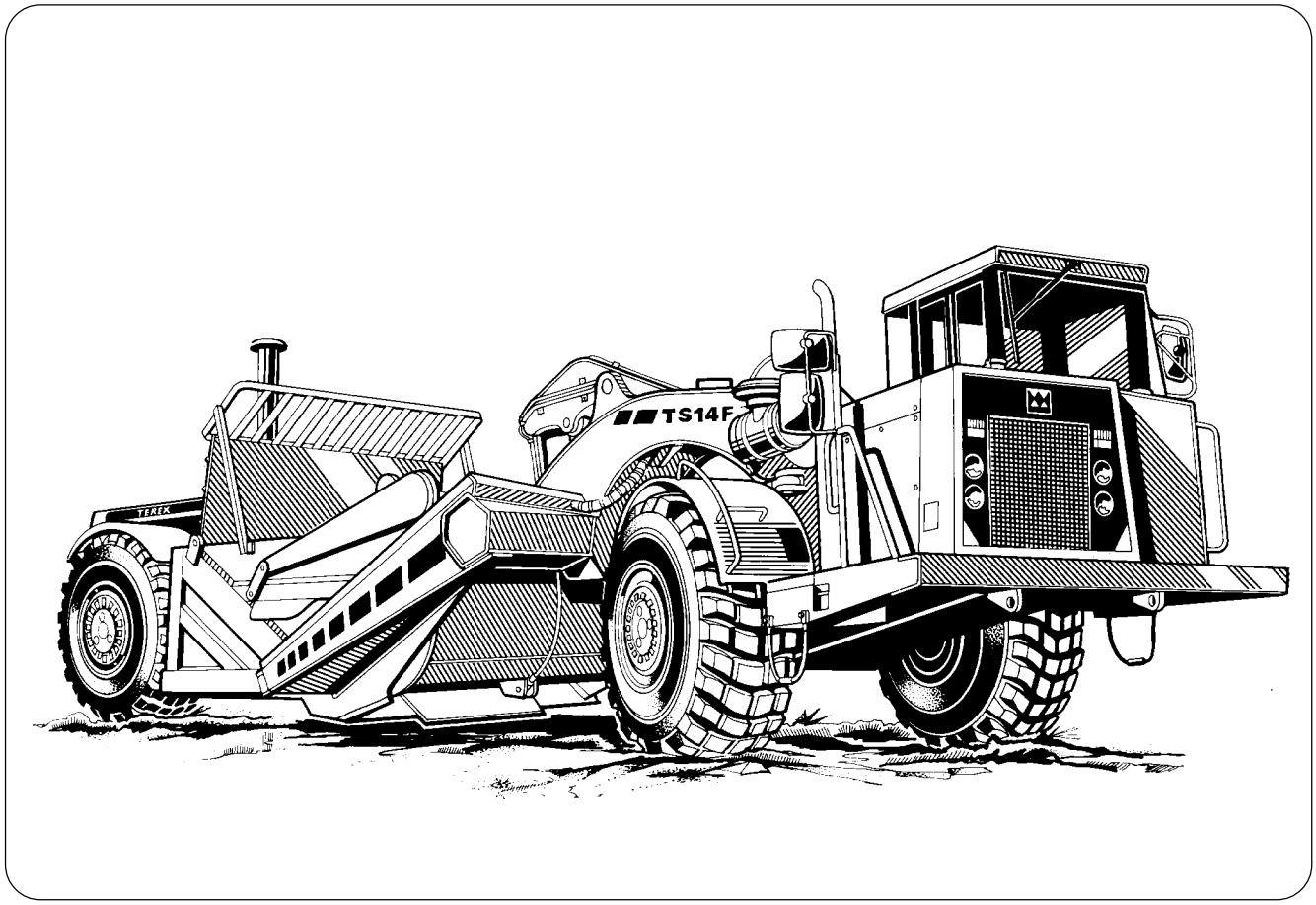
TS14F
Overhung Scraper
Maintenance Manual



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Service Information Alert

DATE: **April 1994** **B168**

MODEL: **General**

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

PURPOSE:

To advise potentially hazardous condition.

DETAIL:

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

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

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

a. Visually inspect for any gaskets or seals which have suffered from heat; they will appear black and sticky.

b. If this is affirmed - **Do Not Touch**

c. Make enquiries to ascertain the material composition. Any Fluoro-elastomer (Viton, Fluorel or Tecmoflon) should be considered dangerous but natural rubber and nitrile are non-hazardous.

d. If Fluoro-elastomer seals have been used, then the affected area MUST be decontaminated before undertaking further work.

e. Disposable Heavy Duty Gloves (Neoprene) MUST be worn and the affected area decontaminated by washing thoroughly with Limewater (Calcium Hydroxide solution).

f. Any cloths, residue and gloves used MUST be safely discarded after use.

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

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IMPORTANT SAFETY NOTICE

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

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

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

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

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

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

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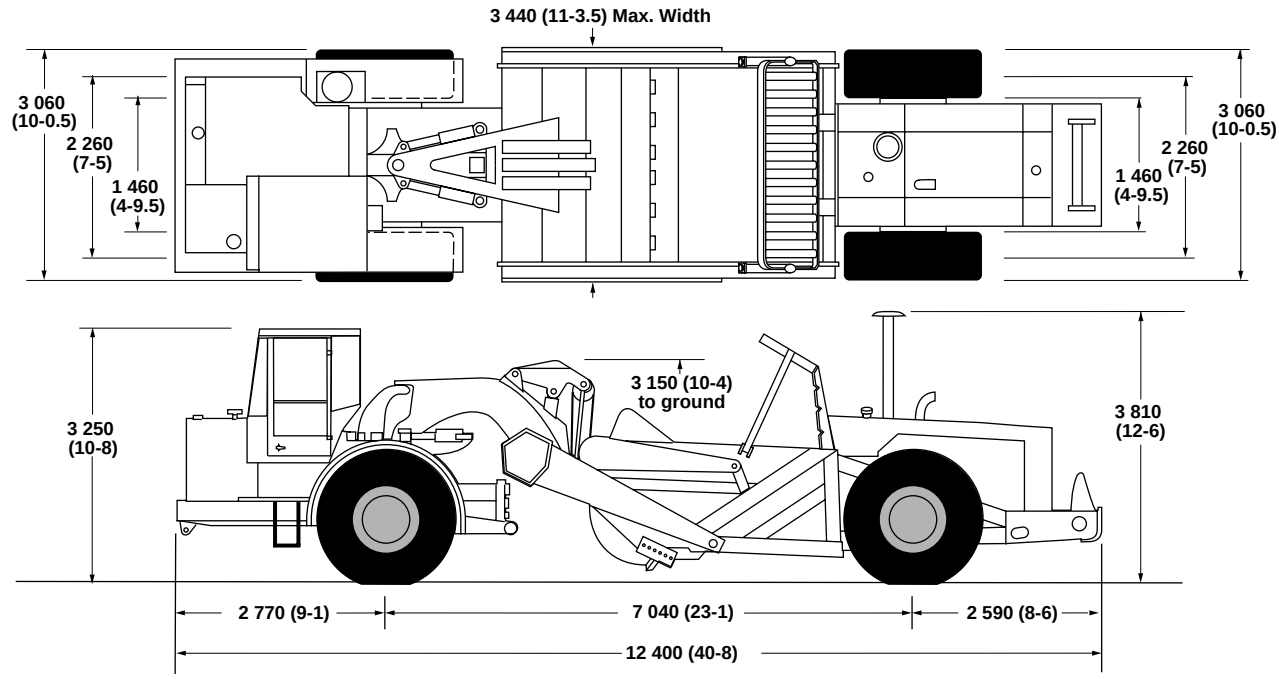

Dimensions in mm (ft-in)

Apron opening ..... 2 100 mm (6 ft 10.7 in)
Width of Bowl and Cutting Edge ..... 2 910 mm (9 ft 6.6 in)
Width of cut ..... 3 000 mm (9 ft 10 in)
Depth of cut - maximum ..... 305 mm (1 ft 0 in)
Depth of spread - maximum ..... 685 mm (2 ft 3 in)
Clearance under drive axle ..... 585 mm (1 ft 11 in)
Clearance under bowl - maximum ..... 585 mm (1 ft 11 in)

Overall length with optional Twin Hitch
Bail Raised ..... 13.6 m (44 ft 7 in)
Bail Lowered ..... 14.04 m (56 ft 8 in)

Note: All vertical measurements are with bowl at 300 mm (12 in) carry position. Unit empty.

Fig. 1 - Machine Dimensions

ENGINE

Tractor

Engine Series ..... Detroit Diesel Series 40E
Type ..... 4 Cycle Diesel, Turbocharged, Electronic Management
Gross power at 2 200 rev/min ..... 134 kW (180 hp)
Net power at 2 200 rev/min ..... 121 kW (162 hp)

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

Maximum Torque
at 1 600 rev/min ..... 720 Nm (531 lbf ft)
Number of cylinders/configuration ..... 6, Inline
Bore x Stroke ..... 109 x 136 mm (4.30 x 5.35 in)
Total Displacement ..... 7.6 litres (466 in³)
Air cleaner ..... Dry, Aspirated
Starting ..... Electric
Maximum Speed (No load) ..... 2 450 rev/min
Maximum Speed (Full load) ..... 2 200 rev/min
Idle Speed ..... 700 rev/min
Safe Operating Angle ..... 30°/57% Grade

Scraper

Engine Series ..... Detroit Diesel Series 40E
Type ..... 4 Cycle Diesel, Turbocharged, Electronic Management
Gross power at 2 200 rev/min ..... 119 kW (160 hp)
Net power at 2 200 rev/min ..... 109 kW (146 hp)

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

Maximum Torque
at 1 600 rev/min ..... 644 Nm (475 lbf ft)
Number of cylinders/configuration ..... 6, Inline
Bore x Stroke ..... 109 x 136 mm (4.30 x 5.35 in)
Total Displacement ..... 7.6 litres (466 in³)
Air cleaner ..... Dry, Aspirated
Starting ..... Electric
Maximum Speed (No load) ..... 2 450 rev/min
Maximum Speed (Full load) ..... 2 200 rev/min
Idle Speed ..... 700 rev/min
Safe Operating Angle ..... 30°/57% Grade

TRANSMISSION

Make/Model ..... Funk DF158 Powershift, counter-shaft type transmission with integral torque converter. Seven speeds forward and one reverse. Automatic lockup in the top six forward gears. Manual, electric shifting and downshift inhibitor. Rear transmission is equipped with an alarm to warn the operator in the event of transmission malfunction.

SPEEDS WITH STANDARD DIFFERENTIAL							
Forward							
Gear	1	2	3	4	5	6	7
Ratio	5.72	4.05	2.90	2.03	1.45	1.03	0.74
km/h	5.9	8.3	11.5	16.5	23.1	32.5	49.7
mile/h	3.6	5.1	7.2	10.2	14.3	20.2	30.9
Reverse							
Ratio	4.05						
km/h	8.3						
mile/h	5.1						

Stall Speed ..... 1 885 rev/min
Torque Converter Ratio (front and rear) 2.408:1

AXLES

Heavy duty axles with fully-floating axle shafts, single reduction bevel gear differential and planetary reduction in each wheel. A NoSpin differential is standard in the rear axle for improved traction in difficult conditions. A pedal controlled power-locking differential is optional in the front axle, operational in first gear only.

Ratios:
Differential 4.11:1
Planetary 5.33:1
Total Reduction 21.91:1

BRAKES

Full air operated drum brakes with automatic application on loss of air pressure. Secondary system can also be manually applied. Parking by mechanical locking of service brakes. Air dryer standard.

Braking Lining:
Diameter ..... 508 mm (20 in)
Shoe Width ..... 152 mm (6 in)
Lining Thickness ..... 19 mm (0.75 in)
Lining Area - Each Axle ..... 3 355 cm² (520 in²)
Air Compressor Capacity ..... 374 litre/min (13.2 ft³/min)

WHEELS AND TYRES

Wheel Rim Width ..... 25 in
Tyres:
Standard ..... 29.5 R25** Radial
Optional 29.5-25 (28PR) E3

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

STEERING SYSTEM

Full hydraulic type provided by two interchangeable single stage, double acting steering cylinders. Steering cylinders are mounted below the gooseneck to aid stability.

System Pressure ..... 135 bar (1 950 lbf/in²) at 1 500 rev/min
Steering Cylinder:
Bore and Stroke ..... 140 x 145 mm (5.5 x 17.5 in)
Pump:
Type ..... Gear
Drive ..... In tandem with hydraulic pump
Capacity at 2 200 rev/min ..... 147 litre/min (38.7 US gal/min)
Steering Angle to either side ..... 90°
Vehicle clearance circle (SAE) ..... 10 m (33 ft)

HYDRAULICS AND CONTROLS

Hydraulic system is filtered and has one reservoir supplying a triple section gear pump for steering and scraper hydraulics.

Scraper Functions:
Capacity at 2 200 rev/min ..... 270 litre/min (71.2 US gal/min)
System Pressure
at 1 500 rev/min ..... 103 bar (1 500 lbf/in²)

Servo Control Functions:
Capacity at 2 200 rev/min ..... 43 litre/min (11.3 US gal/min)
System Pressure
at 1 500 rev/min ..... 17 bar (250 lbf/in²)

Steering Pump ..... See Steering System

Three fingertip servo assisted control levers allow independent operation of the bowl, apron and ejector.

BOWL

High strength alloy steel used in sides and floor for increased strength and life. Low, wide design aids loading ability. Bowl employs two single stage, double acting cylinders to exert positive down pressure on the cutting edge to help penetrate hard material and load faster. Cylinders are interchangeable.

Cylinder Bore and Stroke ..... 203 x 460 mm (8.00 x 18.12 in)
Maximum Hydraulic Force at Cutting Edge with Bowl Empty .... 214 kN (21 822 kgf) (48 000 lbf)

APRON

Gravity closed, semi-radial design, power closing apron operated by one single stage, single acting cylinder with apron arms mounted outside the bowl. Apron and ejector cylinders are interchangeable.

Cylinder Bore and Stroke ..... 233 x 635 mm (9.17 x 25.0 in)

EJECTOR

Positive roll-out type operated by one single stage, single acting cylinder.

Cylinder Bore and Stroke ..... 233 x 635 mm (9.17 x 25.0 in)

CUTTING EDGE

Four section hardened cutting edge with drop centre capability. All edges are interchangeable and reversible.
Dimensions (Each) ..... 25 x 406 x 724 mm (1.0 x 16.0 x 28.5 in)

ELECTRICAL SYSTEM

Type ..... 24 volt, Negative Ground.
Battery ..... Two, 12 Volt, 165 Ah each
Accessories ..... 24 Volt
Alternator ..... 70 Amp

SERVICE CAPACITIES

Tractor
Cooling System ..... 43 litres (11.4 US gal)
Fuel Tank ..... 378 litres (100 US gal)
Engine Crankcase (& filters) ..... 24.6 litres (6.5 US gal)
Transmission and Converter .... 48.5 lites (12.8 US gal)
Hydraulic System ..... 204 litres (54 US gal)
Drive Axle ..... 17 litres (4.5 US gal)

Scraper
Cooling System ..... 42 litres (11.1 US gal)
Fuel Tank ..... 303 litres (80 US gal)
Engine Crankcase (& filters) ..... 24.6 litres (6.5 US gal)
Transmission and Converter ..... 49 litres (12.9 US gal)
Drive Axle ..... 17 litres (4.5 US gal)

VOLUMES

Struck (SAE) ..... 10.7 m³ (14.0 yd³)
Heaped 3:1 ..... 12.2 m³ (16.0 yd³)
Heaped 2:1 ..... 13.0 m³ (17.0 yd³)
Heaped 1:1 (SAE) ..... 15.3 m³ (20.0 yd³)

VEHICLE WEIGHTS			
Standard Vehicle	%	kg	lb
Net Weight Distribution			
Tractor Axle	58.5	16 560	36 510
Scraper Axle	41.5	11 710	25 815
Net Vehicle Weight		**28 270**	**62 325**
Rated Payload		**21 770**	**48 000**
Gross Weight Distribution			
Tractor Axle	52.0	26 020	57 370
Scraper Axle	48.0	24 020	52 955
Gross Vehicle Weight		**50 040**	**110 325**

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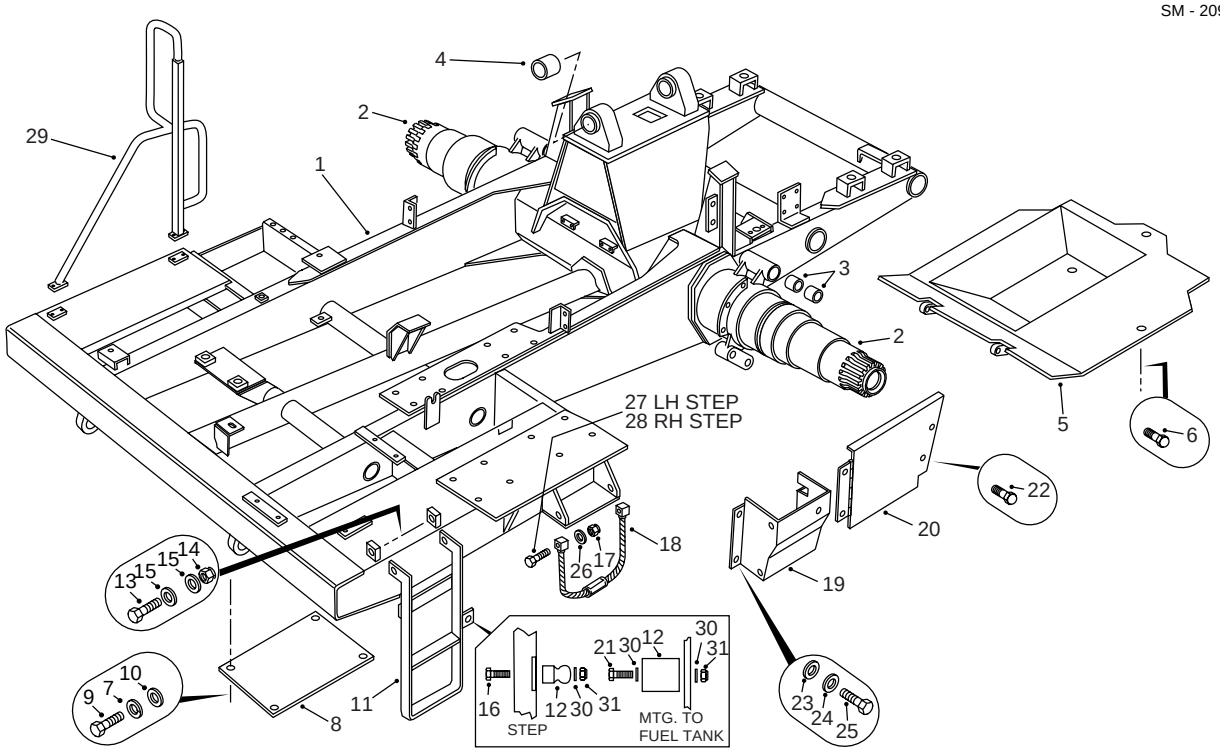


1 - Frame Assembly
2 - Spindle Assembly
3 - Bushing
4 - Bushing
5 - Guard Assembly
6 - Bolt
7 - Lockwasher
8 - Belly Guard
9 - Bolt
10 - Washer
11 - Step Assembly
12 - Retainer
13 - Bolt
14 - Nut
15 - Washer
16 - Bolt
17 - Locknut
18 - Step Assembly
19 - Cover
20 - Cover Assembly
21 - Bolt
22 - Bolt
23 - Washer
24 - Washer
25 - Bolt
26 - Hardened Washer
27 - Bolt
28 - Bolt
29 - Mirror Bracket
30 - Washer
31 - Locknut

Fig. 1 - Exploded View of Chassis and Guards

DESCRIPTION

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

The frame assembly (1) is constructed of heavy box-section side rails which are held in alignment by welded steel crossmembers.

An important feature of the frame's construction is its integral drive axle banjo housings and spindles (2). These parts are welded to the box-section side rails. The banjo housing in this design becomes an important load-carrying and strengthening member of the chassis. The upper part of the banjo housing also serves as the pivot point for the steering assembly.

The engine supports, transmission supports and various other brackets are welded in position on the frame.

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. Operate the steering in both directions several times to relieve any pressure in the steering system.

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

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

INSTALLATION

Note: Tighten all fasteners to standard torques listed in Section 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.

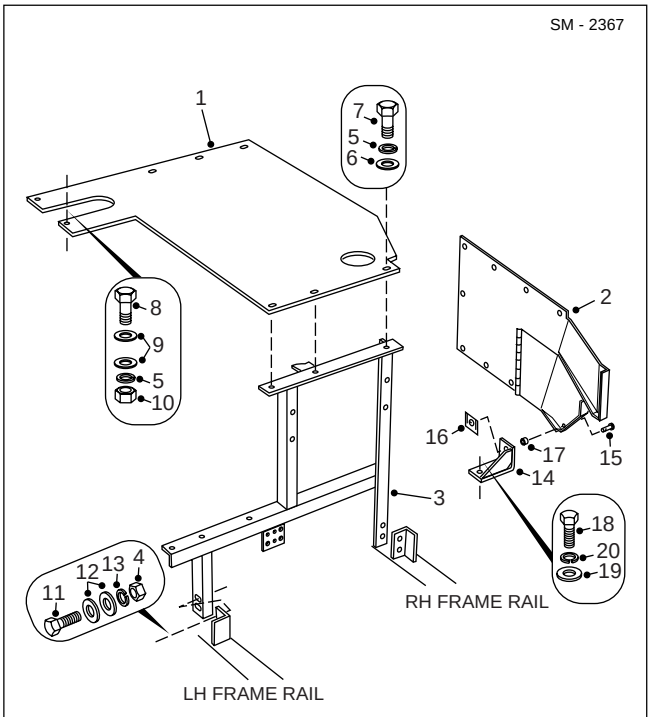
REPLACEMENT OF SPINDLE

Damaged spindles (2, Fig. 1), oil transfer tubes and banjo outer plates can be removed and new ones installed by following the procedures described in this section.

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.

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

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



1 - Hood Assembly
2 - Cover Assembly
3 - Support Assembly
4 - Nut
5 - Lockwasher
6 - Washer
7 - Bolt
8 - Bolt
9 - Washer
10 - Nut
11 - Bolt
12 - Washer
13 - Lockwasher
14 - Bracket
15 - Stud
16 - Recepticle
17 - Retainer
18 - Bolt
19 - Washer
20 - Lockwasher

Fig. 2 - Exploded View of Hood and Mounting

3. Remove all components from the spindle to be replaced. Attach a suitable lifting device to the component and remove mounting hardware. Remove the component from the vehicle. Refer to Section 160-0050, WHEEL RIM AND TYRE, for tyre and wheel removal; Section 160-0040, PLANETARY GEARING, for axle and planetary removal; and Section 165-0031, BRAKE PARTS, for brake removal.

4. Remove sun pinion and axle shaft from the opposite side of the machine. Refer to Section 160-0040, PLANETARY GEARING, for procedure.

5. Remove differential from the banjo. Refer to Section 160-0020, DIFFERENTIAL.

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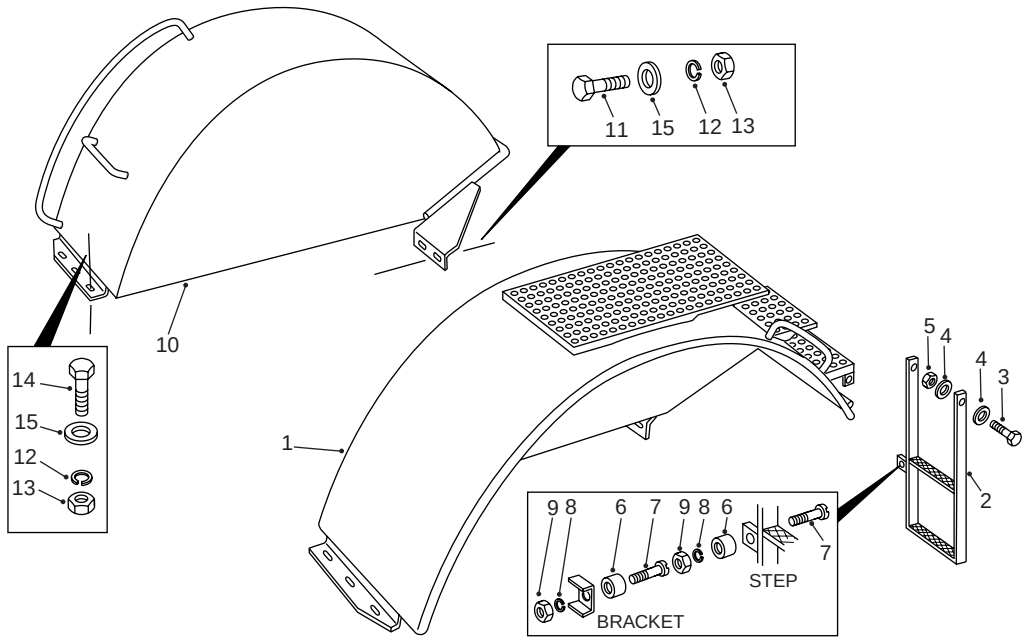

1 - LH Fender Assembly
2 - Step Assembly
3 - Bolt
4 - Washer
5 - Locknut
6 - Retainer
7 - Screw
8 - Lockwasher
9 - Nut
10 - RH Fender Assembly
11 - Bolt
12 - Lockwasher
13 - Nut
14 - Bolt
15 - Hardened Washer

Fig. 3 - Exploded View of Fenders and Mounting

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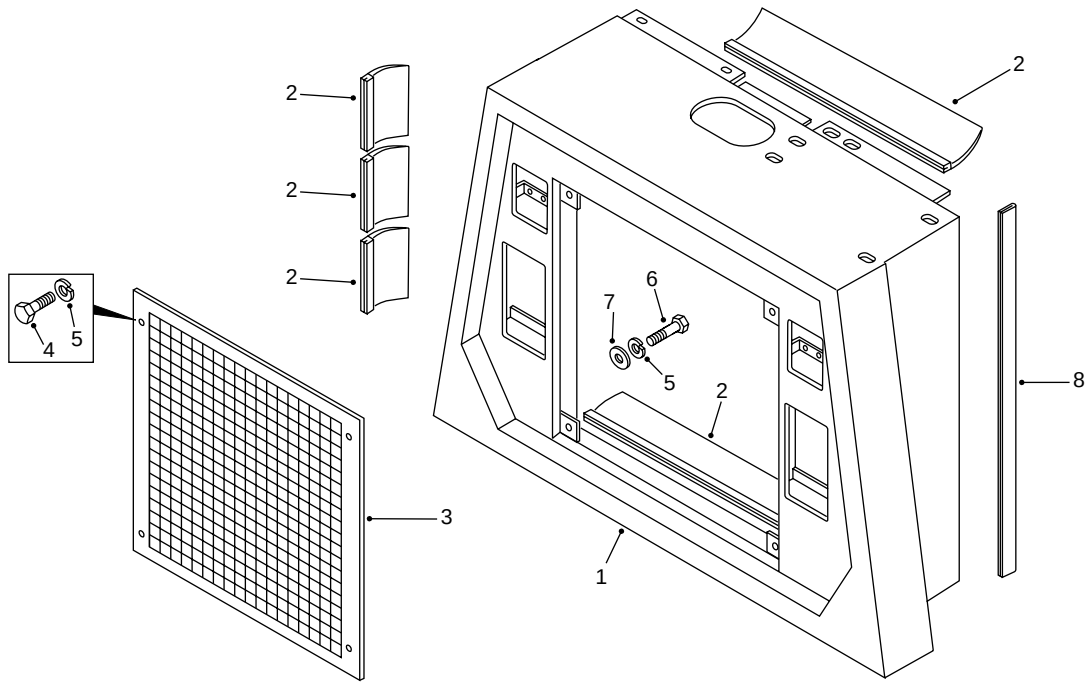


1 - Radiator Guard
2 - Seal
3 - Grille
4 - Bolt
5 - Lockwasher
6 - Bolt
7 - Washer
8 - Seal

Fig. 4 - Radiator Guard and Mounting

Oil Transfer Tube

1. Burn off weld that fastens oil transfer tube to spindle.

2. Reaching into the banjo, burn off the weld that holds the oil transfer tube to the banjo housing.

3. Remove and discard oil transfer tube from the spindle.

4. Using a grinder, remove all burrs and slag from the spindle end and inside the banjo weld joint areas.

5. Thoroughly clean the spindle and banjo cavities to remove all metal chips.

6. Install new oil transfer tube in the spindle.

7. Weld all round the oil transfer tube at the spindle end and banjo end. Use E-70 low hydrogen weld rod and make a 1/1 6 in (1.6 mm) oil tight fillet weld all around the tube.

8. Install brakes, wheel, planetary and tyre assemblies on the spindle. Refer to Section 165-0031, BRAKE PARTS, for brake installation, Section 160-0040, PLANETARY GEARING, for planetary installation and Section 160-0050, WHEEL RIM AND TYRE, for tyre and wheel installation.

Spindle

1. Remove oil transfer tube as described under heading 'Oil Transfer Tube'.

2. Attach a suitable lifting device to the spindle.

3. Burn off weld that fastens the spindle to the banjo outer plate and remove spindle.

4. If the spindle is to be reused, clean up the spindle as shown in Fig. 5.

5. With a grinder, clean up the weld area on the banjo outer plate.

6. Clean the spindle and banjo with a suitable solvent to remove chips and metal dust.

7. With a suitable lifting device, position the spindle on the banjo outer plate.

8. Install spindle alignment tool, which can be fabricated as shown in Fig. 6, through the spindles and banjo. Align the spindle to the dimensions shown in Fig. 5 and tighten alignment tool.

9. Pre-heat the weld joint to 149 - 205° C (360 - 400° F) and maintain the heat during the welding process.

10. Weld spindle to the banjo outer plate as shown in Fig. 5, using E-70 low hydrogen electrode.

11. If removed, install new bushings in spindle.

12. To install oil seal bushing, if removed, on spindle, heat the new bushing to 177 - 205° C (350 - 400° F) in oil to expand it for installation. If oil heating equipment is not available, heat the bushing evenly to 205° C (400° F). This takes about one minute using a torch with a heating tip. Use a templistik or other temperature gauge to make sure the bushing is hot enough. Slide heated bushing on spindle and tap lightly with a hammer to seat it.

Note: Do not apply flame directly to bushing. Place bushing on steel plate and direct flame to centre of plate to evenly distribute heat.

13. Install oil transfer tube in the spindle and banjo as described under the heading ‘Oil Transfer Tube.’

Banjo Outer Plate

1. Remove oil transfer tube as described under the heading ‘Oil Transfer Tube'.

2. Remove spindle as described under heading ‘Spindle'.

3. Burn off the weld that secures banjo outer plate to the banjo.

4. Using a grinder, grind off all burrs and slag from the end of the banjo.

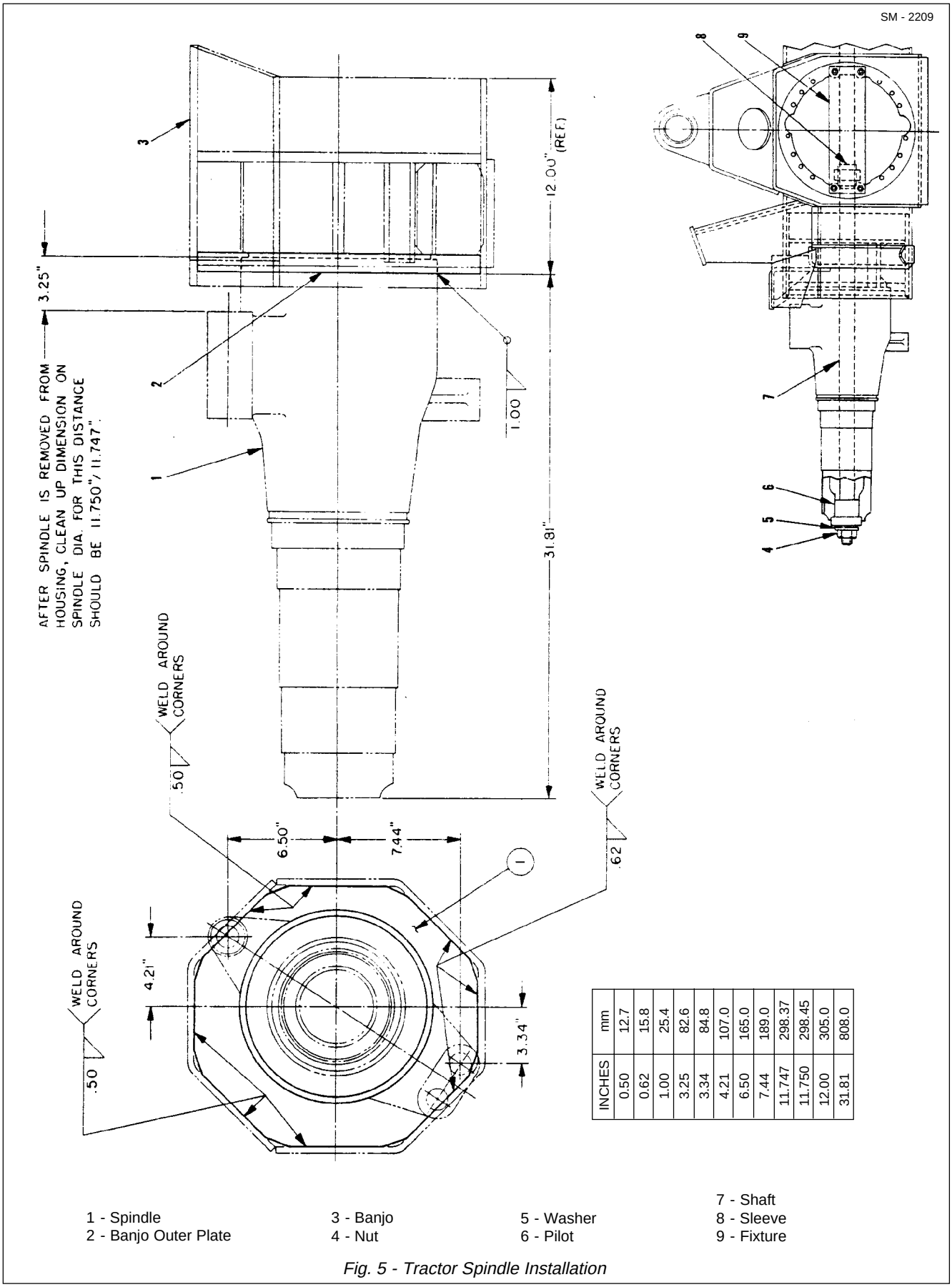
5. Using a suitable solvent, clean the banjo thoroughly to remove all chips and metal dust.

6. Install a new banjo outer plate and seat firmly against the inner reinforcing plates.

7. Weld the banjo outer plate to the banjo as shown on Fig. 5, using E-70 low hydrogen welding rod.

8. Install the spindle to the banjo as described under heading ‘Spindle'.

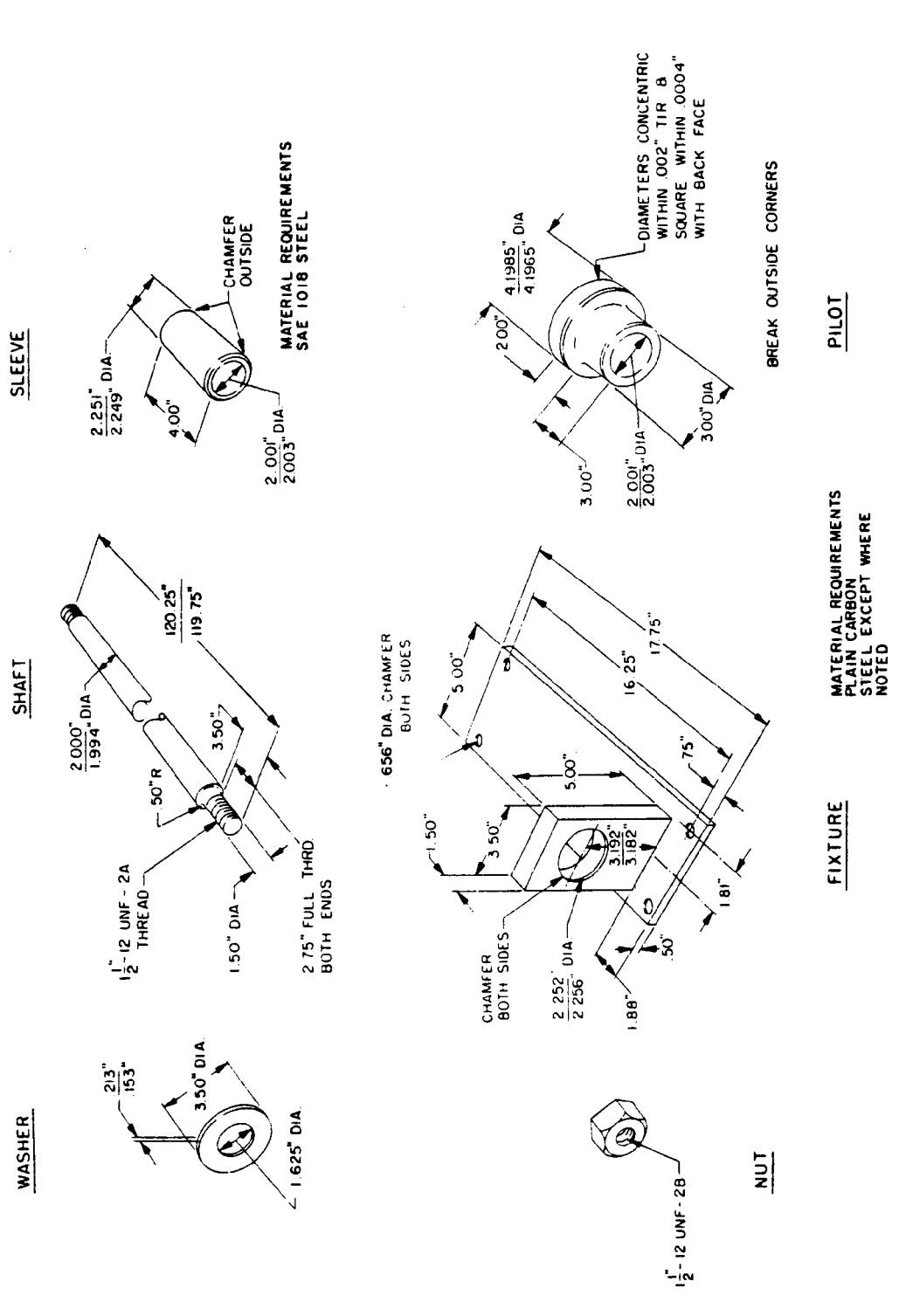
9. Install the oil transfer tube as described under the heading ‘Oil Transfer Tube'.



INCHES	mm
0.50	12.7
0.62	15.8
1.00	25.4
3.25	82.6
3.34	84.8
4.21	107.0
6.50	165.0
7.44	189.0
11.747	298.37
11.750	298.45
12.00	305.0
31.81	808.0

1 - Spindle
2 - Banjo Outer Plate
3 - Banjo
4 - Nut
5 - Washer
6 - Pilot
7 - Shaft
8 - Sleeve
9 - Fixture

Fig. 5 - Tractor Spindle Installation



INCHES	mm
0.0004	0.010
0.002	0.05
0.153	3.89
0.213	5.41
0.50	12.7
0.656	16.66
0.75	19.05
1.50	3.81
1.625	41.28
1.81	46.0
1.88	47.8
1.994	50.65
2.0	50.8
2.001	50.83
2.003	50.88
2.249	57.12
2.251	57.18
2.252	57.20
2.256	57.30
2.75	69.9
3.00	7.60
3.182	80.82
3.192	81.08
3.50	88.9
4.00	101.6
4.1965	106.59
4.1985	106.64
5.00	127.0
16.25	412.8
17.75	450.9
119.75	3 041.7
120.25	3 054.4

Fig. 6 - Spindle Alignment Tool

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.

Straightening

Hydraulic straightening or aligning equipment should be used to straighten bent or twisted frames whenever possible. However, if heat must be applied, never heat the metal beyond a dull cherry red colour, as too much heat will weaken the metal. When it is necessary to heat the metal, apply heat uniformly over the area to be straightened and protect the heated surface from sudden cooling. Frame parts, that cannot be straightened should be replaced.

Welding

⚠ WARNINGS

Before any welding is done on a machine equipped with the HEUI electronic management system, disconnect the following in this order: Battery earth cable, battery supply cable, alternator earth cables, alternator supply cables, front & rear transmission ECU connectors (located behind access door below cab door) and front & rear engine ECU connectors (located on LH side of engine). Turn off battery master switch before disconnecting any components. After welding connect all of the above in the reverse order.

⚠

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 - Turn battery master switch off
c - Battery earth cables
d - Battery supply cables
e - Alternator earth cables
f - Alternator supply cables
g - Transmission ECU connectors (front & rear)
h - Engine ECU connectors (front & rear)

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.

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.

Reinforcement

Frame reinforcement can be made with channel, angle, or flat structural stock. Whenever possible, the reinforcement should extend well beyond the bent, broken, or cracked area. The reinforcement stock thickness should not exceed that of the frame stock and the material should be of the same tensile strength.

Painting

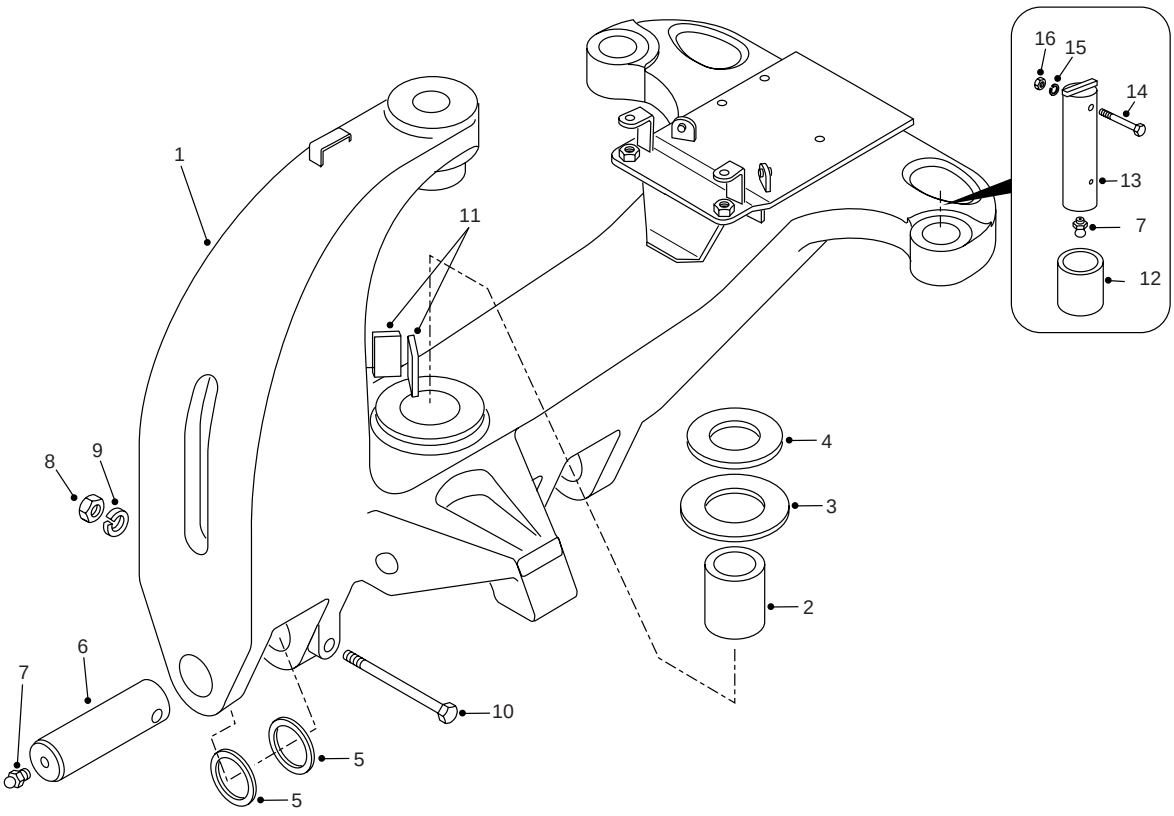
A check of the condition of the paint should be made approximately twice a year and chassis repainted if necessary.

⚠ WARNING
Welding, burning, heating or dressing surfaces previously painted using polyurethane paint produces fumes which are toxic. Surfaces must be prepared using paint stripper prior to area being reworked. Recommended Industrial Hygiene and Safety Rules should be followed for protection of the welding operator from fumes.

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

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

* * * *



1 - Steering Trunnion
2 - Bushing
3 - Washer
4 - Washer
5 - Washer
6 - Pin
7 - Lube Fitting
8 - Nut
9 - Lockwasher
10 - Bolt
11 - Stop Block
12 - Bushing
13 - Pin
14 - Bolt
15 - Lockwasher
16 - Nut

Fig. 1 - Exploded View of Steering Trunnion

DESCRIPTION AND OPERATION

Numbers in parentheses refer to Fig. 1.

The steering trunnion (1) is a heavy steel casting mounted on the main frame banjo housing with two trunnion mounting pins (6).

Upper and lower king pins mounted in the trunnion, connect scraper pull yoke to the tractor. Refer to Section 280-0020, PULL YOKE.

Steering cylinders are mounted to the trunnion by pins (13). Base assembly at rear of trunnion serves as a mount for flow reversing valve. Refer to Section 220-0010, STEERING LINES AND FITTINGS.

Stop block assemblies (11), prevent steering cylinder pistons from bottoming when cylinder rods are extended to their maximum strokes. Refer to Section 220-0010, STEERING LINES AND FITTINGS.

REMOVAL AND DISASSEMBLY

Numbers in parentheses refer to Fig. 1.

⚠ 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.

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

2. Operate the treadle valve continuously relieve any pressure in the braking system.

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

4. Separate scraper from tractor. Refer to Section 280-0020, PULL YOKE.

5. Remove steering cylinders. Refer to Section 220-0120, STEERING CYLINDER.

6. Attach suitable lifting equipment to steering trunnion (1) before removing it from tractor frame.

7. Remove bolts (10), lockwashers (9) and nuts (8) from steering trunnion (1).

8. Slide pins (6) out of the steering trunnion (1) bores.

9. When pins (6) are released, washers (5) will be free for removal.

10. Remove steering trunnion (1) from the tractor frame.

11. While removing steering trunnion (1), be careful not to damage hydraulic lines, air lines and wiring.

⚠ WARNING
Make sure to use a soft drift and drive when removing bushing, to prevent presonal injury from flying chips.

12. If necessary, drive bushing (2) from steering trunnion (1) with a soft drift and drive.

13. If necessary, remove lube fittings (7) from mounting pins (6).

14. If necessary, remove washer (3) by breaking weld.

INSTALLATION AND ASSEMBLY

Numbers in parentheses refer to Fig. 1.

⚠ 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.

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

1. If removed, install bushing (2) in steering trunnion (1).

2. If removed, position washer (3) on steering trunnion (1) and weld as shown in Fig. 2.

3. Attach suitable lifting equipment to steering trunnion (1) and position it on tractor frame.

4. While installing steering trunnion (1), guide hydraulic lines, and hose containing air lines and wiring through the opening in the steering trunnion (1). Be careful not to damage lines and wiring during installation.

5. Install thrust washers (5) and mounting pins (6), attaching steering trunnion (1) to tractor frame.

6. Check clearance at thrust washers (5) by forcing the trunnion (1) rearward against the forward thrust washer on each mounting pin (6). With the rear washer on each pin positioned forward against the tractor frame mount, measure the gap between the rear washers and the trunnion. The gap should be 0.25 - 1.02 mm (0.010 - 0.040 inch). The standard thrust washers used are 13.59 - 13.72 mm (0.535 - 0.540 inch) thick. If the gap is more than specified above when using standard thrust washers, oversize thrust washers should be installed to obtain the specified clearance. Oversize thrust washers, 14.48 - 14.73 mm (0.570 - 0.580 inch) and 16.00 -16.26 mm (0.630 - 0.640 inch) are available.

7. Secure mounting pins (6) with bolts (10), lockwashers (9) and nuts (8).

8. If removed, install lube fittings (7) in mounting pins (6).

9. Connect scraper to tractor. Refer to Section 280-0020, PULL YOKE.

10. Install steering cylinders. Refer to Section 220-0120, STEERING CYLINDER.

SPECIAL TOOLS

There are no special tools required for procedures outlined in this section. Refer to Section 300-0070, SERVICE TOOLS, for part numbers of the general service tools required. These tools are available from your dealer.

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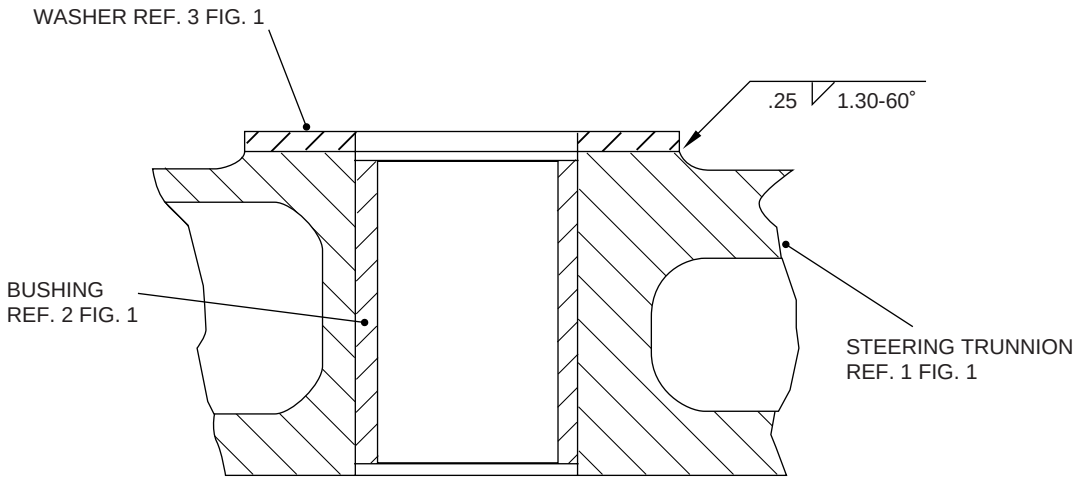

Fig. 2 - Washer and Bushing Installation

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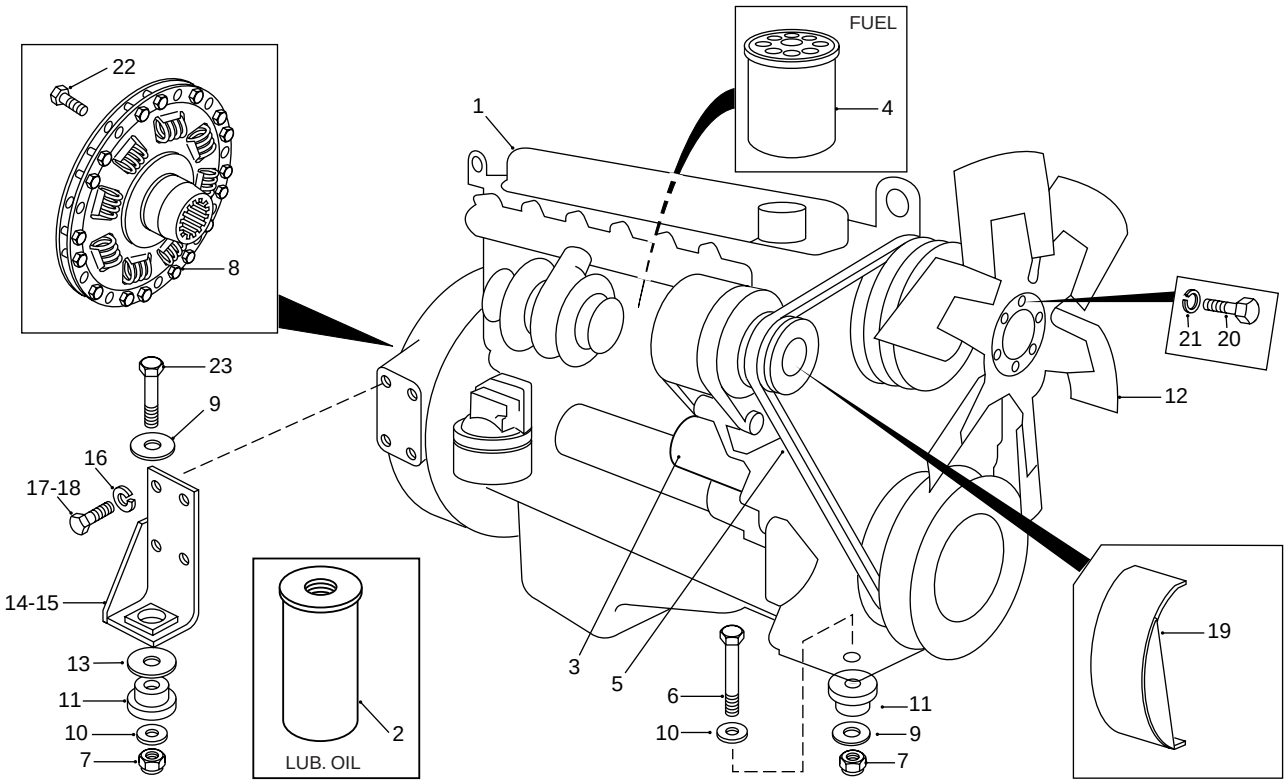


1 - Engine
2 - Oil Filter
3 - Coolant Filter
4 - Fuel Filter
5 - 'V' Belt
6 - Bolt
7 - Locknut
8 - Engine Coupling
9 - Spacer
10 - Washer
11 - Isolation Mount
12 - Fan
13 - Snubbing Washer
14 - Rear LH Mount
15 - Rear RH Mount
16 - Lockwasher
17 - Bolt
18 - Screw
19 - Alternator Guard
20 - Bolt
21 - Lockwasher
22 - Bolt
23 - Bolt

Fig. 1 - Engine and Mounting

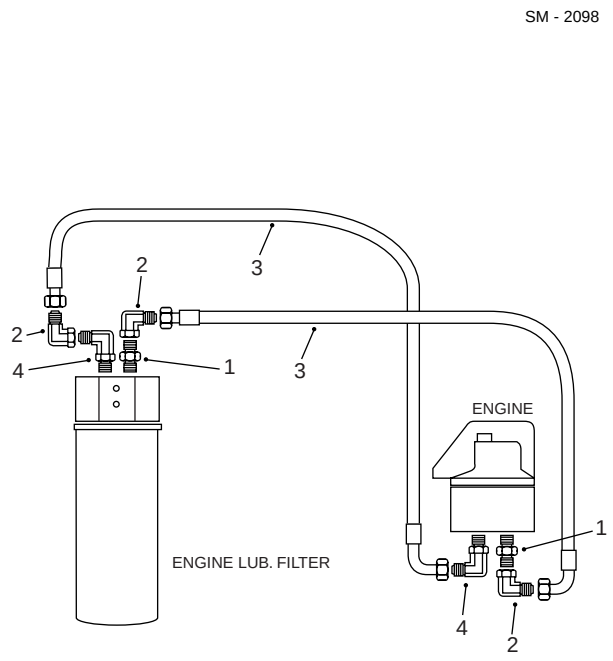
DESCRIPTION

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 tractor frame at three points by a mounting bracket at the front of engine (1) and two rear mounts (14 & 15). Rubber isolation mounts (11) through engine mounts provide sufficient flexibility to absorb varying engine vibration and torsional loads.

There is a full-flow oil filter (2) remote mounted on the right hand side of the frame in a downward position. Refer to Fig. 2. The filter is of the throw away, spin-on type. Oil supplied by the engine oil pump passes through oil filter (2) before reaching the various moving



1 - Adaptor
2 - Elbow
3 - Hose
4 - Elbow

Fig. 2 - Lube Oil Filter Lines

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 (3) and conditioner is a compact bypass type unit with a replaceable spin-on type element mounted on the gear case cover at the front right hand side of engine (1).

The spin-on type fuel filter (4) is mounted on the left hand side of engine (1). The fuel filter (4) is in the fuel flow and acts as a strainer.

HEUI ELECTRONIC CONTROL SYSTEM

Description

Refer to Fig. 3.

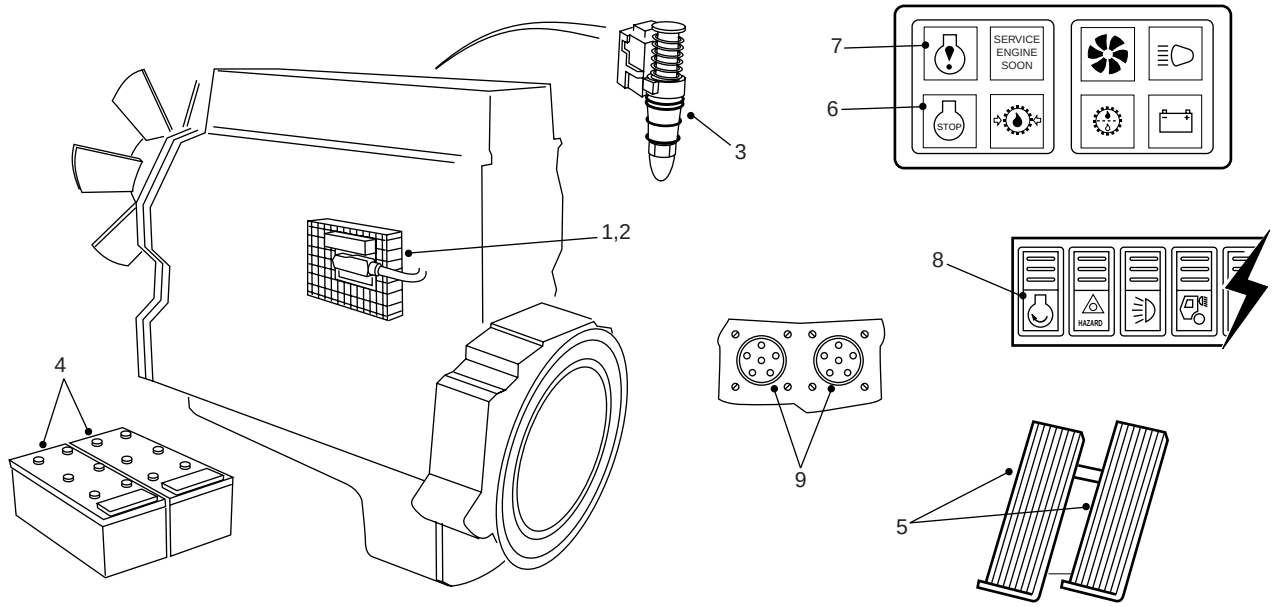
⚠ WARNING
Before any welding is done on a machine equipped with the HEUI electronic management system, disconnect the following in this order: Battery earth cable, battery supply cable, alternator earth cables, alternator supply cables, front & rear transmission ECU connectors (located behind access door below cab door) and front & rear engine ECU connectors (located on LH side of engine). Turn off battery master switch before disconnecting any components.
After welding connect all of the above in the reverse order.

This machine is equipped with the HEUI electronic management system which continually monitors the engine and warns the operator when a problem develops. The 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.



1 - Electronic Control Module (ECM)
2 - Programmable Read Only Memory (PROM)
3 - HEUI Fuel System Injectors
4 - Batteries
5 - Electronic Foot Pedals
6 - Stop Engine Light
7 - Check Engine Light
8 - Diagnostic Request Switch
9 - Diagnostic Test Points

Fig. 3 - HEUI Components

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 or engine sensors as they will burn out. Before removing injectors, the fuel passages must be blown out to prevent fuel flow from entering the cylinder head.

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

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

Note: The HEUI 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. 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.

7. 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.

8. Diagnostic Request Switch - Operates as a diagnostic request switch when:

a - the engine is not running and ignition is 'On'.

Pressing and releasing the switch will flash out the engine codes. Pressing the switch a second time will stop the engine codes flashing.
Note: Active codes are displayed initially, followed by inactive codes.

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

Operation

Refer to Fig. 3.

When either 'Stop' engine light on the dash panel illuminates, the computer has detected a major malfunction in the respective 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 system, which records fault codes when an out-of-range conditions is found. The stop engine and check engine lights illuminate when the engine protection system is initiated. If a fault occurs within the tractor engine, resulting in a loss of power and speed, then the scraper engine will rampdown in accordance, as a safety feature, allowing the operator to maintain full control of the vehicle. The operator MUST shut down the engine, at the first safe opportunity, 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.

Conditions that will cause the Stop Engine light to come on are; Low coolant level, High coolant temperature, Low oil pressure and High oil temperature.

Whenever the Check Engine light or Stop Engine light comes on, the Electronic Management 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.

The operator can check for fault codes by turning the ignition key switch to the 'OFF' position, pressing the diagnostic request switch 'ON' and holding it down, turning the ignition key switch to position '1' and then releasing the diagnostic request switch. Do NOT start the engine.

To retrieve any active or inactive (historic) codes recorded, press the diagnostic request switch. The fault codes flash in the following sequence: the red Stop light flashes once, then there is a pause where both lights are off. Then the numbers of the recorded fault code flash in amber (Check light). There is a pause between each number. When the number is done, the red light flashes again. e.g. red flashes once - pause - amber flashes twice - pause - amber flashes three times - pause - amber flashes five times - pause - red flashes once, indicates fault code 235. If the red light flashes once again, this indicates that there are more active codes recorded. If code 111 is flashed, no faults have been detected. All of the active codes will be displayed first. Once all the active codes have been displayed, the red Stop light will flash twice, indicating the start of the inactive code transmission. These are displayed in the same manner as the active codes. On completion of the inactive code transmission, the red Stop light will flash three times.

Refer to 'Electronic Fuel System Diagnostic Codes' tables for fault code descriptions.

A special diagnostic data reader (DDR) is available that can be plugged into the engine computer memory to extract information related to the cause of the problem. Once the malfunction has been corrected, the Electronic Management System will return the engine to normal operation. The fault code recorded in the ECM memory will remain until it is erased by a technician.

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

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

HEUI ELECTRONIC MANAGEMENT SYSTEM DIAGNOSTIC CODES			
Code	**Description**	**Fault Lamp**	**Additional Actions Taken**
111	Detectable problems may be present, but do not have a dedicated code: 1. No faults. 2. TRS signal problem not identified with Code 143, 144, 145 or 612. 3. Fan control or transmissionrelay circuit may not be functioning properly. 4. Simultaneously energizing PTO control pins 36 & 37. 5. Main power relay may not be functioning properly.	None	1. None. 2. Engine cannot be started. 3. Functionality will be degraded. 4. PTO control will be disabled. 5. None - functionality may be affected.
112	A voltage more than 28V was provided to the ECM.	None	Intermittent voltage gives inactive code. Continuous supply causes power down.
113	A voltage less than 6V was provided to the ECM.	None	Intermittent voltage gives inactive code. Continuous supply causes power down.
114	CTS signal less than 0.127V for more than 0.1 seconds.	Check	ECM will ignore CTS signal & assume a coolant temp of -29°F (-34°C) for start & 180°F (82°C) for engine operation. Fan control feature is disabled, fan is kept on all the time.
115	CTS signal more than 4.6V for more than 0.1 seconds.	Check	ECM will ignore CTS signal & assume a coolant temp of -29°F (-34°C) for start & 180°F (82°C) for engine operation. Fan control feature is disabled, fan is kept on all the time.
121	MAPS signal more than 4.9V for more than 0.1 seconds.	Check	ECM will ignore MAPS signal & operate engine using program default values.
122	MAPS signal less than 0.39V for more than 0.1 seconds.	Check	ECM will ignore MAPS signal & operate engine using program default values.
123	MAPS signal more than 16.7 lb/in² (115 kPa) at low idle.	Check	ECM will ignore MAPS signal & operate engine using program default values.
124	IPS signal less than 0.039V for more than 1 second.	Check	ECM will ignore IPS signal & use open loop strategy (ECM uses calibrated value based on engine load, speed & temp to estimate it).
125	IPS signal more than 4.9V for more than 1 second.	Check	ECM will ignore IPS signal & use open loop strategy (ECM uses calibrated value based on engine load, speed & temp to estimate it).
131	TPS signal less than 0.146V for more than 0.5 seconds.	Check	Engine speed reduced to low idle setting, LO-IDLE-SPEED while code active.
132	TPS signal more than 4.55V for more than 0.5 seconds.	Check	Engine speed reduced to low idle setting, LO-IDLE-SPEED while code active.
133	TPS & IVS signals disagree. Code caused by an intermittent condition.	Check	ECM assumes TPS is the conflict source. Engine speed reduced to low idle setting, LO-IDLE-SPEED. Code remains active until engine is shutdown & restarted. Will not recover without cycling the ignition switch.
134	TPS & IVS signals disagree. Either TPS or IVS is varying: TPS & IVS signal are varying or ECM cannot determine fault/code in allotted time. Code caused by intermittent condition.	Check	Engine speed reduced to low idle speed settting, LO-IDLE-SPEED. Code remains active until engine is shutdown & restarted. Will not recover without cycling the ignition switch.
135	IVS signal is varying, while TPS signal is constant. Code caused by intermittent condition.	Check	Engine speed reduced to 50% of throttle requested. Code remains active until engine is shutdown & restarted. Will not recover without cycling the ignition switch.
141	Test voltage across VSS too low for more than 0.5 seconds.	None	ECM will disable, cruise control, PTO operation, fast idle control & road speed limiting, if enabled and limites engine speed in all gears.
142	Test voltage across VSS too high for more than 0.5 seconds.	None	ECM will disable, cruise control, PTO operation, fast idle control & road speed limiting, if enabled and limites engine speed in all gears.
143	23 wide-window TRS signals were not received between two narrow signals.	None	If condition persists, engine will stop running.

ELECTRONIC MANAGEMENT SYSTEM DIAGNOSTIC CODES			
Code	**Description**	**Fault Lamp**	**Additional Actions Taken**
144	TRS signal has detected a voltage spike.	None	If condition persists, engine may stop running.
145	Inactive TRS, during cranking when ICP pressure is sufficient to start engine.	Check	Code will cause a not start condition.
151	BAPS signal more than 4.95V for more than 1 seconds.	None	ECM uses MAPS signal generated at low idle to determine barometric pressure, calculate altitude & adjust fuel quantity & timing to optimise engine operation and smoke control. If MAPS signal is bad, sea level is assumed.
152	BAPS signal less than 1.0V for more than 1 seconds.	None	ECM uses MAPS signal generated at low idle to determine barometric pressure, calculate altitude & adjust fuel quantity & timing to optimise engine operation and smoke control. If MAPS signal is bad, sea level is assumed.
154	ATS signal less than 0.127V for more than 0.2 seconds.	None	ECM will ignore ATS signal & assume air temp is 77°F (-25°C). Fan control feature is disabled, fan is kept on all the time.
155	ATS signal more than 4.6V for more than 0.2 seconds.	None	ECM will ignore ATS signal & assume air temp is 77°F (-25°C). Fan control feature is disabled, fan is kept on all the time.
211	OPS signal less than 0.39V for more than 0.1 seconds.	None	ECM will ignore OPS signal & disable oil press warning & critical level alerts of engine warning & protection feature, with an active code.
212	OPS signal more than 4.9V for more than 0.1 seconds.	Check	ECM will ignore OPS signal & disable oil warning & critical level alerts of engine warning & protection feature, with an active code.
213	Secondary throttle device signal is/was less than 0.25V.	None	Device will be disabled. Engine speed will return to idle speed setting.
214	Secondary throttle device signal is/was more than 4.5V.	None	Device will be disabled. Engine speed will return to idle speed setting.
215	VSS signal frequency is/was more than 4,365Hz.	None	ECM will disable, cruise control, PTO operation, fast idle control & road speed limiting, if enabled and limites engine speed in all gears.
216	HPS signal voltage less than 0.39V for more than 0.1 seconds.	None	HPG is disabled when active.
221	Speed adjustment switch signal is different than ECM expected.	None	ECM will disable, cruise control, PTO operation & fast idle control. TPS position will be used when this code is active.
222	Brake switch status signals at pins 44 and 43 differ.	None	All features using brake signal inputs will be disabled, when this code is active (ie. cruise control, fast idle, HPG, PTO control, CAP & idle shutdown).
224	Flash memory fault.	None	
225	OPS signal is/was more than 40lb/in², when key was ON and the engine was OFF.	None	ECM will ignore OPS signal & disable oil press warning & critical level alerts of engine warning & protection feature, with an active code.
226	HPS voltage signal is/was more than 4.9V for more than 0.1 sec.	None	HPG is disabled when active.
231	ECM can't communicate with data link: data link wiring and/or connector fault; interference on data bus; or faulty ECM (eg. dash or WTEC controller).	None	Devices requiring information from data link won't function, including DDR, speedo, tacho etc. Use diagnostic data switch to retrieve codes.
241	Injection pressure regulator failed the output circuit check, during the key ON engine OFF standard diagnostic test (ie. voltage drop across pins 17 & 37 was not between 5 - 20 Ohms).	None	Engine will not run when this code is active.
243	Main power relay failed the output circuit check, during key ON engine OFF standard diagnostic test.	None	None.