Service Manual

TM320

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World Class
Customer Support

FOPS Data Plate

WARNING

Do not use the machine if the falling objects protection level provided by the structure is not sufficient for the application. Falling objects can cause serious injury.

8-2-8-17

If the machine is used in any application where there is a risk of falling objects then a falling-objects protective structure (FOPS) must be installed. For further information contact your JCB Dealer

The falling objects protection structure (FOPS) is fitted with a dataplate. The dataplate indicates what level protection the structure provides.

There are two levels of FOPS:

- **Level I Impact Protection** - impact strength for protection from small falling objects (e.g. bricks, small concrete blocks, hand tools) encountered in operations such as highway maintenance, landscaping and other construction site services.
- **Level II Impact Protection** - impact strength for protection from heavy falling objects (e.g. trees, rocks) for machines involved in site clearing, overhead demolition or forestry.

⇨ *Fig 8. (1-7)*

ROPS Data Plate

WARNING

You could be killed or seriously injured if you operate a machine with a damaged or missing ROPS/FOPS. If the Roll Over Protection Structure (ROPS)/Falling Objects Protection Structure (FOPS) has been in an accident, do not use the machine until the structure has been renewed. Modifications and repairs that are not approved by the manufacturer may be dangerous and will invalidate the ROPS/FOPS certification.

INT-2-1-9_6

WARNING

Seat Belts

The ROPS/FOPS is designed to give you protection in an accident. If you do not wear your seat belt, you could be thrown out of the machine and crushed. You must wear a seat belt when using the machine. Fasten the seat belt before starting the engine.

0153

Machines built to FOPS/ROPS standards have a data plate attached to the inside of the cab.

⇨ *Fig 8. (1-7)*

Service Tools

Numerical List

The tools listed in the table are special tools required for carrying out the procedures described in this manual. These tools are available from JCB Service.

Some tools are available as kits or sets, the part numbers for parts within such kits or sets are not listed here. For full details of all tools, including the content of kits and sets, refer to ***Tool Detail Reference, Section 1***.

Note: *Tools other than those listed will be required. It is expected that such general tools will be available in any well equipped workshop or be available locally from any good tool supplier.*

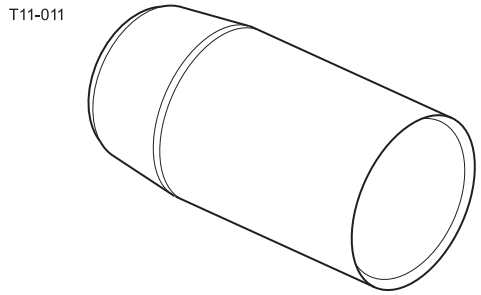


Fig 46. Ram Protection Sleeves

892/01016	For 25 mm Rod Diameter
892/01017	For 30 mm Rod Diameter
892/01018	For 40 mm Rod Diameter
892/01019	For 50 mm Rod Diameter
892/01020	For 50 mm Rod Diameter (slew ram)
892/01021	For 60 mm Rod Diameter
892/01022	For 60 mm Rod Diameter (slew ram)
892/01023	For 65 mm Rod Diameter
892/01024	For 70 mm Rod Diameter
892/01025	For 75 mm Rod Diameter
892/01026	For 80 mm Rod Diameter
892/00167	For 90 mm Rod Diameter

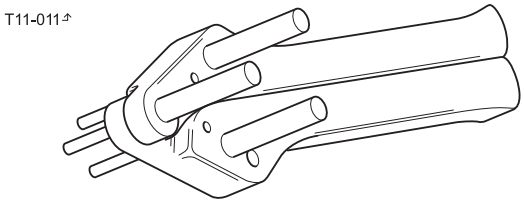


Fig 47. 892/00334 Ram Seal Fitting Tool

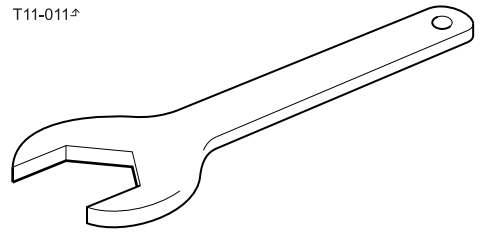


Fig 48. Hexagon Spanners for Ram Pistons and End Caps

992/09300	55mm A/F
992/09400	65mm A/F
992/09500	75mm A/F
992/09600	85mm A/F
992/09700	95mm A/F
992/09900	115mm A/F
992/10000	125mm A/F

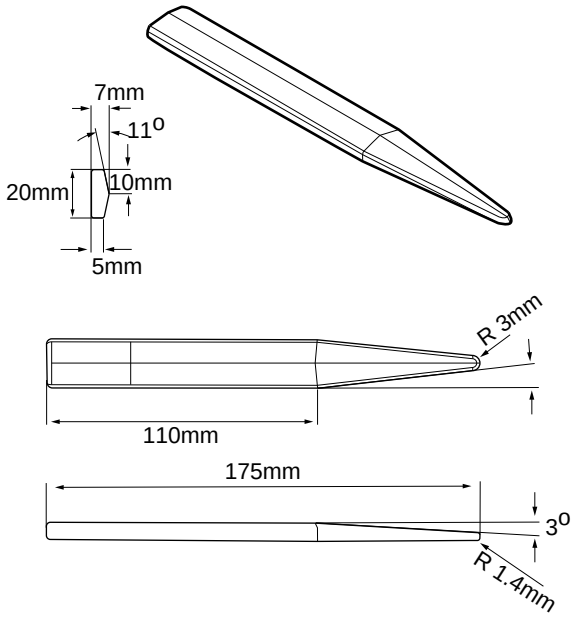


Fig 49. 892/01027 Piston Seal Assembly Tool

Service Consumables

Sealing and Retaining Compounds

T11-001_4

Table 13.

Type	Description	Part No.	Quantity
JCB Multi-Gasket	A medium strength sealant suitable for all sizes of gasket flanges, and for hydraulic fittings of 25-65 mm diameter.	4102/1212	50 ml
JCB High Strength Threadlocker	A high strength locking fluid for use with threaded components. Gasketing for all sizes of flange where the strength of the joint is important.	4102/0551	50 ml
JCB Retainer (High Strength)	For all retaining parts which are unlikely to be dismantled.	4101/0601	10 ml
		4101/0651	50 ml
JCB Threadlocker and Sealer	A medium strength locking fluid for sealing and retaining nuts, bolts, and screws up to 50 mm diameter, and for hydraulic fittings up to 25 mm diameter.	4101/0250	10 ml
		4101/0251	50 ml
JCB Threadlocker and Sealer (High Strength)	A high strength locking fluid for sealing and retaining nuts, bolts, and screws up to 50 mm diameter, and for hydraulic fittings up to 25 mm diameter.	4101/0550	10 ml
		4101/0552	200 ml
JCB Threadseal	A medium strength thread sealing compound.	4102/1951	50 ml
JCB Activator	A cleaning primer which speeds the curing rate of anaerobic products.	4104/0251	200 ml (Aerosol)
		4104/0253	1 ltr (Bottle)
JCB Cleaner/Degreaser	For degreasing components prior to use of anaerobic adhesives and sealants.	4104/1557	400 ml (Aerosol)
Direct Glazing Kit	For one pane of glass; comprises of: – 1 x Ultra Fast Adhesive (310 ml) – 1 x Active Wipe 205 (30 ml) – 1 x Black Primer 206J (30 ml) – plus applicator nozzle etc.	993/55700	
Ultra Fast Adhesive	For direct glazing.	4103/2109	310 ml
Active Wipe 205	For direct glazing.	4104/1203	250 ml
Black Primer 206J	For direct glazing.	4201/4906	30 ml
Clear Silicone Sealant	To seal butt jointed glass.	4102/0901	
Plastic to Metal Bonder	To seal plastic to metal joints.	4103/0956	50 g
Black Polyurethane Sealant	To finish exposed edges of laminated glass.	4102/2309	310 ml

Operating Safety

⚠ WARNING

Machine Condition

A defective machine can injure you or others. Do not operate a machine which is defective or has missing parts. Make sure the maintenance procedures in this manual are completed before using the machine.

INT-2-1-2_2

⚠ WARNING

Machine Limits

Operating the machine beyond its design limits can damage the machine, it can also be dangerous. Do not operate the machine outside its limits. Do not try to upgrade the machine performance with unapproved modifications.

INT-2-1-4

⚠ WARNING

Engine/Steering Failure

If the engine or steering fails, stop the machine as quickly as possible. Do not operate the machine until the fault has been corrected.

INT-2-1-5

⚠ WARNING

Exhaust Gases

Breathing the machine exhaust gases can harm and possibly kill you. Do not operate the machine in closed spaces without making sure there is good ventilation. If possible, fit an exhaust extension. If you begin to feel drowsy, stop the machine at once and get into fresh air.

INT-2-1-10_2

⚠ WARNING

Work Sites

Work sites can be hazardous. Inspect the site before working on it. You could be killed or injured if the ground gives way under your machine or if piled material collapses onto it. Check for potholes and hidden debris, logs, ironwork etc. Any of these could cause you to lose control of your machine. Check for utilities such as electric cables (overhead and underground), gas and water pipes etc. Mark the positions of the underground cables and pipes. Make sure that you have enough clearance beneath overhead cables and structures.

INT-2-2-1_2

⚠ WARNING

Communications

Bad communications can cause accidents. Keep people around you informed of what you will be doing. If you will be working with other people, make sure any hand signals that may be used are understood by everybody. Work sites can be noisy, do not rely on spoken commands.

INT-2-2-3

⚠ WARNING

Parking

An incorrectly parked machine can move without an operator. Follow the instructions in the Operator Manual to park the machine correctly.

INT-2-2-4_2

⚠ WARNING

Banks and Trenches

Banked material and trenches can collapse. Do not work or drive too close to banks and trenches where there is danger of collapse.

INT-2-2-5

⚠ WARNING

Before moving the machine onto the trailer, make sure that the trailer and ramp are free from oil, grease and ice. Remove oil, grease and ice from the machine tires. Make sure the machine will not foul on the ramp angle. See Static Dimensions in SPECIFICATION section for the minimum ground clearance of your machine.

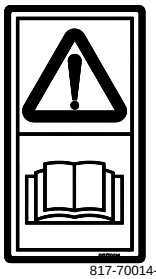
2-2-7-5U_1

Part Numbers and Descriptions

ISO-01A

Part Number: 817/70014

Description: Warning. Read the operator manual before you operate the machine.


817-70014-3

ISO-02A

Part Number: 332/S9994

Description: Crushing of whole body. Install the articulation lock before you start maintenance work or transport the machine.


332-S9994-3

ISO-04A

Part Number: 817/70004

Description: Burns to fingers and hands. Stay a safe distance away.


817-70004-4

ISO-05C

Part Number: 817/70012

Description: Runover. Start the engine from the operator seat only. Do not short across the terminals.


817-70012-2

ISO-06A

Part Number: 332-F5855

Description: Pressure hazard. Read operators manual


332-F5855-1

ISO-06C

Part Number: 817/70002

Description: Pressure hazard. Stop the engine, remove the starter key and refer to ***Releasing the Hydraulic Pressure (Routine Maintenance Section)*** before you start maintenance work.


817-70002-2

ISO-06D

Part Number: 817/70005

Description: Hot fluid under pressure. Refer to ***Cooling System (Routine Maintenance Section)***.


817-70005-3

ISO-07D

Part Number: 817/70112

Description: Crush hazard. Keep a safe distance from the moving parts.


817-70112-2

remain in effect; unless damage is caused to such components by the non-JCB Service approved parts.

Service/Maintenance Agreements

To help plan and spread the costs of maintaining your machine, we strongly recommend you take advantage of the many Service and Maintenance Agreements your Distributor can offer. These can be tailor made to meet your operating conditions, work schedule etc.

Please consult your JCB Distributor for details.

Initial Service and Inspection

T3-005_2

To further protect your machine's performance it is essential your JCB Distributor carries out an initial service and inspection when the machine is one month old or when it has completed 100 hours of operation (whichever occurs first). You should notify your Distributor in advance to allow the necessary arrangements to be made.

Fit for Purpose Tests for Lifting Equipment

T3-097

All lifting equipment (for example forks, lifting hooks and shackles) need regular inspection and testing by a competent person to ensure they are fit for purpose.

This may be needed every six months or at least annually in some countries to meet and comply with legislation and for insurance purposes.

Check with your local JCB distributor for further advice.

Obtaining Replacement Parts

T3-096

If you use non-genuine JCB parts or consumables, then you can compromise the health and safety of the operator and cause machine failure

A Parts Book for your machine is available from your JCB Distributor. The Parts Book will help you identify parts and order them from your JCB distributor.

Your dealer will need to know the exact model, build and serial number of your machine. See ***Identifying Your Machine (Introduction section)***.

The data plate also shows the serial numbers of the engine, transmission and axle(s), where applicable. But remember if any of these units have been changed, the serial number on the data plate may be wrong. Check on the unit itself.

Functional Test and Final Inspection

Table 8. Engine

	Operation	10	50	100(1)	500	1000	2000
Idle Speed	- Check/Adjust			☐		☐	☐
Maximum No Load Speed	- Check/Adjust			☐		☐	☐
Throttle System and Control Cable	- Check/Adjust			☐		☐	☐
Exhaust Smoke - Excessive	- Check			☐		☐	☐
Exhaust System - Security	- Check					☐	☐
Air Inlet System - Security	- Check					☐	☐
Crankcase Breather	- Check						☐

(1) Initial service and inspection, to be done by your JCB dealer.

Table 9. Brakes

	Operation	10	50	100(1)	500	1000	2000
Foot Brake - Operation	- Check	☐	☐	☐	☐	☐	☐
Park Brake - Operation	- Check			☐	☐	☐	☐

(1) Initial service and inspection, to be done by your JCB dealer.

Table 10. Transmission, Axles and Steering

	Operation	10	50	100(1)	500	1000	2000
Transmission - Operation	- Check	☐	☐	☐	☐	☐	☐
Forward/Reverse/Speed Range - Operation	- Check	☐	☐	☐	☐	☐	☐
Neutral Start - Operation	- Check	☐	☐	☐	☐	☐	☐
Steering - Operation	- Check	☐	☐	☐	☐	☐	☐

(1) Initial service and inspection, to be done by your JCB dealer.

Table 11. Hydraulics

	Operation	10	50	100(1)	500	1000	2000
All Services - Operation	- Check	☐	☐	☐	☐	☐	☐
Hose Burst Protection Valves (If Fitted)	- Check			☐		☐	☐
Piston Rods Chrome - Condition	- Check			☐		☐	☐
Parallel Lift/Lower Forks	- Check			☐		☐	☐

(1) Initial service and inspection, to be done by your JCB dealer.

How to Make the Machine Safe (Boom Lowered)

1 Park the machine on level, solid ground

If necessary, refer to ***Stopping and Parking the Machine***.

2 Lower the boom.

3 Put the attachment flat on the ground.

4 Install the articulation lock. Refer to ***Articulation Lock***.

5 Stop the engine and remove the starter key.

6 Disconnect the battery to prevent accidental operation of the engine. Refer to ***Battery Isolation***.

7 If necessary, put chocks against the two sides of the wheels before you get below the machine.

How to Make the Machine Safe (Boom Lifted)

⚠ WARNING

You could be killed or injured if the boom drops while you are working under it. Support the boom before doing any maintenance work with the boom raised.

5-3-1-14

Note: *If you lift the boom to get access for maintenance, you must properly support the boom.*

Important: *You can complete most of the maintenance procedures with the boom lowered. Unless a maintenance procedure instructs you differently, you must lower the boom.*

1 Park the machine on level, solid ground

If necessary, refer to ***Stopping and Parking the Machine***.

2 Install the articulation lock. Refer to ***Articulation Lock***.

3 Support the boom.

Note: *JCB can supply a suitable support, 331/42592.*

4 Stop the engine and remove the starter key.

5 Disconnect the battery to prevent accidental operation of the engine. Refer to ***Battery Isolation***.

6 If necessary, put chocks against the two sides of the wheels before you get below the machine.

Access Panels

Engine Cover

Opening the Cover

⚠ WARNING

The engine has exposed rotating parts. Switch OFF the engine before working in the engine compartment. Do not use the machine with the engine cover open.

5-2-6-5

⚠ WARNING

Touching hot surfaces can burn skin. The engine and machine components will be hot after the unit has been running. Allow the engine and components to cool before servicing the unit.

10-1-1-40

Important: *Before you stop the engine, you must allow the engine to operate at low idle for four minutes. The delay allows the coolant temperatures to stabilise before you open the engine cover.*

1 Make the machine safe with the boom lowered. ⇨ ***Prepare the Machine for Maintenance (🗋 3-21)***.

2 Use the key to open the lock **A**.

3 Push and hold the button to release the cover, then lift the cover.

4 Lift the cover.

Note: *Two gas struts help to lift the cover. The gas struts also hold the cover in the fully open position.*

Important: *Do not stand on the engine cover for any reason, for example to get access to the rear number plate light or the rear screen wiper.*

Closing the Cover

⚠ CAUTION

The struts holding the engine cover can over time become weak. This will be noticed by the fact that the cover will not hold in the fully open position, but will tend to sag slightly. Do not work under an engine cover that will not retain its fully open position.

0107

1 Close the cover.

2 Make sure the cover is closed and latched.

3 Use the key to close the lock and secure the cover.

Important: *Make sure that the cover is securely closed before you operate the machine.*

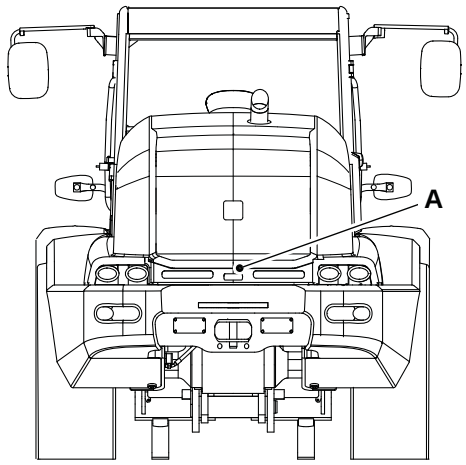


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Fig 8.

A Lock

Engine

Engine Oil and Filter

Introduction

A failure to change the oil and filter at the recommended interval could cause serious engine failure. ⇒ ***Pre-start Cold Checks, Service Points and Fluid Levels (3-8)***.

⚠ CAUTION

It is illegal to pollute drains, sewers or the ground. Clean up all spilt fluids and/or lubricants.

Used fluids and/or lubricants, filters and contaminated materials must be disposed of in accordance with local regulations. Use authorised waste disposal sites.

INT-3-2-14

⚠ WARNING

Oil

Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice. Used engine oil contains harmful contaminants which can cause skin cancer. Do not handle used engine oil more than necessary. Always use barrier cream or wear gloves to prevent skin contact. Wash skin contaminated with oil thoroughly in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

INT-3-2-3

⚠ WARNING

Do not exceed the correct level of engine oil in the sump. If there is too much engine oil, the excess must be drained to the correct level. An excess of engine oil could cause the engine speed to increase rapidly without control.

GEN-1-18

Checking the Oil Level

1 Make the machine safe with the boom lowered. ⇒ ***Prepare the Machine for Maintenance (3-21)***.

2 Open the engine cover. ⇒ ***Engine Cover (3-32)***.

3 Check that the oil level is between the two marks on the dipstick **A**.

4 If necessary, remove a filler cap **B** then add the recommended oil through one of the filler points to the maximum level. ⇒ ***Fluids, Lubricants and Capacities (3-14)***.

5 Replace the filler cap and dipstick, make sure they are secure.

6 Close and secure the engine cover.

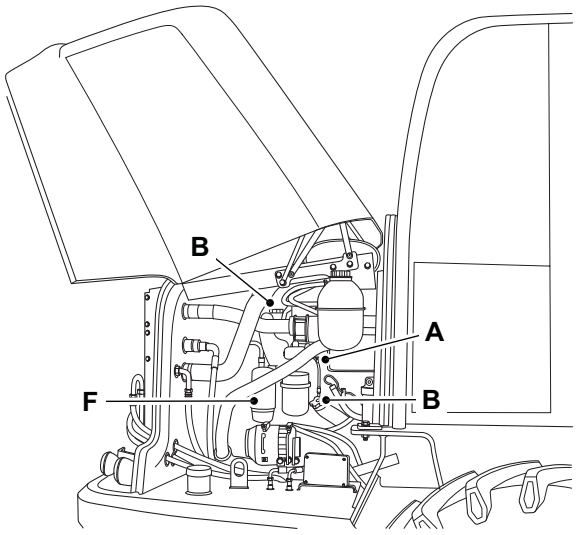

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Fig 19.

A Dipstick
B Filler caps
F Filter canister

Changing the Water Separator Pre-Filter

1 Get access to the water separator. ⇨ *Introduction (3-50)*

2 Drain and remove the water separator bowl **C**. ⇨ *Draining the Water Separator and the Engine Fuel Filter (3-51)*

3 Release the locking ring **B**, then remove and discard the filter element **A**.

4 Install the new filter element and secure in position with the locking ring **B**.

5 Install the water separator bowl **C** and secure in position with its locking ring **F**.

Important: *Make sure the seal **D** is seated correctly before the bowl is installed.*

6 Make sure that the electrical connector **E** is correctly fitted.

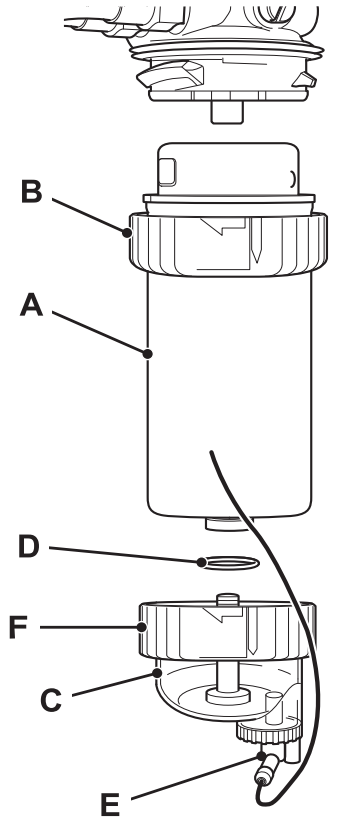

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Fig 29.

A Fuel filter element
B Locking ring
C Water separator bowl
D Seal
E Locking ring
F Electrical connector

Tyres and Wheels

Tyre Inflation

Introduction

T3-066

WARNING

An exploding tire can kill. Inflated tires can explode if over-heated or over-inflated. Follow the instructions given when inflating the tires. Do not cut or weld the rims. Use a tire/wheel specialist for all repair work.

2-3-2-7U_2

WARNING

Wheels and tires are heavy. Take care when lifting or moving them.

Store with care to ensure that they cannot fall and cause injury.

13-3-1-7U_1

Always try to maintain your tyre pressure to the recommended settings. Using your machine with under-inflated tyres means:

- Decreasing the machines stability
- Higher tyre temperatures
- Excessive strain of the tyre fabric
- More bulging of the sidewalls
- Shortens the tyres life.

Using the machine with over inflated tyres is dangerous:

- It causes excessive tensile loads in the fabric: this makes a tyre more susceptible to cuts and punctures.

Do not cut or weld on the rim of an inflated tyre.

After checking or amending the tyre pressure always replace and secure the valve cap.

Always deflate the tyre before removing foreign obstacles from the tread.

Procedure

T3-067_2

These instructions are for adding air to a tyre which is already inflated. If the tyre has lost all its air pressure, call in a qualified tyre mechanic. The tyre mechanic should use a tyre inflation cage and the correct equipment to do the job.

1 Prepare the wheel.

Before you add air to the tyre, make sure it is correctly fitted on the machine or installed in a tyre inflation cage. ⇒ ***Fig 40. (3-62)***.

2 Prepare the equipment.

a Use only an air supply system which includes a pressure regulator. Set the regulator no higher than 1.38 bar (20 psi) above the recommended tyre pressure. For recommended tyres and pressures for your machine, see ***Specifications, Tyre Sizes and Pressures***.

b Use an air hose fitted with a self-locking air chuck and remote shut-off valve.

3 Add the air.

a Make sure that the air hose is correctly connected to the tyre valve. Clear other people from the area. Stand behind the tread of the tyre while adding the air.

b Inflate the tyre to the recommended pressure. Do not over-inflate.

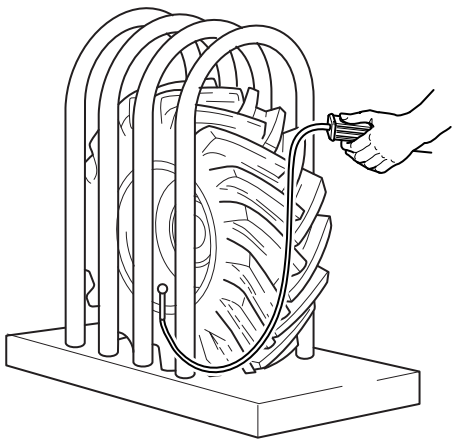

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Fig 40.

Contents Page No.

General Fault Finding

The fault finding procedures are given in the form of tables. The tables are designed to identify possible causes by performing checks and where applicable, specific tests on the system.

Fault:

⇨ *Table 11. Display box does not work. (B-10)*
⇨ *Table 12. The display box seems to go out of calibration. (B-10)*
⇨ *Table 13. System not functioning correctly (B-11)*

Table 11. Display box does not work.

Possible Cause	Action
Blown fuse.	Check fuses.
Display box faulty.	Do ***Display Box Functional Test***, ⇨ *Diagnostic Tests (B-12)*
Display box not receiving 12V supply.	Do ***12V Supply and Fuse Test (V1)***, ⇨ *Diagnostic Tests (B-12)*

Table 12. The display box seems to go out of calibration.

Possible Cause	Action
Transducer not fixed down correctly.	Check torque of transducer fixing screws. Check transducer fixing screws are not bottoming out in their holes. Check mounting surfaces are clean and flat, see ***Transducer, Removal and Replacement***.
Faulty transducer.	Replace transducer and re-calibrate the system, see ***Service Procedures***.

Fitting Procedure

1 Drill a hole in the machine body/framework where the rivet nut is to be fitted. De-burr hole edges.

2 Screw the rivet nut onto the mandrel of the installation tool. The bottom of the mandrel should be in line with the bottom of the rivet nut **18-A**.

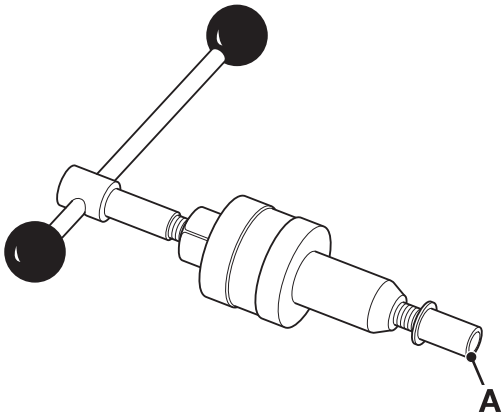

Fig 18.

3 Wind the body of the installation tool down the threaded mandrel until it touches the head of the rivet nut **19-B**.

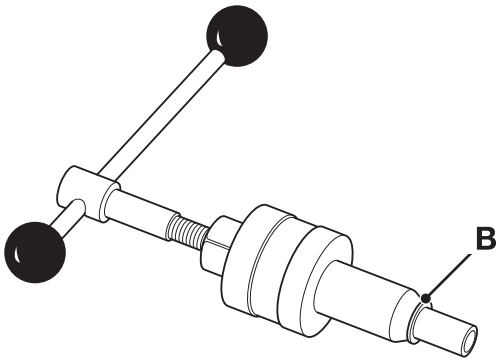

Fig 19.

4 Insert the rivet nut (assembled to the tool) into the hole drilled in step 1.

5 Hold handle **20-C** and at the same time draw the mandrel into the installation tool by turning nut **20-D**. The rivet nut will contract in length and form an 'upset' (smooth bulge) seating itself against the body/framework **20-E**.

Note: *The thread of the rivet nut must not be stripped, take care when 'upsetting' the rivet nut.*

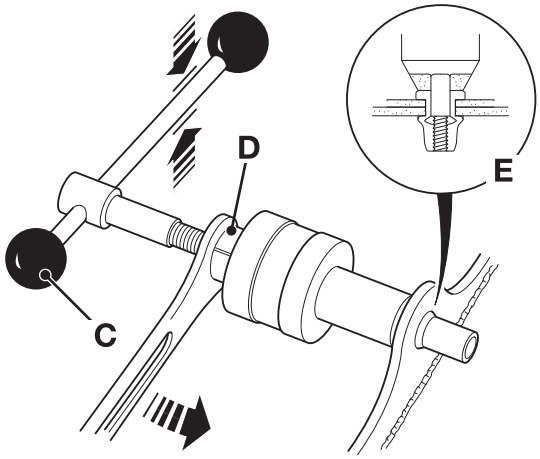

Fig 20.

6 Remove the installation tool.

Condenser Matrix Cleaning

It is likely that over a period of time, because of the machine's working environment, the airflow around the condenser matrix will become restricted due to a build up of airborne particles.

If the build up of particles is severe, heat dissipation from the refrigerant to the air will be significantly reduced, resulting in poor air conditioning performance.

In extreme cases, over-pressurisation of the system occurs, causing the high pressure cut-out switch to operate and switch off the system.

High pressure cut-out can also be caused by an internal blockage of the condenser matrix.

1 Park the machine on firm level ground, engage the parking brake and set the transmission to neutral. Lower the attachments to the ground. Stop the engine and remove the starter key.

2 Raise the engine cover.

3 Release fastener **28-A** and hinge condenser **28-B** away from the radiator. Clean both sides of condenser **28-B** and the front of the cooling pack. Swing the condenser back into position and close the fastener.

4 Lower the engine cover.

5 Run the air conditioning and check cooling performance.

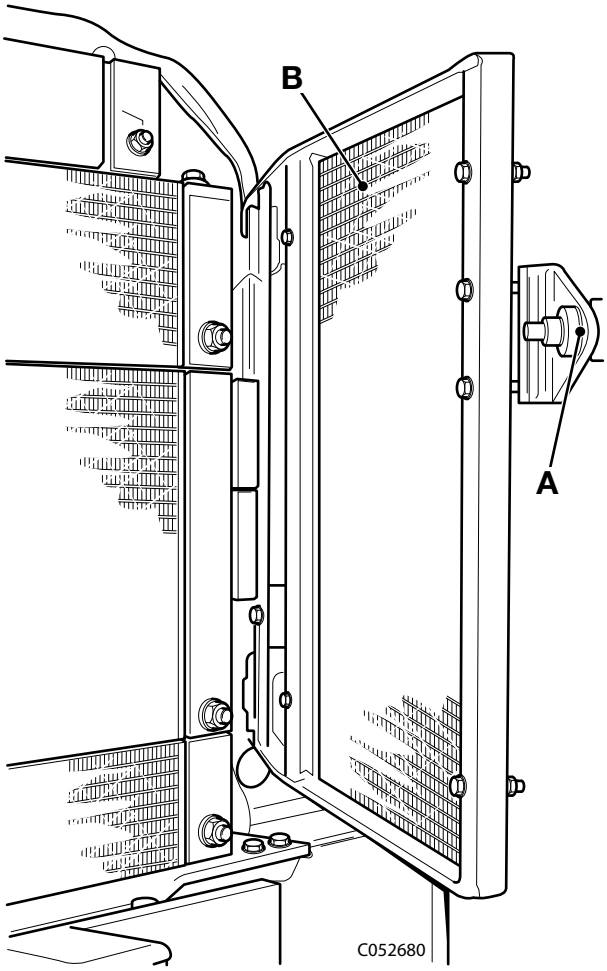

Fig 28.

12 Remove the boom strap bolts **45-3**.

13 Remove the boom strap **45-2**.

14 Remove the front pivot nut **45-5** and bolt **45-4.**

15 Using the slide hammer kit, see ***Section 1 - Service Tools***, remove the pivot pin **45-6**.

16 Raise the boom.

17 Using a sling, support the boom in the raised position.

18 Make sure the boom is fully supported. Remove nuts **45-14**, bolts **45-17** and the pivot pin **45-18**.

Note: *Make sure to keep the shims **45-19**.*

19 Using the lifting equipment gently move the boom towards the front of the machine to get access to the boom hose connections. Be careful not to strain or damage the hoses.

20 Disconnect the tilt ram hoses **45-22** and auxiliary hoses **45-23** at the manifold **45-21**.

21 Make sure the extension ram hoses **45-20** & **45-24** will not get caught or damaged when lifting the boom away from the machine.

22 Carefully lift the boom away from the machine ⇨ ***Fig 44. (B-40)***, checking for any remaining connections. Lower the boom onto packing material.

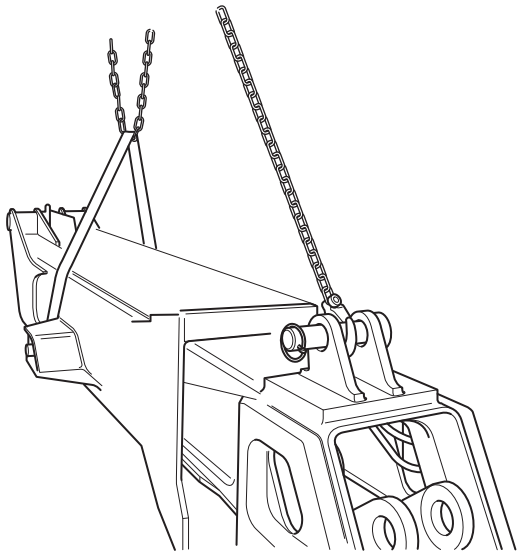

Fig 44. Lifting the Boom

Replacement

Replacement is the opposite of Removal.

Do a check of the hydraulic oil level and add oil if necessary.

Do a check of the condition of the pivot bushes **45-16** and seals **45-15**. Replace if damaged.

Do a check of the condition of the grease nipples **45-13**. Clean if blocked or replace if damaged.

Grease the pivot pins, see ***Section 3 -Service Schedules.***

Table 17. Torque Settings

Item	Nm	lbf ft
45-22 & **45-23**	44-50	32.5-37

Front Side Wear Pads

1 Make the machine safe, r**efer to Section 3 - Maintenance, Preparing the Machine for Maintenance**.

2 Chock both sides of all four wheels.

3 Lift the boom so that the forks / carriage are clear of the ground.

4 Pull the inner boom to one side and measure the total side clearance **48-F** between the side wear pads **49-4** and the inner boom.

5 Loosen the side wear pad bolts and shim as necessary. Divide the number of shims equally between both sides to make sure the inner boom runs centrally in the outer boom.

6 Measure the total thickness of shims under each pad

7 There must be 8-10 mm of thread engaged between the bolt thread and the wear pad assembly. This can be adjusted by adding or removing the wear pad retaining bolt washers. The bolt thread must not protrude beyond the surface of the wear pad insert.

Note: *At the initial vehicle build, two washers are installed below the head of the retaining bolt.*

8 Apply a coating of JCB High Strength Threadlocker to the bolts before fitting.

9 Refit the shims and torque tighten the bolts ⇨ *Table 22. Torque Settings (B-53)*.

Note: *For initial application of bolt sizes and their locations* ⇨ *Table 20. (B-52)*.

Rear Side Wear Pads

1 Remove the boom ***See Section B - Boom Removal and Replacement***.

2 Pull the inner boom to one side and measure the total side clearance **48-F** between the side wear pads **49-7** and the inner boom.

3 Loosen the side wear pad bolts and shim as necessary. Divide the number of shims equally between both sides to make sure the inner boom runs centrally in the outer boom.

4 Measure the total thickness of shims under each pad.

5 There must be 8-10 mm of thread engaged between the bolt thread and the wear pad assembly. This can be adjusted by adding or removing the wear pad retaining bolt washers. The bolt thread must not protrude beyond the surface of the wear pad insert.

Note: *At the initial vehicle build, two washers are installed below the head of the retaining bolt.*

6 Apply a coating of JCB High Strength Threadlocker to the bolts before fitting.

7 Install the shims and torque tighten the bolts ⇨ *Table 22. Torque Settings (B-53)*.

8 Replace the boom.

Rear Lower Wear Pads

1 Remove the boom ***See Section B - Boom Removal and Replacement***.

2 Position the inner boom so that it is resting on the lower wear pads.

3 Measure the distance **48-B** between the lower inner and outer boom faces. If this measurement is below the limits given ⇨ *Table 19. Measurements (B-48)* add or remove shims under the lower wear pads to give the correct dimension.

4 Wedge or lift the inner boom slightly to remove the load on the lower wear pads **49-6**.

5 Remove the lower wear pad retaining bolts and add shims as necessary to give the correct dimension.

6 Measure the total thickness of the shims under each pad.

7 There must be 8-10 mm of thread engaged between the bolt thread and the wear pad assembly. This can be adjusted by adding or removing the wear pad retaining bolt washers. The bolt thread must not protrude beyond the surface of the wear pad insert.

Note: *At the initial vehicle build, two washers are installed below the head of the retaining bolt.*

8 Apply a coating of JCB High Strength Threadlocker to the bolts before fitting.

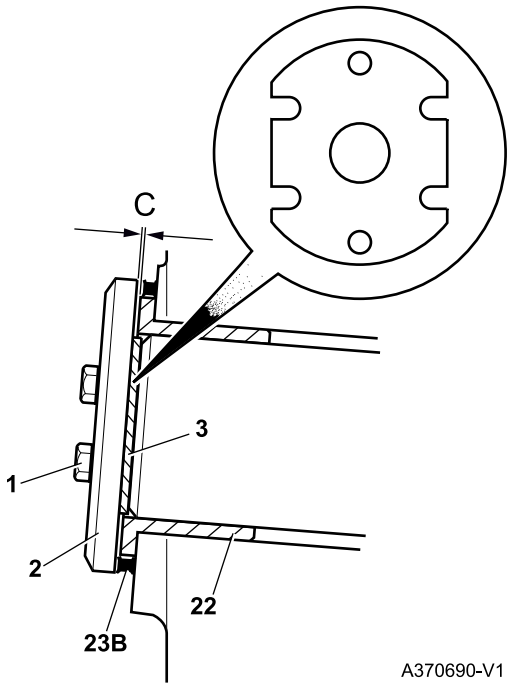

Fig 55.

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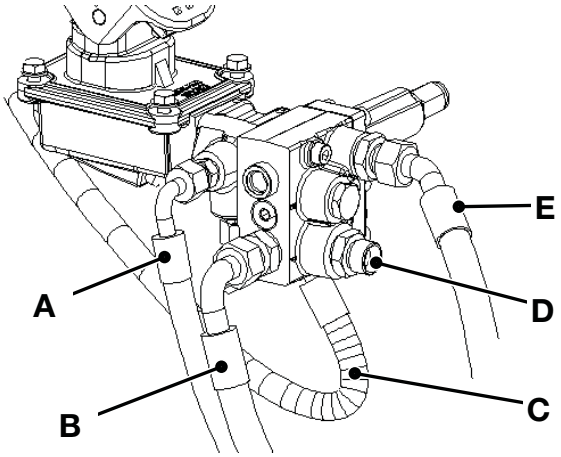


Fig 71. Brake Hose Connections

Item	⇒ *Fig 71. (B-80)*
A	From Accumulator Block
B	Supply from Gear pump
C	To Brakes on Front Chassis
D	To Tank or Trailer Brake Valve (if fitted)
E	Tank Return

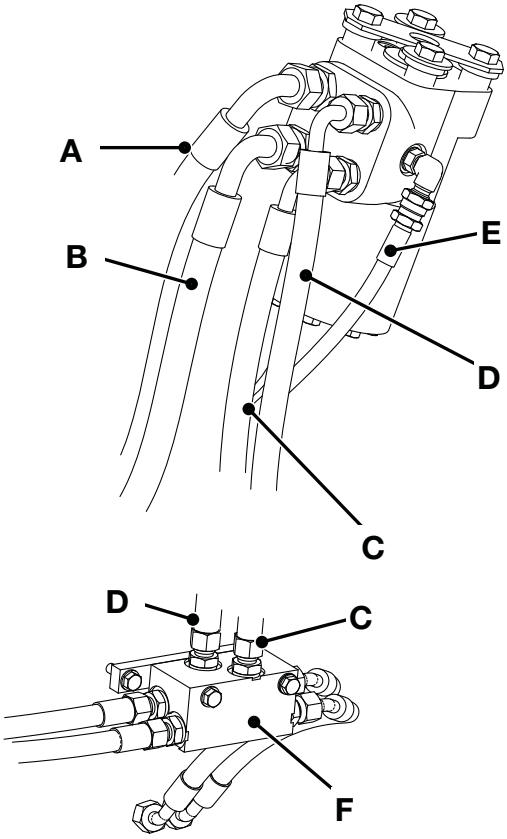


Fig 72. Steer Hose Connections

Item	⇒ *Fig 72. (B-80)*
A	Tank Return
B	Steering Supply
C	To Steer Manifold (F)
D	To Steer Manifold (F)
E	Load Sense Line
F	Steering Manifold

Rear Mudguard

Removal

1 Park the machine and make it safe. Obey the general safety procedures, see ***Section 2 - General Procedures***.

2 Remove the road wheel to aid access if necessary, see ***Section F - Transmission***.

3 Support the mudguard **A**.

4 Remove the bolts and washers **B**.

5 Remove the mudguard **A** from the machine.

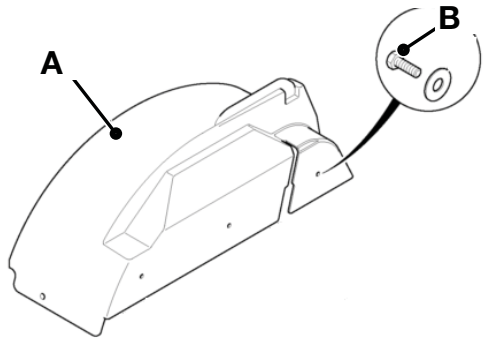


Fig 83.

Replacement

Replacement is the opposite of the removal procedure.

Relays

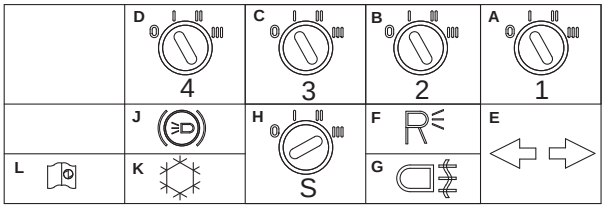


Fig 5.

Circuit

- **A** Ignition 1 Warning buzzer
- **B** Ignition 2
- **C** Ignition 3
- **D** Ignition 4
- **E** Direction indicators
- **F** Reverse
- **G** Fog light
- **H** Ignition
- **J** Brake lights
- **K** Heating\air conditioning
- **L** LiveLink

Bulb Specification

Main beam	12v/55W
Dip beam	12v/55W
Side light	12v/5W
Indicator	12v/21W
Rear light	12v
Stop light	12v/21W
Rear fog	12v/21W
Worklight	12v/55W
Beacon	12/H1 55W
Interior light	12v
Number plate light	12v/5W

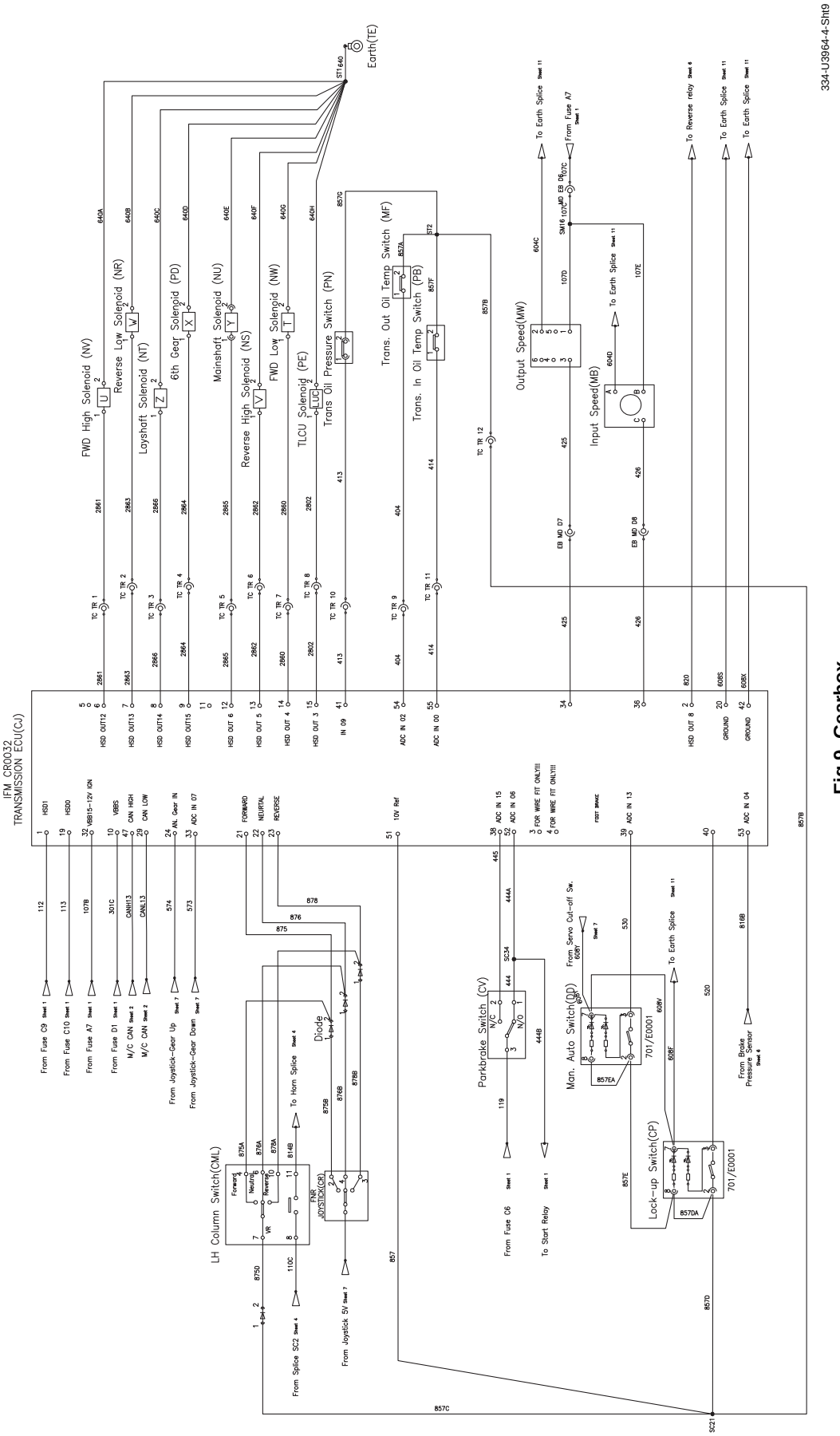


Fig 9. Gearbox

AVO 2002
- Red lead to volts (middle) socket on meter.
- Black lead to negative on meter.
- RH slider to DC voltage.
- LH slider. ⇨ *Fig 6. (C-23)*.

AVO 2003
- Red lead to amps socket (marked A) on the meter.
- Black lead to negative on meter.
- RH slider to DC voltage
- LH slider to 200 Shunt

FLUKE 85
- Red lead to volts socket (marked V) on meter.
- Black lead to COM socket on meter.
- Set dial to mV.

7 Start the engine and run at maximum speed (see ***Technical Data***). Meter should show maximum alternator output in Amps (see ***Technical Data***).

Note: *The meter reading should be taken as soon as possible after starting the engine, as the charging current will fall rapidly.*

8 A zero reading indicates failure of the alternator and may be caused by one of the following conditions. These are listed in the order of probability.

a Defective suppression capacitor.

b Dirty slip rings or worn brushes.

c Defective regulator.

d Defective rectifier.

e Open or short - circuited field (rotor) windings.

f Open or short - circuited power (stator) windings.

9 To check for fault a, disconnect the capacitor and repeat the charging test. Renew the capacitor if necessary.

10 To check for faults b and c, remove the regulator and brush box assembly. Check the condition of the brushes and, if necessary, clean the slip rings using extra-fine glass paper. The regulator may only be checked by substitution.

11 Faults d, e, and f may be checked only by removing and dismantling the alternator for further testing.

Test Procedures

High Rate Discharge Test

This test is to determine the electrical condition of the battery and to give an indication of the remaining useful `life'. Before testing ensure that the battery is at least 75% charged (SG of 1.23 to 1.25 for ambient temperature up to 27°C).

Ensure that the battery is completely disconnected from the machine.

C096270

Fig 1. Battery Tester

Check:

1 Connect the battery tester to the battery. Ensure that the positive terminal is connected first.

2 Use rocker switch **A** to select the correct battery voltage.

3 Hold switch **B** to the 'Check' position. The battery no-load voltage should be at least 12.4 volts.

Test:

1 Hold down switch **B** to the 'Load' position for 5-10 seconds until the meter reading stabilises. The reading should be at least 9 volts.

Note: *Do not hold the switch in the LOAD position for more than 10 seconds.*

Check the results against the table:

Table 1. Tester Readings and Remedies

Battery Tester Readings	Remedy
CHECK: 0 - 12.6 volts LOAD: Less than 6 volts	Renew battery
CHECK: 6 - 12.4 volts LOAD: less than 9 Volts and falls steadily but remains in yellow zone.	Recharge and re-test. If tests still unsatisfactory renew battery.
CHECK: less than 10 volts LOAD: Less than 3 volts	Indicates battery has been over-discharged and unlikely to recover. Renew battery.
CHECK: more than 11 volts LOAD: 6 - 10 volts	Charge battery which will probably recover.

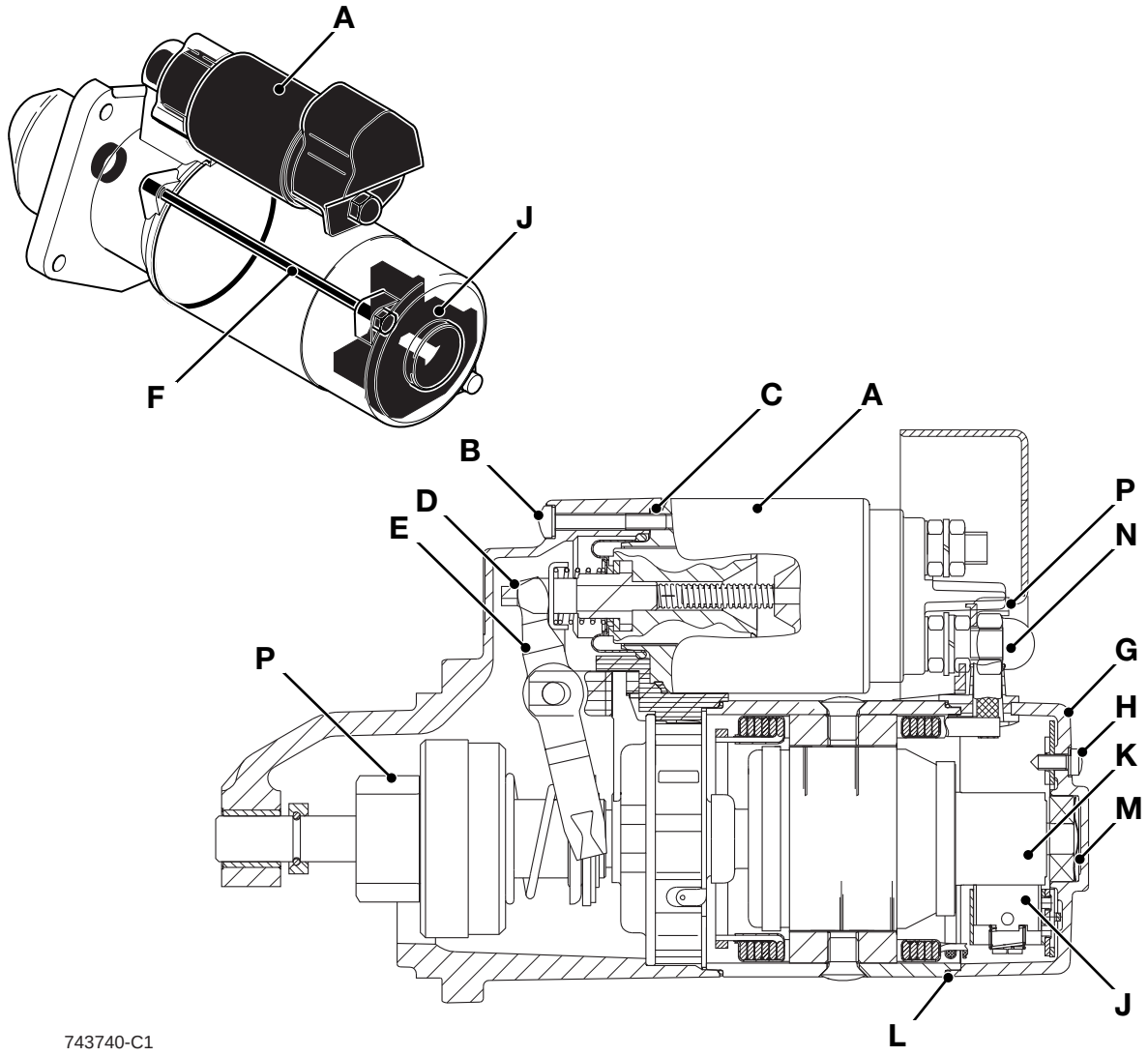


Fig 2. Starter Motor

Component Key:

A Starter solenoid
B Screws - starter solenoid (3 off)
C Sealing ring - solenoid
D Solenoid actuator rod
E Pinion lever arm
F Tie bolts (2 off)
G Commutator end cover
H Screws - commutator end cover (2 off)
J Brush set
K Commutator
L Sealing ring - commutator end cover
M Wave washer
N Cable connector post
P Pinion gear

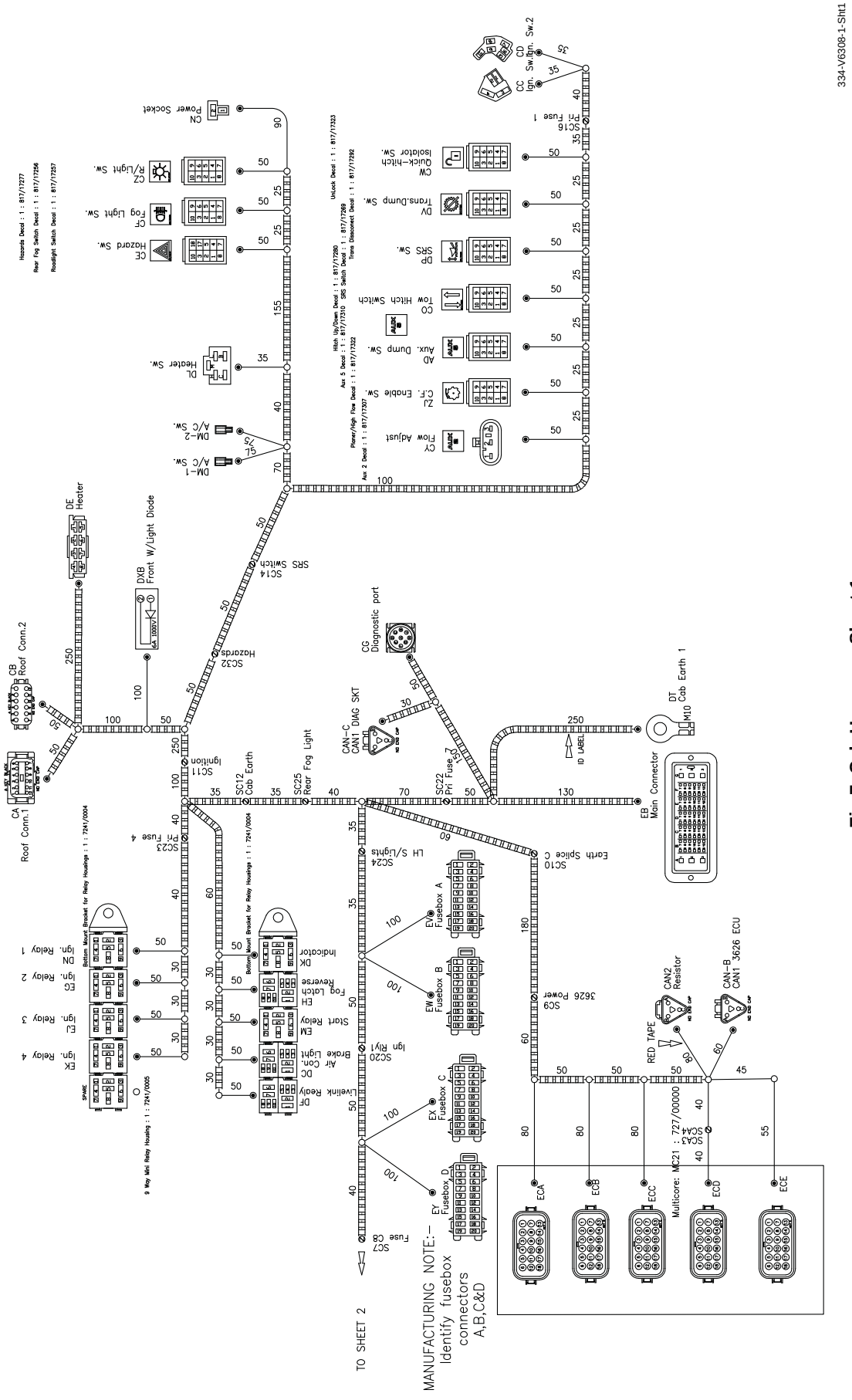


Fig 7. Cab Harness - Sheet 1

Notes:

Component Location and Identification

Table 1. Component Key

Item	Description	
1	Oil Cooler	Mounted on the machine cooling pack.
2	Hydraulic Oil Filter	Positioned in hydraulic tank
3	Pump Assembly	A variflow pump mounted on the gearbox.
4	Control Lever	Servo control lever.
5	Pump Control Solenoid (HVCS)	Located on the variflow pump **3**.
6	Control Valve Block	Flowshare valve with solenoid and servo control spools.
6A	Load Sense Relief Valve	Controls maximum system pressure.
7	Hydraulic Tank	Mounted on the rear of the machine.
8	Electrical Connector	Positioned behind the fuse and relay panel.
9	3626 ECU	Positioned behind the fuse and relay panel.
10	Accumulator Valve Block (Servo and brake pressure)	Positioned at the front right of the chassis to the right of the valve block.
11	Anti Cavitation Valve	Positioned at the front right of the chassis below the valve block.

Wires and Connectors

Wires and connectors ⇒ *Fig 3. (E-17)* as applicable. On the electrical diagram the electrical connectors (example, EA) are shown looking on the mating face of each connector when they are disconnected.

The wire numbers and colours, where appropriate, are shown as an aid to identification while fault finding.

Before fault finding make sure that you understand how the electrical circuits work. Most potential faults can be traced using a multimeter to carry out continuity checks on wires, switches and solenoid coils.

Note: *When fault finding do not use a multimeter on the ECU pins. Only test the associated wiring. Uncouple the connector* ***ER*** *and then use a multimeter at the pins inside the connector as applicable. The ECU is inherently more reliable than its associated wiring and components. Before renewing the ECU be sure to check all the related equipment first.*

Earth Points

Faults may be caused by poor earth connections. Although earth connections are shown, it must be remembered that the cab assembly is earthed via further earth strap and cable connections. For details of these connections refer to ***Section C, Machine Earth Connections***.

Component Key:

The following key identifies the component connectors on the electrical diagram. For harness drawings, see ***Section C, Harness Data***.

h1	Harness - 332/R6766 Panel
h2	Harness - 721/12544 Rear Chassis

Connectors (h1)

EA	h1 - h2
ER	Pump controller ECU
EY	Fusebox C
CU	Instrument Panel
CJ	Transmission ECU Connector A
DT	Cab Earth Point 2
DY	Diode Pack 2

Connectors (h1)

DD	Sense Resistor HVCS

Connectors (h2)

PX	HVCS Proportional solenoid valve (Variflow pump)
PY	Hydraulic fluid temperature switch (Variflow pump - suction port)
MB	h2 - h1
PC	Earth Point 1

Splices (h1)

SC12	Earth Splice D
SC13	
SC29	
SC30	
SC33	
SC34	

Splices (h2)

SM13	Rear Chassis Earth Splice

Bleeding the Hydraulic System

Whenever any hydraulic component is disconnected or removed the system must be bled as follows:

Important: *Before starting the engine the variflow pump body must be filled with hydraulic fluid. If the engine is started with no fluid in the pump, damage to the pump can occur. Obey the replacement procedures.*

1 Park the machine and make it safe. Obey the general safety procedures, see ***Section 2 - General Procedures***.

2 Vent the hydraulic pressure, see ***Section 2 - General Procedures***.

3 If the pump has been removed or replaced it must be primed before starting the engine.

a Remove the variflow pump access cover, see ***Section B - Cab***.

b Remove the pump case drain hose **7-A** and adaptor **7-B**.

c Fill the pump case with clean hydraulic fluid through the drain adaptor port **7-C** until the fluid is level with the port.

d Reconnect the hose **7-A** and adaptor **7-B**.

4 Fill the hydraulic tank to the correct level with clean hydraulic fluid.

5 Start the engine and let it run at idle speed (i.e. do not push the accelerator).

6 Turn the steering wheel a minimum of 10 times in both directions.

7 Operate the main hydraulic services until the air is removed from the pump. The pump will be noisy until the air has been evacuated.

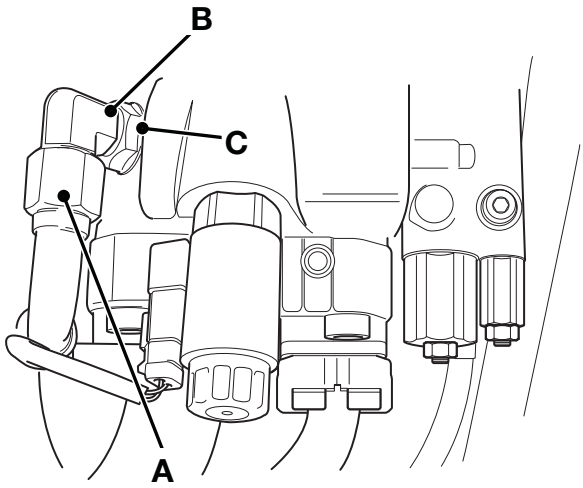


Fig 7.

Control Valve Block

Handling

Incorrect handling will result in permanent damage to the valve assembly. The valve block should be lifted by holding either end of the valve body. Do not use the electric solenoids to lift the valve.

Extreme care should be taken to avoid damaging the electric solenoids when handling the valve assembly.

Lift Ram

Removal

WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before connecting or removing any hydraulic hose, residual hydraulic pressure trapped in the service hose line must be vented. Make sure the hose service line has been vented before connecting or removing hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11_2

1 Remove all attachments from the carriage.

2 Remove the boom ***See Section B - Boom Removal and Replacement***.

3 Carry out the General Safety Procedures, see ***Section C - Machine Safety***.

4 Put a label on each lift ram hose to identify them.

5 Disconnect and plug the lift ram hydraulic hoses at **1-2** & **1-3**.

6 Remove the nut **1-6**, bolt **1-5** and the pivot pin **1-4** from the head end of the lift ram.

7 Attach the correct lifting equipment to the ram rod eye end and lift away from the vehicle.

WARNING

This component is heavy. It must only be removed or handled using a suitable lifting method and device.

BF-4-1_1

Replacement

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

1 Grease the pivot pins. See ***Section 3 - Service Schedules***.

2 Do a check of the hydraulic oil level and add oil if necessary. See ***Section 3 - Routine Maintenance***.

3 Bleed the hydraulic system. ***⇨ Bleeding the Hydraulic System (E-26)***.

4 Do a check of the condition of the grease nipples **1-1**. Clean if blocked or replace if damaged.

3 New ram Shaft and piston head fitted. If both are required, the following procedure should be followed:

a Drill through piston head into piston rod. Use an undersized diameter drill first as a guide and then drill with the correct size diameter drill to suit, see ⇒ *Fig 11. (E-56)* and ⇒ *Table 2. Drill Diameters and Depths (E-56)*.

b Remove all swarf and contamination. Insert dowel **6** into drilled hole, make sure tapped extractor hole is to outside.

4 New piston head fitted on a **pre-drilled piston rod**. Re-drill and dowel **BOTH** the piston head and piston rod at 90° from the existing drilled dowel hole in the piston rod. Follow the procedures described in step 3.

5 New piston rod fitted to a **pre-drilled piston head**. Use the pre-drilled hole in the piston head. Care must be taken not to elongate the existing hole in the piston head.

a Use a drill the same diameter as the pre-drilled hole in the piston head to make a 'centre mark' in the piston rod. DO NOT drill the piston rod at this stage.

b Use an undersized diameter drill as a guide and drill into the piston rod to the required depth, ⇒ *Table 2. Drill Diameters and Depths (E-56)*. Make sure the drill has centred correctly on the 'centre mark' made at step 5a.

c Use the correct size diameter drill to suit the dowel and drill to the required depth, ⇒ *Table 2. Drill Diameters and Depths (E-56)*.

d Remove all swarf and contamination, insert the dowel.

Position cylinder on bench and install rod assembly into cylinder.

Apply JCB Threadlocker and Sealer (High Strength) to first three threads of cylinder, torque tighten the end cap, ⇒ *Table 1. Torque Settings (E-56)*.

Note: *If hydraulic oil contacts the uncured JCB Threadlocker and Sealer (High Strength) a weakening of the bond will result. Cure times vary according to the ambient temperature. Allow a minimum of 2 hours between assembly and filling the ram with oil.*

Note: *Cold weather operation. When operating in conditions which are consistently below freezing, it is recommended that the rams are operated slowly to their full extent before commencing normal working.*

Table 1. Torque Settings

Item	Nm	kgf m	lbf ft
1	678	69.2	500
7	405	41.3	300

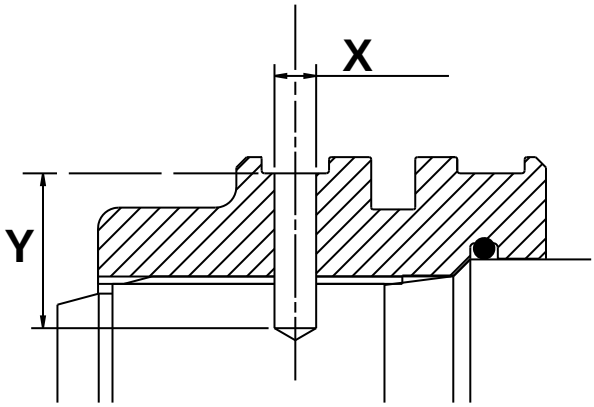


Fig 11.

Table 2. Drill Diameters and Depths

All Dimensions are in mm

Ram Size	Dowel Size	Guide Drill Ø	Guide Drill Depth	Dowel Drill Ø **X**	Dowel Drill Depth **Y**
80 x 50 70 x 40	6Ø x 20	4	21	6.02-6.1	22-23
90 x 50 100 x 60	8Ø x 25	5	24	8.02-8.1	27-28
110 x 60 110 x 65	12Ø x 30	8	28	12.02-12.1	32-33
120 x 65 130 x 75	12Ø x 35	8	33	12.02-12.1	37-38

Hydraulic Schematic

The Smooth Ride Systems's hydraulic schematic diagram is contained in the main hydraulic schematic. The section of the schematic showing the SRS controls is shown below.

Item	
A	Rod Side Drain Valve
B	Counterbalance Valve
C	Accumulators
D	Accumulator Select Valve
E	Pressure Switch
F	Lift Ram

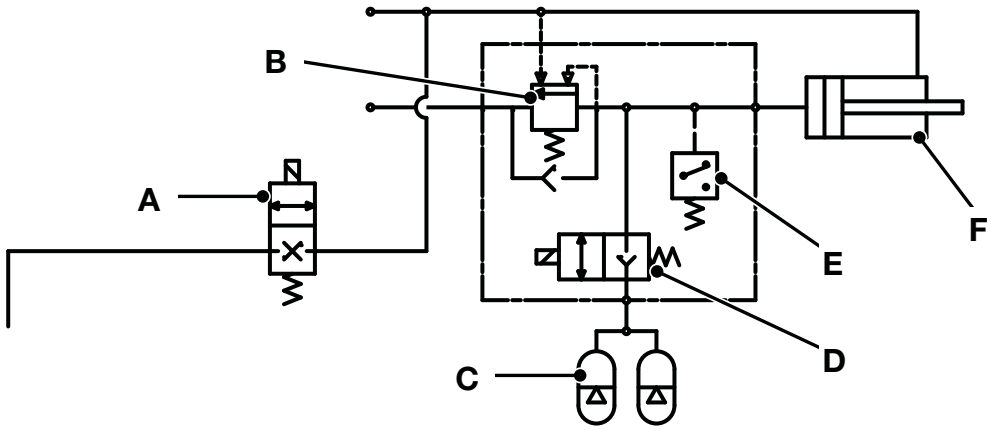


Fig 4.

Anti-Cavitation Valve

Removal and Replacement

Removal

The anti-cavitation valve in located on the inner side of the chassis under the right side of the machine.

1 Make the machine safe, refer to ***Section 3 - Maintenance, Prepare the Machine for Maintenance.***.

⚠ WARNING

A raised and badly supported machine can fall on you. Position the machine on a firm, level surface before raising one end. Ensure the other end is securely chocked. Do not rely solely on the machine hydraulics or jacks to support the machine when working under it.

Disconnect the battery, to prevent the engine being started while you are beneath the machine.

GEN-1-1

2 Vent the hydraulic pressure, refer to ***Section 3 - Maintenance, Hydraulic System, Releasing the Hydraulic Pressure***.

3 Put a label on each hose before disconnecting to help identification when replacing.

4 Disconnect and plug the hydraulic hoses **1-A**, **B**, **C** and **G**.

5 Undo bolts **1-E** and remove the anti-cavitation valve **1-D**.

If the anti-cavitation valve is being renewed, remove the adaptors.

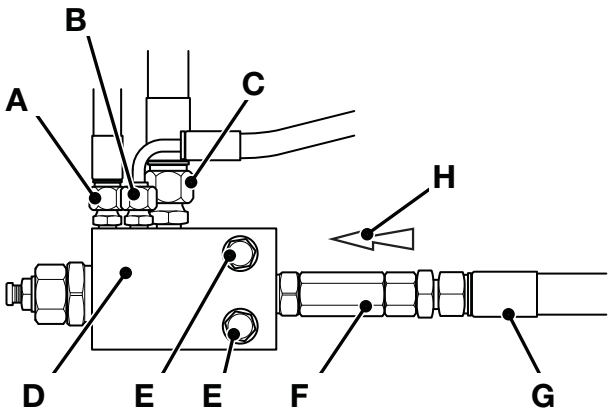


Fig 1.

Replacement

Replacement is the opposite of the removal procedure.

During the replacement procedure do this work also:

1 Discard the old seals and fit new seals and `O' rings.

When installing adaptors, do not overtighten as this distorts the body and the valve may fail to operate correctly. ⇨ ***Table 1. Torque Settings (E-77)***

2 Reconnect the hoses in the correct positions as labelled during removal. ⇨ ***Hose Connections (E-77)***

3 Make sure that the flow check valve is replaced with the flow direction arrow **1-H** pointing towards the valve.

4 Check the hydraulic fluid level, see ***Section 3 - Routine Maintenance***.

5 Bleed the hydraulic system. ⇨ ***Service Procedures (E-21)***

Table 4.

	TM310/320
Boom is fully lowered - a safe LMI signal and no green, amber or red LEDs (except the power LED at the bottom)	750mA
Boom is fully raised and fully retracted - a safe LMI signal and no green, amber or red LEDs (except the power LED at the bottom)	1250mA
Boom is fully raised and extended by a minimum of 150mm - a safe LMI signal and no green, amber or red LEDs (except the power LED at the bottom)	825mA
Boom pivots horizontally (maximum reach) and extended by a minimum of 150mm - a safe LMI signal and no green, amber or red LEDs (except the power LED at the bottom)	1250mA

The system does not have a feedback loop from the solenoid pressure output.

The system depends on an accurate solenoid current to give the correct pilot pressure. A sense-resistor feedback circuit accurately maintains the coil current. Make sure that the sense-resistor is within specification, this is essential if the ECU is to pass the correct current to the coil.

The current at the boom lower control solenoid continuously changes because of the inputs from the LMI and the angle sensor. The system does have some set-points for reference that can be used as a guide for system conformance.

Test Weight

The machines test weights are:

– TM310/320: 2.6-2.9t.

LLMI, LLMC Calibration Check

Fully retract the boom and lift the forks 100mm (4in.) clear of the ground, this is the DATUM position.

Connect both of the transducers into a Y-splitter lead, and then through the link harness and back into one of the machine harness connectors.

Measure using a multimeter set to mA and make a record of the output.

Lift the test weight until the boom is horizontal (Quickhitch pivot at same height as load tower pivot), extend the boom slowly until there is an amber flashing LED on the LMI display. This is the 100% capacity point.

Make a record of the transducer mA output.

100% capacity - Datum = transducer swing.

The transducer swing should be:

– TM310/320: 10 +/- 1mA.

Machine Stability Check

With a load positioned at the 100% stability point, the machine should remain stable when steered from left to right.

A momentary lifting of the outer rear tyre can be expected due to the centre joint 'wind up' when carrying heavy loads that can prevent chassis oscillation without a significant opposing force.

System Checks

LLMC Cut Out of Telescopic and Lower

Lift the test weight.

Extend the boom, the boom should extend a short distance to clear the retract sensor before coming to a stop. The display will change into 'Pick and Place' mode

T058820-9

Fig 12.

There may be sufficient boom speed and movement to trigger the red LED, or it may stop at the amber flashing LED.

– Boom lower function should be prevented
– Boom extend function should be prevented
– Boom raise function will continue to operate
– Boom retract function will continue to operate
– Fork tilt function will continue to operate
– Fork crowd function will continue to operate
– Auxiliary function will continue to operate in both directions.

Retract the boom, the retract sensor should be triggered, and the lower display will change into 'Groundworks' mode

T058820-10

Fig 13.

Despite the display retaining a high stability warning (potentially still a red LED) the boom functions should all work again.

Change the position of the weight.

Contents **Page No.**

Table 3. PS763 3-Speed

Converter Pressures (in neutral)		bar	kgf/cm^2	lbf/in^2
Converter In at 50 ^{0}C	1000 rev/min.	1.4 - 2.2	1.4 - 2.2	20.3 - 31.9
	2000 rev/min.	5.8 - 6.9	5.9 - 7.0	84.1 - 100.0
Converter In at 100 ^{0}C	1000 rev/min.	0.5 - 1.3	0.5 - 1.3	7.2 - 18.9
	2000 rev/min.	2.5 - 3.5	2.5 - 3.7	36.2 - 50.8
Converter Out at 50 ^{0}C	1000 rev/min.	0.6 - 1.6	0.6 - 1.6	8.7 - 23.2
	2000 rev/min.	2.8 - 3.8	2.9 - 3.9	40.6 - 55.1
Converter Out at 100 ^{0}C	1000 rev/min.	0.2 - 1.0	0.2 - 1.0	2.9 - 14.5
	2000 rev/min.	1.0 - 1.9	1.0 - 1.9	14.5 - 27.6
Converter Inlet Relief Pressure (max.)		7.1	7.2	103.0
Lubrication Pressure (in neutral)				
Oil at 50 ^{0}C	1000 rev/min.	0.2 - 0.9	0.2 - 0.9	2.9 - 13.1
	2000 rev/min.	1.1 - 2.1	1.1 - 2.1	16.0 - 30.5
Oil at 100 ^{0}C	1000 rev/min.	0.1 - 0.4	0.1 - 0.4	1.5 - 5.8
	2000 rev/min.	0.4 - 1.4	0.4 - 1.4	5.8 - 20.3
Main Line Pressure (in neutral)				
Oil at 50 ^{0}C	1000 rev/min.	11.0 - 13.0	11.2 - 13.3	159.5 - 188.5
	2000 rev/min.	13.0 - 15.2	13.3 - 15.5	188.5 - 220.5
Oil at 100 ^{0}C	1000 rev/min.	10.2 - 12.2	10.4 - 12.4	147.9 - 176.9
	2000 rev/min.	11.4 - 14.5	11.6 - 14.8	165.3 - 210.3
Clutch Pressure	All clutch pressures should be the same as mainline pressure to within 0.7 bar (10 lbf/in^2)			

Flow Rates (in neutral)		L/min.	US gal/min.	UK gal/min.
Cooler oil flow at 50 ^{0}C	1000 rev/min.	8.5 - 11.0	2.1 - 2.9	1.9 - 2.4
	2000 rev/min.	17.0 - 25.1	4.5 - 6.6	3.7 - 5.5
Cooler oil flow at 100 ^{0}C	1000 rev/min.	6.2 - 9.5	1.6 - 2.5	1.4 - 2.1
	2000 rev/min.	15.0 - 19.5	4.0 - 5.2	3.3 - 4.3
Pump oil flow at 100 ^{0}C	1000 rev/min.	11.5 - 15.6	3.0 - 4.1	2.5 - 3.4
	2000 rev/min.	24.0 - 33.0	6.3 - 8.7	5.3 - 7.3
Control Solenoid Valves	3 way, 2 position, normally closed, integral suppression diode.			
Initial coil current draw	1.68 amps @ 12 volts & 20 ^{0}C			

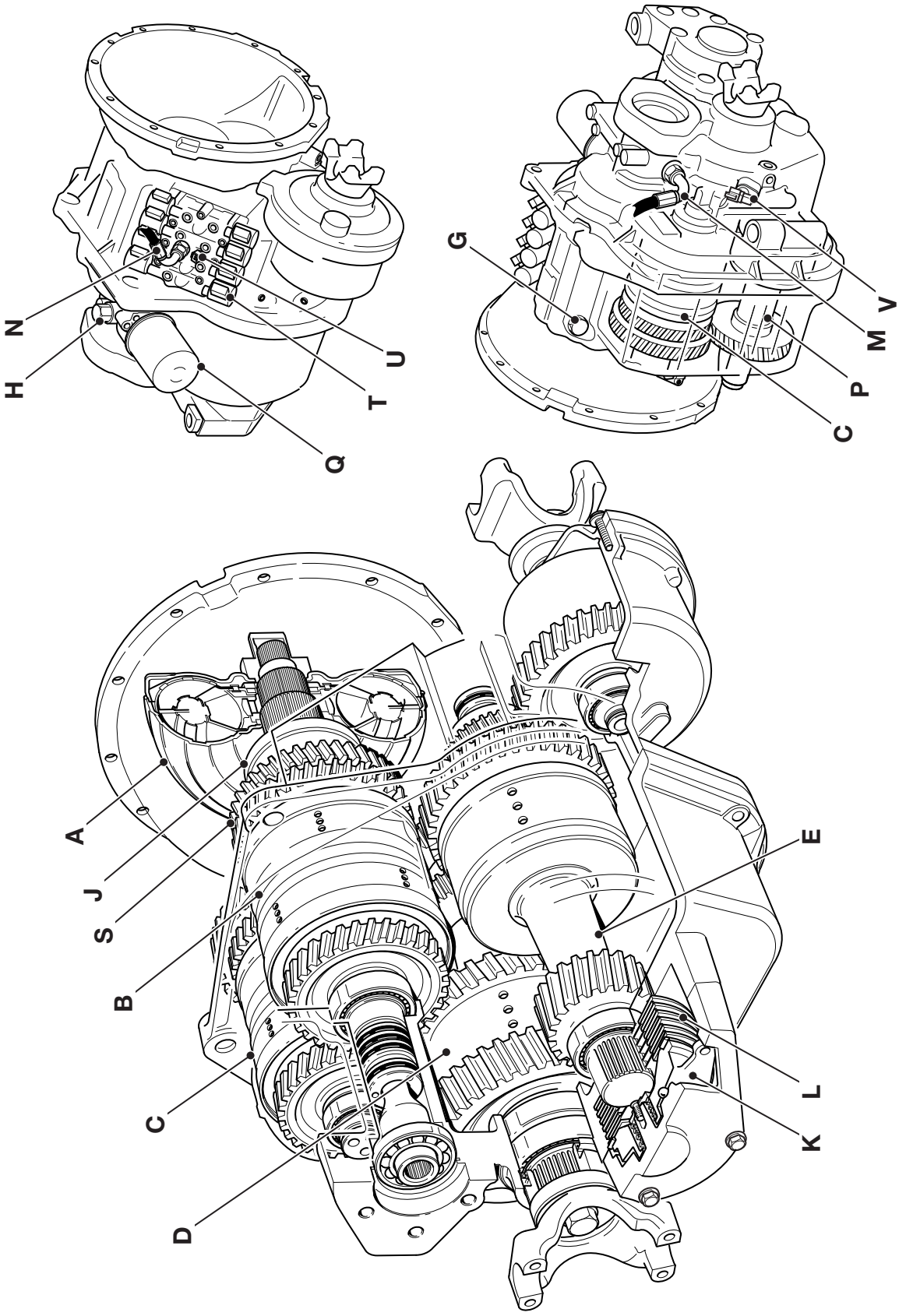


Fig 8. Component Identification

Reverse

1R ⇨ *Fig 19. (F-29)*

1st GEAR REVERSE

Clutches Engaged		**Solenoids Energised**
W	Reverse Low	**Ws**
Z	Layshaft	**Zs**

2R ⇨ *Fig 21. (F-29)*

2nd GEAR REVERSE

Clutches Engaged		**Solenoids Energised**
V	Reverse High	**Vs**
Z	Layshaft	**Zs**

3R ⇨ *Fig 20. (F-29)*

3rd GEAR REVERSE

Clutches Engaged		**Solenoids Energised**
W	Reverse Low	**Ws**
Y	Mainshaft	**Ys**

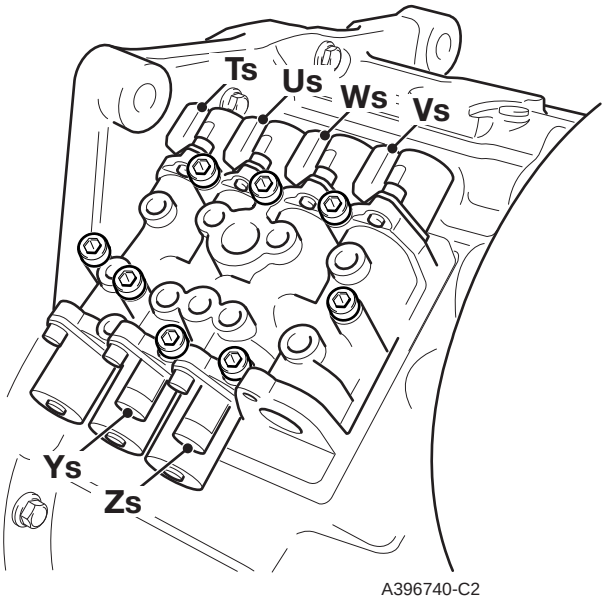


Fig 18.

State 1: Torque Converter Unlocked

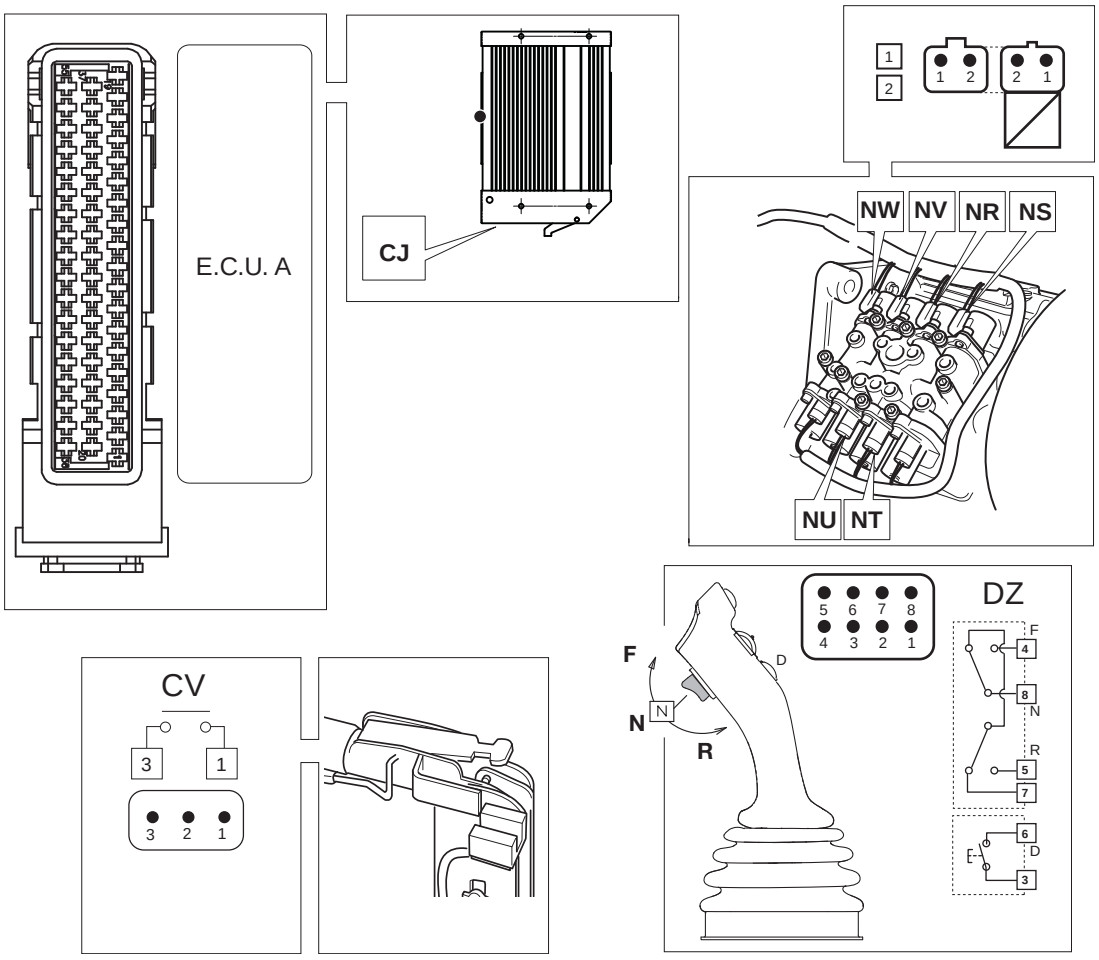
When inputs to the ECU **J** from the joystick lever **K** and speed sensors **G** and **H** are outside pre-determined values, solenoid control valve **F** is not energised and oil enters the converter casing nearest the flywheel via the centre of the gearbox input shaft **E**.

Oil then flows past the front of the clutch assembly **A**. This causes the clutch assembly **A** to move on its splined hub away from the torque converter casing **C**.

Oil leaves the torque converter via ports in the oil pump assembly and then passes through the oil cooler **M** via the control valve **F**.

The torque converter operates in the normal way.

Note: *Although the torque converter operates in the normal way, it should be noted that the oil flow to and from the converter is opposite to the normal system.*



C025280-C5

Fig 40. Electrical Connectors

T.B.A.

Fig 46. Solenoid Actuation

Transmission Dump Operation

T.B.A.

Lock Up Torque Converter

Introduction

This section explains how the Lock Up Torque Converter electrical system works.

Central to the system is the ECU (Electronic Control Unit) **1**. The unit receives `inputs' from electrical devices such as the engine speed sensor **B**. Depending on the input signals an ECU `output' energises the lock up torque converter solenoid control valve **2**. The ECU can be connected to diagnostics software loaded on a laptop PC. The communications link is facilitated via diagnostics socket **3** ⇒ *Fig 51. (F-69)*. See also **Powershift Gearbox - JCB Diagnostics - User Guide**.

Component Key

1 ECU

ECU Input Devices

A Joystick Controller

B Engine speed sensor

C Transmission speed sensor

ECU Output - Activated Devices

D Lock up torque converter solenoid control valve

E In-cab warning light(1) - torque converter lock up

(1) For identification of in-cab warning lights see the machine Operator Handbook.

Table 15.

Fault	Possible Cause	Action
Machine drives but lacks power in all gears. Gearbox oil may also be overheating.	Gearbox oil level low.	Check for leaks and top up oil level as required.
	Gearbox oil contaminated or wrong grade.	Investigate the reason for the contamination and rectify as required. Drain the oil and flush the gearbox, refer to ***Service Procedures - Powershift Gearbox, Flushing the Transmission Oil***.
	Suction strainer restricted or blocked.	Remove the suction strainer and clean or renew as applicable, refer to ***Section3, Routine Maintenance***.
	Pressure maintenance valve defective.	Carry out oil pressure and flow tests, refer to ***Pressure and Flow Tests - Mainline Pressure***.
		Remove the pressure maintenance valve and inspect for signs of damage or excessive wear. Clean or renew as applicable.
	Torque converter relief valve defective.	Carry out oil pressure and flow tests, refer to ***Pressure and Flow Tests - Converter IN Pressure***.
		Remove the torque converter relief valve and inspect for signs of damage or excessive wear. Clean or renew as applicable.
	Oil cooler lines restricted or blocked. Internal blockage within the oil cooler matrix due to contamination.	Carry out oil pressure and flow tests, refer to ***Pressure and Flow Tests - Converter OUT Pressure*** and ***Lubrication Pressure***.
		Clear the restriction. Inspect the hose routing and renew the hoses or oil cooler matrix as applicable.
	Faulty torque converter.	Carry out torque converter stall tests to confirm stall speeds are within specification, refer to ***Torque Converter Stall Tests***.
		Remove the gearbox and renew the torque converter. Note that the torque converter assembly is a non serviceable item.
	Failure of oil pump assembly.	Carry out oil pressure and flow tests, refer to ***Pressure and Flow Tests - Pump Flow***.

Table 23.

Fault	Possible Cause	Action
Gearbox fails to change into the selected mode (Field, Road `ECO', Road `Power', PS766 gearbox only).	Mode switch faulty	Check the function of the mode switch. Inspect the condition of the associated electrical wiring, plugs and connectors for damage and check that the relevant fuses are intact. See ***Electrical Connections, Powershift Gearbox (PS766 6 speed)***. Renew the switch if it is faulty.
	Mode relay faulty.	Check the function of the mode relay. Inspect the condition of the associated electrical wiring, plugs and connectors for damage and check that the relevant fuses are intact. See ***Electrical Connections, Powershift Gearbox (PS766 6 speed)***. Renew the relay if it is faulty.
	IFT electronic control unit (ECU) faulty	Check the relevant electrical input and output form the IFT ECU for the transmission mode function. Inspect the condition of the associated electrical wiring, plugs and connectors for damage and check that the relevant fuses are intact. See ***Electrical Connections, Powershift Gearbox (PS766 6 speed)***. Renew the ECU if it is faulty.(1)
	Gearbox electronic control unit (ECU) defective.	Check the relevant ECU inputs and outputs. See ***Electrical Connections, Powershift Gearbox (PS766 6 speed)***. Renew the ECU if it is faulty.(1)

(1) The ECU is inherently reliable. It is protected internally from electrical damage. It is housed in a rugged case for protection from mechanical damage and ingress of dirt and moisture. Faults with associated systems are more likely to be caused by wiring or other input and output device failure. Before renewing the ECU make sure beyond reasonable doubt that it is faulty.

⇨ ***Fault Finding Tables (F-77)***.

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Inspection

Before inspecting the brake components carefully remove all traces of sealing compound from component mating faces. Using a suitable degreaser clean the brake components including the brake housing in the gearbox rear casing.

1 Carefully inspect the friction plates **11-A** and counter plates **11-B**. If any of the plates show signs of damage or distortion, renew the complete friction pack.

2 Assemble the friction and counter plates (including the thrust plate **11-C**) on a suitable datum table. Measure the overall thickness of the assembled friction pack. The thickness **10-X** must be between 39.6 mm and 37.1mm. If the pack is out side these limits the complete friction pack assembly must be renewed.

Note: *The friction pack may be outside the maximum thickness value if the plates are distorted, typically after the brake has performed an emergency stop.*

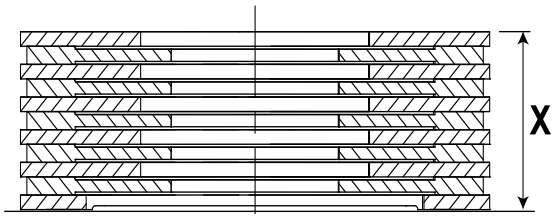


Fig 5.

3 Inspect the following components for signs of excessive wear or damage: Balls **11-D** and their tapered locating slots (cover **11-E** and actuator plate **11-F**), needle roller thrust bearing **11-G** and the corresponding bearing surfaces (actuator plate **11-F** and thrust plate **11-C**).

Note: *Some discolouration of the needle rollers is acceptable providing the surface of the rollers is otherwise undamaged.*

4 Make sure that the park brake cable is smooth and free in operation. Inspect the cable outer for signs of damage. Renew the cable if it is damaged or stiff to operate.

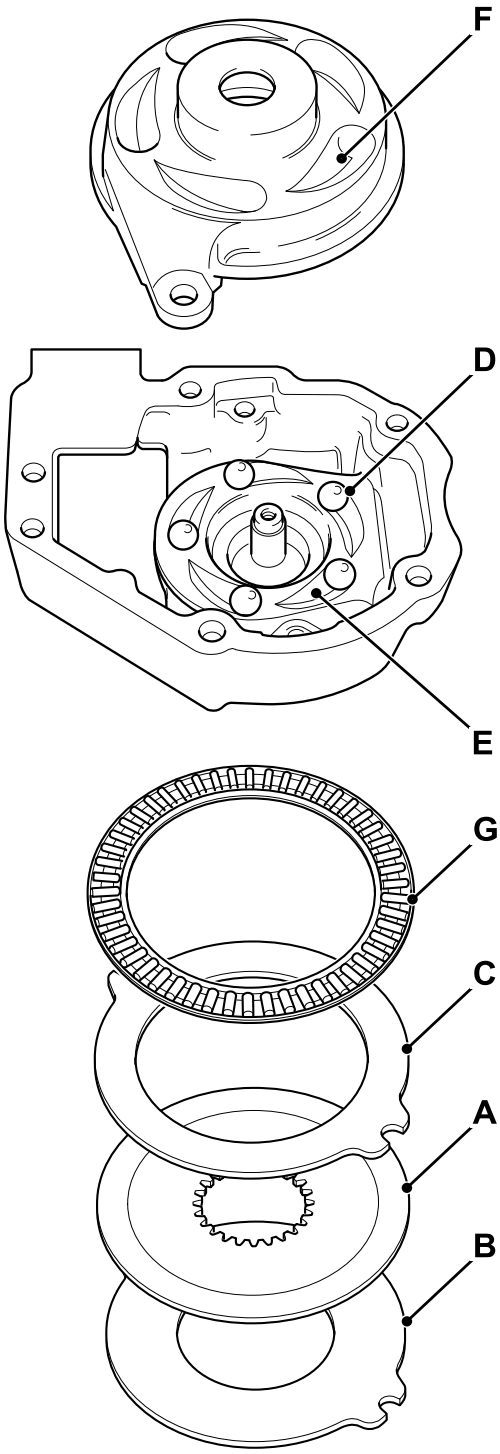


Fig 6.

Contents Page No.

1 Make sure the steering hoses are connected to the correct connectors. ⇒ *Hose Connections (H-10)*

2 Check the hydraulic fluid level. See ***Section 3 - Routine Maintenance***.

3 Before driving the machine, bleed the steering system, see ⇒ *Bleeding the System (H-1)*

Hose Connections

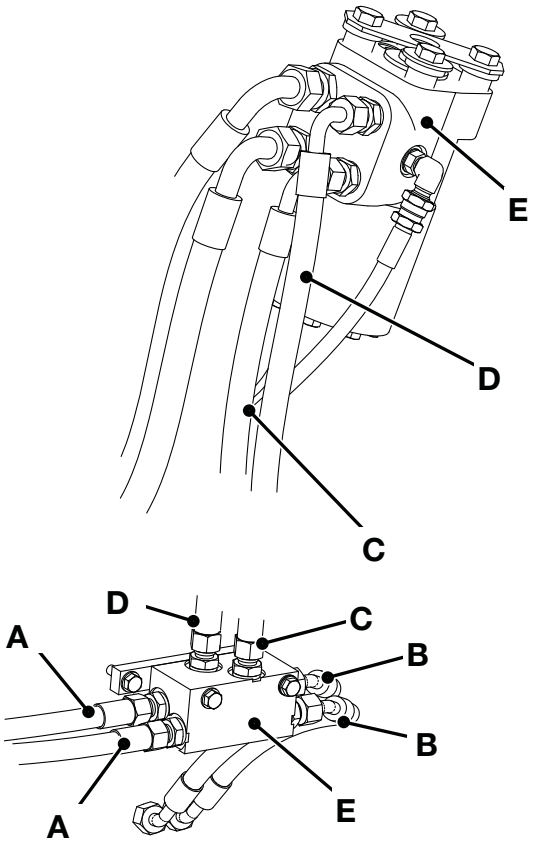


Fig 6. Steering Manifold Hose Connection

Item	⇒ Fig 6. (H-10)
A	Left Steer Ram
B	Right Steer Ram
C	To Steer Valve
D	To Steer Valve
E	Steer Valve

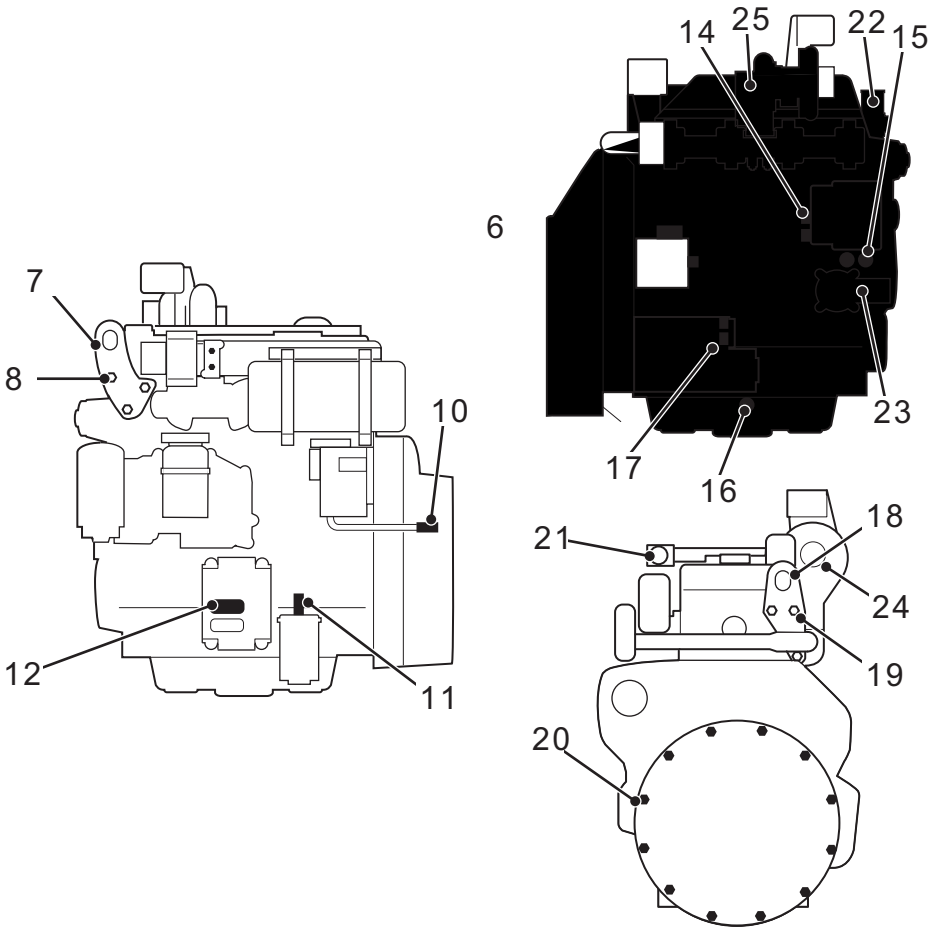


Fig 3.

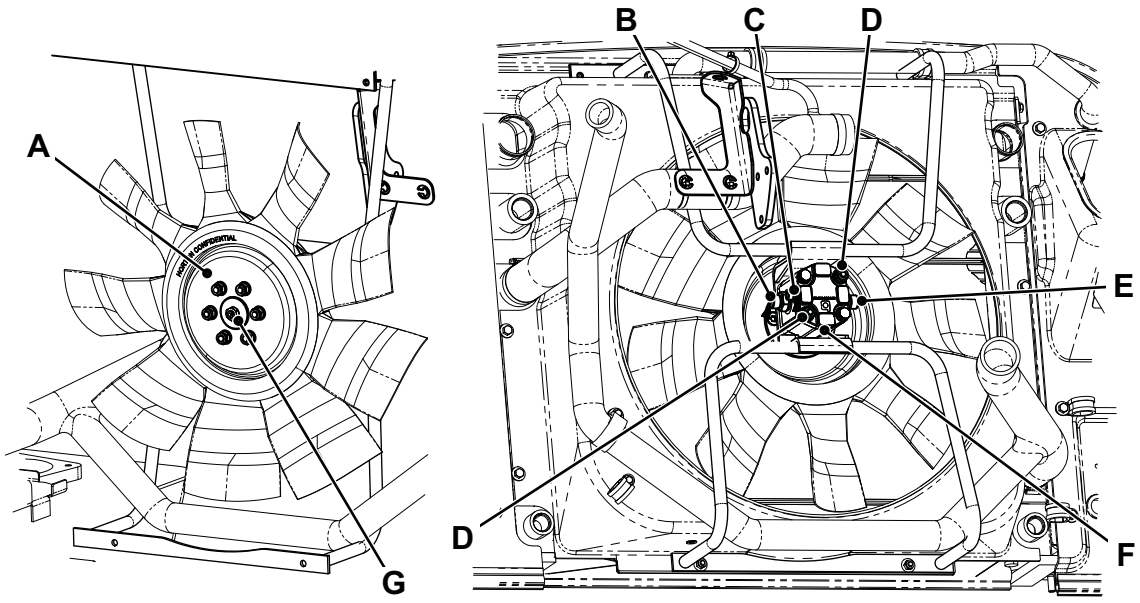
6	Engine mouting bolts
7	Lifting bracket - front
8	Lifting bracket fixing bolts
10	Fuel line connector - return to tank line
11	Fuel line conector at fuel filter - feed line from fuel pump
12	Electrical connector - engine ECU machine side connector (grey)
14	Electrical connections - alternator
15	Hose connection - cab heater
16	Electrical sensor - engine oil level
17	Electrical connections - starter motor
18	Lifting bracket - rear
19	Lifting bracket fixing bolts
20	Fixing bolts - gearbox to engine
21	Electrical connector - engine harness
22	Top hose
23	Bottom hose
24	Air inlet hose
25	Exhaust pipe

– Ensure that the flywheel housing and starter motor mating faces are clean.
– Smear the drive pinion splines with MPL grease before assembly.
– Torque tighten bolts **8**. ⇨ *Table 3. Torque Settings (K-26)*
– Be sure to reconnect the electrical leads to the starter motor in the correct positions.

Table 3. Torque Settings

Item	Nm	kgf m	lbf ft
C	47	4.8	34.7

Removal and Replacement



C147190

Fig 17.

Removal

1 Park the machine and make it safe. Vent the hydraulic pressure. Obey the care and safety procedures Refer to ***Section 3***.

Important: *Switch OFF the engine before working in the engine compartment. Remove key or isolate battery to prevent the engine from being started.*

2 Put a label on the hydraulic hose feed and return pipes to aid identification when replacing.

3 Disconnect and plug the feed hose **B** and return hose **E**.

4 Disconnect and plug the case drain hose **c** (if fitted).

5 Remove the cooling pack ⇨ ***Removal and Replacement (K-12)***.

6 Prevent the fan from turning, release the tab washer and then undo nut **G**.

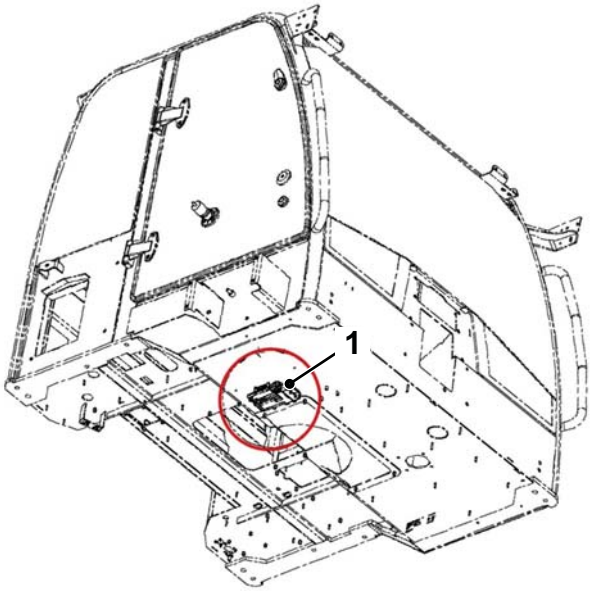
7 Withdraw the fan from the motor shaft. Retain the drive key (not shown).

8 Undo motor retaining bolts **D** and remove the motor.

SCR ECU

Location

The SCR ECU **1** is located on the underside of the cab as shown.



C147120

Fig 23.

Description

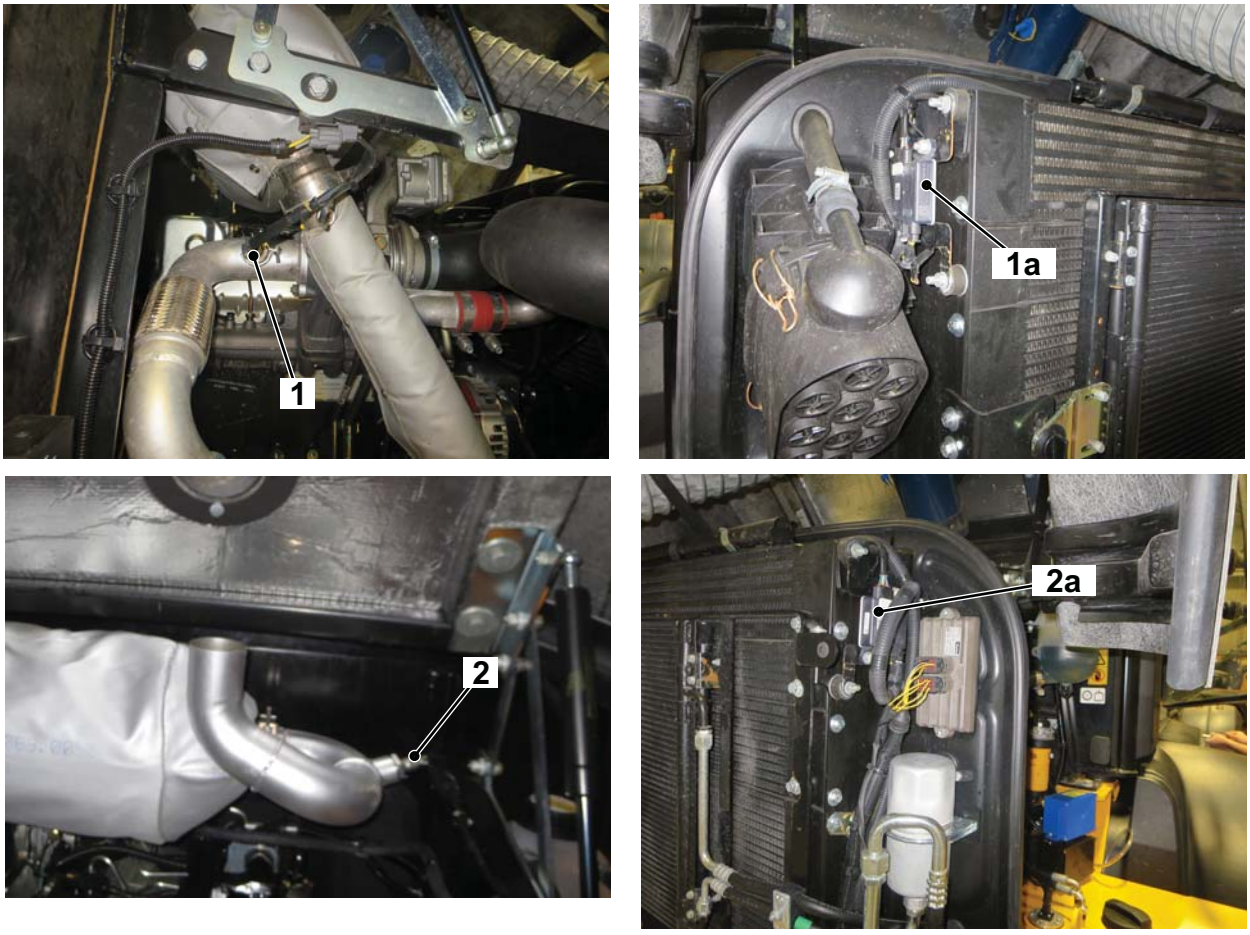
The SCR ECU controls the SCR system. It processes the inputs from the NOx and exhaust gas temperature sensors and operates the DEF supply module, in-line heaters, coolant circulation and the DEF dosing module. For information about the electrical connections refer to the applicable connected device.

The SCR ECU communicates on the engine and machine CANbus networks. This enables effective engine management in the event of DEF faults or quality issues. The RH instrument cluster enables the emissions symbol illumination by means of communication on the CANbus.

NOx and Exhaust Temperature Sensors

NOx Sensors

The upstream NOx sensor **1** and downstream NOx sensor **2** are connected by integral leads to the CANbus interface units **1a** and **1b**. The CANbus signals from the NOx sensors are seen by the SCR ECU.



C147180

Fig 32.

Contents **Page No.**

Connected Devices

The tables show how the monitoring system ECUs respond to inputs from connected devices.

Note: *Some of the warning and indicator light signals are sent through the CANBus system and do not have a dedicated input.*

Important: *The connector pin numbers are for the harness connectors, NOT the pins on the ECUs. The connectors are viewed from the front. DO NOT TOUCH the pins on the ECUs.*

Table 1.

Pin	Device	Input/Output	Function	Display
1	Not Used			
2	Sidelight	Input	Trigger for display backlight.	
3	Fused Power Supply	+12V		
4	Fused Power Supply	+12V		
5	Not Used			
6	Left Direction Indicator	High Side Digital Input	Operate warning light when direction indicator active.	
7	Right Direction Indicator	High Side Digital Input	Operate warning light when direction indicator active.	
8	Earth	Cab Earth		
9	SRS	High Side Digital Input	Operate warning light when SRS system is active or transmitting a fault.	
10	Not Used			
11	Park Brake Sensor	High Side Digital Input	Operate warning light when parkbrake applied.	
12	Not Used			
13	Air Filter Vacuum Switch	Low Side Digital Input	Operate warning light when air filter is blocked	

Electronic Monitoring System ECU Fault Codes

Fault Code	Description
P2080-2F	Turbo in temperature count noise fault
P0546-24	Turbo in temperature count high fault
P0545-23	Turbo in temperature count low fault
P0544-00	Turbo in temperature fault
P0473-24	Exhaust manifold pressure (P3) signal high fault
P0472-23	Exhaust manifold pressure (P3) signal low fault
P0473-24	Exhaust manifold pressure (P3) signal drifted high
P0472-23	Exhaust manifold pressure (P3) signal drifted low
P0470-00	Exhaust manifold pressure (P3) signal ADC fault
P0650-13	
P0650-11	
P0650-00	
P061B-00	Functional Safety Fault
P0685-72	Main relay unexpected low state
P0685-00	Main ECU relay stuck
P062D-12	Injector Bank 0 fault shorted to ground (SC2VBAT)
P062D-11	Injector Bank 0 fault shorted to ground (SC2GND)
P062E-12	Injector Bank 1 fault shorted to ground (SC2VBAT)
P062E-11	Injector Bank 1 fault shorted to ground (SC2GND)
P0612-12	
P0612-13	
P0612-11	
P0612-00	
P0400-00	EGR flow reached its limit
P2147-00	injector supply voltage faulty
P2146-00	injector supply voltage faulty
P0641-00	ECU Internal 5V Supply 1 fault
P0651-00	ECU Internal 5V Supply 2 fault
U0140-87	Aftertreatment Refresh Inhibit/Force Switch message missing
P0520-12	Low oil pressure Lamp/Gauge drive short circuit to battery voltage (SC2VBATT)

Fault Code	Description
P0520-13	Low oil pressure Lamp/Gauge drive open circuit (OC)
P0520-11	Low oil pressure Lamp/Gauge drive short circuit to ground (SC2GND)
P0520-00	Low oil pressure Lamp/Gauge drive short circuit (SC)
P2103-12	Throttle H-Bridge driver in ECU fault: SC2VBATT
P2100-13	Throttle H-Bridge driver in ECU fault: OC
P2102-11	Throttle H-Bridge driver in ECU fault: SC2G
P0607-4B	Throttle H-Bridge driver in ECU fault: Over temperature
P0406-24	
P0697-00	
P1500-00	Foot pedal signal fault set (triggers limp home mode)
P1501-00	Foot pedal signal fault set (triggers reduced torque mode)
P1503-00	Hand pedal signal fault set (triggers limp home mode)
P1504-00	Hand pedal signal fault set (triggers reduced torque mode)
P1506-00	Pedal global limp home mode triggered
P0120-00	Foot pedal signal track 1 fault
P0220-00	Foot pedal signal track 2 fault
P2120-00	Hand pedal signal track 1 fault
P2125-00	Hand pedal signal track 2 fault
P1101-00	Rail Pressure Control Error Positive fault
P1102-00	Rail Pressure Control Error Negative fault
P0088-00	Rail Pressure overpressure timeout
P1103-00	Rail Pressure Fault detected - not able to maintain pressure after a stop and start request
P2269-00	Water in fuel sensor feedback signal setting fault
P250B-00	Oil level sensor signal global fault
P0521-00	Oil pressure sensor signal global fault
P0522-23	High Oil Pressure During Engine Stopped
P0523-24	Low Oil Pressure During Engine Running

Electronic Monitoring System ECU Fault Codes

Fault Code	Description
P20C3-14	ERROR FOR SHORT TO GROUND OF UREA SUCTIONLINE HEATER ACTUATOR POWERSTAGE
P20C1-13	OPEN LOAD ERROR OF UREA SUCTIONLINE HEATER ACTUATOR POWERSTAGE
P20B6-4B	ERROR FOR OVERTEMPERATURE OF SUPPLY MODULE HEATER ACTUATOR POWERSTAGE
P20B8-15	ERROR FOR SHORT TO BATTERY OF SUPPLY MODULE HEATER ACTUATOR POWERSTAGE
P20B7-14	ERROR FOR SHORT TO GROUND OF SUPPLY MODULE HEATER ACTUATOR POWERSTAGE
P20B5-13	OPEN LOAD ERROR OF SUPPLY MODULE HEATER ACTUATOR POWERSTAGE
P242B-17	ERROR ON CATALYST TEMPERATURE SENSOR PLAUSIBILITY ABOVE MAX THRESHOLD
P242B-16	ERROR ON CATALYST TEMPERATURE SENSOR PLAUSIBILITY BELOW MIN THRESHOLD
P242D-17	EXHAUST CATALYST TEMPERATURE T4 VOLTAGE SIGNAL ABOVE MAXIMUM LIMIT
P242C-16	EXHAUST CATALYST TEMPERATURE T4 VOLTAGE SIGNAL BELOW MINIMUM LIMIT
P242B-00	ERROR ON SCR CATALYST UPSTREAM TEMPERATURE SENSOR STATIC PLAUSIBILITY
P2000-00	ACTUAL AVERAGE CONVERSION EFFICIENCY IS BELOW THE THRESHOLD
P205B-24	ERROR ON TANK TEMPERATURE SENSOR PLAUSIBILITY EXCEEDS MAXIMUM THRESHOLD
P205B-23	ERROR ON TANK TEMPERATURE SENSOR PLAUSIBILITY BELOW MINIMUM THRESHOLD
P20BE-93	ERROR ON PRESSURE LINE TO PERFORM AFTERRUN
P203B-15	UREA TANK LEVEL SIGNAL IS ABOVE MAXIMUM VOLTAGE LIMIT
P203B-14	UREA TANK LEVEL SIGNAL IS BELOW MINIMUM VOLTAGE LIMIT
P203B-16	ERROR ON TANK LEVEL PLAUSIBILITY
P208B-4B	OVERTEMPERATURE ERROR OF SUPPLY MODULE PUMP MOTOR
P208D-13	SHORT CIRCUIT TO BATTERY ERROR OF SUPPLY MODULE PUMP MOTOR
P208C-14	SHORT CIRCUIT TO GROUND ERROR OF SUPPLY MODULE PUMP MOTOR
P208A-13	OPEN LOAD ERROR OF SUPPLY MODULE PUMP MOTOR
P208B-61	ERROR ON SUPPLY MODULE PUMP SPEED DEVIATION
P208B-02	ERROR ON SUPPLY MODULE PUMP SPEED PERMANENT DEVIATION
P208A-31	SUPPLY MODULE PUMP FEEDBACK ERROR
P2000-02	ACTUAL AVERAGE CONVERSION EFFICIENCY IS BELOW THE THRESHOLD
P208B-85	SUPPLY MODULE MOTOR SPEED DUTY CYCLE ABOVE MAXIMUM RANGE
P208B-84	SUPPLY MODULE MOTOR SPEED DUTY CYCLE BELOW MINIMUM RANGE
U059E-9A	CAN BUS MESSAGE ERROR FOR HEATER RATIO FROM UPSTREAM NOX SENSOR
U059E-02	CAN BUS MESSAGE ERROR FOR NO2 LEVEL FROM UPSTREAM NOX SENSOR
U059E-62	CAN BUS MESSAGE ERROR FOR NH3 LEVEL FROM UPSTREAM NOX SENSOR
U059F-9A	CAN BUS MESSAGE ERROR FOR HEATER RATIO FROM DOWNSTREAM NOX SENSOR
P2201-17	DOWNSTREAM NOX OFFSET MAX ERROR DETECTION
P2201-16	DOWNSTREAM NOX OFFSET MIN ERROR DETECTION

Error Code	Description
B1041-11	Boom extend/retract solenoid return short circuit
B1042-13	Boom extend/retract solenoid return open circuit
B1043-12	Auxiliary solenoid return back driven
B1044-11	Auxiliary solenoid return short circuit
B1045-13	Auxiliary solenoid return open circuit
B1046-12	Boom lower solenoid return back driven
B1047-11	Boom lower solenoid return short circuit
B1048-13	Boom lower solenoid return open circuit
B1049-12	Servo cutoff solenoid return back driven
B104A-11	Servo cutoff solenoid return short circuit
B104B-13	Servo cutoff solenoid return open circuit
B1063-64	Constant flow switch rationality fault
C1030-64	Quickhitch unlock switch rationality fault
C1031-64	Tow hitch switch rationality fault

Check the DLA Firmware File

Important: *Do not connect the DLA to the machine until this procedure has been completed.*

The DLA has software embedded in its own flash memory. This file must be replaced with a new one when new firmware is released. You will only have to Check the DLA firmware file version if you receive a new Servicemaster version or use a different DLA.

1 Make sure that the DLA is connected to the laptop computer. ⇒ ***Connect the 'USB PC Cable' 25A to the DLA and a free port on your laptop computer. (M-50)***

2 Start the Servicemaster software on your laptop computer. ⇒ ***Start Servicemaster (M-45)***

3 Select `DLA' from the drop down menu. ⇒ ***Fig 16. (M-46)***

4 Double click on the USB DLA Flash Loader icon. ⇒ ***Fig 21. (M-48)***

Fig 21.

Note: *Older DLAs and laptop computers may not be compatible with USB ports. Double click the `Flash loader for Serial/Parallel DLA' icon.*

5 The device flash update tool window opens. The details of the firmware in the DLA are displayed including the application version, for example 1.04.

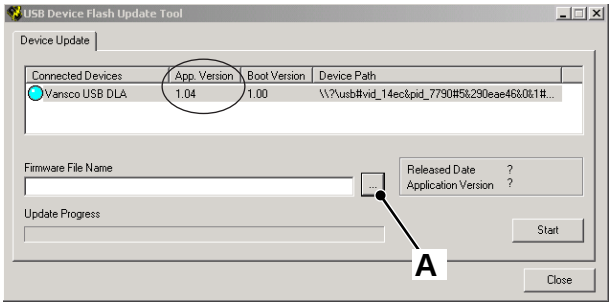


Fig 22.

6 **Check for a new firmware file**: Click on the browse button **22A** and locate the file stored within the JCB_Servicemaster directory on your laptop hard drive.

a Click the `Open' button. The selected file appears in the `Firmware File Name' field together with its release date and application version, for example 2.01.⇒ ***Fig 24. (M-48)***

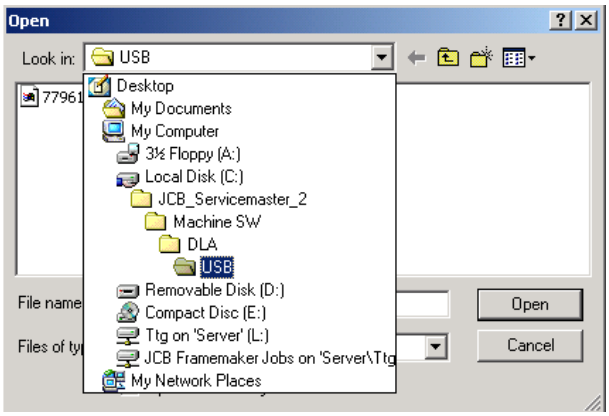


Fig 23.

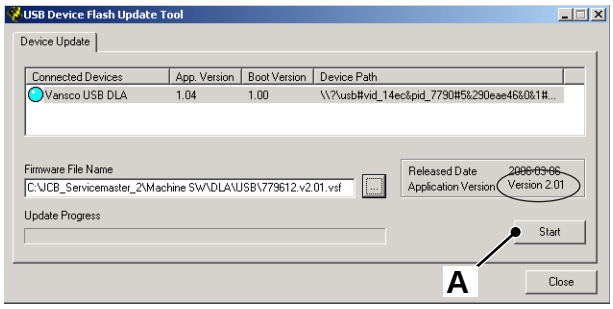


Fig 24.

Start and Stop Buttons

These offer the same function as the **Start Diagnostics** and **Stop Diagnostics** options within the Options Menu.To start the **Diagnostics** tool communicating with the gearbox ECU simply click on the **Start Button** (large green LED) at the top of the Main Window.Similarly, click on the **Stop Button** (large red LED) to cease communications ⇨ *Fig 37. (M-58)*.

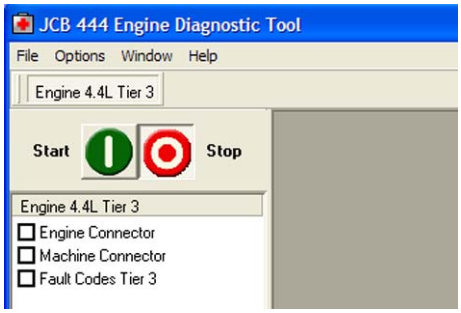


Fig 37.

Page List

In the top left corner of the main window is displayed a list of pages which can be displayed ⇨ *Fig 38. (M-58)*.

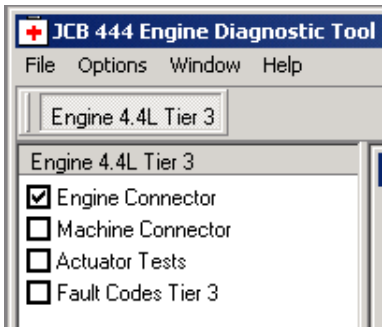


Fig 38.

Clicking in the box next to the required page will make that page appear in the main window display area. (A tick will also appear in the box to show it is being displayed.) At any time the user may swap between displayed pages simply by clicking in the check box of the required page in the page list. The function keys, F2, F3 etc. can also be used to select pages as required.

Starting ShiftMaster Diagnostics

1 Turn ON the machine ignition and additionally start the engine if required (taking normal precautions).

2 Start **JCB Service Master** on the laptop computer.

Fig 46.

3 Make sure that the correct DLA is selected in the chooser. Click on `Utilities', DLA Setup. The DLA Chooser window opens. Check the button to match to the Current Device. Click `Apply' ⇨ *Fig 28. (M-53)*.

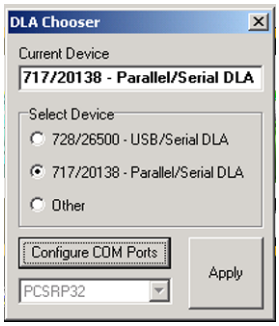


Fig 47.

4 Select `Compact Wheeled Loading Shovels' from the drop down list ⇨ *Fig 27. (M-53)* and then start the diagnostics tool running by clicking on the **ShiftMaster Diagnostics** icon ⇨ *Fig 29. (M-53)*.

Fig 48.

5 Warning message appears ⇨ *Fig 49. (M-68)*. Read and understand the Warning message. If you can comply with the requirements press the `Accept' button.

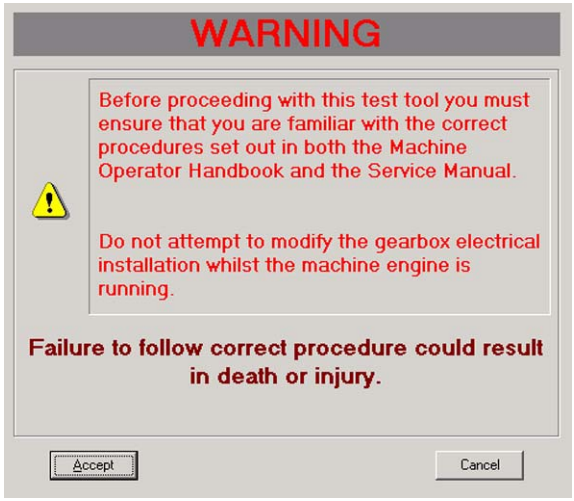


Fig 49.

6 The **ShiftMaster Diagnostics** tool will then open up displaying the main window ⇨ *Fig 30. (M-53)*.

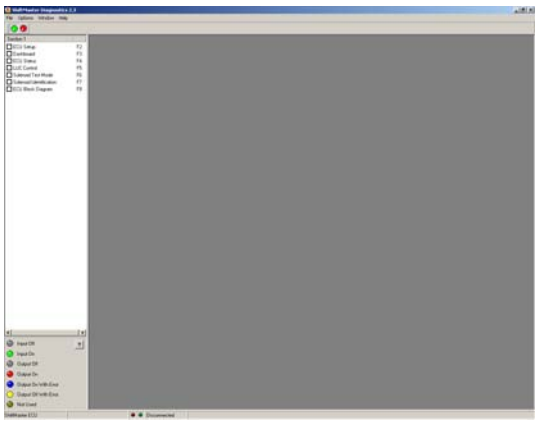


Fig 50.

LED will be coloured yellow when ON, or blue when OFF.

- **4WD Configuration**: Depending on the type of 4WD clutch fitted 4wheel drive OR 2 wheel drive may be selected when the `4WD' solenoid is energised. The clutch may be a `**Spring Applied**' or `**Pressure Applied**' type.
- **4WD Status**: Indicates if 4WD is `**Engaged**' or `**Disengaged**'.

Misc Inputs

These inputs are derived from the remaining operator controls. The input status is indicated by a coloured LED, grey - input OFF, green - input ON.

- **Handbrake Switch:** Signal derived from the Parkbrake switch. Used to hold the transmission in Neutral if the parkbrake is applied. Two types of switch may be fitted NO (Normally Open) or NC (Normally Closed).
- **Footbrake Switch:** If fitted. Two types of switch may be fitted NO (Normally Open) or NC (Normally Closed).
- **Dump Switch:** (or Transmission Disconnect) Signal usually derived from a momentary switch. Temporarily selects Neutral when pressed (usually to divert engine power to hydraulics).
- **Throttle Switch:** Signal derived from a switch fitted to the machine throttle pedal. Used to interact with the Automatic Mode of gear-shifting.
- **Pressure Switch:** Signal derived from the transmission mounted Low Oil Pressure Switch.
- **Kickdown Switch:** Signal derived from a momentary button used to temporarily select the next lowest gear.
- **Oil Temp Switch:** Signal derived from the transmission oil temperature switch.

Misc Outputs

These are the additional ECU outputs, generally used to control cab instrumentation such as a **Driver Indicator** (lamp and buzzer where fitted), low **Oil Pressure Lamp** and **Kickdown Indicator**. The output status is indicated by a coloured LED, grey - output OFF, red - output ON.

Load Mode (ECU 2.2/2.3 only)

Some machines utilise transmission `modes'. The transmission can be configured to change the shift pattern data depending on the machines mode of operation. The operator is able to preselect different transmission modes using a selector switch in the cab.

- **Bit 0**: An ECU input signal derived from a mode selection switch.
- **Bit 1**: An ECU input signal derived from a mode selection switch.
- **Set #**: Indicates the transmission shift pattern data sets selected. There can be upto three different data set combinations selected by the ECU depending on the combination of inputs at Bit 0 and Bit 1.
- **Enable Footbrake Dump:** If fitted.

Menu Bar - Utilities Menu

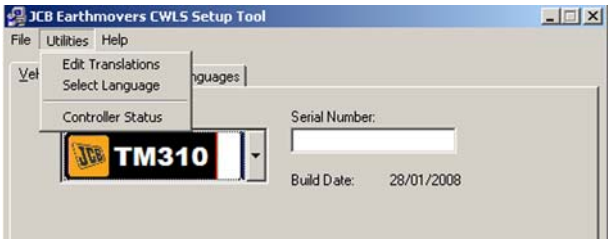


Fig 86.

– **Select Language:** - to select the language of the setup program. ⇒ *Fig 87. (M-88)*

– **Controller Status:** to show that the ECU is online.When the ECU is online the machine codes are displayed. This diagram shows the actual settings read from a test machine.⇒ *Fig 88. (M-88)*

Fig 87.

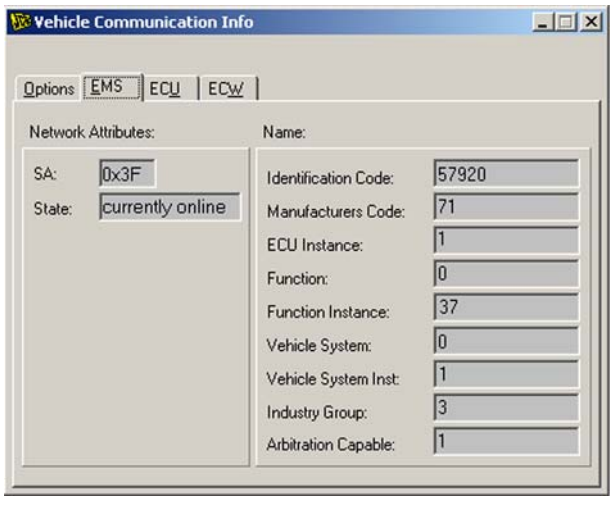


Fig 88.

Menu Bar - Help Menu

⇒ *Fig 36. (M-57)*

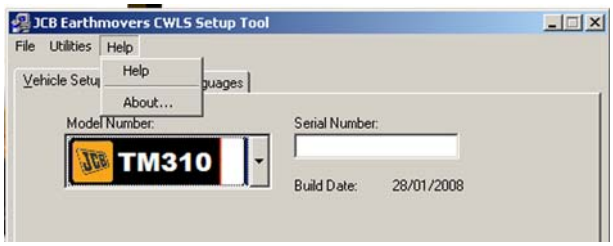


Fig 89.

– **Help:** opens the help program ⇒ *Fig 90. (M-88)*

– **About**: Opens a window showing the version number of the installed copy of the software ⇒ *Fig 91. (M-88)*.

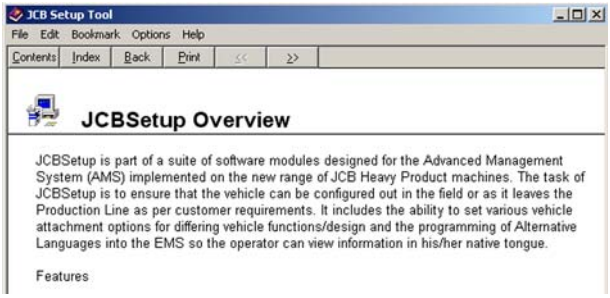


Fig 90.

Fig 91.