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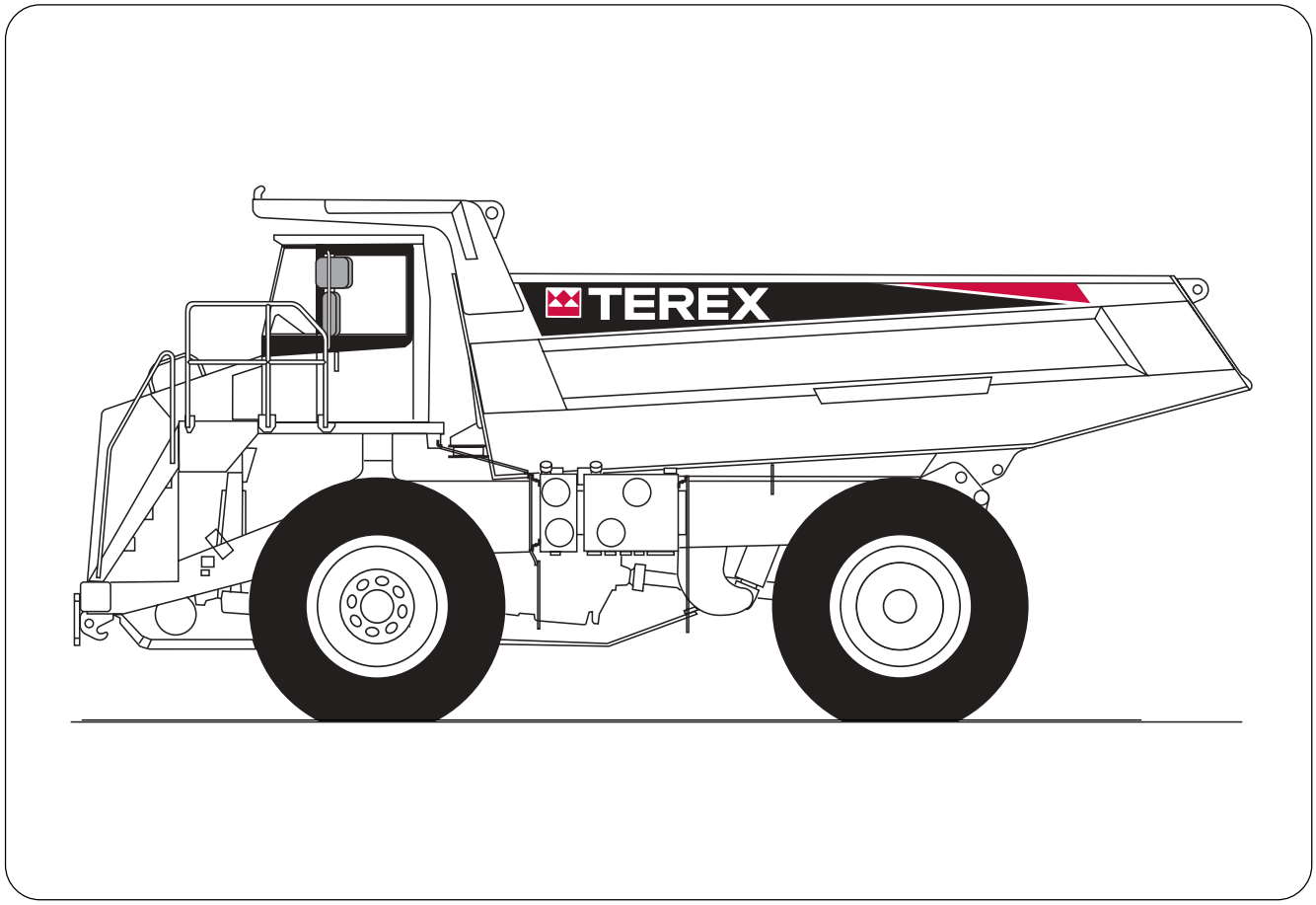
TEREX

TR70
Off-Highway Truck
Maintenance Manual



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TEREX EQUIPMENT LIMITED,
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REF. NO. SM789

SM1999 Rev 8.03-06

TEREX

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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TEREX

IMPORTANT SAFETY NOTICE

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

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

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

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

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

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

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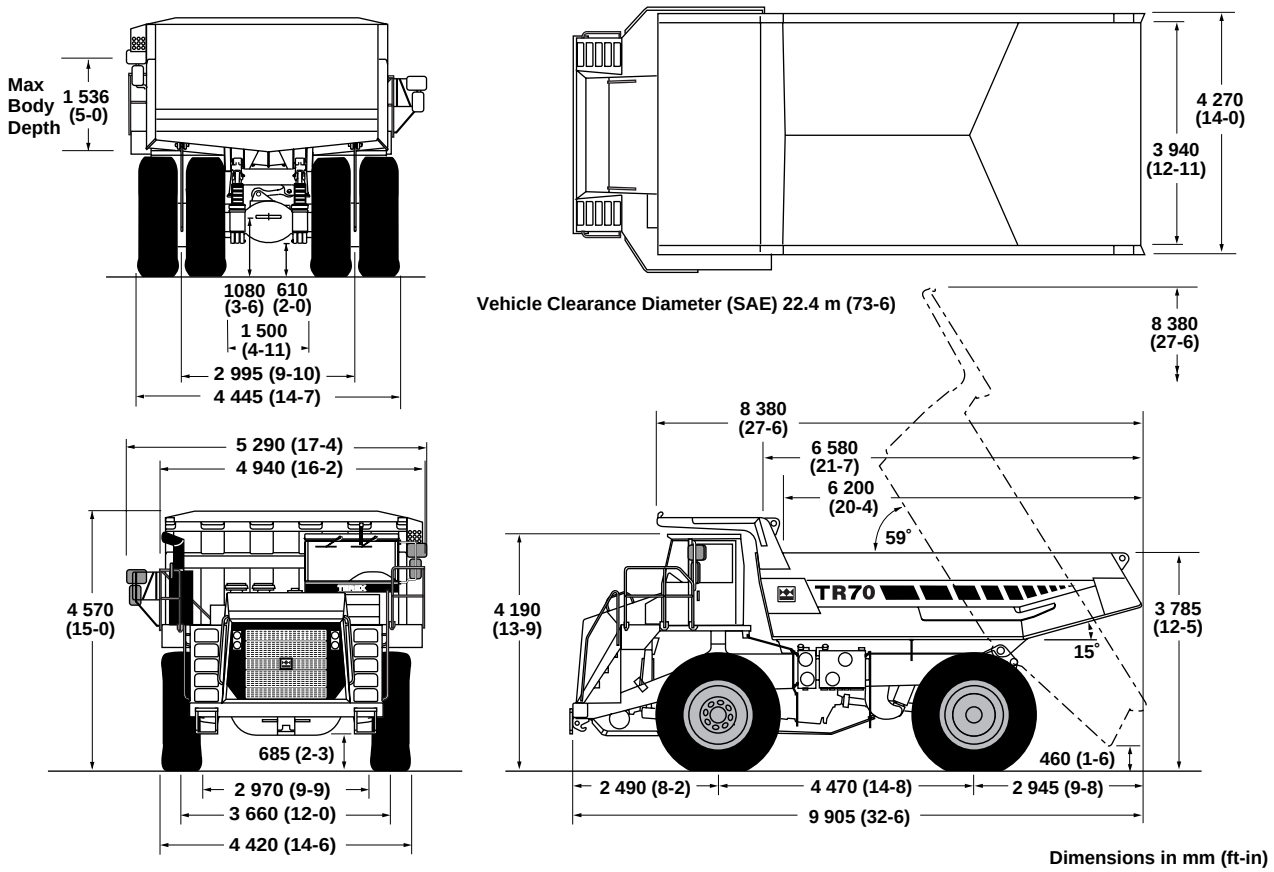

Fig. 1 - Machine Dimensions

ENGINE

Make/Model ..... Detroit Diesel 12V 2000
Type ..... 4 Cycle, Turbocharged/Aftercooled. Electronic Management
Gross Power @ 2 100 rev/min ..... 567 kW (760 hp, 770 PS)
Net Power @ 2 100 rev/min ..... 522 kW (700 hp, 710 PS)

Note: Power ratings to SAE J1995 Jun 95. Engine emission meets USA EPA/CARB MOH 40 CFR 89 and EU NRMM (non-road mobile machinery directive).

Maximum Torque ... 3 118 Nm (2 300 lbf ft) @ 1 200 rev/min
Number of Cylinders/Configuration ..... 12, V
Bore x Stroke ..... 130 x 150 mm (5.11 x 5.91 in)
Total Displacement ..... 24 litres (1 464 in³)
Starting ..... Electric
Maximum Speed, Full Load ..... 2 100 rev/min
Maximum Speed, No Load ..... 2 250 rev/min
Idle Speed ..... 750 rev/min
Safe Operating Angle ..... 30°/60% Grade

TRANSMISSION

Make/Model ..... Allison M6600AR automatic electronic control with soft shift feature. Remote mounted in the frame. Integral TC 682 torque converter and planetary gearing. Six speeds forward, two reverse. Automatic converter lockup action in all speed ranges. With body up, gear range is limited to 1st forward only. Downshift inhibitor. Intregal hydraulic retarder.

Speeds With 24.00 R 35 Tyres						
Forward						
Gear	1	2	3	4	5	6
Ratio	4.00	2.68	2.01	1.35	1.00	0.67
km/h	9.5	14.2	18.9	28.2	38.1	57.0
mile/h	5.9	8.8	11.8	17.5	23.7	35.5
Reverse						
Gear	1	2				
Ratio	5.12	3.46				
km/h	7.4	11.0				
mile/h	4.6	6.8				

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	3.73:1	3.15:1
Planetary	5.80:1	5.80:1
Total Reduction	21.63:1	18.27:1

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 ..... 235 mm (9.25 in)
- Rear ..... 193 mm (7.6 in)

Maximum Rear Axle Oscillation ..... ± 7.5 Degrees

WHEELS AND TYRES

Wheel Rim Width ..... 17 in
Standard Tyres (Front & Rear) ..... 24.00 R 35** Radial
Optional Tyres (Front & Rear) ..... 24.00-35 (48 PR) E-3

Note: 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 ..... 110 bar (1 600 lbf/in²)
Rear Brake Circuit Pressure ..... 52 bar (750 lbf/in²)
Accumulators:
- Nitrogen Precharge Pressure ..... 55 bar (800 lbf/in²)

Front:
- Type ..... Dry Disc with 2 callipers per wheel
- Disc Diameter ..... 710 mm (28 in)
- Pad Area, Total ..... 2 788 cm² (432 in²)

Rear:
- Type ..... Oil cooled, multiple friction discs, completely sealed from dirt and water.
- Braking Surface, Total ..... 67 390 cm² (10 445 in²)

Parking

Application of rear brakes by springs in brake disc pack. Hydraulically released.
Hold-off Pressure ..... 83 bar (1 200 lbf/in²)

Retardation

Modulated lever control of rear disc pack. . 670 kW (900 hp) continuous.
Retarder Actuation Pressure ..... up to 33 bar (480 lbf/in²)

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 meets SAE J53.

Relief Pressure ..... 210 bar (3 000 lbf/in²)
Steering Cylinders ..... Double Acting, Single Stage
Accumulator:
- Nitrogen Precharge Pressure ..... 55 bar (800 lbf/in²)

Steering Angle (Left and Right) ..... 42°
Pump:
- Type ..... Piston
- Capacity at 2 100 rev/min ..... 1.75 litres/s (32 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/in²)
Pump:
- Type ..... Gear
- Capacity at 2 100 rev/min ..... 6.1 litres/s (97 US gal/min)

Control Valve ..... Servo Controlled, Open Centre
Body Raise Time ..... 13 Seconds
Body Lower Time ..... 11.5 Seconds

ELECTRICAL

Type ..... 24 Volt, Negative Ground
Battery ..... Two, 12 Volt, 165 Ah each, Maintenance Free
Accessories ..... 24 Volt
Alternator ..... 70 Amp
Starter ..... 9 kW

BODY

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

Body floor wear surfaces are high hardness (450 BHN) abrasion resistant steel. Yield strength of plates 1 200 MPa (174 000 lbf/in²). All other 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) ..... 29 m³ (38 yd³)
- Heaped 2:1 (SAE) ..... 41.5 m³ (54.3 yd³)

SERVICE CAPACITIES

Engine Crankcase and Filters ..... 94 litres (25 US gal)
Transmission and Filters ..... 85 litres (22.5 US gal)
Cooling System ..... 236 litres (62.3 US gal)
Fuel Tank ..... 938 litres (248 US gal)
Steering Hydraulic Tank ..... 61 litres (16 US gal)
Steering System ..... 92 litres (24.3 US gal)
Body and Brake Cooling Tank ..... 258 litres (68 US gal)
Body and Brake Cooling System ..... 432 litres (114 US gal)
Planetaries (Total) ..... 43 litres (11.4 US gal)
Differential ..... 52 litres (13.7 US gal)
Front Ride Strut (Each) ..... 25 litres (6.6 US gal)
Rear Ride Strut (Each) ..... 21 litres (5.5 US gal)
Power Takeoff ..... 4 litres (1 US gal)
Air Conditioning Compressor ..... 0.135 litres (0.036 US gal)

Typical Noise Levels

Operator Ear (ISO 6394) ..... 81 dbA

*Exterior Sound Rating (SAE J88 JUN 86) ..... 91 dbA
* - The above result is for the mode giving the highest exterior sound level when measured and operated as per the prescribed procedures of the standard. Results shown are for the vehicle in base configuration.

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

Vehicle Weights (Mass)

	kg	lb
Chassis, with hoists	36 190	79 780
Body, standard	11 500	25 350
Net Weight	47 690	105 140
PAYLOAD, maximum	**65 000**	**143 300**
Maximum Gross Weight*	112 690	248 440
FOR UNIT EQIPPED WITH OPTIONAL HARD ROCK BODY:		
Chassis, with hoists	36 190	79 780
Body, with wear plates	16 450	36 270
Net Weight	52 640	116 050
PAYLOAD, maximum	**60 050**	**132 390**
Maximum Gross Weight*	112 690	248 440
* Maximum permissable gross vehicle weight with options, attachments, full tank and payload.		
WEIGHT DISTRIBUTION	Front Axle	Rear Axle
Empty %	48	52
Loaded %	34	66

* * * *

Welding

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

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

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

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

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

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

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

General Welding Procedure

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

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

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

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

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

5. Allow repair weld to cool slowly.

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

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

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

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

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

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

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

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

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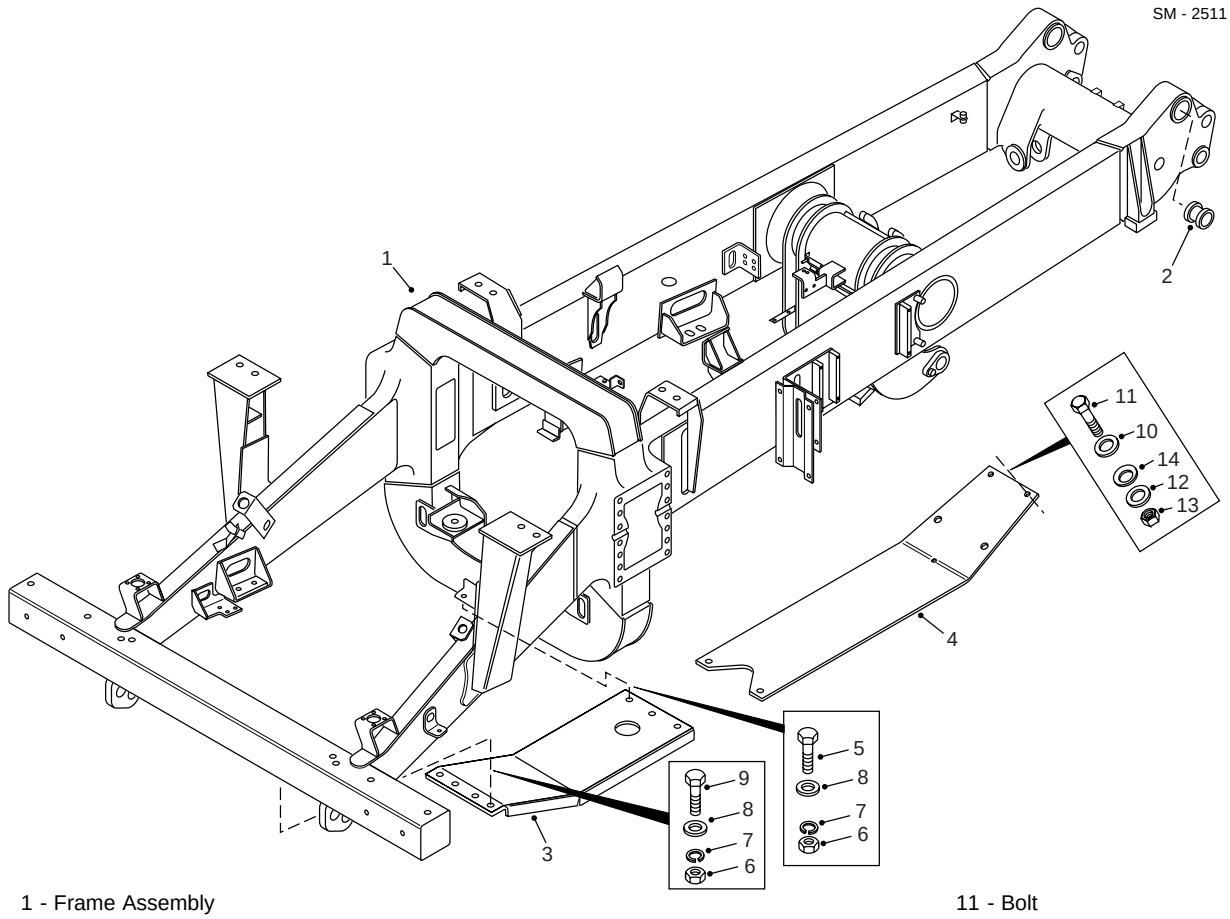


1 - Frame Assembly
2 - Bushing
3 - Engine Guard
4 - Transmission Guard
5 - Bolt
6 - Nut
7 - Lockwasher
8 - Washer
9 - Bolt
10 - Washer
11 - Bolt
12 - Hardened Washer
13 - Locknut
14 - Spring Disc

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 to 7 (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.

MAINTENANCE

Inspection

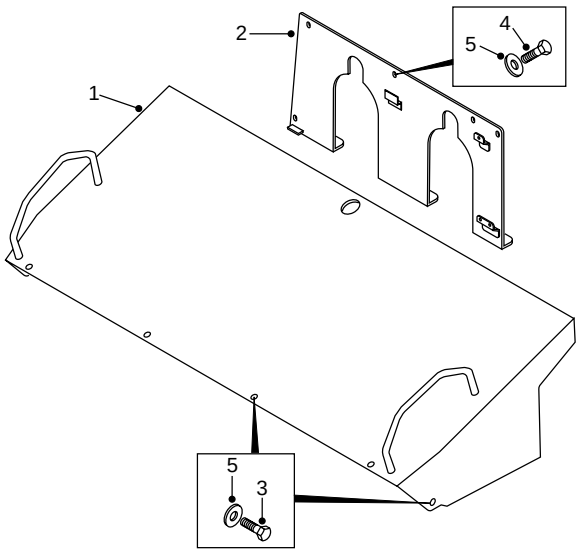
Inspect the frame and attached parts at intervals not exceeding 250 hours for cracked or broken welds and bending/twisting of the frame. Any defects found should be repaired before they progress into major failures. Contact your dealer for recommended weld and repair instructions.

⚠ WARNINGS
Before any welding is done on a machine equipped with the Detroit Diesel DDEC IV system, disconnect the following in this order: Battery earth cable, battery supply cable, alternator earth cables, alternator supply cables, electrical connections at the engine ECMs and transmission ECU to avoid damage to electrical components. Turn off ignition key switch to isolate the batteries before disconnecting any components.
After welding connect all of the above in the reverse order.

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

⚠ 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.



1 - Hood Assembly
2 - Plate
3 - Bolt
4 - Bolt
5 - Hardened Washer

Fig. 2 - Exploded View of Hood and Mounting

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.

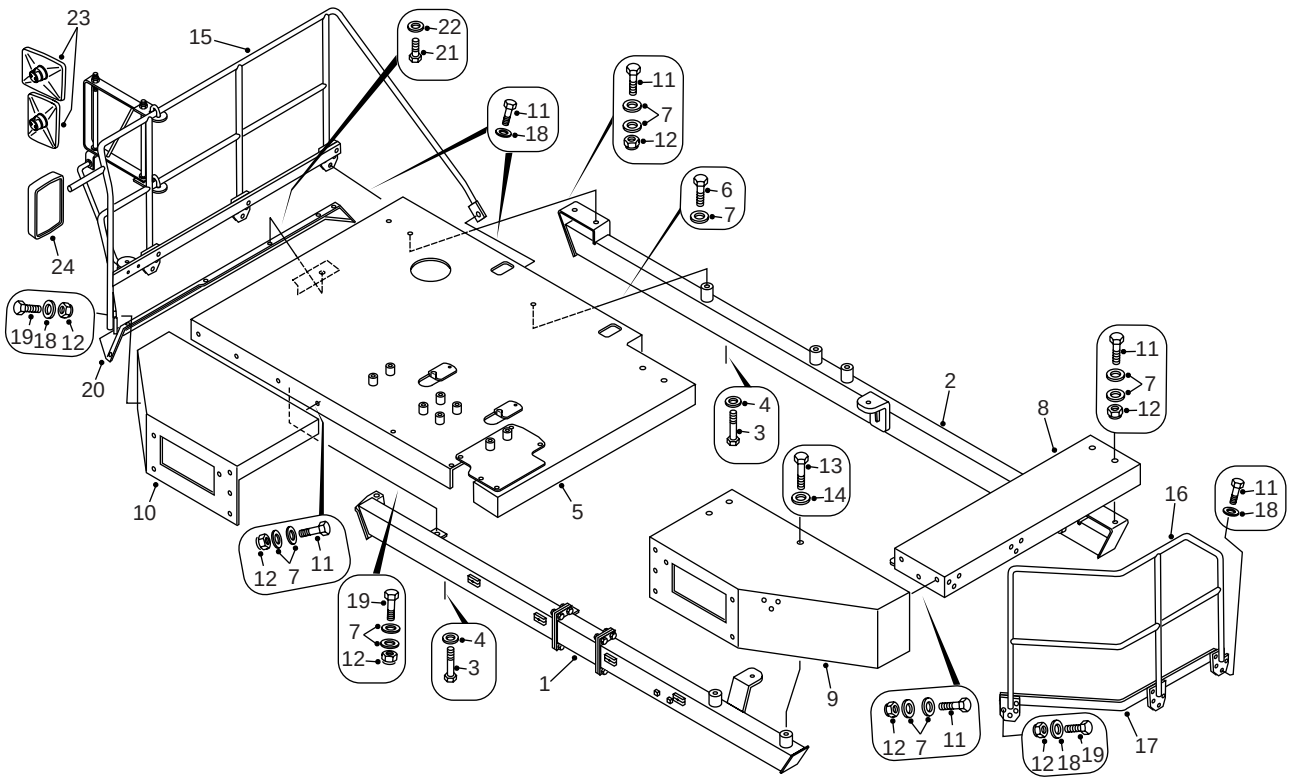
Painting

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 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.

SM - 2555



1 - Front Crossmember Assembly
2 - Rear Crossmember Assembly
3 - Bolt
4 - Hardened Washer
5 - Platform & Cover Assembly
6 - Bolt
7 - Hardened Washer
8 - Platform LHS
9 - Fender Assembly LH
10 - Fender Assembly RH
11 - Bolt
12 - Locknut
13 - Bolt
14 - Snubbing Washer
15 - Handrail & Kickstrip Assembly
16 - Handrail Assembly LH
17 - Kickstrip
18 - Hardened Washer
19 - Bolt
20 - Platform Extension
21 - Bolt
22 - Hardened Washer
23 - Mirror
24 - Mirror Wide Angle

Fig. 3 - Exploded View of Fenders and Mounting

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

SM - 2942

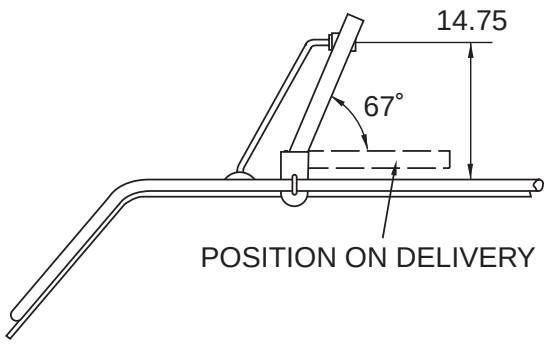


Fig. 4 - Right Hand Mirror Bracket Position

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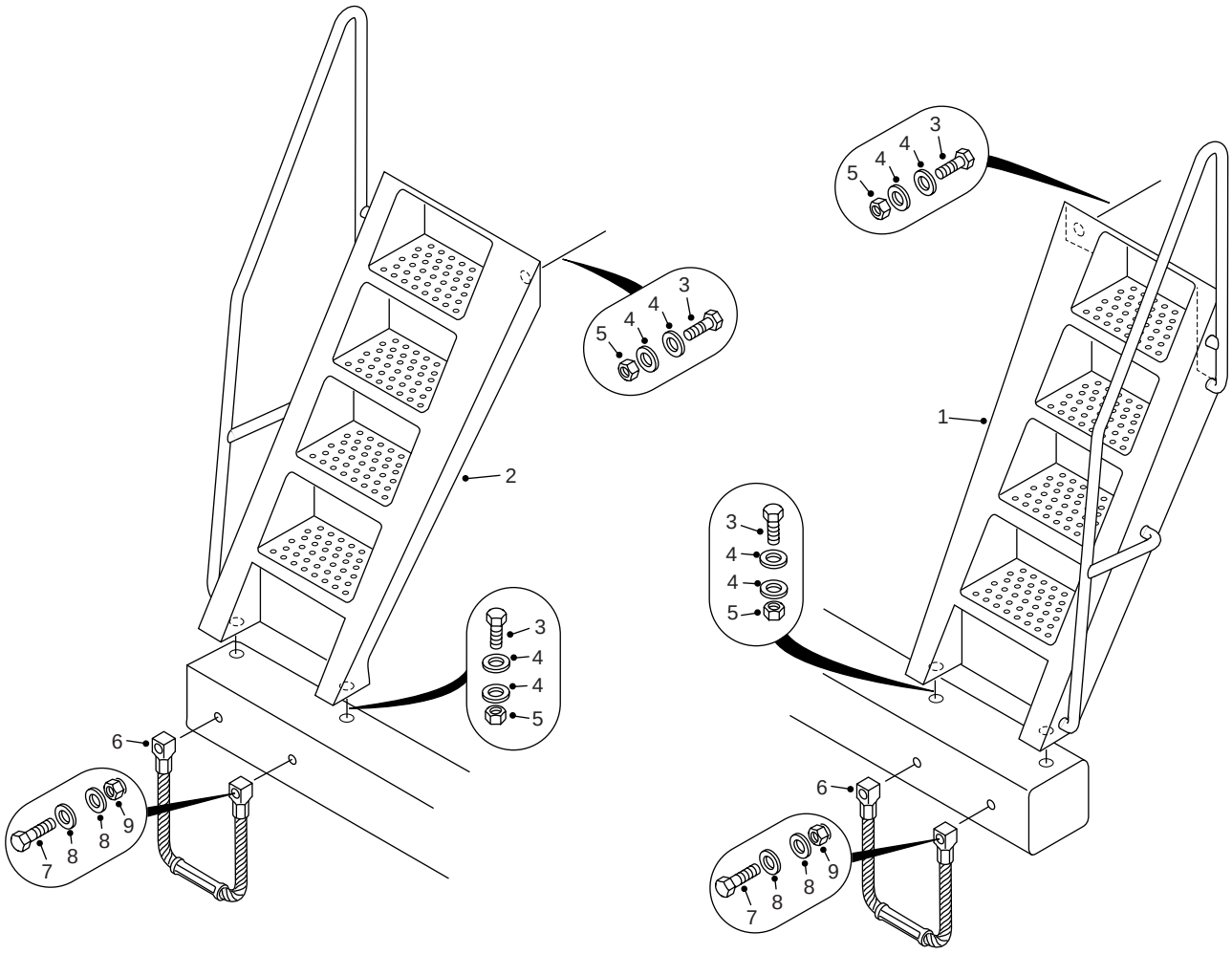
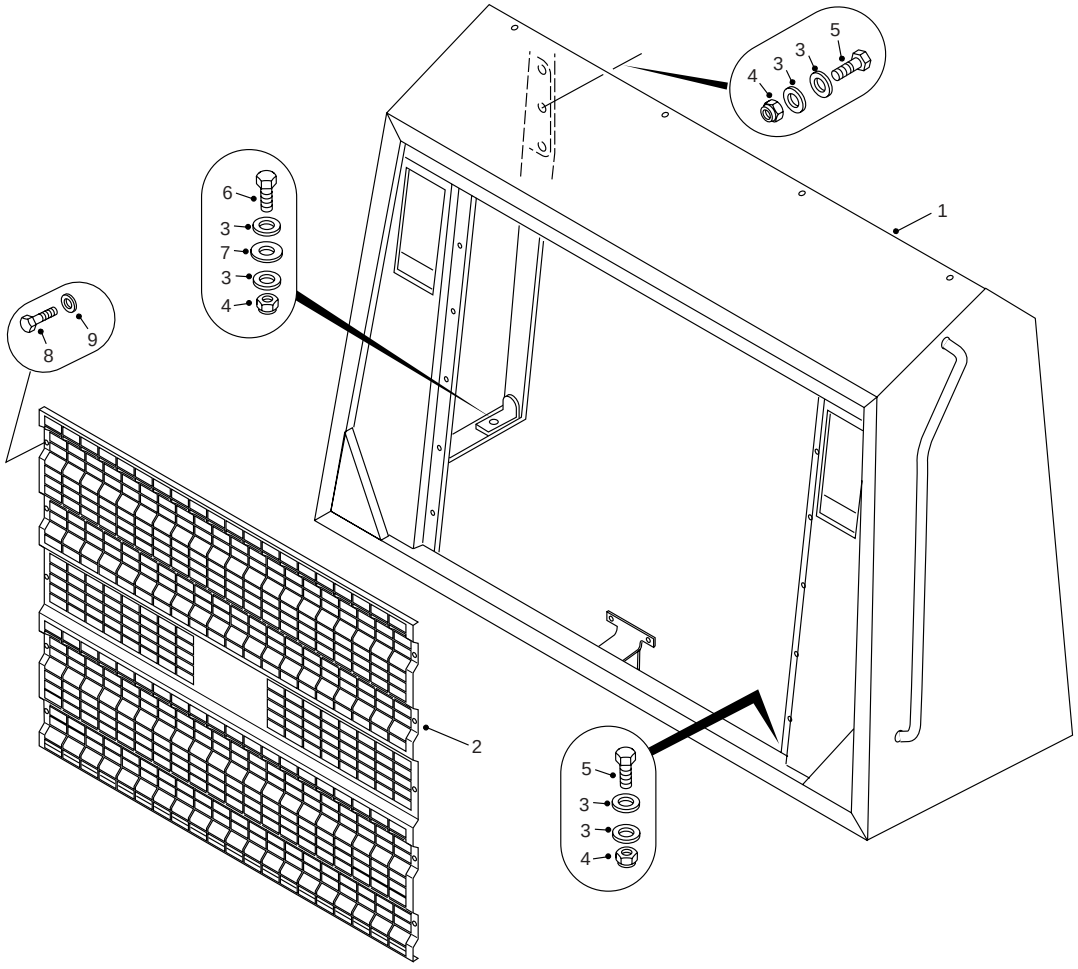


1 - LH Step Assembly
2 - RH Step Assembly
3 - Bolt
4 - Washer
5 - Nut
6 - Step
7 - Bolt
8 - Washer
9 - Locknut

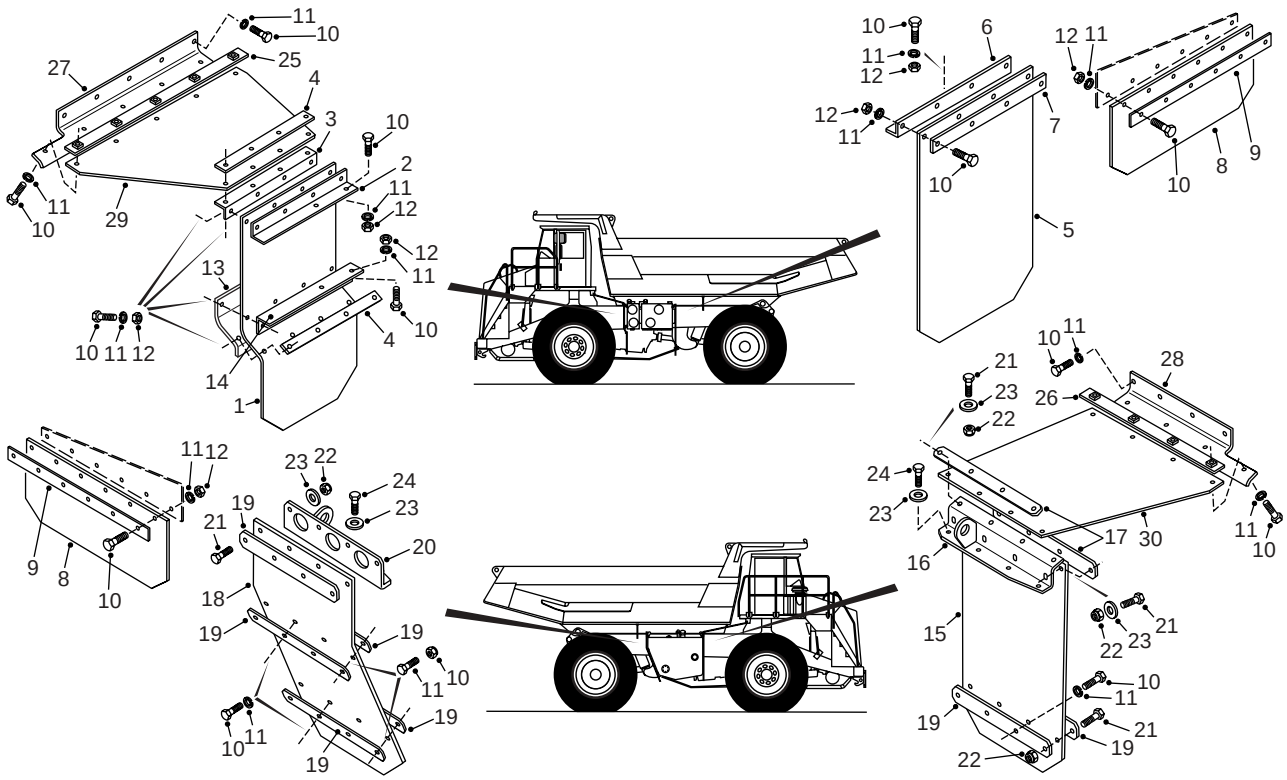
Fig. 5 - Exploded View of Ladders and Handrails

SM - 2556



1 - Radiator Guard
2 - Grille
3 - Hardened Washer
4 - Locknut
5 - Bolt
6 - Bolt
7 - Washer
8 - Bolt
9 - Hardened Washer

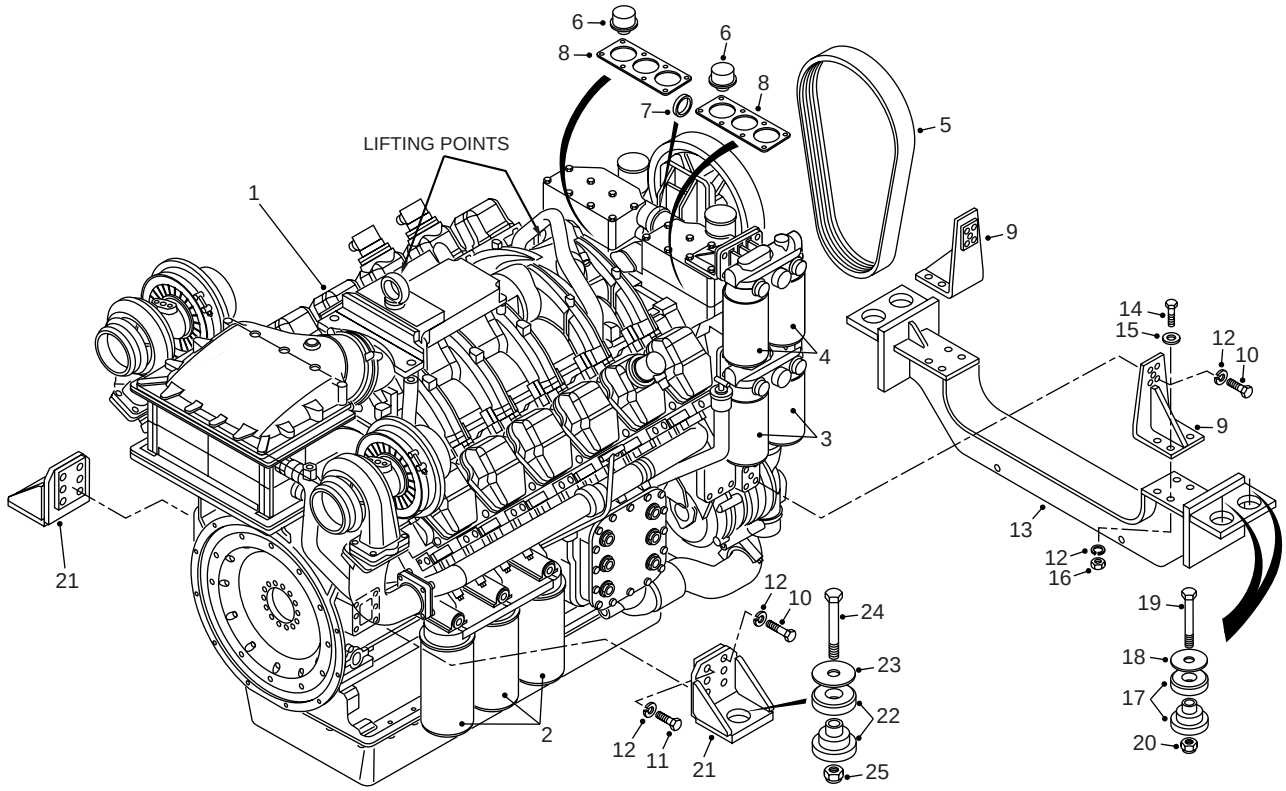
Fig. 6 - Radiator Guard and Mounting



1 - Mudflap Front
2 - Angle Bracket
3 - Angle Bracket
4 - Plate
5 - Mudflap
6 - Angle Bracket
7 - Clamp Plate
8 - Mudflap
9 - Clamp Plate
10 - Bolt
11 - Lockwasher
12 - Nut
13 - Plate
14 - Plate
15 - Mudflap RH Front
16 - Bracket Assembly
17 - Backing Strip
18 - Mudflap RH Rear
19 - Backing Strip
20 - Bracket Assembly
21 - Bolt
22 - Locknut
23 - Hardened Washer
24 - Bolt
25 - Plate Assembly LH
26 - Plate Assembly RH
27 - Mudguard Plate LH
28 - Mudguard Plate RH
29 - Mudflap LH
30 - Mudflap RH

Fig. 7 - Exploded View of Mudflaps and Mounting

* * * *



1 - Engine
2 - Oil Filter
3 - Primary Fuel Filter
4 - Secondary Fuel Filter
5 - Fan Belt
6 - Thermostat
7 - Thermostat Seal
8 - Gasket
9 - Front Mounting Bracket
10 - Bolt
11 - Bolt
12 - Lockwasher
13 - Mounting Crossmember
14 - Bolt
15 - Washer
16 - Nut
17 - Isolation Mount
18 - Snubbing Washer
19 - Bolt
20 - Locknut
21 - Rear Mounting Bracket
22 - Isolation Mount
23 - Snubbing Washer
24 - Bolt
25 - Locknut

Fig. 1 - Engine and Mounting

DESCRIPTION

Numbers in parentheses refer to Fig. 1.

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

The engine is mounted to the frame by mounting crossmember (13) and two mounting brackets (9) at the front of engine (1) and two rear mounts (21).

Rubber isolation mounts (17 & 22) through engine mounts provide sufficient flexibility to absorb varying engine vibration and torsional loads.

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

elements. Impurities are filtered out as the oil passes through the elements and out through another passage in the filter adaptor.

There are four spin-on type fuel filters mounted on the right hand side of engine (1), two primary fuel filters (3) and two secondary fuel filters (4). Primary fuel filters (3) are in the fuel flow and act as strainers and secondary fuel filters (4) filter the fuel after having passed through primary fuel filters (3).

DETROIT DIESEL ELECTRONIC CONTROL (DDEC)

Description

Refer to Fig. 2.

⚠ WARNING
Before any welding is done on a machine equipped with the DDEC IV system, disconnect the following in this order: Battery earth cable, battery supply cable, alternator earth cables, alternator supply cables, transmission connector, ECM interface harness connectors (30 pin RHS), ECM powerharness connectors (5 pin RHS), ECM engine to transmission datalink connectors (6 pin RHS), ECM sensor harness connectors (30 pin LHS) and ECM injector harness connectors (5 pin LHS - 2 connectors) (Note: this engine is equipped with 2 ECMs). Turn off ignition key switch to isolate the batteries before disconnecting any components.

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

The engine is equipped with DDEC IV which which continually monitors the engine and warns the operator when a problem develops. The DDEC IV system also takes action to prevent damage to the engine and, provides the serviceman with diagnostic capabilities so that problems can be corrected quickly and easily.

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

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

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

The EUI performs four functions:

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

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

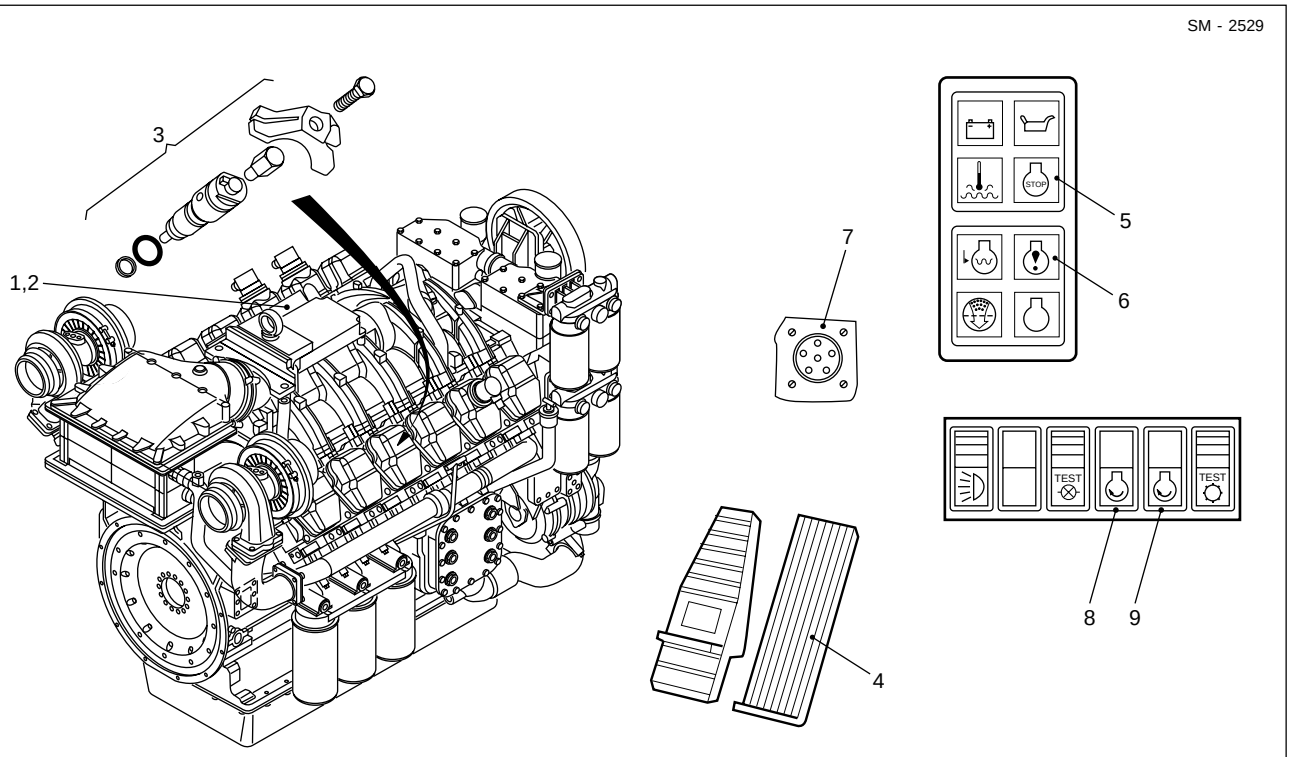
Note: Never apply 12 V directly to terminals on the injector or engine sensors as they will burn out. Before removing injectors, the fuel passages must be blown out to prevent fuel flow from entering the cylinder head.

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

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

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

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



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

Fig. 2 - DDEC IV Components

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

8. Master ECM 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. Receiver ECM Diagnostic Request 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.

Operation

Numbers in parentheses refer to Fig. 2.

The DDEC system operates from a 24 volt supply. However, in the event of a loss of power supply, the system will operate at reduced voltage. At reduced voltage the electronic control system will detect a malfunction and the check engine light on the dash panel will illuminate.

At this point the ECM (1) will go into backup control

and a change in engine operation will be noticed. The engine will operate only at reduced rev/min until the battery voltage reaches a point where it will no longer function and the engine will shut down. The machine can still be operated when the check engine light is illuminated, however, the fault should be diagnosed and corrected at the earliest possible opportunity.

Note: When the stop engine light on the dash panel illuminates, 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.

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

To allow for the possibility of the engine protection system being activated while the machine is operating in a critical situation, a stop engine override switch (8) is provided. If the switch is pressed and released during rampdown, the 30 second timer will reset, restoring torque to the level immediately following illumination of stop engine (5) 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 (5) 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 (5) 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 IV Diagnostic Codes' table for other code descriptions.

Note: Only one light will be flashing at any one time. When code flashing is initiated, the active codes (or code 25) will be flashed on stop engine light (5), 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.

DDEC IV DIAGNOSTIC CODES

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

DDEC IV DIAGNOSTIC CODES

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

DDEC IV DIAGNOSTIC CODES

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

DDEC IV DIAGNOSTIC CODES

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

REMOVAL

Numbers in parentheses refer to Fig. 1.

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

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

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

1. Position the vehicle in a level work area, ensure the body is fully lowered, apply the parking brake and switch off the engine.

2. 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.

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 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.

7. Evacuate air conditioning system and disconnect air conditioner lines at the engine compressor. Refer to Section 260-0130, 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 210-0040, 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. 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.

14. 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.

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

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

17. 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.

18. Attach suitable lifting equipment to the lifting points on engine (1) assembly and raise lifting equipment to take up the slack. Refer to Fig. 1.

19. Remove locknuts (16), lockwashers (12), bolts (14) and hardened washers (15) securing front mounting brackets (9) to mounting crossmember (13). Remove locknuts (25), snubbing washers (23) and bolts (24) securing rear mounting brackets (21) to the frame.

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

21. 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.

22. If required, attach suitable lifting equipment to the front mounting crossmember (13) assembly and raise lifting equipment to take up the slack.

23. Remove locknuts (20), bolts (19) and snubbing washers (18) securing mounting crossmember (13) to the frame.

24. Carefully lift mounting crossmember (13) clear of the frame and move to a clean work area for further disassembly.

DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

1. Remove bolts (10) and lockwashers (12) securing front mounting brackets (9) to engine (1). Remove front mounting brackets (9).

2. Remove bolts (10 & 11) and lockwashers (12) securing rear mounting brackets (21) to engine (1). Remove rear mounting brackets (21).

3. If required, remove rubber isolation mounts (22) from rear mounting brackets (21).

4. If required, remove rubber isolation mounts (17) from mounting crossmember (13).

5. Remove mounting hardware securing fan to engine (1) then remove fan.

6. Loosen the fan hub mounting bolts and turn the adjusting rod anticlockwise enough to allow slack in poly 'V' belts. Remove poly 'V' belts.

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

8. Remove mounting hardware securing alternator guard to engine (1). Remove alternator guard.

9. Loosen alternator mounting bolt to allow slack in 'V' belts. Remove 'V' belts.

Note: Adjuster screw and link assembly will have been released when removing radiator assembly from the vehicle.

10. Remove bolt and lockwasher securing screw and link assembly to alternator. Support alternator and remove mounting hardware. Remove alternator from engine (1).

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

12. With power takeoff assembly removed, remove mounting hardware and damper from engine (1). If necessary, remove mounting hardware from flange coupling and remove flange coupling from damper.

13. Remove and discard filters (2, 3 & 4) 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 (17 & 22) for damage and replace if required.

2. Check rear mounting brackets (21), front mounting brackets (9), mounting crossmember (13) and brackets on the frame for cracks and/or damage. Repair or replace as necessary.

3. Inspect engine damper and flange coupling for damage and repair or replace as required.

