafts (5) to the side walls of the body using the bolts (6) and lockwashers (7).

Note: Ensure that the stub shaft is fitted with the radial grease aperture uppermost.

2. Attach the outrigger assemblies (20) to the left-hand and right-hand equalization beams by firstly bolting the outrigger main beams to the bodies of the equalization beams using the bolts (21), washers (22) and nuts (23), then by securing the outrigger lower arms to the equalization beam lower lugs using the bolts (24), washers (27) and nuts (23).

3. Install a bush (9) to each of the two tailgate side arms (1 and 2 respectively).

Note: The bushes may be a tight fit in the side arms. Take care not to damage the bushes if using mechanical assistance during the installation process.

4. Lift both tailgate side arms (1 and 2) into position on their respective stub shafts, correctly orientated. Measure the linear distance between the two side arms (1 and 2), which should be in accordance with the reference dimension identified on Figure 4. If necessary, remove the side arms (1 and 2) and insert sufficient shims (8) over the stub shafts (5), in order to achieve the reference dimension of 2945 mm, then re-fit the side arms (1 and 2) and check the dimension again.

5. Fit a thrust plate (10) to each stub shaft (5), orientated as shown on Figure 5, securing them with the locking plates (25), bolts (11) and washers (12). Ensure that the thrust plates (10) are secured to the stub shafts (5) and NOT to the side arms (1 and 2 respectively). If a thrust plate (10) is impinging on a side arm, undo the bolts (11), remove the bolts (11),

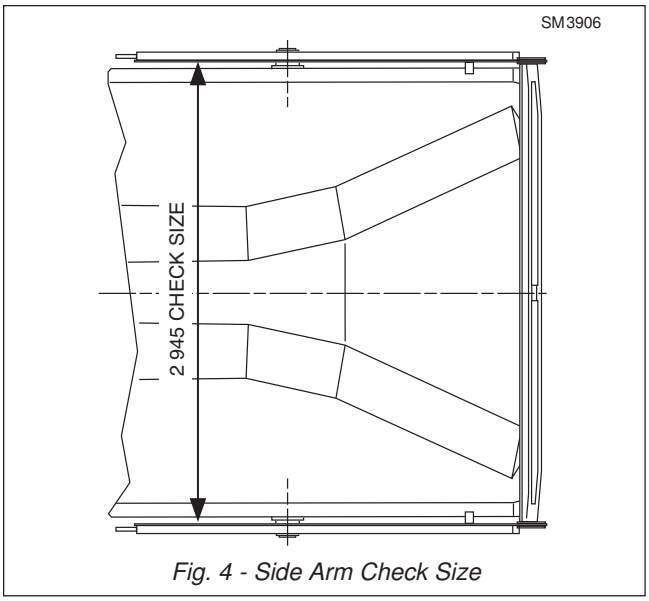


Fig. 4 - Side Arm Check Size

washers (12), locking plate (25) and thrust plate (10), then fit a shim (26), and finally re-fit the thrust plate (10), locking plate (25), bolts (11) and washers (12). There must be a clearancebetween each side arm (1 and 2) and their respective thrust plate (10) of 0.3-1.3 mm. Bend up the corners of the locking plates (25) against the flats of the bolts (11) on completion.

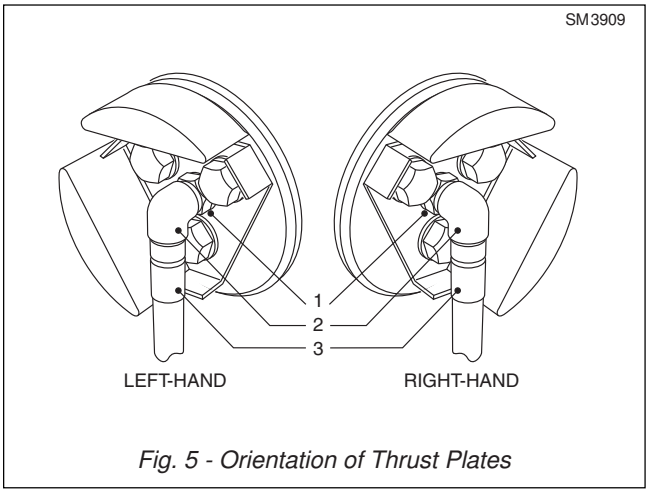


Fig. 5 - Orientation of Thrust Plates

6. Refer to Figure 5. Fit the two grease lubrication hoses (3) complete with elbows (2) and adapters (1) to the stub shafts (5, Figure 3). Fit the couplings and grease nipples (17, Figure 3) to the bottom of the hoses (3).

7. Apply retaining compound (Loctite™ 638) to the areas of the tailgate (3) identified on Figure 6, at BOTH ENDS of the tailgate.

8. Transfer the lifting tackle to the tailgate (3) and lift it into position at the rear of the body. Loosely assemble

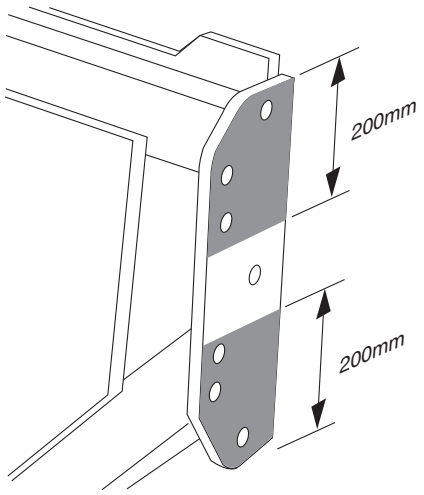


Fig. 6 - Retaining Compound Application Areas

the tailgate (3), with the side arms (1 and 2) and the locking plates (4), using the bolts (13), washers (18) and lock-nuts (14).

9. Manipulate the tailgate (3) until it makes contact with the rear lip of the body. Tighten the bolts (13) with washers (18) and lock-nuts (14), in accordance with Section 300-0080, Standard Bolt and Nut Torque Specifications.

10. Manually operate the side arms (1 and 2) to ensure that the tailgate (3) operates correctly, and does not impinge on the top of the body in its lifted position.

11. Lubricate the tailgate (3) via the grease nipples (17), until excess lubricant can be observed exiting the pivot bushes (9).

12. Fit the two outrigger assemblies (20) to the suspension equalization beams using the bolts (21), washers (22) and nuts (23) to secure each one to the body of the respective beam, and the bolts (24), washers (27) and nuts (23) to secure the lower leg of each outrigger assembly (20) to the lug on the underside of each respective beam.

13. Fit the chains (16) with shackles (15) to the drilled lugs at the forward end of the side arms (1 and 2) and to the corresppponding drilled lugs on the top of the outrigger assemblies (20).

Note: The tailgate (3) should begin to open when the body has tilted 2° from the horizontal. If necessary, remove chain links to achieve this action. DO NOT remove sufficient chain lionks to allow the axis of wither chain (16) to coincide with an imaginary axis bbetween the respetive tailgate pivot point and the chain location pint on the associated outrigger assembly (20), whe the body is fully open.

14. When the chains have been adjusted to their required length, cut appropriate lengths of spiral wrap (19) to cover as much of the chains (16) as possible.

TAILGATE MAINTENANCE

Every 50 hours: Lubricate the tailgate stub shafts (5) with lubricant specified in Section 300-0020, Lubrication System. Lubricate slowly until excess lubricant is observed.

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⚠ SAFETY PRECAUTIONS

Do not allow unauthorized personnel to service or maintain this vehicle. Study the Operator's 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 and plugs, to prevent dirt from entering any system while carrying out servicing procedures. Lubricants must be at normal operating temperature when draining.

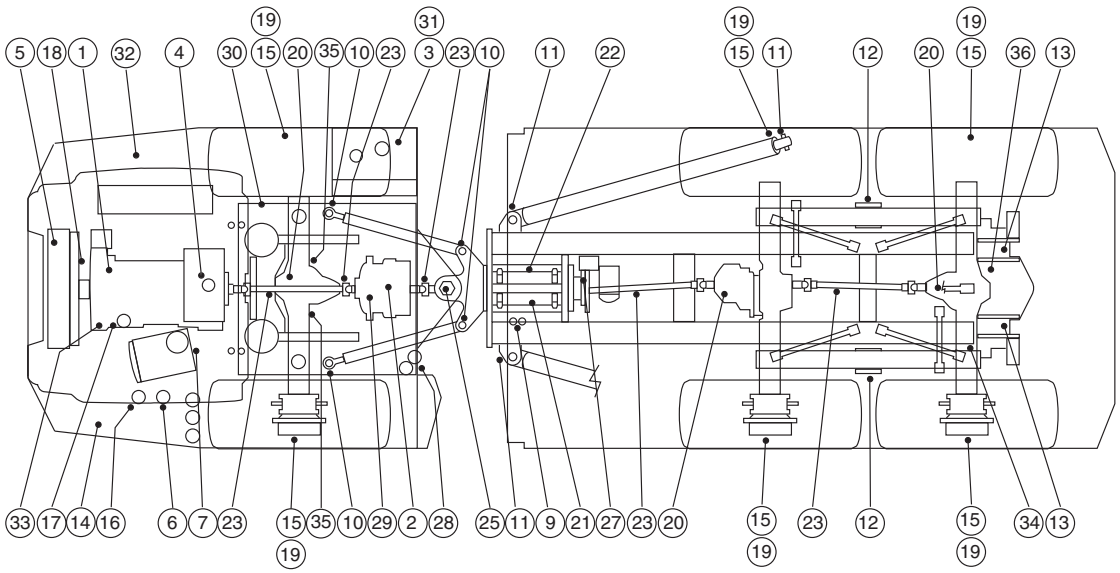
Note: Do not operate any system unless oil level is within the recommended operating levels as indicated on oil level dipstick, sight gauge or level plug.

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.

Miscellaneous - Lubrication System

Section 300-0020



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
	3	Hydraulic Tank	Check oil level. Add if low.	1	HO	As Required
	4	Radiator Header Tank	Check coolant level. Add if low.	1	-	See Page 4
10	6	Fuel Filter/Water Separator	Drain.	1	-	-
(Daily)	7	Air Filter Restriction Gauge	Check. Renew element if required.	1	-	See Note 5
	18	Drive Belts	Check for damage.	-	-	See Engine Manual
	32	Fuel Tank	Check fuel level. Add if low.	1	-	As Required
	-	Engine Crankcase Breather	Inspect and clean if required.	1	-	-
	-	Cooling Fans	Check for damage.	-	-	-
	-	Hydraulic Filter Restriction Indicator	Check. Replace element if required.	1	-	-
	-	Tyres	Check condition and pressure.	6	-	Section 160-0050
	-	Hood	Check air intake/vents for blockage.	3	-	-
	-	General	Check for debris, leaks and damage.	-	-	-
	9	Oscillation Bushes	Lubricate	2	EP, NLGI	See Note 1
	12	Suspension Beam Bushings	Lubricate	2	EP, NLGI	See Note 1
	15	Wheel Rim Nuts	Check torque. (Torque Seal)	72	-	600 Nm (442 lbf ft)
50	14	Battery Electrolyte	Check Level. Add if low	2	-	As required
(Weekly)	30	Cab Ventilation Filter	Inspect and clean if required.	1	-	-
	10	Steering Cylinder Pins	Lubricate	4	EP, NLGI	See Note 1
	11	Body Cylinder Pins	Lubricate	4	EP, NLGI	See Note 1
	13	Body Hinge Pins/Optional Tailgate Pins	Lubricate	2	EP, NLGI	See Note 1
	36	Panhard Rod Bearings	Lubricate	4	EP, NLGI	See Note 1
	-	Engine Air Cleaner	Inspect inlet screen. Renew if necessary	-	-	-
	-	Differential Breathers	Clean if required.	3	-	-
	35	Independent Front Suspension	Lubricate	2	EP, NLGI	See Note 6
250	21	Oscillation Pivot	Check end float. Adjust if required.	1	-	-
(Monthly)	25	Articulation Bearings	Lubricate	2	EP LI COMP	See Note 1
	27	Parking Brake Pads	Check wear. Renew if required.	2	-	-
	-	Transmission Cooler	Clean and inspect fins.	1	-	See Note 3
	-	Radiator and Charge Air Cooler	Clean and inspect fins.	1	-	See Note 3
	-	Drive Belts	Check tension. Tighten if required.	-	-	-
	19	Wheel Planetaries	Check oil level. Add if low.	6	EPL	See Page 5
	20	Differentials	Check oil level. Add if low.	3	EPL	See Note 2

LUBRICATION AND SERVICE CHART (continued)

Interval Hours	Ref. Points	Identification	Service Instructions	No. of Points	Lubricant	Service/Quantities
	1	Engine	Drain oil and refill with new oil	1	EO	See Page 5
500	16	Engine Oil Filter	Renew	1	-	-
(3 Monthly)	32	Fuel Tank	Clean filler neck, screen and cap.	1	-	-
	2	Transmission	Drain oil and refill with new oil	1	EO	See Page 5
	2	Transmission	Run AEB Starter	1	-	-
	2	Transmission Breather	Clean if required	1	-	-
	6	Fuel Filter/Water Separator	Renew	1	-	See Note 7
	22	Driveshaft Bearings	Check oil level. Add if low.	1	EPL	To fill plug. See Note 4.
	28	Transmission Oil Filters	Renew	2	-	-
1000	29	Transmission Internal Oil Filter	Clean	1	-	-
(6 Monthly)	30	Cab Ventilation Filter	Renew	1	-	-
	32	Fuel Tank	Renew cap filter/cartridge.	1	-	-
	-	Hydraulic Tank Breather	Renew	1	-	-
	17	DCA4 Coolant Filter	Renew	1	-	See engine manual
	-	DCA4 Coolant Additive	Check DCA4 Concentration	-	-	See engine manual
	3	Hydraulic Tank	Drain oil and refill with new oil	1	HO	See Page 5
	19	Wheel Planetaries	Drain oil and refill with new oil	6	EPL	See Page 5
	20	Differentials	Drain oil and refill with new oil	3	EPL	See Note 2
	25	Articulation Pivot Nut	Check torque.	1	-	1425 Nm (1050 lbf ft)
	31	Hydraulic Oil Filter	Renew	1	-	See Page 5
2000	3	Hydraulic Tank Strainer	Clean	1	-	
(Annually)	23	Drivelines (Low Maintenance)	Check for leaks and damage.	-	-	See Page 5
	-	Engine Mounting Bolts	Check torque. (Torque Seal)	4	-	298 Nm (220 lbf ft)
	-	Transmission Mounting Bolts	Check torque. (Torque Seal)	3	-	Section 120-0010
	-	Turbocharger Mounting Nuts	Check torque. (Torque Seal)	4	-	65 Nm (50 lbf ft)
	-	Engine Water Pump	Inspect drain hole. Clean if required.	1	-	
	19	Brake Packs	Check brake wear	6	-	Section 160-0030
	34	Axle Mounting Bolts	Check torque	24	-	671 Nm (495 lbf ft)
4000	33	Air Conditioning Compressor	Drain, flush and refill with new refrigerant oil	1	PAG Oil	See Page 5
	5	Cooling System	Drain, flush and refill with new coolant	-	-	See Page 5

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 lubricant is observed.

Note 2 - Capacity of front and rear differentials is 28 l (7.4 US gal). Capacity of centre differential is 31 l (8.2 US gal).

Note 3 - Clean the radiator and cooler fins more often when operating under extremely dusty conditions.

Note 4 - 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 5 - Change safety element after every third primary element service.Check the air cleaner restriction gauge and operate the vacuator valve. Renew the element if the indicator moves from the yellow to the orange section.

Note 6 - Independent Front Suspension (IFS) grease points (2). Remove excess grease from the grease holes in the pivot blocks (8 per side) and at the damper pins (2 per side).

Lubricate the left-hand IFS grease manifold until excess is observed exiting through the grease holes in the pivot blocks (8) and at the damper pins (2).

Lubricate the right-hand IFS grease manifold until excess is observed exiting through the grease holes in the pivot blocks (8) and at the damper pins (2).

Note 7 - This service interval is dependant on fuel quality. If a lesser grade of fuel is used than that specified within the Recommended Lubricant, the service interval should be reduced accordingly.

EO - Engine Oil. Refer to 'Recommended Lubricants' and 'Engine Oil Drain Intervals'.
HO - Hydraulic Transmission Oil. Refer to 'Recommended Lubricants'.
EPL - Extreme Pressure Gear Lubricant spec. MIL-L-2105D.
EP, NLGI - Extreme Pressure Lithium No. 2 Grease (without 'Molybdenum').
EP LI COMP - Extreme Pressure Lithium Complex Grease. Ref. EEMS19057
PAG Oil - Polyalklene Glycol (PAG) Compressor Lubricating Oil - Low Viscosity (ISO46).

MISCELLANEOUS SERVICING

WHEN REQUIRED

Seat Belts - Inspect for damage. Replace if required.

Windscreen Wipers And Washers - Replace wiper blades and top up reservoirs.

Wheel Rim Nuts - After first 10 hours (1 day) of operation re-torque nuts to 600 Nm (442 lbf ft). Check torque every 50 hours thereafter.

Engine - Steam clean the engine prior to performing any repair or service work on it, and if heavily contaminated due to prevailing site conditions.

CAUTION

Electrical and electronic connections, the Engine ECM and harness connections should be protected or not directly steam cleaned when on or removed from the engine.

Note: The engine and its components that are scheduled to be checked, serviced or replaced must be cleaned in accordance with the manufacturer's recommendations.

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 air restriction gauge locks up in the red. Service vacuator valves daily. Inspect and remove any obstructions from the vacuator valve lips which should be open and pliable with the engine stopped.

Note: Service air cleaners more often when operating under extremely dusty conditions.

Engine Crankcase - Check oil level and add oil if low. With the engine off, the oil should be between the lower and upper marks on the dipstick, up to the upper mark is preferable.

Transmission - Check oil level and add 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 the body down the oil should be visible in the sight gauge.

Radiator Header Tank - Check coolant level when cold and add if low. Fill the radiator header tank with coolant until coolant reaches the bottom of the filler neck and holds that level.

Note: Any time a significant amount of coolant is added, the coolant concentration MUST be checked. Failure to use recommended coolant and to maintain mixture at sufficient concentration levels can result in damage to the cooling system and its related components. Always maintain concentrations at recommended levels. Refer to 'Recommended Coolants', within Section 210-0000, Cooling System.

AFTER FIRST 250 HOURS OF OPERATING NEW OR REBUILT COMPONENTS

Wheel Planetaries - Drain oil and refill.

Differentials - Drain oil and refill.

AFTER FIRST 500 HOURS OF OPERATING NEW OR REBUILT COMPONENTS

Transmission - Drain oil, replace filter, clean internal filter and finger magnet. Refill transmission.

Note: When refilling transmission ensure that the transmission cooler is primed to prevent damage.

EVERY 250 HOURS OF OPERATION (MONTHLY)

Oil Can Points - Oil working parts with engine oil.

General Inspection - Check entire dumptruck for leaks, loose bolts and nuts or damaged parts. Examine the vehicle, particularly the chassis, for cracks or broken welds. Repair where necessary.

Engine Air Intake - Check air intake system for wear points or damage to piping, loose clamps and leaks.

Note: This service interval applies to normal driving. check the pads more frequently under more severe conditions. Thickness of pad friction material should never be allowed to wear below 3 mm (0.12 in).

Parking Brake - Check pads and disc for wear. Adjust or replace if required. Test for proper function. Friction material thickness should never be allowed to wear below 3 mm (0.12 in).

EVERY 500 HOURS OF OPERATION (THREE MONTHS)

Differentials - Check Oil level and add if low.The correct oil level is up to the rim of the oil filler and level-check hole. Refer to relevant Differential section within the service manual for specific details.

Planetaries - Check oil level and add if low.Oil level should be at the lower bottom edge of the thread, with the wheel hub orientated so that the oil drain plugs are positioned horizontally in the middle of the axle. Refer to relevant Planetary section within the service manual for specific details.

EVERY 2000 HOURS OF OPERATION (ANNUALLY)

Hydraulic Oil Tank - Drain oil, remove and clean filter screen assemblies. Reinstall filter screens and refill tank.

Hydraulic Oil Filter - Clean filter housing and install new element when filter restriction gauge reads in red zone, or after 2000 hours of operation, whichever comes first.

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.

Multi Disc Brakes - Check operation and brake wear is within the prescribed limit. Refer to Section 160-0030 Rear Axle Group - Axle Group Hub for details.

Differentials - Drain oil and refill. Perform oil change when oil is warm. For specific details of oil fill and drain plug locations, refer to the relevant differential section contained within the service manual for details.

Planetaries - Drain oil and refill. Perform oil change when oil is warm and simultaneously with the differential. For specific details of oil fill and drain plug locations and steps, refer to the relevant planetary section contained within the service manual for details.

ENGINES AND TRANSMISSIONS

All information contained in the 'Lubrication and Service Chart' was extracted from the relevant manufacturers' Operators' Manuals and was correct at time of publication. User should ensure that information contained in this chart, regarding Engines and Transmissions, reflects the information shown in the relevant manufacturers' Operators' Manuals, supplied with the machine. Maintenance procedures should be carried out in conjunction with any additional procedures contained in the relevant manufacturers' 'Operation and Maintenance Manual', at the intervals specified.

RECOMMENDED LUBRICANTS					
COMPONENT	LUBRICANT	*CAPACITY	SPECIFICATIONS	API CODE	SAE GRADE
Engine Crankcase (Including Filters)	Engine Oil with 1.00% sulphated ash limit is recommended. Sulphated ash must not exceed 1.85% limit	41 l (10.8 US gal)		CH-4	15W-40 (See Note 1)
Transmission (Including cooler)	Engine Oil with 1.85% max. sulphated ash limit	63 l (16.6 US gal)	(See Note 2)	CH-4	15W-40 See Trans. Oil Table.
Transmission Cooler	Engine Oil with 1.85% max. sulphated ash limit	8.25 l (2.18 US gal)	(See Note 2)	CH-4	15W-40 See Trans. Oil Table.
Hydraulic System (Including Lines)	Hydraulic Transmission Oil	202 l (53.4 US gal)	See Hydraulic Oil Table (See Note 3)		
Cooling System	Anti-freeze, Ethylene Glycol	54 l (14.3 US gal)			
Differential (Front [non IFS] and Rear)	Extreme Pressure Gear Lubricant	28 l each (7.4US gal)	MIL-L-2105 B	GL-5	80W-90
Differential (Front, IFS)	Extreme Pressure Gear Lubricant	26 l (7 US gal)			
Differential (Centre)	Extreme Pressure Gear Lubricant	31 l (8.2 US gal)	MIL-L-2105 B	GL-5	80W-90
Planetaries (Front)	Extreme Pressure Gear Lubricant	11.0 l each (2.9 US gal)	MIL-L-2105 D (See Notes 5 and 6)	GL-5	80W-90
Planetaries (Centre & Rear)	Extreme Pressure Gear Lubricant	7.5 l each (2.0 US gal)	MIL-L-2105 D (See Notes 5 and 6)	GL-5	80W-90
Fuel Tank	Diesel Fuel Oil with max. sulphur 0.5%	390 l (103 US gal)	DIN EN590		
Grease Nipples	Extreme Pressure Lithium Grease				No.2 Consistency
Driveshaft through Bearings	Extreme Pressure Gear Lubricant	(See Note 4 - Pag e 3)	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 l (0.033 US gal)	ISO46 SP 10		

***** - Capacities given are approximate, work to dipstick, sight gauges or level plugs.

Note 1 - The use of low viscosity oils, such as 10W-30 or 5W-30, can be used to aid in starting the engine and providing sufficient oil flow at low ambient temperatures. Continuous use of low viscosity oils can decrease engine life due to wear.

Note 2 - Operation below the minimum temperatures listed for the oil used without proper preheat or warm-up results in greatly reduced transmission life. Proper warm-up requires 20 minutes minimum operation in neutral (with engine at part throttle) before operating the transmission in gear.

Note 3 - Hydraulic Transmission Oil meeting Specification EMS19058 is suitable for use in the hydraulic system.

Note 4 - 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.

Note 5 - 1.5% of Lubrizol (TEREX Part No. 15250489), must be added to planetary capacity to prevent brake squeal.

Warning

Any increase in the stated volume of Lubrizol will result in a decrease in brake performance.

Note 6 - Volume of Lubrizol to each planetary is as follows:

Front: 1.5% = 165 ml (5.57 oz)
Centre & Rear: 1.5% = 110ml (3.71 oz)

ENGINE OIL DRAIN INTERVALS

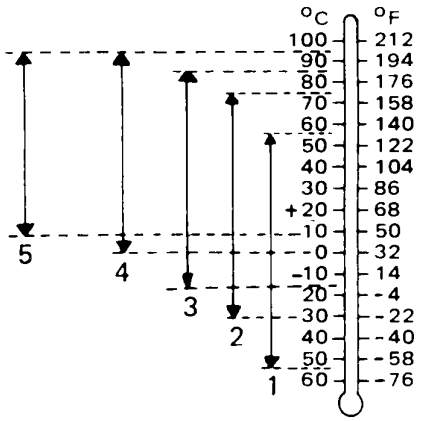
Engine oil drain intervals are dependant on working environment and oil type used. Refer to table below for engine manufacturer's recommended oil drain intervals.

ENGINE OIL DRAIN INTERVALS BY DUTY CYCLE (HOURS)				
	Severe	**Heavy**	**Medium**	**Light**
Fuel Consumption	> 13 gal/hr	10 to 13 gal/hr	8.5 to 10 gal/hr	< 8.5 gal/hr
API CF-4	150	200	250	300
API CG-4	250	300	400	500
API CH-4 or ACEA E5	300	350	500	600
CES20076 or CES20077	350	400	550	700

LUBRICANT GRADE SELECTION GUIDE AT AMBIENT (START-UP) TEMPERATURE

HYDRAULIC OIL

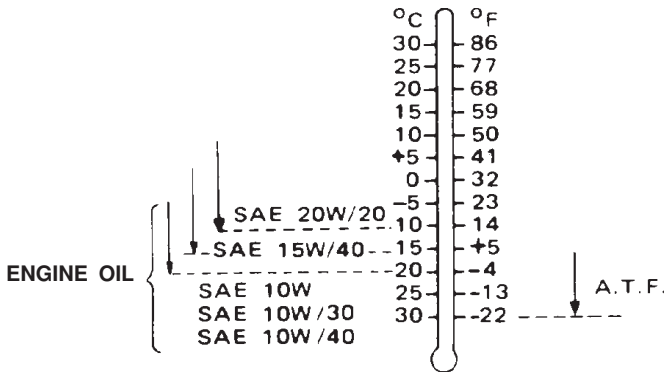
SM637



	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

SM639



(See Note 5)

Note - Consult your lubricant supplier for correct viscosity of lubricant when ambient temperatures are consistently above or below those listed.

Section 300-0020

TYRE PRESSURES

Tyre pressures on this pages apply to the truck serial number ranges specified only, Gross Vehicle Weight (GVW) and axle weights may vary between truck derivatives. Tyre pressure should be recalculated if not shown for a particular truck. Contact TEREX for assistance.

The tyre inflation pressures listed are manufacturers' recommendations for GVW travelling at maximum speed. TEREX Advise that operators check tyre inflation pressures with tyre manufacturers to ensure the correct setting for each particular application.

				Front		Centre		Rear	
Truck	Brand	Size	Pattern	b	lbs/in²	b	lbs/in²	b	lbs/in²
TA27	Bridgestone	23.5 R25	VLT	4.4	64	4.4	64	4.4	64
A889	Bridgestone	23.5 R25	VMT	4.4	64	4.4	64	4.4	64
A892	Bridgestone	23.5 R25	VKT	4.4	64	4.4	64	4.4	64
	Michelin	23.5 R25	XADT	3.8	55	3.4	50	3.8	55
	Double Coin	23.5 R25	REM2	4.5	65	4.5	65	4.5	55
	Triangle	23.5 R25	TB516	5.2	76	5.2	76	5.2	76
	Triangle	23.5 R25	TM518	5.2	76	5.2	76	5.2	76
	Triangle	23.5 R25	TL528	5.2	76	5.2	76	5.2	76
	Bridgestone	30/65 R25	VLT	3	43	3	43	3	43
	Michelin	30/65 R25	XADN	3.1	45	2.8	40	2.8	40
	Michelin	750/65 R25	XAD 65	3.1	45	2.8	40	2.8	40
TA30	Bridgestone	23.5 R25	VLT	4.8	69	4.8	69	4.8	69
A894	Bridgestone	23.5 R25	VMT	4.8	69	4.8	69	4.8	69
A908	Bridgestone	23.5 R25	VKT	4.8	69	4.8	69	4.8	69
A897	Michelin	23.5 R25	XADT	4.1	60	4.1	60	4.1	60
A911	Double Coin	23.5 R25	REM2	4.5	65	4.5	65	4.5	65
	Triangle	23.5 R25	TB516	5.2	76	7.2	76	5.2	76
	Triangle	23.5 R25	TM518	5.2	76	5.2	76	5.2	76
	Triangle	23.5 R25	TL528	5.2	76	5.2	76	5.2	76
	Bridgestone	30/65 R25	VLT	3.2	46	3.2	46	3.2	46
	Michelin	30/65 R25	XADN	3.1	45	3.1	45	3.1	45
	Michelin	750/65 R25	XAD 65	3.1	45	3.1	45	3.1	45

* * * *

INTRODUCTION

Contained in this section are recommended service tools and equipment required for maintenance, overhaul and troubleshooting. In certain instances, both Metric and Imperial equivalents of the same tools are listed.

Note: A tool may be of one piece construction or consist of a number of parts.

General

*15269784 - Multi-Gauge - Pressure range of 30 in of vacuum to 5 000 lbf/in²
15269785 - Non-contact Infrared Thermometer
15271082 - ORFS 'O' Ring Kit
15268968 - Strap Type Filter Wrench
15268969 - Socket Type Filter Wrench
15268970 - Universal Belt Tension Gauge
15269858 - Digital Tachometer
15269859 - Multimeter
15269813 - Water Manometer
15269802 - Dial Indicator Gauge - Metric
15269803 - Dial Indicator Gauge - Imperial
15269804 - Magnetic Base for Dial Indicator Gauge
15269805 - Micrometer - 0 to 25 mm
15269806 - Micrometer - 0 to 1 in
15269860 - 92 Piece Heavy Equipment Tool Kit
15269861 - Torque Wrench - 3/8 in drive, 20 - 100 Nm (15 - 80 lbf ft) range
15269862 - Torque Wrench - 1/2 in drive, 60 - 330 Nm (45 - 250 lbf ft) range
15269863 - Torque Wrench - 3/8 in drive, 4 - 20 Nm (40 - 180 lbf in) range
15269864 - Torque Wrench - 3/4 in drive, 300 - 1 000 Nm (200 - 750 lbf ft) range
15269865 - Torque Wrench - 3/4 in drive, 700 - 1 500 Nm (500 - 1 000 lbf ft) range
15269866 - Torque Multiplier - 1/2 in to 1 in drive, 25:1 Ratio, 3 000 Nm (2 200 lbf ft) range

* - The following items should be added to the multi-gauge to enable the gauge to be used on diagnostic test points:
15018226 - Diagnostic Coupling
00118748 - Connector (2 off)
15004085 - Hose Assembly (-4 HP, 84 in long)

Engine

QSM - Electronic Diagnostic Tooling

15500622 - Insite Kit - Includes Insite program and inline adaptor. Note; 15500716 Deutsch Cable should be added to this kit.
15500623 - Insite Program (Individual Spare)
15500624 - Inline Connector (Individual Spare)
15500716 - Deutsch Cable (Individual Spare)
15500388 - QuickCheck II Kit (For use with palm top) - Includes; Adaptors, Software and Cables.

The following tools are recommended for Engine Maintenance Procedures. These tools should be used in conjunction with procedures outlined in the engine manufacturers service manual.

15270076 - Vacuum Gauge
15270075 - Dial Depth Gauge
15270006 - Connecting Rod Checking Fixture
15269956 - Standard Puller
15269958 - Piston Ring Expander
15270078 - Manometer
15269959 - Main Bearing Cap Puller
15270081 - Pressure Gauge
15269960 - Dial Gauge Attachment
15270009 - Threaded Insert Kit
15269962 - Dial Bore Gauge Kit
15270079 - Manometer Tool
15270042 - Pressure Gauge (0 - 160 lbf/in²)
15270010 - Crack Detection Kit
15270082 - Pressure Gauge (0 - 300 lbf/in²)
15269971 - Connecting Rod Guide Pins
15269966 - Cylinder Liner Puller Plate
15269961 - Dial Indicator Gauge
15269973 - Oil Seal Guide
15269974 - Oil Seal Guide
15269975 - Pulley Installation Tool
15269980 - Regulator Retainer Plug Driver
15269981 - Oil Seal Guide
15269982 - Torque Wrench - lb in
15269985 - Flywheel Housing Alignment Plate
15270070 - Coupling Puller
15270004 - Magnetic Base
15269994 - Cylinder Head Lifting Bracket
15270084 - Blowby Check Tool
15269996 - Injector Puller
15269997 - Piston Ring Compressor
15269999 - Gauge Block
15270072 - Drive Gear Driver
15270020 - Needle Bearing Kit
15270021 - Bearing Installation Tool
15269984 - Engine Barring Tool
15270003 - Cylinder Liner Clamping Tool
15274125 - Cooling System Test Kit
15274126 - Refractometer
15274129 - Hose Adaptor
15274130 - Hose Adaptor
15274127 - Belt Tension Gauge
15274128 - Hose Assembly Tools
15274060 - Heavy Duty Cam Gear Puller Kit
15274131 - Wrench, Air Impact

15274138 - Installer, Valve Guide
15274146 - Adaptor, Fuel Restriction
15274141 - Lubriplate 105 Lubricant
15274136 - Kit, Torque Wrench
15274139 - Pliers, Boot
15274142 - Lamp, 100W Black Light Kit
15274143 - Charger Set International
15274135 - Kit, Guide Pin
15274140 - Fixture, Pulley Alignment
15274134 - Kit, Inline II Datalink Adaptor
15274059 - Liner Puller
15274061 - Injector Protrusion Comparator
15274062 - Tube, Fuel Line Sight #12
15274063 - Pilot, Oil Seal Puller Drills
15274064 - Kit, Turbo Rebuild
15274065 - Digital Tachometer Kit
15274066 - Bent Wrench
15274067 - Adaptor, Fuel Line Sight #16 Hose
15274068 - Gear Puller, Jaw
15274069 - Guide, Valve Installation
15274070 - Expander, Fan Hub Seal
15274071 - Capscrew, Pulley Puller
15274072 - Driver, Regulator Valve Seat
15274073 - Gauge, Cylinder Liner Ring
15274074 - Tube, Fuel Line Sight
15274075 - Cam Guide Expander - Large Dia
15274076 - Fluorescent Tracer
15274077 - Expander, Accessory Drive Shaft Seal
15274078 - Fuel Pump S Wrench
15274079 - Kit, Torque Wrench
15274080 - Fitting Quick Connect
15274081 - Fitting Quick Connect
15274082 - Tube, Cooling System Sight
15274083 - Tube, Cooling System Sight
15274084 - Tube, Cooling System Sight
15274148 - Wrench, Dial Type Torque
15274144 - Wrench, Nylon Strap Filter
15274145 - Gauge, Torque Angle
15274147 - Wrench, Crows Foot 13 mm
15274124 - Set, Torx Plus Driver
15274137 - Bit, Screw Driver
15274085 - Engine Parts Rack
15274086 - Gauge, Belt Tension
15274087 - Socket, Engine Position Sensor
15274088 - Kit, Combustion Gas Leak Test
15274132 - Test Fluid
15274089 - Thermocouple Wire Kit
15274090 - Engine Coolant Analyser
15274091 - Gauge, Belt Tension
15274092 - Wrench, CELECT Torque
15274093 - Screwdriver, CELECT
15274094 - Puller, Water Pump Pulley
15274095 - Adjuster, STC Tappet
15274096 - Super Chip Vacuum Kit
15274097 - Gauge, Cyl. Head Capscrew Length
15274098 - Kit, Counterbore Ledge Cutter
15274099 - Cutter Plate
15274100 - Clamp On Current Probe
15274101 - Injector Puller/driver
15274102 - Kit, Hydraulic Actuator
15274103 - Kit, Hydraulic Cylinder Support
15274104 - Kit, Cam Bushing I/R
15274105 - Kit, Rail Pressure Response
15274106 - Kit, Pulley Installation Adaptor
15274107 - Socket, Deep Flank Drive
15274108 - Template, Cylinder Head Capscrew
15274109 - Torque Angle Gauge
15274110 - Small Bushing Driver Set
15274111 - Kit,CNG Wastegate Test
15274112 - Fixture, Cam Follower Assy R/I
15274113 - Validator, Torque Wrench
15274114 - Kit, Cylinder Head Leak Test
15274115 - Kit, Charge Air Cooler Tester
15274116 - Module, Vacuum Pressure
15274117 - Meter, Automotive
15274118 - Puller, STC Injector
15274119 - Driver, Thermostat Seal
15274120 - Sensor Break-out Kit
15274121 - Counterbore Salvage Kit
15274122 - Installer, Oil Capacitor
15274123 - Kit, Wiring Repair, Basic
15274133 - Cable, Throttle Breakout

Transmission

The following tools are recommended for Transmission Maintenance Procedures. These tools should be used in conjunction with procedures outlined in the transmission manufacturers service manual.

15270087 - Straight Pin
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

Axles and Differentials

15503031 - Grooved Socket Wrench
15503032 - Lifting Device
15503033 - Seal Punch
15503034 - Seal Punch
15503090 - Driver
15503093 - Lifting Device
15503094 - Bearing Tool
15503095 - Bearing Tool
15503096 - Lifting Device

For Fabricated tools refer to Section 140-0020 AXLE GROUP HUB.

Front Suspension

The following tools are recommended for any front suspension maintenence procedures. These tools should be used in conjunction with the proecedures outlined in Section 180-0020 SUSPENSION SYSTEM - FRONT SUSPENSION.

Those tools with an asterix* can be fabricated if wished.

15503485 - Assembly rig* (Fig. 7)
15503486 - Assembly support* (Fig. 8)
15503487 - Assembly stand* (Fig. 9)
15503488 - Locknut tool
15503489 - 3/8" x 17mm Crows Foot
15503490 - 3/8" x 19mm Crows Foot
15503491 - Puller Set
15503492 - Puller set
15503493 - 1/2 shaft Assy Removal Tool* (Fig. 10)
15503494 - 1/2 Shaft Seal Insertion Tool* (Fig. 11)
15503495 - 1/2 Shaft Seal Flinger Assy Tool* (Fig. 12)
15503496 - 1/2 Shaft Seal IBearing Assy Tool* (Fig.13)
15503497 - 1/2 Shaft Locknut Assy Tool* (Fig. 14)
15503498 - Damper Extension Tool* (Fig. 15)
15503499 - Pivot Block Seal Insertion Tool* (Fig. 16)
15503500 - Socket head tightening bolt* (Fig. 17)
15503501 - LWB Bush Insertion Tool 1* (Fig. 18)
15503502 - LWB Bush Insertion Tool 2* (Fig. 19)
15503503 - Knuckle dowel Removal Tool* (Fig. 20)

Miscellaneous - Service Tools

Section 300-0070

Hydraulic Control System

15500834 - IQAN Develop Change Interface
Contact Local Dealer - Hydraulic ECU Electronic Diagnostic Software.

Nitrogen Charging/Inflation

15269121 - Nitrogen Tyre Inflation Kit
09359489 - Charging Assembly

Cooling and Air Conditioning

15269814 - DCA4 Test Kit - Metric Version
15269815 - DCA4 Test Kit - US Gallon Version
15269816 - Refractometer - °C Scale
15269817 - Refractometer - °F Scale
15269844 - Portable High Vacuum Charging Station - R-134a Gas
15269845 - Halogen Leak Tester

Cab

15271016 - Glass Removal Tool
15271017 - Bonding Kit (Quick Dry)

Adhesives and Sealants

15500552 - Torque Seal
15269103 - Loctite 221
09362529 - Loctite 225
09029849 - Loctite 243
15500690 - Loctite 262
09244598 - Loctite 270
09985300 - Loctite 271
15269104 - Loctite 275
15269245 - Loctite 277
15233715 - Loctite Prism 406
15269111 - Loctite Prism 410
15269105 - Loctite 515
09007209 - Loctite 574 (50 ml)
09379518 - Loctite 574 (160 ml)
15269106 - Loctite 577 (Superflex)
15270244 - Loctite 592 - Pipe Sealer with Teflon

15023696 - Loctite 635
09371048 - Loctite 638
15269107 - Loctite 641
15269108 - Loctite Superclean Safety Solvent 706
15229541 - Loctite Activator 'N'
09243825 - Loctite Activator 'T'
09175039 - General Adhesive
15269114 - Tectyl 280 Wax Based Rust Preventive
09380475 - Hylosil RTV Silicone Compound

Fabricated Tools

The service tools shown in Figs. 1 through 6 can be fabricated as shown.

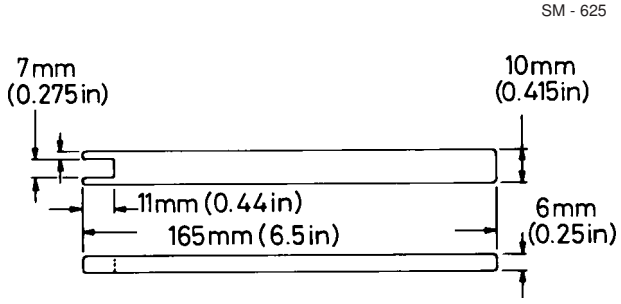
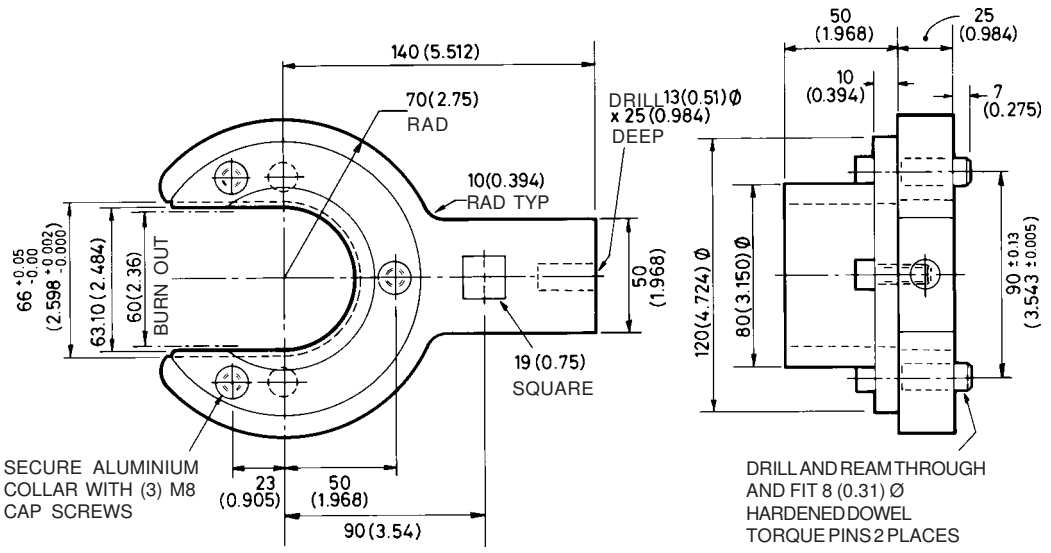


Fig. 1 - Centring Spring Installation Tool (Section 220-0090, STEERING VALVE)

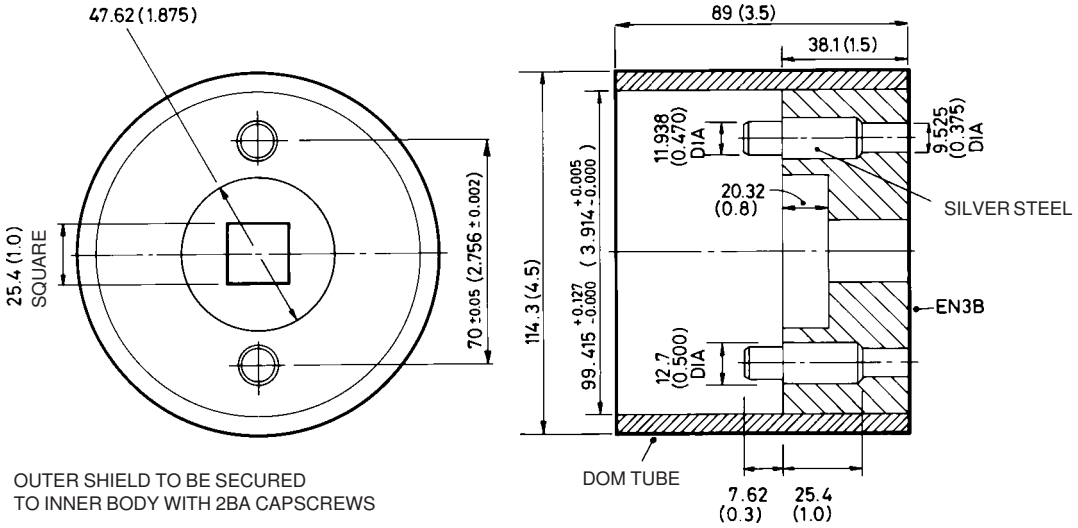
SM - 407



Dimensions in mm (inches)

Fig. 2 - End Cap Torque Tool (Section 220-0120, STEERING CYLINDER)

SM - 633



Dimensions in mm (inches)

Fig. 3 - Piston Torque Tool (Section 220-0120, STEERING CYLINDER)

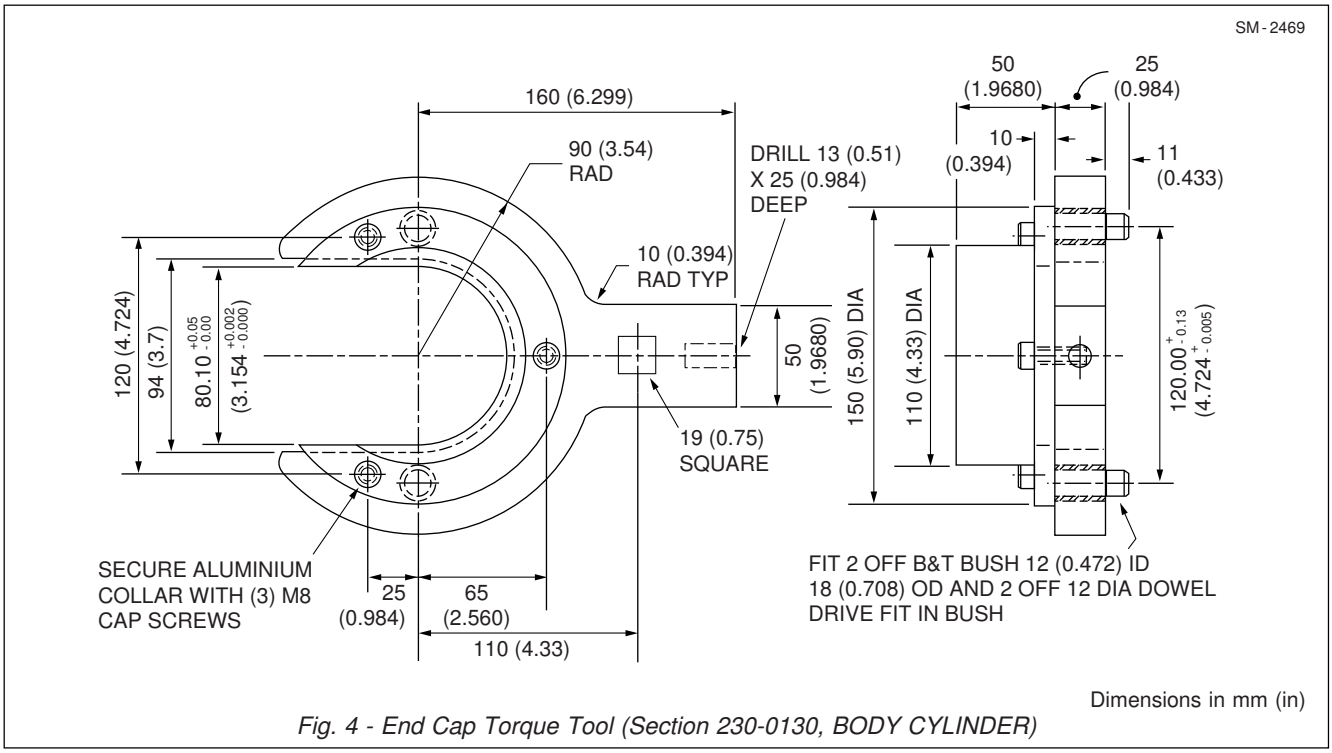


Fig. 4 - End Cap Torque Tool (Section 230-0130, BODY CYLINDER)

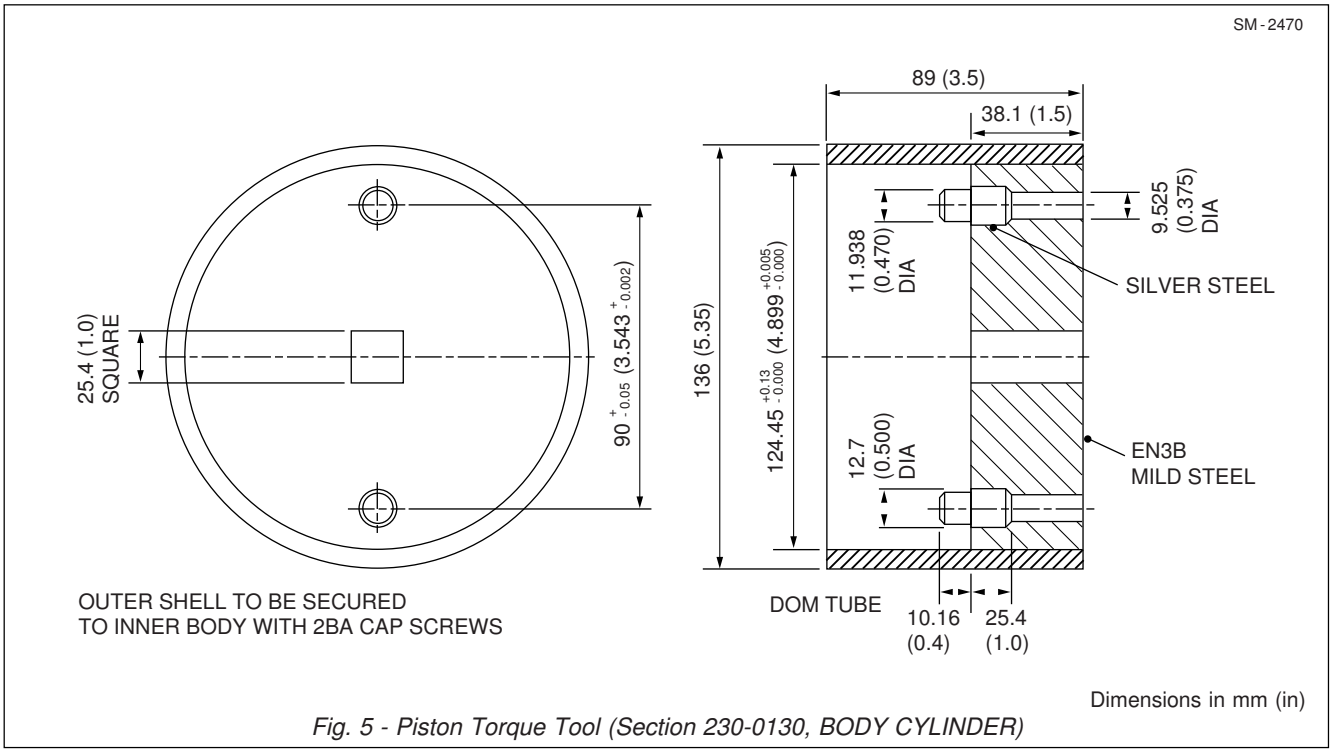


Fig. 5 - Piston Torque Tool (Section 230-0130, BODY CYLINDER)

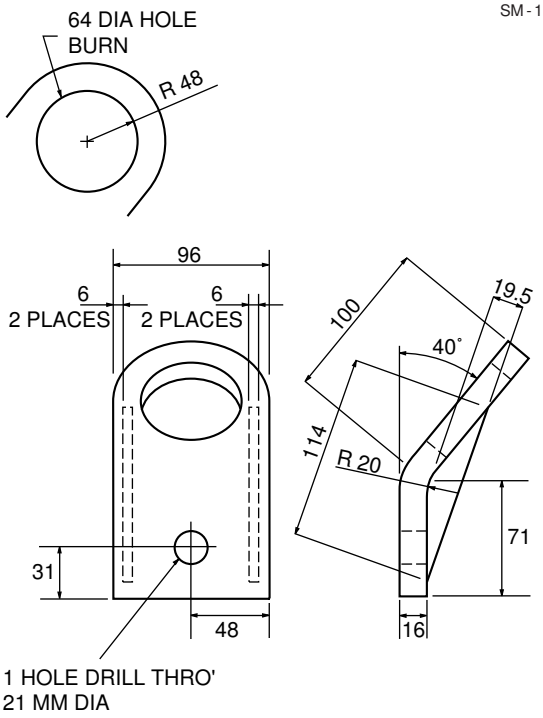


Fig. 6 - Body Lifting Lug Dimensions
(Section 270-0010, BODY AND MOUNTING)

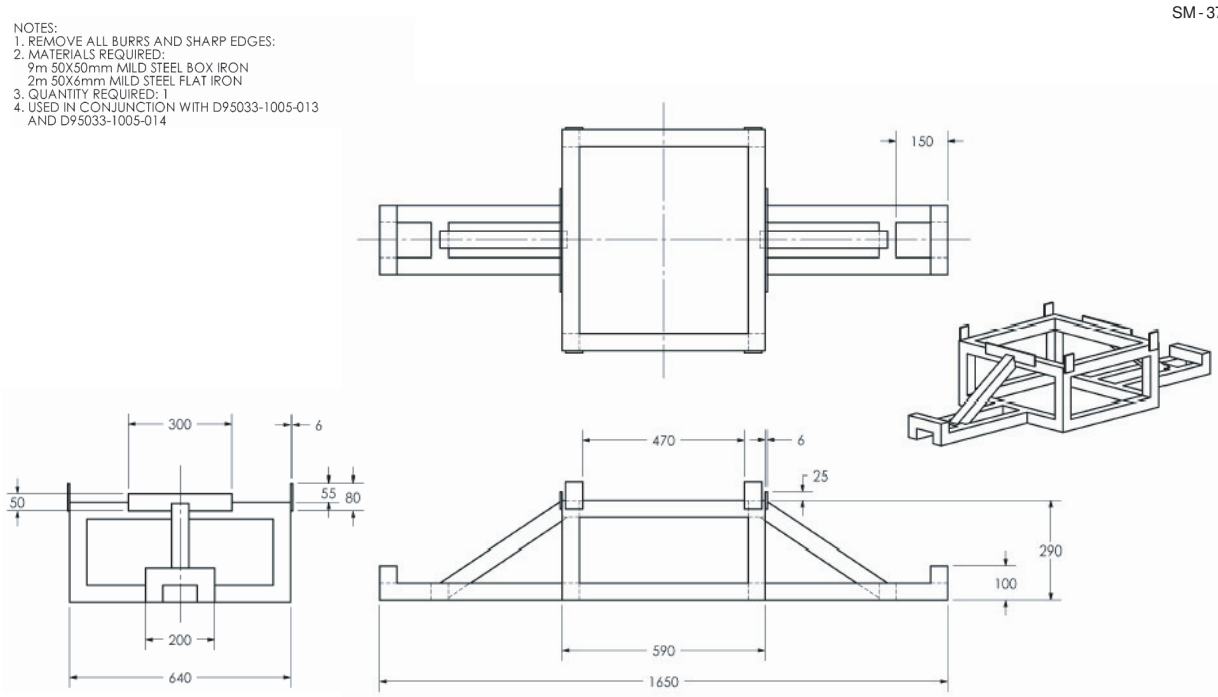


Fig. 7 - Assembly Rig Drawing (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

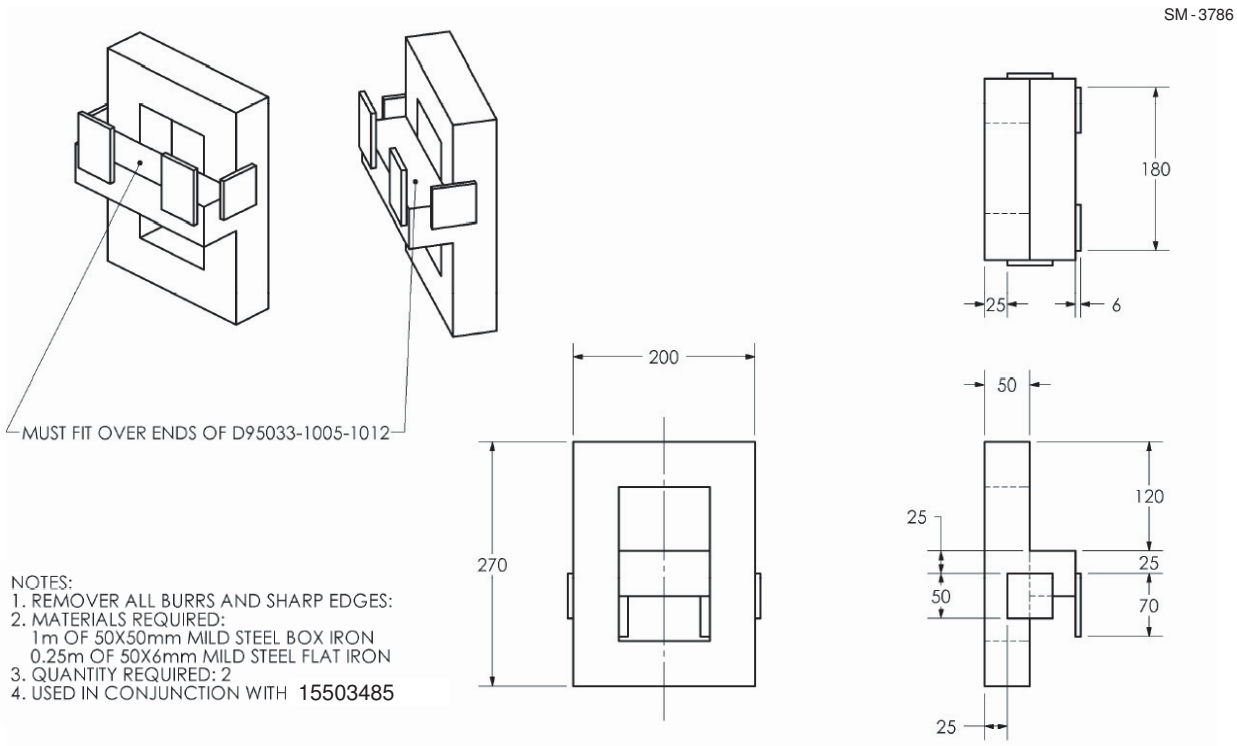


Fig. 8 - Assembly Support Drawing (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

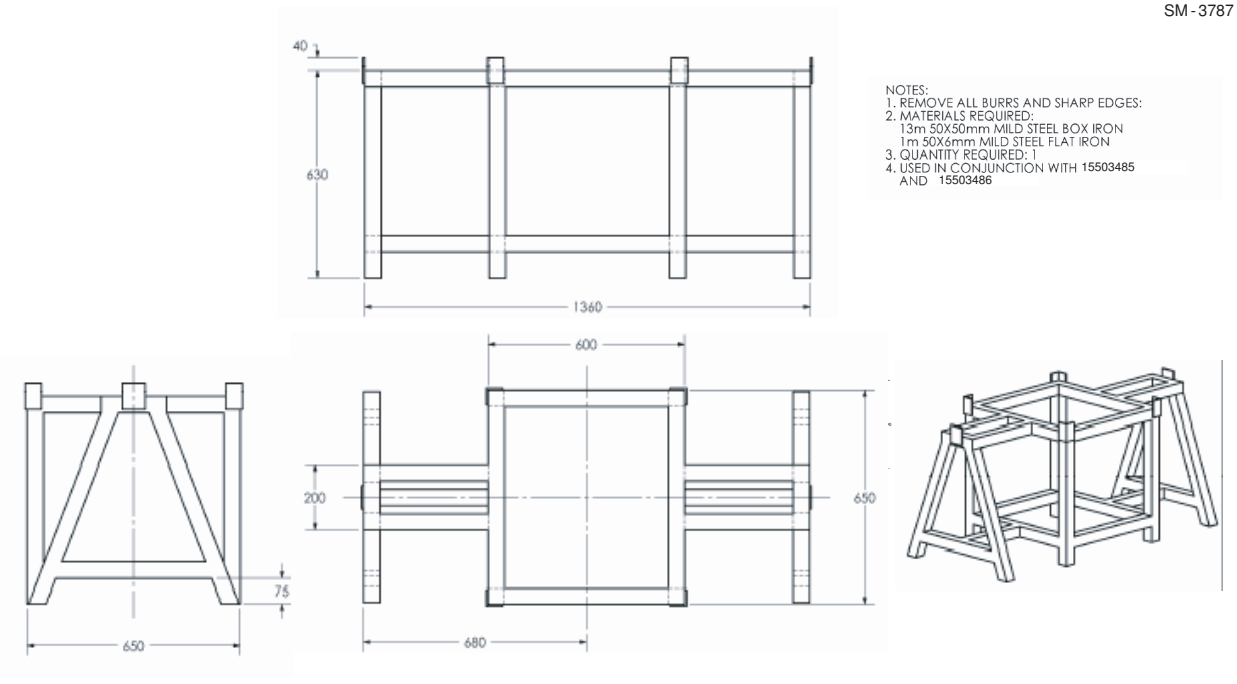
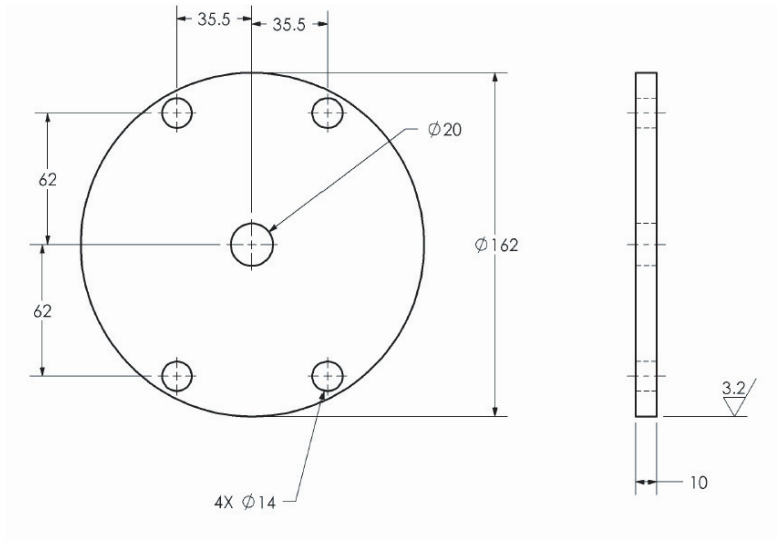


Fig. 9- Assembly Stand Drawing (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

SM-3774

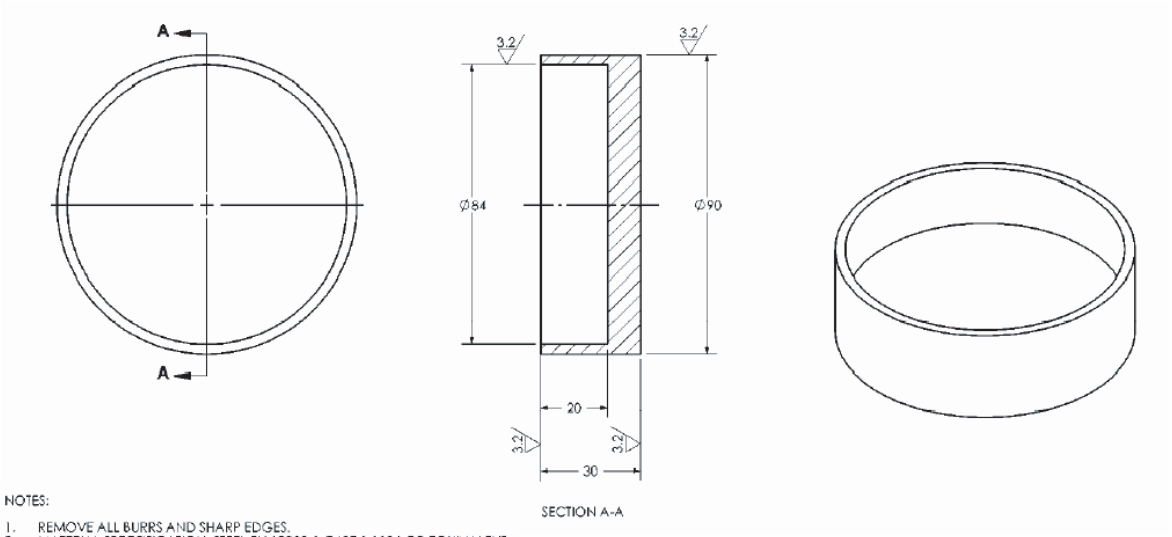


NOTES:

1. REMOVE ALL BURRS AND SHARP EDGES.
2. MATERIAL SPECFIFICATION: STEEL EN 10083-1 C40E 1.1186 OR EQUIVALENT.

Fig. 10- 1/2 Shaft Assy Removal Tool (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

SM-3775



NOTES:

1. REMOVE ALL BURRS AND SHARP EDGES.
2. MATERIAL SPECFIFICATION: STEEL EN 10083-1 C40E 1.1186 OR EQUIVALENT.

Fig. 11- 1/2 Shaft Seal Insertion Tool (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

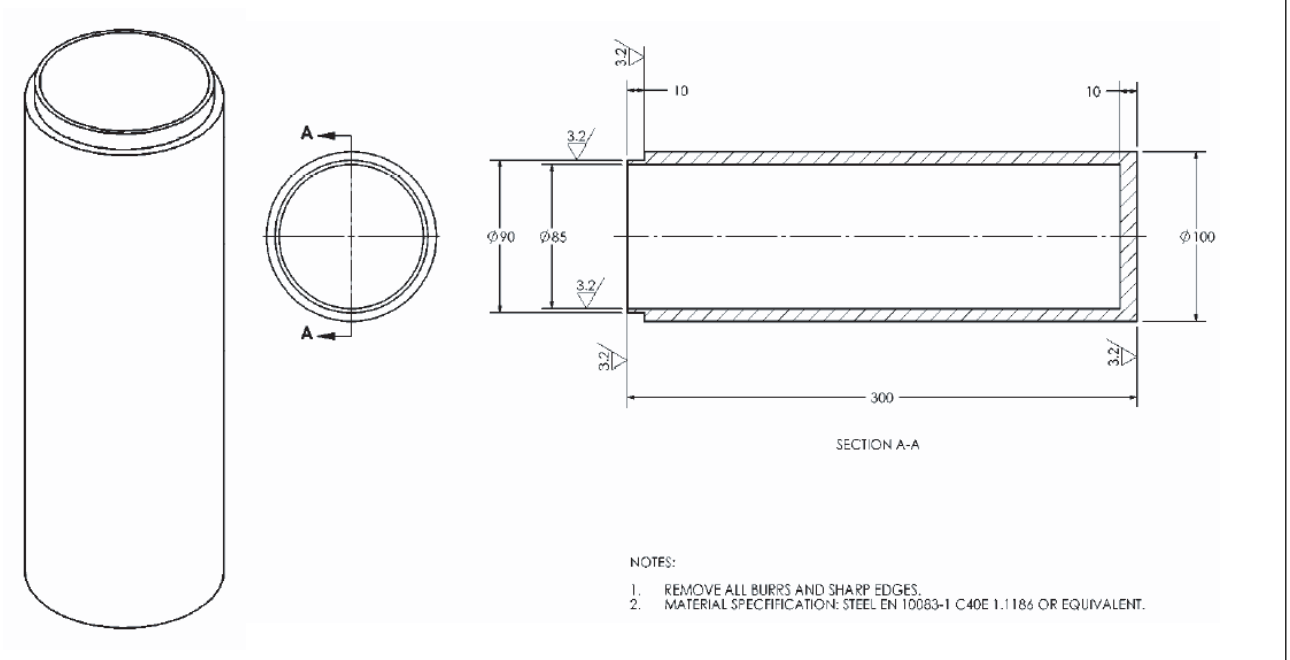


Fig. 12- 1/2 Shaft Seal Insertion Tool (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

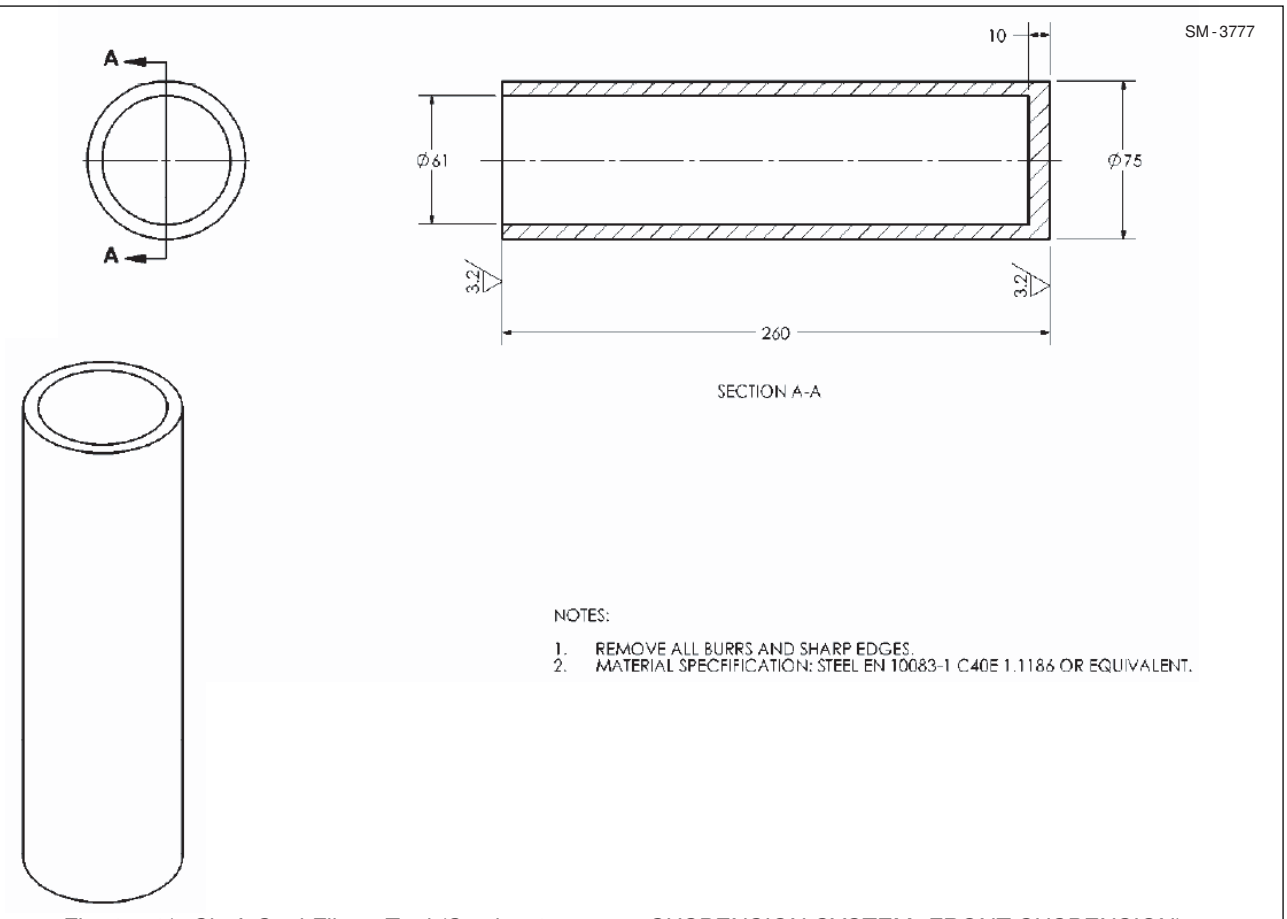


Fig. 13- 1/2 Shaft Seal FlingerTool (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

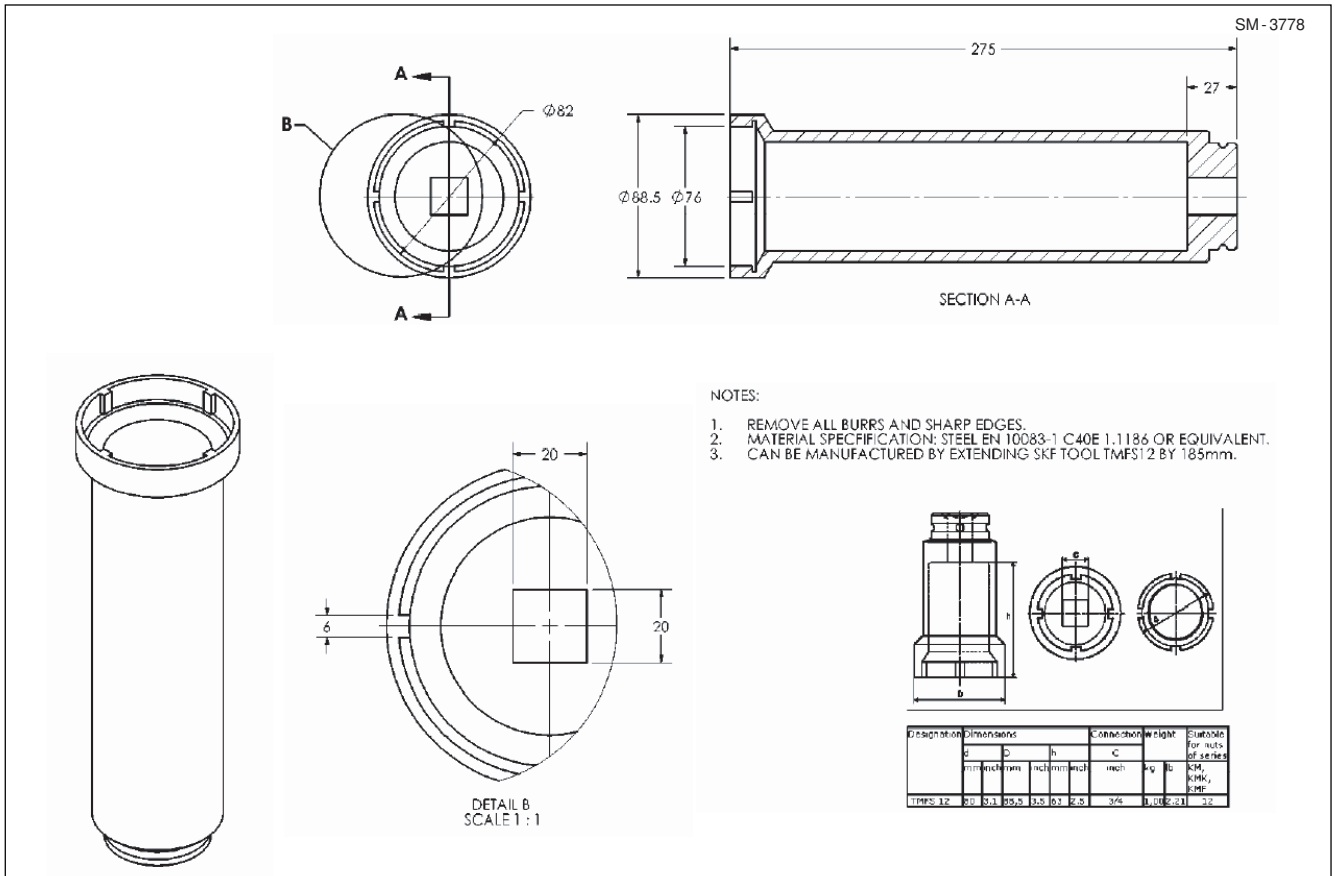


Fig. 14- 1/2 Shaft Locknut Assembly Tool (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

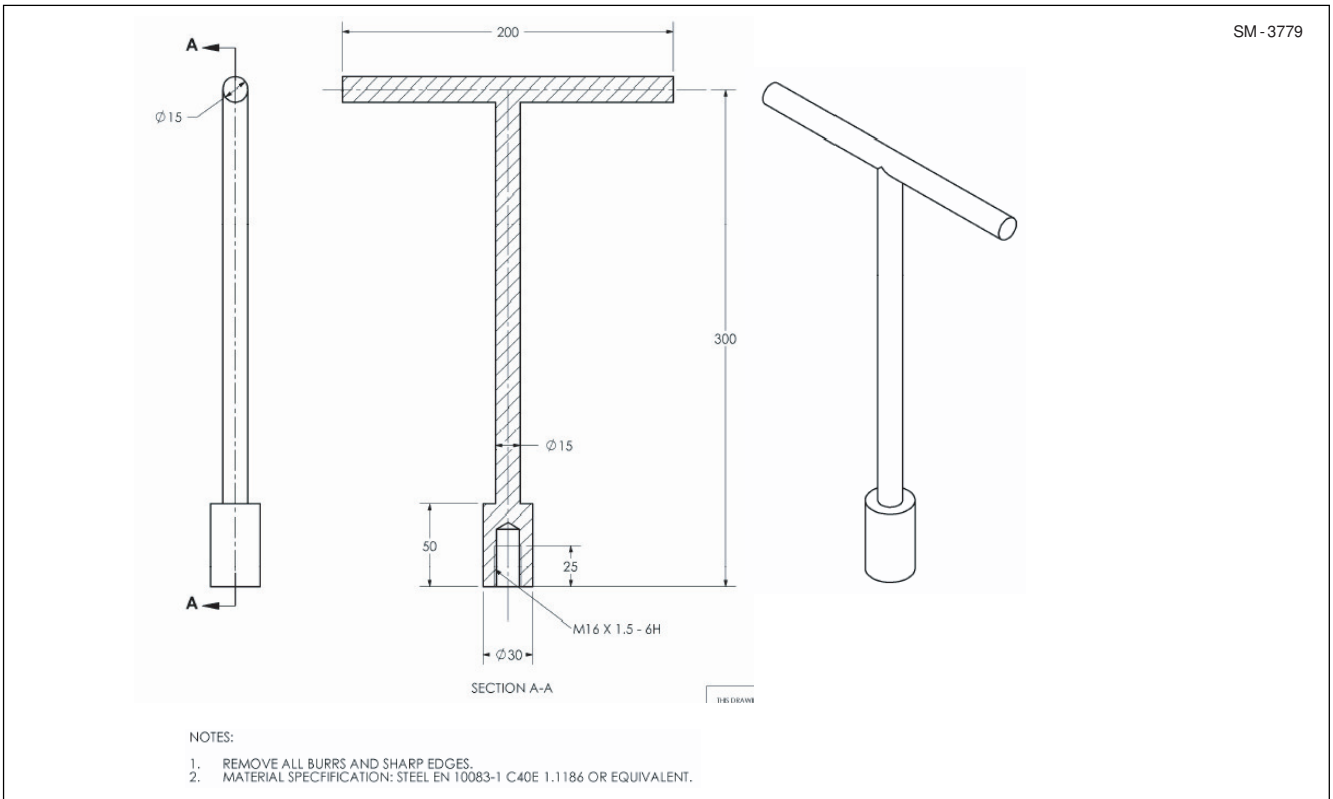


Fig. 15- Damper Extention Tool (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

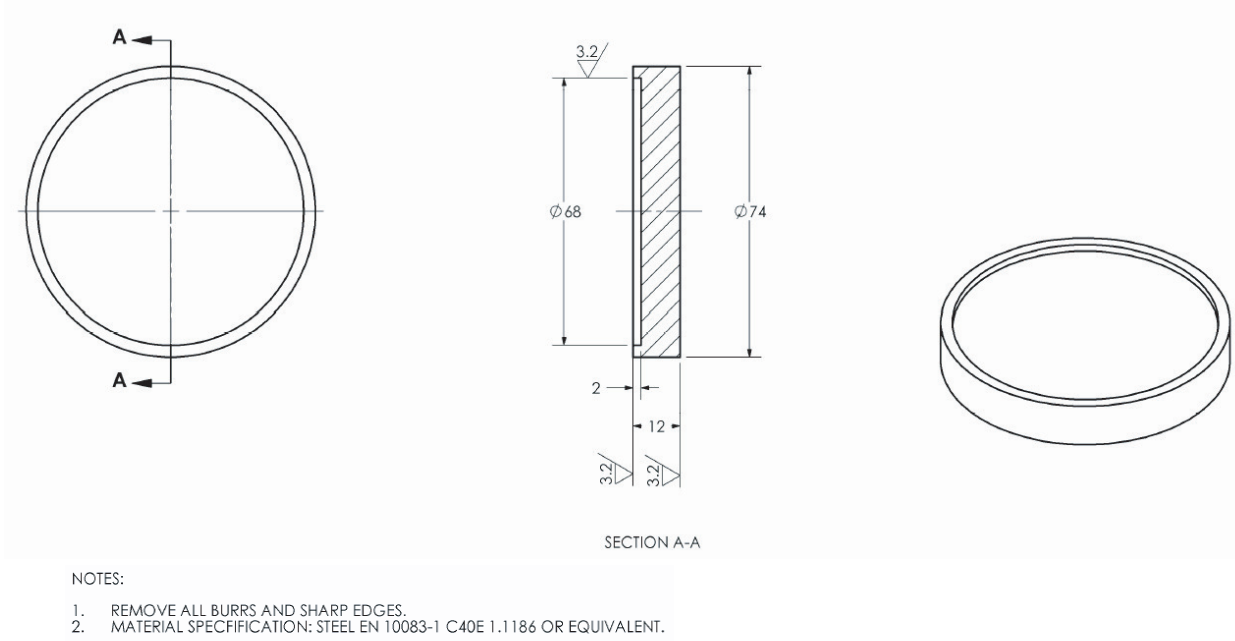


Fig. 16-Pivot Block Seal Insertion Tool (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

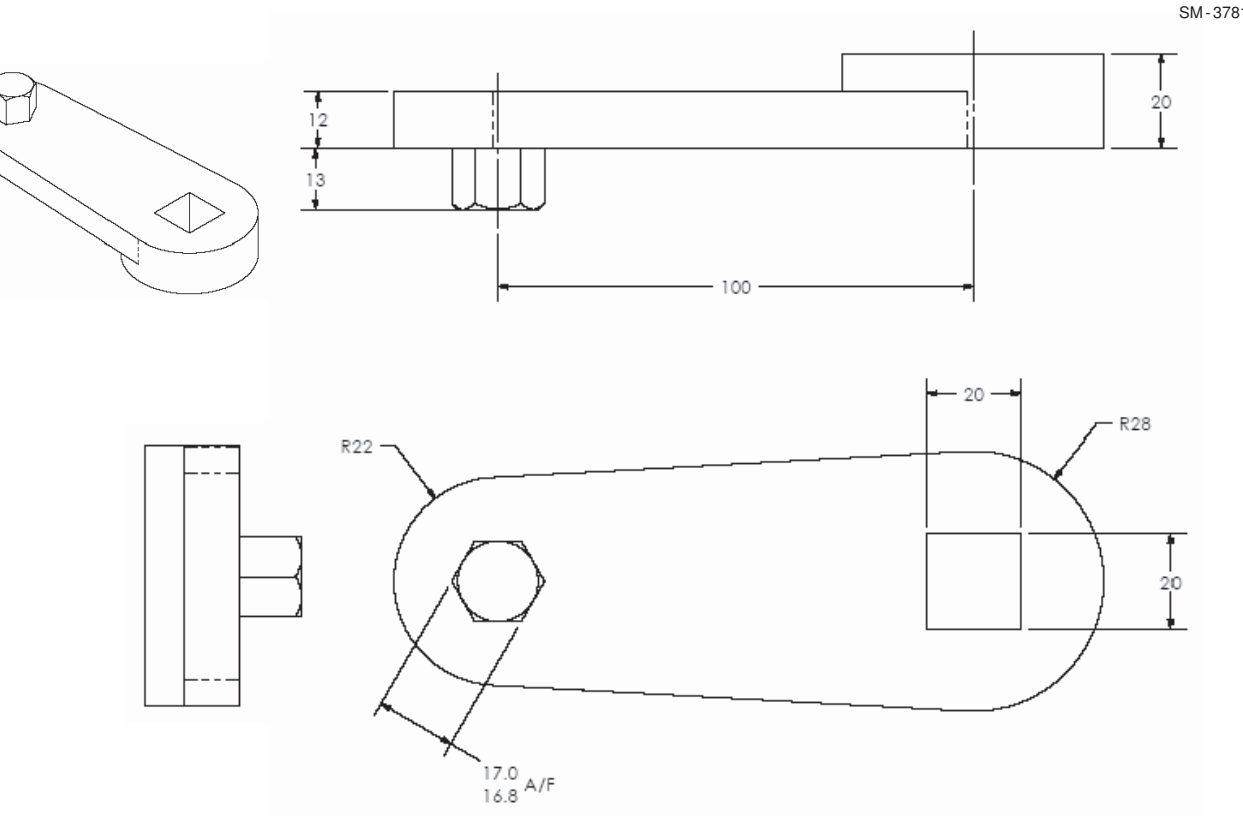


Fig. 17- Socket Head Bolt Tightening Tool (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

SM - 3782

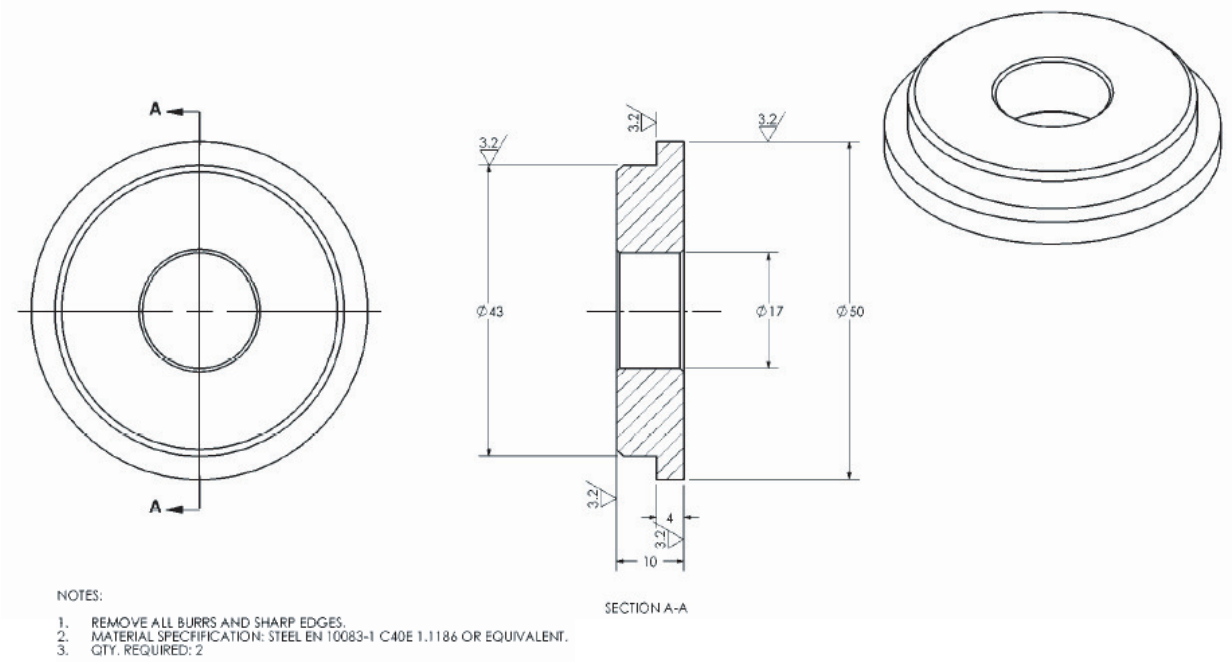


Fig. 18- LWB Bush Insertion Tool 1(Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

SM - 3783

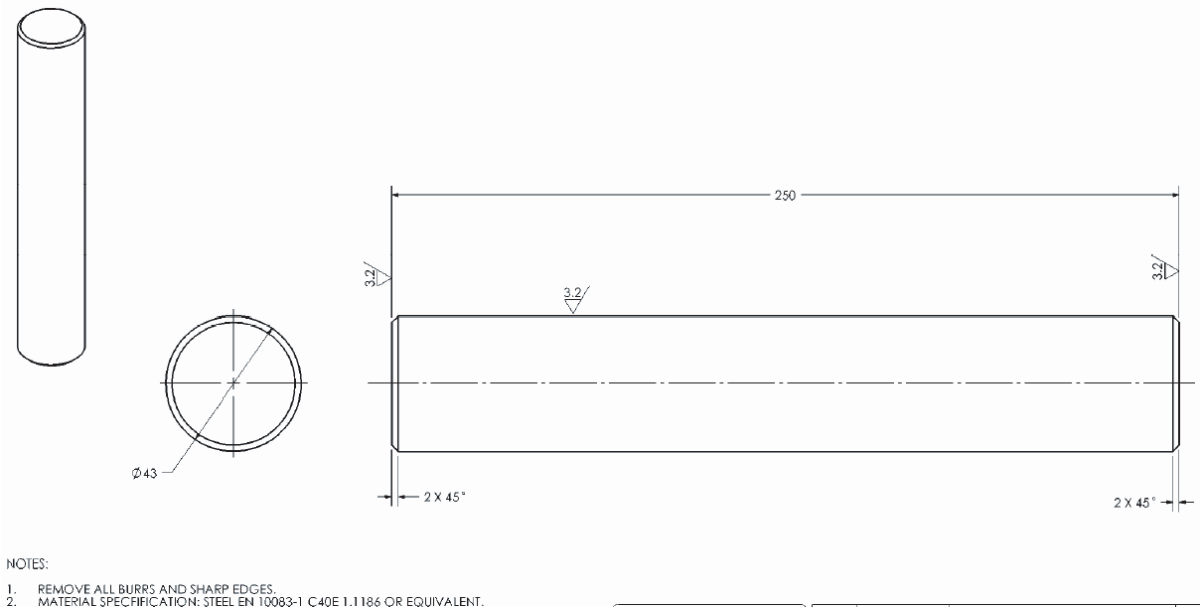


Fig. 19- LWB Bush Insertion tool 2(Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

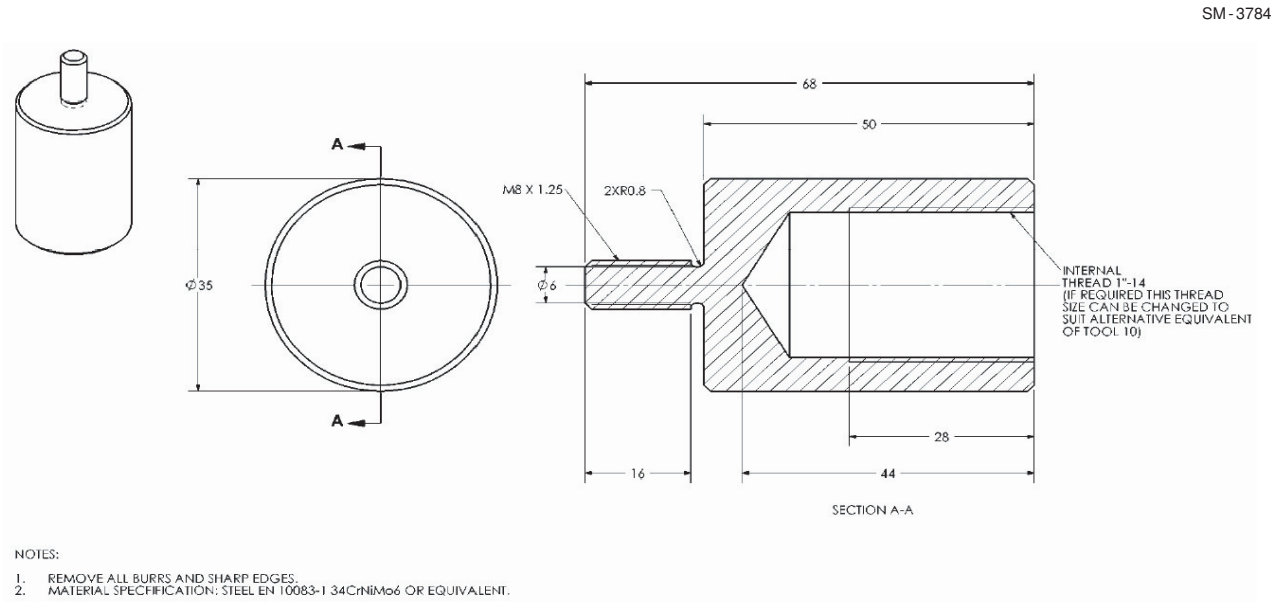


Fig. 20 - Knuckle Dowel Removal Tool (Section 180-0020, SUSPENSION SYSTEM- FRONT SUSPENSION)

TORQUE LIMITS IN Nm (lbf ft)

Friction coefficient total 0.125 for screws and nuts without after treatment as well as for phosphated nuts.
Tighten by hand!

If nothing special is indicated, select correct Torque Limits from the following tabulations -

Metric ISO Thread DIN 13 TABLE161

Size	6.9		8.8		10.9		12.9	
	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)
M 6	8	(5.9)	9.5	(7)	13	(9.6)	16	(11.8)
M 8	19	(14)	23	(16.9)	32	(23.6)	39	(28.8)
M 10	39	(28.8)	46	(33.9)	64	(47.2)	77	(56.8)
M 12	67	(49.4)	80	(59)	110	(81.1)	135	(99.6)
M 14	105	(77)	125	(92)	180	(133)	215	(159)
M 16	165	(122)	195	(144)	275	(203)	330	(243)
M 18	225	(166)	270	(199)	390	(288)	455	(336)
M 20	325	(240)	385	(284)	540	(398)	650	(479)
M 22	435	(321)	510	(376)	720	(531)	870	(642)
M 24	560	(413)	660	(487)	930	(686)	1 100	(812)
M 27	830	(612)	980	(723)	1 400	(1 033)	1 650	(1 217)
M 30	1 100	(811)	1 350	(996)	1 850	(1 365)	2 250	(1 660

Metric ISO Fine Thread DIN 13 TABLE162

Size	6.9		8.8		10.9		12.9	
	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)
M 8 x 2	21	(15.5)	25	(18.4)	35	(25.8)	42	(31)
M 10 x 1.25	41	(30.3)	49	(36.1)	68	(50.2)	82	(60.5)
M 12 x 1.25	74	(54.6)	88	(64.9)	125	(92.2)	150	(110.6)
M 12 x 1.5	70	(51.6)	83	(61.2)	115	(84.8)	140	(103.3)
M 14 x 1.5	115	(85)	140	(103)	195	(144)	235	(173)
M 16 x 1.5	175	(129)	210	(155)	295	(218)	340	(251)
M 18 x 1.5	255	(188)	305	(225)	425	(314)	510	(376)
M 20 x 1.5	360	(266)	425	(314)	600	(443)	720	(531)
M 22 x 1.5	480	(354)	570	(420)	800	(590)	960	(708)
M 24 x 2	610	(450)	720	(531)	1 000	(738)	1 200	(885)
M 27 x 2	890	(656)	1 050	(774)	1 500	(1 106)	1 800	(1 328)
M 30 x 2	1 250	(922)	1 450	(1 070)	2 050	(1 512)	2 500	(1 844)

Miscellaneous - Axle Bolt and Nut Torque Specifications

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Friction coefficient total 0.14 for screws and nuts without after treatment as well as for phosphated nuts.
Tighten by hand!

If nothing special is indicated, select correct Torque Limits from the following tabulations -

Metric ISO Thread DIN 13 TABLE163

	6.9		8.8		10.9		12.9	
Size	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)
M 6	8.5	(6.3)	10	(7.4)	14	(10.3)	17	(12.5)
M 8	21	(15.5)	25	(18.4)	35	(25.8)	41	(30.2)
M 10	41	(30.2)	49	(36.1)	69	(50.9)	83	(61.2)
M 12	72	(53.1)	86	(63.4)	120	(88.5)	145	(106.9)
M 14	115	(85)	135	(100)	190	(140)	230	(170)
M 16	180	(133)	210	(155)	295	(218)	355	(262)
M 18	245	(181)	290	(214)	400	(295)	485	(358)
M 20	345	(255)	410	(302)	580	(428)	690	(509)
M 22	465	(343)	550	(406)	780	(575)	930	(686)
M 24	600	(443)	710	(524)	1 000	(738)	1 200	(885)
M 27	890	(656)	1 050	(774)	1 500	(1 106)	1 800	(1 328)
M 30	1 200	(885)	1 450	(1 070)	2 000	(1 475)	2 400	(1 770)

Metric ISO Fine Thread DIN 13 TABLE164

	6.9		8.8		10.9		12.9	
Size	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)	Nm	(lbf ft)
M 8 x 1	23	(17)	27	(19.9)	38	(28)	45	(33.2)
M 10 x 1.25	44	(32.5)	52	(38.4)	73	(53.8)	88	(65)
M 12 x 1.25	80	(59)	95	(70)	135	(99)	160	(118)
M 12 x 1.5	76	(56.1)	90	(66.4)	125	(92)	150	(111)
M 14 x 1.5	125	(92)	150	(111)	210	(155)	250	(184)
M 16 x 1.5	190	(140)	225	(166)	315	(232)	380	(280)
M 18 x 1.5	275	(203)	325	(240)	460	(339)	550	(406)
M 20 x 1.5	385	(284)	460	(339)	640	(472)	770	(568)
M 22 x 1.5	520	(384)	610	(450)	860	(634)	1 050	(774)
M 24 x 2	650	(479)	780	(575)	1 100	(811)	1 300	(959)
M 27 x 2	970	(715)	1 150	(848)	1 600	(1 180)	1 950	(1 438)
M 30 x 2	1 350	(997)	1 600	(1 180)	2 250	(1 660)	2 700	(1 991)

* * * *

⚠ 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% TABLE 144

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
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	1021	753
1.00 - 12	285	210	719	530	881	650	1003	740	1119	825
1.00 - 14	285	210	732	540	902	665	1030	760	1148	847

Miscellaneous - Standard Bolt and Nut Torque Specifications

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RECOMMENDED MAXIMUM TORQUES (IMPERIAL) ±10% TABLE 145

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	1132	835	1302	960	1447	1067
1.12 - 12	407	300	902	665	1274	940	1451	1075	1624	1198
1.25 - 7	515	380	1132	835	1600	1180	1830	1350	2043	1507
1.25 - 12	569	420	1254	925	1776	1310	2034	1500	2267	1672
1.38 - 6	664	490	1478	1090	2095	1545	2400	1770	2676	1974
1.38 - 12	759	560	1688	1245	2393	1765	2739	2020	3056	2254
1.50 - 6	881	650	1966	1450	2786	2055	3186	2350	3556	2623
1.50 - 8	936	690	2088	1540	2962	2185	3390	2500	3781	2789
1.50 - 12	990	730	2217	1635	3145	2320	3593	2650	4010	2958
1.75 - 5	-	-	-	-	4393	3240	5016	3700	5604	4133
1.75 - 12	-	-	-	-	5091	3755	5830	4300	6497	4792
1.88 - 8	-	-	-	-	6006	4430	6874	5070	7664	5653
1.88 - 12	-	-	-	-	6304	4650	7213	5320	8048	5936
2.00 - 4.5	-	-	-	-	6623	4885	7565	5580	8448	6231
2.00 - 8	-	-	-	-	7342	5415	8406	6200	9367	6909
2.00 - 12	-	-	-	-	7687	5670	8786	6480	9811	7236
2.25 - 4.5	-	-	-	-	9701	7155	11090	8180	12377	9129
2.25 - 8	-	-	-	-	10629	7840	12148	8960	13566	10006
2.25 - 12	-	-	-	-	11050	8150	12636	9320	14102	10401
2.50 - 12	-	-	-	-	15280	11270	17463	12880	19500	14383

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 (for example SAE 1018 or 1020)	Rockwell "B" 85-100	GM 260-M	
Plain Medium Carbon (for example SAE 1035, 1038 and 1045)	Rockwell "C" 19-30	GM 280-M	
Medium Carbon Alloy (for example SAE 4140, 8642 and 5157)	Rockwell "C" 28-34	GM 290-M	
Medium Carbon Alloy (for example SAE 4140, 8642 and 5147)	Rockwell "C" 32-38	GM 300-M	

RECOMMENDED MAXIMUM TORQUES (METRIC) ±10% TABLE 146

Size	Class 8.8		Class 9.8		Class 10.9		Class 12.9	
	Nm	lbf ft	Nm	lbf ft	Nm	lbf ft	Nm	lbf ft
M1.6 - 0.35	-	-	0.20	0.15	-	-	0.20	0.15
M1.6 - 0.20	-	-	0.25	0.20	-	-	0.40	0.30
M2.0 - 0.40	-	-	0.25	0.20	-	-	0.45	0.30
M2.0 - 0.25	-	-	0.45	0.30	-	-	0.45	0.30
M2.0 - 0.45	-	-	0.25	0.20	-	-	0.45	0.30
M2.5 - 0.35	-	-	1	0.75	-	-	1	0.75
M3.0 - 0.50	-	-	1	0.75	-	-	2	1.5
M3.0 - 0.35	-	-	1	0.75	-	-	2	1.5
M3.5 - 0.60	-	-	2	1.5	-	-	3	2
M4.0 - 0.70	-	-	3	2	-	-	4	3
M4.0 - 0.35	-	-	3	2	-	-	5	3
M5.0 - 0.80	-	-	5	4	-	-	8	6
M5.0 - 0.50	-	-	6	4	-	-	9	6
M6.0 - 1.00	-	-	9	6	-	-	13	10
M6.3 - 1.00	-	-	10	8	13	10	16	11
M6.0 - 0.75	-	-	10	7	12	9	14	10
M8.0 - 1.25	-	-	21	15	27	20	32	23
M8.0 - 1.00	-	-	23	17	29	21	34	25
M10.0 - 1.50	-	-	42	31	54	39	63	46
M10.0 - 1.25	-	-	45	32	57	41	67	48
M12.0 - 1.75	-	-	74	53	94	68	110	80
M12.0 - 1.25	-	-	81	58	103	74	121	87
M14.0 - 2.00	-	-	118	85	151	109	176	127
M14.0 - 1.50	-	-	128	92	163	118	190	137
M16.0 - 2.00	169	122	-	-	234	169	274	197
M16.0 - 1.50	181	130	-	-	250	180	292	211
M18.0 - 2.50	234	169	-	-	323	234	378	273
M18.0 - 1.50	263	190	-	-	363	262	425	307
M20.0 - 2.50	330	239	-	-	457	330	531	386
M20.0 - 1.50	367	265	-	-	507	366	593	423
M22.0 - 2.50	451	325	-	-	623	450	728	526
M22.0 - 1.50	495	357	-	-	684	494	800	577
M24.0 - 3.00	571	412	-	-	790	570	923	667
M24.0 - 2.00	623	450	-	-	861	622	1007	727
M27.0 - 3.00	837	605	-	-	1158	836	1354	977
M27.0 - 2.00	903	652	-	-	1250	902	1461	1055
M30.0 - 3.00	1135	820	-	-	1570	1134	1835	1325
M30.0 - 2.00	1258	908	-	-	1740	1256	2034	1468
M30.0 - 1.50	1300	939	-	-	1799	1299	2102	1516
M36.0 - 4.00	1985	1433	-	-	2745	1982	3208	2317
M36.0 - 3.00	2102	1517	-	-	2907	2099	3398	2453

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 TABLE 537

	Lock Screws		Lock-nuts			
	SAE Grade 5 and 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

* * * *

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. COOLING SYSTEM - Verify that the cooling system is adequately protected for the climatic conditions expected at the storage locatin. Adjust if necessary.

4. 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.

Note: If the machine is delivered from the Terex facility with a wax coating to protect the paint-work, do not remove it until the machine is removed from storage.

5. FUEL TANK - Fill the fuel tank to prevent moisture condensation within the tank. Coat filler neck and cap threads with oil.

6. HYDRAULIC TANKS - Coat filler neck and cap threads with oil. Fill the tank to operating level if necessary.

7. AIR RESERVOIRS - Open all drain cocks at bottom of air tanks.

8. 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. Coat the battery terminals and cable ends with acid resistant petroleum jelly.

9. TYRES - Remove all grease and oil. Inflate all tyres to correct pressure. During storage, check inflation pressure approximately once every two weeks.

10. TRACKS - Check recoil cylinder pressure and track adjustment. Remove all oil and grease (rubber tracks).

11. EXHAUSTS - Cover exhaust stack openings with plastic or waterproof paper and secure with adhesive tape.

12. AIR INTAKES - Cover openings with plastic or waterproof paper and secure with adhesive tape.

13. SUSPENSION RIDE CYLINDERS - Release the pressure in the cylinders to retract them for minimum piston rod exposure. Coat the remaining exposed piston rod surface with a suitable oil or grease.

14. HYDRAULIC CONTROL VALVES - Where possible position hydraulic controls for minimum exposure of valve spools (spool inside valve body). Coat the remaining exposed spool surface with a suitable oil or grease.

15. HYDAULIC CYLINDERS - Where possible retract cylinders for minimum rod exposure. Coat the remaining exposed piston rod surface with a suitable oil or grease.

16. AIR CYLINDERS - Coat the exposed piston rod surface with a suitable oil or grease.

17. CONTROL CABLES & LINKAGE - All exposed linkage, clevis ends, ball joints etc, wchich are not protected during "lubrication" should be protected by a suitable oil or grease.

18. OPEN PORTS & HOSE ENDS - Plug or seal with adhesive tape all open ports.

19. MACHINED SURFACES - Coat any exposed machined bores and surfaces with a suitable rust preventative.

Note: Do not apply oil or grease to brake discs.

20. HINGES - Apply oil to all the hinges.

21. SEAT SLIDE ADJUSTERS - Coat with grease.

22. SEATS, ARMRESRTS & CUSHIONS - When

machine is not equipped with a cab, cover these items with plastic or waterproof barrier paper, and secure with adhesive tape. Provide an opening in the underside of the protective materials to prevent condensation build up.

23. CABS - All windows, doors and vents closed.

24. HOODS, HOODSIDES, COVERS, PANELS, ETC - Installed.

25. SECURITY PANELS AND SECURITY LOCKS - Installed and locked.

EXTENDED STORAGE - Under Six Months

When storing a machine for periods of longer than 30 days, but less than six months, the following procedure must be followed, in addition to the procedure described above:

1. ENGINE - Consult the relevant Engine Manual/Dealer for storage procedure for periods longer than 30 days.

2. TRANSMISSION - Consult the relevant Transmission Manual/Dealer for storage procedure for periods longer than 30 days.

3. BATTERIES - Remove the batteries from the machine and store in shop. Protect batteries from temperature extremes. Coat the terminals and cable ends with acid resistant petroleum jelly.

4. VENTS AND BREATHERS - Remove all vents and breathers and plug all the openings with pipe plugs or seal with adhesive waterproof tape.

5. BELTS - Release tension on all the belts.

6. TYRES - When extended storage is anticipated, the machines should be blocked up so weight does not rest on the tyres, and inflation pressure reduced to 1 bar (15 lbf/in^2). Storage of such machines should be under cover if possible; otherwise tyres should be protected from the elements by an opaque waterproof covering.

If it is not possible to block up the machines, inflation pressure in the tyres should be increased to 25% above the rated pressure for the actual load on the tyre in storage condition.

The storage area surface should be firm, reasonably level, well drained and free of all oil, fuel or grease.

Clean 8-19 mm (0.25-0.75 in) gravel under each tyre is desirable if the area is not paved. Storage should not be permitted on blacktop or oil stabilised surfaces.

Except in very cold weather, stored machines should be moved occasionally, at least once every six months, so the same section of the tyre is not always under strain from deflection.

Inflation in the tyres must be adjusted to the recommended service pressure before shipping or putting a stored machine into service.

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. WHEEL BEARINGS - 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

The following procedure must be followed when a machine is removed from storage.

1. FUEL TANK - Drain off any condensation. Remove covers from openings and re-install breather.

2. HYDRAULIC TANKS - Remove covers from openings and re-install breathers. Fill tank to operating level if necessary.

3. AIR RESERVOIRS - Close all drain cocks.

4. BATTERIES - Check batteries are fully charged and re-install.

5. TYRES - Inflate to the recommended pressure.

6. TRACKS - Check recoil cylinder pressure and track adjustment.

7. EXHAUSTS - Remove temporary storage covers from exhaust stack openings.

8. AIR INTAKES - Remove temporary storage covers from air intake openings.

9. SUSPENSION RIDE CYLINDERS - Remove protective coating from piston rod surface. Charge with Nitrogen.

10. HYDRAULIC CYLINDERS - Remove protective coating from piston rod surface.

11. VENTS AND BREATHERS - Remove seals and plugs from all breather openings, then install all breathers and vents.

12. BELTS - Adjust tension on all belts.

13. ENGINES - Consult the relevant Maintenance Manual/Dealer for instructions on removing an engine from storage.

14. TRANSMISSION - Consult the relevant Maintenance Manual/Dealer for instructions on removing a transmission from storage.

15. PAINT - Check machine for rust. Remove all rust spots and repaint rusted areas.

16. DECALS - Check condition of decals and replace if necessary.

17. LUBRICATION - Completely lubricate the machine according to the instructions in the "Lubricatin System" section of the relevant Manual.

18. GENERAL - Check for fuel, hydraulic oil, coolant and air leaks. Replace all leaking seals.

Field rework should always be implemented in accordance with the appropriate instructions in the Maintenance Manuals.

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