TEREX

TEREX Equipment Limited Maintenance Manual

MAINTENANCE MANUAL
TR45 Tier3

15503446
SM881

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TEREX

TEREX Equipment Limited Operator Handbook Re-order

MAINTENANCE MANUAL

TR45 Tier 3

15503446
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TEREX

TEREX Equipment Limited Maintenance Manual - Introduction

MAINTENANCE MANUAL

TR45 Tier 3

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

Alternatively, please contact;

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The illustrations, technical information, data and descriptive text in this manual, to the best of our knowledge, were correct at the time of print. The right to change specifications, equipment and maintenance instructions at any time without notice, is reserved as part of the Terex Equipment Limited policy of continuous development and improvement of the product.

Please refer to TEREX Specification Sheets or consult Factory Representatives to ensure that information is current.

IMPORTANT SAFETY NOTICE

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

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

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

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

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

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

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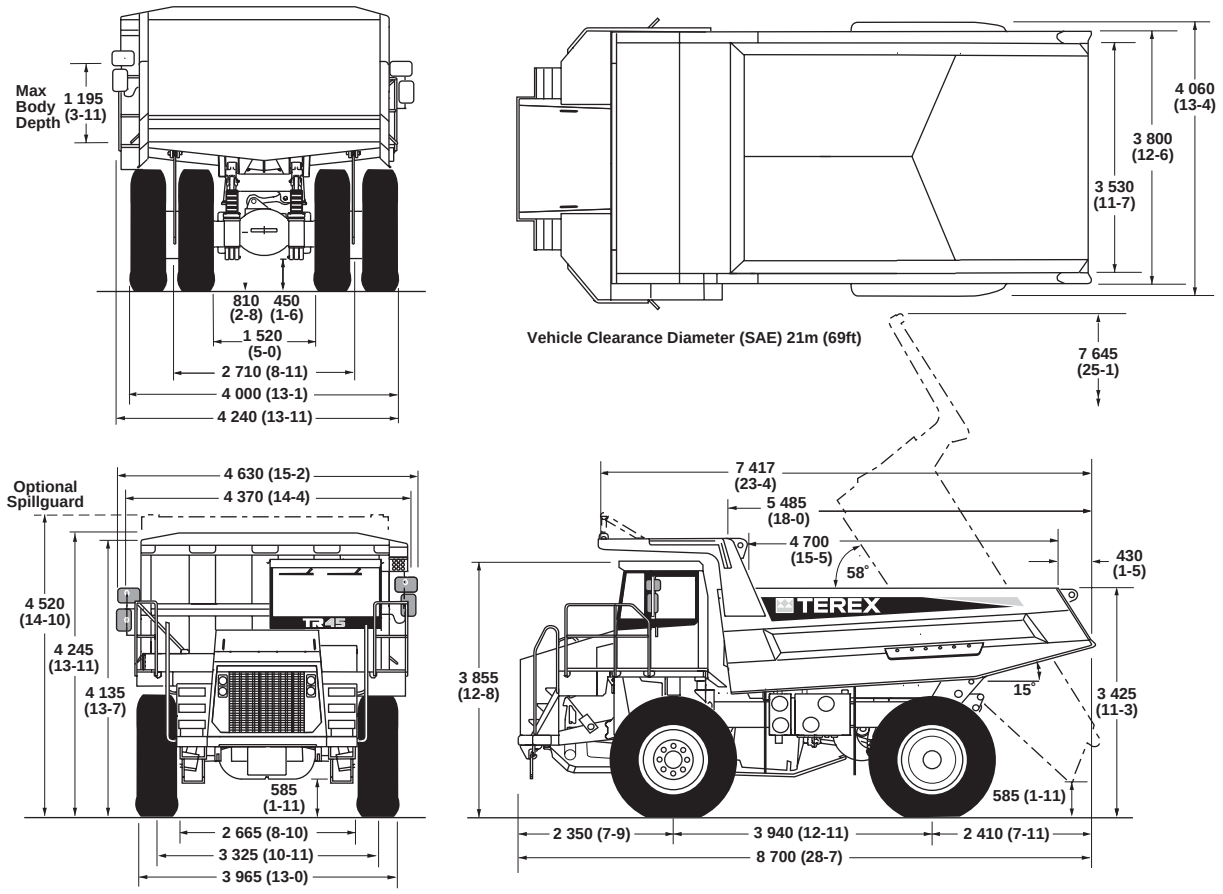

Fig. 1 - Machine Dimensions

ENGINE

Make/Model ..... Cummins QSK 19-C525
Type ..... 4 Cycle, Turbocharged/Low Temperature Aftercooled. Electronic Management.
Gross Power at 2000 rev/min ..... 392 kW (525 hp, 532 PS)
Net Power at 2000 rev/min ..... 370 kW (495 hp, 502 PS)

Note: Power ratings to SAE J1995 Jun 90. Engine emission meets Tier 3 USA EPA/CARB MOH 40 CFR 89 and proposed EU NRMM (non-road mobile machinery directive).

Maximum Torque ..... 2407 Nm (1800 lbf ft) at 1300 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 l (1 150 in³)
Starting ..... Electric
Maximum Speed, Full Load ..... 2000 rev/min
Maximum Speed, No Load ..... 2244 rev/min
Idle Speed ..... 700/750 rev/min

TRANSMISSION

Make/Model ..... Allison M5610AR
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. Hydraulic retarder.

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	11.3	16.8	22.4	33.4	45.2	65.0
mile/h	7.0	10.5	13.9	20.8	28.1	40.4
Reverse						
Gear	1	2				
Ratio	5.12	3.46				
km/h	7.1	12.9				
mile/h	4.4	8.0				

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
Wheel Rim Width (Optional) ..... 15 in

Standard Tyres (Front & Rear) ..... 18.00 R33 ** Radial
Optional Tyres (Front & Rear) ..... 21.00 R35 ** Radial

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/hydraulic accumulator which stores energy to provide consistent braking response.

Front Brake Circuit Pressure ..... 159 bar (2300 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 1 calliper per wheel
- Disc Diameter ..... 660 mm (25.5 in)
- Pad Area, Total ..... 1395 cm² (216 in²)

Rear:
- Type ..... Oil cooled, multiple friction discs (14 total), completely sealed from dirt and water.
- Braking Surface, Total ..... 38310 cm² (5 938 in²)
- Cooling Flow, Max. ..... 553 l/min (146 US gal/min)

Parking

Application of rear brakes by springs in brake disc pack. Hydraulically released.
Hold-off Pressure ..... 83 bar (1200 lbf/in²)

Retardation

Modulated lever control of rear disc pack.
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 ISO 5010, SAE J53.

System Pressure ..... 159 bar (2300 lbf/in²)
Relief Pressure ..... 207 bar (2495 lbf/in²)
Steering Cylinders ..... Double Acting, Single Stage
Accumulator:
- Oil Capacity ..... 14.0 l (3.70 US gal)
- Nitrogen Precharge Pressure ..... 55 bar (800 lbf/in²)

Steering Angle (Left and Right) ..... 39°
Pump:
- Type ..... Piston
- Capacity at 2 100 rev/min ..... 1.4 l/s (22 US gal/min)

BODY HYDRAULICS

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

System Relief Pressure ..... 190 bar (2750 lbf/in²)
Pump:
- Type ..... Gear
- Capacity at 2100 rev/min ..... 227 l/min (60 US gal/min)

Control Valve ..... Servo Controlled, Open Centre
Body Raise Time ..... 13 Seconds
Body Lower Time ..... 9 Seconds

ELECTRICAL

Type ..... 24 V, Negative Ground
Battery ..... Two, 12 V, 165 Ah each, Maintenance Free
Accessories ..... 24 V
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 1000 MPa (145000 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) ..... 19.6 m³ (25.6 yd³)
Heaped 2:1 (SAE) ..... 26.0 m³ (34.0 yd³)

SERVICE CAPACITIES

Engine Crankcase and Filters ..... 55 l (17.4 US gal)
Transmission and Filters ..... 68 l (18 US gal)
Cooling System ..... 126 l (35.5 US gal)
Fuel Tank ..... 606 l (160 US gal)
Steering Hydraulic Tank ..... 61 l (16 US gal)
Steering System ..... 85 l (22.5 US gal)
Body and Brake Cooling Tank ..... 216 l (62 US gal)
Body and Brake Cooling System ..... 368 l (97 US gal)
Planetaries (Total) ..... 66 l (17.4 US gal)
Differential ..... 60 l (15.8 US gal)
Front Ride Strut (Each) ..... 14 l (3.7 US gal)
Rear Ride Strut (Each) ..... 17 l (4.5 US gal)
Power Takeoff ..... 2 l (1 US gal)
Air Conditioning Compressor ..... 0.135 l (0.036 US gal)

Typical Noise Levels

Operator Ear (ISO 6394) ..... 80 dbA

*Exterior Sound Rating (SAE J88 JUN 86) ..... 88 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	27835	61365
Body, standard	9300	20500
Net Weight	37135	81870
PAYLOAD, maximum	**40825**	**90000**
Maximum Gross Weight*	77960	171870
FOR UNIT EQUIPPED WITH OPTIONAL BODY LINER PLATES:		
Chassis, with hoists	27835	61365
Body, Heavy Duty	10800	23810
Net Weight	38635	85175
PAYLOAD, maximum	**39325**	**86695**
Maximum Gross Weight*	77960	171870
* 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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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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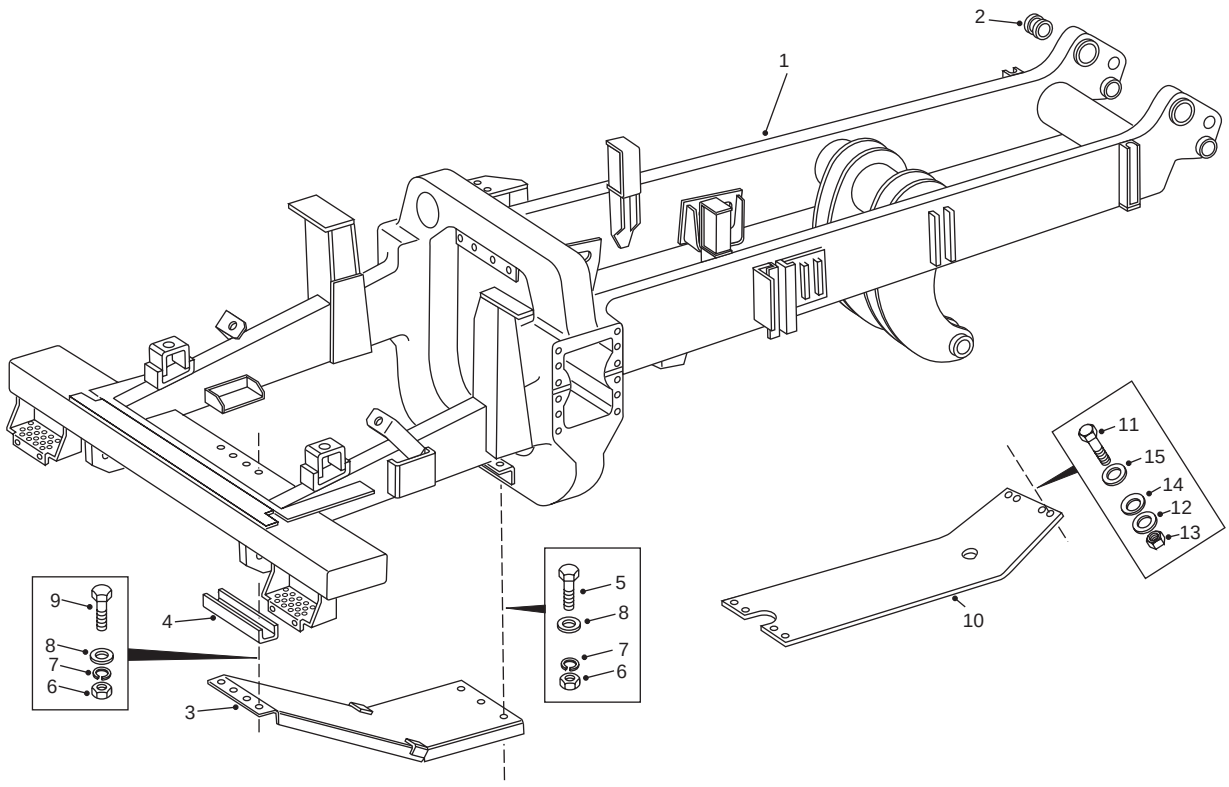


1 - Frame Assembly
2 - Bushing
3 - Engine Guard
4 - Channel
5 - Bolt
6 - Nut
7 - Lockwasher
8 - Washer
9 - Bolt
10 - Transmission Guard
11 - Bolt
12 - Hardened Washer
13 - Locknut
14 - Spring Disc
15 - Washer

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, 4 or 5 (or similar components) the following procedures should be carried out.

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

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

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

INSTALLATION

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

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

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

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:

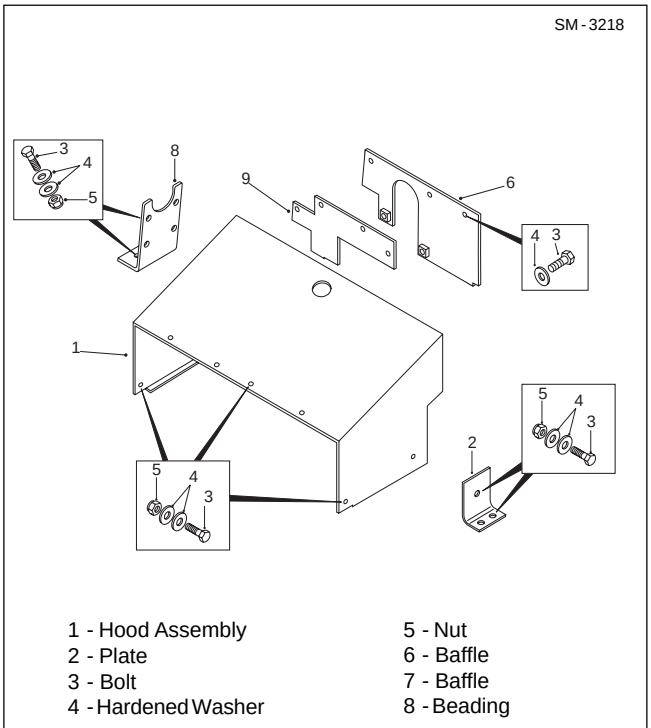
a. Disconnect battery equalizer ground cables.
b. Disconnect battery cables from terminal posts (ground cable first).
c. Disconnect battery equalizer positive cables.
d. Disconnect electrical connections at the ECU.

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.



1 - Hood Assembly
2 - Plate
3 - Bolt
4 - Hardened Washer
5 - Nut
6 - Baffle
7 - Baffle
8 - Beading

Fig. 2 - Exploded View of Hood and Mounting

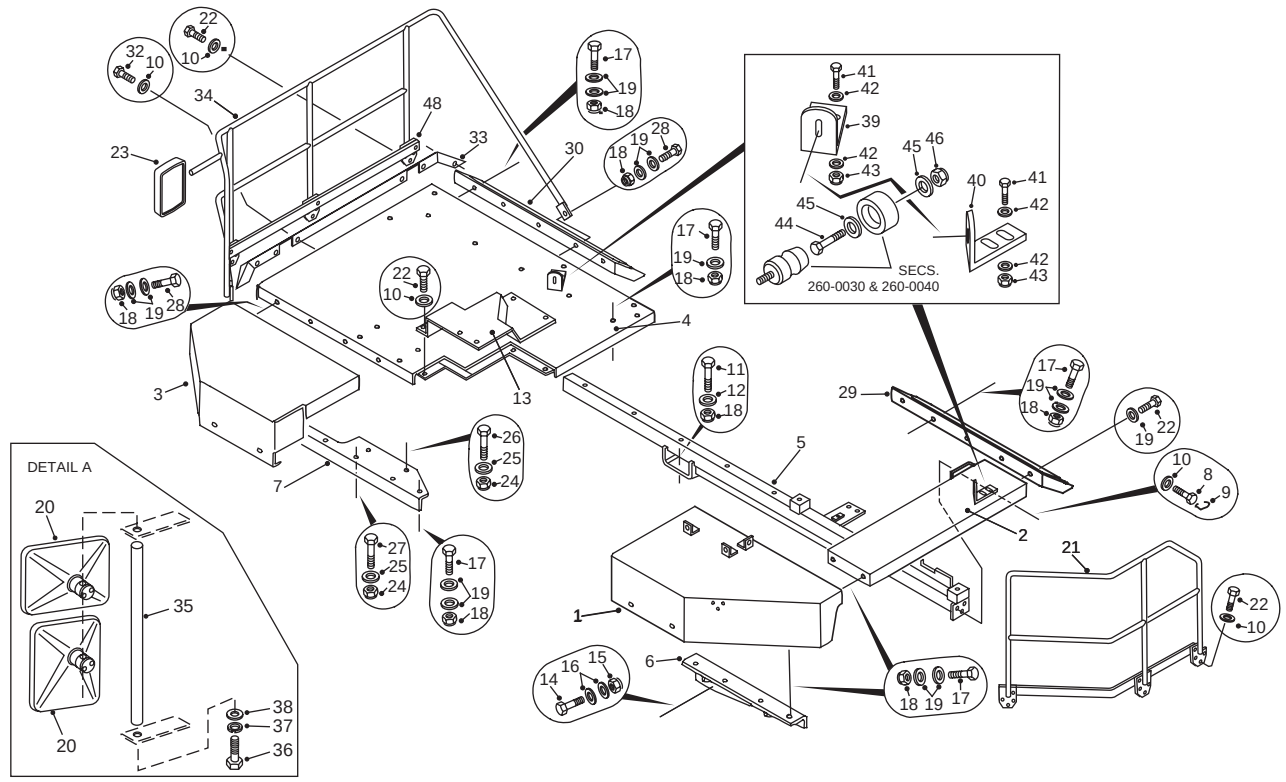
Painting

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.

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



1 - LH Fender Assembly
2 - LH Platform Assembly
3 - RH Fender Assembly
4 - RH Platform Assembly
5 - Crossmember
6 - Support
7 - Support
8 - Bolt
9 - Lockwire
10 - Hardened Washer
11 - Bolt
12 - Washer
13 - Engine Access Cover
14 - Bolt
15 - Locknut
16 - Hardened Washer
17 - Bolt
18 - Locknut
19 - Hardened Washer
20 - Mirror
21 - LH Handrail
22 - Bolt
23 - Mirror Wide Angle
24 - Nut
25 - Washer
26 - Bolt
27 - Bolt
28 - Bolt
29 - Mudguard
30 - Mudguard
31 - Bolt
32 - Bolt
33 - Fender Extension RH
34 - RH Handrail
35 - Mirror Bracket
36 - Bolt
37 - Lockwasher
38 - Washer
39 - Plate Bent
40 - Plate bent
41 - Bolt
42 - Washer
43 - Nut
44 - Bolt
45 - Washer
46 - Nut
47 - Kick Plate
48 - Kick Plate
49 - Bolt
50 - Hardened Washer
51 - Nut

Fig. 3 - Exploded View of Fenders and Mounting

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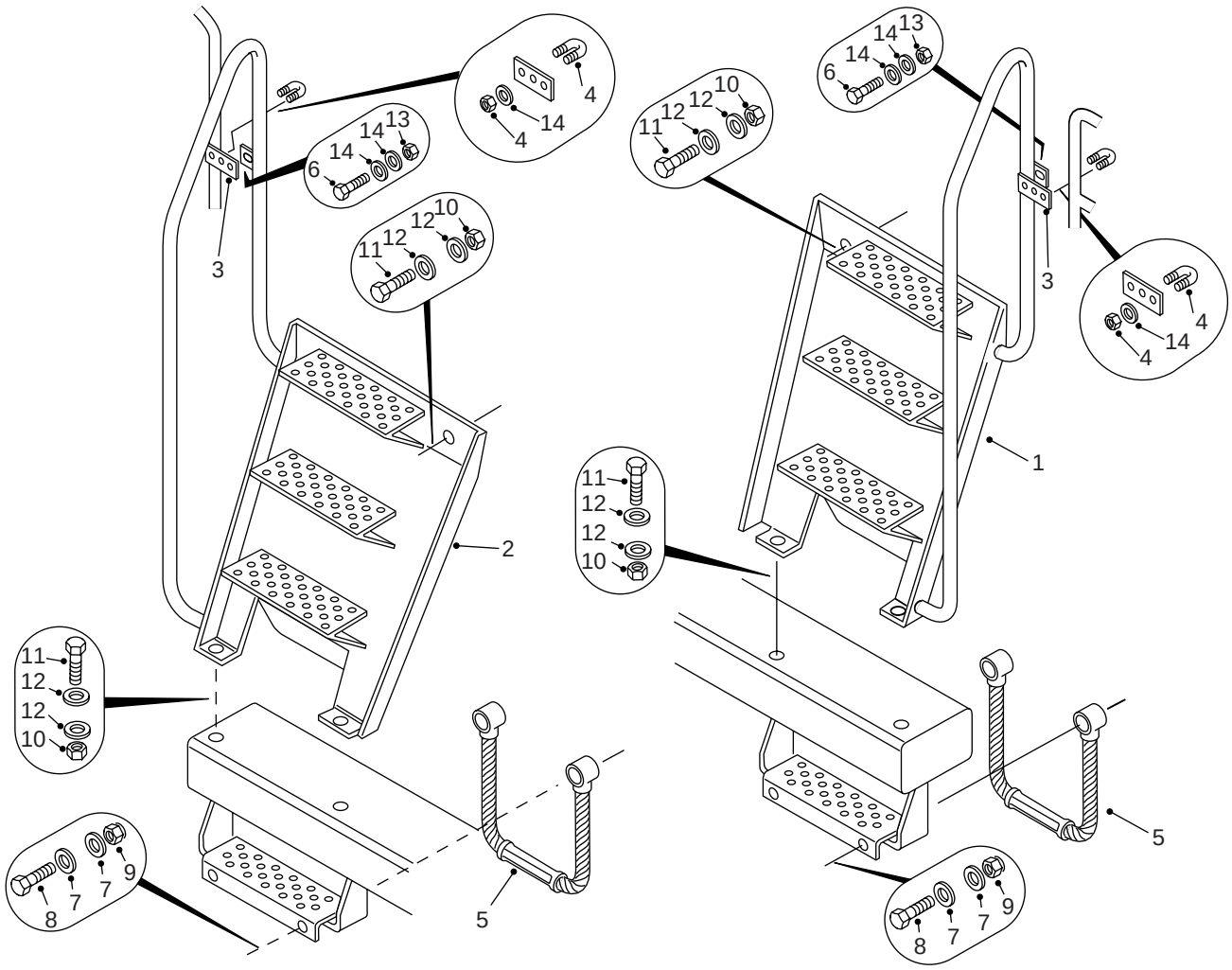
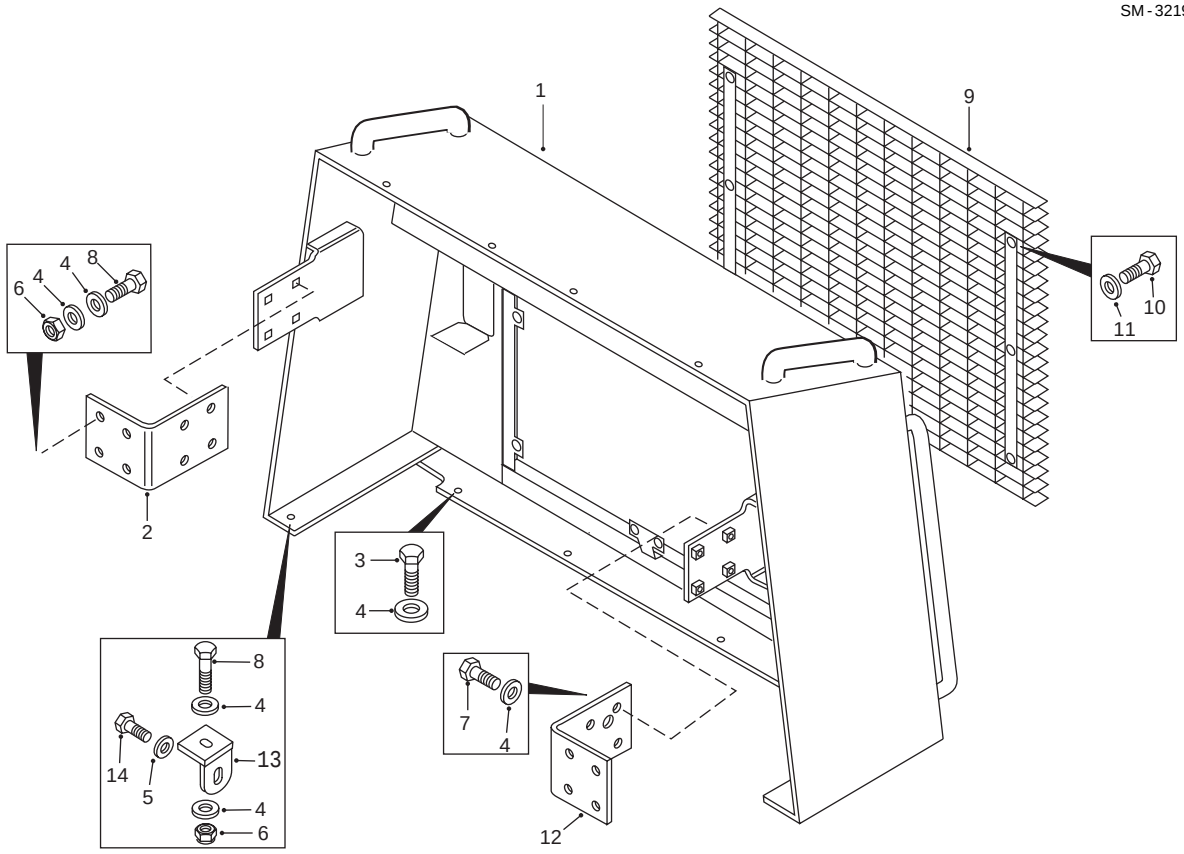


1 - LH Step Assembly
2 - RH Step Assembly
3 - Plate
4 - 'U' Bolt
5 - Step
6 - Bolt
7 - Washer
8 - Bolt
9 - Locknut
10 - Nut
11 - Bolt
12 - Hardened Washer
13 - Nut
14 - Hardened Washer

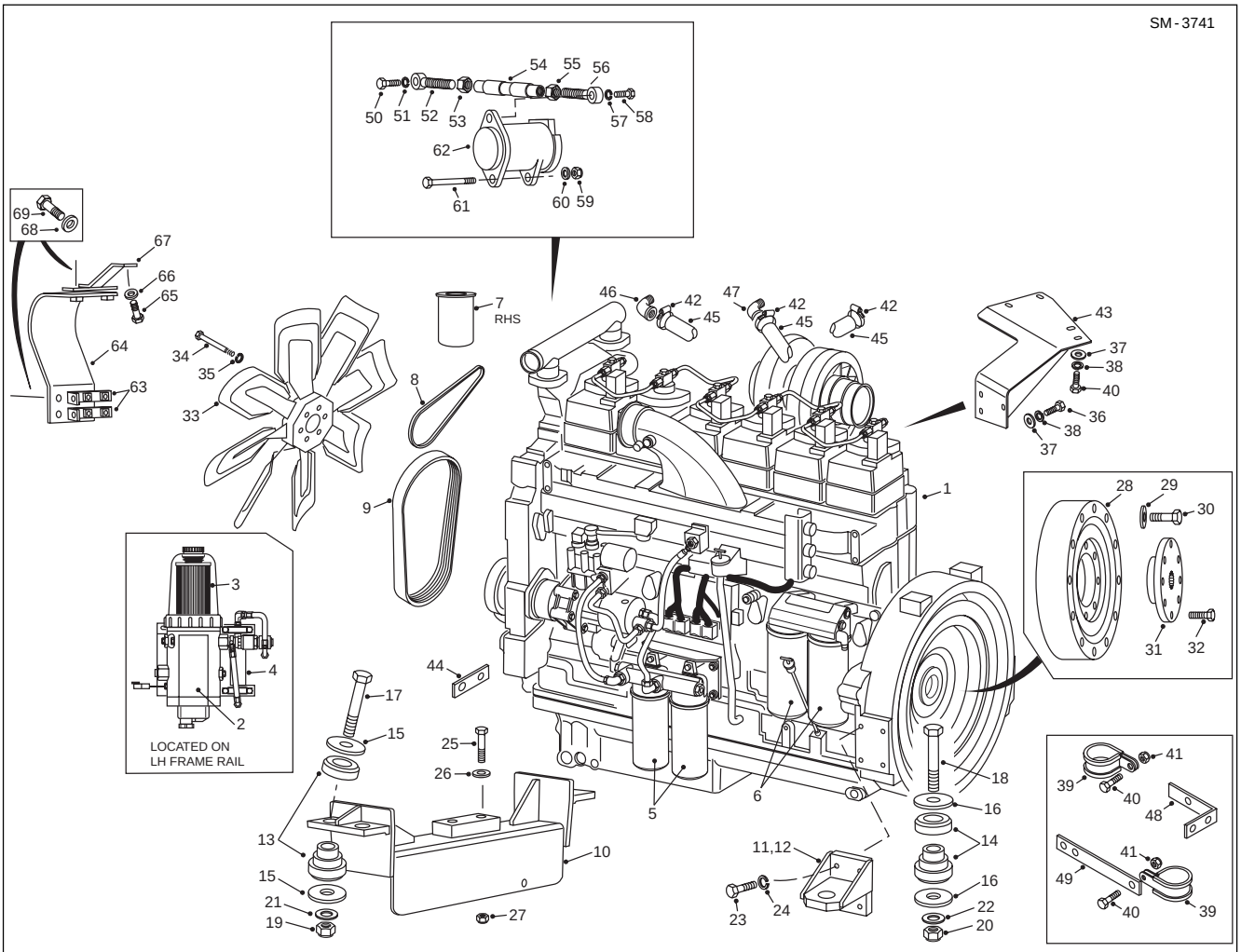
Fig. 4 - Exploded View of Ladders and Handrails



1 - Radiator Guard
2 - Bracket
3 - Bolt
4 - Hardened Washer
5 - Washer
6 - Nut
7 - Bolt
8 - Locknut
9 - Grille
10 - Bolt
11 - Washer
12 - Plate
13 - Bracket
14 - Bolt

Fig. 5 - Radiator Guard and Mounting

* * * *



1 - Engine
2 - Fuel Pre-filter
3 - Fuel Pre-filter Element
4 - Pre-filter Primer Pump
5 - Fuel Filter
6 - Oil Filter
7 - Corrosion Resistor
8 - Alternator Belt
9 - Fan Belt
10 - Front Mount
11 - Rear Left Hand Mount
12 - Rear Right Hand Mount
13 - Isolation Mount
14 - Isolation Mount
15 - Snubbing Washer
16 - Snubbing Washer
17 - Bolt
18 - Bolt
19 - Nut
20 - Nylon Insert Nut
21 - Hardened Washer
22 - Hardened Washer
23 - Bolt
24 - Lockwasher
25 - Bolt
26 - Hardened Washer
27 - Locknut
28 - Drive Coupling
29 - Washer
30 - Bolt
31 - Flange Coupling
32 - Bolt
33 - Fan Assembly
34 - Bolt
35 - Lockwasher
36 - Bolt
37- Washer
38- Lockwasher
39- P-Clip
40- Bolt
41- Locknut
42- Clamp
43- Turbo Support Bracket
44- Bracket
45- Bulk Hose
46- Elbow
47- Street Elbow
48- Bracket
49- Plate
50 - Bolt
51 - Lockwasher
52 - Eye Bolt
53 - Jam Nut
54 - Link
55 - Nut
56 - Eyebolt
57 - Lockwasher
58 - Bolt
59 - Locknut
60 - Lockwasher
61 - Bolt
62 - Alternator
63 - Plate Support
64 - Alternator Guard
65 - Bolt
66 - Washer
67 - Support Bracket
68 - Washer
69 - Bolt

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 at three points by a mounting bracket (10) at the front of engine (1) and a left-hand and a right-hand rear mounts (11,12). Rubber isolation mounts (13,14) through engine mounts provide sufficient flexibility to absorb varying engine vibration and torsional loads.

There are two full-flow oil filters (5) mounted on the left 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 (5) before reaching the various moving parts of engine (1). The oil is forced by pump pressure through a passage in the filter adaptor and into the elements. Impurities are filtered out as the oil passes through the elements and out through another passage in the filter adaptor.

Engine coolant filter (7) and conditioner is a compact bypass type unit with a replaceable spin-on type element mounted on the gear case cover at the front right hand side of engine (1). Refer to Section 210-0000, COOLING SYSTEM.

There are two spin-on type fuel filters (5) mounted on the left hand side of engine (1). The primary fuel filter is in the fuel flow and acts as a strainer and the secondary fuel filter filters the fuel after having passed through the primary fuel filter.

There is also a fuel pre-filter (2) attached to the LH frame rail which remaoves any dust particles for the fuel injectors. Refer to Section 110-0150 ENGINE - FUEL PRE FILTER.

QUANTUM ELECTRONIC FUEL CONTROL SYSTEM

Description

Refer to Fig. 2.

⚠ WARNING
Before any welding is done on a machine equipped with the Quantum Electronic Fuel System, disconnect the following in this order: Battery earth cable, battery supply cable, alternator earth cables, alternator supply cables, transmission black box 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 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 Quantum Electronic Fuel System which controls the timing and amount of fuel injection by the electronic fuel system injectors. The system also monitors several engine functions using electrical sensors which send electrical signals to the electronic control module (ECM). The ECM then computes the incoming data and determines the correct fuel output and timing for optimum power, fuel economy and emissions.

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

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

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

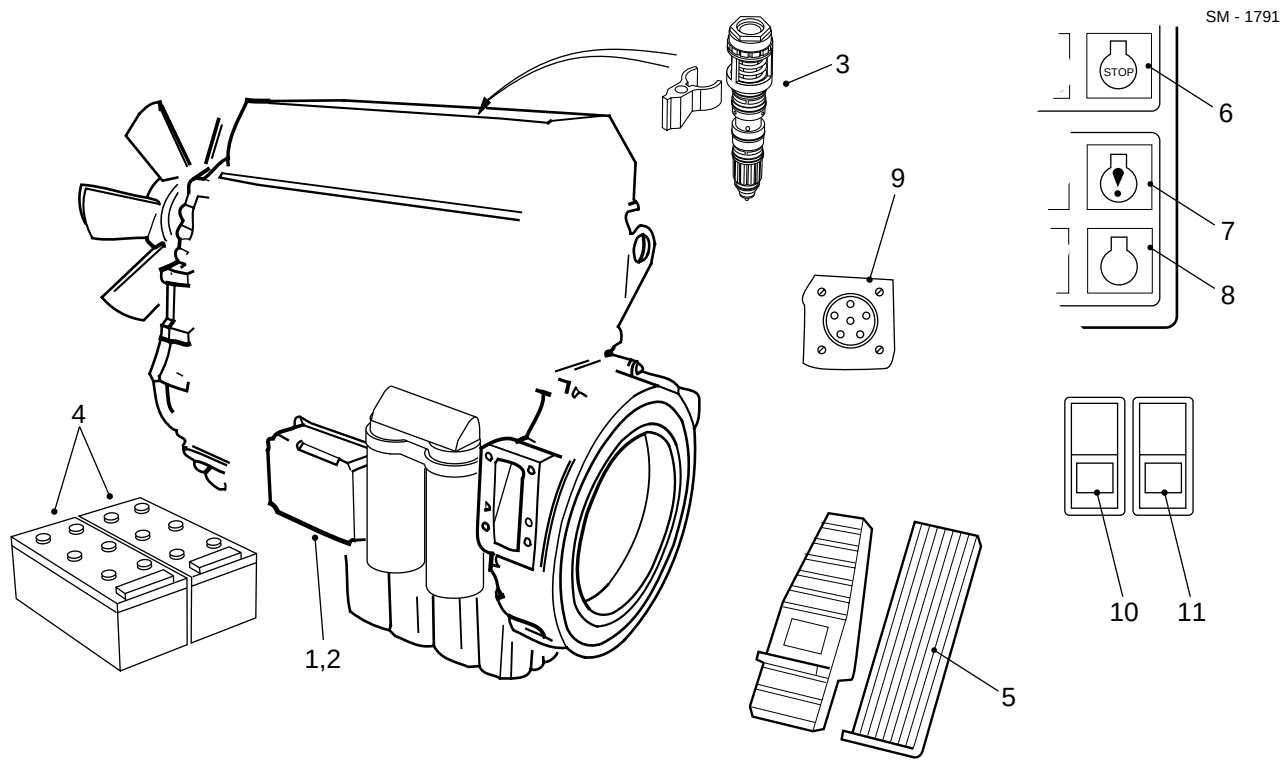
3. Electronic Fuel System Injectors - The injector is a lightweight, compact unit that injects diesel fuel directly into the combustion chamber. The amount of fuel injected and the beginning of injection timing is determined by the ECM. The ECM sends a command pulse which activates the injector solenoid.

The injector performs four functions:

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

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

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



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

Fig. 2 - Quantum Electronic Fuel System Components

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

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

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

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

7. Engine Warning Light (Yellow) - When the engine 'Warning' light comes on, the computer has detected a fault in the engine which may result in power loss. The fault should be diagnosed and corrected at the earliest opportunity.

8. Engine Protection Fluid Light (Amber) - When the engine 'Fluid' light comes on, the computer has detected a fault in the engine. The light will remain on as long as the fault is occurring. The fault should be diagnosed and corrected at the earliest opportunity. If the fault continues to get worse the light will flash. Stop the machine and do not operate until the fault is corrected.

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

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

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

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

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

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

If active codes are recorded the 'Stop', 'Warning' and 'Fluid' lights will illuminate momentarily. The yellow 'Warning' and red 'Stop' lights will begin to flash the code of the recorded fault.

11. Diagnostic Search Switch - When the engine is in diagnostic mode this switch is used to search through a list of fault codes, i.e.. pressing the top of the switch momentarily will advance to the next active fault code, pressing the bottom of the will go back to the previous code.

On machines which have a Low Idle Adjustment feature, this switch can also be used to increase or decrease (in increments of 25 RPM), the idle or intermediate speed of the engine.

Operation

Numbers in parentheses refer to Fig. 2.

The machine is equipped with the Quantum engine protection system which records fault codes in the ECM (1), when the engine malfunctions and when an out-of-range condition is found.

When the 'Stop' light (6) 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.

When an out-of-range conditions is found, the 'Fluid' light (8) illuminates and the engine protection system is initiated. The 'Fluid' light will start to flash if the out-of-range condition continues to get worse. The operator MUST shut down the engine to avoid serious damage.

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

Conditions that will cause the amber 'Fluid' light (8) to come on are; Low coolant level, High coolant temperature, Idle validation/throttle pedal switch mismatch, High intake manifold temperature, Low oil pressure and High fuel rail pressure.

Whenever the 'Stop' light (6), 'Warning' light (7) or 'Fluid' light (8) come on, the Electronic Fuel System computer will determine where the problem is and will store this information in its memory. If the malfunction is intermittent, the lights will come on and go off as the computer senses the changing engine condition.
A special diagnostic data reader (INSITE) is available that can be plugged into the engine computer memory via the onboard diagnostic test point (9). The reader is used to extract information related to the cause of the problem. Once the malfunction has been corrected, the Electronic Fuel System will return the engine to normal operation. The data reader can now distinguish between active codes and those stored in the historic code memory (inactive codes). Inactive codes can only be viewed using the data reader. The fault code recorded in the ECM memory will remain until it is erased by a technician.

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

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

If no active fault codes are recorded, all three ('Stop', 'Warning' & 'Fluid') lights will come on and stay on. If active codes are recorded, all three lights will come on momentarily. The yellow ('Warning') and red ('Stop') lights will begin to flash the code of the recorded fault. The fault codes flash in the following sequence: the yellow light flashes once, then there is a pause where both lights are off. Then the numbers of the recorded

ELECTRONIC FUEL SYSTEM DIAGNOSTIC CODES

Error Code	Description	Fault Lamp
111	ECM Hardware Internal Failure - Mission disabling	Red
112	Timing Actuator - Mechanically stuck	Red
113	Timing Actuator - Component shorted high	Yellow
114	Timing Actuator - Component shorted low	Yellow
115	Engine Speed Sensor - Both signals lost	Red
116	Fuel Timing Pressure Sensor - Component shorted high	Red
117	Fuel Timing Pressure Sensor - Component shorted low	Red
118	Fuel Pump Pressure Sensor - Component shorted high	Yellow
119	Fuel Pump Pressure Sensor - Component shorted low	Yellow
121	Engine Speed Sensor - One signal lost	Yellow
122	Intake Manifold 1 - Component high voltage or shorted high	Amber
123	Intake Manifold 1 - Component low voltage or shorted low	Amber
131	Throttle Position Sensor - Component shorted high	Red
132	Throttle Position Sensor - Component shorted low	Red
135	Oil Pressure Sensor - Component shorted high	Amber
141	Oil Pressure Sensor - Component shorted low	Amber
143	Oil Pressure Sensor - Data below normal range	Amber
144	Engine Coolant Temperature Sensor - Component shorted high	Amber
145	Engine Coolant Temperature Sensor - Component shorted low	Amber
146	Engine Coolent Temperature Sensor - Data moderately above normal range	Amber
151	Engine Coolant Temperature Sensor - Data excessively above normal range	Red
153	Intake Manifold 1 Temperature Sensor - Component shorted high	Amber
154	Intake Manifold 1 Temperature Sensor - Component shorted low	Amber
155	Intake Manifold 1 Temperature Sensor - Data above normal range	Red
187	Sensor Supply 2 Circuit - Component Low Voltage or shorted low	Amber
195	Coolent Level Sensor Circuit 1 - Component High Voltage or shorted high	Amber
196	Coolent Level Sensor Circuit 1 - Component Low Voltage or shorted low	Amber
197	Coolent Level Sensor Circuit 1 - Data below normal range, moderate severity	Amber
221	Ambient Air Pressure Sensor - Component shorted high	Amber
222	Ambient Air Pressure Sensor - Component shorted low	Amber
223	Engine Oil Burn Valve Solenoid - Low Voltage or shorted low	Amber
224	Engine Oil Burn Valve Solenoid - High Voltage orshorted high	Amber
227	Sensor Supply 2 Circuit - Component High Voltage or shorted high	Amber
231	Coolant Pressure Sensor - Component shorted high	Yellow
232	Coolant Pressure Sensor - Component shorted low	Yellow
233	Coolant Pressure, Engine Protection - Low coolant pressure	Amber
234	Engine Speed - Data above normal range	Red
235	Engine Coolant Level - Data below normal range	Red
237	External Speed Input (Multiple Unit Synchronization) - Data Incorrect	Amber
238	Sensor Supply 3 Circuit - Component Low Voltage or shorted low	Amber
254	Fuel Shutoff Value - Component shorted low	Red
259	Fuel Shutoff Solenoid - Fuel shutoff valve stuck open	Red
261	Fuel Temperature, Engine Protection - Fuel temperature high	Amber
263	Engine Fuel Temperature Sensor 1 Circuit - Component High Voltage or shorted high	Amber
265	Engine Fuel Temperature Sensor 1 Circuit - Component Low Voltage or shorted low	Amber
271	Fuel Pump Pressurizing Assembly 1 Circuit Component Low Voltage or shorted low	Amber
272	Fuel Pump Pressurizing Assembly 1 Circuit Component High Voltage or shorted high	Amber
285	SAE J1939 Multiplexing PGN Timeout Error - abnormal update rate	Amber
286	SAE J1939 Multiplexing Configuration Error - Out of calibration	Amber
316	Fuel Pump Actuator - Component shorted high or low	Yellow
318	Fuel Pump Flow - Mismatch between estimated and desired pressures	Yellow
319	Real Time Clock Power Interrupt - Data Erratic, Intermmitant or Incorrect	Maint
322	Injector Solenoid Driver Cylinder 1 Circuit - Current below normal or open circuit	Amber
323	Injector Solenoid Driver Cylinder 5 Circuit - Current below normal or open circuit	Amber
324	Injector Solenoid Driver Cylinder 3 Circuit - Current below normal or open circuit	Amber
325	Injector Solenoid Driver Cylinder 6 Circuit - Current below normal or open circuit	Amber
331	Injector Solenoid Driver Cylinder 2 Circuit - Current below normal or open circuit	Amber
332	Injector Solenoid Driver Cylinder 4 Circuit - Current below normal or open circuit	Amber
342	ECM Not Calibrated - ECM software mission disabling failure	Red

Error Code	Description	Fault Lamp
343	ECM Hardware Failure - Bad Intelligent Device or Component	Amber
346	ECM Software - Read/write, checksum error - Non mission disabling	Yellow
351	Injector Power Supply - Bad Intelligent Device or Component	Amber
352	Sensor Supply 1 Circuit - Component Low Voltage or shorted low	Amber
386	Sensor Supply 1 Circuit - Component High Voltage or shorted high	Amber
415	Oil Pressure Sensor - Data indicates very low oil pressure	Red
418	Water in Fuel Indicator - Data Valid but only slightly above operating range	Maint
422	Engine Coolant Level Sensor Signals - Data invalid	Yellow
423	Fuel Timing Pressure Sensor - In-range failure	Yellow
426	SAE J1939 Datalink - Cannot transmit	Yellow
427	SAE J1939 Not Fast Enough	-
431	Throttle Position Idle Validation Switch - Invalid	Yellow
432	Throttle Position Idle Validation Switch - Switch position and throttle percent mismatch	Amber
441	Battery Voltage, Unswitched - Data below normal engine range (moderately severe)	Amber
442	Battery Voltage, Unswitched - Data above normal engine range (moderately severe)	Amber
449	Injector Metering Line 1 Pressure	Red
451	Fuel Pressure Sensor - Component shorted high	Amber
452	Fuel Pressure Sensor - Component shorted low	Amber
455	Fuel Control Valve - Component shorted high or open	Red
467	Timing Fuelling Flow - Mismatch between estimated and desired timing	Yellow
468	Fuelling Rail Flow - Mismatch between estimated and desired rail pressure	Yellow
471	Engine Oil Level Low - Maintenance	Maint
472	Engine Oil Level #2 Low - Maintenance	Maint
473	Engine Oil Level #2 Low - Warning	Yellow
487	Start Assit Device - Canister empty (Ether injection)	-
488	Intake Manifiold 1 Temperature - Data Valid but only slightly above operating range (moderately severe)	Amber
489	Transmission Output Shaft Speed - Data Valid but only slightly below operating range (moderetely severe)	Amber
511	Fuel Control Valve - Component - shorted low	Red
514	Fuel Control Valve - Actuator mechanically stuck open	Red
524	Alternate Droop Switch Fault	Yellow
527	Auxiliary Input/Output #2 Circuit - Shorted high	Yellow
529	Auxiliary Input/Output #3 Circuit - Shorted high	Yellow
551	Idle Validation Circuit - No voltage detected on both off-idle and idle pins	Red
546	Fuel Delivery Pressure Sensing Circuit- Component High Voltage or shorted high	Amber
547	Fuel Delivery Pressure Sensing Circuit - Component Low Voltage or shorted low	Amber
553	Engine Fuelling Pressure Exceeded - Data above normal range	Red
554	Fuel Pressure Sensor - In-range failure	Yellow
555	Blowby Pressure, Engine Protection - Blowby pressure high	Amber
559	Injector Metering Line 1 Pressure - Data Valid but only slightly below operating range (moderetely severe)	Amber
611	Engine Hot Shutdown	-
649	Change Lubricating Oil and Filter	-
689	Engine Crankshaft Speed/Position - Data Erratic, Intermittant or Incorrect	Amber
719	Blowby Pressure Sensor - Component shorted high	Yellow
729	Blowby Pressure Sensor - Component shorted low	Yellow
731	Engine Speed/Position Camshaft and Crankshaft Misalignment- Mechanical system not responding or out of adjustment	Amber
753	Engine Speed Sensor - Engine speed signals do not match	Off
777	Turbocharger #1 Turbibe Inlet Temperature High - Warning level	Yellow
1117	Power Lost with Ignition On - Data Erratic, Intermittant or Incorrect	None
1357	Engine Oil Level Remote Reservoir - Data Valid but only slightly below operating range (moderetely severe)	Amber
1363	Intake Manifold 1 Pressure - Data Valid but only slightly below operating range (least severe level)	Maint
1376	Engine Camshaft Speed/Position Sensor - Data Erratic, Intermittant or Incorrect	Maint
1387	SAE J1939 Engine Commanded Shutdown	-
1597	Engine Control Module Critical Internal Failure - Bad Intelligent Device or Component	Maint

Error Code	Description	Fault Lamp
1845	Water in Fuel Injector Sensor Circuit - Component High Voltage or shorted high	Maint
1846	Water in Fuel Injector Sensor Circuit - Component Low Voltage or shorted low	Maint
1852	Water in Fuel Indicator - Data Valid but only slightly above operating range (moderately severe)	Amber
1891	Engine Oil Change Interval	Amber
1911	Injector Metering Rail 1 Pressure - Data Valid but above normal operating range (most severe level)	Amber
2185	Sensor Supply 4 Circuit - Component High Voltage or shorted high	Maint
2186	Sensor Supply 4 Circuit - Component Low Voltage or shorted low	Maint
2215	Fuel Pump Delivery Pressure - Data Valid but only slightly below operating range (moderately severe)	Amber
2261	Fuel Pump Delivery Pressure - Data Valid but above operating range (least severe level)	Maint
2262	Fuel Pump Delivery Pressure - Data Valid but below operating range (least severe level)	Maint
2265	Electric Lift Pump for Engine Fuel Supply Circuit - Component High Voltage or shorted high	Amber
2266	Electric Lift Pump for Engine Fuel Supply Circuit - Component Low Voltage or shorted low	Amber
2311	Electronic Fuel Injection Control Valve Circuit	Amber
2321	Engine Crankshaft Speed/Position - Data Erratic, Intermittant or Incorrect	-
2322	Engine Camshaft Speed/Position Sensor - Data Erratic, Intermittant or Incorrect	-

fault code flash in red. There is a pause between each number. When the number is done, the yellow light flashes again. e.g. yellow flashes once - pause - red flashes twice - pause - red flashes three times - pause - red flashes five times - pause - yellow flashes once, indicates fault code 235. The number will repeat in the same sequence until the system is advanced to the next active fault code or the diagnostic switch is switched to the 'OFF' position. Refer to 'Electronic Fuel System Diagnostic Codes' table for fault code descriptions.

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

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.