TEREX

TEREX Equipment Limited Maintenance Manual

MAINTENANCE MANUAL
TR35 Tier 3

15503255
SM877

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TEREX

TEREX Equipment Limited Maintenance Manual Re-order

Maintenance Manual
TR35 Tier 3
15503255
SM877

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This controlled document is the original instruction and should remain with the vehicle at all times.

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TEREX

TEREX Equipment Limited

Maintenance Manual

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For further information on the subject matter detailed within this operator handbook, please refer to Terex Equipment Limited Service Manuals and Product Parts Books.

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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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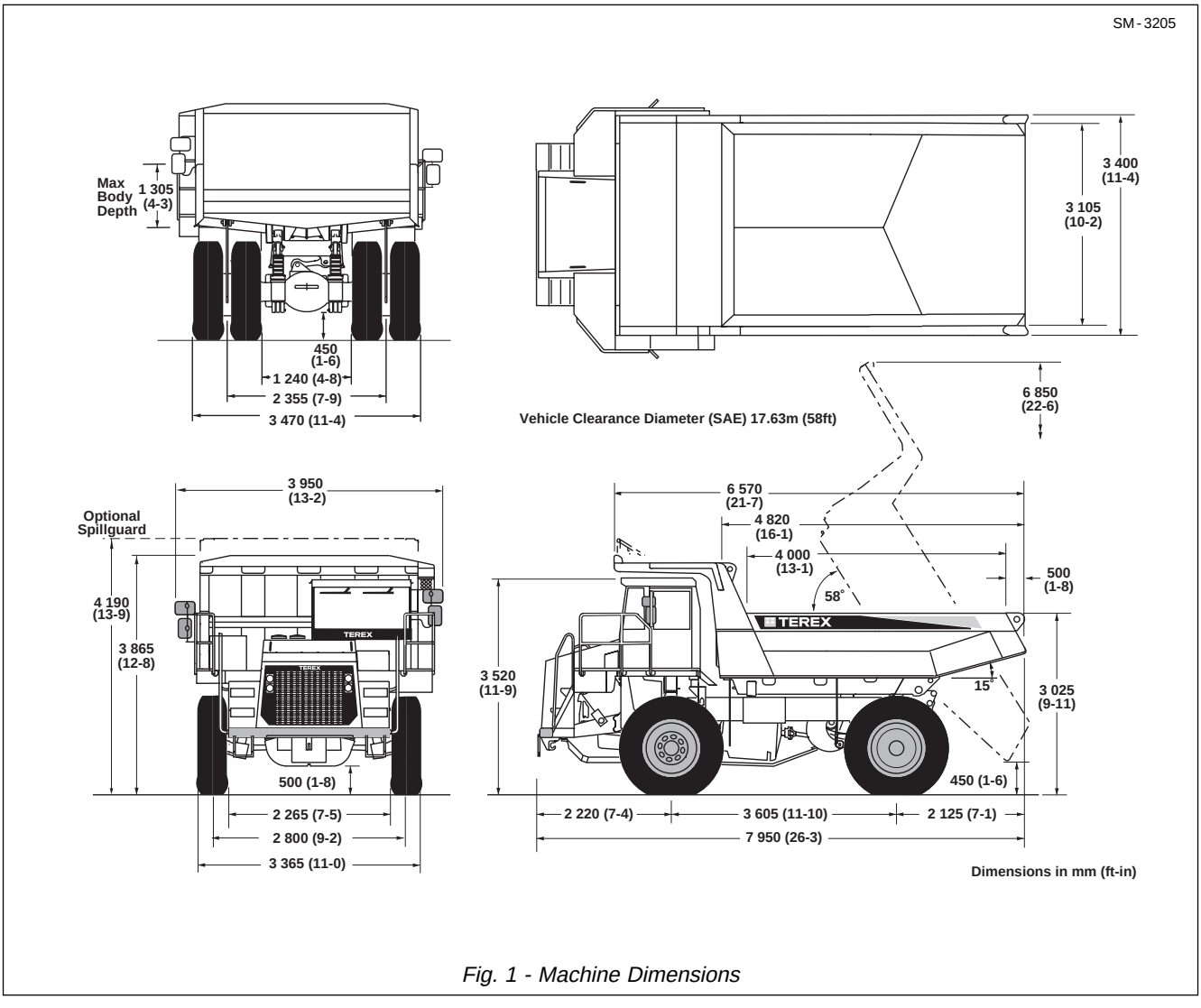

Fig. 1 - Machine Dimensions

ENGINE

Make/Model ..... Cummins QSM11-C400E
Type ..... 4 Cycle, low emission, air to air charge, air-cooled electronic diesel engine
Gross Power at 2 100 rev/min ..... 298 kW (400 hp)
Net Power at 2 100 rev/min ..... 276 kW (319 hp)

Note: Gross power rated to SAE J1995 Jun 90. Engine emission meets USA EPA/CARB MOH Tier 2, CARB Tier 2 ans EU NRMM Stage 2 emissions (non-road mobile machinery) directive.

Maximum Torque ..... 1898 Nm (1400 lbf ft) at 1300 rev/min
Number of Cylinders/Configuration ..... 6, in line
Bore x Stroke ..... 125 x 147 mm (4.9 x 5.8 in)
Total Displacement ..... 10.8 litres (661 in³)
Starting ..... Electric
Maximum Speed, Full Load ..... 2100 rev/min
Maximum Speed, No Load ..... 2450 rev/min
Idle Speed ..... 800 rev/min

TRANSMISSION

Make/Model ..... Allison 4500 ORS_R Automatic
Remote mounted in the frame with integral torque converter, hydraulic retarder and planetary gearing. Five speeds forward, one reverse. Automatic shifting in forward range. Downshift and reverse inhibitors. Automatic converter lockup action in all speed ranges.

Speeds With Standard Planetary					
Forward					
Gear	1	2	3	4	5
Ratio	4.70	2.21	1.53	1.00	0.67
km/h	9.50	20.2	29.3	44.8	58.6
mile/h	5.90	12.6	18.2	27.8	36.4
Reverse					
Gear	1				
Ratio	5.55				
km/h	8.4				
mile/h	5.2				

DRIVE AXLE

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

Ratios:	Standard	Optional
Differential	2.50:1	3.13:1
Planetary	4.59:1	4.59:1
Total Reduction	11.48:1	14.37:1

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 ..... 225 mm (9.0 in)
- Rear ..... 160 mm (6.3 in)

Maximum Rear Axle Oscillation ..... ± 8.0 Degrees

WHEELS AND TYRES

Wheel Rim Width ..... 13 in
Tyres (Front & Rear):
- Standard ..... 18.00 R 25** Radial
- Optional ..... 18.00-25 (32 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

Dual shoe, internal expanding, mechanically actuated by air pressure. Independent front and rear circuits actuated by single treadle valve with auxiliary manual control. Operator controlled wet/dry road valve reduces front brake pressure by 50% for improved control in slippery conditions.

Front Linings:
- Diameter X Width ..... 508 x 152 mm (20 x 6 in)
- Area, Front Axle ..... 3459 cm² (536 in²)

Rear Linings:
- Diameter X Width ..... 508 x 190 mm (20 x 7.5 in)
- Area, Rear Axle ..... 4323 cm² (670 in²)

Total Lining Area ..... 7782 cm² (1 206 in²)
Air Compressor Capacity ..... 425 litre/min (15 ft³/min)

Parking

Service brakes act as parking brakes when applied by manual control valve on the instrument panel.

Retardation

Non-wearing hydrodynamic retarder integral with transmission, 320 kW (430 hp) continuous.

Emergency

Warning light in cab indicates when air pressure drops below 5.5 bar (80 lbf/in²). Front and rear brakes automatically actuate if system air pressure falls to 3.1 bar (45 lbf/in²).

Total brake air reservoir capacity ..... 81 l (4950 in³)

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 (1200 lbf/in²). Steering conforms to ISO 5010, SAE J53.

System Pressure ..... 120.6 bar (1750 lbf/in²)
Relief Pressure ..... 207 bar (3000 lbf/in²)
Steering Cylinders ..... Double Acting, Single Stage
Accumulator:
- Oil Capacity ..... 16.4 litres (4.33 US gal)
- Nitrogen Precharge Pressure ..... 48.3 bar (700 lbf/in²)

Steering Angle (Left and Right) ..... 42°
Pump:
- Type ..... Piston
- Capacity at 2 100 rev/min ..... 1.45 l/s (23 US gal/min)

BODY HYDRAULICS

Two body hoist cylinders are mounted between the frame rails. Cylinders are two-stage with power down in the second stage. The body hydraulic system is independent of the steering hydraulic system.

System Relief Pressure ..... 138 bar (2000 lbf/in²)
Pump:
- Type ..... Gear
- Capacity at 2 100 rev/min ..... 210 l/min (55.5 US gal/min)

Control Valve ..... Servo Controlled Open Centre
Body Raise Time ..... 14 Seconds
Body Lower Time ..... 9.5 Seconds

ELECTRICAL

Type ..... 24 Volt, Negative Ground
Battery ..... Two, 12 Volt, 165 Ah each, Maintenance Free
Accessories ..... 24 Volt
Alternator ..... 70 Amp
Starter ..... 7.7 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 wear surfaces are high hardness (360-440 BHN)

abrasion resistant steel. Yield strength of plates 1000 MPa (145 000 lbf/in²).

Plate Thicknesses:
- Floor ..... 16 mm (0.63 in)
- Side ..... 8 mm (0.31 in)
- Front, lower ..... 10 mm (0.39 in)

ROPS Cabguard SAE J1040 Feb 86. ISO 3471

Volumes:
- Struck (SAE) ..... 15.3 m³ (20 yd³)
- Heaped 2:1 (SAE) ..... 19.4 m³ (25 yd³)

SERVICE CAPACITIES

Engine Crankcase and Filters ..... 33 l (8.7 US gal)
Transmission and Filters ..... 61 l (16 US gal)
Cooling System ..... 90 l (23.8 US gal)
Fuel Tank ..... 371 l (98 US gal)
Steering Hydraulic Tank ..... 30 l (8 US gal)
Steering System ..... 47 l (12.4 US gal)
Main Hydraulic Tank ..... 83 l (22 US gal)
Main Hydraulic System ..... 121 l (32 US gal)
Planetaries (Total) ..... 30 l (8 US gal)
Differential ..... 57 l (15 US gal)
Front Ride Strut (Each) ..... 14 l (3.7 US gal)
Rear Ride Strut (Each) ..... 8 l (2.1 US gal)
Power Takeoff ..... 2.0 l (0.53 US gal)

Typical Noise Levels

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

*Exterior Sound Rating (SAE J88 JUN 86) ..... 86 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	17250	38030
Body, standard	6000	13230
Net Weight	23250	51260
PAYLOAD, maximum	**31750**	**70000**
Maximum Gross Weight*	**55000**	**121260**
FOR UNIT EQUIPPED WITH OPTIONAL BODY WEAR PLATES:		
Chassis, with hoists	17250	39030
Body, standard	7200	15880
Net Weight	24450	53910
PAYLOAD, maximum	**30550**	**67350**
Maximum Gross Weight*	**55000**	**121260**
* Maximum permissible gross vehicle weight with options, attachments, full fuel tank and payload.		
WEIGHT DISTRIBUTION	Front Axle	Rear Axle
Empty %	48	52
Loaded %	33	67

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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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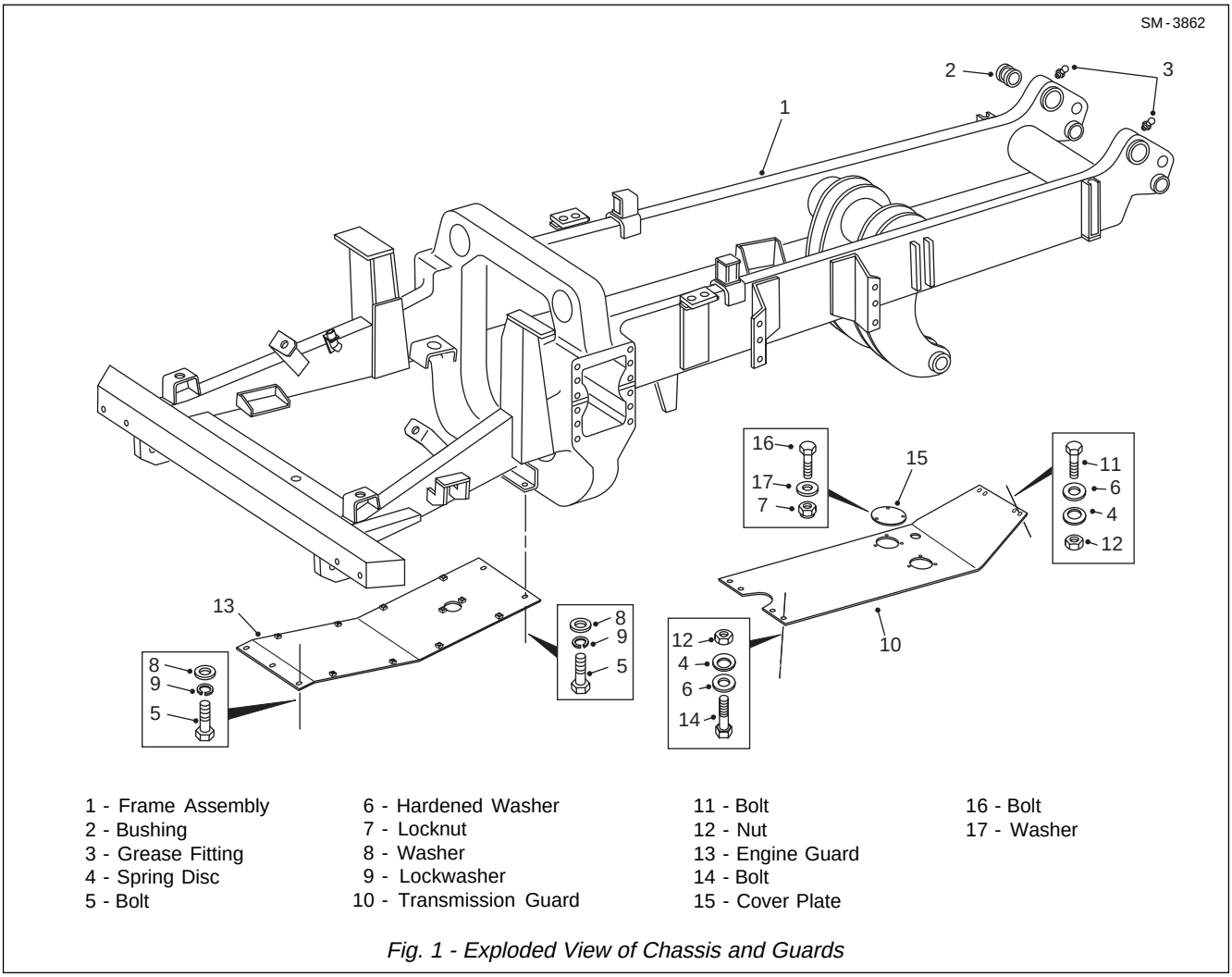


1 - Frame Assembly
2 - Bushing
3 - Grease Fitting
4 - Spring Disc
5 - Bolt
6 - Hardened Washer
7 - Locknut
8 - Washer
9 - Lockwasher
10 - Transmission Guard
11 - Bolt
12 - Nut
13 - Engine Guard
14 - Bolt
15 - Cover Plate
16 - Bolt
17 - Washer

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

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

2. Turn steering wheel 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

⚠ 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.

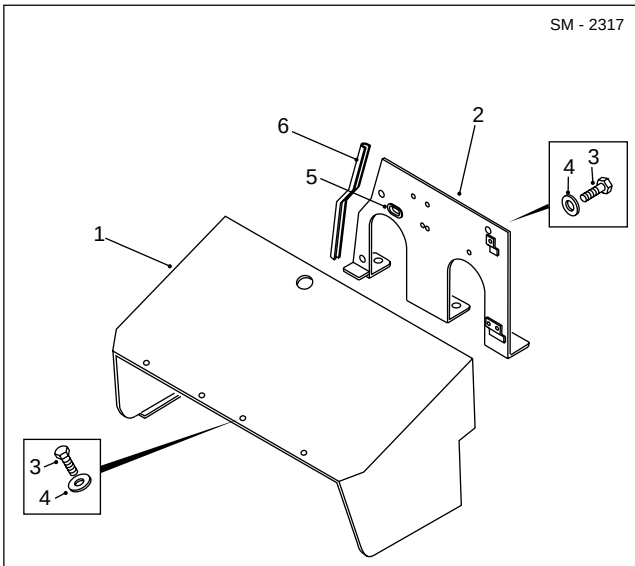
Note: Prior to welding, switch off/disconnect the following in the order given. Failure to do so may seriously damage the machines electrical components.

a - Turn ignition keyswitch off
b - Battery earth cables
c - Battery supply cables
d - Alternator earth cables
e - Alternator supply cables

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

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.



1 - Hood Assembly
2 - Baffle Plate
3 - Bolt
4 - Hardened Washer
5 - Grommet
6 - Beading

Fig. 2 - Exploded View of Hood and Mounting

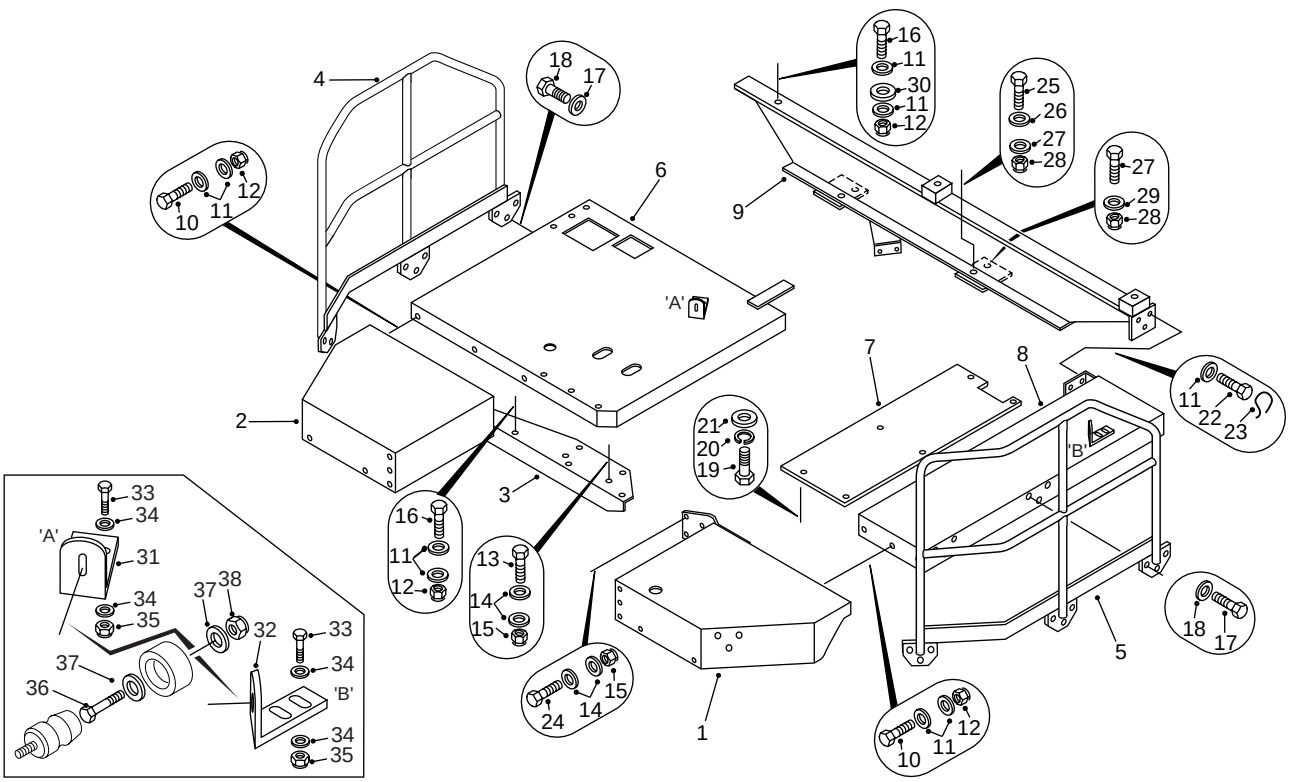
Successfully welded repairs will depend to a great extent upon the use of the proper equipment, materials and the ability of the welder. The Service Department can be consulted regarding the feasibility of welding repairs.

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 followed for protection of the welding operator from fumes.



1 - LH Fender Assembly
2 - RH Fender Assembly
3 - Bracket
4 - RH Handrail Assembly
5 - LH Handrail Assembly
6 - RH Platform Assembly
7 - Plate
8 - LH Platform Assembly
9 - Channel
10 - Bolt
11 - Hardened Washer
12 - Locknut
13 - Bolt
14 - Washer
15 - Locknut
16 - Bolt
17 - Bolt
18 - Hardened Washer
19 - Bolt
20 - Lockwasher
21 - Washer
22 - Bolt
23 - Lockwire
24 - Bolt
25 - Bolt
26 - Tapered Washer
27 - Washer
28 - Locknut
29 - Bolt
30 - Tapered Washer
31 - Bracket
32 - Bracket
33 - Bolt
34 - Hardened Washer
35 - Locknut
36 - Bolt
37 - Washer
38 - Locknut

Fig. 3 - Exploded View of Fenders and Mounting

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.

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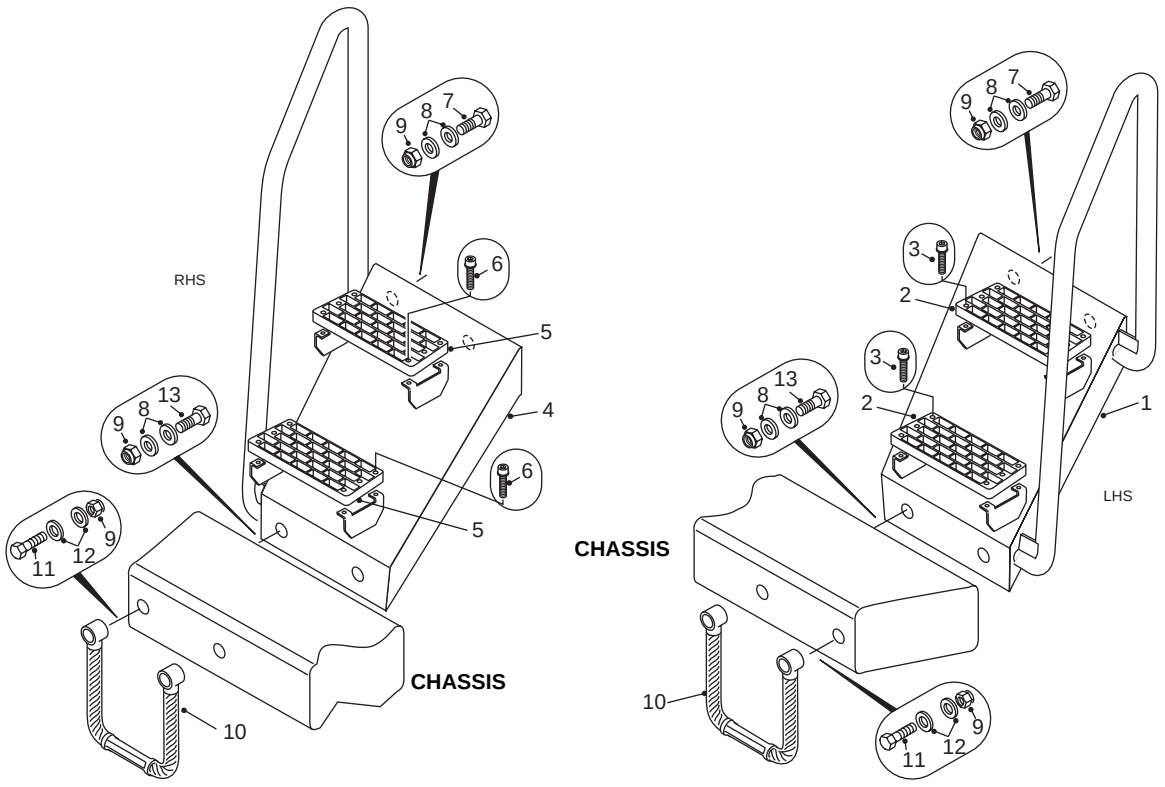
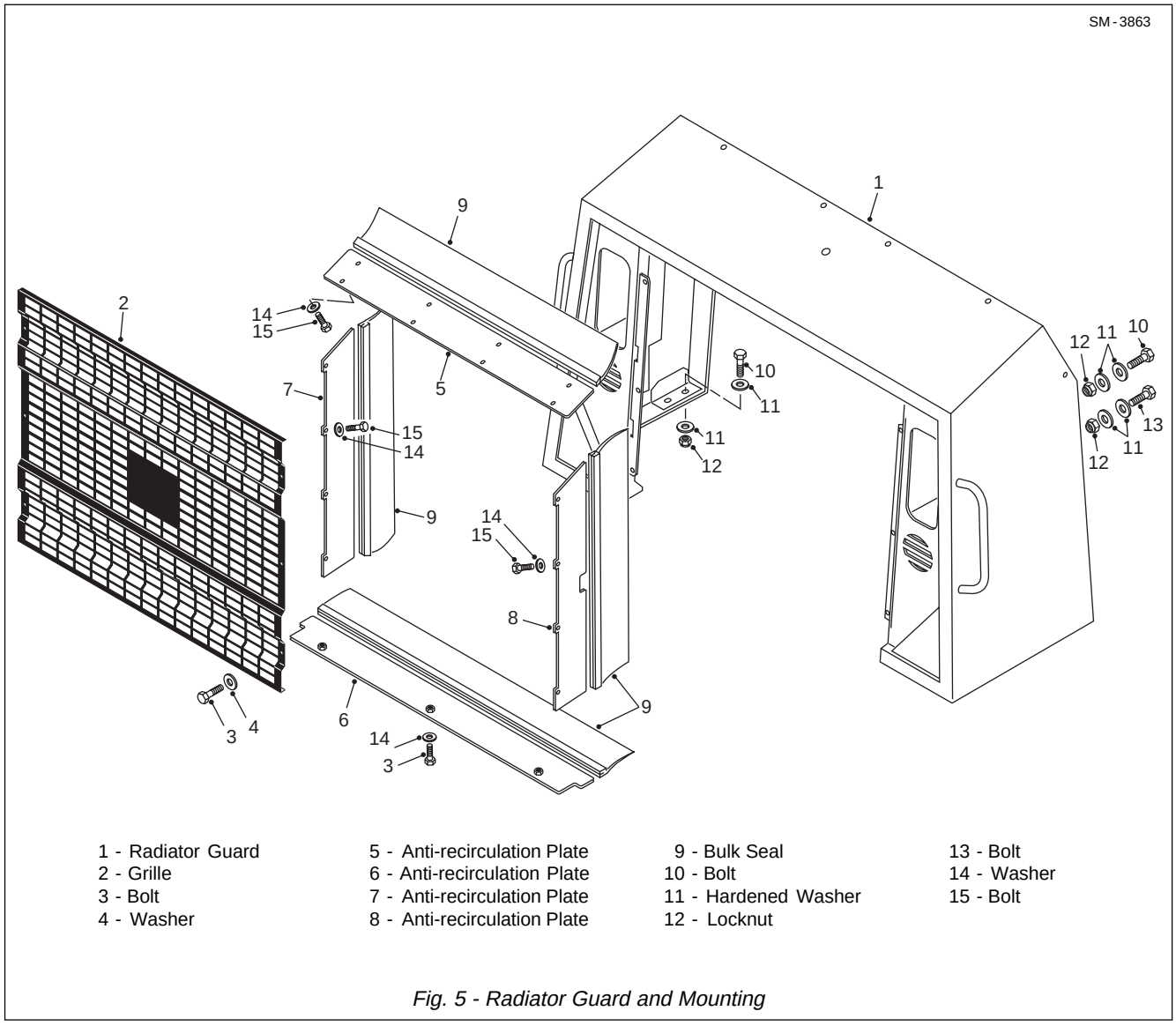


1 - LH Step Assembly
2 - Treadplate
3 - Capscrew
4 - RH Step Assembly
5 - Treadplate
6 - Capscrew
7 - Bolt
8 - Hardened Washer
9 - Locknut
10 - Step Assembly
11 - Bolt
12 - Hardened Washer
13 - Bolt

Fig. 4 - Exploded View of Ladders and Handrails



1 - Radiator Guard
2 - Grille
3 - Bolt
4 - Washer
5 - Anti-recirculation Plate
6 - Anti-recirculation Plate
7 - Anti-recirculation Plate
8 - Anti-recirculation Plate
9 - Bulk Seal
10 - Bolt
11 - Hardened Washer
12 - Locknut
13 - Bolt
14 - Washer
15 - Bolt

Fig. 5 - Radiator Guard and Mounting

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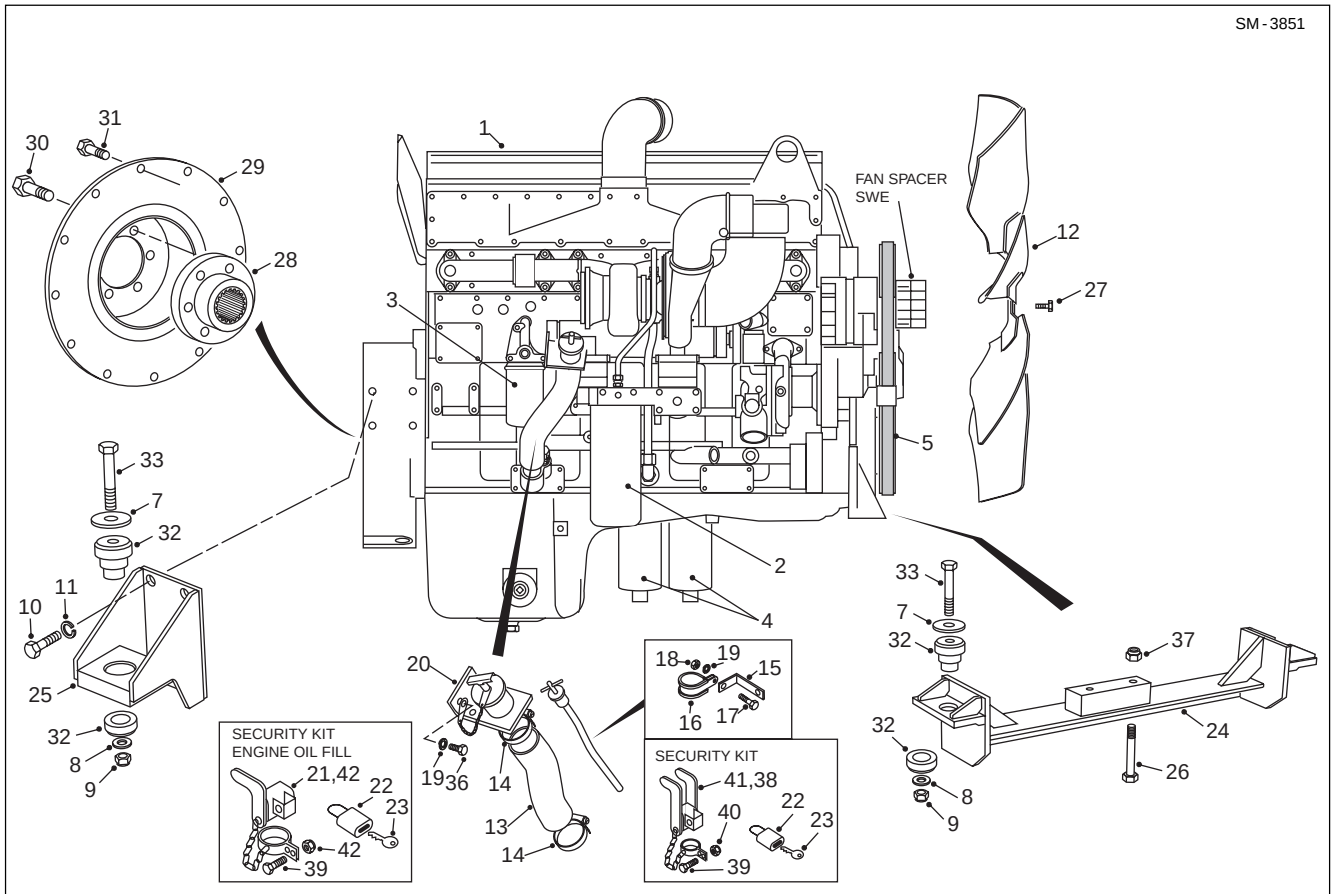

1 - Engine
2 - Lube Oil Filter
3 - Coolant Filter
4 - Fuel Filter
5 - Fan Belt
6 - Locknut
7 - Snubbing Washer
8 - Washer
9 - Locknut
10 - Bolt
11 - Lockwasher
12 - Fan
13 - Tube
14 - Clamp
15 - Bracket
16 - P-Clip
17 - Bolt
18 - Nut
19 - Lockwasher
20 - Tube
21 - Security Latch
22 - Lock
23 - Key
24 - Front Mounting Bracket
25 - Rear Mounting Bracket
26 - Bolt
27 - Bolt
28 - Flange Coupling
29 - Hub Flanged
30 - Bolt
31 - Bolt
32 - Isolation Mount
33 - Bolt
34 - Dipstick
35 - Dipstick Tube
36 - Bolt
37 - Nut
38 - Clamp
39 - Bolt
40 - Locknut
41 - Security Latch
42 - Clamp

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 supported by front mounting bracket (24) and two rear mounting brackets (25) which are bolted to the engine and attached to the tractor frame through isolation mounts (32). Isolation mounts (32) provide sufficient flexibility to absorb varying engine vibration and torsional loads.

Lube oil filter (2) and coolant filter (3) are mounted on the right hand side of engine (1) and fuel filters (4) are mounted on the left hand side.

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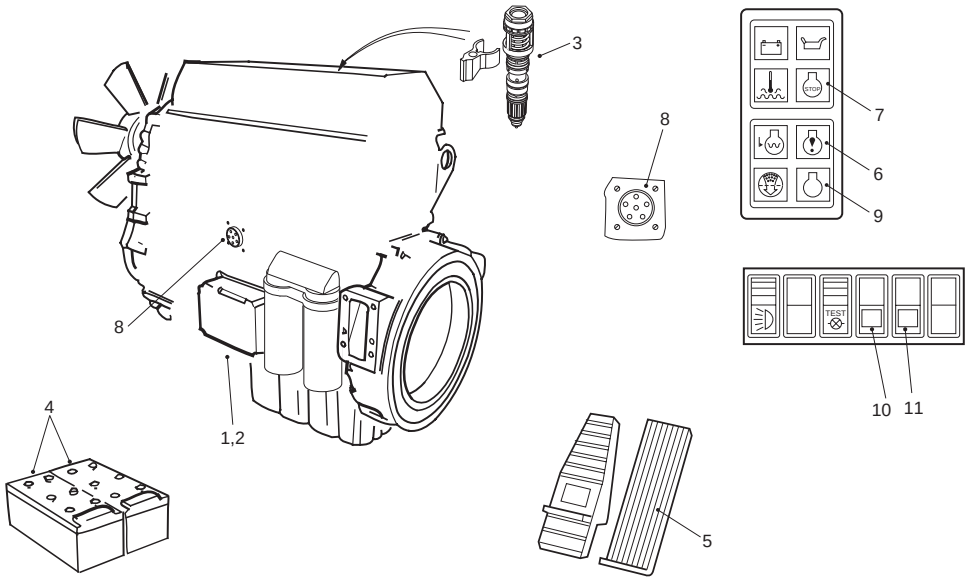

1 - Electronic Control Module (ECM)
2 - Programmable Read Only Memory (PROM)
3 - Electronic Fuel System Injectors
4 - Batteries
5 - Electronic Foot Pedal
6 - Check Engine Light
7 - Stop Engine Light
8 - Diagnostic Test Point
9 - Engine Protection Fluid light
10 - Engine Diagnostic Switch
11 - Engine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

QUANTUM ELECTRONIC FUEL 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 and electrical connections at the engine ECM, transmission ECU, body control lever, hydraulics ECU and cab bulkhead to avoid damage to electrical components. Turn off battery master switch to isolate the batteries before disconnecting any components.

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

The engine is equipped with Quantum Electronic Fuel System which controls the timing and amount of fuel injection by the electronic fuel system injectors. The system also monitors several engine functions using electrical sensors which send electrical signals to the electronic control module (ECM).

The ECM then computes the incoming data and determines the correct fuel output and timing for optimum power, fuel economy and emissions. The Quantum Electronic Fuel System also takes action to prevent damage to the engine and, provides the serviceman with diagnostic capabilities so that problems can be corrected quickly and easily.

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

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

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

The injector performs four functions:

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

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

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

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

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

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

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

6. 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.

7. 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.

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

9. Engine Protection Fluid Light - Illuminates when a fault has been detected in the engine. Light remains 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 and the engine power and/ or speed will be gradually reduced. Stop the machine and do not operate until the fault is corrected.

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

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

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

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

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

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

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

Operation

Numbers in parentheses refer to Fig. 2.

When the 'Stop' light on the dash panel illuminates, the ECM (1) has detected a major malfunction in the engine that requires immediate attention. It is the operators responsibility to shut down the engine to avoid serious damage.

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

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

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

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

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

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

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

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

If no active fault codes are recorded, both 'Stop' (7) and 'Check' (6) lights will come on and stay on. If active codes are recorded, both lights will come on momentarily. The amber 'Check' (6) and red 'Stop' (7) lights will begin to flash the code of the recorded fault. The fault codes flash in the following sequence: the amber light flashes once, then there is a pause where both lights are off. Then the numbers of the recorded fault code flash in red.

There is a pause between each number. When the number is done, the amber light flashes again. e.g. amber flashes once - pause - red flashes twice - pause - red flashes three times - pause - red flashes five times - pause - amber flashes once, indicates fault code 235. The number will repeat in the same sequence until the system is advanced to the next active fault code by diagnostic request switch (11), or the diagnostic switch (10) is switched to the 'OFF' position. Refer to 'Electronic Fuel System Diagnostic Codes' table for fault code descriptions.

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

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

Maintenance Monitor

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

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

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

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

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

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

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

2. Turn key to position '1'.

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

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

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

6. The maintenance light will flash three times. This means the maintenance monitor is reset.
Note: If the maintenance light does not flash as described, the reset sequence must be performed again.

7. Turn key to position '0'.

8. Remove blocks from road wheels.

Alternative method of resetting maintenance monitor is as follows:

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

2. Turn keyswitch to position '1'.

3. Press engine diagnostic switch on.

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

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

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

7. The maintenance light will flash three times.
Note: If the maintenance light does not flash as described, the reset sequence must be performed again.

8. Press engine diagnostic switch off.

9. Turn key to position '0'.

10. Remove blocks from road wheels.

REMOVAL

Numbers in parentheses refer to Fig. 1.

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

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

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

1. Position the vehicle in a level work area, apply the parking brake, switch off the engine and turn the steering wheel in both directions several times to relieve pressure in the steering system.

2. Block all road wheels. Disconnect battery cables from terminal posts (ground cable first).

3. Remove engine hood assembly. Refer to Section 100-0010, CHASSIS, HOOD AND FENDERS.

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

Note: If anti-spill drain plug is fitted, remove cap from connection, install drain tube connection and drain oil into a suitable container.

WARNING
Air Conditioners contain harmful gas. Refrigerant will rapidly freeze all objects with which it comes into contact. It can cause serious damage to the eyes and skin. Refer to Section 260-0130, AIR CONDITIONING before disconnecting any air conditioner lines.

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

6. With suitable containers in position, open drain cocks and drain coolant from the radiator and engine. Close all drain cocks securely after draining.

7. Identify cooling and heater lines for ease of installation and, with suitable containers in position to catch spillage, disconnect lines from engine (1) and remove the radiator assembly. Refer to Section 210-0040, RADIATOR AND MOUNTING.

8. Disconnect exhaust piping from the engine turbocharger at the silencer.

9. Disconnect compressor air outlet tube and secure clear of engine.

10. Disconnect accelerator cable at engine (1).

11. Identify and disconnect cables at starter motor and alternator.

12. Identify and disconnect electrical cables from the oil pressure sender switch, engine temperature switch, fuel shut off solenoid and proximity switches on engine (1).

13. 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 to prevent entry of dirt.

14. Slacken clamp (14) securing filler tube (13) to filler neck assembly. Disconnect filler tube and tie onto engine (1) to prevent fouling.

15. Disconnect clips securing items to the engine that cannot be removed with the engine.

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

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

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