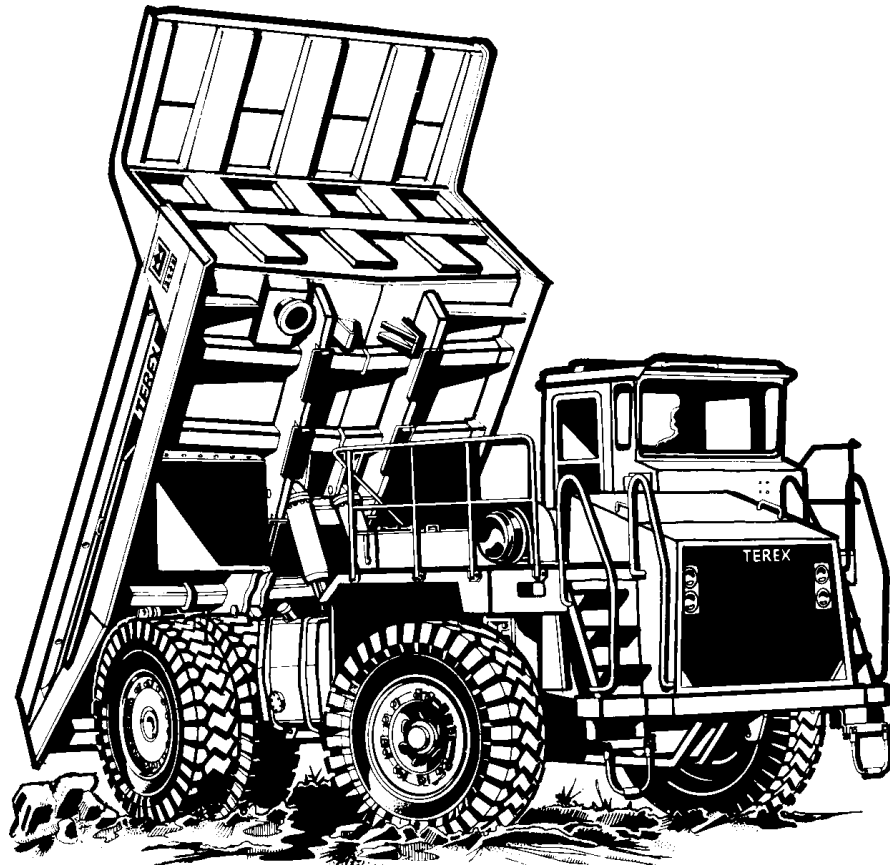




# **3340 and 3345 Off-Highway Trucks Service Manual**



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TECHNICAL PUBLICATIONS DEPARTMENT  
TEREX EQUIPMENT LIMITED,  
MOTHERWELL, SCOTLAND, ML15RY  
REF. NO. SM507

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

# Service Information Alert

**DATE:** April 1994

**B168**

**MODEL:** General

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

## **PURPOSE:**

To advise potentially hazardous condition.

## **DETAIL:**

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

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

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

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

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

## **TEREX SERVICE DEPARTMENT**

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## IMPORTANT SAFETY NOTICE

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

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

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

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

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



### **WARNING**

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

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**Note:** Sections in process for issue later.

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# General Information - 3340 Off-Highway Truck

## Section 0

### ENGINE - Detroit Diesel

Make/Model ..... Detroit Diesel Series 60  
Type .... 4 Cycle Diesel, Turbocharged with air-to-air charge cooling, water-cooled. Electronic management.  
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. Net Power is after deductions for fan and alternator. Engine requires no deaeration up to 3 050 m (10 000 ft) altitude.

Maximum Torque ..... 2 101 Nm (1 550 lbf ft)  
at 1 200 rev/min  
Number of Cylinders/Configuration ..... 6, in line  
Bore x Stroke ..... 130 x 160 mm (5.12 x 6.30 in)  
Total Displacement ..... 12.7 litres (774 in<sup>3</sup>)  
Starting ..... Electric  
Maximum Speed, Full Load ..... 2 100 rev/min  
Maximum Speed, No Load ..... 2 225 rev/min  
Idle Speed ..... 700 rev/min  
Safe Operating Angle ..... 30°/57% Grade

### TRANSMISSION

Make/Model ..... Allison CLT-5963 ATEC  
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 | 57.8 |
| 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  |      |      |      |      |

### 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

Inflation Pressures (Front & Rear) ..... 7.5 bar (109 lbf/in<sup>2</sup>)

**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.

### 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<sup>2</sup>)  
Rear Brake Circuit Pressure ..... 52 bar (750 lbf/in<sup>2</sup>)  
Accumulators:  
Nitrogen Precharge Pressure ..... 55 bar (800 lbf/in<sup>2</sup>)

#### Front:

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

#### Rear:

Type ..... Oil cooled, multiple friction discs (14 total), completely sealed from dirt and water.  
Braking Surface, Total ..... 38 310 cm<sup>2</sup> (5 938 in<sup>2</sup>)  
Cooling Flow, Max. .... 9.2 litres/sec (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<sup>2</sup>)

### Retardation

Modulated lever control of rear disc pack.  
Retarder Actuation Pressure ..... up to 33 bar (480 lbf/in<sup>2</sup>)

### 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.

# General Information - 3340 Off-Highway Truck

Section 0

## 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/in<sup>2</sup>). Steering meets SAE J53.

System Pressure ..... 159 bar (2 300 lbf/in<sup>2</sup>)  
 Relief Pressure ..... 207 bar (3 000 lbf/in<sup>2</sup>)  
 Steering Cylinders ..... Double Acting, Single Stage  
 Accumulator:  
   Oil Capacity ..... 14.0 litres (3.70 US gal)  
   Nitrogen Precharge Pressure ..... 55 bar (800 lbf/in<sup>2</sup>)  
 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. The body hydraulic system is independent of the steering hydraulic system.

System Relief Pressure ..... 190 bar (2 750 lbf/in<sup>2</sup>)  
 Pump:  
   Type ..... Gear  
   Capacity at 2 100 rev/min ..... 3.5 litres/s (55.5 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, Maintenance Free  
 Accessories ..... 24 Volt  
 Alternator ..... 70 Amp  
 Starter ..... 8.9 kW

## 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/in<sup>2</sup>).

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 m<sup>3</sup> (22.5 yd<sup>3</sup>)  
 Heaped 3:1 ..... 21.7 m<sup>3</sup> (28.4 yd<sup>3</sup>)  
 Heaped 2:1 (SAE) ..... 23.9 m<sup>3</sup> (31.2 yd<sup>3</sup>)

## SERVICE CAPACITIES

Cummins Engine Crankcase & Filters 55 litres (14.5 US gal)  
 Detroit Engine Crankcase & Filters ..... 36 litres (9.5 US gal)  
 Transmission and Filters ..... 68 litres (18 US gal)  
 Cooling System ..... 164 litres (43 US gal)  
 Fuel Tank ..... 606 litres (160 US gal)  
 Steering Hydraulic Tank ..... 61 litres (16.1 US gal)  
 Steering System ..... 72 litres (19 US gal)  
 Body and Brake Cooling Tank ..... 216 litres (57 US gal)  
 Body and Brake Cooling System ..... 258 litres (68 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 (1.1 US gal)

## VEHICLE WEIGHTS (MASS)

TABLE839

|                         | kg            | lb            |
|-------------------------|---------------|---------------|
| Chassis, with hoists    | 25 400        | 56 000        |
| Body, standard          | 9 200         | 20 300        |
| Net Weight              | 34 600        | 76 300        |
| <b>PAYLOAD, maximum</b> | <b>36 300</b> | <b>80 000</b> |
| Maximum Gross Weight*   | 70 900        | 156 300       |

FOR UNIT EQUIPPED WITH OPTIONAL BODY LINER PLATES:

|                         |               |               |
|-------------------------|---------------|---------------|
| Chassis, with hoists    | 25 400        | 56 000        |
| Body, with wear plates  | 13 650        | 30 100        |
| Net Weight              | 39 050        | 86 100        |
| <b>PAYLOAD, maximum</b> | <b>31 850</b> | <b>70 200</b> |
| Maximum Gross Weight*   | 70 900        | 156 300       |

\* 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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# GENERAL INFORMATION - 3345 Off-Highway Truck

Section 0

SM - 1317

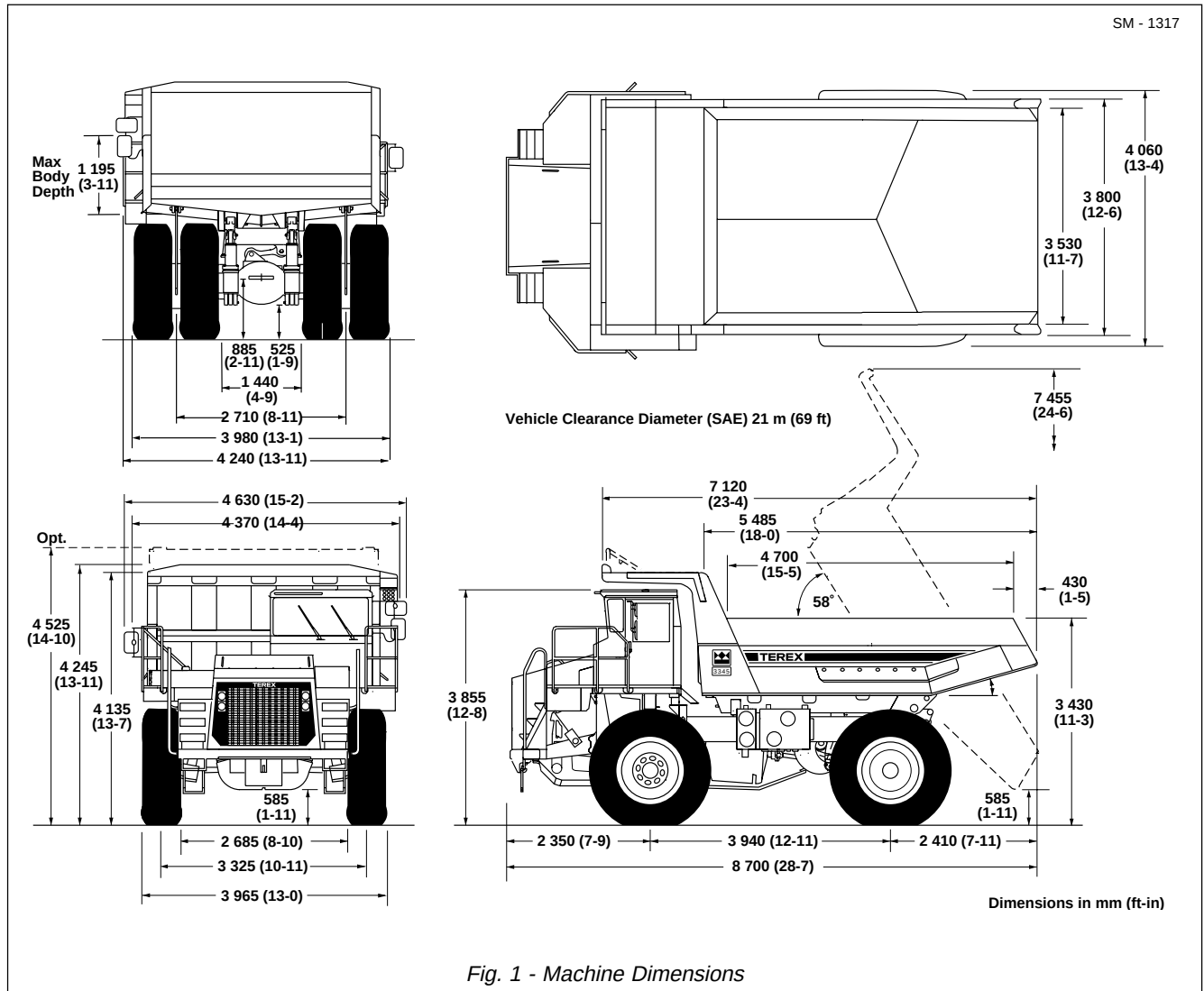


Fig. 1 - Machine Dimensions

## ENGINE

Make/Model ..... Cummins KTA-19-C487  
 Type ..... 4 Cycle Turbocharged/Aftercooled  
 Gross Power at 2 100 rev/min ..... 363 kW (487 hp, 494 PS)  
 Net Power at 2 100 rev/min ..... 340 kW (456 hp, 462 PS)

**Note:** Power ratings to SAE J1995. Net Power is after deductions for fan and alternator. Engine requires no deaeration up to 2 600 m (8 500 ft) altitude.

Maximum Torque ..... 2 069 Nm (1 526 lbf ft)  
 at 1 400 rev/min  
 Number of Cylinders/Configuration ..... 6, in line  
 Bore x Stroke ..... 159 x 159 mm (6.25 x 6.25 in)  
 Total Displacement ..... 18.9 litres (1 150 in<sup>3</sup>)  
 Starting ..... Electric  
 Maximum Speed, Full Load ..... 2 100 rev/min  
 Maximum Speed, No Load ..... 2 450 rev/min  
 Idle Speed ..... 700 rev/min  
 Safe Operating Angle ..... 30°/60° Grade

## TRANSMISSION

Make/Model ..... Allison CLT-5963 ATEC  
 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 |      |      |      |      |      |      | TABLE847 |
|-----------------------------------|------|------|------|------|------|------|----------|
| Forward                           |      |      |      |      |      |      |          |
| Gear                              | 1    | 2    | 3    | 4    | 5    | 6    |          |
| Ratio                             | 4.00 | 2.68 | 2.01 | 1.35 | 1.00 | 0.67 |          |
| km/h                              | 11.0 | 16.5 | 22.0 | 32.7 | 44.2 | 65.9 |          |
| mile/h                            | 6.9  | 10.2 | 13.7 | 20.3 | 27.4 | 41.0 |          |
| Reverse                           |      |      |      |      |      |      |          |
| Gear                              | R1   | R2   |      |      |      |      |          |
| Ratio                             | 5.12 | 3.46 |      |      |      |      |          |
| km/h                              | 8.6  | 12.8 |      |      |      |      |          |
| mile/h                            | 5.4  | 7.9  |      |      |      |      |          |

## General Information - 3345 Off-Highway Truck

### Section 0

#### 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 .....               | 15 in               |
| Standard Tyres (Front & Rear) ..... | 21.00 R35 ** Radial |

Inflation Pressures (Front & Rear) ..... 5.5 bar (80 lbf/in<sup>2</sup>)

**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.

#### 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 <sup>2</sup> ) |
| Rear Brake Circuit Pressure .....  | 52 bar (750 lbf/in <sup>2</sup> )    |
| Accumulators:                      |                                      |
| Nitrogen Precharge Pressure .....  | 55 bar (800 lbf/in <sup>2</sup> )    |

##### Front:

|                       |                                              |
|-----------------------|----------------------------------------------|
| Type .....            | Dry Disc with 1 calliper per wheel           |
| Disc Diameter .....   | 660 mm (25.5 in)                             |
| Pad Area, Total ..... | 1 395 cm <sup>2</sup> (216 in <sup>2</sup> ) |

##### Rear:

|                              |                                                                                        |
|------------------------------|----------------------------------------------------------------------------------------|
| Type .....                   | Oil cooled, multiple friction discs (14 total), completely sealed from dirt and water. |
| Braking Surface, Total ..... | 38 310 cm <sup>2</sup> (5 938 in <sup>2</sup> )                                        |
| Cooling Flow, Max. ....      | 9.2 litres/sec (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<sup>2</sup>)

#### Retardation

Modulated lever control of rear disc pack.  
Retarder Actuation Pressure ..... up to 33 bar (480 lbf/in<sup>2</sup>)

#### 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/in<sup>2</sup>). Steering meets SAE J53.

|                                       |                                      |
|---------------------------------------|--------------------------------------|
| System Pressure .....                 | 159 bar (2 300 lbf/in <sup>2</sup> ) |
| Relief Pressure .....                 | 207 bar (3 000 lbf/in <sup>2</sup> ) |
| Steering Cylinders .....              | Double Acting, Single Stage          |
| Accumulator:                          |                                      |
| Oil Capacity .....                    | 14.0 litres (3.70 US gal)            |
| Nitrogen Precharge Pressure .....     | 55 bar (800 lbf/in <sup>2</sup> )    |
| 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. The body hydraulic system is independent of the steering hydraulic system.

|                               |                                      |
|-------------------------------|--------------------------------------|
| System Relief Pressure .....  | 190 bar (2 750 lbf/in <sup>2</sup> ) |
| Pump:                         |                                      |
| Type .....                    | Gear                                 |
| Capacity at 2 100 rev/min ... | 3.5 litres/s (55.5 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, Maintenance Free |
| Accessories ..... | 24 Volt                                     |
| Alternator .....  | 70 Amp                                      |
| Starter .....     | 8.9 kW                                      |

## General Information - 3345 Off-Highway Truck

Section 0

### 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/in<sup>2</sup>).

#### 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) ..... 19.6 m<sup>3</sup> (25.6 yd<sup>3</sup>)  
Heaped 3:1 ..... 23.8 m<sup>3</sup> (31.1 yd<sup>3</sup>)  
Heaped 2:1 (SAE) ..... 26.0 m<sup>3</sup> (34.0 yd<sup>3</sup>)

### SERVICE CAPACITIES

Engine Crankcase and Filters ..... 55 litres (14.5 US gal)  
Transmission and Filters ..... 68 litres (18 US gal)  
Cooling System ..... 164 litres (43 US gal)  
Fuel Tank ..... 606 litres (160 US gal)  
Steering Hydraulic Tank ..... 61 litres (16.1 US gal)  
Steering System ..... 72 litres (19 US gal)  
Body and Brake Cooling Tank ..... 216 litres (57 US gal)  
Body and Brake Cooling System ..... 258 litres (68 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 (1.1 US gal)

### VEHICLE WEIGHTS (MASS)

TABLE848

|                         | kg     | lb      |
|-------------------------|--------|---------|
| Chassis, with hoists    | 26 685 | 58 830  |
| Body, standard          | 9 600  | 21 165  |
| Net Weight              | 36 285 | 79 995  |
| <b>PAYLOAD, maximum</b> | 40 825 | 90 000  |
| Maximum Gross Weight*   | 77 110 | 169 995 |

### FOR UNIT EQUIPPED WITH OPTIONAL BODY LINER PLATES:

|                         |        |         |
|-------------------------|--------|---------|
| Chassis, with hoists    | 26 685 | 58 830  |
| Body, with wear plates  | 14 100 | 31 085  |
| Net Weight              | 40 785 | 89 915  |
| <b>PAYLOAD, maximum</b> | 36 325 | 80 085  |
| Maximum Gross Weight*   | 77 110 | 170 000 |

\* Maximum permissible gross vehicle weight with options, attachments, full fuel tank and payload.

| <b>WEIGHT DISTRIBUTION</b> | Front Axle | Rear Axle |
|----------------------------|------------|-----------|
| Empty %                    | 48         | 52        |
| Loaded %                   | 34         | 66        |

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## CHASSIS - Chassis, Hood and Fenders

Section 1-1

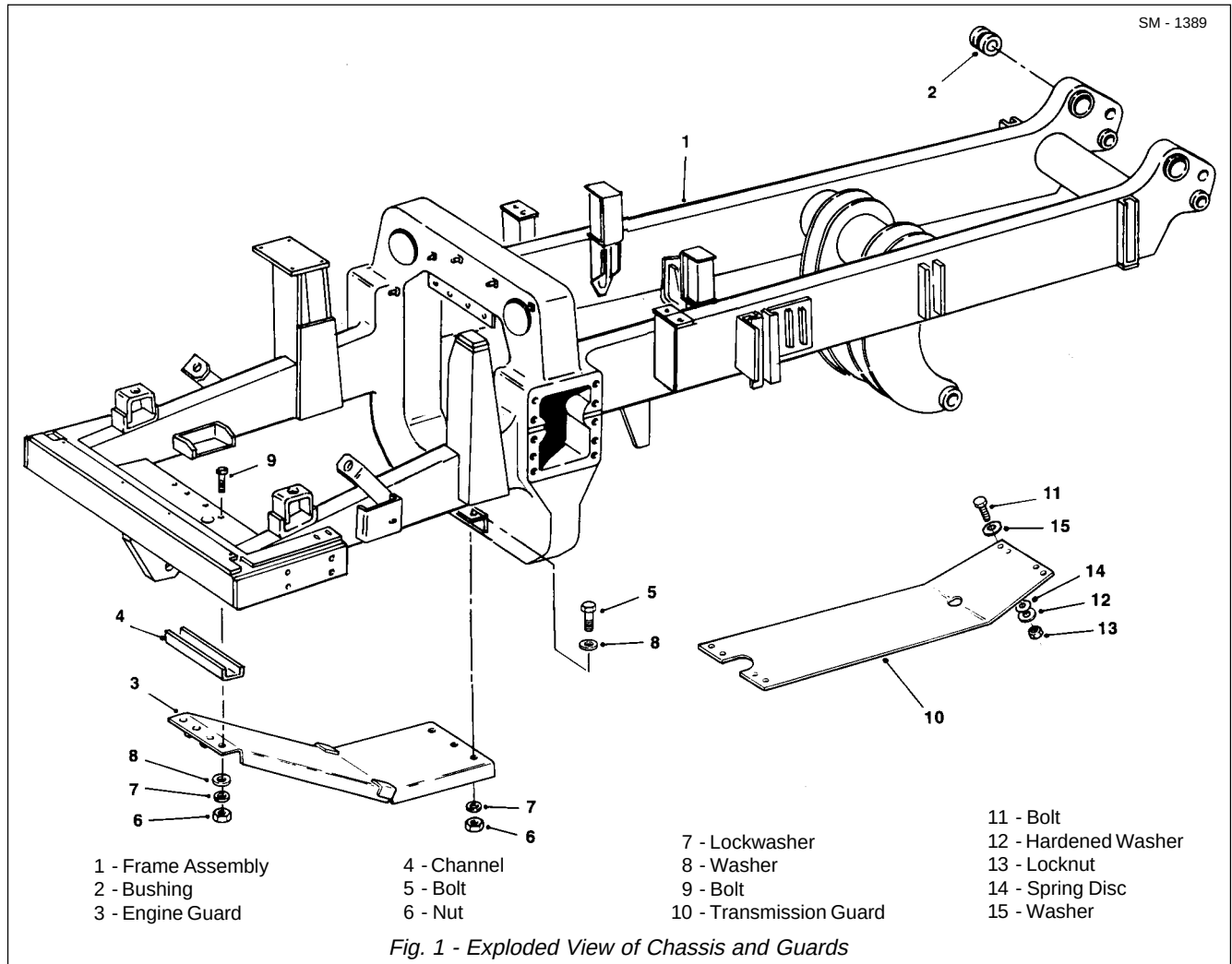


Fig. 1 - Exploded View of Chassis and Guards

### 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 or 4 (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. Turn steering wheel several times to relieve pressure in the steering circuit.

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

3. 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 59-91, 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 1-1

## 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.

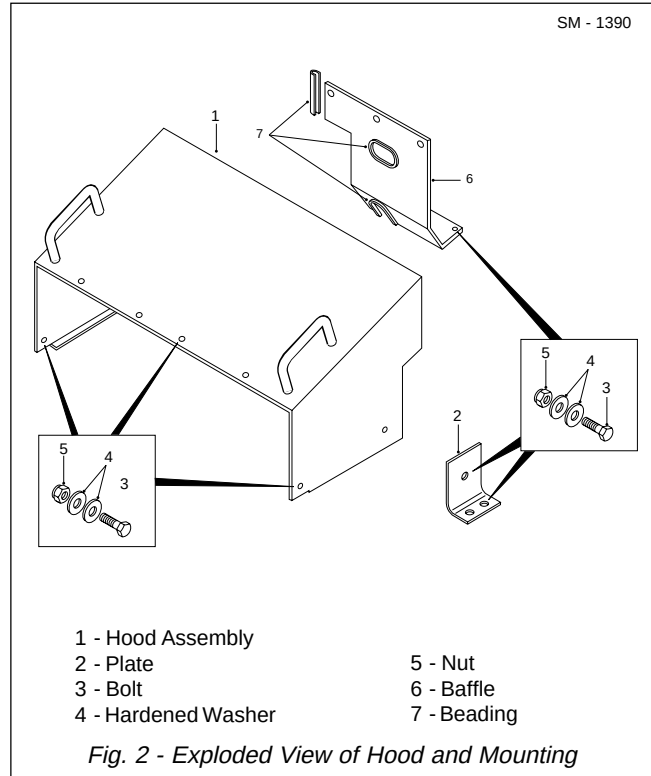
After welding, reconnect all of the above in the reverse order.



#### 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.

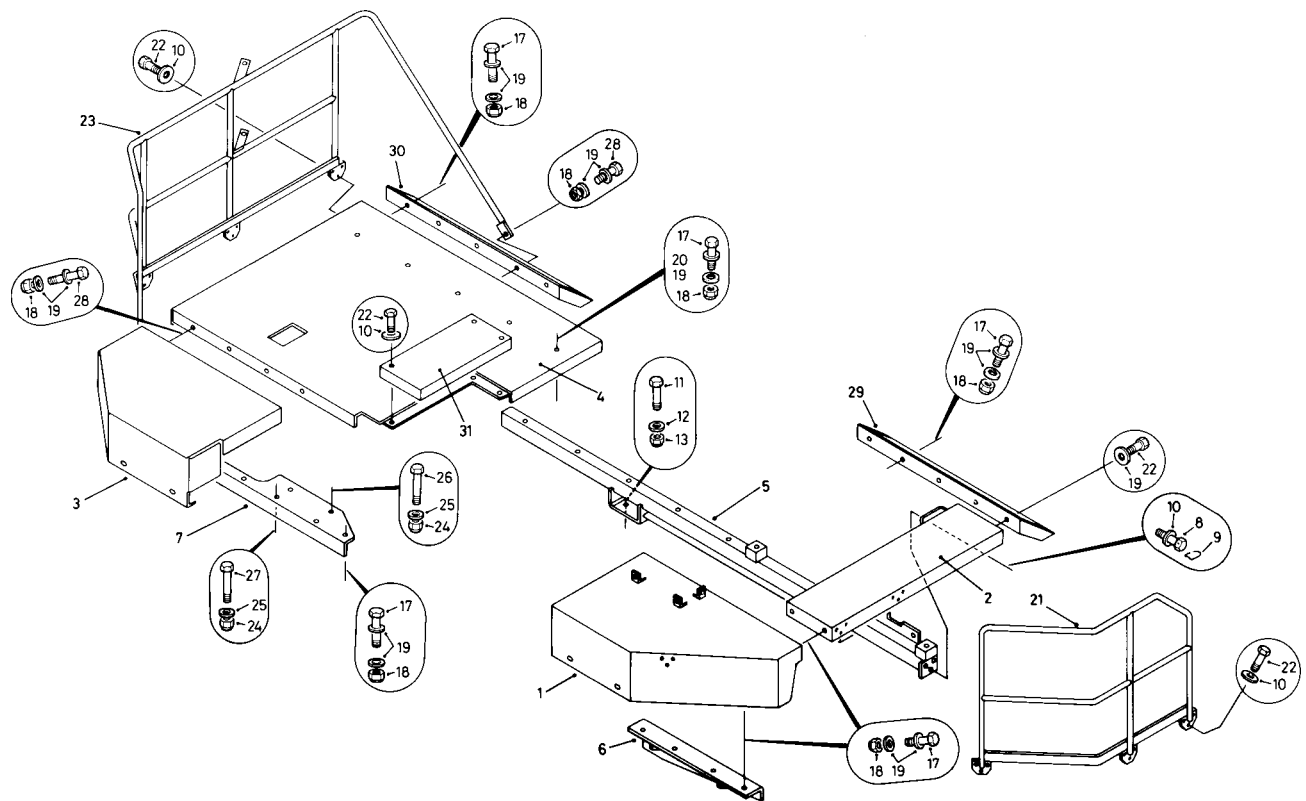
If painting of the actual frame of the unit is required, thoroughly clean the areas to be painted. Apply a primer coat of synthetic red oxide and then a finish coat of synthetic enamel.

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 1-1

SM - 1391



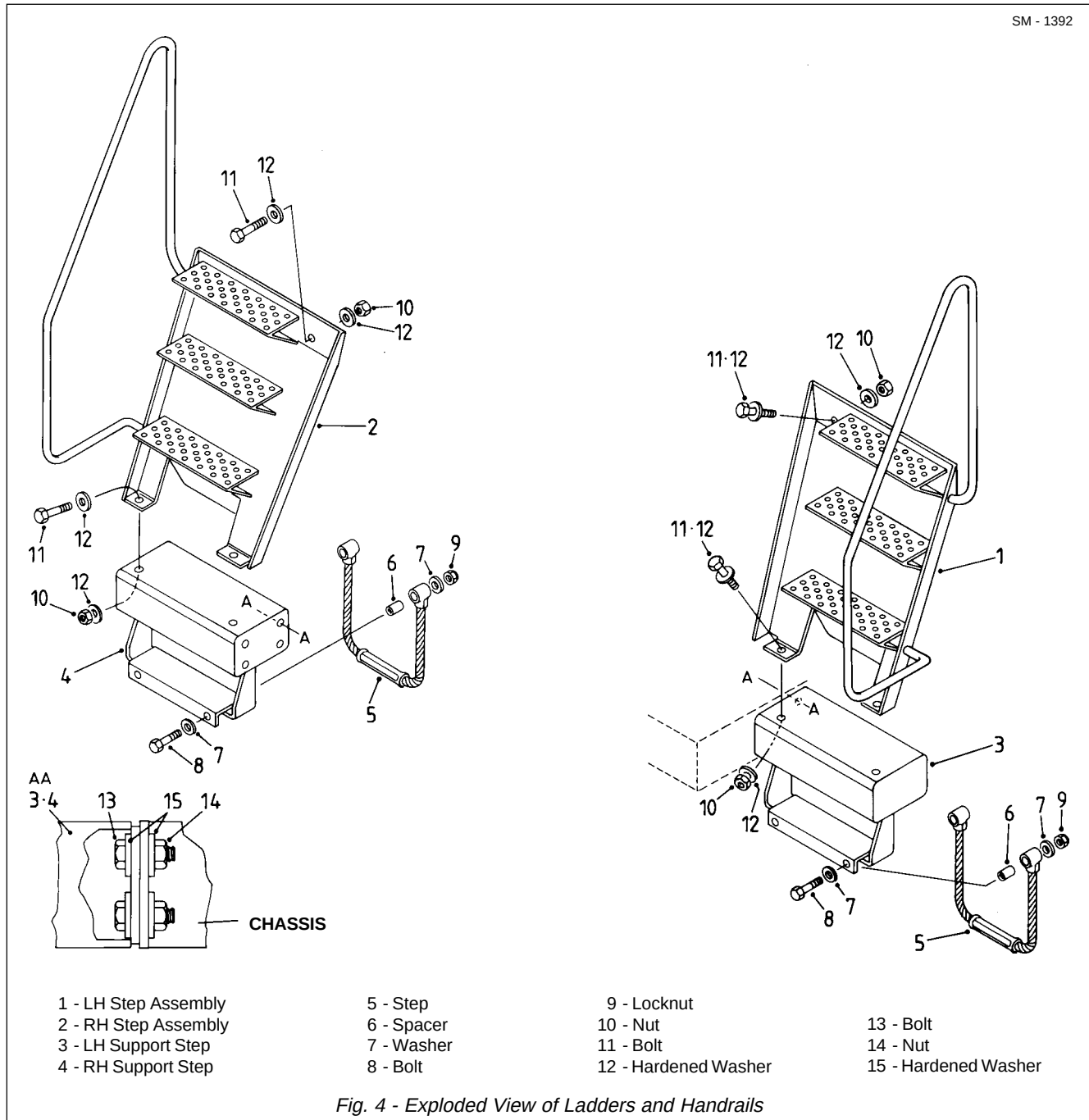
- |                          |                      |                      |               |
|--------------------------|----------------------|----------------------|---------------|
| 1 - LH Fender Assembly   | 9 - Lockwire         | 17 - Bolt            | 25 - Washer   |
| 2 - LH Platform Assembly | 10 - Hardened Washer | 18 - Locknut         | 26 - Bolt     |
| 3 - RH Fender Assembly   | 11 - Bolt            | 19 - Hardened Washer | 27 - Bolt     |
| 4 - RH Platform Assembly | 12 - Washer          | 20 - Tapered Washer  | 28 - Bolt     |
| 5 - Crossmember          | 13 - Locknut         | 21 - LH Handrail     | 29 - Mudguard |
| 6 - Support              | 14 - Bolt            | 22 - Bolt            | 30 - Mudguard |
| 7 - Stiffener            | 15 - Locknut         | 23 - RH Handrail     | 31 - Cover    |
| 8 - Bolt                 | 16 - Hardened Washer | 24 - Nut             |               |

Fig. 3 - Exploded View of Fenders and Mounting

## Chassis - Chassis, Hood and Fenders

### Section 1-1

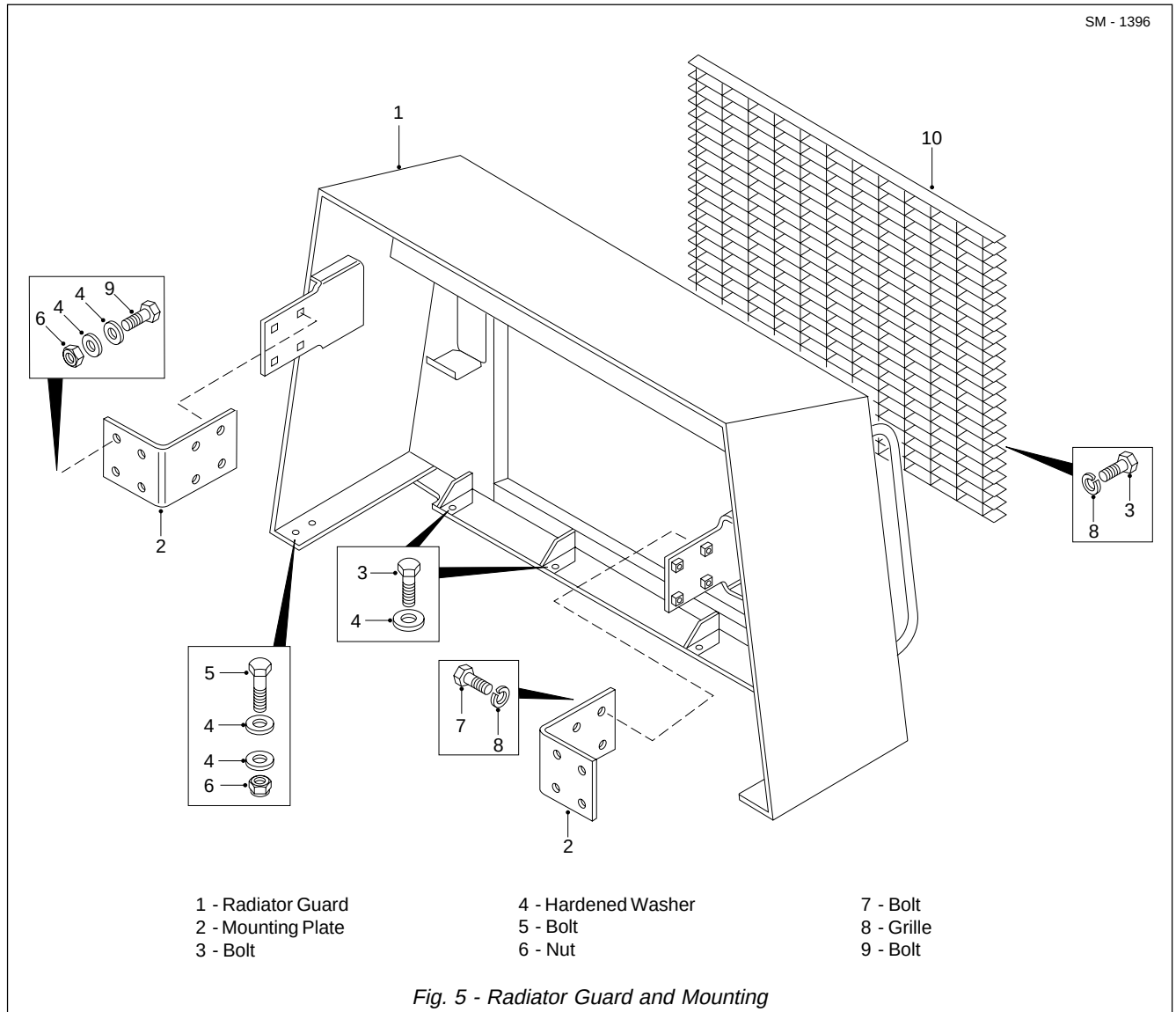
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## Chassis - Chassis, Hood and Fenders

Section 1-1

SM - 1396



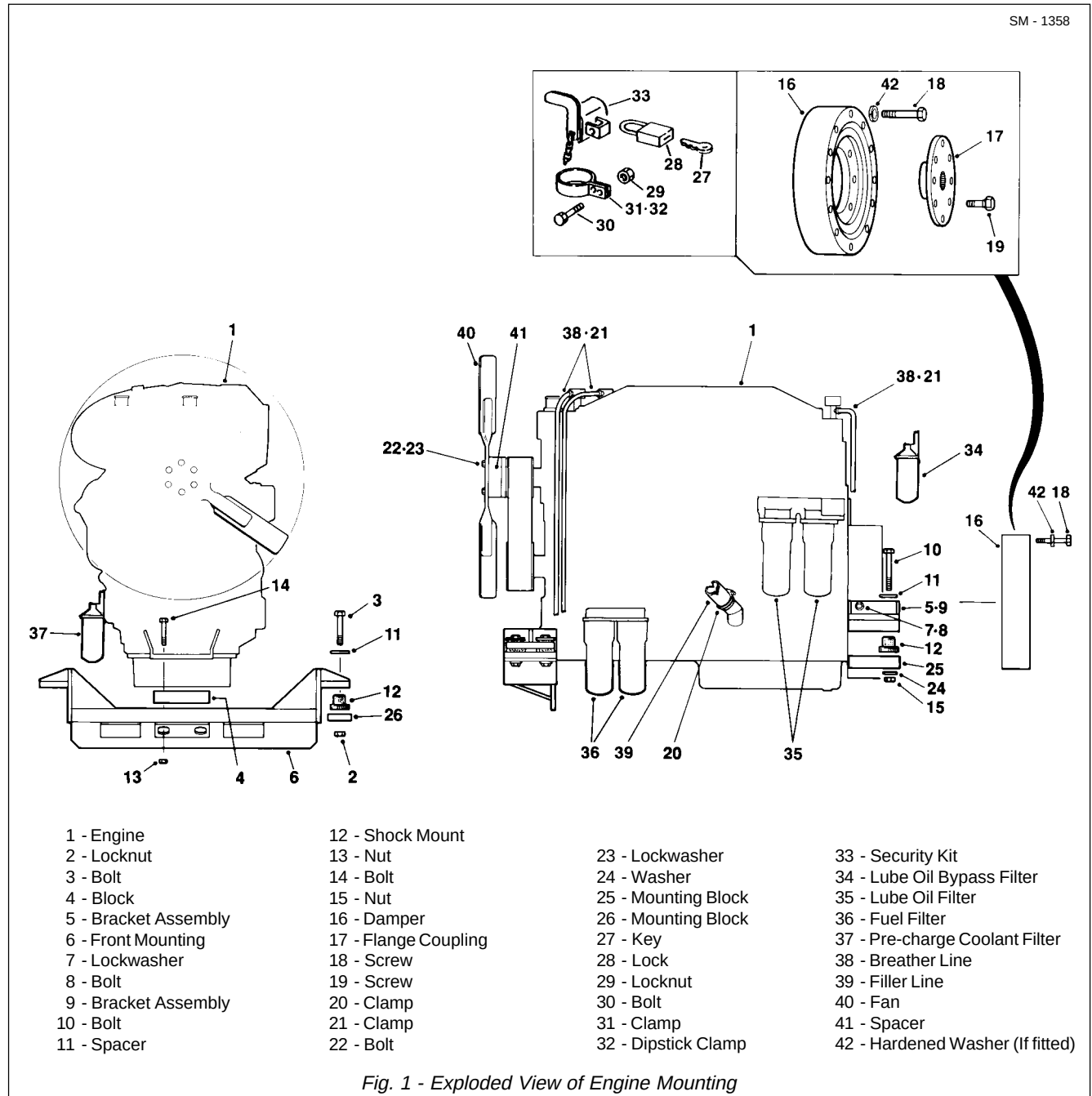
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## ENGINE - Engine and Mounting

Section 2-2

SM - 1358



### DESCRIPTION

Numbers in parentheses refer to Fig. 1.

For engine make, model and specification, refer to Section 0, GENERAL INFORMATION. For detailed engine servicing and repair data refer to the engine manufacturers service manual.

There are two full flow lube oil filters (35), two fuel filters (36) and a pre-charge coolant filter (37) installed on engine (1). A lube oil bypass filter (34) 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 2-2

#### **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. Turn steering wheel several times to relieve pressure in the steering circuit.

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

3. 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.

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.

6. 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.

#### **WARNING**

**Harmful gas. Before disconnecting any air conditioner lines refer to Section 17-10A, 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.**

7. If the truck is equipped with an air conditioning system, evacuate refrigerant from the system and disconnect lines at the compressor. Refer to Section 17-10A, AIR CONDITIONING.

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 16-2, RADIATOR AND MOUNTING.

11. Disconnect and remove air cleaner intake pipe from the engine turbocharger and 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 clamp (20) securing filler line (39) to filler tube mounted off the left hand frame rail. Disconnect filler line (39) 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 driveline from engine coupling and secure clear of engine (1). Refer to Section 7-1, FRONT DRIVELINE.

19. Remove tandem pump from the engine power takeoff. Refer to Section 26-5, 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 brackets on engine (1) assembly and raise lifting equipment to take up the slack.

21. Remove nuts (13) and bolts (14) securing engine

## Engine - Engine and Mounting

Section 2-2

(1) assembly to front mounting (6). Remove nuts (15), washers (24), bolts (10) and spacers (11) securing bracket assemblies (5 & 9) to the frame.

22. 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.

23. If it is necessary to remove front mounting (6) from the frame, remove disc brake oil cooler from front mounting (6). Refer to Section 16-9, DISC BRAKE OIL COOLER.

24. With disc brake oil cooler removed, remove locknuts (2), bolts (3) and spacers (11). Remove front mounting (6) from frame mounts.

25. If necessary, remove shock mounts (12) from bracket assemblies (5 & 9) and front mounting (6). Bracket assemblies (5 & 9) can be removed from engine (1) by removing bolts (8) and lockwashers (7).

26. If necessary, damper (16) can be removed from the flywheel after the power takeoff assembly is removed. Refer to Section 2-12, POWER TAKEOFF.

27. With power takeoff assembly removed, remove bolts (18), hardened washers (42, if fitted) and damper (16) from engine (1). Remove bolts (19) and flange coupling (17) from damper (16).

28. If necessary, remove bolts (22) and lockwashers (23) securing fan (40) and spacer (41) on engine (1). Remove fan (40) and spacer (41).

### INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Inspect shock mounts (12) 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 (16) and flange coupling (17) for wear or damage and replace if necessary.

4. Replace all filters (34, 35, 36 & 37) 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 59-91, 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 spacer (41) and fan (40) on engine (1) and secure with bolts (22) and lockwashers (23). Tighten bolts (22) to a torque of 68 - 81 Nm (50 - 60 lbf ft).

2. Position flange coupling (17) to damper (16) and secure with bolts (19). Position damper (16) assembly to engine flywheel and secure with bolts (18) and hardened washers (42, if fitted). Tighten bolts (18) to a torque of 39 - 47 Nm (29 - 35 lbf ft).

3. Install new shock mounts (12) in front mounting (6) and bracket assemblies (5 & 9). Lubricate shock mounts (12) 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 (6) on the frame and secure with bolts (3), spacers (6) and locknuts (2). Install disc brake oil cooler on front mounting (6). Refer to Section 16-9, DISC BRAKE OIL COOLER.

5. Install bracket assemblies (5 & 9) on engine (1) and secure with bolts (8) and lockwashers (7).

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

7. Secure engine (1) to front mounting (6) with bolts (14) and locknuts (13). Secure bracket assemblies (5 & 9) to frame mounts with bolts (10), spacers (11), washers (24) and nuts (15).

8. Connect front driveline to engine coupling. Refer to Section 7-1, FRONT DRIVELINE.

9. Install tandem pump on power takeoff assembly and secure with mounting hardware. Refer to Section 26-5, TANDEM PUMP.

10. Using suitable lifting equipment, install the radiator

## Engine - Engine and Mounting

### Section 2-2

assembly to the frame and secure with mounting hardware. Refer to Section 16-2, 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 line (39) to filler tube mounted on the left hand frame rail and secure with clamp (20).

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.

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 17-10A, 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.

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 59-2, LUBRICATION SYSTEM. Check the coolant level as described in Section 16-1, COOLING SYSTEM.

25. Fill engine (1) with lube oil specified in Section 59-2, LUBRICATION SYSTEM. Check oil level as described under 'Maintenance'.

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

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.

**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.

## Engine - Engine and Mounting

Section 2-2

### Every 250 Hours or 6 Months

**Fuel Filters (36)** - 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 (36).

Apply a thin film of clean engine oil to the gasket surface of new fuel filters (36) and fill fuel filters (36) with clean fuel specified in Section 59-2, LUBRICATION SYSTEM.

Install new fuel filters (36) on the filter head and tighten by hand until the gasket contacts the filter head surface. Tighten fuel filters (36) 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 Filters (34 & 35)** - Replace the lubricating oil and oil filters.



#### **WARNING**

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

Operate the engine until the water temperature reaches 60° C (140° F). 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.

**Note:** The external appearance of the full flow and bypass filters are the same. However, the full flow filters have 1.5 x 16 in threads and the bypass filter has 1.375 x 16 in threads.

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 (34) and full flow lube oil filters (35). Discard the filters if

they are not required for a failure analysis.

**Note:** Cut all the way around the top of lube oil filter (35) using a pipe cutter or hacksaw. Inspect the pleated paper element for debris. Metal debris can 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 filters with clean lubricating oil prior to installation. The lack of lubrication during the delay until the filters are pumped full of oil is harmful to the engine.

Apply a thin film of clean lubricating oil to the gasket surface of the new filters and fill the filters with clean lubricating oil specified in Section 59-2, LUBRICATION SYSTEM.

Install the filters 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 filters is not recommended, and may result in seal and/or cartridge damage. Tighten filters 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 59-2, LUBRICATION SYSTEM. The oil level should be between the low (L) and high (H) marks on the dipstick.

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

- 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.

## Engine - Engine and Mounting

### Section 2-2

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 (40)** - Visually check fan (40) for cracks, loose rivets, and bent or loose blades. Check fan mounting bolts (22) and tighten if required. Replace fan (40) 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 and place the battery master switch in the 'Off' position.

### 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

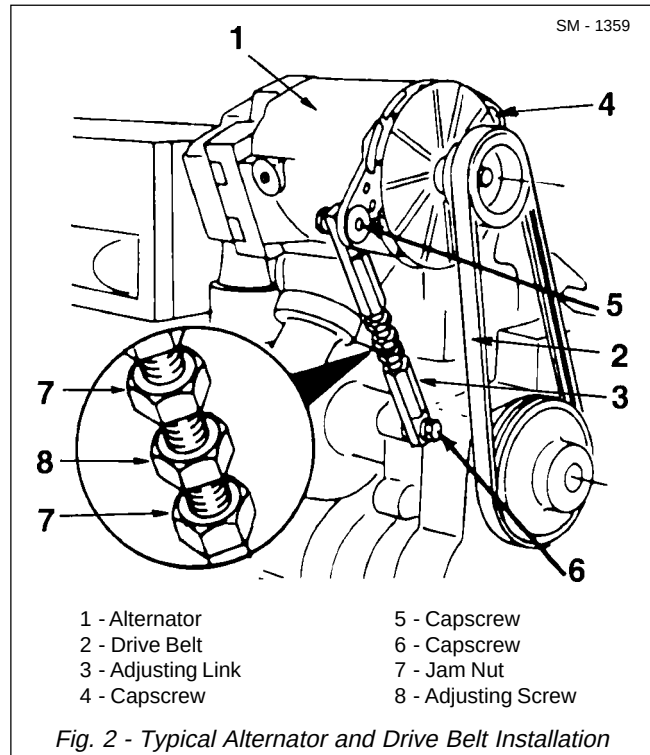


Fig. 2 - Typical Alternator and Drive Belt Installation

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.

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.

## Engine - Engine and Mounting

Section 2-2

### SERVICE TOOLS

Refer to Section 59-10, 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                             | 18       | Bolt            | 39 - 47 | 29 - 35 |
| 1                             | 22       | Bolt            | 68 - 81 | 50 - 60 |
| 2                             | 4, 5 & 6 | Capscrew        | 55      | 40      |
| 2                             | 7        | Jam Nut         | 55      | 40      |
| -                             | -        | Sump Drain Plug | 100     | 75      |

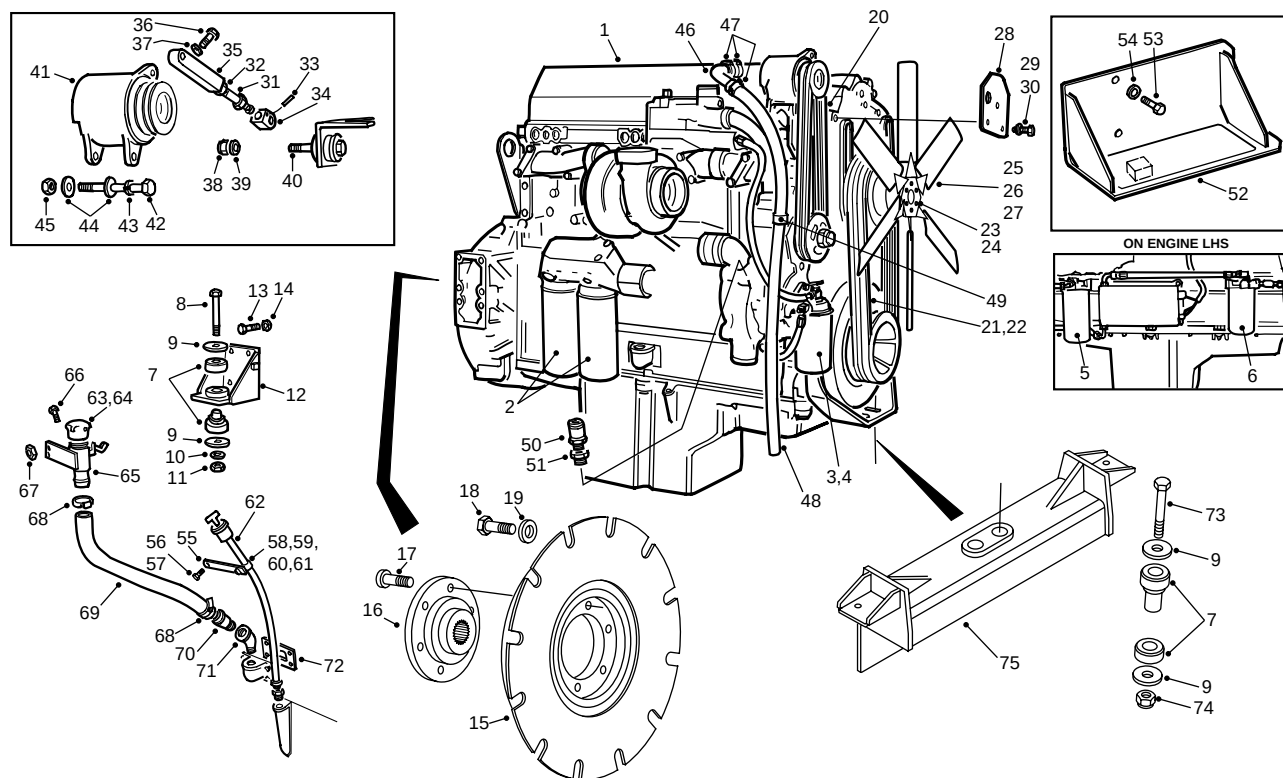
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## ENGINE - Engine and Mounting (Series 60)

Section 2-2

SM - 1674



- |                           |                     |                    |                        |
|---------------------------|---------------------|--------------------|------------------------|
| 1 - Engine                | 20 - Poly 'V' Belt  | 39 - Washer        | 58 - Bolt              |
| 2 - Oil Filter            | 21 - 'V' Belt       | 40 - Bolt          | 59 - Lockwasher        |
| 3 - Coolant Filter        | 22 - 'V' Belt       | 41 - Alternator    | 60 - Nut               |
| 4 - Filter                | 23 - Bolt           | 42 - Bolt          | 61 - Clip              |
| 5 - Primary Fuel Filter   | 24 - Lockwasher     | 43 - Lockwasher    | 62 - Dipstick Assembly |
| 6 - Secondary Fuel Filter | 25 - Fan            | 44 - Washer        | 63 - Filler Cap        |
| 7 - Isolation Mount       | 26 - Spacer         | 45 - Locknut       | 64 - Gasket            |
| 8 - Bolt                  | 27 - Spacer         | 46 - Tube Assembly | 65 - Oil Filler        |
| 9 - Snubbing Washer       | 28 - Plate          | 47 - Clip          | 66 - Bolt              |
| 10 - Washer               | 29 - Washer         | 48 - Breather Line | 67 - Locknut           |
| 11 - Locknut              | 30 - Bolt           | 49 - Clamp         | 68 - Clamp             |
| 12 - Rear Mount           | 31 - Screw Assembly | 50 - Connector     | 69 - Filler Hose       |
| 13 - Bolt                 | 32 - Locknut        | 51 - Bushing       | 70 - Pipe              |
| 14 - Lockwasher           | 33 - Pin            | 52 - Step          | 71 - Elbow             |
| 15 - Damper               | 34 - Link           | 53 - Bolt          | 72 - Gasket            |
| 16 - Flange Coupling      | 35 - Link           | 54 - Lockwasher    | 73 - Bolt              |
| 17 - Bolt                 | 36 - Bolt           | 55 - Plate         | 74 - Locknut           |
| 18 - Bolt                 | 37 - Lockwasher     | 56 - Bolt          | 75 - Front Mount       |
| 19 - Washer               | 38 - Locknut        | 57 - Lockwasher    |                        |

Fig. 1 - Engine and Mounting

### DESCRIPTION

Numbers in parentheses refer to Fig. 1.

For engine make, model and specification, refer to Section 0, GENERAL INFORMATION. For engine servicing and repair data refer to the engine manufacturers service manual.

The engine is mounted to the frame at three points by a mounting bracket (75) at the front of engine (1) and two rear mounts (12). Rubber isolation mounts (7)

through engine mounts provide sufficient flexibility to absorb varying engine vibration and torsional loads.

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

## Engine - Engine and Mounting (Series 60)

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through the elements and out through another passage in the filter adaptor.

Engine coolant filter (3) and conditioner is a compact bypass type unit with a replaceable spin-on type element mounted on the gear case cover at the front right hand side of engine (1). Refer to Section 16-1, COOLING SYSTEM.

There are two spin-on type fuel filters mounted on the left hand side of engine (1). Primary fuel filter (5) is in the fuel flow and acts as a strainer and secondary fuel filter (6) filters the fuel after having passed through primary fuel filter (5). Although they are not marked as such, the threaded sleeves that accept the cartridges are different sizes to prevent mismatching. Primary fuel filter (5) has a 1 x 12 in thread whereas secondary fuel filter (6) has a 13/16 x 12 in thread. The word 'Primary' or 'Secondary' is cast into the top of the respective adaptor.

### DETROIT DIESEL ELECTRONIC CONTROL (DDEC III)

#### Description

Refer to Fig. 2.



#### WARNING

**Before any welding is done on a machine equipped with the DDEC III system, disconnect the following in this order:**

**Battery earth cable, battery supply cable, alternator earth cables, alternator supply cables, transmission black box (Est-25) connector, ECM interface harness connector (30 pin RHS), ECM power harness connector (5 pin RHS) and ECM sensor harness connector (30 pin LHS). Turn off battery master switch before disconnecting any components.**

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

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

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

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

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

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

The EUI performs four functions:

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

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

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

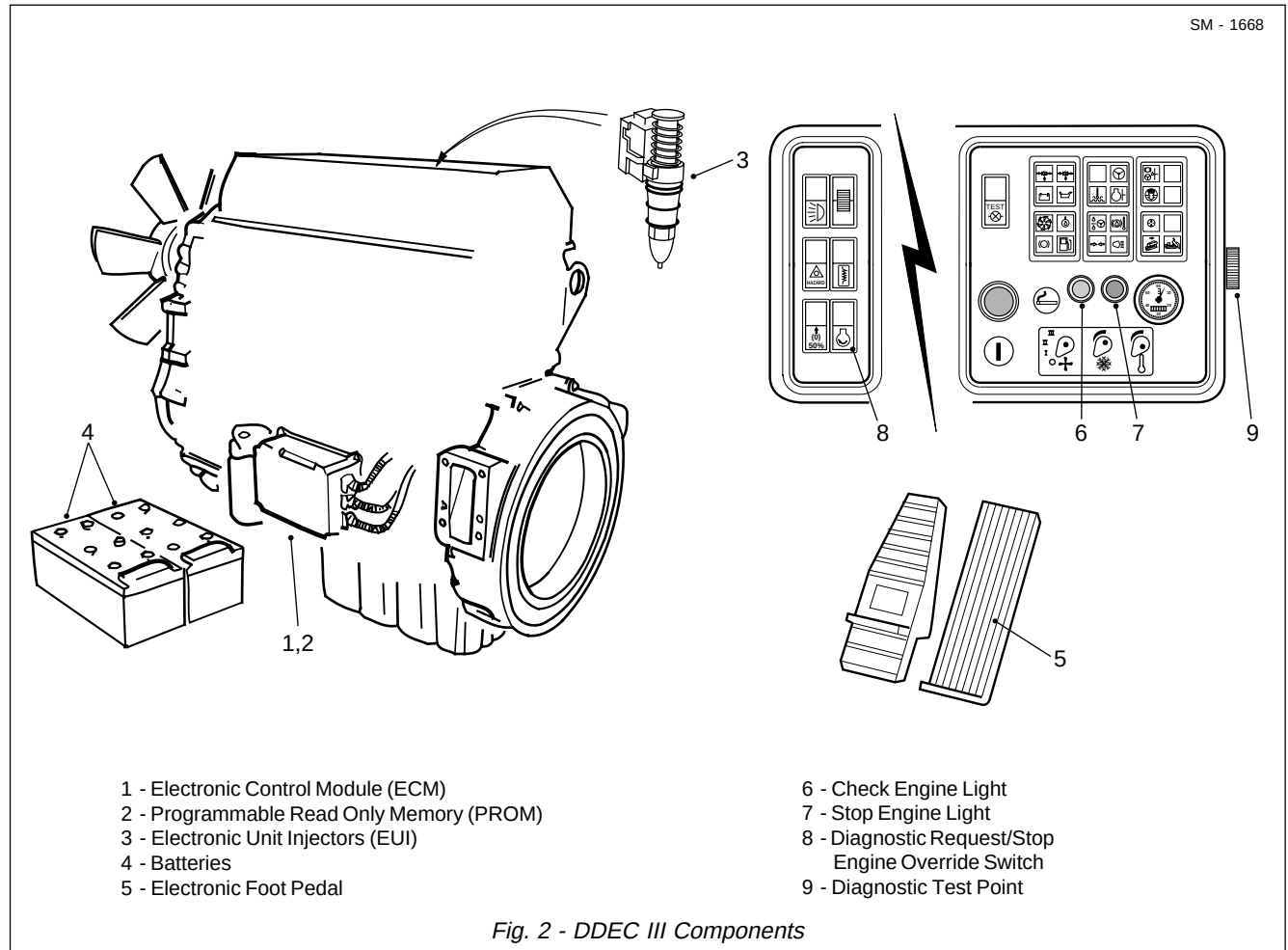
**4. Batteries** - Two 12 volt maintenance free batteries supply the machine with electrical power to operate all electrical components.

**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.

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**Note:** The engine MUST be started with foot 'OFF' the electronic foot pedal.

**6. Check Engine Light (Amber)** - 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.

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

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

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

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

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

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

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

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

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#### Operation

Numbers in parentheses refer to Fig. 2.

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

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

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

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

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

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

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

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



#### WARNINGS

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



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

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

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

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### DDEC III DIAGNOSTIC CODES

TABLE704

| ERROR<br>CODE No. | DESCRIPTION                                   | ERROR<br>CODE No. | DESCRIPTION                                |
|-------------------|-----------------------------------------------|-------------------|--------------------------------------------|
| 11                | PTO input low                                 | 46                | Battery voltage low                        |
| 12                | PTO input high                                | 47                | Fuel press high                            |
| 13                | Coolant level circuit low                     | 48                | Fuel press low                             |
| 14                | Intercooler, coolant or oil temp circuit high | 52                | A/D conversion fail                        |
| 15                | Intercooler, coolant or oil temp circuit low  | 53                | EEPROM write or non volatile fail          |
| 16                | Coolant level circuit high                    | 54                | Vehicle speed sensor fault                 |
| 17                | Bypass position circuit high                  | 55                | J1939 data link fault                      |
| 18                | Bypass position circuit low                   | 56                | J1587 data link fault                      |
| 21                | TPS circuit high                              | 57                | J1922 data link fault                      |
| 22                | TPS circuit low                               | 58                | Torque overload                            |
| 23                | Fuel temp circuit high                        | 61                | Injector response time long                |
| 24                | Fuel temp circuit low                         | 62                | Digital output open or short to battery    |
| 25                | No codes                                      | 63                | PWM open or short to battery               |
| 26                | Auxiliary shutdown #1 or #2 active            | 64                | Turbo speed circuit failed                 |
| 27                | Air temp circuit high                         | 67                | Coolant press circuit high or low          |
| 28                | Air temp circuit low                          | 68                | IVS switch fault, open or grounded circuit |
| 31                | Aux output short or open circuit (high side)  | 71                | Injector response time short               |
| 32                | Stop engine light short or open circuit       | 72                | Vehicle overspeed                          |
| 33                | Boost press circuit high                      | 75                | Battery voltage high                       |
| 34                | Boost press circuit low                       | 76                | Engine overspeed with engine brake         |
| 35                | Oil press circuit high                        | 81                | Oil level or crankcase press circuit high  |
| 36                | Oil press circuit low                         | 82                | Oil level or crankcase press circuit low   |
| 37                | Fuel press circuit high                       | 83                | Oil level or crankcase press high          |
| 38                | Fuel press circuit low                        | 84                | Oil level or crankcase press low           |
| 41                | Too many SRS (missing TRS)                    | 85                | Engine overspeed                           |
| 42                | Too few SRS (missing SRS)                     | 86                | Water pump or baro press circuit high      |
| 43                | Coolant level low                             | 87                | Water pump or baro press circuit low       |
| 44                | Intercooler, coolant or oil temp high         | 88                | Coolant press low                          |
| 45                | Oil press low                                 |                   |                                            |

### REMOVAL

Numbers in parentheses refer to Fig. 1.

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



#### WARNINGS

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



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

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

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.

6. 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.

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#### **WARNING**

**Harmful gas. Before disconnecting any air conditioner lines refer to Section 17-10A, 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.**

7. If the truck is equipped with an air conditioning system, evacuate refrigerant from the system and disconnect lines at the compressor. Refer to Section 17-10A, AIR CONDITIONING.

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). Cap open line ends and fittings.

10. Using suitable lifting equipment, carefully remove the radiator assembly from the vehicle. Refer to Section 16-2, RADIATOR AND MOUNTING.

11. Disconnect and remove air cleaner intake pipe from the engine turbocharger and 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). Cap open line ends and fittings.

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). Cap open line ends and fittings.

16. Slacken clamp (68) securing filler hose (69) to filler tube (65). Disconnect filler hose (69) 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 driveline from engine coupling and secure clear of engine (1). Refer to Section 7-1, FRONT DRIVELINE.

19. Remove tandem pump from the engine power takeoff. Refer to Section 26-5, 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 brackets on engine (1) assembly and raise lifting equipment to take up the slack.

21. Remove locknuts (74), snubbing washers (9) and bolts (73) securing engine (1) assembly to front mounting (75). Remove locknuts (11), washers (10), snubbing washers (9) and bolts (8) securing rear mounting brackets (12) to the frame.

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

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.

## DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. If required, remove bolts (13) and lockwashers (14) securing rear mounts to engine (1). Remove rear mounts (12).

2. If required, remove rubber isolation mounts (7) from rear mounts (12).

3. Remove bolts (23) and lockwashers (24) securing fan (25) to engine (1) then remove fan (25) and spacers (26 & 27).

4. Loosen the fan hub mounting bolts and turn the adjusting rod anticlockwise enough to allow slack in poly 'V' belts (21 & 22). Remove poly 'V' belts (21 & 22).

5. If equipped with air conditioning, loosen compressor drive belt and remove compressor from engine (1). Refer to Section 17-10A, AIR CONDITIONING.

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6. Loosen alternator mounting bolt (42) to allow slack in 'V' belts (20). Remove 'V' belts (20).

**Note:** Adjuster screw and link assembly (31 thru 35) will have been released when removing radiator assembly from the vehicle.

7. Remove bolt (36) and lockwasher (37) securing screw and link assembly (31 thru 35) to alternator (41). Support alternator (41) and remove locknut (45), washers (44), lockwasher (43) and bolt (42). Remove alternator (41) from engine (1).

8. If necessary, damper (15) can be removed from the flywheel after the power takeoff assembly is removed. Refer to Section 2-12, POWER TAKEOFF.

9. With power takeoff assembly removed, remove bolts (18), washers (19) and damper (15) from engine (1). Remove bolts (17) and flange coupling (16) from damper (15).

10. Remove bolts (56 & 58), lockwashers (57 & 59), nut (60), clip (61) and plate (55) supporting dipstick assembly (62) to engine (1). Remove dipstick assembly (62) from engine (1).

11. If required, remove filler pipe (70) and filler hose (69) from engine (1).

12. If required, remove bolts (53), lockwashers (54) and step (52) from LHS of engine (1).

13. Remove and discard filters (2, 3, 4, 5 & 6) from engine (1), as described in 'Maintenance'. Cover engine inlet ports to prevent entry of dirt.

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

### INSPECTION

Numbers in parentheses refer to Fig. 1.

1. Inspect rubber isolation mounts (7) for damage and replace if required.

2. Check rear mounts (12), front mounting bracket (75) and mounting brackets on the front frame for cracks and/or damage. Repair or replace as necessary.

3. Inspect engine damper (15) and flange coupling (16) for damage and repair or replace as required.

### ASSEMBLY

Numbers in parentheses refer to Fig. 1.

**Note:** Tighten all fasteners without special torques specified to standard torques listed in Section 59-91, STANDARD BOLT AND NUT TORQUE SPECIFICATIONS.

1. Remove covers from engine filter ports and install new filters (2, 3, 4, 5 & 6) on engine (1), as described in 'Maintenance'.

2. If removed, secure step (52) assembly to engine (1) with bolts (53) and lockwashers (54).

3. If removed, connect filler pipe (70) and filler hose (69) to elbow (71) on engine (1).

4. Install dipstick assembly (62) on engine (1) and secure with plate (55), clip (61), bolts (56 & 58), lockwashers (57 & 59) and nut (60).

5. Install damper (15) to rear of engine (1) and secure with bolts (18) and washers (19). Install flange coupling (16) to damper (15) and secure with bolts (17).

6. Position alternator (41) on engine mounting bracket and align the holes in the alternator mounting flanges with the tube in the bracket. Secure alternator (41) in position with bolt (42), lockwasher (43), washers (44) and locknut (45). Tighten bolt (42) finger tight at this stage.

7. Install adjuster screw and link assembly (31 thru 35) to alternator (41) and secure with bolt (36) and lockwasher (37). Tighten bolt (36) finger tight at this stage.

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

8. Install 'V' belts (20) in the grooves of alternator (41) and accessory drive pulley.

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

9. If equipped with air conditioning, install air conditioner compressor and drive belt to engine (1). Refer to Section 17-10A, AIR CONDITIONING.

10. Install poly 'V' belts (21 & 22) to the fan pulley and crankshaft pulley.

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11. Adjust poly 'V' belts (21 & 22) by turning the adjusting screw clockwise until the correct tension is obtained. Refer to 'Drive Belt Adjustments'. When correct tension is obtained tighten fan hub mounting bolts to a torque of 101 - 126 Nm (75 - 93 lbf ft).

12. Position spacers (26 & 27) and fan (25) to fan pulley on engine (1) and secure with bolts (23) and lockwashers (24). Tighten bolts (23) in a star shaped pattern to a torque of 34 Nm (25 lbf ft).

13. If removed, install rubber isolation mounts (7) to front mounting bracket (75).

14. Secure rear mounts (12) to engine (1) with bolts (13) and lockwashers (14) as identified at disassembly. Tighten bolts (13) to a torque of 150 Nm (110 lbf ft). If removed, install rubber isolation mounts (7) in rear mounts (12).

### INSTALLATION

Numbers in parentheses refer to Fig. 1.

**Note:** Tighten all fasteners without special torques specified to standard torques listed in Section 59-91, 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 frame.

2. Secure engine (1) assembly to rear mounts on the frame with bolts (8), snubbing washers (9) washers (10) and locknuts (11). Secure engine (1) assembly to front mounting bracket (75) with bolts (73), snubbing washers (9) and locknuts (74).

3. Connect driveline to the engine coupling. Refer to Section 7-1, FRONT DRIVELINES.

4. Install tandem pump on power takeoff assembly and secure with mounting hardware. Refer to Section 26-5, TANDEM PUMP.

5. Using suitable lifting equipment, install the radiator assembly to the frame and secure with mounting

hardware. Refer to Section 16-2, RADIATOR AND MOUNTING.

**Note:** When installing radiator support bracket to engine (1), locate bolt (40) through link (34) then secure with snubbing washer (39) and locknut (38). Tighten locknut (38) to a torque of 165 Nm (122 lbf ft).

6. Adjust 'V' belts (22) by loosening locknut (32) and turning screw assembly (31) clockwise until the correct tension is obtained (refer to 'Drive Belt Adjustments'). When correct tension is obtained tighten locknut (32).

7. Tighten bolt (42) securing alternator (41) to engine mounting bracket and bolt (36) securing link (35) assembly to alternator (41) to a torque of 81 - 95 Nm (60 - 70 lbf ft).

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

9. Install air cleaner intake pipe and exhaust piping to engine turbocharger. Tighten mounting clamps securely.

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

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

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

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

14. Connect filler hose (69) to filler tube (65) and secure with clamp (68).

15. If the vehicle is equipped with air conditioning, connect the 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 17-10A, AIR CONDITIONING.

16. Using suitable lifting equipment, install radiator guard assembly to the frame. Secure with the required mounting hardware and connect electrical connections as identified at removal.

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17. Using suitable lifting equipment, install hood assembly into position on the vehicle. Secure hood assembly with mounting hardware removed at removal.

18. Connect battery positive connections to battery terminal posts. Connect battery earth connections to battery terminal posts.

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

20. Fill the cooling system with coolant specified in Section 59-2, LUBRICATION SYSTEM. Check the coolant level as described in Section 16-1, COOLING SYSTEM.

21. Fill the engine with lube oil specified in Section 59-2, LUBRICATION SYSTEM. Check oil level as described under 'Maintenance'.

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

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

### MAINTENANCE

Numbers in parentheses refer to Fig. 1.

**Note:** Carry out the following maintenance procedures in conjunction with additional procedures listed in Section 59-2, LUBRICATION SYSTEM.

#### Every 10 Hours (Daily)

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

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

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

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

#### Every 250 Hours

**Engine (1):** Drain engine oil and refill. Refer to Section 59-2, LUBRICATION SYSTEM for oil specification.

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

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

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

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

3. Lightly coat new oil filter (2) seal with clean engine oil as specified in Section 59-2, LUBRICATION SYSTEM.

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

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

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

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

7. After the engine has been stopped long enough (approximately 20 minutes) for the oil from various parts of engine (1) to drain back to the crankcase, check oil level and add oil to bring it to the proper level on the dipstick. Refer to Section 59-2, LUBRICATION SYSTEM for oil specification.

**Fuel Filters (5 & 6):** Replace primary fuel filter (5) and secondary fuel filter (6) as follows:

**Note:** There is a fuel system shut off valve on the discharge side of secondary fuel filter (6). Closing this valve will prevent loss of fuel prime at time of filter replacement.

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1. Close shut off valve at secondary fuel filter (6) and, using filter wrench, remove and discard both fuel filters (5 & 6) from engine (1).

2. Fill the replacement filters and coat the gaskets slightly with clean fuel oil as specified in Section 59-2, LUBRICATION SYSTEM.

3. Start new primary fuel filter (5) on the filter adaptor and tighten it by hand until the gasket contacts the adaptor fully with no side movement of the filter evident. Tighten an additional 1/2 of a turn.

**Note:** Mechanical tightening of fuel filters (5 & 6) is not recommended, and may result in seal and/or cartridge damage. Tighten fuel filters by hand only.

4. Repeat step 3 for secondary fuel filter (6).

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

**Coolant Filter (3):** Check condition of coolant inhibitor as described in Section 16-1, COOLING SYSTEM. Replace coolant filter (3) as follows:

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

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

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

3. Lightly coat new coolant filter (3) seal with clean engine oil as specified in Section 59-2, LUBRICATION SYSTEM.

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

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

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

6. Start the engine and check for leaks. If any leaks are noted, have them corrected. Add coolant as required. Refer to Section 16-1, COOLING SYSTEM.

### Drive Belt Adjustments

**Every 50 Hours:** Check all drive belt tensions and adjust if required. If vehicle is equipped with air conditioning, compressor belts should be checked and adjusted as described in Section 17-10A, AIR CONDITIONING.

**Every 2 000 Hours:** Replace all drive belts.

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

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

#### Fan - Poly 'V' Belt

Belt Tension 'New' - 3 340 N (750 lbf)

Belt Tension 'Used' - 2 450 - 3 340 N (550 - 750 lbf)

#### Alternator - 'V' Belt

Belt Tension 'New' - 556 N (125 lbf)

Belt Tension 'Used' - 445 N (100 lbf)

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

Belts should be neither too tight nor too loose. Belts that are too tight impose excess loads on the crankshaft, fan and alternator bearings, shortening both belt and bearing life. Excessively overtightened belts can result in crankshaft breakage. A loose belt will slip and may cause damage to accessory components.

### SPECIAL TOOLS

Refer to Section 59-10, 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.

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