



TR40

Off-Highway Trucks

Service Manual



TECHNICAL PUBLICATIONS DEPARTMENT
TEREX EQUIPMENT LIMITED,
MOTHERWELL, SCOTLAND, ML1 5RY
REF. NO. SM753/780

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Service Information Alert

DATE: April 1994

B168

MODEL: General

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

PURPOSE:

To advise potentially hazardous condition.

DETAIL:

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

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

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

- a. Visually inspect for any gaskets or seals which have suffered from heat; they will appear black and sticky.
- b. If this is affirmed - **Do Not Touch**
- c. Make enquiries to ascertain the material composition. Any Fluoro-elastomer (Viton, Fluorel or Tecmoflon) should be considered dangerous but natural rubber and nitrile are non-hazardous.
- d. If Fluoro-elastomer seals have been used, then the affected area **MUST** be decontaminated before undertaking further work.
- e. Disposable Heavy Duty Gloves (Neoprene) **MUST** be worn and the affected area decontaminated by washing thoroughly with Limewater (Calcium Hydroxide solution).
- f. Any cloths, residue and gloves used **MUST** be safely discarded after use.

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

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IMPORTANT SAFETY NOTICE

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

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

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

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

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



WARNING

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

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TABLE OF CONTENTS

Section No.	Description	SM No.
000 0000	GENERAL INFORMATION TR40 Off-Highway Truck	1665
100 0010	CHASSIS Chassis, Hood and Fenders	1666
110 0030 0050 0130	ENGINE Engine and Mounting Air Cleaner Power Takeoff	1667 1668 1669
120 0010 0070 0090 0100	TRANSMISSION Transmission and Mounting Commercial Electronic Control (CEC) Shift System Power Takeoff Transmission Oil Filter	1671 1680 1178 1673
130 0010 0010 0020 0020	DRIVELINE Front Driveline - Pre June 1998 Production Front Driveline - From June 1998 Production Rear Driveline - Pre June 1998 Production Rear Driveline - From June 1998 Production	1180 1682 1311 1683
140 0040	FRONT AXLE Wheel, Rim and Tyre	1303 Rev 1
160 0020 0030 0050	REAR AXLE Differential Axle Group Wheel, Rim and Tyre	1298 1299 1300 Rev 1
165 0020 0030	BRAKE PARTS Brake Parts - Front Axle Brake Parts - Rear Axle	1186 1301
180 0030 0050	SUSPENSION SYSTEM Ride Cylinder - Front Ride Cylinder - Rear	1584 1302
190 0000 0270	CIRCUIT DIAGRAMS Circuit Diagrams Switches and Sensors	1585 1672
200 0010	FUEL SYSTEM Fuel Tank and Mounting	1674
210 0000 0040 0050 0060	COOLING SYSTEM Cooling System Radiator, Header Tank and Mounting Disc Brake Oil Cooler Transmission Oil Cooler	1686 1677 1679 1678

TABLE OF CONTENTS

Section No.	Description	SM No.
220	STEERING SYSTEM	
0000	Steering System Schematic	1591
0040	Steering and Brake Control Tank	1592
0050	Steering Pump	1204
0080	Accumulator	1205
0090	Steering Valve	1206
0110	Double Relief Valve	1208
0120	Steering Cylinder and Linkage	1304
0130	Accumulator Valve	1209
0150	Steering Filter	1593
230	BODY SYSTEM	
0000	Body System Schematic	1681
0040	Body and Disc Brake Cooling Tank	1595
0050	Tandem Pump	1213
0060	Body Control Valve	1685
0081	Body Control Joystick	1597
0090	Kick-over Valve	1218
0120	Relief Valve	1598
0121	Pilot Supply Valve	1599
0130	Body Cylinder	1221
250	BRAKING SYSTEM	
0000	Braking System Schematic	1222
0050	Brake Manifold Valve	1223
0060	Accumulator	1600
0070	Treadle Valve	1225
0090	Directional Control Valve	1226
0100	Monoblock Brake Valve	1227
0130	Retarder Control Valve	1609
0140	Shuttle Valve	1229
260	OPERATORS COMPARTMENT	
0010	Cab and Mounting	1602
0110	Passenger Seat and Mounting	1603
270	BODY	
0010	Body and Mounting	1675
300	MISCELLANEOUS	
0020	Lubrication System	1670
0070	Service Tools	1684
0080	Standard Bolt and Nut Torque Specifications	1238
0090	Unit Storage	1239

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GENERAL INFORMATION - TR40 Off-Highway Truck

Section 000-0000

SM - 2081

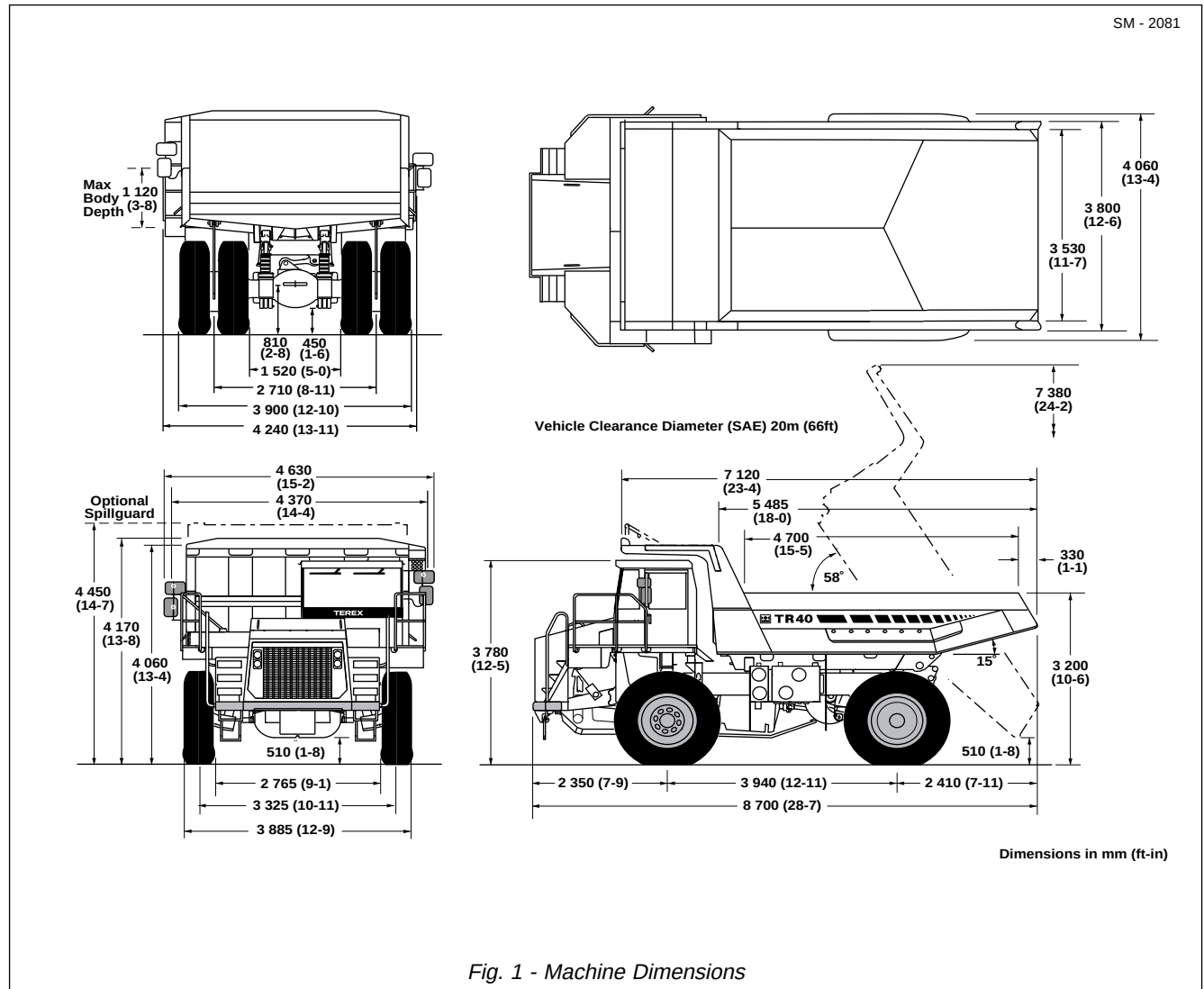


Fig. 1 - Machine Dimensions

ENGINE

Make/Model Cummins N14-C475
 Type 4 Cycle Turbocharged/Aftercooled
 Gross Power at 2 100 rev/min 354 kW (475 hp, 481 PS)
 Net Power at 2 100 rev/min 331 kW (444 hp, 450 PS)

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

Maximum Torque 2 000 Nm (1 475 lbf ft)
 at 1 300 rev/min
 Number of Cylinders/Configuration 6, in line
 Bore x Stroke 140 x 152 mm (6.25 x 6.25 in)
 Total Displacement 14.0 litres (885 in³)
 Starting Electric
 Maximum Speed, Full Load 2 100 rev/min
 Maximum Speed, No Load 2 400 rev/min
 Idle Speed 800 (Free) rev/min
 Safe Operating Angle 45°/100% Grade

TRANSMISSION

Make/Model Allison M5600 A
 Automatic electronic control with soft shift feature.
 Remote mounted in the frame. Integral torque converter and planetary gearing. Six speeds forward, two reverse.
 Automatic converter lockup action in all speed ranges.
 Downshift inhibitor.

Speeds With Standard Differential

Forward						
Gear	1	2	3	4	5	6
Ratio	4.00	2.68	2.01	1.35	1.00	0.67
km/h	9.7	14.5	19.3	28.7	38.7	58.0
mile/h	6.0	9.0	12.0	18.0	24.0	36.0
Reverse						
Gear	R1	R2				
Ratio	5.12	3.46				
km/h	7.6	11.2				
mile/h	4.7	7.0				

General Information - TR40 Off-Highway Truck

Section 000-0000

DRIVE AXLE

Heavy duty axle with single reduction spiral bevel gear differential, full floating axle shafts, and planetary reduction at each wheel.

Ratios:	Standard	Optional
Differential	3.15:1	3.73:1
Planetary	5.66:1	5.66:1
Total Reduction	17.83:1	21.11:1

SUSPENSION

Front: King pin strut type independent front wheel suspension by self-contained, variable rate, nitrogen/oil cylinders.

Rear: Variable rate nitrogen/oil cylinders with A-frame linkage and lateral stabilizer bar.

Maximum Strut Stroke	
Front	251 mm (9.9 in)
Rear	182 mm (7.2 in)
Maximum Rear Axle Oscillation	± 6.5 Degrees

WHEELS AND TYRES

Wheel Rim Width	13 in
Standard Tyres (Front & Rear)	18.00 R 33** Radial

Note: Consult tyre manufacturers for optimum tyre selection and correct t-km/h (ton-mile/h capacity for application).

BRAKES

Service

All hydraulic brake system. Transmission mounted pressure compensating pump provides hydraulic pressure for brakes and steering. Independent circuits front and rear. Each circuit incorporates a nitrogen accumulator which stores energy to provide consistent braking response.

Front Brake Circuit Pressure	159 bar (2 300 lbf/in ²)
Rear Brake Circuit Pressure	52 bar (750 lbf/in ²)
Accumulators:	
Nitrogen Precharge Pressure	55 bar (800 lbf/in ²)

Front:

Type	Dry Disc with 1 calliper per wheel
Disc Diameter	660 mm (25.5 in)
Pad Area, Total	1 395 cm ² (216 in ²)

Rear:

Type	Oil cooled, multiple friction discs (14 total), completely sealed from dirt and water.
Braking Surface, Total	38 310 cm ² (5 938 in ²)
Cooling Flow, Max.	553 litres/min (146 US gal/min)

Parking

Application of rear brakes by springs in brake disc pack. Hydraulically released.

Hold-off Pressure	83 bar (1 200 lbf/in ²)
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Retardation

Modulated lever control of rear disc pack.

Retarder Actuation Pressure	up to 33 bar (480 lbf/in ²)
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Emergency

Push button solenoid control applies service and parking brakes. Automatically applies when engine is switched off. Parking brake applies should system pressure fall below a predetermined level.

Brakes conform to ISO 3450, SAE J1473 OCT 90.

STEERING SYSTEM

Independent hydrostatic steering with closed-centre steering valve, accumulator and pressure compensating piston pump.

Accumulator provides uniform steering regardless of engine speed. In the event of loss of engine power it provides steering of approximately two lock-to-lock turns. A low pressure indicator light warns of system pressure below 83 bar (1 200 lbf/in²). Steering conforms to ISO 5010, SAE J53.

System Pressure	159 bar (2 300 lbf/in ²)
Relief Pressure	207 bar (3 000 lbf/in ²)
Steering Cylinders	Double Acting, Single Stage
Accumulator:	
Oil Capacity	14.0 litres (3.70 US gal)
Nitrogen Precharge Pressure	55 bar (800 lbf/in ²)
Steering Angle (Left and Right)	39°
Pump:	
Type	Piston
Capacity at 2 100 rev/min	1.4 litres/s (22 US gal/min)

BODY HYDRAULICS

Two body hoist cylinders are mounted between the frame rails. Cylinders are two-stage with power down in the second stage.

System Relief Pressure	190 bar (2 750 lbf/in ²)
Pump:	
Type	Gear
Capacity at 2 100 rev/min ..	210 litres/min (56 US gal/min)
Control Valve	Mechanically Controlled Open Centre
Body Raise Time	13 Seconds
Body Lower Time	9 Seconds

ELECTRICAL

Type	24 Volt, Negative Ground
Battery	Two, 12 Volt, 165 Ah each
Accessories	24 Volt
Alternator	70 Amp
Starter	8.9 kW

General Information - TR40 Off-Highway Truck

Section 000-0000

BODY

Longitudinal 'V' type floor with integral transverse box-section stiffeners. The body rests on resilient impact absorption pads.

Body wear surfaces are high hardness (360-440 BHN) abrasion resistant steel. Yield strength of plates 1 000 MPa (145 000 lbf/in²).

Plate Thicknesses:

Floor 19 mm (0.75 in)
Side 10 mm (0.39 in)
Front, lower 10 mm (0.39 in)

ROPS Cabguard SAE J1040 Feb 86. ISO 3471

Volumes:

Struck (SAE) 17.2 m³ (22.5 yd³)
Heaped 2:1 (SAE) 23.9 m³ (31.2 yd³)

SERVICE CAPACITIES

Engine Crankcase & Filters 41 litres (10.8 US gal)
Transmission and Filters 68 litres (18 US gal)
Cooling System 120 litres (31.7 US gal)
Fuel Tank 606 litres (160 US gal)
Steering Hydraulic Tank 61 litres (16.0 US gal)
Steering System 85 litres (22.5 US gal)
Body and Brake Cooling Tank 235 litres (62 US gal)
Body and Brake Cooling System 368 litres (97 US gal)
Planetaries (Total) 66 litres (17.4 US gal)
Differential 60 litres (15.8 US gal)
Front Ride Strut (Each) 14 litres (3.7 US gal)
Rear Ride Strut (Each) 17 litres (4.5 US gal)
Power Takeoff 4 litres (1 US gal)

TYPICAL NOISE LEVELS

OPERATOR EAR (ISO 6394) 80 dbA

*EXTERIOR SOUND RATING

(SAE J88 JUN 86) 90 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 unit in base configuration.

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

VEHICLE WEIGHTS (MASS)		
	kg	lb
Chassis, with hoists	25 350	55 900
Body, standard	9 050	19 950
Net Weight	34 400	75 850
PAYLOAD, maximum	36 300	80 000
Maximum Gross Weight*	70 700	155 850
FOR UNIT EQUIPPED WITH OPTIONAL BODY LINER PLATES:		
Chassis, with hoists	25 350	55 900
Body, with wear plates	10 550	23 260
Net Weight	35 900	79 160
PAYLOAD, maximum	34 800	79 690
Maximum Gross Weight*	70 700	155 850
* Maximum permissible gross vehicle weight with options, attachments, full fuel tank and payload.		
WEIGHT DISTRIBUTION	Front Axle	Rear Axle
Empty %	48	52
Loaded %	34	66

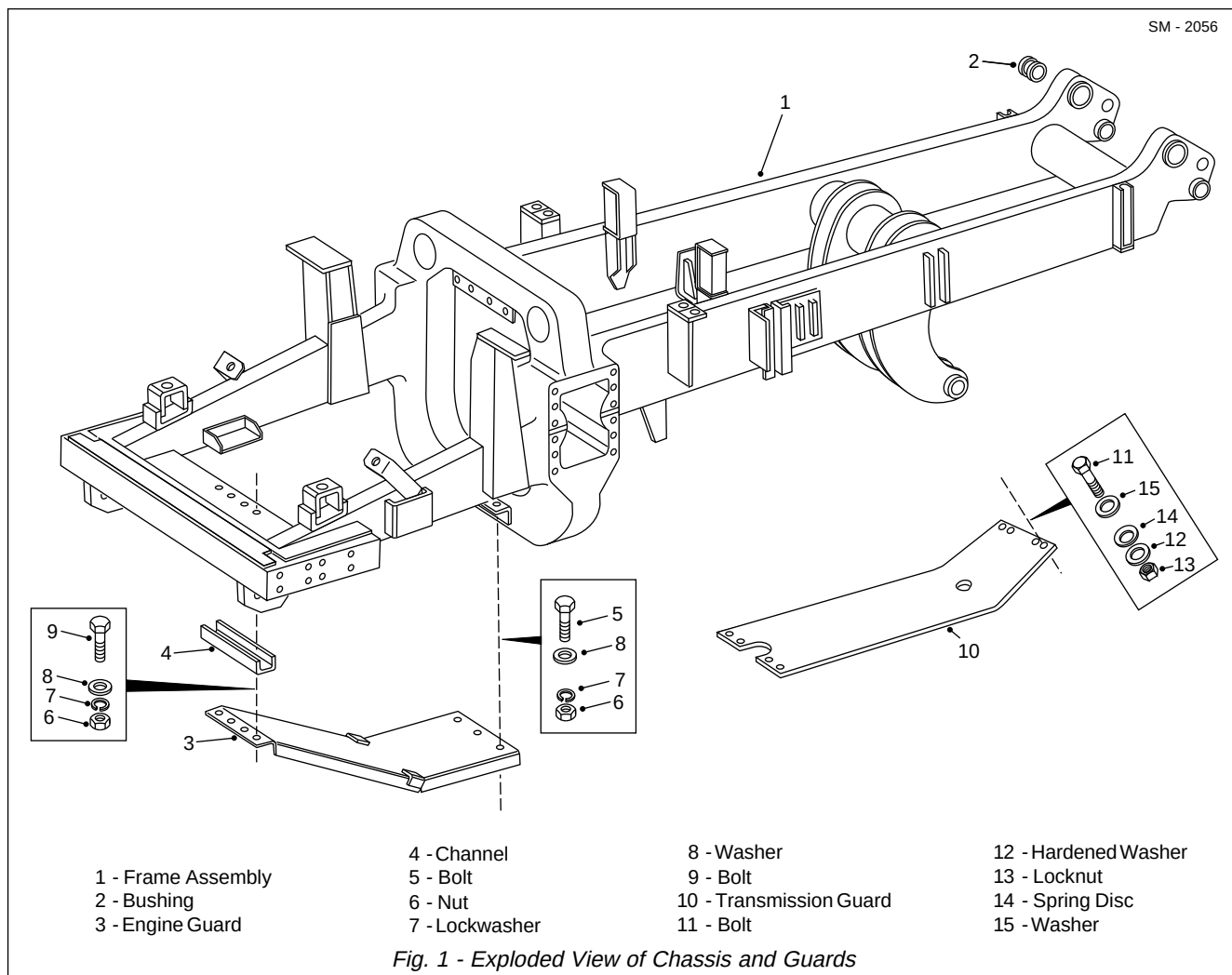
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CHASSIS - Chassis, Hood and Fenders

Section 100-0010

SM - 2056



REMOVAL



WARNING

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

To remove any of the components shown in Figs. 1, 2, 3, 4 or 5 (or similar components) the following procedures should be carried out.

1. Position the vehicle in a level work area, apply the parking brake and switch off the engine.
2. Turn steering wheel in both directions several times to relieve pressure in the steering circuit. Block all road wheels.

3. Attach a suitable lifting device to the component and remove mounting hardware. Remove the component from the vehicle.

INSTALLATION

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



WARNING

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

Using a suitable lifting device, align the component to be installed in position on the chassis. Secure the component securely to the chassis with mounting hardware removed during removal.

Chassis - Chassis, Hood and Fenders

Section 100-0010

MAINTENANCE

Inspection

Inspect the frame and attached parts at intervals not exceeding 250 hours for cracked or broken welds and bending/twisting of the frame. Any defects found should be repaired before they progress into major failures. Contact your dealer for recommended weld and repair instructions.

Welding

Note: It is important that the electrical connections are disconnected in the following order to prevent damage to the electrical components:

- Disconnect battery equalizer ground cables.
- Disconnect battery cables from terminal posts (ground cable first).
- Disconnect battery equalizer positive cables.
- Disconnect electrical connections at the ECU.

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

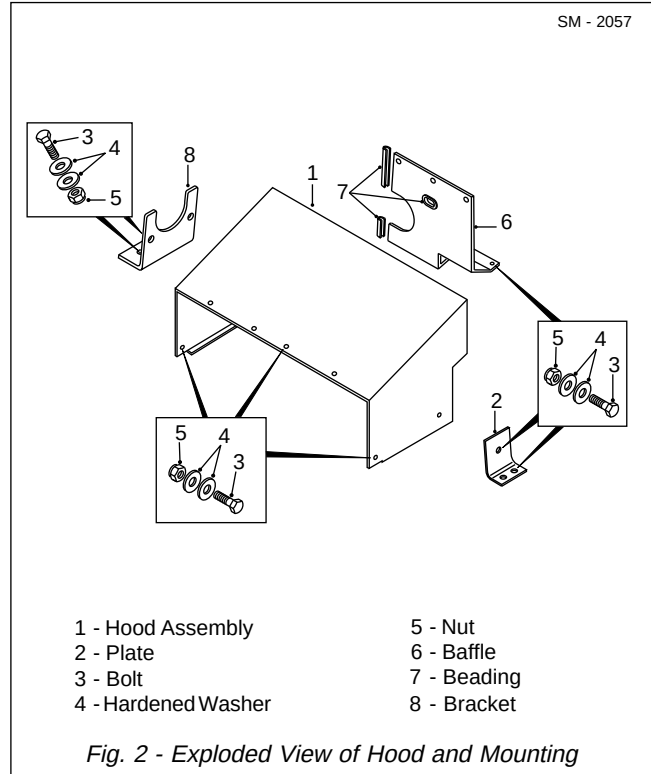


WARNING

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.

Electric arc welding is recommended for all chassis welding. 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 twisted, no welding should be done until the parts are straightened or realigned.

Successfully welded repairs will depend to a great extent upon the use of the proper equipment, materials



and the ability of the welder. The Service Department can be consulted regarding the feasibility of welding repairs.

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 fumes.

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

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

Chassis - Chassis, Hood and Fenders

Section 100-0010

SM - 2058

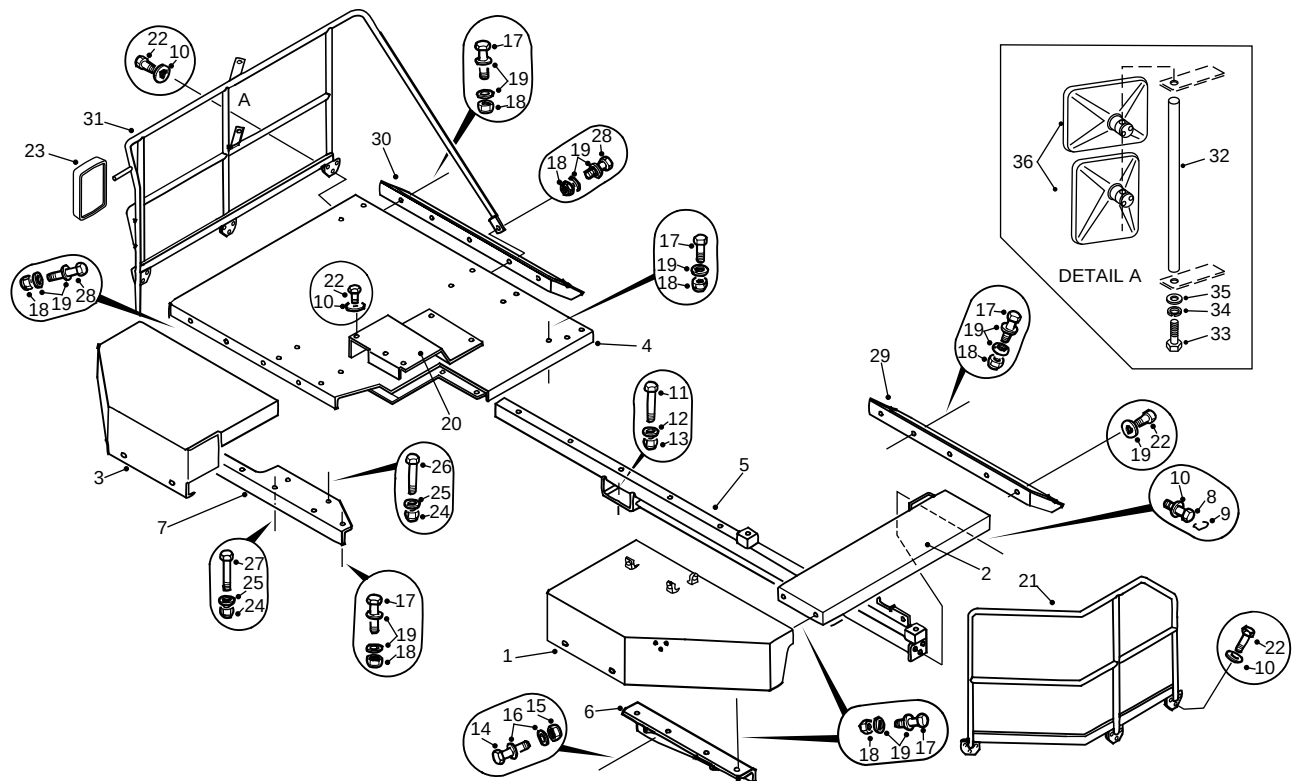
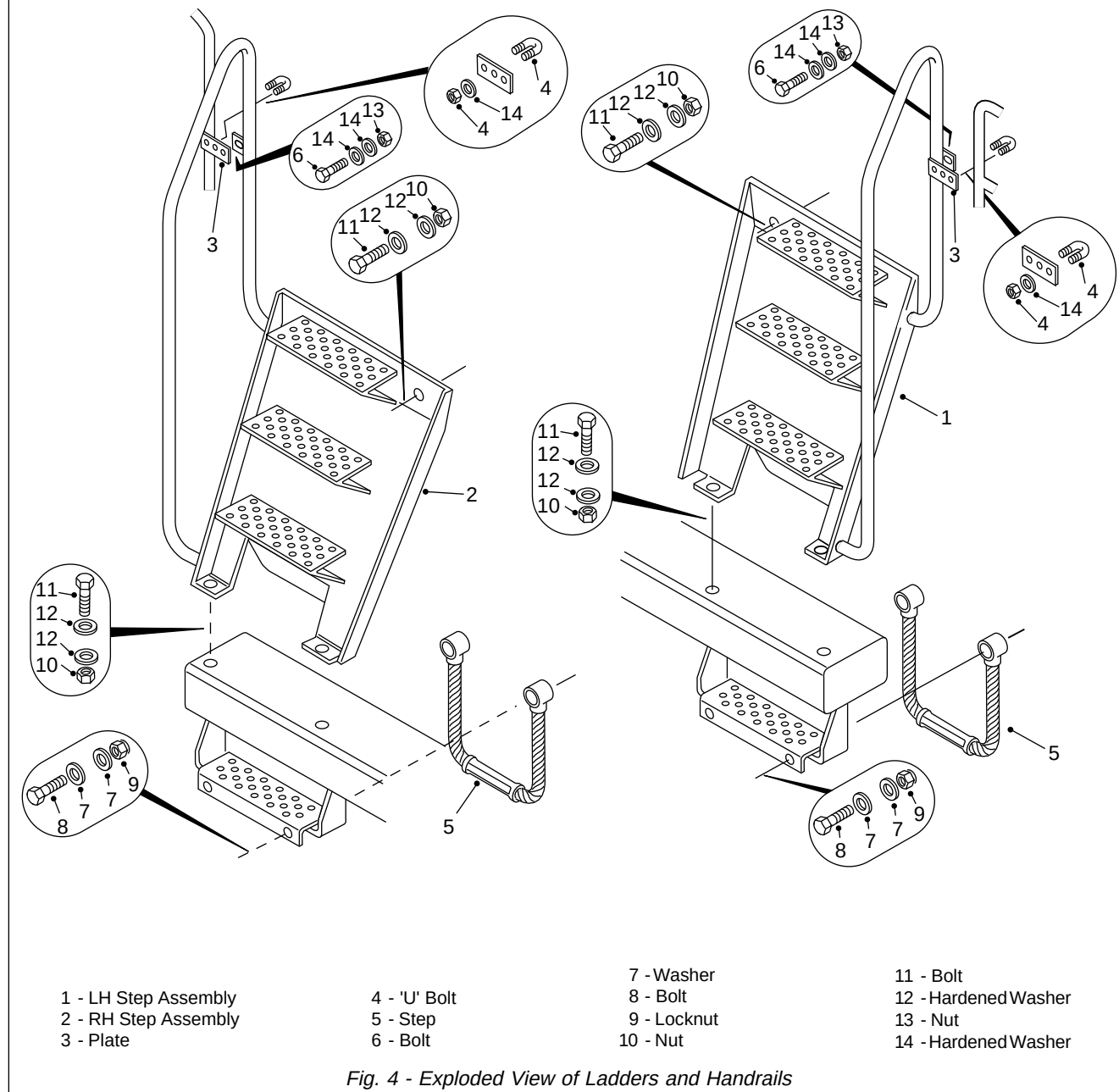


Fig. 3 - Exploded View of Fenders and Mounting

Chassis - Chassis, Hood and Fenders

Section 100-0010

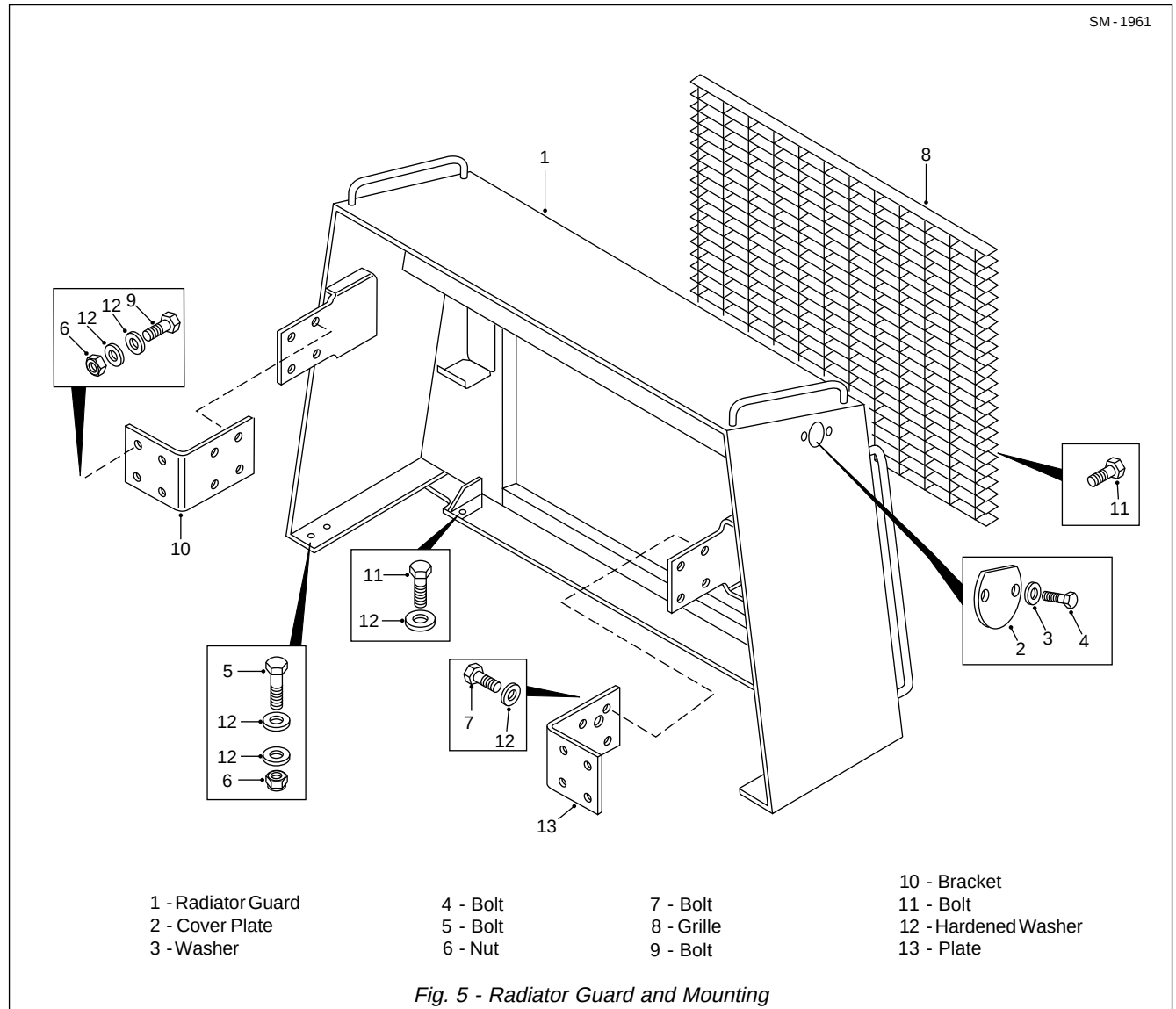
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Chassis - Chassis, Hood and Fenders

Section 100-0010

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ENGINE - Engine and Mounting

Section 110-0030

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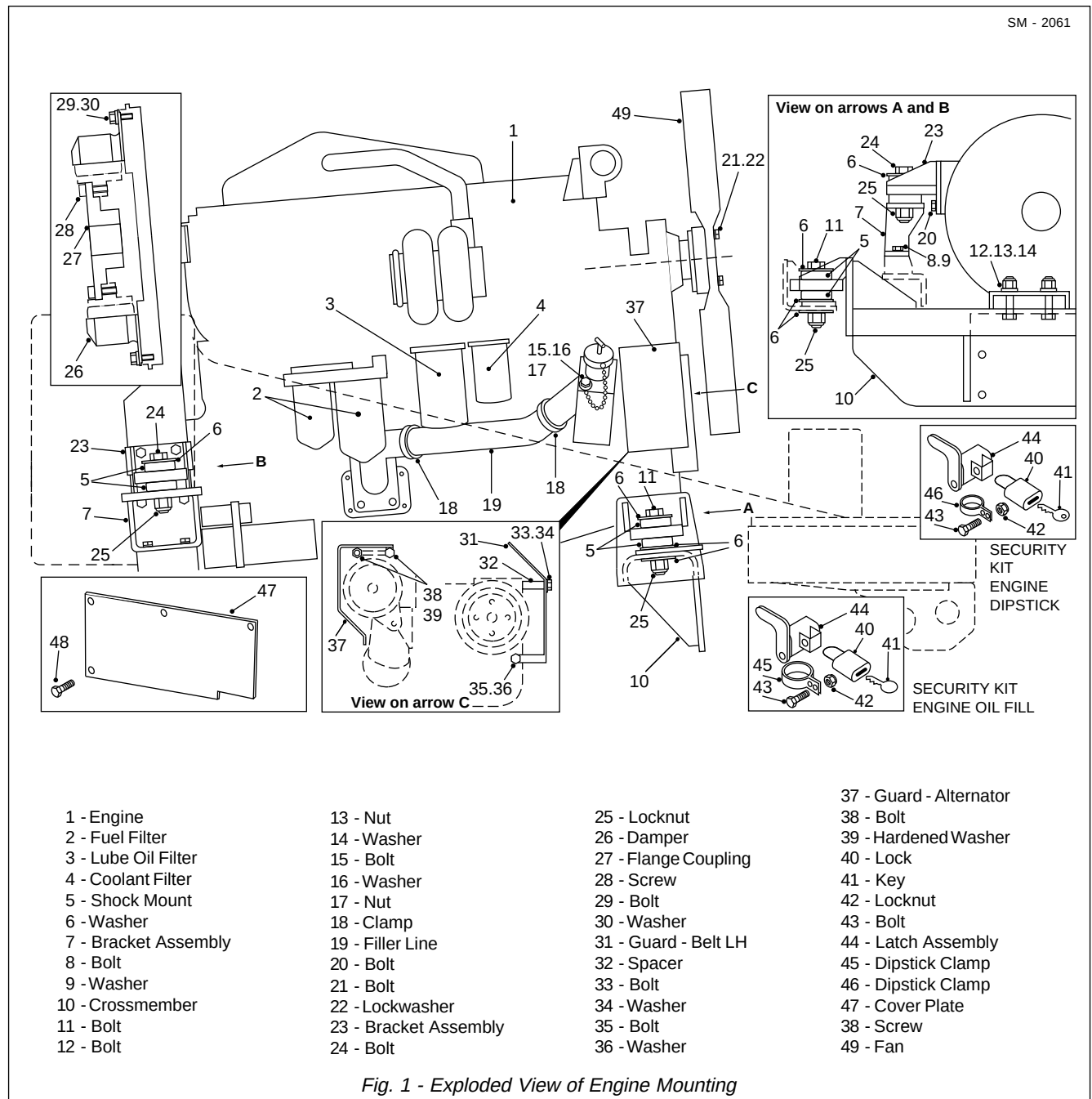


Fig. 1 - Exploded View of Engine Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

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

There are two fuel filters (2), a full flow lube oil filter (3) and a pre-charge coolant filter (4) installed on the right hand side of engine (1). A lube oil bypass filter is mounted off the front left hand of the horse collar.

REMOVAL

Numbers in parentheses refer to Fig. 1.



WARNING

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

Engine - Engine and Mounting

Section 110-0030



WARNING

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

Note: Tag and identify all lines, hoses, cables and linkages disconnected to remove engine.

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. Turn steering wheel several times to relieve pressure in the steering circuit. Block all road wheels.

3. Disconnect battery cables from battery terminal ports before starting removal procedures. Disconnect ground cable first.

4. Remove mounting hardware securing the hood on the vehicle. Remove hood assembly from the vehicle. Refer to Section 100-0010, CHASSIS, HOOD AND FENDERS.

5. Disconnect electrical connections from the radiator guard and remove mounting hardware securing the radiator guard on the vehicle. Remove radiator guard from the vehicle. Refer to Section 100-0010, CHASSIS, HOOD AND FENDERS.



WARNING

Harmful gas. 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, and it can cause serious damage to the skin and eyes.

6. If the vehicle is equipped with an air conditioning system, evacuate refrigerant from the system and disconnect lines at the compressor. Refer to Section 260-0130, AIR CONDITIONING.

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

8. With suitable containers in position, open drain cocks and drain coolant from the radiator and engine

(1) assembly. Close all drain cocks after draining.

9. Identify cooling lines for ease of installation and with suitable containers in position, disconnect cooling lines from engine (1).

10. Using suitable lifting equipment, carefully remove the radiator assembly from the vehicle. Refer to Section 210-0040, RADIATOR AND MOUNTING.

11. Disconnect and remove air cleaner intake pipe from the engine turbocharger and air cleaner. Refer to Section 110-0050, AIR CLEANER.

12. Disconnect and remove exhaust tube from the engine turbocharger.

13. Disconnect throttle control linkage from engine (1).

14. Identify heater lines for ease of installation and, with a suitable container in position, disconnect heater lines from engine (1).

15. Close fuel shutoff valve at filter head, identify fuel lines for ease of installation and, with a suitable container in position, disconnect fuel lines from engine (1).

16. Slacken top clamp (18) securing filler hose (19) to filler tube at the right hand frame rail. Disconnect filler hose (19) and tie onto engine (1) to prevent fouling.

17. Identify all electrical harnesses and cables attached to engine (1) for ease of installation and disconnect from engine (1).

18. Disconnect front driveline from engine coupling and secure clear of engine (1). Refer to Section 130-0010, FRONT DRIVELINE.

19. Remove tandem pump from the engine power takeoff. Refer to Section 230-0050, TANDEM PUMP.

Note: The hydraulic lines can be left attached to the tandem pump.



WARNING

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

20. Attach suitable lifting equipment to the lifting

Engine - Engine and Mounting

Section 110-0030

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

21. Remove nuts (13), washers (14) and bolts (12) securing engine (1) assembly to front mounting crossmember (10).

22. Remove nuts (25), washers (6) and bolts (24) securing rear mounting brackets (23) to the frame. If necessary remove bolts (8), washers (9) and bracket assemblies (7) from frame.

23. Carefully lift engine (1) assembly clear of the frame and move to a clean work area. Securely mount engine (1) assembly to a work stand.

24. If it is necessary to remove front mounting crossmember (10) from the frame, remove disc brake oil cooler from front mounting (6). Refer to Section 210-0050, DISC BRAKE OIL COOLER. With disc brake oil cooler removed, remove locknuts (25), washers (6) and bolts (11). Remove front mounting crossmember (10) from frame mounts.

25. If necessary, remove shock mounts (5) from rear mounting brackets (23) and front mounting crossmember (10). Rear mounting brackets (23) can be removed from engine (1) by removing bolts (20).

26. If necessary, damper (26) can be removed from the flywheel after the power takeoff assembly is removed. Refer to Section 110-0130, POWER TAKEOFF.

27. With power takeoff assembly removed, remove bolts (29), hardened washers (30) and damper (26) from engine (1). Remove screws (29) and flange coupling (27) from damper (26).

28. If necessary, remove bolts (21) and lockwashers (22) securing fan (49) to engine (1). Remove fan (49).

INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Inspect shock mounts (5) for damage and replace if damaged.
2. Check all mounting components for cracks and excessive wear. Repair or replace as required.
3. Inspect engine damper (26) and flange coupling (27) for wear or damage and replace if necessary.

4. Replace all filters (2, 3 & 4) and check all belts for tension and wear, as described under 'Maintenance'.

5. Refer to the Engine Service Manual for additional engine disassembly/assembly, repair, adjustment and tune-up procedures.

INSTALLATION

Numbers in parentheses refer to Fig. 1.

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



WARNING

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

1. Position fan (49) on engine (1) and secure with bolts (21) and lockwashers (22). Tighten bolts (21) to a torque of 68 - 81 Nm (50 - 60 lbf ft).
2. Position flange coupling (27) to damper (26) and secure with bolts (28). Position damper (26) assembly to engine flywheel and secure with bolts (29) and hardened washers (30). Tighten bolts (29) to a torque of 39 - 47 Nm (29 - 35 lbf ft).
3. Install new shock mounts (5) in front mounting crossmember (10) and rear mounting brackets (23). Lubricate shock mounts (5) with water and press in using a driver of same diameter as internal metal sleeve in the shock mount to protect the rubber from damage.
4. Install front mounting crossmember (10) on the frame and secure with bolts (11), washers (6) and locknuts (25). Install disc brake oil cooler on front mounting crossmember (10). Refer to Section 210-0050, DISC BRAKE OIL COOLER.
5. Install rear mounting brackets (23) on engine (1) and secure with bolts (20). If removed, install brackets (7) to frame and secure with bolts (8) and washers (9).
6. Attach suitable lifting equipment to engine (1) lifting brackets and position engine (1) in the frame.
7. Secure engine (1) to front mounting crossmember

Engine - Engine and Mounting

Section 110-0030

(10) with bolts (12), washers (14) and locknuts (13). Secure rear mounting brackets (23) to frame mounts with bolts (24), washers (6) and nuts (25).

8. Connect front driveline to engine coupling. Refer to Section 130-0010, FRONT DRIVELINE.

9. Install tandem pump on power takeoff assembly and secure with mounting hardware. Refer to Section 230-0050, TANDEM PUMP.

10. Using suitable lifting equipment, install the radiator assembly to the frame and secure with mounting hardware. Refer to Section 210-0040, RADIATOR AND MOUNTING.

11. Remove caps from all cooling lines and connect lines to the radiator assembly and engine (1) assembly as identified at removal.

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

13. Remove caps from fuel lines and connect lines to engine (1) as identified at removal. Open fuel shutoff valve at filter head.

14. Connect filler hose (19) to filler tube at the right hand frame rail and secure with clamp (18).

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

16. Install air cleaner intake pipe to the engine turbocharger and air cleaner. Tighten mounting clamps securely. Refer to Section 110-0050, AIR CLEANER.

17. Install exhaust tube on the engine turbocharger and tighten mounting clamp securely.

18. Connect throttle control linkage to engine (1) assembly.

19. If the vehicle is equipped with an air conditioning system, connect the lines at the compressor as identified at removal.

Note: On completion of engine installation the air conditioning system will require to be charged. Refer to Section 260-0130, AIR CONDITIONING.

20. Using suitable lifting equipment, install radiator guard assembly to the frame. Secure with the

required mounting hardware and connect electrical connections removed at removal.

21. Using suitable lifting equipment, install hood assembly into position on the vehicle. Secure hood assembly with mounting hardware removed at removal. Refer to Section 100-0010, CHASSIS, HOOD AND FENDERS.

22. Connect battery positive connections to battery terminal posts. Connect battery negative connections to battery terminal posts.

23. Check that all electrical connections, cables, lines and components removed or disconnected at removal have been reinstalled correctly. Ensure all drain plugs and cocks are secured tightly.

24. Fill the cooling system with coolant specified in Section 300-0020, LUBRICATION SYSTEM. Check the coolant level as described in Section 210-0000, COOLING SYSTEM.

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

26. Start the engine and bring the engine oil to operating temperature. Check all lines and fittings for leaks and tighten as required.

27. Ensure parking brake is applied and remove wheel blocks from road wheels.

MAINTENANCE

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

Every 10 Hours (Daily)

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

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

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

Engine - Engine and Mounting

Section 110-0030

Fuel Filter/Water Separator - 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 approximately 1.5 - 2 turns to close the drain valve.

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

Every 250 Hours or 6 Months

Fuel Filters (2) - Clean the area around the fuel filter head and replace the fuel filters.

Note: There is a fuel system shut off valve at the filter head. Closing this valve will prevent loss of fuel prime at time of filter replacement.

Position the vehicle on a level work area, apply the parking brake and switch off the engine. Close fuel system shut off valve and, using strap type filter wrench, remove and discard fuel filters (2).

Apply a thin film of clean engine oil to the gasket surface of new fuel filters (2) and fill fuel filters (2) with clean fuel specified in Section 300-0020, LUBRICATION SYSTEM.

Install new fuel filters (2) on the filter head and tighten by hand until the gasket contacts the filter head surface. Tighten fuel filters (2) per the filter manufacturer's instructions.

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

Open the shut off valve, start the engine and check for leaks. If leaks are noted, have them corrected.

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



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). Shut 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.

Position the vehicle on a level work area, apply the parking brake and switch off the engine. Using strap type filter wrench, remove lube oil bypass filter and full flow lube oil filter (3). Discard the filters if they are not required for a failure analysis.

Note: Cut all the way around the top of lube oil filter (3) using a pipe cutter or hacksaw. Inspect the pleated paper element for debris. Metal debris in the filter can reveal impending engine failure. If debris is found, find the reason for the debris and make the necessary repairs.

Clean the area around the oil filter head and 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 thin film of clean lubricating oil to the gasket surface of the new filter and fill the filter with clean lubricating oil specified in Section 300-0020, LUBRICATION SYSTEM.

Install the filter on the filter head as specified by the filter manufacturer. The tightening instructions are normally printed on the outside of the filter.

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

Check and clean the engine oil drain plug threads and the seal surface. Install and tighten the drain plug to a torque of 100 Nm (75 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 - Engine and Mounting

Section 110-0030

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

- Disconnect the electrical wire from the fuel pump solenoid valve.
- Switch on the ignition and rotate the crankshaft using the starter motor, until oil pressure appears on the pressure gauge or the warning light goes out.
- Connect the electrical wire to the fuel pump solenoid valve.

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

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.

Cooling Fan (49) - Visually check fan (49) for cracks, loose rivets, and bent or loose blades. Check fan mounting bolts (21) and tighten if required. Replace fan (49) if damaged.

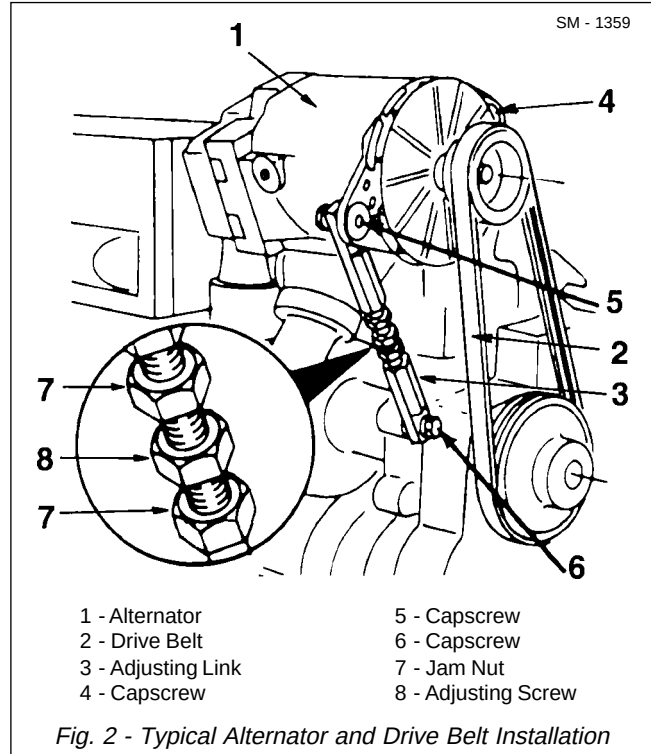
Note: The fan belt is maintained to the correct belt tension by a spring loaded idler arm, therefore, there is no need to check or adjust belt tension.

Alternator Drive Belt (2, Fig. 2) - Visually check belt (2, Fig. 2) and replace if it is cracked or frayed. Adjust belt if it has a glazed or shiny surface which indicates belt slippage. A correctly installed and tensioned belt will show even pulley and belt wear. Check belt tension and adjust if necessary, as described under 'Alternator Drive Belt'.

ALTERNATOR DRIVE BELT

Numbers in parentheses refer to Fig. 2.

Note: Position the vehicle in a level work area, apply the parking brake and switch off the engine. Turn steering wheel several times to relieve pressure in the steering circuit. Block all road wheels.



Belt Tension Check

Measure drive belt (2) tension in the centre span of the drive pulleys using a belt tension gauge. The belt tension should be within the following values:

Belt Tension 'New' - 670 N (150 lbf)

Belt Tension 'Used' - 270 - 530 N (60 - 120 lbf)

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

Note: Tension specifications are based on a cold belt. Hot shut down tension varies greatly depending on engine speed, load and temperature, but is approximately 30% higher.

An alternative method (deflection method) can be used to check drive belt (2) tension by applying 110 N (25 lbf) force on drive belt (2) between the drive pulleys. If the deflection is more than one belt thickness per foot (305 mm) of pulley centre distance, the belt tension must be adjusted.

Drive Belt Adjustment

Note: Lower jam nut (7) on adjusting screw (8) has left hand threads.

Engine - Engine and Mounting

Section 110-0030

1. Loosen alternator (1) and adjusting link (3) capscrews (4, 5 & 6) and jam nuts (7) on adjusting screw (8).
2. Turn adjusting screw (8) clockwise to tighten drive belt (2) tension. Belt tension should be within values previously stated under 'Belt Tension Check'.
3. Tighten jam nuts (7) on adjusting screw (8) to a torque of 55 Nm (40 lbf ft).
4. Tighten adjusting link (3) and alternator (1)

capscrews (4, 5 & 6) to a torque of 55 Nm (40 lbf ft).

5. Check drive belt (2) tension again to make sure tension is correct.

SERVICE TOOLS

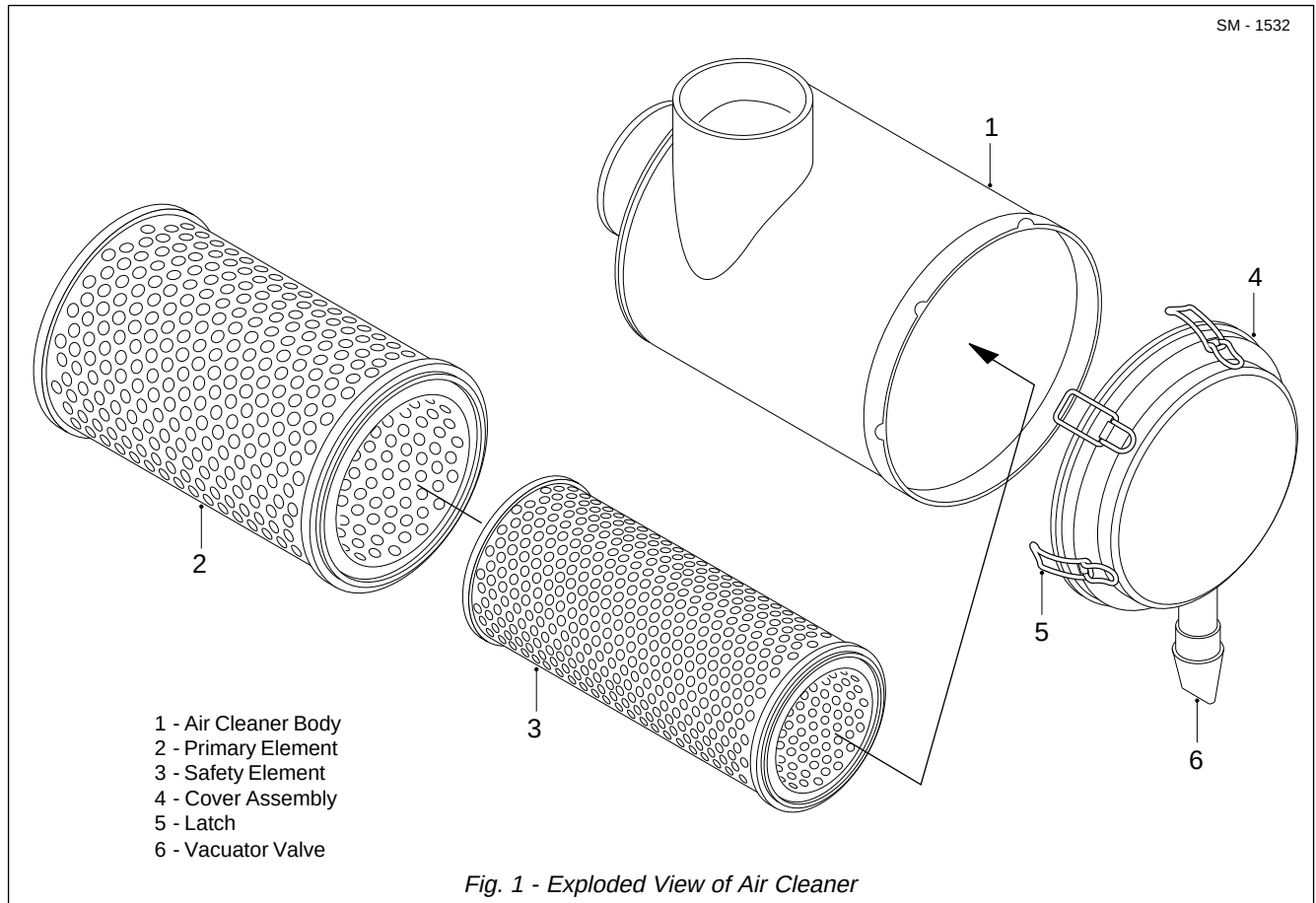
Refer to Section 300-0070, SERVICE TOOLS, for part numbers of tools referenced in this section, general service tools required, and service tools which should be used in conjunction with procedures outlined in the engine manufacturers service manual. These tools are available from your dealer.

SPECIAL TORQUE SPECIFICATIONS				
FIG. NO.	ITEM NO.	ITEM NAME	TORQUE	
			Nm	lbf ft
1	29	Bolt	39 - 47	29 - 35
1	21	Bolt	68 - 81	50 - 60
2	4, 5 & 6	Capscrew	55	40
2	7	Jam Nut	55	40
-	-	Sump Drain Plug	100	75

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SM - 1532

**DESCRIPTION**

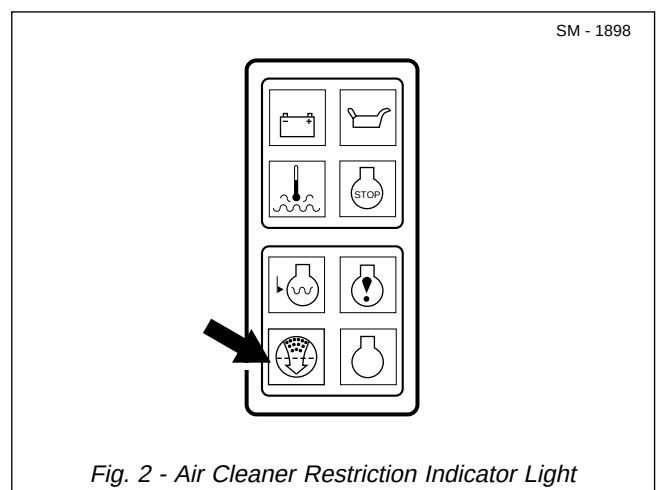
Numbers in parentheses refer to Fig. 1, unless otherwise specified.

There are two, dual dry element type air cleaner assemblies mounted on the platform to the right hand side of the cab. Air cleaner assemblies prolong engine life by removing grit, dust and water from the air as it enters the engine. Grit and dust combined with engine oil, forms a highly abrasive compound which can destroy the engine in a comparatively short period of time.

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

An electrical air restriction gauge (12, Fig. 3) indicates when air restriction levels reach the maximum allowable limit. When air restriction levels are reached,

SM - 1898

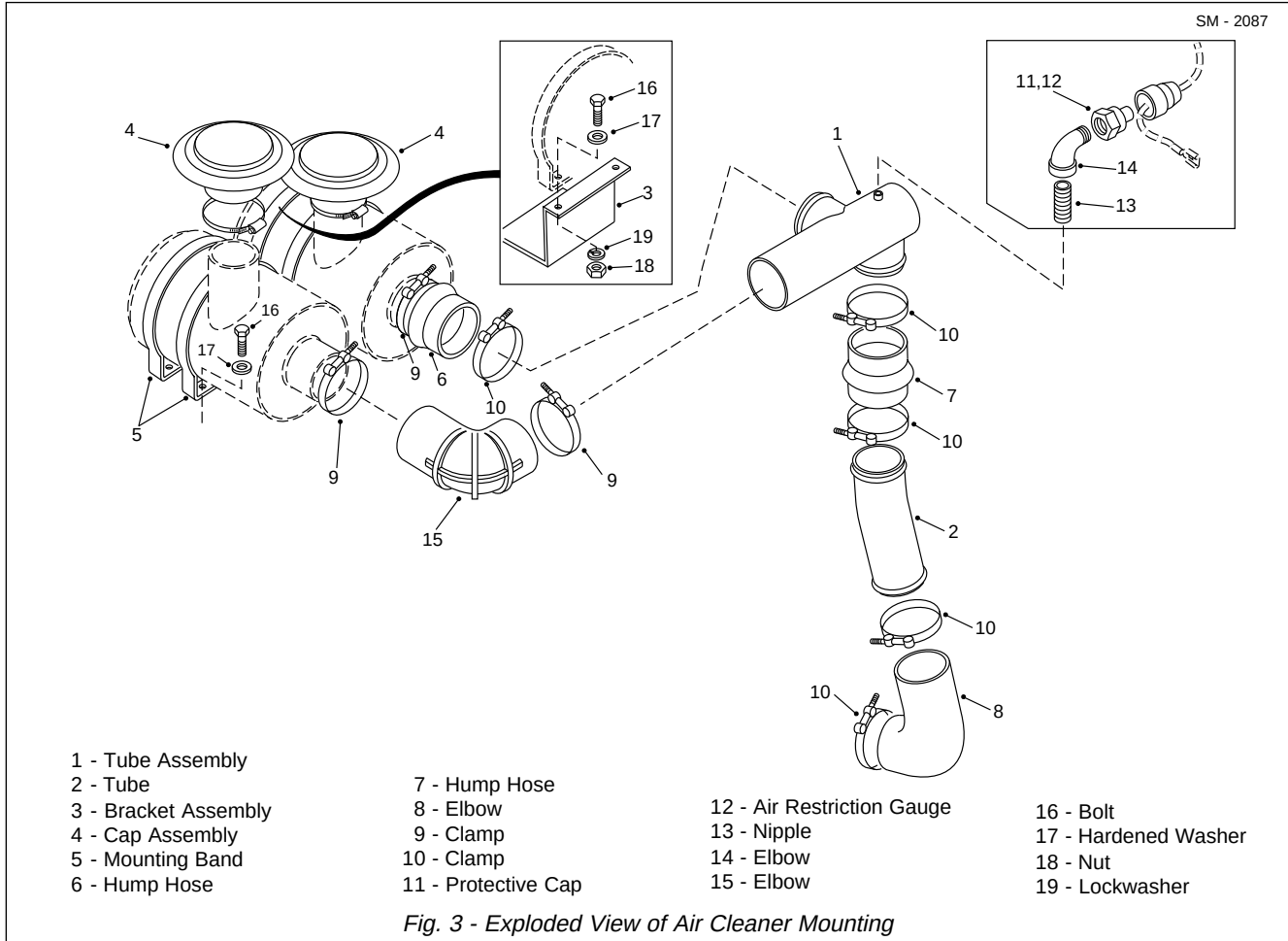


the circuit closes and a restriction indicator light in the dash panel (Fig. 2) illuminates. This light shows at a glance when the system air flow is being restricted indicating that primary element (2) should be serviced. Air restriction gauge (12, Fig. 3) automatically resets after each air cleaner assembly is serviced.

While the indicator light indicates the need for servicing, it does not give as precise a measurement as a water manometer or vacuum gauge. Refer to

Engine - Air Cleaner

Section 110-0050



'Measuring Air Restriction'.

Safety element (3) is installed in each air cleaner assembly inside of primary element (2). This element increases the reliability of the air cleaner's protection of the engine from airborne dirt. It protects the engine from dirt admitted by a damaged primary element (2), or dirt that might be dropped into the air cleaner assembly while servicing primary element (2).

MAINTENANCE

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



WARNING
Always shutdown the engine before servicing air cleaner.

The air cleaner elements should be serviced only when the maximum allowable restriction has been reached, as indicated by air cleaner restriction indicator light. The elements should not be serviced on the basis of visual observation as this would lead to

over service. When restriction readings finally indicate a change, remove primary element (2) carefully and clean/replace as required. Refer to 'Primary Element'.

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

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

Check condition of clamps (9 & 10, Fig. 3), hump hoses (6 & 7, Fig. 3), elbows (8 & 15, Fig. 3), tube assembly (1, Fig. 3) and tube (2, Fig. 3). Tighten/replace as necessary.

Air Cleaner Assembly

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

Note: Air cleaner body (1) should be thoroughly

Engine - Air Cleaner

Section 110-0050

cleaned twice a year. Do not apply heat in any form to air cleaner body (1).

1. Release latches (5) on cover assembly (4) and remove cover assembly from air cleaner body (1).
2. Remove primary element (2) and safety element (3) from air cleaner body (1).
3. Slacken clamps (9, Fig. 3) and disconnect hump hose (6, Fig. 3) from air cleaner body (1).
4. Slacken clamps (9, Fig. 3) and disconnect elbow (15, Fig. 3) from air cleaner body (1).
5. Remove nuts (18, Fig. 3), lockwashers (19, Fig. 3), hardened washers (15, Fig. 3) and bolts (16, Fig. 3) securing the air cleaner assemblies to bracket assembly (3, Fig. 3) and the platform.
6. Remove the air cleaner assemblies from the platform for cleaning.
7. Open clamps (6) and remove from air cleaner body (1). Open clamp on cap assembly (7) and remove cap assembly from air cleaner body (1).
8. 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.
9. Remove all loose dust from air cleaner body (1) and remove tape or cardboard from body outlets.

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

Primary Element

Numbers in parentheses refer to Fig. 1.

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

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

Visually determine the condition of primary element (2)

and choose either the compressed air or washing method.

1. Release latches (5) on cover assembly (4) and remove cover assembly from air cleaner body (1).
2. Remove primary element (2) from air cleaner body (1).
3. Using a damp cloth and a suitable solvent, wipe out all excess dust from air cleaner body (1) and allow to dry.
4. If the major contaminant on primary element (2) is light dust, direct a jet of compressed air, not exceeding 6.9 bar (100 lbf/in²), against the pleats of the element. The air jet should be directed in the opposite direction of normal operating air flow. Move the air jet up and down the pleats, holding the air nozzle 25 mm (1.0 in) away from the pleats, to prevent rupturing the element with either the nozzle or air jet.
5. In cases where the dust cake on primary element (2) contains oil or carbon, air will not clean effectively. Using manufacturers recommended solution and warm water, not exceeding 48° C (120° F), soak primary element (2) for fifteen minutes. Element should be gently agitated to assist cleaning process.

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

6. Rinse washed element thoroughly with a low pressure stream of water, not exceeding 0.7 bar (10 lbf/in²), opposite from the normal air flow, until rinse water runs clear.
7. Air dry primary element (2) thoroughly before returning it to service. Drying is a slow process which may be hastened by exposing element to slowly circulating heated air. Heated air temperature should not exceed 46° C (115° F). Drying time can be reduced to about three hours with heated air. DO NOT use a light bulb for drying. DO NOT use compressed air on a wet element.
- Note:** Replace paper elements after six cleanings or two years in service, whichever comes first. Mark each cleaned element to show total cleanings to date.
8. After primary element (2) is thoroughly dried, inspect for damage or ruptures, especially close to the end caps. To detect paper ruptures, place a bright light bulb inside the element and rotate element slowly.

Engine - Air Cleaner

Section 110-0050

Inspection of element on the outside will disclose any holes where concentrated light shines through. Even the smallest hole will pass dust to the engine and may result in costly engine repairs.

9. Install primary element (2) in air cleaner body (1).
10. Install cover assembly (4) on air cleaner body (1) and secure with latches (5).

Secondary Element

Numbers in parentheses refer to Fig. 1.

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

1. With primary element (2) removed from air cleaner body (1), remove safety element (3).
2. Remove any dust dislodged into air cleaner body (1) outlet and, using a damp cloth and a suitable solvent, wipe out all excess dust from air cleaner body (1) and allow to dry.
3. Install new safety element (3) followed by primary element (2) in air cleaner body (1)
4. Install cover assembly (4) on air cleaner body (1) and secure with latches (5).

Recommendations

Numbers in parentheses refer to Fig. 3.

1. Under no condition should the vehicle be operated without both filter elements in each air cleaner assembly.
2. It is very important that hump hoses (6 & 7), tube assembly (1), tube (2) and elbows (8 & 15) from the air cleaner assembly to the engine be airtight or the purpose of the air cleaner will be completely defeated. All clamps (9 & 10) 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. 3.

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-H₂O (15 in-H₂O) with clean filter elements.
- b. 635 mm-H₂O (25 in-H₂O) 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 protective cap (11) and disconnect harness at air restriction gauge (12). Remove air restriction gauge (12) from elbow (14).
- b. Hold water manometer vertically and fill both legs approximately half full of water. Connect one of the upper ends to elbow (14) 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 protective cap (11) and disconnect harness at air restriction gauge (12). Remove air restriction gauge (12) from elbow (14).
- b. Connect the hose from the vacuum gauge to elbow (14) and, with the engine drawing maximum air, take a note of the reading on the gauge.
- c. If the restriction exceeds the levels indicated, engine performance will be affected. Primary filter element should be cleaned or replaced.

SERVICE TOOLS

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

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