Introduction

About this Manual

Machine Model and Serial Number

This manual provides information for the following model(s) in the JCB machine range:

JCB JS360 from serial number 1807000 to 1807299.

Using the Service Manual

T11-004

This publication is designed for the benefit of JCB Distributor Service Engineers who are receiving, or have received, training by JCB Technical Training Department.

These personnel should have a sound knowledge of workshop practice, safety procedures, and general techniques associated with the maintenance and repair of hydraulic earthmoving equipment.

The illustrations in this publication are for guidance only. Where the machines differ, the text and/or the illustration will specify.

General warnings in Section 2 are repeated throughout the manual, as well as specific warnings. Read all safety statements regularly, so you do not forget them.

Renewal of oil seals, gaskets, etc., and any component showing obvious signs of wear or damage is expected as a matter of course. It is expected that components will be cleaned and lubricated where appropriate, and that any opened hose or pipe connections will be blanked to prevent excessive loss of hydraulic fluid and ingress of dirt.

Where a torque setting is given as a single figure it may be varied by plus or minus 3%. Torque figures indicated are for dry threads, hence for lubricated threads may be reduced by one third.

The manufacturer's policy is one of continuous improvement. The right to change the specification of the machine without notice is reserved. No responsibility will be accepted for discrepancies which may occur between specifications of the machine and the descriptions contained in this publication.

Finally, please remember above all else safety must come first!

Section Numbering

T11-005

The manual is compiled in sections, the first three are numbered and contain information as follows:

1 General Information - includes torque settings and service tools.

2 Care and Safety - includes warnings and cautions pertinent to aspects of workshop procedures etc.

3 Maintenance - includes service schedules and recommended lubricants for all the machine.

The remaining sections are alphabetically coded and deal with Dismantling, Overhaul etc. of specific components, for example:

A Attachments

B Body and Framework, etc.

Section contents, technical data, circuit descriptions, operation descriptions etc. are inserted at the beginning of each alphabetically coded section.

Identifying Your Machine

Machine Identification Plate

Your machine has a data plate, located on the outside the cab as shown at **A**. The machine serial number is inscribed at **B** which is the baseplate of the rear frame.

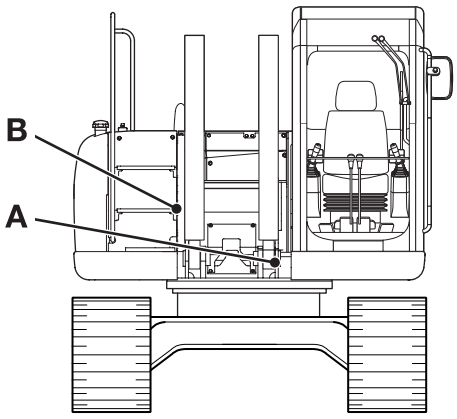

Fig 2.

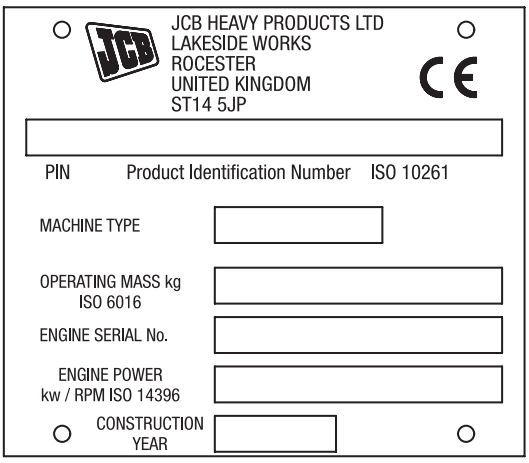

Fig 3.

Typical Product Identification Number (PIN)

1	2	3	4
JCB	JS102	C	01474000

1 World Manufacturer Code (JCB)

2 Machine Type and Model (JS102 = JS330 Tracked)

3 Randomly Generated Check Letter

4 Machine Serial Number (01474000)

Torque Settings

Zinc Plated Fasteners and Dacromet Fasteners

T11-002

Introduction

Some external fasteners on JCB machines are manufactured using an improved type of corrosion resistant finish. This type of finish is called Dacromet and replaces the original Zinc and Yellow Plating used on earlier machines.

The two types of fasteners can be readily identified by colour and part number suffix. ⇒ *Table 1. Fastener Types (1-7)*.

Table 1. Fastener Types

Fastener Type	Colour	Part No. Suffix
Zinc and Yellow	Golden finish	'Z' (e.g. 1315/3712Z)
Dacromet	Mottled silver finish	'D' (e.g. 1315/3712D)

Note: *As the Dacromet fasteners have a lower torque setting than the Zinc and Yellow fasteners, the torque figures used must be relevant to the type of fastener.*

Note: *A Dacromet bolt should not be used in conjunction with a Zinc or Yellow plated nut, as this could change the torque characteristics of the torque setting further. For the same reason, a Dacromet nut should not be used with a Zinc or Yellow plated bolt.*

Note: *All bolts used on JCB machines are high tensile and must not be replaced by bolts of a lesser tensile specification.*

Note: *Dacromet bolts, due to their high corrosion resistance are used in areas where rust could occur. Dacromet bolts are only used for external applications. They are not used in applications such as gearbox or engine joint seams or internal applications.*

Bolts and Screws

Use the following torque setting tables only where no torque setting is specified in the text.

Note: *Dacromet fasteners are lubricated as part of the plating process, do not lubricate.*

Torque settings are given for the following conditions:

Condition 1

- Un-lubricated fasteners
- Zinc fasteners
- Yellow plated fasteners

Condition 2

- Zinc flake (Dacromet) fasteners
- Lubricated zinc and yellow plated fasteners
- Where there is a natural lubrication. For example, cast iron components

Verbus Ripp Bolts

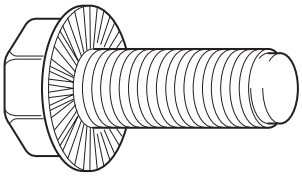

Fig 1.

Torque settings for these bolts are determined by the application. Refer to the relevant procedure for the required settings.

Torque Settings

Zinc Plated Fasteners and Dacromet Fasteners

T11-002

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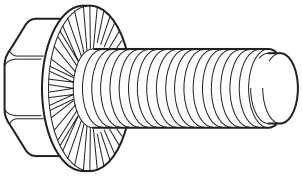

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Hydraulic Connections

T11-003

'O' Ring Face Seal System

Adaptors Screwed into Valve Blocks

Adaptor screwed into valve blocks, seal onto an 'O' ring which is compressed into a 45° seat machined into the face of the tapped port.

Table 8. Torque Settings - BSP Adaptors

BSP Adaptor Size	Hexagon (A/F)			
in.	mm	Nm	kgf m	lbf ft
1/4	19.0	18.0	1.8	13.0
3/8	22.0	31.0	3.2	23.0
1/2	27.0	49.0	5.0	36.0
5/8	30.0	60.0	6.1	44.0
3/4	32.0	81.0	8.2	60.0
1	38.0	129.0	13.1	95.0
1 1/4	50.0	206.0	21.0	152.0

Table 9. Torque Settings - SAE Connections

SAE Tube Size	SAE Port Thread Size	Hexagon (A/F)			
		mm	Nm	kgf m	lbf ft
4	7/16 - 20	15.9	20.0 - 28.0	2.0 - 2.8	16.5 - 18.5
6	9/16 - 18	19.1	46.0 - 54.0	4.7 - 5.5	34.0 - 40.0
8	3/4 - 16	22.2	95.0 - 105.0	9.7 - 10.7	69.0 - 77.0
10	7/8 - 14	27.0	130.0 - 140.0	13.2 - 14.3	96.0 - 104.0
12	1 1/16 - 12	31.8	190.0 - 210.0	19.4 - 21.4	141.0 - 155.0
16	1 5/16 - 12	38.1	290.0 - 310.0	29.6 - 31.6	216.0 - 230.0
20	1 5/8	47.6	280.0 - 380.0	28.5 - 38.7	210.0 - 280.0

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.*

Part Number	Description	See Section
993/68100	Slide Hammer Kit - see ***Tool Detail Reference (Section 1)*** for content	**B**
-	Rivet Nut Tool - see ***Tool Detail Reference (Section 1)***	**B**
892/00842	Glass Lifter	**B**
892/00843	Folding Stand for Holding Glass	**B**
892/00845	Cartridge Gun	**B**
892/00846	Glass Extractor (Handles)	**B**
892/00847	Nylon Spatula	**B**
892/00848	Wire Starter	**B**
892/00849	Braided Cutting Wire	**B**
926/15500	Rubber Spacer Blocks	**B**
992/12300	12V Mobile Oven	**B**
992/12400	240V Static Oven (2 Cartridge)	**B**
992/12800	Cut-Out Knife	**B**
992/12801	'L' Blades	**B**
4104/1310	Hand Cleaner	**B**
892/00281	AVO Meter (not illustrated)	**C**
892/00298	Fluke Meter	**C**
892/00285	Hyd. Oil Temperature Probe	**C**
892/00284	Digital Tachometer	**C**
892/01174	DLA Kit	**C**
331/22966	Pump Drive Alignment Tool (not illustrated)	**E**
-	Male Adapters - BSP x BSP - see ***Tool Detail Reference (Section 1)***	**E**
-	Male Adapters - BSP x NPT (USA only) - see ***Tool Detail Reference (Section 1)***	**E**
-	Pressure Test Points - Adaptors - see ***Tool Detail Reference (Section 1)***	**E**
-	Pressure Test Points - 'T' Adaptors - see ***Tool Detail Reference (Section 1)***	**E**
-	'T' Adaptors - see ***Tool Detail Reference (Section 1)***	**E**

Tool Detail Reference

Section B - Body and Framework

Note: *Not all service tools are illustrated.*

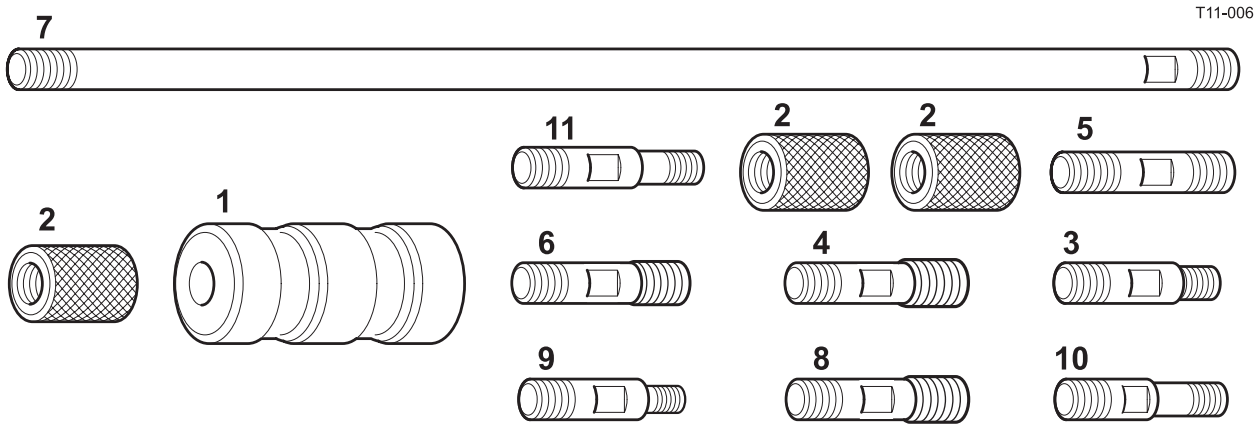

Fig 1. 993/68100 Slide Hammer Kit

1	993/68101	Slide Hammer	**7**	993/68107	Bar - M20 x M20 X 800 mm
2	993/68102	End Stops	**8**	993/68108	Adaptor - M20 x 7/8" UNF
3	993/68103	Adaptor - M20 x 5/8" UNF	**9**	993/68109	Adaptor - M20 x M12
4	993/68104	Adaptor - M20 x 1" UNF	**10**	993/68110	Adaptor - M20 x 5/8" UNF (Shoulder)
5	993/68105	Adaptor - M20 x M20	**11**	993/68111	Adaptor - M20 x 1/2" UNF
6	993/68106	Adaptor - M20 x M24			

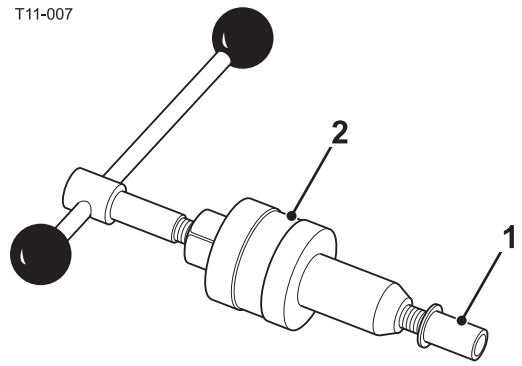

Fig 2. Rivet Nut Tool

1	826/01099	M6 x 16 mm Rivet Nut
	826/01101	M6 x 19 mm Rivet Nut
	826/01102	M8 x 18 mm Rivet Nut
	826/01103	M8 x 21 mm Rivet Nut
	826/01104	M10 x 23 mm Rivet Nut
	826/01105A	M10 x 26 mm Rivet Nut
2	-	Installation Tool available from: Bollhoff Fastenings Ltd (***www.bollhof.com***)

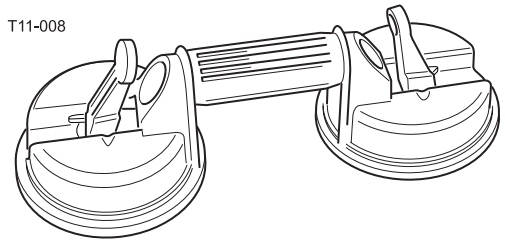

Fig 3. 892/00842 Glass Lifter

Minimum 2 off - Essential for glass installation, 2 required to handle large panes of glass. Ensure suction cups are protected from damage during storage.

Service Consumables

Sealing and Retaining Compounds

T11-001_3

Table 1.

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.	4101/0651	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

Terms and Definitions

Colour Coding

Hydraulic Schematic Colour Codes

T11-006

The following colour coding, used on illustrations to denote various conditions of oil pressure and flow, is standardised throughout JCB Service Publications.

Red	**Full Pressure:** Pressure generated from operation of a service. Depending on application this may be anything between neutral circuit pressure and MRV operating pressure.
Pink	**Pressure:** Pressure that is above neutral circuit pressure but lower than that denoted by Red.
Orange	**Servo:** Oil pressure used in controlling a device (servo).
Blue	**Neural:** Neutral circuit pressure.
Green	**Exhaust**
Light Green	**Cavitation:** Oil subjected to a partial vacuum due to a drop in pressure (cavitation).
Yellow	**Lock Up:** Oil trapped within a chamber or line, preventing movement of components (lock up).

Safety Notices

Important Information

T1-042

The Operator Manual

WARNING

You and others can be killed or seriously injured if you operate or maintain the machine without first studying the Operator Manual. You must understand and follow the instructions in the Operator Manual. If you do not understand anything, ask your employer or JCB dealer to explain it.

INT-1-4-2

Do not operate the machine without an Operator Manual, or if there is anything on the machine you do not understand.

Treat the Operator Manual as part of the machine. Keep it clean and in good condition. Replace the Operator Manual immediately if it is lost, damaged or becomes unreadable.

Safety Warnings

This safety alert system identifies important safety messages in this manual. When you see this symbol, be alert, your safety is involved, carefuly read the message that follows, and inform other operators.

In this publication and on the machine, there are safety notices. Each notice starts with a signal word. The signal word meanings are given below.

DANGER

Denotes an extreme hazard exists. If proper precautions are not taken, it is highly probable that the operator (or others) could be killed or seriously injured.

INT-1-2-1

WARNING

Denotes a hazard exists. If proper precautions are not taken, the operator (or others) could be killed or seriously injured.

INT-1-2-2

CAUTION

Denotes a reminder of safety practices. Failure to follow these safety practices could result in injury to the operator (or others) and possible damage to the machine.

INT-1-2-3

Safety Check List

P11-1008_2

Safety - Yours and Others

INT-1-3-1_3

All machinery can be hazardous. When a machine is correctly operated and properly maintained, it is a safe machine to work with. But when it is carelessly operated or poorly maintained it can become a danger to you (the operator) and others.

In this manual and on the machine you will find warning messages. Read and understand them. They tell you of potential hazards and how to avoid them. If you do not fully understand the warning messages, ask your employer or JCB distributor to explain them.

But safety is not just a matter of responding to the warnings. All the time you are working on or with the machine you must be thinking what hazards there might be and how to avoid them.

Do not work with the machine until you are sure that you can control it.

Do not start any job until you are sure that you and those around you will be safe.

If you are unsure of anything, about the machine or the job, ask someone who knows. Do not assume anything.

Remember

BE CAREFUL
BE ALERT
BE SAFE

General Safety

T1-043

WARNING

To operate the machine safely you must know the machine and have the skill to use it. You must abide by all relevant laws, health and safety regulations that apply to the country you are operating in. The Operator Manual instructs you on the machine, its controls and its safe operation; it is not a training manual. If you are a new operator, get yourself trained in the skills of using a machine before trying to work with it. If you don't, you will not do your job well, and you will be a danger to yourself and others.

INT-1-4-1

WARNING

Care and Alertness

All the time you are working with or on the machine, take care and stay alert. Always be careful. Always be alert for hazards.

INT-1-3-5

WARNING

Clothing

You can be injured if you do not wear the proper clothing. Loose clothing can get caught in the machinery. Wear protective clothing to suit the job. Examples of protective clothing are: a hard hat, safety shoes, safety glasses, a well fitting overall, ear-protectors and industrial gloves. Keep cuffs fastened. Do not wear a necktie or scarf. Keep long hair restrained. Remove rings, watches and personal jewellery.

INT-1-3-6_2

WARNING

Alcohol and Drugs

It is extremely dangerous to operate machinery when under the influence of alcohol or drugs. Do not consume alcoholic drinks or take drugs before or while operating the machine or attachments. Be aware of medicines which can cause drowsiness.

INT-1-3-9_2

Safety Labels

Introduction

T1-014_2

⚠ WARNING

Safety Labels

Safety labels on the machine warn you of particular hazards. You can be injured if you do not obey the safety instructions shown.

INT-1-3-11

Safety labels are strategically placed around the machine to remind you of possible hazards.

If you need eye-glasses for reading, make sure you wear them when reading the safety labels. Do not over-stretch or place yourself in dangerous positions to read the safety labels. If you do not understand the hazard shown on the safety label, then refer to ***Safety Label Identification***.

Note: *The illustration(s) show a typical machine model. Your machine may look different from the model shown.*

Keep all safety labels clean and readable. Replace lost or damaged safety labels. Make sure replacement parts include safety labels where necessary. Each safety label has a part number printed on it, use this number to order a new safety label from your JCB distributor.

Routine Maintenance

Service Requirements

Introduction

T3-095

Your machine has been designed and built to give maximum performance, economy and ease of use under a wide variety of operating conditions. Prior to delivery, your machine was inspected both at the Factory and by your Distributor to ensure that it reaches you in optimum condition. To maintain this condition and ensure trouble free operation it is important that the routine services, as specified in this Manual, are carried out by an approved JCB Distributor at the recommended intervals.

This section of the Manual gives full details of the service requirements necessary to maintain your JCB machine at peak efficiency.

A Service Manual for your machine is available from your JCB Distributor. The Service Manual contains information on how to repair, dismantle and assemble your machine correctly.

It can be seen from the Service Schedules on the following pages that many essential service checks should only be carried out by a JCB trained specialist. Only JCB Distributor Service Engineers have been trained by JCB to carry out such specialist tasks, and only JCB Distributor Service Engineers are equipped with the necessary special tools and test equipment to perform such tasks, thoroughly, safely, accurately and efficiently.

JCB regularly updates its Distributors advising them of any product developments, changes in specifications and procedures. Therefore only a JCB Distributor is fully able to maintain and service your machine.

A Service Record Sheet or Book is provided which will enable you to plan your service requirements and keep a service history record. It should be dated, signed and stamped by your Distributor each time your machine is serviced.

Remember, if your machine has been correctly maintained, not only will it give you improved reliability but its resale value will be greatly enhanced.

Owner/Operator Support

JCB together with your Distributor wants you to be completely satisfied with your new JCB machine. If you do encounter a problem however, you should contact your Distributor's Service Department who are there to help you!

You will have been given the names of the relevant service contacts at your Distributor when the machine was installed.

To get the most from your Distributor please help them to satisfy you by:

1 Giving your name, address and telephone number.

2 Quoting your machine model and serial number.

3 Date of purchase and hours of work.

4 Nature of the problem.

Remember, only your JCB Distributor has access to the vast resources available at JCB to help support you. In addition, your Distributor is able to offer a variety of programmes covering Warranty, Fixed Price Servicing, Safety Inspections, including weight tests, covering both legal and insurance requirements.

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.

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.

Health and Safety

Lubricants

T3-060_3

Introduction

It is most important that you read and understand this information and the publications referred to. Make sure all your colleagues who are concerned with lubricants read it too.

Hygiene

JCB lubricants are not a health risk when used properly for their intended purposes.

However, excessive or prolonged skin contact can remove the natural fats from your skin, causing dryness and irritation.

Low viscosity oils are more likely to do this, so take special care when handling used oils, which might be diluted with fuel contamination.

Whenever you are handling oil products you should maintain good standards of care and personal and plant hygiene. For details of these precautions we advise you to read the relevant publications issued by your local health authority, plus the following.

Storage

Always keep lubricants out of the reach of children.

Never store lubricants in open or unlabelled containers.

Waste Disposal

⚠ 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

All waste products should be disposed of in accordance with all the relevant regulations.

The collection and disposal of used oil should be in accordance with any local regulations. Never pour used engine oil into sewers, drains or on the ground.

Handling

⚠ 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

New Oil

There are no special precautions needed for the handling or use of new oil, beside the normal care and hygiene practices.

Used Oil

Used engine crankcase lubricants contain harmful contaminants.

Here are precautions to protect your health when handling used engine oil:

1 Avoid prolonged, excessive or repeated skin contact with used oil.

2 Apply a barrier cream to the skin before handling used oil. Note the following when removing engine oil from skin:

- **a** Wash your skin thoroughly with soap and water.
- **b** Using a nail brush will help.
- **c** Use special hand cleansers to help clean dirty hands.
- **d** Never use petrol, diesel fuel, or paraffin for washing.

Battery

T3-061

⚠ WARNING

Batteries give off an explosive gas. Do not smoke when handling or working on the battery. Keep the battery away from sparks and flames.

Battery electrolyte contains sulphuric acid. It can burn you if it touches your skin or eyes. Wear goggles. Handle the battery carefully to prevent spillage. Keep metallic items (watches, rings, zips etc) away from the battery terminals. Such items could short the terminals and burn you.

Set all switches to OFF before disconnecting and connecting the battery. When disconnecting the battery, take off the earth (-) lead first.

Re-charge the battery away from the machine, in a well ventilated area. Switch the charging circuit off before connecting or disconnecting the battery. When you have installed the battery in the machine, wait five minutes before connecting it up.

When reconnecting, fit the positive (+) lead first.

5-3-4-12

⚠ CAUTION

Do not disconnect the battery while the engine is running, otherwise the electrical circuits may be damaged.

INT-3-1-14

⚠ WARNING

Electrical Circuits

Understand the electrical circuit before connecting or disconnecting an electrical component. A wrong connection can cause injury and/or damage.

INT-3-1-4

⚠ DANGER

Electrolyte

Battery electrolyte is toxic and corrosive. Do not breathe the gases given off by the battery. Keep the electrolyte away from your clothes, skin, mouth and eyes. Wear safety glasses.

INT-3-2-1_3

⚠ CAUTION

Damaged or spent batteries and any residue from fires or spillage should be put in a closed acid proof receptacle and must be disposed of in accordance with local environmental waste regulations.

INT-3-1-12

⚠ WARNING

Battery Gases

Batteries give off explosive gases. Keep flames and sparks away from the battery. Do not smoke close to the battery. Make sure there is good ventilation in closed areas where batteries are being used or charged. Do not check the battery charge by shorting the terminals with metal; use a hydrometer or voltmeter.

INT-3-1-8

Service Schedules

Introduction

T3-036_3

⚠ WARNING

Maintenance must be done only by suitably qualified and competent persons.

Before doing any maintenance make sure the machine is safe, it should be correctly parked on level ground.

To prevent anyone starting the engine, remove the starter key. Disconnect the battery when you are not using electrical power. If you do not take these precautions you could be killed or injured.

8-3-1-1

A badly maintained machine is a danger to the operator and the people working around him. Make sure that the regular maintenance and lubrication jobs listed in the service schedules are done to keep the machine in a safe and efficient working condition.

Apart from the daily jobs, the schedules are based on machine running hours. Keep a regular check on the hourmeter readings to correctly gauge service intervals. When there is no hourmeter fitted, use the calendar equivalents to determine the service intervals. Refer to ***Calendar Equivalents***. Do not use a machine which is due for a service. Make sure any defects found during the regular maintenance checks are rectified immediately.

How to Use the Service Schedules

T3-012_4

In the example shown, **A** shows all service requirements to be carried out every 10 hours and **B** shows the requirements to be carried out every 500 hours.

Important: *Services should be carried out at either the hourly interval or calendar interval, whichever occurs first. Refer to* ***Calendar Equivalents****.*

Important: *The intervals given in the schedules must not be exceeded. If the machine is operated under severe conditions (high temperature, dust, water, etc.), shorten the intervals.*

Pre-start Cold Checks, Service Points and Fluid Levels

	Operation	A: 10	50	100(1)	B: 500	1000	2000	8000
ENGINE								
Coolant Quality and Level	- Check	□	□	□	□	□		
Cooling System	- Drain and Refill						□	□
Oil level	- Check	□	□					
Oil and Filter(2)(3)(4)	- Change				□	□	□	□
Air Cleaner Dust Valve(5)	- Change				□	□	□	□
Air Cleaner Outer Element(5)	- Change					□	□	□
Air Cleaner Inner Element	- Change						□	□
Pre-Cleaner (if fitted)	- Check			□				
Water Seperator	- Check for contamination and Drain		□	□	□	□	□	□
Engine Fuel Filter	- Change					□	□	□
Front End Accessory Drive (FEAD) Belt Condition	- Check				□	□	□	□
Front End Accessory Drive (FEAD) Belt	- Change							□
Engine Mounting Bolts for Tightness	- Check			□	□	□	□	□
All Hoses - Condition	- Check			□	□	□	□	□
Radiator(5)	- Clean				□	□	□	□
Crankcase Ventilation Filter	- Change					□	□	□

795390-1

Calendar Equivalents

Every 10 Hours	=	Daily
Every 50 Hours	=	Weekly
Every 250 Hours	=	Monthly
Every 500 Hours	=	Three Months
Every 1000 Hours	=	Six Months
Every 2000 Hours	=	1 Year
Every 4000 Hours	=	2 Years
Every 5000 Hours	=	2 Years 6 Months

Pre Start Cold Checks, Service Points and Fluid Levels

	Operation	10	50	250	500	1000	2000	4000	5000
ENGINE									
Oil level	- Check	☐	☐	☐	☐	☐	☐	☐	☐
Oil and Filter (1)	- Sample/Change				☐	☐	☐	☐	☐
Pre Cleaner (if fitted)	- Clean			☐	☐	☐	☐	☐	☐
Air Cleaner Outer Element	- Change					☐	☐	☐	☐
Air Cleaner Inner Element	- Change						☐	☐	
Air Cleaner Dust Valve	- Check and Clean			☐	☐	☐	☐	☐	☐
Fuel Level	- Check	☐	☐	☐	☐	☐	☐	☐	☐
Fuel Tank - Water and Sediment	- Drain		☐	☐	☐	☐	☐	☐	☐
Coolant Quality/Level	- Check	☐	☐	☐	☐	☐	☐	☐	☐
Coolant	- Change							☐	
Fuel Pump Filter Element	- Change				☐	☐	☐	☐	☐
Primary Fuel Filter/Sedimenter	- Drain and Clean		☐	☐	☐	☐	☐	☐	☐
Primary Fuel Filter/Sedimenter-filter	- Change				☐	☐	☐	☐	☐
Main Fuel Filter/Sedimenter	- Drain and Clean		☐	☐	☐	☐	☐	☐	☐
Main Fuel Filter/Sedimenter-filter	- Change				☐	☐	☐	☐	☐
Fuel Filler Cap	- Check and Clean			☐	☐	☐	☐	☐	☐
Fuel Filler Cap (Dusty conditions)	- Check and Clean		☐	☐	☐	☐	☐	☐	☐
Fan Belt Tension/Condition	- Check			☐	☐	☐	☐	☐	☐
Valve Clearances	- Check and Adjust					☐	☐	☐	☐
Engine Mounting Bolts for Tightness	- Check				☐	☐	☐	☐	☐
Exhaust System Security	- Check				☐	☐	☐	☐	☐
Air Inlet System Security	- Check			☐	☐	☐	☐	☐	☐
Radiator	- Clean and Check			☐	☐	☐	☐	☐	☐

Functional Test and Final Inspection

	Operation	10	50	250	500	1000	2000	4000
ENGINE								
Maximum No-Load Speed	- Check				☐	☐	☐	☐
Exhaust Smoke (excessive)	- Check	☐	☐	☐	☐	☐	☐	☐
Coolant System - Leaks	- Check			☐	☐	☐	☐	☐
Stop Control - Operation	- Check			☐	☐	☐	☐	☐
Fuel System - Leaks and Contamination	- Check	☐	☐	☐	☐	☐	☐	☐
All Fuel Hoses	- Change							☐
TRANSMISSION								
Slew Brake Operation	- Check				☐	☐	☐	☐
HYDRAULICS								
Operation All Services	- Check	☐	☐	☐	☐	☐	☐	☐
Accumulator (engine stopped)	- Check	☐	☐	☐	☐	☐	☐	☐
Hoses and Pipework - Damage/Leaks	- Check	☐	☐	☐	☐	☐	☐	☐
ELECTRICS								
Starter Motor - Connections	- Check/Clean			☐	☐	☐	☐	☐
Alternator - Output	- Check			☐	☐	☐	☐	☐
All Electrical Equipment Operation, (e.g. warning lights, beacon, alarms, horn, wipers etc.)	- Check	☐	☐	☐	☐	☐	☐	☐
UNDERCARRIAGE								
Track operation	- Check	☐	☐	☐	☐	☐	☐	☐
BODYWORK AND CAB								
Doors and Canopy - Fitment/Leaks	- Check				☐	☐	☐	☐
Locks	- Check				☐	☐	☐	☐
SEAT								
Seat and Seat Belts - Condition and Security	- Check					☐	☐	☐
Seat Adjustments - Correct Operation	- Check and Grease				☐	☐	☐	☐
Seat Adjustments - Correctly Setup for Operator	- Check	☐	☐	☐	☐	☐	☐	☐
ATTACHMENTS								
Teeth and Side Cutters	- Check				☐	☐	☐	☐
Attachment Circuit Pressure	- Check				☐	☐	☐	☐
Operation	- Check				☐	☐	☐	☐

Service Intervals for Attachments

When using a breaker, crusher or pulveriser, contamination and degradation of the hydraulic oil occurs much more quickly than in normal excavating use. If the machine is used with increasingly degrading oil it can cause problems in the control valve, premature wear of the hydraulic pump and damage to the hydraulic system as a whole.

Servicing of the hydraulic oil and filters must be done more frequently according to the percentage of total operating hours involving use of the breaker, crusher or pulverizer. When a breaker, crusher or pulverizer is fitted, ensure that the oil and filters are changed at the intervals shown in the table below.

The hydraulic oil must be sampled and checked for contamination and degradation at the intervals shown. Consult your JCB Distributor who will have the facilities to do this work and ensure that the hydraulic system is properly maintained.

Table 1. Service Intervals for Hydraulic Oil and Filters according to Frequency of Breaker, Crusher or Pulverizer Use

Item	Use Frequency														
	Greater than 75%			50 - 75%			25 - 50%			10 - 25%			Less than 10%		
	10 hrs	100 hrs	600 hrs	10 hrs	200 hrs	1000 hrs	10 hrs	300hrs	1500hrs	10 hrs	600hrs	3000hrs	10 hrs	800hrs	4000hrs
Hydraulic Oil	○		●	○		●	○		●	○		●	○		●
Return Filter(1)		●			●			●			●			●	
Suction Filter(1)		□	●		□	●		□	●		□	●		□	●
Drain Filter(1)		●			●			●			●			●	
Servo Filter(1)		●			●			●			●			●	
Plexus Filter(1)		●			●			●			●			●	
Breaker In-Line Filter(1)		●			●			●			●			●	
Hydraulic Oil Sampling	Every 200 hrs			Every 200 hrs			Every 300 hrs			Every 600 hrs			Every 800 hrs		

(1) The filters must be changed whenever the period of breaker/crusher/pulverizer use exceeds 100hrs, regardless of the total number of hours the machine has worked

○ Check oil level and top up as required

● Change

□ Clean

Periodic Replacement of Safety Related Components

Routinely replace important parts concerned with safety. It is difficult to determine by visual inspection or from operation the service life of specific parts, so routinely replace them as important parts every 2 years.

Table 2. Fuel System

Important Parts	Replacement Interval
Fuel Hose (Fuel Tank - Engine)	Every 2 years or every 4000 hours, whichever comes first.
Fuel Hose (Fuel Filter - Injection Pump)	

Table 3. Hydraulic System

Important Parts	Replacement Interval
Pump Exit Hose (Pump - Operation Valve)	Every 2 years or every 4000 hours, whichever comes first.
Boom Ram Line Hose	
Dipper Ram Line Hose	
Bucket Ram Line Hose	

If any abnormality is found with any of these parts before the replacement time, repair or replace as you would do normally.

When replacing the hoses, if the hose clamps are found to be deformed or cracked, replace the clamps at the same time as the hoses.

Regarding hydraulic hoses not included in the routine replacement of safety parts, carry out the inspection described ⇨ *Table 4. (3-15)*. Retighten, replace, etc, when any abnormality is found.

Note: *Replace O-rings, gaskets at the same time as hoses. Contact your JCB distributor for replacement of safety parts. Carry out inspection of the hydraulic hoses and fuel hoses at the routine inspection described* ⇨ *Table 4. (3-15)*.

Table 4.

Inspection Classification	Inspection Item
Start-up Inspection	Fuel, Hydraulic hose connections, Oil Leakage from caulked parts.
Special Independent Inspection (Monthly Inspection)	Fuel, Hydraulic hose connections, Oil Leakage from caulked parts. Fuel, Hydraulic hose damage (cracks, wear, picking)
Special Independent Inspection (Yearly Inspection)	Fuel, Hydraulic hose connections, Oil Leakage from caulked parts. Fuel, Hydraulic hose interference, squeezing, aging, twisting, damage (cracks, wear, picking)

Fluids, Lubricants and Capacities

JCB recommend that you use the JCB lubricants shown as they have been verified by JCB for use on JCB machines. However, you could use other lubricants that are equivalent to the JCB standards and quality or offer the same machine component protection.

JS115 - JS145 and Variants

Table 5.

Item	Capacity	Fluid/Lubricant	JCB Part No.	Container Size(1)
ENGINE	15 litres (3.3 UK gal) (4 US gal)	JCB Engine Oil HP 15W40 -15°C to +40°C (5°F to 104°F)	4001/1505	20 Litres
		JCB Engine Oil HP 10W30 -30°C to +30°C (-22°F to 86°F)	4001/1705	20 Litres
COOLING SYSTEM	16.4 litres (3.8 UK gal) (4.3 US gal)	JCB HP Coolant ⇨ *Coolant Mixtures (3-25)*	4006/1120	20 Litres
TRACK GEARBOX	2 x 3.5 litres (2 x 0.77 UK gal) (2 x 0.9 US gal)	JCB HP90 Gear Oil	4000/0301	5 Litres
SLEW GEARBOX	2.2 litres (0.5 UK gal) (0.6 US gal)		4000/0305	20 Litres
TRACK ROLLERS AND IDLER WHEEL				
RECOIL SPRING CYLINDER		JCB Special HP Grease	4003/2017	400g
HYDRAULIC SYSTEM	124 litres (27.3 UK gal) (32.8 US gal)	JCB Hydraulic Fluid HP32 -20°C to +15°C (-4°F to 59°F)	4002/1024	200 Litres
		JCB Hydraulic Fluid HP46 -10°C to +30°C (14°F to 86°F)	4002/0803	
		JCB Hydraulic Fluid HP68 0°C to +40°C (32°F to 104°F)	4002/0701	
SLEW RING		JCB Special HP Grease	4003/2017	400g
- BEARING	60 g (0.13 lb)			
- GEAR TEETH	11 kg (24.25 lb)		4003/2006	12.5kg
ALL OTHER GREASE POINTS	--	JCB Special HP Grease		
FUEL TANK	253 litres (55.6 UK gal) (66.7 US gal)	⇨ *Fuel System (3-74)*		

(1) For information about the different container sizes that are available (and their part numbers), contact your JCB Dealer.

JS160 - JS190 and Variants

Table 6.

Item	Capacity	Fluid/Lubricant	JCB Part No.	Container Size(1)
ENGINE - JS160-JS180	15 litres (3.3 UK gal) (4 US gal)	JCB Engine Oil HP 15W40 -15°C to +40°C (5°F to 104°F)	4001/1505	20 Litres
		JCB Engine Oil HP 10W30 -30°C to +30°C (-22°F to 86°F)	4001/1705	20 Litres
ENGINE - JS190	23.5 litres (5.2 UK gal) (6.2 US gal)	JCB Engine Oil HP 15W40 -15°C to +40°C (5°F to 104°F)	4001/1505	20 Litres
		JCB Engine Oil HP 10W30 -30°C to +30°C (-22°F to 86°F)	4001/1705	20 Litres
COOLING SYSTEM - JS160-JS180	16.4 litres (3.8 UK gal) (4.3 US gal)	JCB HP Coolant ⇨ *Coolant Mixtures (3-25)*	4006/1120	20 Litres
COOLING SYSTEM - JS190	26 litres (5.7 UK gal) (6.9 US gal)	JCB HP Coolant ⇨ *Coolant Mixtures (3-25)*	4006/1120	20 Litres
TRACK GEARBOX	2 x 4.4 litres (2 x 1 UK gal) (2 x 1.2 US gal)	JCB HP90 Gear Oil	4000/0301	5 Litres
SLEW GEARBOX	6 litres (1.3 UK gal) (1.6 US gal)		4000/0305	20 Litres
TRACK ROLLERS AND IDLER WHEEL				
RECOIL SPRING CYLINDER		JCB Special HP Grease	4003/2017	400g
HYDRAULIC SYSTEM	142 litres (31.2 UK gal) (37.5 US gal)	JCB Hydraulic Fluid HP32 -20°C to +15°C (-4°F to 59°F)	4002/1024	200 Litres
		JCB Hydraulic Fluid HP46 -10°C to +30°C (14°F to 86°F)	4002/0803	
		JCB Hydraulic Fluid HP68 0°C to +40°C (32°F to 104°F)	4002/0701	
SLEW RING		JCB Special HP Grease	4003/2017	400g
- BEARING	75 g (0.17 lb)			
- GEAR TEETH	11 kg (24.25 lb)		4003/2006	12.5kg
ALL OTHER GREASE POINTS	--			
FUEL TANK	253 litres (55.6 UK gal) (66.7 US gal)	⇨ *Fuel System (3-74)*		

(1) For information about the different container sizes that are available (and their part numbers), contact your JCB Dealer.

JS200 - JS235 and Variants

Table 7.

Item	Capacity	Fluid/Lubricant	JCB Part No.	Container Size(1)
ENGINE	23.5 litres (5.2 UK gal) (6.2 US gal)	JCB Engine Oil HP 15W40 -15°C to +40°C (5°F to 104°F)	4001/1505	20 Litres
		JCB Engine Oil HP 10W30 -30°C to +30°C (-22°F to 86°F)	4001/1705	20 Litres
COOLING SYSTEM	28 litres (6.2 UK gal) (7.4 US gal)	JCB HP Coolant ⇨ *Coolant Mixtures (3-25)*	4006/1120	20 Litres
TRACK GEARBOX	2 x 4.7 litres (2 x 1 UK gal) (2 x 1.2 US gal)	JCB HP90 Gear Oil	4000/0301	5 Litres
SLEW GEARBOX	5 litres (1.1 UK gal) (1.3 US gal)		4000/0305	20 Litres
TRACK ROLLERS AND IDLER WHEEL				
RECOIL SPRING CYLINDER		JCB Special HP Grease	4003/2017	400g
HYDRAULIC SYSTEM	200 litres (44 UK gal) (52.8 US gal)	JCB Hydraulic Fluid HP32 -20°C to +15°C (-4°F to 59°F)	4002/1024	200 Litres
		JCB Hydraulic Fluid HP46 -10°C to +30°C (14°F to 86°F)	4002/0803	
		JCB Hydraulic Fluid HP68 0°C to +40°C (32°F to 104°F)	4002/0701	
SLEW RING			4003/2017	400g
- BEARING	100 g (0.22 lb)	JCB Special HP Grease		
- GEAR TEETH	17 kg (37.5 lb)		4003/2006	12.5kg
ALL OTHER GREASE POINTS	--			
FUEL TANK	343 litres (75.5 UK gal) (90.6 US gal)	⇨ *Fuel System (3-74)*		

(1) For information about the different container sizes that are available (and their part numbers), contact your JCB Dealer.

JS240/260 and Variants

Table 8.

Item	Capacity	Fluid/Lubricant	JCB Part No.	Container Size(1)
ENGINE	21.5 litres (4.7 UK gal) (5.6 US gal)	JCB Engine Oil HP 15W40 -15°C to +40°C (5°F to 104°F)	4001/1505	20 Litres
		JCB Engine Oil HP 10W30 -30°C to +30°C (-22°F to 86°F)	4001/1705	20 Litres
COOLING SYSTEM	26.8 litres (5.9 UK gal) (7.1 US gal)	JCB HP Coolant ⇒ *Coolant Mixtures (3-25)*	4006/1120	20 Litres
TRACK GEARBOX	2 x 4.7 litres (2 x 1 UK gal) (2 x 1.2 US gal)	JCB HP90 Gear Oil	4000/0301	5 Litres
SLEW GEARBOX	6 litres (1.3 UK gal) (1.6 US gal)		4000/0305	20 Litres
TRACK ROLLERS AND IDLER WHEEL				
RECOIL SPRING CYLINDER		JCB Special HP Grease	4003/2017	400g
HYDRAULIC SYSTEM	241 litres (53 UK gal) v(63.6 US gal)	JCB Hydraulic Fluid HP32 -20°C to +15°C (-4°F to 59°F)	4002/1024	200 Litres
		JCB Hydraulic Fluid HP46 -10°C to +30°C (14°F to 86°F)	4002/0803	
		JCB Hydraulic Fluid HP68 0°C to +40°C (32°F to 104°F)	4002/0701	
SLEW RING		JCB Special HP Grease	4003/2017	400g
- BEARING	100 g (0.22 lb)			
- GEAR TEETH	17 kg (37.5 lb)		4003/2006	12.5kg
ALL OTHER GREASE POINTS	--			
FUEL TANK	343 litres (75.5 UK gal) (90.6 US gal)	⇒ *Fuel System (3-74)*		

(1) For information about the different container sizes that are available (and their part numbers), contact your JCB Dealer.

JS290 and Variants

Table 9.

Item	Capacity	Fluid/Lubricant	JCB Part No.	Container Size(1)
ENGINE	38 litres (8.4 UK gal) (10.1 US gal)	JCB Engine Oil HP 15W40 -15°C to +40°C (5°F to 104°F)	4001/1505	20 Litres
		JCB Engine Oil HP 10W30 -30°C to +30°C (-22°F to 86°F)	4001/1705	20 Litres
COOLING SYSTEM	38 litres (8.4 UK gal) (10.0 US gal)	JCB HP Coolant ⇒ *Coolant Mixtures (3-25)*	4006/1120	20 Litres
TRACK GEARBOX	2 x 3.5 litres (2 x 0.76 UK gal) (2 x 0.92 US gal)	JCB HD90 Gear Oil	4000/0301	5 Litres
SLEW GEARBOX	16 litres (3.5 UK gal) (4.2 US gal)		4000/0305	20 Litres
TRACK ROLLERS AND IDLER WHEEL				
RECOIL SPRING CYLINDER		JCB Special HP Grease	4003/2017	400g
HYDRAULIC SYSTEM	305 litres (67.1 UK gal) (80.6 US gal)	JCB Hydraulic Fluid HP32 -20°C to +15°C (-4°F to 59°F)	4002/1024	200 Litres
		JCB Hydraulic Fluid HP46 -10°C to +30°C (14°F to 86°F)	4002/0803	
		JCB Hydraulic Fluid HP68 0°C to +40°C (32°F to 104°F)	4002/0701	
SLEW RING		JCB Special HP Grease	4003/2017	400g
- BEARING	--			
- GEAR TEETH	--		4003/2006	12.5kg
ALL OTHER GREASE POINTS	--			
FUEL TANK	650 litres (143.0 UK gal) (171.7 US gal)	⇒ *Fuel System (3-74)*		

(1) For information about the different container sizes that are available (and their part numbers), contact your JCB Dealer.

JS330 and Variants

Table 10.

Item	Capacity	Fluid/Lubricant	JCB Part No.	Container Size(1)
ENGINE	38 litres (8.4 UK gal) (10.1 US gal)	JCB Engine Oil HP 15W40 -15°C to +40°C (5°F to 104°F)	4001/1505	20 Litres
		JCB Engine Oil HP 10W30 -30°C to +30°C (-22°F to 86°F)	4001/1705	20 Litres
COOLING SYSTEM	38 litres (8.36 UK gal) (10 US gal)	JCB HP Coolant ⇒ *Coolant Mixtures (3-25)*	4006/1120	20 Litres
TRACK GEARBOX	2 x 5 litres (2 x 1.10 UK gal) (2 x 2.32 US gal)	JCB HD90 Gear Oil	4000/0301	5 Litres
SLEW GEARBOX	14.5 litres (3.19 UK gal) (3.83 US gal)		4000/0305	20 Litres
TRACK ROLLERS AND IDLER WHEEL				
RECOIL SPRING CYLINDER		JCB Special HP Grease	4003/2017	400g
HYDRAULIC SYSTEM	320 litres (70.4 UK gal) (84.5 US gal)	JCB Hydraulic Fluid HP32 -20°C to +15°C (-4°F to 59°F)	4002/1024	200 Litres
		JCB Hydraulic Fluid HP46 -10°C to +30°C (14°F to 86°F)	4002/0803	
		JCB Hydraulic Fluid HP68 0°C to +40°C (32°F to 104°F)	4002/0701	
SLEW RING		JCB Special HP Grease	4003/2017	400g
- BEARING	125g (0.28 lb)			
- GEAR TEETH	--		4003/2006	12.5kg
ALL OTHER GREASE POINTS	--			
FUEL TANK	518 litres (114 UK gal) (137 US gal)	⇒ *Fuel System (3-74)*		

(1) For information about the different container sizes that are available (and their part numbers), contact your JCB Dealer.

JS360 and Variants

Table 11.

Item	Capacity	Fluid/Lubricant	JCB Part No.	Container Size(1)
ENGINE	38 litres (8.4 UK gal) (10.1 US gal)	JCB Engine Oil HP 15W40 -15°C to +40°C (5°F to 104°F)	4001/1505	20 Litres
		JCB Engine Oil HP 10W30 -30°C to +30°C (-22°F to 86°F)	4001/1705	20 Litres
COOLING SYSTEM	38 litres (8.36 UK gal) (10 US gal)	JCB HP Coolant ⇒ *Coolant Mixtures (3-25)*	4006/1120	20 Litres
TRACK GEARBOX	2 x 5 litres (2 x 1.10 UK gal) (2 x 2.32 US gal)	JCB HD90 Gear Oil	4000/0301	5 Litres
SLEW GEARBOX	16 litres (3.52 UK gal) (4.23 US gal)		4000/0305	20 Litres
TRACK ROLLERS AND IDLER WHEEL				
RECOIL SPRING CYLINDER		JCB Special HP Grease	4003/2017	400g
HYDRAULIC SYSTEM	320 litres (70.4 UK gal) (84.5 US gal)	JCB Hydraulic Fluid HP32 -20°C to +15°C (-4°F to 59°F)	4002/1024	200 Litres
		JCB Hydraulic Fluid HP46 -10°C to +30°C (14°F to 86°F)	4002/0803	
		JCB Hydraulic Fluid HP68 0°C to +40°C (32°F to 104°F)	4002/0701	
SLEW RING		JCB Special HP Grease	4003/2017	400g
- BEARING	--			
- GEAR TEETH	--		4003/2006	12.5kg
ALL OTHER GREASE POINTS	--			
FUEL TANK	650 litres (143.0 UK gal) (171.7 US gal)	⇒ *Fuel System (3-74)*		

(1) For information about the different container sizes that are available (and their part numbers), contact your JCB Dealer.

Typical Lubrication Chart

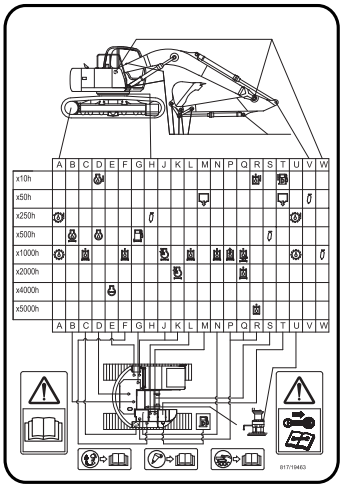

Fig 1.

Table 12. Location Identifier

A	Travel gearbox
B	Engine oil filter
C	Plexus filter
D	Engine oil pan
E	Engine cooling system
F	Servo oil filter
G	Fuel filter
H	Swing ring bearing
J	Air cleaner, outer
K	Air cleaner, inner
L	Drain line filter
M	Fuel separator
N	Hydraulic return filter
P	Hydraulic tank air breather
Q	Suction strainer
R	Hydraulic tank
S	Swing ring gear teeth
T	Fuel tank
U	Slew gearbox
V	Boom/arm grease points
W	Boom/arm grease points

Table 13. Icon Definitions

	Excavator grease
	Engine oil change
	Engine oil filter change
	Engine coolant change
	Engine air filter clean
	Engine air filter change
	Transmission oil change
	Transmission oil level
	Fuel (diesel)
	Fuel filter change
	Hydraulic oil change

Coolant Mixtures

T3-009_3

Check the strength of the coolant mixture at least once a year, preferably at the start of the cold period.

Replace the coolant mixture according to the intervals shown in the machine's Service Schedule.

⚠ WARNING

Antifreeze can be harmful. Obey the manufacturer's instructions when handling full strength or diluted antifreeze.

7-3-4-4_1

You must dilute full strength antifreeze with clean water before use. Use clean water of no more than a moderate hardness (pH value 8.5). If this cannot be obtained, use de-ionized water. For further information advice on water hardness, contact your local water authority.

The correct concentration of antifreeze protects the engine against frost damage in winter and provides year round protection against corrosion.

The protection provided by JCB High Performance Antifreeze and Inhibitor is shown below.

50% Concentration (Standard)

Protects against damage down to -40 °C (-39 °F)

60% Concentration (Extreme Conditions Only)

Protects against damage down to -56 °C (-68 °F)

Important: *Do not exceed a 60% concentration, as the freezing protection provided reduces beyond this point.*

If you use any other brand of antifreeze:

- Ensure that the antifreeze complies with International Specification ASTM D6210.
- Always read and understand the manufacturer's instructions.
- Ensure that a corrosion inhibitor is included. Serious damage to the cooling system can occur if corrosion inhibitors are not used.
- Ensure that the antifreeze is ethylene glycol based and does not use Organic Acid Technology (OAT).

Fuel

Introduction

The quality and grade of fuel can seriously affect the service life of the fuel system. It is vitally important that the correct grade of fuel is used, a high standard of fuel storage is maintained and the use of old fuel is avoided.

The following factors should be used to ensure that the service life of the fuel system is maintained.

- ⇨ *Fuel Specifications (3-25)*
- ⇨ *Cleanliness (3-26)*
- ⇨ *Fuel Bulk Storage (3-27)*
- ⇨ *Fuel Analysis (3-27)*

Fuel Specifications

⚠ CAUTION

Consult your fuel supplier or JCB distributor about the suitability of any fuel you are unsure of.

GEN-9-2

Recommended Fuel Specification

The following fuels are recommended for use with Tier III machines.

- EN590 Diesel Fuel Types - Auto/Co/C1/C2/C3/C4.
- ASTM D975-91 Class 2, US DF1, US DF2, US DFA.
- JIS K2204 (1996) Grades 2, 3, and Special Grade 3.

Acceptable Fuel Specification

The following fuels will require some additional care and service requirements.

⚠ CAUTION

The fuel specification below is acceptable, however this fuel may reduce the life of the fuel injection equipment. The use of this fuel may also affect the engine performance.

GEN-9-3

- ASTM D975-91 Class 1-1DA.
- JP7, MIL T38219 XF63.
- NATO F63.
- French EN590 (RME5) with 5% maximum.
- RME content blended with mineral derived diesel (5% maximum)

Low Sulphur Fuels

Low sulphur fuels must have the appropriate fuel lubricity additives added to prevent premature wear of the pump

Tools

Carrying Tools onto the Machine

When you carry tools onto the machine you must maintain three points of contact with the machine at all times. Lift tools onto the machine in intervals if necessary. Place the tools down before you adjust your grips on the machine. Do not try to adjust your grips on the machine while holding tools.

Locations

The machine is equipped with a a grease gun (option) and remote oil-drain tube attachment.

The grease gun is stowed into position with clips **A**, ⇨ *Fig 2. (3-28)*.

The drain tube is stowed into position by its screw thread **B**, ⇨ *Fig 3. (3-28)*.

Keep the tools in their stowage positions until they are needed. The location of the tools will vary dependant on the machine variant:

JS115-JS290

The grease gun is stowed in the toolbox. The toolbox can be locked with the key.

The drain tube is stowed in the service bay behind the cab, next to the engine air filter. The service bay can be locked with the key.

JS330/JS360

The grease gun is stowed in the service bay behind the cab. The service bay can be locked with the key.

The drain tube is stowed in the radiator bay. The radiator bay can be locked with the key.

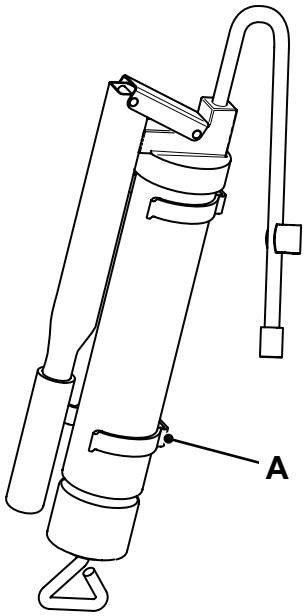

Fig 2.

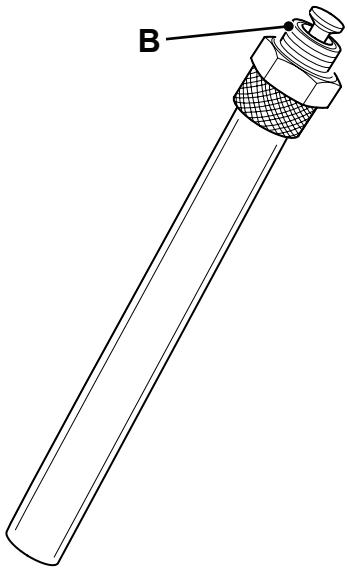

Fig 3.

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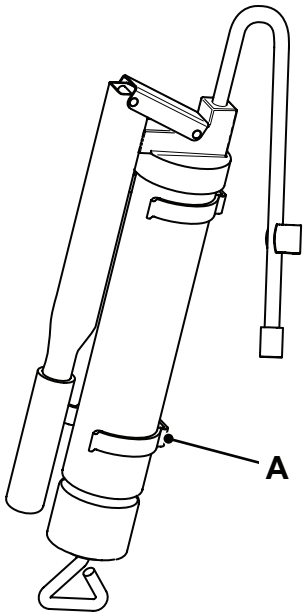

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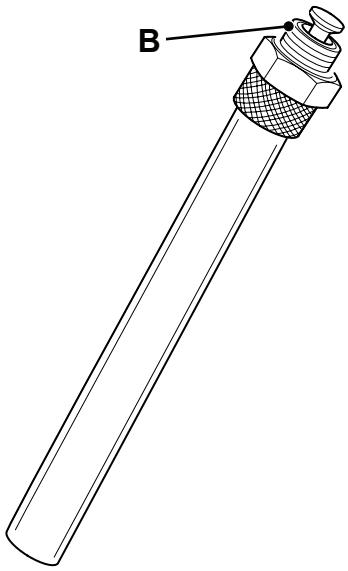


Fig 3.

Prepare the Machine for Maintenance

Introduction

⚠ WARNING

Maintenance must be done only by suitably qualified and competent persons.

Before doing any maintenance make sure the machine is safe, it should be correctly parked on level ground.

To prevent anyone starting the engine, remove the starter key. Disconnect the battery when you are not using electrical power. If you do not take these precautions you could be killed or injured.

8-3-1-1

Make the machine safe before you start a maintenance procedure.

Unless a maintenance procedure instructs you differently, you must lower the Excavator. Refer to ***How to Make the Machine Safe (Excavator Lowered)***.

How to Make the Machine Safe (Excavator Lowered)

Important: *Unless a maintenance procedure instructs you differently, you must lower the Excavator.*

1 Park the machine on level, solid ground.

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

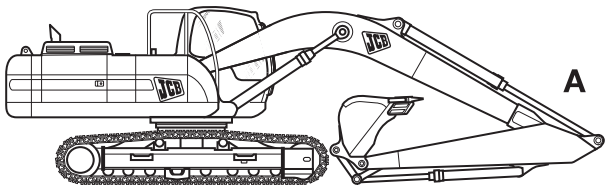
2 Lower the excavator so the attachment is flat on the ground as at **A**.

3 Stop the engine and remove the starter key.

4 Release tank pressure. Refer to ***Releasing Tank Pressure***.

5 Release the hydraulic pressure. Refer to ***Releasing the Hydraulic Pressure***.

6 Disconnect the battery to prevent accidental operation of the engine.



808071-2

Fig 4.

Cleaning the Machine

Introduction

T3-062_2

Clean the machine using water and or steam. Do not allow mud, debris etc. to build upon the machine.

Before carrying out any service procedures that require components to be removed:

1 Cleaning must be carried out either in the area of components to be removed or, in the case of major work, or work on the fuel system, the whole engine and surrounding machine must be cleaned.

2 When cleaning is complete move the machine away from the wash area, or alternatively, clean away the material washed from the machine.

Important: *When removing components be aware of any dirt or debris that may be exposed. Cover any open ports and clean away the deposits before proceeding.*

Detergents

Avoid using full strength detergent - always dilute detergents as per the manufacturer's recommendations, otherwise damage to the paint finish may occur.

Always adhere to local regulations regarding the disposal of debris created from machine cleaning.

Pressure Washing and Steam Cleaning

⚠ WARNING

When using a steam cleaner, wear safety glasses or a face shield as well as protective clothing. Steam can cause serious personal injury.

13-3-2-10_2

⚠ CAUTION

The engine or certain components could be damaged by high pressure washing systems; special precautions must be taken if the engine is to be washed using a high pressure system.

Ensure that the alternator, starter motor and any other electrical components are shielded and not directly cleaned by the high pressure cleaning system.

ENG-3-3

Important: *Do not aim the water jet directly at bearings, oil seals or electrical and electronic components such as the engine electronic control unit (ECU), alternator or fuel injectors.*

Use a low pressure water jet and brush to soak off caked mud or dirt.

Use a pressure washer to remove soft dirt and oil.

Note: *The machine must always be greased after pressure washing or steam cleaning.*

Preparing the Machine for Cleaning

P11-3004

1 Make the machine safe with the excavator lowered. Refer to ***Prepare the Machine for Maintenance***.

Important: *Stop the engine and allow it to cool for at least one hour. Do not attempt to clean any part of the engine while it is running.*

2 Make sure that all electrical connectors are correctly coupled. If connectors are open fit the correct caps or seal with water proof tape.

Cleaning the Machine

Introduction

T3-062_2

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Cleaning the Machine

Exterior

Clean the exterior of the machine using water and/or steam.

If steam is used the machine must be completely greased afterwards. ⇨ *Greasing (3-36)*

Pay particular attention to the cab windows. Make sure that the radiator grille is not blocked.

Do not allow mud to build up on the tracks and running gear. ⇨ *Tracks and Running Gear (3-93)*

Interior

⚠ CAUTION

Never use water or steam to clean inside the cab. The use of water or steam could damage the on-board computer and render the machine inoperable. Remove dirt using a brush or damp cloth.

8-3-4-8

Cleaning the Tracks

⚠ WARNING

If two people are doing this job make sure that the person operating the controls is a competent operator. If the wrong control lever is moved, or if the controls are moved violently, the other person could be killed or injured.

If you will be working with another person, make sure that you both understand what is to be done. Learn and use the recognised signalling procedures. Do not rely on shouting - he will not hear you.

To clean the tracks, you must turn them. When the tracks are turning, keep clear of rotating parts. Before starting this job, make sure that you have no loose clothing (cuffs, ties etc.) which could get caught in moving parts. Keep people not involved with this job well away!

MD-3-3-2

1 Prepare the Machine. ⇨ *Prepare the Machine for Maintenance (3-29)*.

Park the machine on level ground. Open the bucket and swing the boom until it is at 90° to the track. Lower the bucket to the ground.

2 Raise the Track.

Operate the boom and dipper controls so that the track on the side nearest the bucket is lifted up clear of the ground.

3 Rotate the Track.

When it is safe to do so and you are sure that everyone is clear of the machine, operate the controls to rotate the track which is off the ground. Rotate it first one way and then the other to shake off the mud. If necessary, the person outside may use water to get the mud off.

4 Inspect the Track.

When you have finished, inspect the track rollers, sprockets and idler wheels for damage and oil leaks.

5 Lower the Track.

Operate the boom and dipper controls to lower the track to the ground.

6 Repeat for the Opposite Track.

Swing the boom round to the other side and repeat steps 2 to 5 inclusive for the other track.

Cleaning the Radiator and Oil Cooler

A clogged radiator and/or oil cooler can lead to engine overheating. Regularly check for a build-up of dirt and debris and if necessary, use compressed air to clean-out the grille. At the same time check all hoses for damage or perishing, and replace if necessary.

Checking for Damage

Check the Machine Body and Structure

T3-063_5

Make sure that all guards and protective devices are in place, attached by their locking devices and free from damage.

Inspect all steelwork for damage. Pay particular attention to the following:

- Inspect all lifting point welds.
- Inspect all pivot point welds.
- Inspect the condition of all pivot pins.
- Check pivot pins are correctly in place and secured by their locking devices.

Check steps and handrails are undamaged and secure.

Check for broken, cracked or crazed window glass and mirrors. Replace damaged items.

Check all lamp lenses for damage.

Check all attachment teeth are undamaged and secure.

Check all safety and instructional labels are in place and undamaged. Fit new labels where necessary.

Note damaged paintwork for future repair.

Check the Seat and Seat Belt

T3-008_2

⚠ WARNING

When a seat belt is fitted to your machine replace it with a new one if it is damaged, if the fabric is worn, or if the machine has been in an accident. Fit a new seat belt every three years.

2-3-1-7_1

Inspect the seat belt for signs of fraying and stretching. Check that the stitching is not loose or damaged. Check that the buckle assembly is undamaged and works correctly.

Check that the belt mounting bolts are undamaged, correctly fitted and tightened.

Check seats are undamaged and secure. Check seat adjustments for correct operation.

Checking the FOPS Structure

All excavators are designed so that an operator's protective structure can be fitted. In certain applications such as demolition, machines must be fitted with the optional Falling Objects Protection Structure (FOPS). It is the operator's responsibility to identify the risk of an application.

⚠ 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

Check that all the FOPS mounting bolts are in place and undamaged. Check the FOPS mounting bolts for correct torque tightness.

Cab Mounted

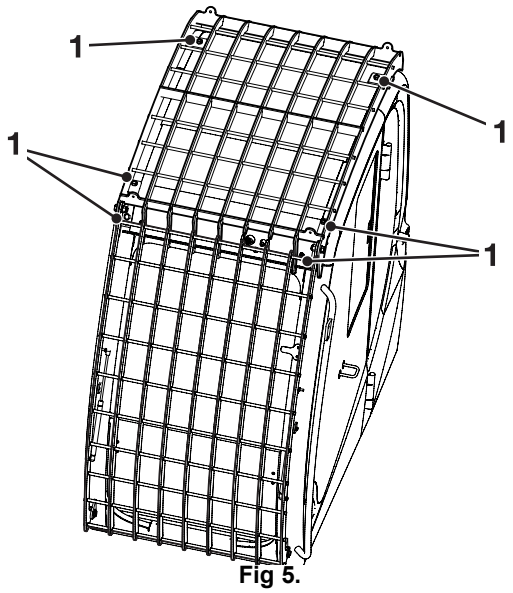

Fig 5.

1 Torque tightness is 78.4 Nm (58 lbf ft)

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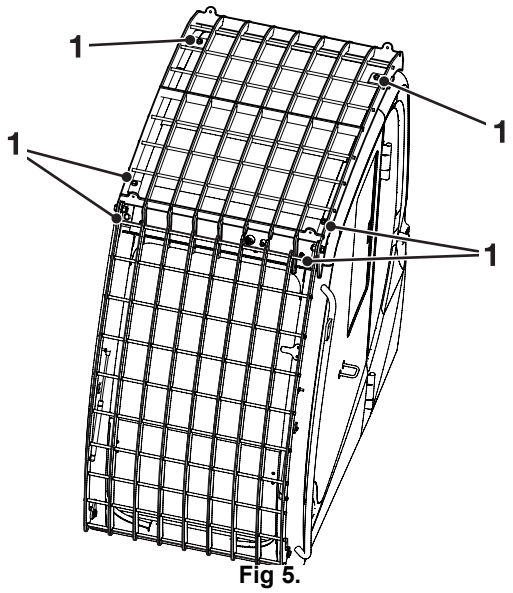

Fig 5.

1 Torque tightness is 78.4 Nm (58 lbf ft)

Daily Checking

It is vital to check certain machine functions and components daily to ensure that the machine can be operated safely and efficiently.

1 Prepare the machine. ⇨ ***Prepare the Machine for Maintenance (3-29)***.

2 Visual check. Check the machine for the following:

- **a** Oil, fuel and coolant leakage.
- **b** Broken or loose fasteners.
- **c** Wire breakage, short circuit of cables and terminal anchorage.
- **d** Oil cleanliness.
- **e** Dust accumulation.
- **f** Structures for damage.

⚠ WARNING

The cooling system is pressurised when the coolant is hot. When you remove the cap, hot coolant can spray out and burn you. Make sure that the engine is cool before you work on the cooling system.

9-3-3-1_2

- **g** Coolant level check and refilling. ⇨ ***Engine (3-56)***.

3 Checking after initial start-up

- **a** Engine oil level is checked automatically. Check monitor display at start up for possible warning.
- **b** Operation of horn and gauges.
- **c** Ease of engine starting, abnormal noise and exhaust gas colour.
- **d** Oil, fuel and coolant leakage.

4 Fuel level check and refilling. refer to ***Operation Section, Refuelling the Machine***.

⚠ WARNING

Do not remove the hydraulic tank filler cap or cover plate when the engine is running. The hydraulic system is under pressure. You or others could be injured. First stop the engine and then release the pressure.

8-3-4-4

5 Hydraulic oil level check and refilling. ⇨ ***Checking the Fluid Level (3-82)***, ⇨ ***Topping-up Fluid Level (3-82)***.

6 Check the mounting bolts of the fuel and hydraulic oil tanks for looseness and for fuel and hydraulic oil leakage.

7 Check the mounting bolts of the electrical parts and battery terminals for looseness and wire breakage.

8 Crawler.

- **a** Check the shoes for looseness, wear and breakage. Refer to ***Introduction Section, Component Location***.
- **b** Check the track motor, upper/lower rollers and idler wheel for oil leakage and wear. Refer to ***Introduction Section, Component Location***.
- **c** Check each mounting bolt for looseness and/or missing bolts.

9 Boom/Dipper

Check the high pressure hoses/joints and the hydraulic rams for oil leakage.

10 Accumulator - Check charge

- **a** Extend dipper and raise boom.
- **b** Apply engine shutdown.
- **c** Operate boom down function.
- **d** Ensure boom lowers to the ground under its own weight.

11 Bucket and Linkage.

Greasing

Introduction

T3-028_2

You must grease the machine regularly to keep it working efficiently. Regular greasing will also lengthen the machine's working life. Refer to the ***Service Schedule*** for the correct intervals.

Note: *The machine must always be greased after pressure washing or steam cleaning.*

Greasing should be done with a grease gun. Normally, two strokes of the gun should be sufficient. Stop greasing when fresh grease appears at the joint. Use only the recommended type of grease. Do not mix different types of grease, keep them separate.

In the following illustrations, the grease points are numbered. Count off the grease points as you grease each one. Refit the dust caps after greasing.

Note: *Where applicable, refer to the manufacturers manual for instructions on the maintenance of optional attachments.*

⚠ CAUTION

Waxoyl contains turpentine substitute which is flammable. Keep flames away when applying Waxoyl. Waxoyl can take a few weeks to dry completely. Keep flames away during the drying period.

Do not weld near the affected area during the drying period. Take the same precautions as for oil to keep Waxoyl off your skin. Do not breathe the fumes. Apply in a well-ventilated area.

5-3-1-9

Slew Ring Bearing

There are two grease nipples on the front of the machine and one on the front of the ring.

Check that the grease extrudes from under the seal around the entire circumference.

Note: *It is not possible to add too much grease.*

Slew Ring Teeth and Slew Pinion

Ensure slew ring is kept full of grease. Always grease whenever the machine has been steam-cleaned.

For location of the slew ring gear refer to Identification of Machine Components.

1 Make the machine safe. Stop the engine and remove the starter key.

2 Grease the Slew Ring.

- **a** Remove the inspection port cover **A** (on the lower centre section).
- **b** Remove the grease discharge port cover **B** (on the lower inner side).
- **c** Remove contaminated grease.
- **d** Replace the discharge port cover.
- **e** Apply grease to the slew ring via aperture **C**.

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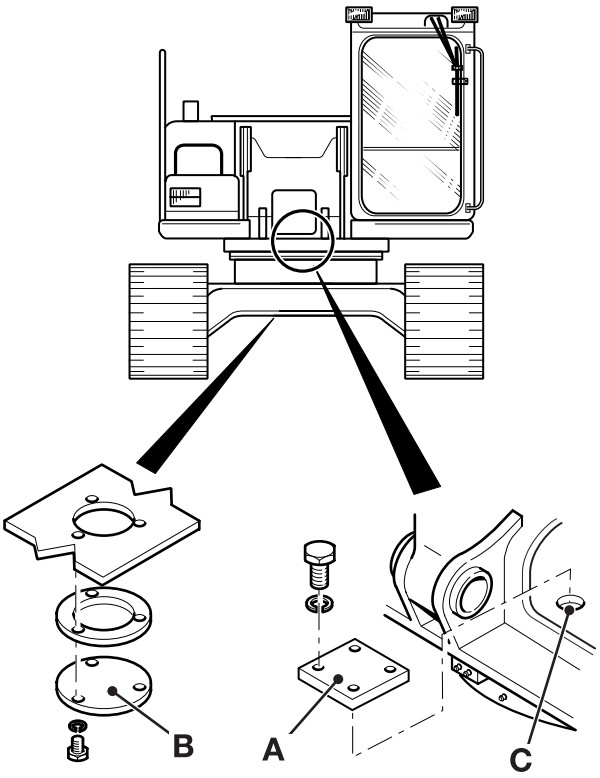


Fig 8.

3 Slew the Machine.

Start the engine and slew the machine a few degrees.Stop the engine, remove the starter key and apply grease again.

Repeat until the whole ring is greased. Check that grease exudes around the entire circumference.

4 Refit the inspection port cover.

Greasing Points

⚠ WARNING

You will be working close into the machine for these jobs. Lower the attachments if possible. Remove starter key and disconnect the battery. This will prevent the engine being started.

8-3-1-3

Table 15.

Greasing Points		No.	Hours
A	Boom Base	3	1000
B	Boom ram, eye end pin	2	50
C	Dipper ram, dump end pin	1	50
D	Boom ram, dump end pin	2	50
E	Bucket ram to Bucket linkage	3	50
F	Bucket linkage to Bucket pin	1	50
G	Dipper to Bucket Linkage pin	1	50
H	Dipper to Bucket pin	1	50
J	Bucket ram, dump end pin	1	50
K	Dipper ram, eye end pin	1	50
L	Boom to Dipper, connecting pin	1	1000
M	TAB positioning ram, dump end pin	1	50
N	TAB positioning ram, eye end pin	1	50
O	TAB upper/lower boom pivot pin JS115-190	1	50
O	TAB upper/lower boom pivot pin JS200-360	1	1000
R	Slew Ring Teeth	1	500
S	Slew Ring Bearing	3	250

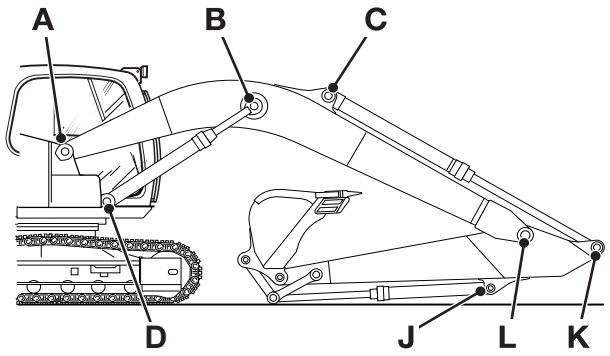


Fig 9.

Electrical System

Battery

Note: *Before commencing work on the batteries you must read the following procedure in Health and Safety;* ⇒ *Battery (3-5)*.

Note: *If a battery requires replacement then both batteries must be replaced.*

Battery Isolator

T3-101

To disconnect the batteries from the machine electrics a battery isolator has been fitted.

Important: *DO NOT use the battery isolator when the engine is running, this may result in damage to the machine electrics.*

⚠ CAUTION

Before carrying out arc welding on the machine, disconnect the battery and alternator to protect the circuits and components. The battery must still be disconnected even if a battery isolator is fitted.

INT-3-1-13

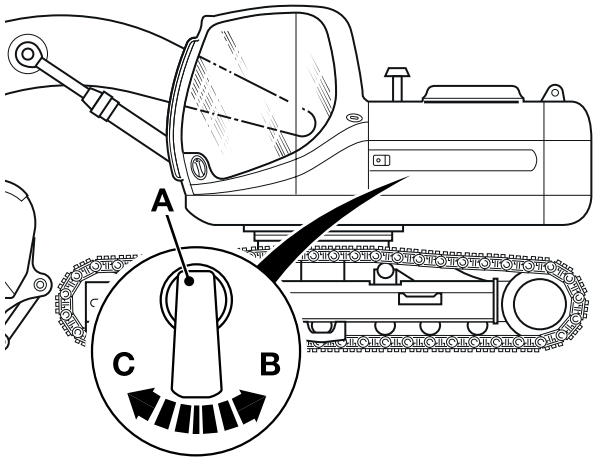
At the end of a working cycle or if the machine is being left unattended or if carrying out maintenance, the battery must be isolated. Before attempting to start the engine or use the machine electrics the battery isolator key must be fitted and switched on.

Note: *If the batteries are isolated, the radio may loose its preset memories.*

1 Make the machine safe. Refer to ***Prepare the Machine for Maintenance***.

2 Locate the battery isolator in the battery bay.

3 To allow the engine ECU to shutdown correctly, you must wait 30 seconds (**X**) before you isolate the battery. The 30 second period starts when you switch OFF the machine ignition.



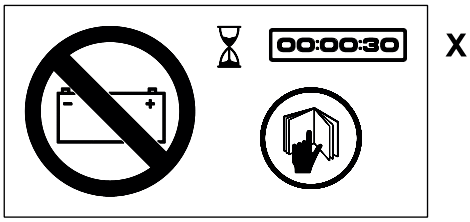


Fig 14.

4 Disconnect the batteries from the machine electrics.

a Turn the battery isolator key **A** in a counter-clockwise direction **B** and remove.

b Keep the key in a safe place and available for when the machine is next required.

To connect the batteries insert the key **A** and turn in a clockwise direction **C**.

Jump-Starting the Engine

⚠ WARNING

In temperatures below freezing, the battery electrolyte may freeze if the battery is discharged or poorly charged. Do not use a battery if its electrolyte is frozen. To prevent the battery electrolyte from freezing, keep the battery at full charge.

If you try to charge a frozen battery or jump-start and run the engine, the battery could explode.

Batteries produce a flammable gas, which is explosive; do not smoke when checking the electrolyte levels.

When jump-starting from another vehicle, make sure that the two vehicles do not touch each other. This prevents any chance of sparks near the battery.

Switch off all circuits which are not controlled by the starter switch.

Do not connect the booster (slave) supply directly across the starter motor.

Use only sound jump leads with securely attached connectors. Connect one jump lead at a time.

The machine has a negative earth electrical system. Check which battery terminal is positive (+) before making any connections. Keep metal watch straps and jewellery away from the jump lead connectors and the battery terminals - an accidental short could cause serious burns and damage equipment. Make sure you know the voltage of the machine. The booster (slave) supply must not be higher than that of the machine. Using a higher voltage supply will damage your machine's electrical system. If you do not know the voltage of your booster (slave) supply, then contact your JCB dealer for advice. Do not attempt to jump-start the engine until you are sure of the voltage of the booster (slave) supply.

8-2-7-4

1 Set all Switches in the Cab to OFF.

2 Connect the Booster Cables as follows:

Note: *These machines have 2 batteries which are connected in series to give 24 volts. Use a booster supply of 24 volts.*

a Open the side panel to gain access to the batteries.

b Connect the positive booster cable to the positive (+) terminal on the front battery of the machine **A**.

c Connect the other end of this cable to the positive (+) terminal of the booster supply **B**.

d Connect the negative (-) booster cable to a clean metal part of the machine **C** away from and below the battery.

Note: *The connection on the machine must be free from paint and dirt. Do not use a pivot pin for an earth.*

e Connect the other end of this cable to the negative (-) terminal on the booster supply.

3 Do the Pre-Start Checks.

4 Start the Engine.

Run the machine on Redundancy mode for ten minutes before switching to computer mode.

5 Disconnect the Booster Cables.

a Disconnect the negative (-) booster cable from the machine frame earth. Then disconnect it from the booster supply.

b Disconnect the positive (+) booster cable from the positive (+) terminal on the battery. Then disconnect it from the booster supply.

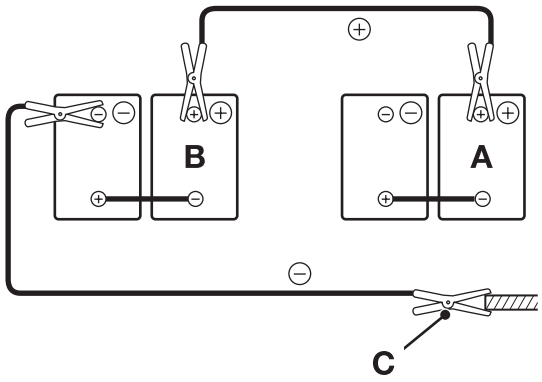


Fig 21.

Fuses

⚠ CAUTION

Fuses

Always replace fuses with ones of correct ampere rating to avoid electrical system damage.

8-3-3-5

The electrical circuits are protected by fuses. The fuse box is located in the rear stowage area. Open the fuse box cover **A** to gain access to fuses.

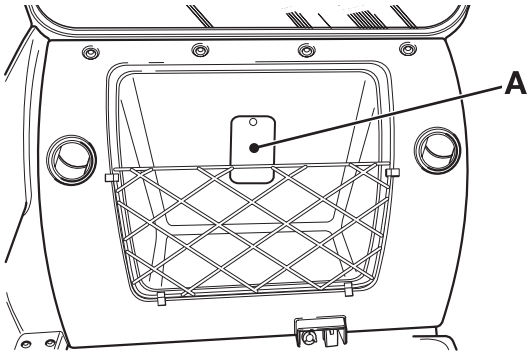


Fig 22. Machines Built Up To December 2011

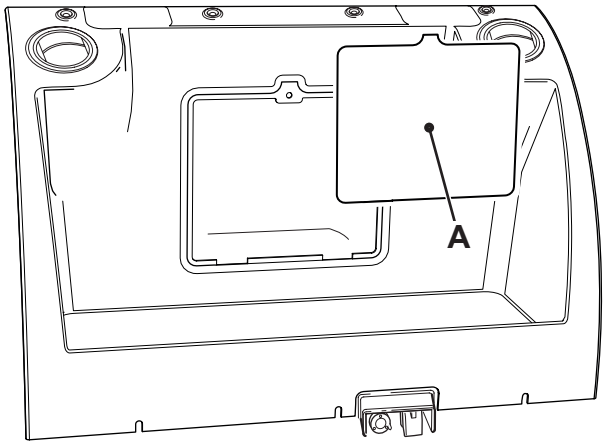


Fig 23. Machines Built After December 2011

If a fuse blows, find out why before fitting a new one.

For fuse identification, label **B** is attached to the rear of cover **A**.

Fuse Identification

Table 16.

Fuse	Circuit(s) Protected	Rating
1	Controller Outputs 1-6	15A
2	Controller Outputs 7-12	15A
3	Controller Outputs 13-16	15A
4	Controller Outputs 17-22	10A
5	Controller Outputs 23-28	10A
6	Heater/Air Conditioner, Auto fan	20A
7	Wiper, Heated Seat	20A
8	Work Lamps, Opt Hyd, Radio (Ign), lighter	20A
9	Radio (Memory), Cab Interior Lamp Switch	10A
10	Key Switch	10A
11	ECU-STD, EMS Battery Supply	10A
12	Diagnostic	10A
13	Auxiliary	15A
14	ECU-STD, EMS, Fascia Ign Supply	5A
15	Re-fuelling Pump	15A
16	Engine Electric Lift Pump	10A
C1	Engine ECM Battery Supply (Harness colour - WR/R)	25A
C2	Main Fuse Box Battery Supply (Harness colour - WB/W)	25A
C3	Ignition Supply (Harness colour - W/R)	60A

Bolt and Nut Torque Specifications

JS115 - JS360 and Variants

Tighten the bolts and nuts according to the tables below. Before and after daily work, check the bolts and nuts for looseness and for those missing. Tighten if loose and renew if missing.

Tighten the bolts and nuts after the first 50 hours of the running-in stage and every 250 hours thereafter.

For tightening torques for the bolts and nuts not listed ⇨ *Table 24. (3-55)*.

Table 17. JS115 and variants

No.	Tightening Point	Bolt Diameter	Wrench mm	Tightening Torque		Checking Torque	
				Nm	lbf ft	Nm	lbf ft
1(1)	Travel Motor	M16	24	290	213	265	195
2(1)	Drive Sprocket	M16	24	290	213	265	195
3(1)	Idler Wheel	M16	24	290	213	265	195
4(1)	Upper (Carrier) Roller	M16/M20	24/30	290/550	213/405	265/515	195/380
5(1)	Lower (Track) Roller	M16	24	290	213	265	195
6(1)	Track Guard	M16	24	290	213	265	195
7	Shoe Bolt	M16	24	382-440	282-325	344-396	254-292
8	Counter weight	M27	41	925	682	840	620
9(1)	Turntable Bearing (Undercarriage)	M16/M20	24/30	296/525	218/387	275/470	203/347
10(1)	Turntable Bearing (Slew Frame)	M16/M20	24/30	296/525	218/387	275/470	203/347
11(1)	Slew Equipment	M16/M20	24/30	290/550	213/405	265/515	195/370
12(1)	Engine (Engine Mount)	M16	24	290	213	265	195
13(1)	Engine Bracket	M10/M12	17/19	68/118	50/87	62/107	45/79
14	Radiator	M12	19	65	48	60	44
15(1)	Hydraulic Pump	M10	17	68	50	62	45
16(1)	Hydraulic Oil Tank	M16	24	250	184	225	162
17(1)	Fuel Tank	M16	24	250	184	225	162
18(1)	Control Valve	M16	24	290	213	265	195
19	Battery	M6	10	7	5	6	4
20(1)	Rotary Coupling	M12	19	116	85	105	80
21	Cab	M16	24	132	97	125	92

(1) Use JCB Threadlocker and sealer (High Strength) and tighten to the torque listed.

Engine

Oil and Filter

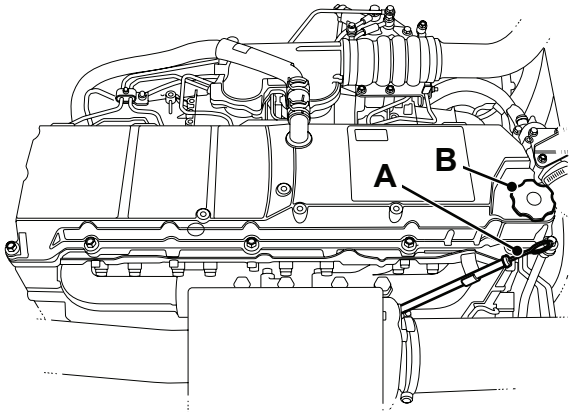
Checking the Oil Level

1 Open the Engine Compartment.

2 Check the Oil Level.

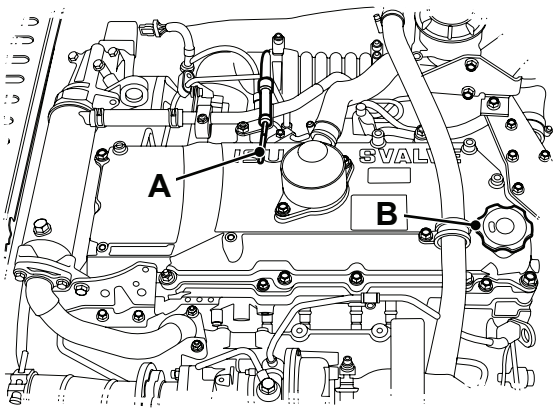
a Locate the dipstick **A** and remove. Oil should be between the two marks. Add oil if necessary through filler **B**. Use only the recommended oil ⇨ *Fluids, Lubricants and Capacities (3-16)*. Re-check the oil level about 10-15 minutes after refilling.

b Make sure that the dipstick and filler cap are secure.



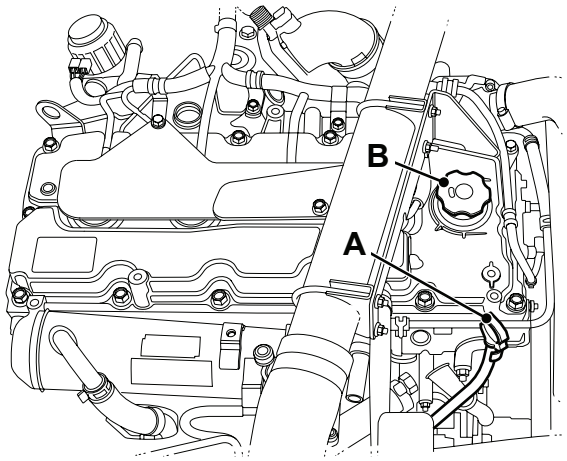
T022950

Fig 29. 6HK Engine



T022970

Fig 28. 4HK Engine



T022960

Fig 30. 4JJ Engine

Cooling System

Checking the Coolant Level - 4JJ Engines (Non-Pressurized Expansion Bottle Type)

1 Park the machine on solid, level ground.

2 Turn the engine OFF and remove the ignition key.

3 Let the engine cool down.

⚠ WARNING

The cooling system is pressurised when the coolant is hot. When you remove the cap, hot coolant can spray out and burn you. Make sure that the engine is cool before you work on the cooling system.

9-3-3-1_2

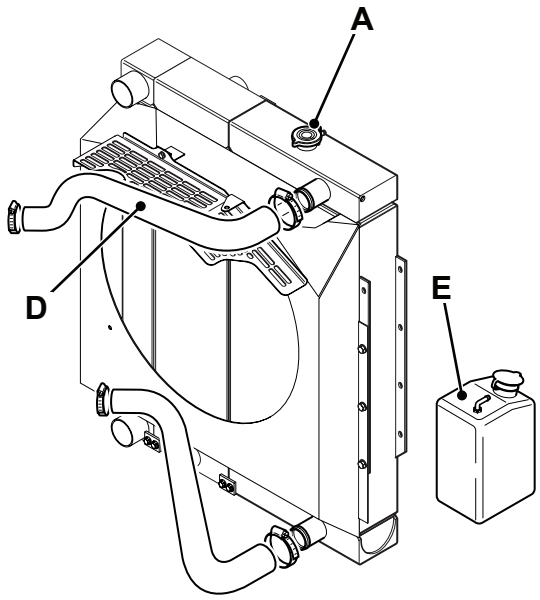


Fig 33.

4 Carefully release the radiator cap **A** to release system pressure.

5 Remove the radiator cap **A**.

6 Check the radiator is full of coolant to the top of the filler neck.

If the level is low:

a Switch the ignition ON and switch the cab heater onto hot and full blower speed.

b Top up the radiator with coolant to the top of the filler neck.

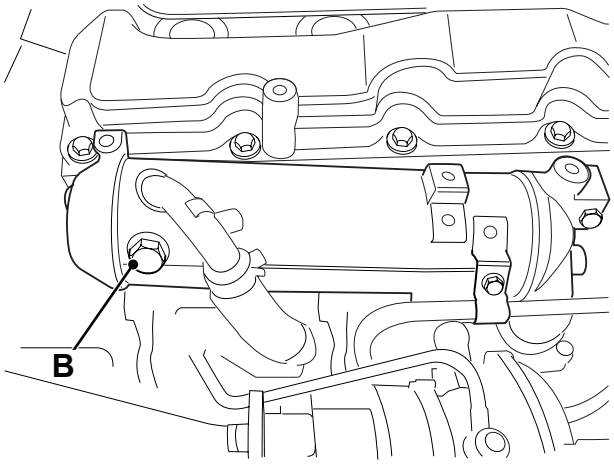


Fig 34.

c Open the EGR cooler plug **B** to bleed air from the system.

d Close the EGR cooler plug.

Note: *Torque tighten the EGR cooler plug to 25Nm.*

e Fit the radiator cap.

7 Check the level in the expansion bottle **E**. ⇨ *Fig 37. (3-63)*.

The level must be at the FULL mark.

If the level is low:

a Top-up the expansion bottle **E** with coolant.

8 Start the engine.

9 Turn the slew lock ON.

Fan Belt

Checking the Fan Belt Tension

⚠ WARNING

Make sure the engine cannot be started. Disconnect the battery before doing this job.

2-3-3-5

1 Prepare the machine. ⇨ *Prepare the Machine for Maintenance (3-29)*.

2 Check the fan belt tension. There must be 6-8 mm (0.24-0.31 in) slack at **X**.

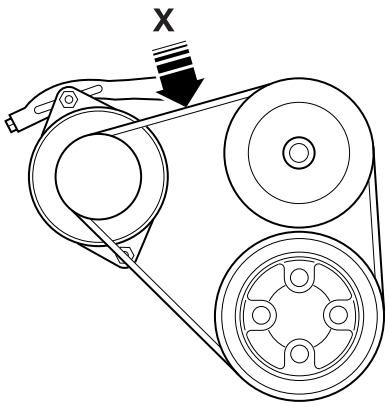


Fig 45.

3 Loosen the alternator. Slacken bolts **A** and **B**.

4 Adjust the fan belt

- **a** Use a lever to re-position the alternator so as to adjust the fan belt tension.

Note: *If the fan belt is stretched so much that it cannot be adjusted correctly, fit a new belt.*

- **b** While levering the alternator pinch the bolt **A** and check the tension on the belt.
- **c** If it is not correctly tensioned complete steps 4 and 5.
- **d** When correct tension is achieved fully tighten bolts **A** and **B**.

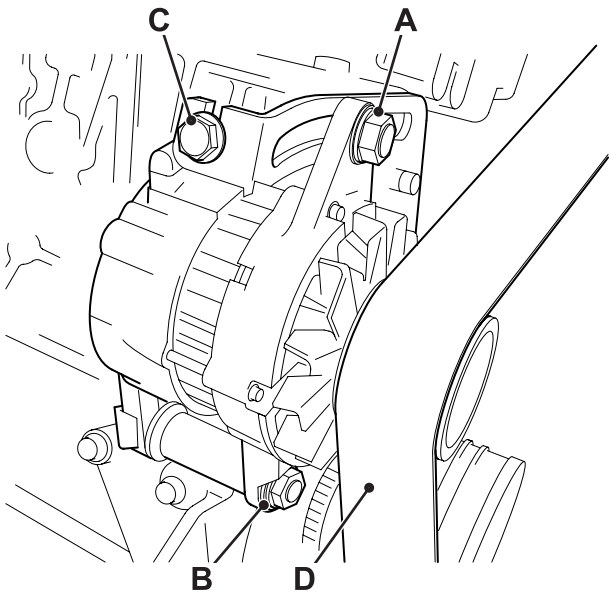


Fig 46.

Fitting a New Fan Belt

Complete steps 1 and 2.

1 Loosen the alternator. Slacken bolts **A, B** and adjust plate **C** so that the alternator is levered towards the engine, so that the fan belt **D** can be removed.

2 Fit a new fan belt. Remove the fan belt **D** and replace it with a new one, make sure the `V' profile locates in the pulleys correctly.

Note: *It may be necessary to apply leverage to the new belt to get it over the pulleys.*

3 Adjust the fan belt. Carry out step 5 of Adjusting the Fan Belt.

4 Re-check the fan belt tension. Check after running the machine for 5 minutes at low idle.

Engine Air Filter

Changing the Outer Air Filter Element

⚠ CAUTION

The outer element must be renewed immediately if the warning light on the instrument panel illuminates.

2-3-3-1

Note: *Do not attempt to wash or clean the elements - they must only be renewed.*

Note: *Do not run the engine with the dust valve **F** removed.*

Note: *Change the outer element more frequently if operating in dusty conditions. A new inner element must be fitted at least every other time the outer element is changed. As a reminder, mark the inner element with a pen each time the outer element is changed.*

1 Stop the engine.

2 Press clips **A** and lift off cover **B**. Remove outer element **C**. Take care not to tap or knock the element.

3 Clean the inside of cover **B** and canister **D**.

4 Insert a new element into the canister, check seal **E** is fully seated. Fit cover **B** with dust valve **F** at the bottom. Push the cover firmly into position and make sure it is secured by clips **A**.

5 Make sure that the wire is connected to the Air Filter Blocked switch.

6 Check all hoses for condition and tightness.

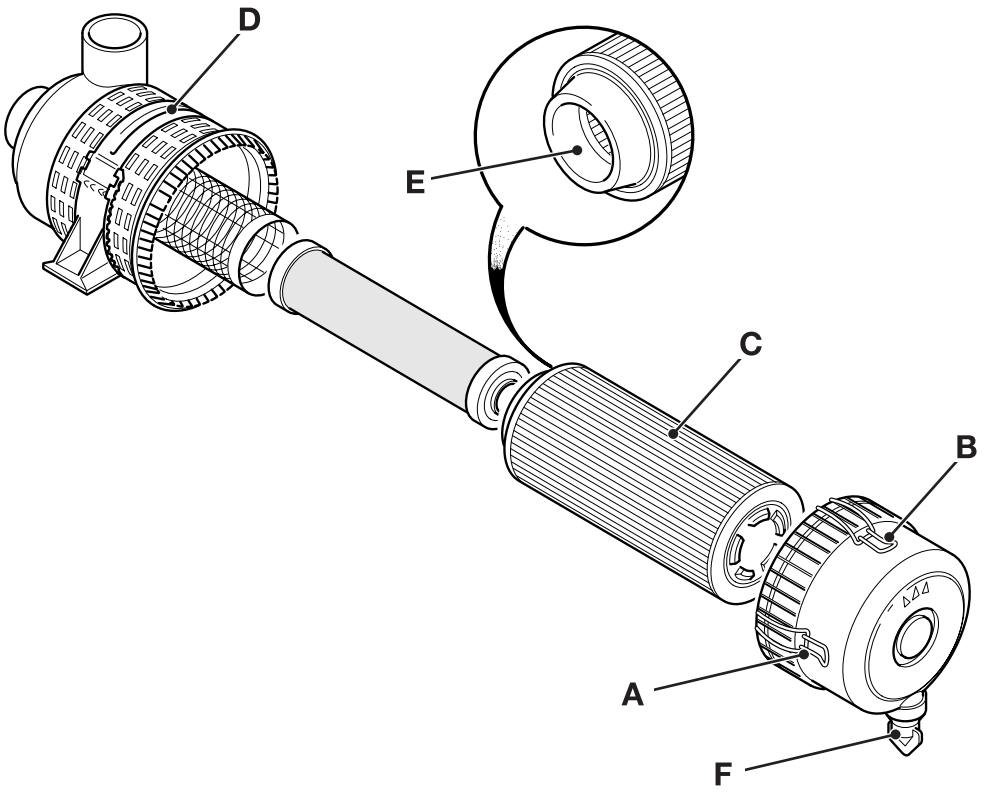


Fig 47.

Fuel System

Introduction

⚠ WARNING

Fuel

Fuel is flammable; keep naked flames away from the fuel system. Stop the engine immediately if a fuel leak is suspected. Do not smoke while refuelling or working on the fuel system. Do not refuel with the engine running. Completely wipe off any spilt fuel which could cause a fire. There could be a fire and injury if you do not follow these precautions.

INT-3-2-2_3

⚠ WARNING

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of pressurised fluid and wear protective glasses. If fluid penetrates your skin, get medical help immediately.

0177

⚠ CAUTION

Do not allow dirt to enter the system. Before disconnecting any part of the system, thoroughly clean around the connection. When a component has been disconnected, always fit protective caps and plugs to prevent dirt ingress.

Failure to follow these instructions will lead to dirt entering the system. Dirt in the system will seriously damage the systems components and could be expensive to repair.

INT-3-3-12

⚠ CAUTION

Running the engine with air in the system could damage the fuel injection pump. After maintenance, the system must be bled to remove any air.

2-3-3-11

Draining Fuel Tank Impurities

1 Stop the engine and remove the key.

2 Remove screws and take off the cover plate from below the fuel tank.

3 Position a suitable container under the drain.

Note: *The machine is fitted with a self sealing drain plug* ***X****.*

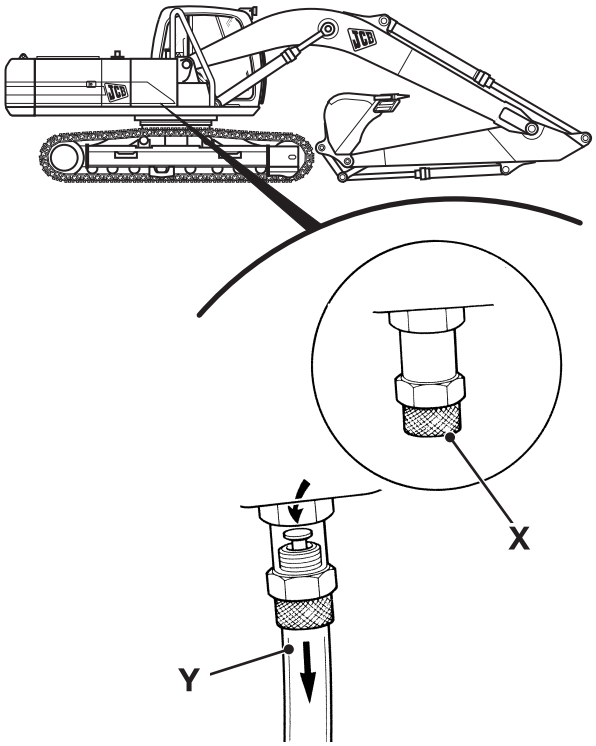


Fig 49.

4 Remove the self sealing drain plug outer threaded cover.

5 Fit the self sealing drain kit threaded union with attached pipe **Y**. Drain water and deposits until clean diesel oil flows.

6 Remove the self seal drain kit, clean and refit the outer cover. Do not over tighten the cover.

Note: *The JS290 and JS360 are fitted with a round access hatch to enable the inside of the tank to be cleaned.*

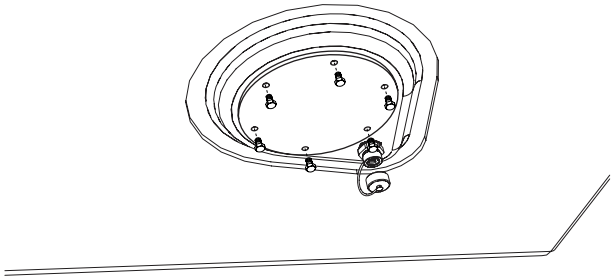


Fig 50. JS290 and JS360

7 Remove the 6 x bolts securing the access hatch.

Note: *Always replace the O-ring before re-fitting the hatch.*

Draining the Primary Filter/Sedimenter

The filter/sedimenter should be drained at least every 50 hours, but more often if necessary.

1 Park the machine on firm and level ground. Stop the engine and remove the key.

2 Locate filter/sedimenter **A** ⇒ *Fig 51. (3-75)*.

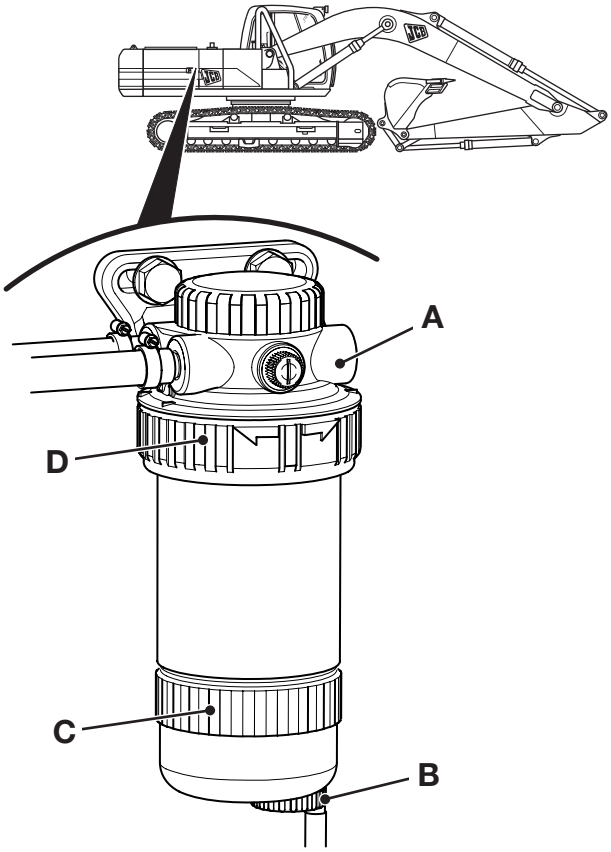


Fig 51.

3 Drain off the water by opening tap **B**. When the water is drained off turn off tap **B**, make sure it is turned off and secure.

4 If there is sediment in the bowl, after draining, support the bowl and release the locking ring **C**.

5 Wash the bowl in clean fuel.

6 Refit the bowl, secure in position with locking ring **C**.

Changing the Primary Filter/Sedimenter Element

1 Park the machine on firm and level ground. Stop the engine and remove the key.

2 Locate filter/sedimenter **A**.

3 Drain and remove the water separator bowl.

4 To remove the filter element, release locking ring **D** and discard element.

5 Fit new element and secure in position with locking ring **D**.

6 Refit water separator bowl.

Changing the Fuel Feed Pump Filter

1 Park the machine on firm and level ground. Stop the engine and remove the key.

2 Locate fuel feed pump **A**.

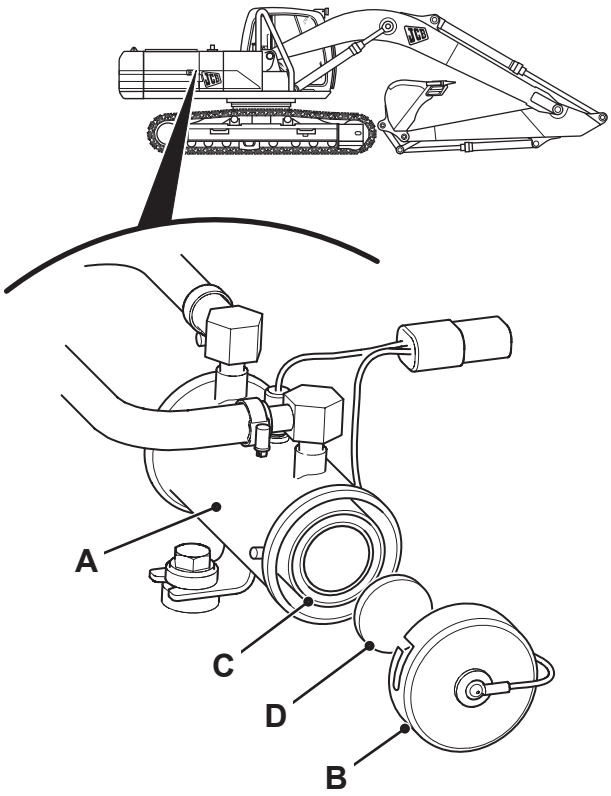


Fig 52.

3 Rotate cover **B** counter clockwise and remove.

4 Remove magnet **D** and wash with clean fuel.

5 Remove filter element **C**.

6 Replace magnet and fit new filter element.

7 Fit cover **B** and rotate clockwise to secure.

8 Remove any spilt fuel.

Draining the Main Filter/Sedimenter

The fuel filter housing contains a float which moves up and down in accordance with the amount of separated water. Drain any water in the bowl as follows.

1 Prepare the machine. ⇒ *Prepare the Machine for Maintenance (3-29)*.

2 Locate the fuel filter **A**, ⇒ *Fig 55. (3-79)*.

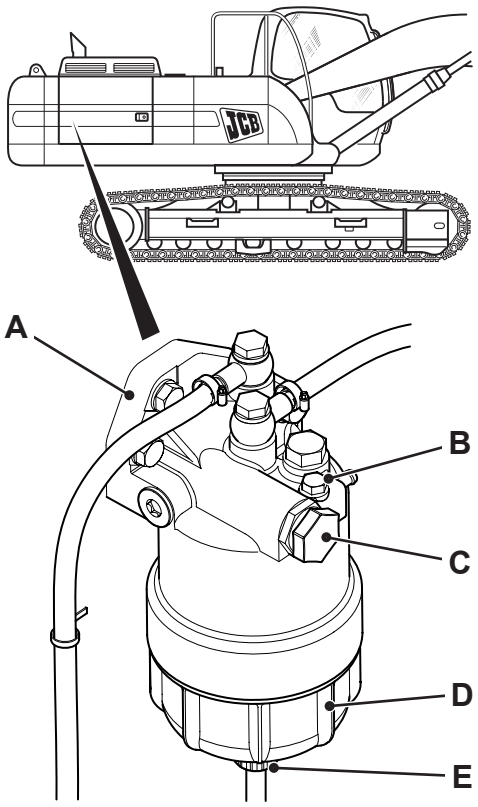


Fig 53.

3 Loosen the air bleeder plug **B** and open tap **E** to drain any water in the bowl.

4 After draining, close tap **E** and ensure air bleeder plug **B** is closed.

5 Wipe up any spilt fuel.

6 Bleed the fuel system.

Changing the Main Filter/Sedimenter Element

1 Prepare the machine. ⇒ *Prepare the Machine for Maintenance (3-29)*.

2 Locate the fuel filter **A**, ⇒ *Fig 54. (3-78)*.

3 Loosen the air bleeder plug **B** and open tap **C** to drain fuel from the filter into a suitable container

4 Using filter wrench, part no. 892/01236, unscrew the filter bowl **D** from the filter head.

5 Remove seal and filter element **E**.

6 Smear the new sealing ring with fuel oil and fit with filter element into bowl **D**.

7 Refit bowl to filter head and tighten using filter wrench, part no. 892/01236.

8 Wipe up any spilt fuel.

9 Bleed the fuel system.

Bleeding the System

Air in the fuel system could cause misfiring or failure to start. Air will enter the system if any part of it is disconnected or emptied.

Note: *Running the engine with air in the system could damage the fuel injection pump. After maintenance, remove air from the fuel system as detailed below.*

1 Prepare the machine. ⇨ ***Prepare the Machine for Maintenance (3-29)***.

2 Locate the fuel filter **A**, ⇨ ***Fig 55. (3-79)***.

3 Loosen the air bleeder plug **B** and operate the priming pump **C** until fuel appears at plug **B**.

4 Tighten plug **B** and operate pump **C** until the fuel filter is filled with fuel.

5 Wait approximately one minute and loosen air bleeder plug **B** to bleed any air from the fuel filter.

6 Repeat the previous three steps until no air comes from the bleeder plug **B**.

7 Tighten the plug **B** securely and wipe off any spilt fuel.

8 Start the engine but do not increase engine speed. If the engine fails to start repeat procedure from step 5.

9 After engine start up, keep at idle speed for five seconds before increasing speed slowly for three minutes.

10 Use throttle dial to operate the machine at maximum speed.

11 Stop machine and check for leaks.

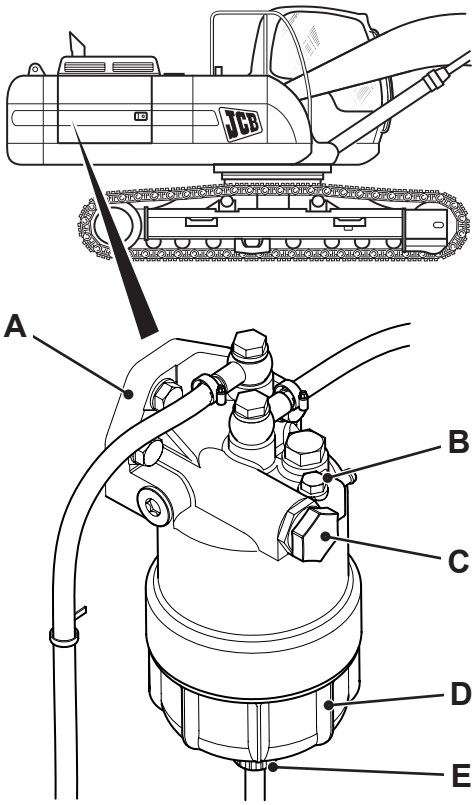


Fig 55.

Hydraulic System

Introduction

⚠ WARNING

The temperature of the hydraulic oil will be high soon after stopping the engine. Wait until it cools (less than 40°C) before beginning maintenance.

8-3-4-10

⚠ WARNING

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear protective glasses and gloves. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

INT-3-1-10_3

⚠ 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

⚠ CAUTION

Using incorrect fluid could damage the system. See Fluids, Capacities and Lubricants for the correct fluid. The fluid can harm your skin. Wear rubber gloves. Cover cuts or grazes.

2-3-5-1_2

⚠ CAUTION

Do not allow dirt to enter the system. Before disconnecting any part of the system, thoroughly clean around the connection. When a component has been disconnected, always fit protective caps and plugs to prevent dirt ingress.

Failure to follow these instructions will lead to dirt entering the system. Dirt in the system will seriously damage the systems components and could be expensive to repair.

INT-3-3-12

Releasing Tank Pressure

⚠ WARNING

Do not remove the hydraulic tank filler cap or cover plate when the engine is running. The hydraulic system is under pressure. You or others could be injured. First stop the engine and then release the pressure.

8-3-4-4

1 Prepare the machine. ⇨ ***Prepare the Machine for Maintenance (*** 3-29***)***.

2 Release tank pressure.

Depress rubber boot **A**, to release the pressure from the tank.

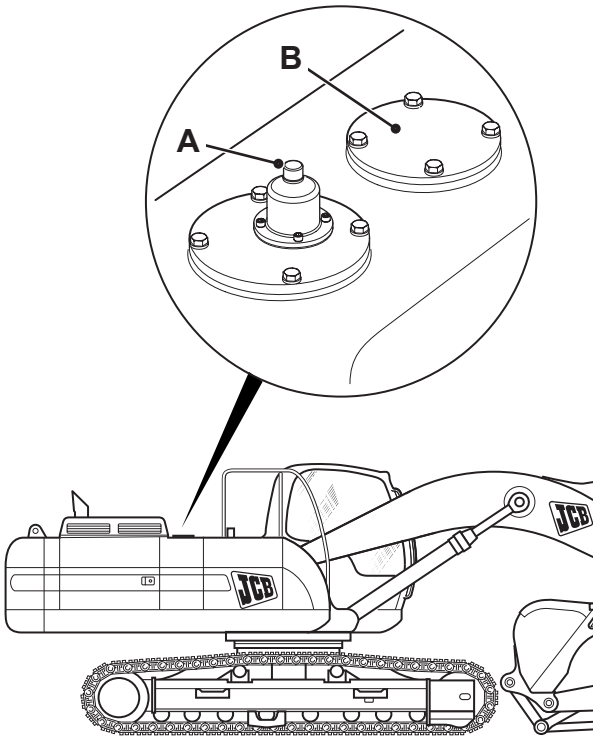


Fig 56.

Releasing the Hydraulic Pressure

Use the procedure below to release the hydraulic pressure. You must release the hydraulic pressure before carrying out maintenance on the machine for example.

1 Park the machine on hard, level ground and lower the attachment.

2 Stop the engine.

3 Turn the ignition to the 'ON' position.

4 Lower the control lock lever.

5 Operate the hand controllers in all directions to release pressure in the hydraulic system.

6 Turn the ignition to the 'OFF' position.

7 Remove the starter key.

8 Release the hydraulic oil tank pressure, refer to ***Maintenance, Releasing Tank Pressure***.

Oil and Filters

Checking the Fluid Level

1 Prepare the machine. ⇒ *Prepare the Machine for Maintenance (3-29)*.

Position the machine on level ground with the bucket and dipper rams fully extended and the boom lowered to rest the attachment on the ground, as at **A**.

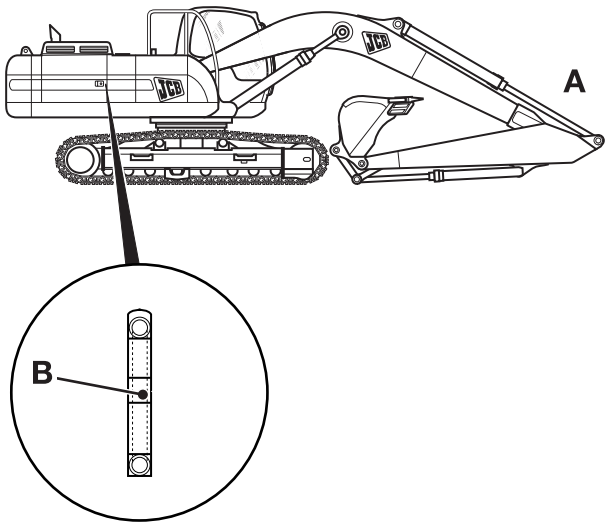


Fig 57.

2 Check the level. Look at the fluid level in the sight tube **B**. The level should be between the two marks on the tube. If the fluid is cloudy, water or air has entered the system.

Water or air in the system could damage the hydraulic pump. Contact your JCB distributor if the fluid is cloudy.

Topping-up Fluid Level

1 Prepare the machine. ⇒ *Prepare the Machine for Maintenance (3-29)*.

2 Release tank pressure. ⇒ *Releasing Tank Pressure (3-81)*

3 Add Fluid.

a Remove plate **B**.

b Refill oil through the filler port using a suitable tundish.

c Check the level through the level gauge on the side of the tank.

d Refit plate **B**.

Draining Water and Sediment from the Hydraulic Tank

1 Prepare the machine. ⇨ *Prepare the Machine for Maintenance (3-29)*.

2 Release tank pressure, ⇨ *Releasing Tank Pressure (3-81)*.

3 Draining the water and sediment. Carefully loosen the drain plug **C** on the bottom of the tank and drain the sediment and water accumulated at the bottom of the tank.

Note: *Have a drain pan ready. The task is complete when clean hydraulic oil flows out.*

4 Seal the system. Tighten the drain plug **C**.

Air Bleeding Procedures

After replacing the hydraulic oil or repairing or replacing hydraulic components or removing hydraulic pipes, bleed air from the hydraulic circuit

Bleeding Air from the Hydraulic Pump

1 Prepare the machine. ⇨ *Prepare the Machine for Maintenance (3-29)*.

2 Locate the hydraulic pump, ⇨ *Machine Description (1-5)*.

3 Temporarily loosen the hose connection at **A** to check that oil does not come out of the pump.

4 If oil comes out re-tighten the connection, if it does not come out remove the hose and pour hydraulic oil into the pump case through the port. When oil comes out of the port refit the hose connection.

5 Run the machine at idle for five minutes.

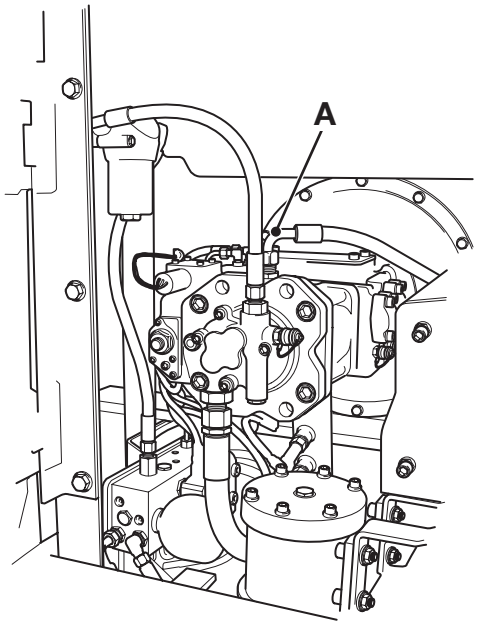


Fig 67. JS115-190

Draining Water and Sediment from the Hydraulic Tank

1 Prepare the machine. ⇨ *Prepare the Machine for Maintenance (3-29)*.

2 Release tank pressure, ⇨ *Releasing Tank Pressure (3-81)*.

3 Draining the water and sediment. Carefully loosen the drain plug **C** on the bottom of the tank and drain the sediment and water accumulated at the bottom of the tank.

Note: *Have a drain pan ready. The task is complete when clean hydraulic oil flows out.*

4 Seal the system. Tighten the drain plug **C**.

Air Bleeding Procedures

After replacing the hydraulic oil or repairing or replacing hydraulic components or removing hydraulic pipes, bleed air from the hydraulic circuit

Bleeding Air from the Hydraulic Pump

1 Prepare the machine. ⇨ *Prepare the Machine for Maintenance (3-29)*.

2 Locate the hydraulic pump, ⇨ *Machine Description (1-5)*.

3 Temporarily loosen the hose connection at **A** to check that oil does not come out of the pump.

4 If oil comes out re-tighten the connection, if it does not come out remove the hose and pour hydraulic oil into the pump case through the port. When oil comes out of the port refit the hose connection.

5 Run the machine at idle for five minutes.

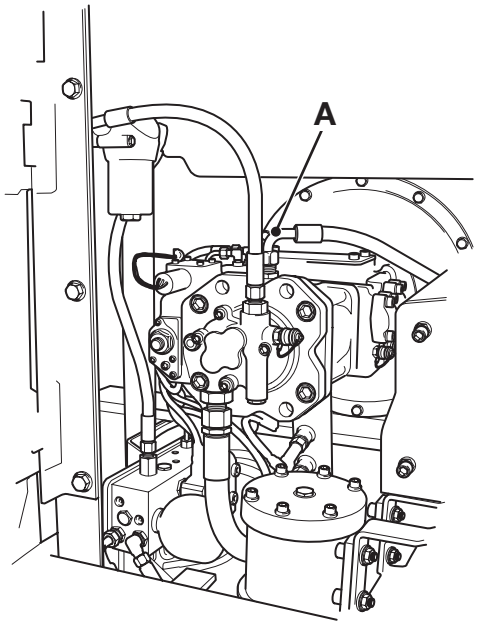


Fig 67. JS115-190

Slew Gearbox

Checking the Slew Gearbox Oil Level

1 Prepare the machine. ⇨ *Prepare the Machine for Maintenance (3-29)*.

2 Locate the slew gearbox, ⇨ *Machine Description (1-5)*.

3 Check the level.

a Remove the dipstick **A**, wipe it clean and re-fit.

b Remove the dipstick again and check that the oil level is within the min -max range.

c If necessary, top up through filler port **B**.

If there is no separate filler port fitted, top up through the dipstick port.

⇨ *Fluids, Lubricants and Capacities (3-16)* for oil type.

4 Refit the dipstick.

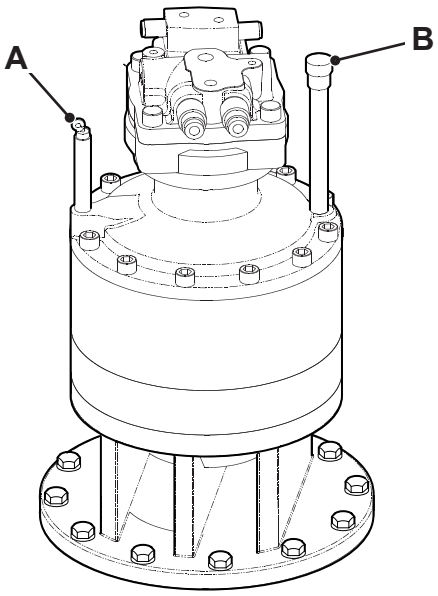


Fig 71.

Changing the Slew Gearbox Oil

1 Prepare the machine. ⇨ *Prepare the Machine for Maintenance (3-29)*.

2 Drain the oil.

a Remove the drain plug, located under the valve block. Allow the oil to drain out.

b Wipe the drain plug clean. Remove any metallic particles.

c Refit the drain plug. Make sure it is tight.

3 Fill with recommended oil through filler port **B**. ⇨ *Fluids, Lubricants and Capacities (3-16)*.

4 Check the level.

a Remove the dipstick **A**, wipe it clean and re-fit.

b Remove the dipstick again and check that the oil level is within the min-max range.

c If necessary, top up through filler port **B**. ⇨ *Fluids, Lubricants and Capacities (3-16)* for oil type.

5 Refit the dipstick.

6 Check for leaks. Run the machine, operate the slew controls and make sure there are no leaks.

Tracks and Running Gear

Tracks

Checking/Adjusting the Track Tension

1 Prepare the Machine. ⇨ *Prepare the Machine for Maintenance (3-29)*.

Position the machine on level ground. Run it backwards and forwards several times. Stop after running it forwards.

Carry out steps **1** to **3** of ***Cleaning the Tracks***. Block up the undercarriage frame. Finish track rotation by running the track forwards. Stop the engine and remove the starter key

⚠ WARNING

Raised Machine

NEVER position yourself or any part of your body under a raised machine which is not properly supported. If the machine moves unexpectedly you could become trapped and suffer serious injury or be killed.

INT-3-3-7_1

2 Check the Tension.

Measure gap **A** in line with the third roller from the front and between the lower surface of the track frame and the upper surface of the shoe.

Table 26.

Machine	Dimension A (Hard Ground Conditions)
JS130-JS160	235-255mm
JS180-JS260	275-295mm
JS290-JS460	340-360mm

3 Adjust the Track Tension.

Adjustment is made by either injecting or releasing grease from the check valve **B**. Inject grease to reduce the gap (increase the tension) or open the check valve to release grease and increase the gap. When closing the check valve torque tighten to 60Nm.

⚠ WARNING

When opening the check valve always stand to one side and loosen a little at a time until grease starts to come out. If you over-loosen too much grease could spurt out or the valve cover fly out and cause serious injury.

8-3-4-5

⚠ WARNING

Under no circumstances must the check valve be dismantled or any attempt made to remove the grease nipple from the check valve.

8-3-4-9

If a gap **C** exists between the idler wheel shaft and the track frame, you may use pressure to apply the grease. If there is no gap **C** after the application of grease, then the necessary repairs must be carried out by your JCB distributor.

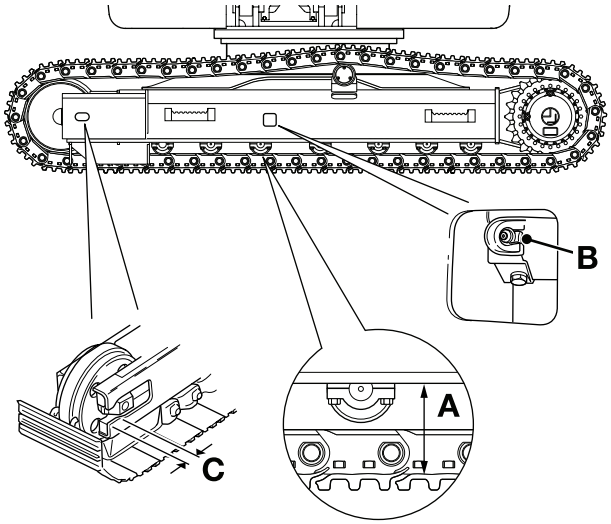


Fig 72.

Note: *Excessive tension can cause the track rail to wear the drive rollers and sprocket, insufficient tension can cause wear to the drive sprocket and track rail.*

Running Gear

Checking the Track Gearbox Oil Level

1 Prepare the machine. ⇨ *Prepare the Machine for Maintenance (3-29)*.

Position the machine on level ground with the level and drain plugs as illustrated ⇨ *Fig 74. (3-95)*.

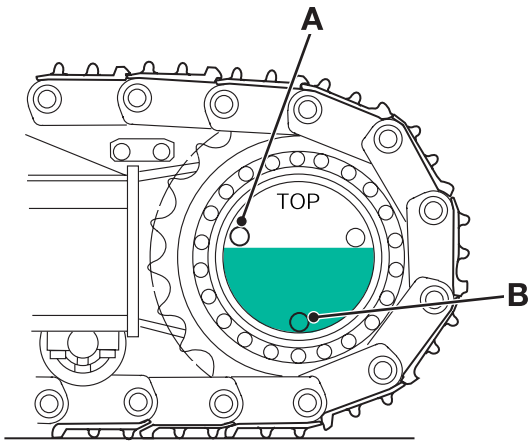


Fig 74.

2 Check the level on one side.

Clean the area around filler/level plug **A** and remove it. Oil should be level with plug **A**. Top up through plug **A** if necessary for oil types. ⇨ *Fluids, Lubricants and Capacities (3-16)*

3 Clean and refit the plug. Torque tighten to 37Nm.

4 Check the level on the other side.

Repeat steps **1** to **3**.

Changing the Track Gearbox Oil

1 Prepare the machine. ⇨ *Checking the Track Gearbox Oil Level (3-95)*

2 Drain the oil on one side.

a Place a container below the drain plug to catch the oil. The container must be large enough to hold the maximum gearbox capacity. ⇨ *Fluids, Lubricants and Capacities (3-16)*

CAUTION

Oil will gush from the hole when the drain plug is removed. Keep to one side when you remove the plug.

2-3-4-2

b Remove filler/level plug **A** and drain plug **B**. Allow the oil to drain out.

c Wipe the plugs clean. Make sure you remove all metal particles.

d Wrap seal tape on the drain plug **B** and refit. Torque tighten to 37Nm.

3 Fill with new oil for oil type and volume. ⇨ *Fluids, Lubricants and Capacities (3-16)* .

a Pour new oil through filler/level plug **A** until oil runs out of plug **A**.

b Check the condition of the o-ring, renew if it is damaged. Refit filler/level plug. Torque tighten to 37Nm.

4 Change the oil on the other side.

Repeat steps **1** to **3**.

5 Check for Leaks.

Run the machine, operate the tracking controls and then make sure there are no leaks.

Bucket

Checking/Adjusting For Side Play

It is possible to compensate for lateral wear which leads to sideways play of the bucket. Regular use of this compensating facility leads to less wear on the bucket swivel pin **A** and the dipper bushes **B**.

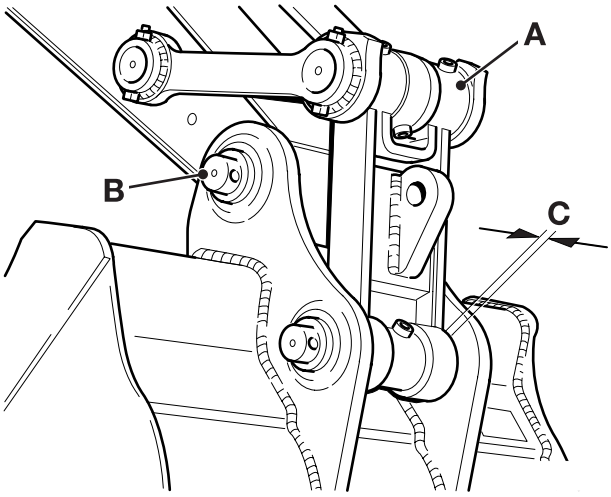


Fig 75.

1 Prepare the machine. ⇨ *Prepare the Machine for Maintenance (3-29)*.

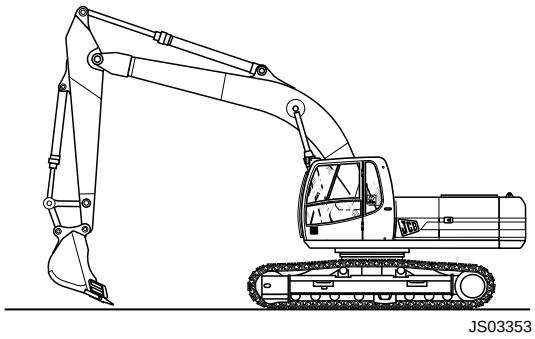


Fig 76.

Position the machine on level ground. Set the bucket as shown ⇨ *Fig 76. (3-96)*. Turn it slightly to the left and position it so that the arm end is pressed to the side which is not to be adjusted. Stop the engine, remove the starter key.

2 Measure the Clearance at **C**.

The clearance should be approximately 0.8 mm ⇨ *Fig 75. (3-96)*.

3 Check the clearance.

Windscreen Washer

Checking the Level

Locate the front window washer bottle **A** and fill with clean water. The liquid should contain a de-icing fluid to prevent it freezing. Do not use engine coolant antifreeze.

Note: *Do not use the washer when there is no liquid in the bottle as it will damage the motor.*

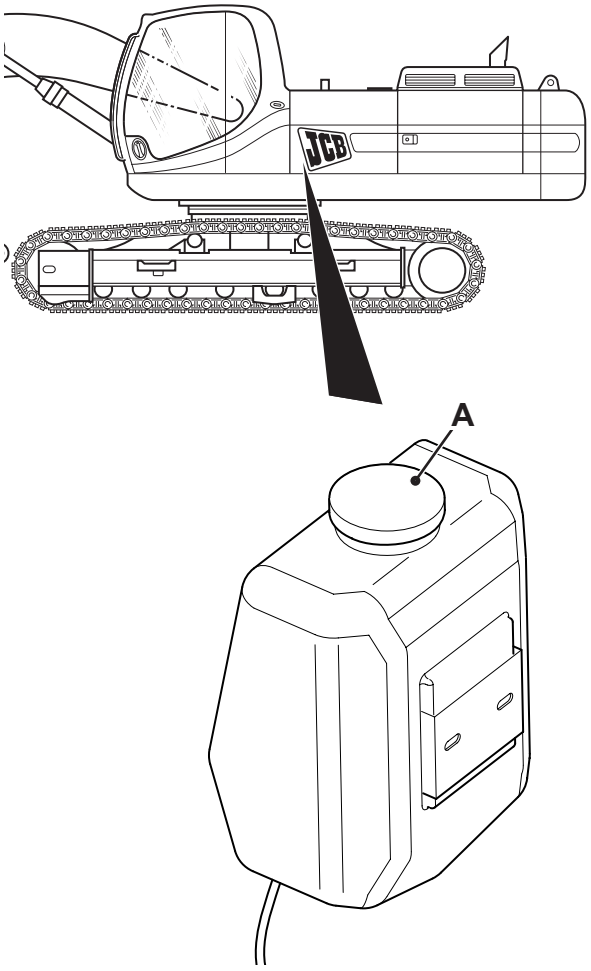


Fig 77.

Fire Extinguisher (If fitted)

The fire extinguisher should be inspected daily.

⚠ WARNING

Do not use the fire extinguisher in a confined space. Make sure that the area is well ventilated during and after using the fire extinguisher.

4-2-3-1

The fire extinguisher is located in the cab behind the drivers seat at **A**. Ensure the extinguisher is only used as directed on the canister.

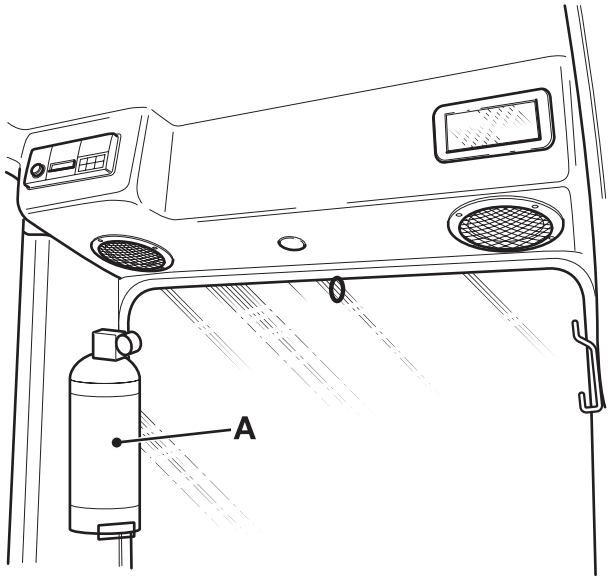


Fig 78. Machines Built Up To December 2011

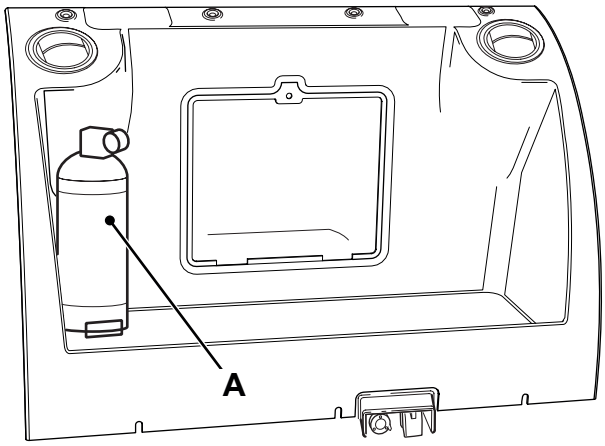


Fig 79. Machines Built After December 2011

⚠ WARNING

After any use, the extinguisher should be replaced or serviced.

4-2-3-2

Fire Extinguisher (If fitted)

The fire extinguisher should be inspected daily.

⚠ WARNING

Do not use the fire extinguisher in a confined space. Make sure that the area is well ventilated during and after using the fire extinguisher.

4-2-3-1

The fire extinguisher is located in the cab behind the drivers seat at **A**. Ensure the extinguisher is only used as directed on the canister.

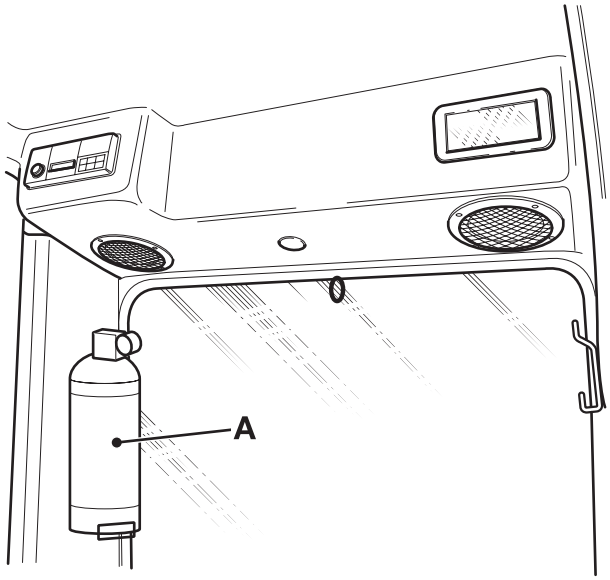


Fig 78. Machines Built Up To December 2011

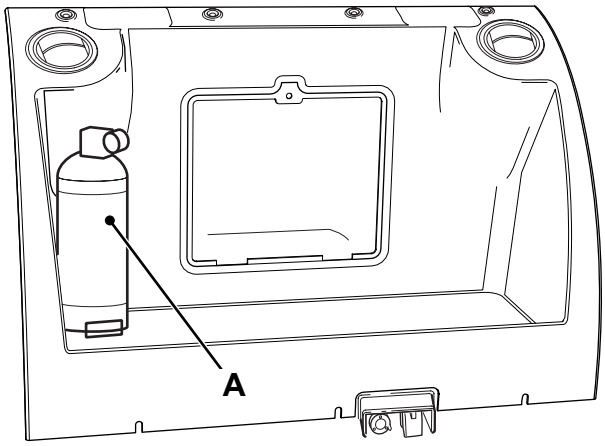


Fig 79. Machines Built After December 2011

⚠ WARNING

After any use, the extinguisher should be replaced or serviced.

4-2-3-2

Troubleshooting

To extend the service life and improve the operation of the machine, daily inspection and lubrication are necessary as well as immediately isolating any problem found and dealing with it. If the machine is operated with the problem uncorrected, it may lead to larger trouble and possibly to a big accident.

If trouble occurs, search for the cause in the items below and make adjustments, repairs, etc. as necessary. If the cause cannot be isolated, contact your JCB distributor.

Engine and Related Area

Table 27. Engine does not start

Cause	Remedy
Defective starter switch	Connect, repair connection
Defective rotation of starter (Starter rotates slowly)	Discharged battery, starter problems, contaminated or loose wiring connection
Improper viscosity of engine oil	Inspect and replace as necessary
Excessive cooling of engine (Cold weather)	Preheat with air heater. Warm up the coolant (add hot water)
Possible seizure in engine	Repair(1)
Incomplete air bleeding of fuel system	Completely bleed air
No fuel in fuel tank	Refill
Fuel quality unsuitable	Inspect and replace as necessary
Fuel filter clogged	Clean or replace
Low compression	Repair(1)
Defective fuel injection system	Repair(1)

Table 28. Engine stops during operation

Cause	Remedy
No fuel in fuel tank	Refill
Fuel filter clogged	Clean and replace
Air is mixed in the fuel system	Retighten fuel pipe connections and bleed system

Table 29. Low oil pressure

Cause	Remedy
Low oil	Refill
Defective oil pressure switch	Replace(1)
Oil filter clogged	Replace element
Low oil viscosity	Replace with oil of viscosity matching temperature
Improper operation of oil pump	Replace parts(1)
Oil leakage at connections	Tighten connections

Monitor Display - Fault Messages

Note: *For further information refer to Monitor Panel.*

Table 37. Water and Hydraulic oil temperature

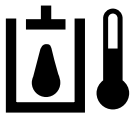
Message	Cause	Remedy
WATER TEMP   HYD TEMP	Water leakage	Repair
	Belt elongation, soiled with oil	Clean or replace
	Defective radiator	Repair or replace(1)
	Broken fan	Replace(1)
	Improper anti-freeze mixture	Replace
	Defective thermostat	Replace(1)
	Defective water pump	Replace(1)
	Dirty oil cooler (clogged)	Clean
	Dirty radiator (clogged)	Clean
	Defective dust protection net (clogged)	Clean
	Defective monitor	Replace(1)

Table 38. Low oil pressure

Message	Cause	Remedy
OIL PRESS 	Low Engine oil	Refill
	Oil leakage at connections	Repair
	Defective engine oil pressure sensor	Replace(1)
	Engine oil viscosity low	Replace with oil of viscosity matching the temperature
	Defective engine oil pump	Adjust, clean, replace(1)
	Defective monitor	Replace(1)

Table 39. Air filter

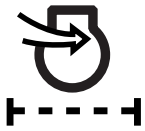
Message	Cause	Remedy
AIR FILTER 	Air filter element clogged	Clean, replace
	Intake system clogged, foreign matter inside.	Clean

Table 40. Low fuel

Message	Cause	Remedy
LOW FUEL	Fuel low	Refill
	Defective sensor	Replace(1)

Table 41. Alternator

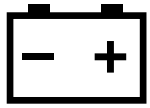
Message	Cause	Remedy
ALTERNATOR 	Belt tension	Adjust
	Wiring fault	Repair
	Defective battery	Replace
	Defective regulator	Replace (1)
	Defective alternator	Repair or replace(1)

Table 42. Low coolant

Message	Cause	Remedy
COOLANT LOW 	Coolant low	Refill
	Defective sensor	Replace(1)

Table 43. Engine oil filter

Message	Cause	Remedy
OIL FILTER 	Engine oil dirty	Replace engine oil, oil filter
	Defective sensor	Replace(1)

Table 44. Electrical fault

Message	Cause	Remedy
ELECT FAULT	Short circuit, etc abnormalities	Inspect, repair(1)

(1) Indicates jobs which should be done by a specialist.

Operations

Table 45. Operating controls hard to operate

Cause	Remedy
Foreign matter caught on control valve spool	Wash the control valve(1)
Valve sticking	Repair or replace valve assembly(1)
Improper lubrication of lever link	Grease
Lever link seizure	Grease

(1) Indicates jobs which should be done by a specialist.

Hydraulic pump

Table 46. Oil not delivered by oil pump

Cause	Remedy
Low hydraulic oil	Refill
Clogged suction filter	Repair

Table 47. Hydraulic pump does not build pressure

Cause	Remedy
Oil leakage inside hydraulic pump	Replace hydraulic pump(1)
Air inside the hydraulic pump	Refill oil or check hose on suction side
Main relief valve pressure set too low	Adjust pressure(1)

Table 48. Abnormal noise from hydraulic pump

Cause	Remedy
Cavitation resulting from deformed hose on the suction side or suction filter clogged	Replace filter, replace hydraulic oil if dirty
Joint of the suction side is loose or hydraulic oil is low and air is being sucked in	Retighten or grease the joints. Check that oil is filled to proper level inside casing
Cavitation resulting from excessively high viscosity of hydraulic oil	Replace with hydraulic oil of suitable viscosity

Table 49. Oil leakage from hydraulic pump

Cause	Remedy
Defective seal in hydraulic pump	Replace seal or hydraulic pump(1)

(1) Indicates jobs which should be done by a specialist.

Working Attachments

Table 50. Overall low power

Cause	Remedy
Insufficient engine output	Refer to Engine Service Manual
Function drops due to wear of hydraulic pump	Replace hydraulic pump(1)
Defective main relief valve	Adjust the pressure or replace(1)
Low hydraulic oil	Refill
Viscosity of hydraulic oil incorrect	Replace with hydraulic oil of proper viscosity
Suction filter clogged	Replace suction filter

Table 51. Defective operations

Cause	Remedy
Hydraulic pump broken	Replace hydraulic pump(1)
Hydraulic oil low	Replace suction filter

Table 52. Insufficient work power

Cause	Remedy
Set pressure for main or port relief valve is low or incorrect	Adjust pressure or replace relief valve(1)
Damaged hydraulic ram seals	Replace hydraulic ram seals(1)
Damaged hydraulic ram, cylinder	Replace hydraulic ram/cylinder or the assembly(1)

Table 53. Attachment sinks down

Cause	Remedy
Damaged hydraulic ram seals	Replace hydraulic ram seals(1)
Damaged hydraulic ram, cylinder	Replace hydraulic ram/cylinder or the assembly(1)
Oil leakage inside control valve	Repair valve assembly, replace(1)
Oil leakage inside holding valve	Repair valve assembly, replace(1)

(1) Indicates jobs which should be done by a specialist.

Table 54. Abnormal noise from joints of the attachment

Cause	Remedy
Insufficient grease	Grease
Connecting pin seizure	Replace the bushing and/or pin

Travel

Table 55. Insufficient travel force

Cause	Remedy
Pressure setting for main relief valve is too low	Adjust the pressure(1)
Defective counterbalance valve	Replace the counterbalance valve(1)
Performance reduction of travel motor	Replace travel motor(1)
Swivel joint packing damage	Replace swivel joint packing(1)
Performance reduction of hydraulic pump	Replace hydraulic pump(1)

Table 56. Rough travel

Cause	Remedy
Excessively tightened track	Adjust to proper tension
Stone or foreign matter caught in track	Remove stone or foreign matter
Defective valve	Repair valve or replace(1)
Performance reduction of travel motor	Replace travel motor(1)
Air in travel motor	Refill with oil

Table 57. Crooked travel

Cause	Remedy
Left and right tracks are not equally tightened	Bleed air from left and right, adjust tracks to equal tension
Performance reduction of hydraulic pump	Replace hydraulic pump(1)
Performance reduction of travel motor	Replace travel motor(1)
Oil leakage inside control valve	Replace valve housing assembly(1)
Swivel joint packing damage	Replace swivel joint packing(1)
Loose lever link	Adjust

(1) Indicates jobs which should be done by a specialist.

Slew

Table 58. Insufficient slew force

Cause	Remedy
Performance reduction of slew motor	Replace slew motor(1)
Thermal seizure of slew shaft	Supply grease or replace the slew shaft(1)

Table 59. Idle slew during slew braking

Cause	Remedy
Low setting of brake valve	Adjust the pressure(1)
Clogged valve	Wash the valve(1)
Performance reduction of slew motor	Replace slew motor(1)
Internal oil leakage of control valve	Repair or replace valve assembly(1)

Table 60. Idle slew during slew stopping

Cause	Remedy
Low setting of brake valve or port relief	Adjust the pressure(1)
Clogged valve	Wash the valve(1)
Performance reduction of slew motor	Replace slew motor(1)
Internal oil leakage of control valve	Repair or replace valve assembly(1)

Table 61. Abnormal noise during slew

Cause	Remedy
Air in slew motor	Refill with oil
Insufficient greasing of slew bearing	Add grease

Hydraulic ram

Table 62. Insufficient force of hydraulic ram

Cause	Remedy
Low pressure setting for the relief valve	Adjust the pressure(1)
Oil leakage inside the hydraulic ram	Replace the ram seals(1)
Damage of the hydraulic ram or rod	Replace the hydraulic ram or rod(1)
Oil leakage inside the control valve	Repair or replace the valve assembly(1)

Table 63. Oil leakage outside the hydraulic ram

Cause	Remedy
Defective hydraulic ram seals	Replace hydraulic ram seals(1)
Hydraulic cylinder rod damage*	Replace hydraulic ram rod(1)

(1) Indicates jobs which should be done by a specialist.

Slew

Table 58. Insufficient slew force

Cause	Remedy
Performance reduction of slew motor	Replace slew motor(1)
Thermal seizure of slew shaft	Supply grease or replace the slew shaft(1)

Table 59. Idle slew during slew braking

Cause	Remedy
Low setting of brake valve	Adjust the pressure(1)
Clogged valve	Wash the valve(1)
Performance reduction of slew motor	Replace slew motor(1)
Internal oil leakage of control valve	Repair or replace valve assembly(1)

Table 60. Idle slew during slew stopping

Cause	Remedy
Low setting of brake valve or port relief	Adjust the pressure(1)
Clogged valve	Wash the valve(1)
Performance reduction of slew motor	Replace slew motor(1)
Internal oil leakage of control valve	Repair or replace valve assembly(1)

Table 61. Abnormal noise during slew

Cause	Remedy
Air in slew motor	Refill with oil
Insufficient greasing of slew bearing	Add grease

Hydraulic ram

Table 62. Insufficient force of hydraulic ram

Cause	Remedy
Low pressure setting for the relief valve	Adjust the pressure(1)
Oil leakage inside the hydraulic ram	Replace the ram seals(1)
Damage of the hydraulic ram or rod	Replace the hydraulic ram or rod(1)
Oil leakage inside the control valve	Repair or replace the valve assembly(1)

Table 63. Oil leakage outside the hydraulic ram

Cause	Remedy
Defective hydraulic ram seals	Replace hydraulic ram seals(1)
Hydraulic cylinder rod damage*	Replace hydraulic ram rod(1)

(1) Indicates jobs which should be done by a specialist.

Technical Data

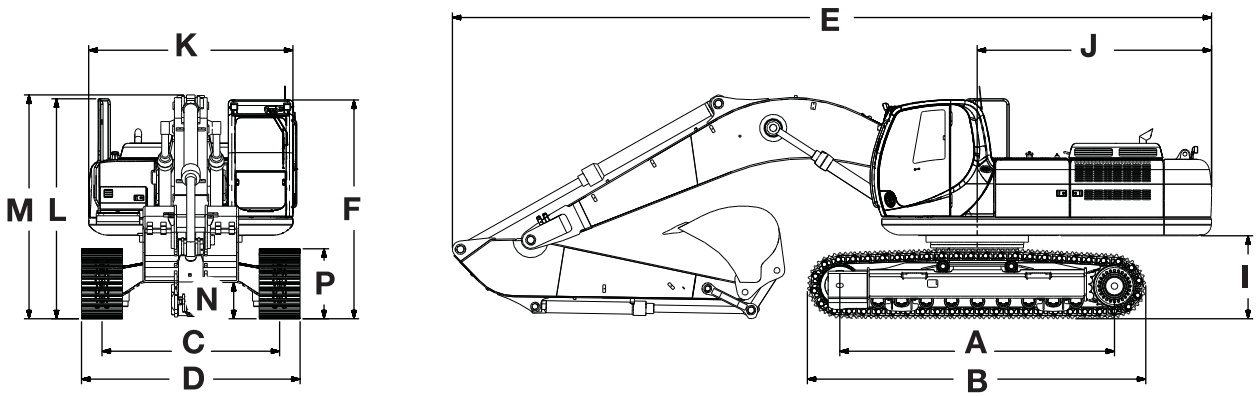
General

Table 1.

Item	Tension
A/C Belt	Belt installation tension - 600N.
	After 30 - 120 min running - 400N.
	Minimum tension - 250N.

Static Dimensions

JS360 - Monoboom



Dimensions in millimetres (ft. in)	
A Track length on ground	4021 (13 ft 2in)
B Undercarriage overall length	4954 (16 ft 3 in)
C Track gauge	2600 (8 ft 6 in)
D Width over tracks (600 shoes)	3200 (10 ft 6 in)
D Width over tracks (700 shoes)	3300 (10 ft 10 in)
D Width over tracks (800 shoes)	3400 (11 ft 2 in)
D Width over tracks (900 shoes)	3500 (11 ft 6 in)

Table 2. Standard Boom

Dipper lengths	2.21m	2.63m	3.23m	4.03m
E Transport length	11280 (37 ft 0 in)	11220 (36 ft 10 in)	11120 (36 ft 6 in)	11200 (36 ft 9 in)
F Transport height	3440 (8 ft 10 in)	3510 (11 ft 6 in)	3280 (10 ft 9 in)	3700 (12 ft 2 in)

Dimensions in millimetres (ft. in)	
I Counterweight clearance	1214 (4 ft 0 in)
J Tailswing radius	3431 (11 ft 3 in)
K Width of superstructure	2990 (9 ft 10 in)
L Height over cab	3220 (10 ft 7 in)
M Height over grab rail	3277(10 ft 9 in)
N Ground clearance	530 (1 ft 9 in)
P Track height	1024 (3 ft 4 in)

Shipping Weight

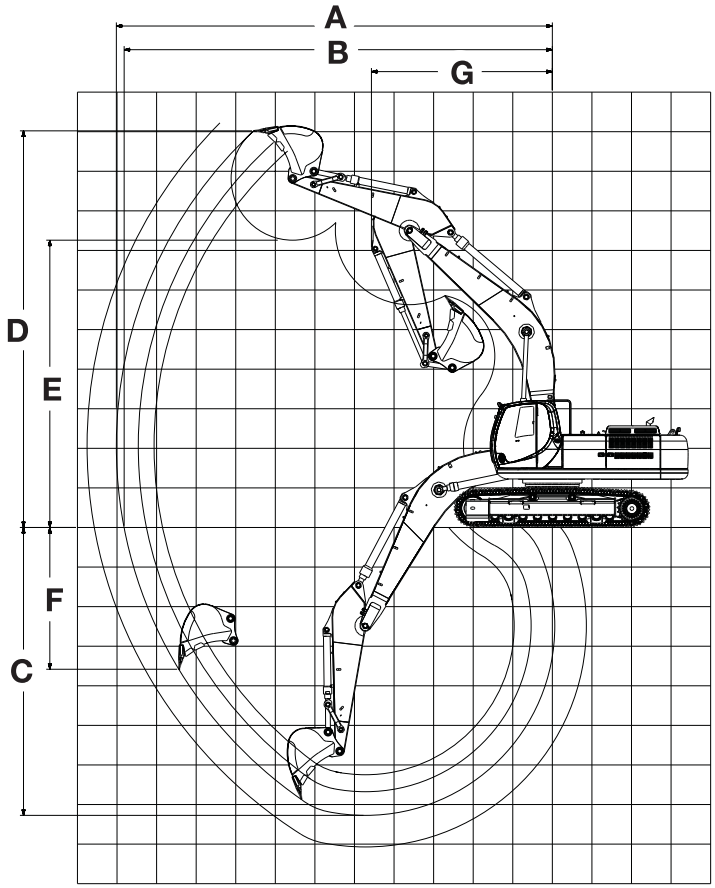
Approximate weight when equipped with monoboom, medium length dipper, bucket, operator and full fuel tank except where indicated otherwise.

Model	Track shoe width	Weight
JS360LC	600mm	36681 kg
JS360LC	700mm	37126 kg
JS360LC	800mm	37571 kg
JS360LC	900mm	38016 kg

Model	Track shoe width	Weight
JS360NLC	600mm	36552 kg
JS360NLC	700mm	36967 kg
JS360NLC	800mm	37412 kg
JS360NLC	900mm	37857 kg

Dig Depth Chart

JS360 - Standard Monoboom



	Standard Boom 6.45 m			
Dipper	**2.21**	**2.63**	**3.23**	**4.03**
	m (ft in)	m (ft in)	m (ft in)	m (ft in)
A Maximum digging reach	10.06 (33 0)	10.46 (34 4)	11.02 (36 2)	11.76 (38 7)
B Maximum digging reach (on ground)	9.85 (32 4)	10.25 (33 8)	10.82 (35 6)	11.57 (38 0)
C Maximum digging depth	6.25 (20 6)	6.68 (21 11)	7.27 (23 10)	8.07 (26 6)
D Maximum digging height	9.51 (31 2)	9.73 (31 11)	10.02 (32 11)	10.22 (33 6)
E Maximum dumping height	6.80 (22 4)	7.00 (23 0)	7.26 (23 10)	7.57 (24 10)
F Maximum vertical wall cut depth	2.39 (7 10)	2.91 (9 7)	3.58 (11 9)	4.39 (14 5)
G Maximum swing radius	4.74 (15 7)	4.71 (15 5)	4.57 (15 0)	4.62 (15 2)

Air Conditioning (option)

TB-012

Automatic Temperature Control (ATC) System

Table 3.

Pressure Switch Setting	Bar	lbf/in²
Low Pressure Cut In	1.4 (+/- 0.1)	20 (+/- 1.5)
Low Pressure Cut Out	0.3 (+/- 0.1)	4 (+/- 1.5)
High Pressure Cut In	17.2 (+/- 0.7)	250 (+/- 10)
High Pressure Cut Out	27.6 (+/- 0.7)	400 (+/- 10)

Table 4.

Refrigerant Gas Charge Weight	
R-134a	1400g +/- 10g

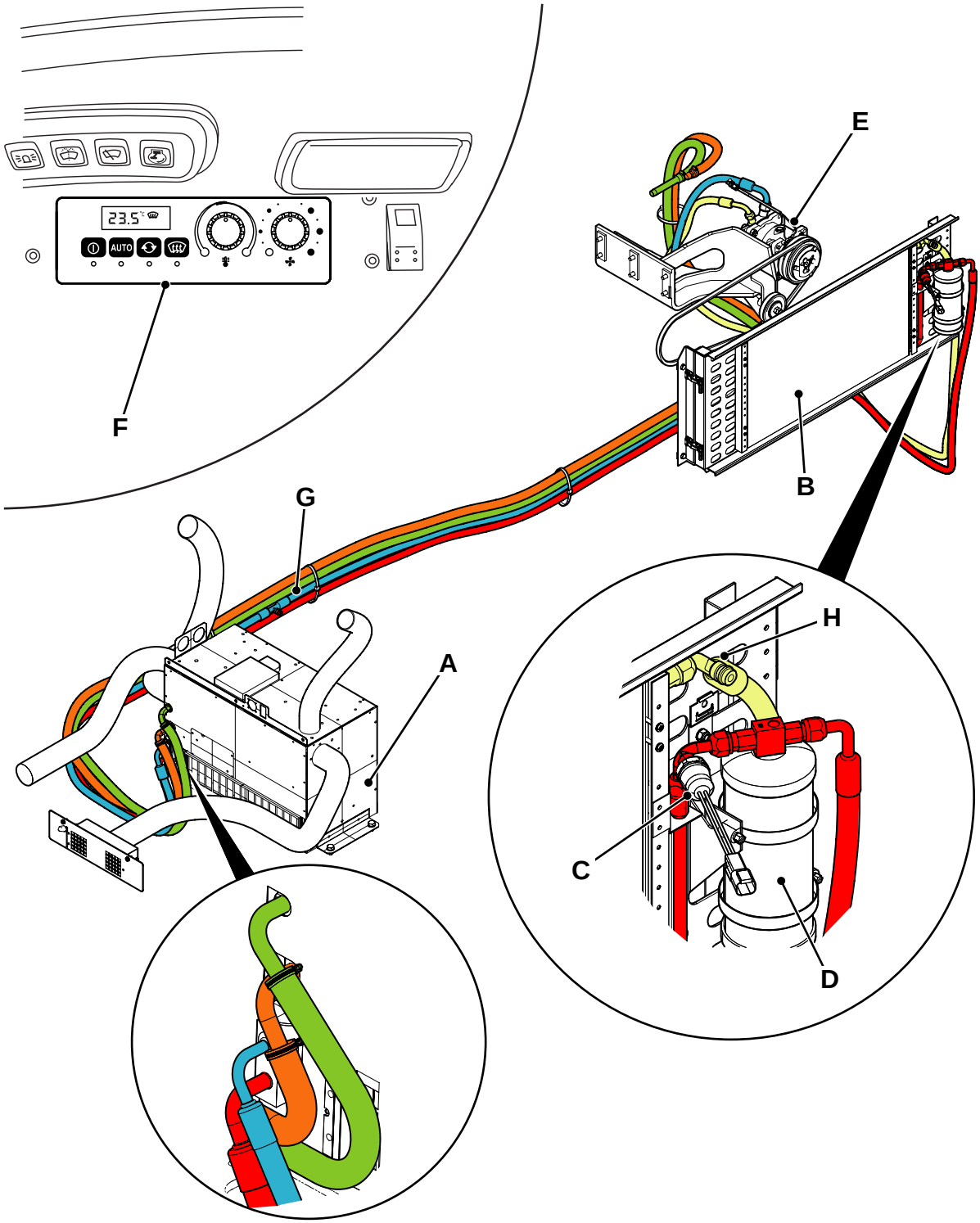
Table 5.

Oil Quantity	
Full System	150g +/- 5g PAG (PolyAlkylene Gycol) oil to ISO 100
Evacuation/Charge	If the system is being evacuated, add 57g (59ml) of lubrication oil to the system before or during the charge.

Basic Operation

Automatic Temperature Control (ATC) System

TB-011



716480-C3

Fig 1.

Fault Finding

Air Conditioning

TB-010_2

Preliminary Checks

Before any checks are carried out on the refrigerant circuit the following checks should be made:

1 Check the compressor drive belt is serviceable and correctly tensioned.

2 Check the condenser and engine radiator are not blocked by debris, clean with compressed air or water if necessary.

3 Check that the condenser fins are not flattened or damaged, the fins must allow air to pass freely.

4 Check the cab fresh air inlet filter for blockage.

5 Check that, with the ignition switch on (engine not running), the blower operates over whole speed range.

6 Check that, with the ignition switch on (engine not running), the blower and air conditioning switched on, the compressor clutch engages.

Charge level:

Note: *It is not possible to check refrigerant charge level with R134a systems using the receiver drier sightglass. Any bubbles seen at the sight glass on the receiver drier may be bubbles of oil and are perfectly normal.*

- Gas -1400g R134A +/- 10g
- Oil - 150g +/- 5g PAG (PolyAlkylene Gycol) oil to ISO 100

Fault finding:

Important: *Refer to appropriate remove and replace procedures before working on any system component*

Fault Finding

Air Conditioning

TB-010_2

Preliminary Checks

Before any checks are carried out on the refrigerant circuit the following checks should be made:

1 Check the compressor drive belt is serviceable and correctly tensioned.

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4 Check the cab fresh air inlet filter for blockage.

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- Gas -1400g R134A +/- 10g
- Oil - 150g +/- 5g PAG (PolyAlkylene Gycol) oil to ISO 100

Fault finding:

Important: *Refer to appropriate remove and replace procedures before working on any system component*

Service Procedures

HVAC/Air Conditioning Unit

TB-009

Removal

Note: *Before removing the HVAC/Air Conditioning Unit, the system must be discharged.*

⚠ WARNING

The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system should be disconnected until the system has been discharged by a refrigeration engineer or a suitably trained person. You can be severely frostbitten or injured by escaping refrigerant.

4-3-4-1_2

⚠ CAUTION

Do not operate the air conditioning system when there is no refrigerant in the system, otherwise the compressor will be damaged.

4-3-4-4

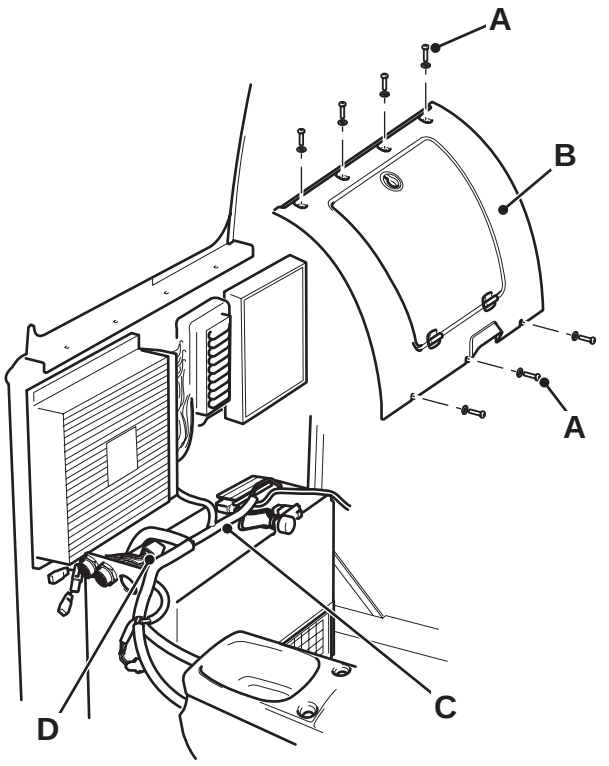
⚠ WARNING

Do not carry out welding operations close to the air conditioning refrigerant circuit. A poisonous gas is produced when refrigerant comes into contact with naked flames. Do not smoke or allow naked flames close to the refrigerant circuit.

BF-1-9

The heater and air conditioning units are built into the same module, enabling the units to be interchanged as complete assemblies.

1 Working in the cab, remove the drivers seat from its runners to provide access to the heater unit.



C030670-C2

Fig 8.

2 Remove the fixing screws **A** and lift off the rear panel **B**.

3 Disconnect the harness **C** from the heater unit by releasing the cable ties. Disconnect the heater assembly plug **D**.

Air Conditioning Compressor

Removal and Replacement

Removal

Note: *Before removing any of the hoses from the compressor, the system must be discharged.*

⚠ WARNING

The air conditioning system is a closed loop system and contains pressurised refrigerant. No part of the system should be disconnected until the system has been discharged by a refrigeration engineer or a suitably trained person. You can be severely frostbitten or injured by escaping refrigerant.

4-3-4-1_2

⚠ CAUTION

Do not operate the air conditioning system when there is no refrigerant in the system, otherwise the compressor will be damaged.

4-3-4-4

⚠ WARNING

Do not carry out welding operations close to the air conditioning refrigerant circuit. A poisonous gas is produced when refrigerant comes into contact with naked flames. Do not smoke or allow naked flames close to the refrigerant circuit.

BF-1-9

1 Label and remove hoses **10-A** from the compressor **10-B**.

2 Loosen the compressor drive belt tensioner **10-C** and remove drive belt **10-D**.

3 Disconnect the wiring harness from the compressor at **10-E**.

4 Remove the four capscrews **10-G** and remove the compressor from the mounting bracket **10-F**.

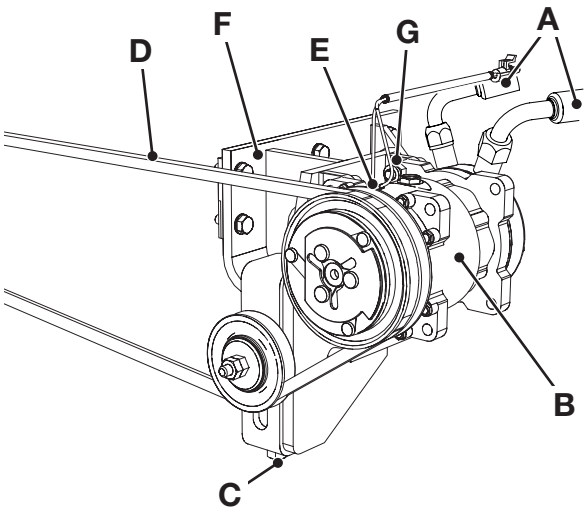


Fig 10.

Replacement

Replacement is the reverse of the removal procedure.

Note: *If the machine was not previously fitted with Air conditioning a new engine mounting bracket 2 must be fitted.*

The Air Conditioning system should be recharged.

For belt tension ⇨ *Technical Data (B-1)*

Cab Structure

Direct Glazing

TB-002_5

The following procedures explain how to correctly remove and install panes of glass that are directly bonded to the cab frame apertures. When carrying out the procedures, relevant safety precautions must be taken.

1 Always wear safety glasses during both removal and replacement.

2 Use protective gloves - heavy duty leather gauntlet type gloves when cutting out the broken glass; 'non-slip' type gloves when handling/moving panes of glass; surgical type gloves when using the polyurethane adhesives.

3 Wear protective overalls.

4 Do not smoke - the activators and primers used in the procedures are highly flammable.

5 Do not attempt to handle or move panes of glass unless you are using glass lifters.

Several special tools are required to successfully complete the removal and replacement procedures. Reference is made to the tools in the text. The majority of these tools can be obtained locally and the remainder from JCB Service (see ***Service Tools***).

The work must only be carried out in a dry, frost free environment. A protective canopy may be required or the machine/frame must be moved to a sheltered area. In damp or wet conditions, hinged doors and window frames can be removed from the machine and taken to a more suitable (dry) environment.

Glass should not be replaced at temperatures below 5°C (41°F).

⚠ WARNING

Laminated glass must be handled with extra care to prevent breakage. Wherever possible, store and handle it in a vertical attitude. When placing or lifting the glass in a horizontal attitude it must be supported over its whole area, not just at the edges.

BF-1-8_1

Removing the Broken Glass and Old Sealant

⚠ WARNING

Always wear safety glasses when removing or installing screen glass. Never use a power operated knife when removing the sealant around a toughened glass screen. The action of the knife could cause particles of glass to be thrown with sufficient force to cause serious injury, even when safety glasses are being worn. Use only hand operated tools when working with toughened glass.

BF-2-3_1

1 Position the machine on level ground and apply the park brake. Stop the engine. Put protective covers over the cab seat and control pedestals.

2 If a laminated pane breaks it will stay in one piece even though the glass is cracked. A toughened pane will shatter and fall apart. The method of removal of the glass depends upon which type it is.

a Laminated glass - leave installed until the old sealant has been cut away, after which it will be possible to lift the broken screen away from its frame housing in one piece.

b Toughened glass - remove as much of the shattered glass as possible prior to cutting out the old sealant.

3 Cut out the old sealant, leaving approximately 1 to 2 mm on the cab frame. There are several tools and techniques for doing this:

a Pneumatic Knife. ⇨ *Fig 11. (B-27)*. This provides one of the easiest methods of removing the sealant around laminated glass. The tool, powered by compressed air, should be sourced locally.

Cab Panels

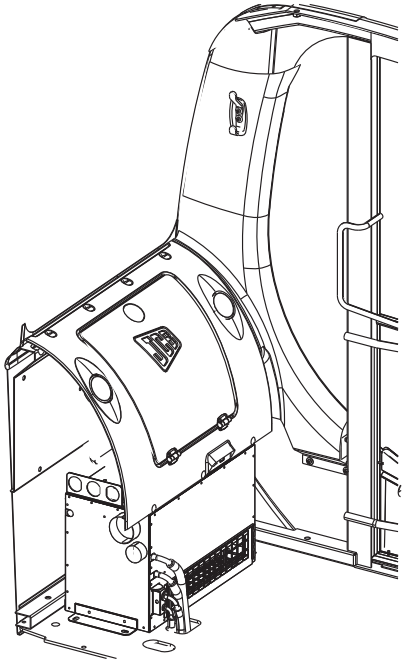
Cab Panel Removal

TB-008

Remove the screws as shown in the following illustrations.

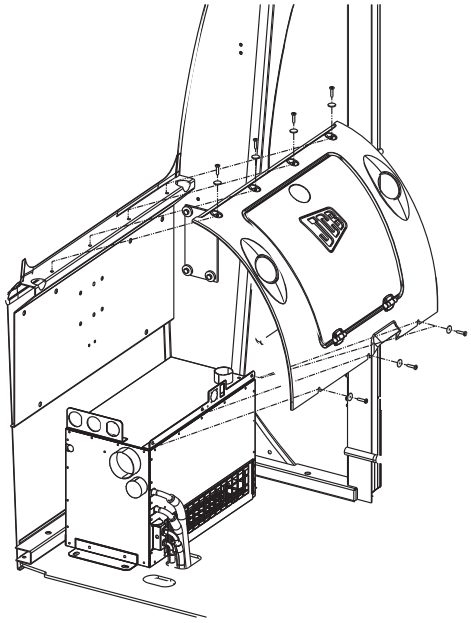
Note: *Care must be taken not to force the panels away from cab frame, as this could result in breakage of the cab panel*

Right Hand Cab Panels



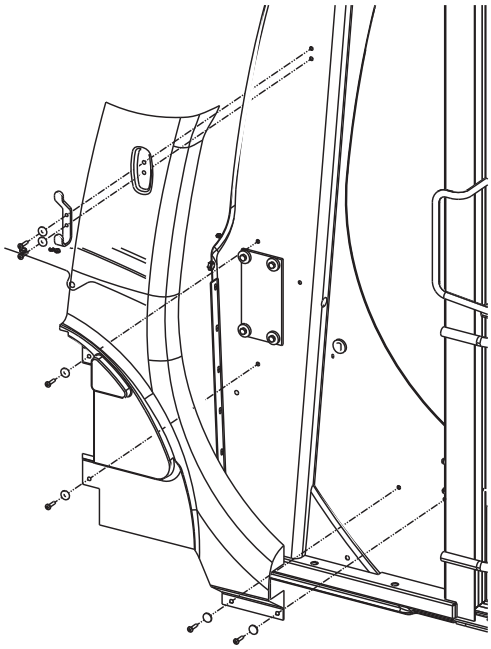
C006280

Fig 26.



C006290

Fig 27.



C006300

Fig 28.

Cab Panels

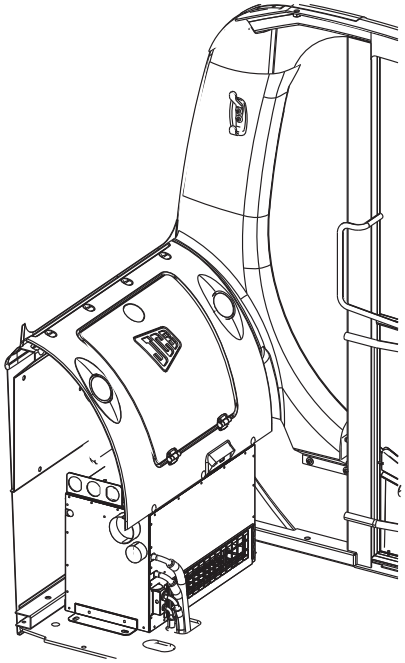
Cab Panel Removal

TB-008

Remove the screws as shown in the following illustrations.

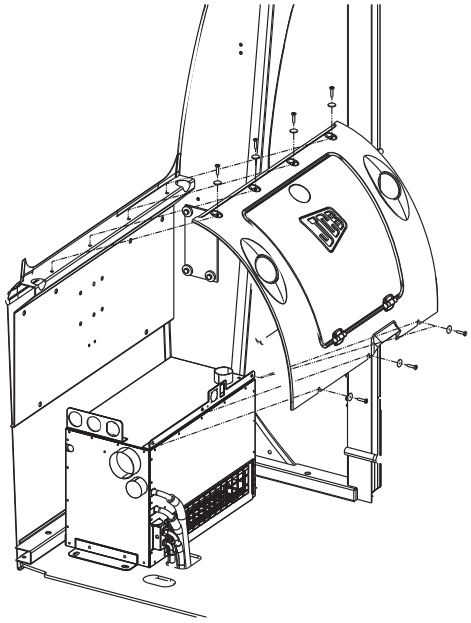
Note: *Care must be taken not to force the panels away from cab frame, as this could result in breakage of the cab panel*

Right Hand Cab Panels



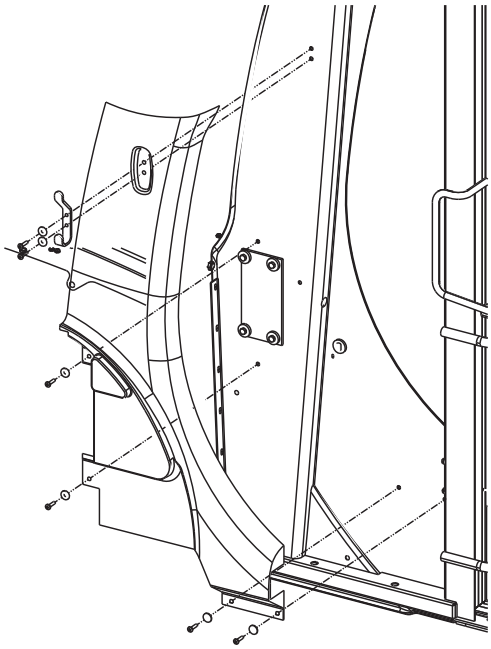
C006280

Fig 26.



C006290

Fig 27.



C006300

Fig 28.

Technical Data

Battery Installation

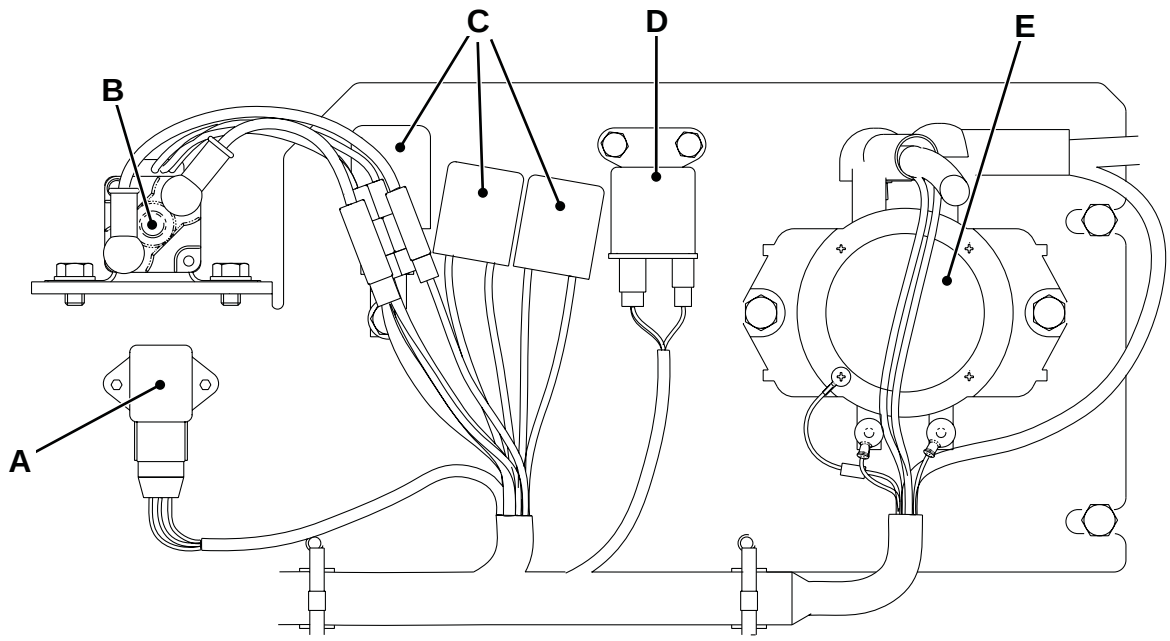


Fig 1.

Table 1.

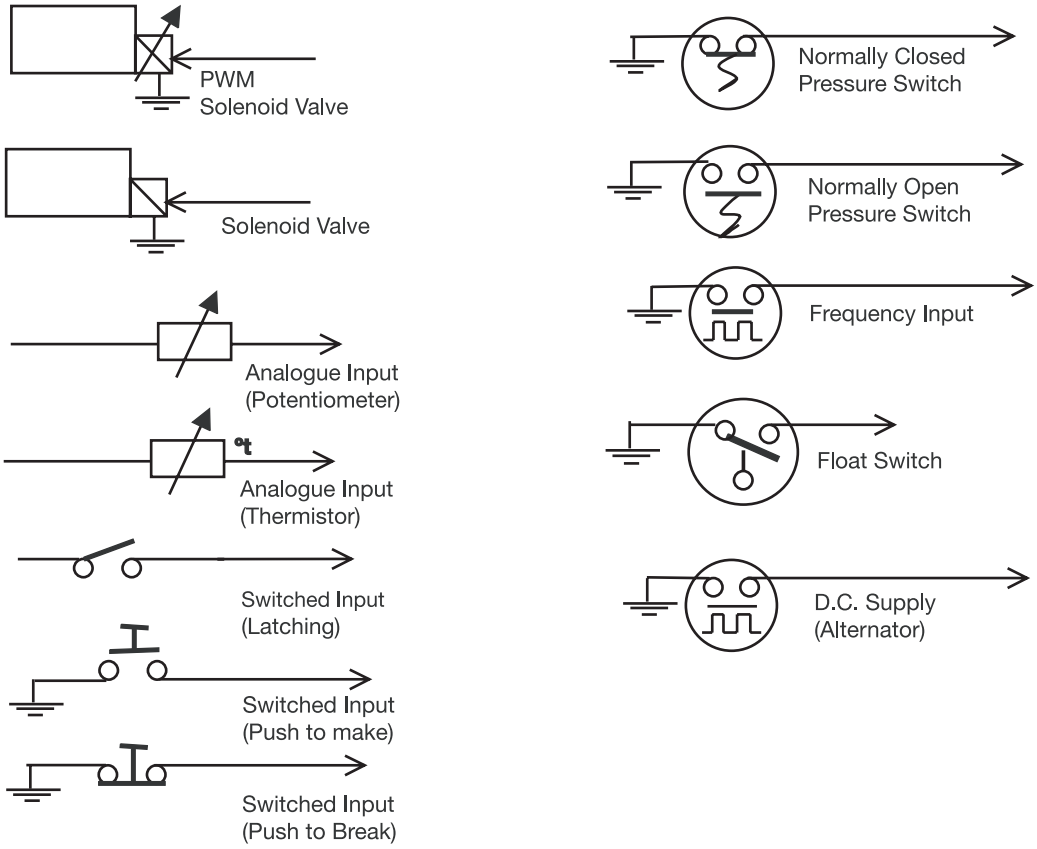
Item	Description
A	Barometric Pressure Sensor
B	Starter Relay (Safety)
C	Fuses, see ***Section 3, Maintenance***
D	Glow Relay
E	Battery Relay

Basic System Operation

Circuit Symbols

TC-013

The following notations are used in the description circuit, drawings.



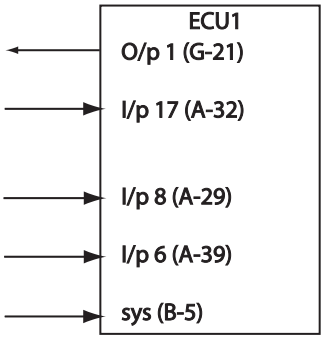
C005310GB-2

Fig 1.

Inputs and Outputs

The letters i/p and o/p refer to input and output.

The letters in brackets i.e. (C-21) refer to the connector and pin number.



C001660-2

Fig 2.

Component Identification

JS360

The item numbers in the following table are identified on the Wiring schematics in this section. ⇨ *Fig 5. (C-8)*

Item	Part Number	Description	Location
1	728/80071	Electronic control unit 1	Behind the rear cab panel.
2	728/80073	Electronic monitor system	Front of cab.
3	701/80369	Facia switch panel	Right hand side of cab.
4	30/927073	Controller (heater)	On Right hand console.
5	716/30155	Throttle dial	On Right hand console.
6	701/80184	Key switch	On Right hand console.
7	701/80214	Switch (redundancy)	Behind the drivers seat.
8	30/927074	ATC	Below the rear cab panel.
9	30/927072	Heater	Below the rear cab panel.
10	30/927075	Controller (ATC)	On Right hand console.
11	701/60030	Switch body	Under right hand console.
12	701/58826	Switch cap (worklamp)	On Right hand console.
13	717/12900	Cigar lighter (12v)	On Right hand console.
14	332/J4821	Radio	Rear of cab in the roof.
15	701/80215	Limit switch (lever)	Below the lever lock bar.
16	701/60041	Switch (cab light)	Outer side of left hand console.
18	700/43900	Work lamp	Toolbox
19	700/50022	Work lamp	Boom
20	332/J0670	Breaker pilot switch	Under the cab on the breaker pedal.
21	25/221094	LH Lever switch	Left hand joystick.
22	25/221095	RH Lever switch	Right hand joystick.
23	332/J2740	Volt dropper	Behind the rear cab panel on top of the heater box.
25	6900/0624	Wiper	Front windscreen.
26	6900/0587	Room lamp	Rear of cab in the roof.
27	716/30205	Battery relay	In the left hand side compartment.
28	708/04100	Battery	In the left hand side compartment.
29	KHR1589	Fuse link (25A)	In the left hand side compartment.
30	KHR1592	Fuse link (60A)	In the left hand side compartment.
31			
32	25/222203	8 spool solenoid valve	In the right hand side pump bay.
33	25/220996	Slew brake valve	Under cab.
34	01/145194	Engine (JZ230 T3)	Rear of machine.

Schematic Diagram

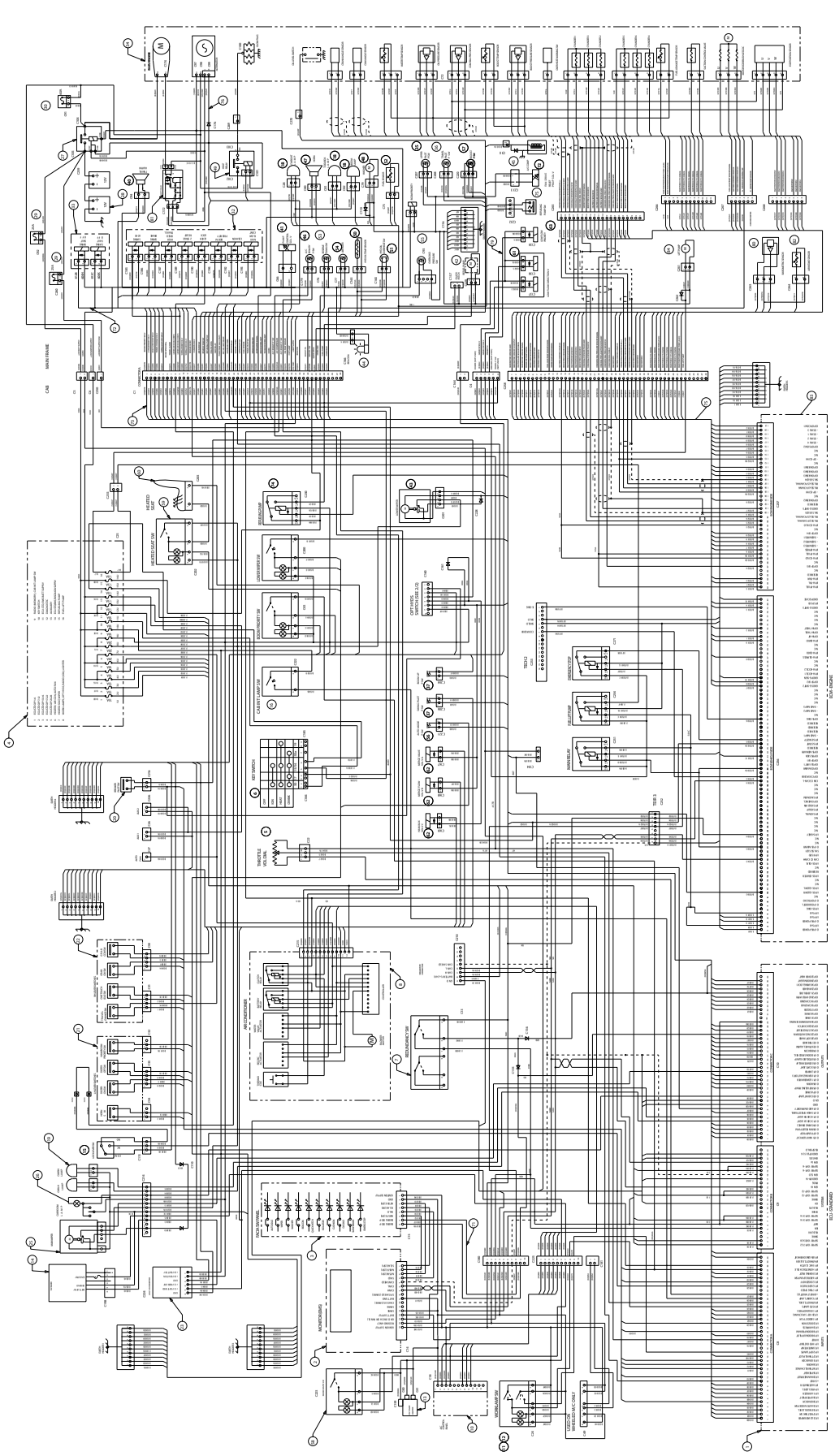


Fig 5. Electrical Schematic 332/J4979 Issue 1

A.M.S (Advanced Management System)

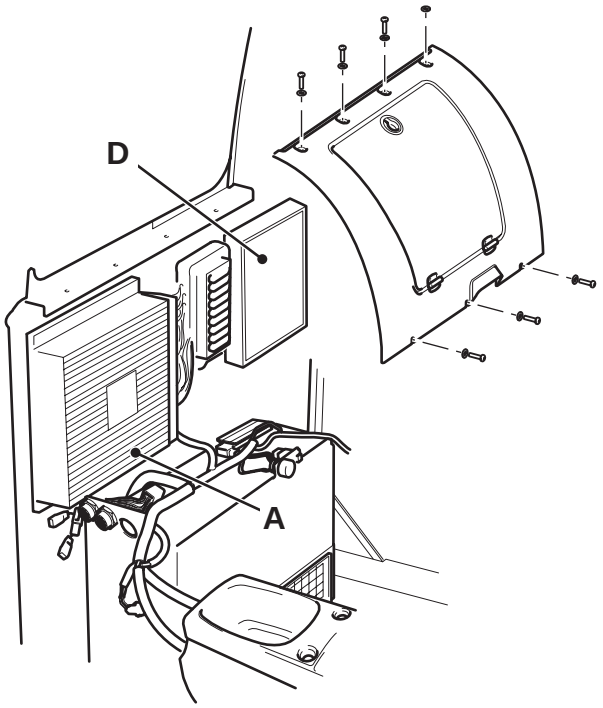
TC-011

Operation

The JCB A.M.S system is a whole machine electronic control system. The system controls engine speed, pump power, transmission, excavator functions, lights, wiper, auxiliary circuits, warning lamps, etc. The system is a 'CAN BUS' system which links Electronic Control Units (ECUs) on the vehicle. This stands for 'Controlled Area Network' and uses a special cable in the vehicle harness which consists of two signal wires twisted together covered by a metal foil to prevent any electrical interference. These signal wires form the CAN -BUS. The CAN - BUS is used to send text and fault codes between the ECUs. The electronic units receive inputs from switches and sensors and drive outputs such as solenoids, lamp bulbs and motors. The outputs of the ECUs are rated to the current requirement of the actuator.

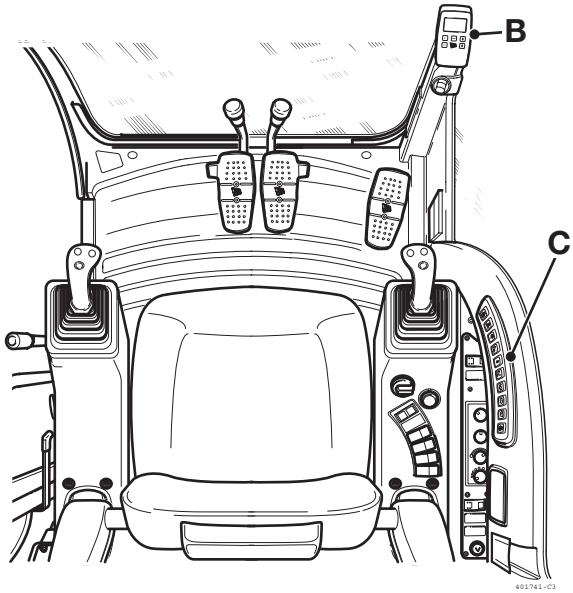
The system comprises of the following main electronic components.

- **A** Electronic Control Unit -1 (ECU-1)
- **B** Electronic Monitoring System (EMS)
- **C** Fascia switch panel (FSP).
- **D** Engine Control Module (ECM)



C030670-C3

Fig 6.



401741-C4

Fig 7.

Circuit Concepts

Inputs

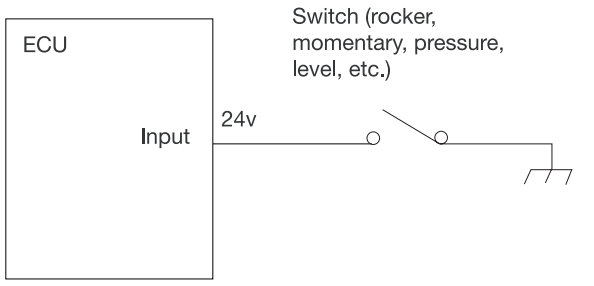
There are two main types of input, Digital and Analogue.

Digital type inputs are on/off type inputs (i.e. switches) and can be Low side inputs or High side inputs. Low side inputs are inputs that provide a ground to the ECU. High side inputs are inputs that provide a positive feed to the ECU.

Analogue Inputs are sensor type inputs that provide a varying type input to the ECU, this input could be a resistance or frequency type input.

Digital inputs (on/off switch type inputs)

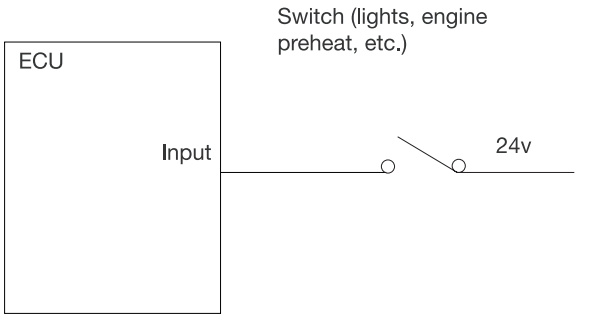
1 Low side input. The low side input is the most frequently used input on the A.M.S system. The low side input can be in the form of rocker switches or pressure switches.



C007170GB-2

Fig 9.

2 High side input. The high side input is used on circuits that require a positive feed when the ignition is switched off, i.e. sidelights or hazard lights. The high side input is also used on the engine preheat circuit.



C007180GB-2

Fig 10.

Pulse Width Modulation (PWM)

Ohms law states that, the amount of current flow in a circuit is determined by the voltage, and the resistance. A 24v circuit with a resistance of 6 ohms, would draw a current of 4 amps. This would be the case for a standard solenoid, which is either on or off.

Once the voltage is applied to the circuit, it is present 100% of the time. This would be known as a 100% duty cycle. Therefore the circuit will draw 4 amps constantly.

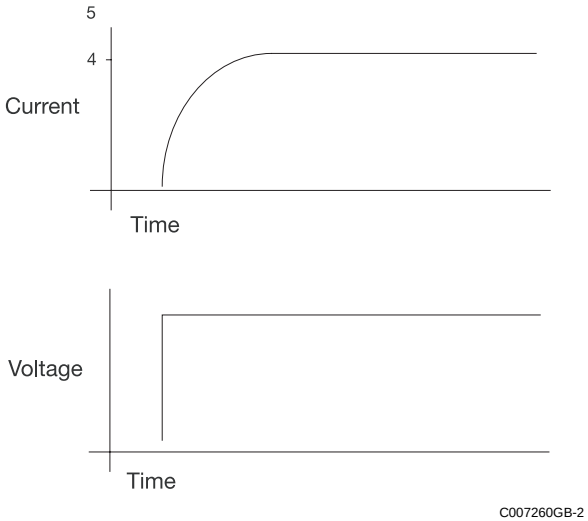


Fig 15.

A proportional solenoid requires differing amounts of current, depending on its condition. As the coil has a fixed resistance, changing the current rating can be done in either of two ways,

1 Having lots of different resistors switched in and out of the circuit at different times to change the current flowing.

2 To change the duty cycle of the solenoid.

It is easier, more economical, and more reliable to change the duty cycle of the circuit, especially using today's computer/ controller technology.

The duty cycle is the amount of time a component is switched on compared to the time it is switched off. If a solenoid is on for three seconds, then off for one second, on for three, off for one etc. this would be a 75% duty cycle.

The graph A although unstable would give a current rating of three amps. To stabilize the current in the circuit, the frequency would need to be increased. If the time scale on the graph A was one second, the frequency would be 4Hz (Hertz (cycles per second)). The graph B shows the same duty cycle, but at a higher frequency of 32 Hz. The proportional solenoids fitted to JS machines operate at a frequency of 75 Hz.

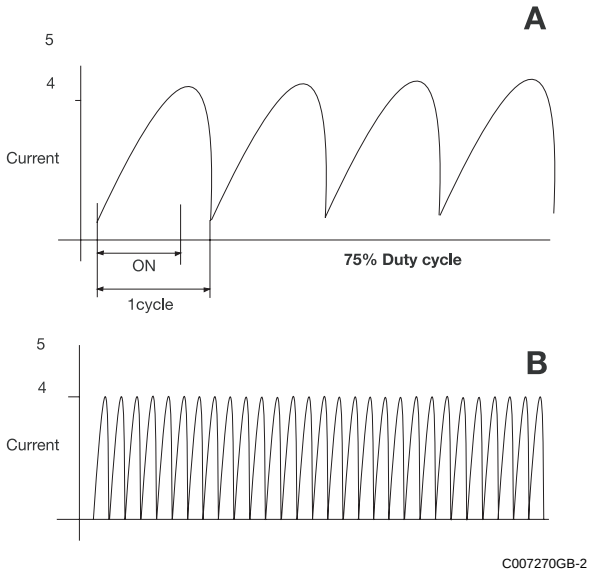


Fig 16.

ECU1/EMS/FACIA Power Supply and Network

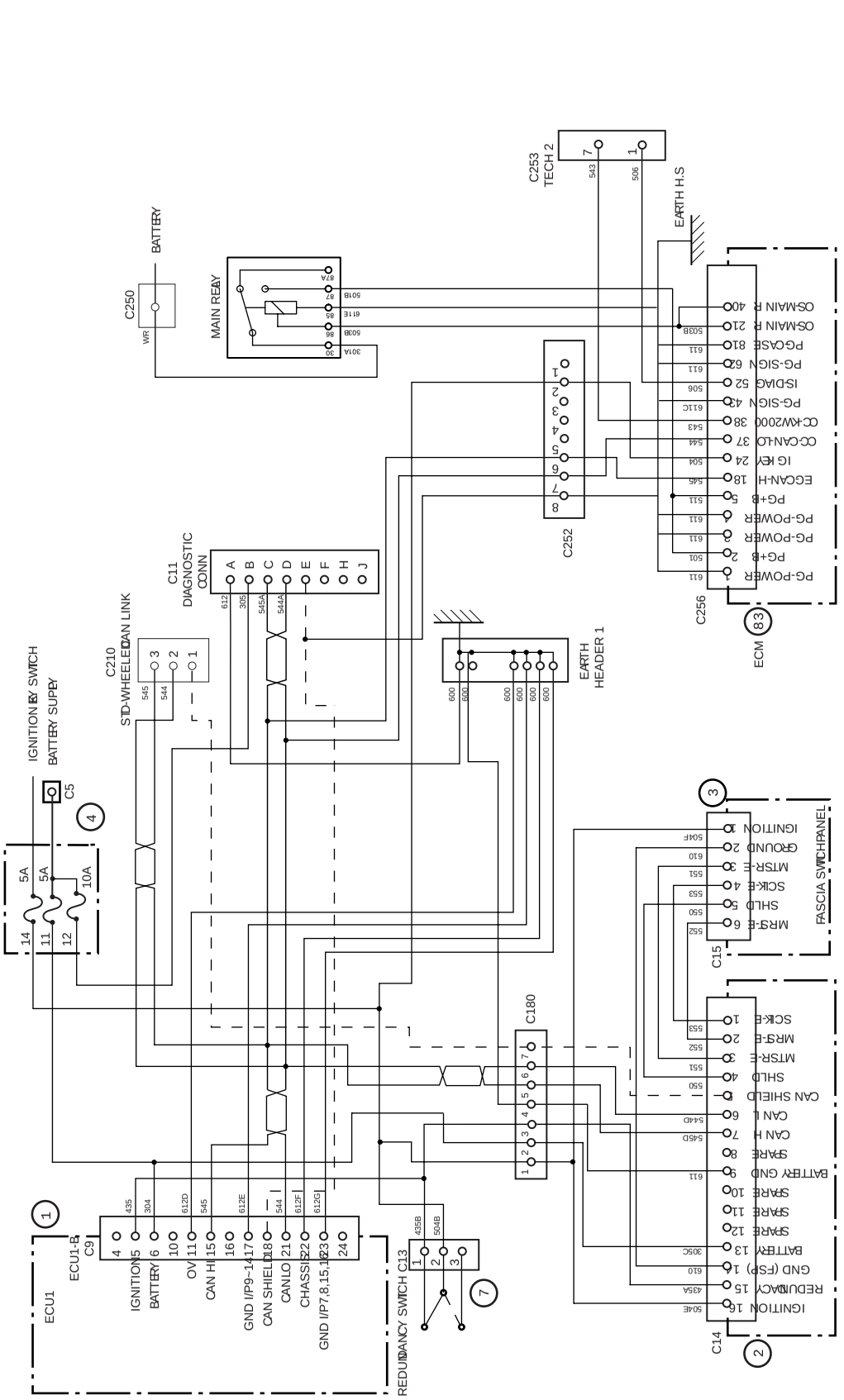


Fig 17.

ECU 1 Supply to Output Drivers

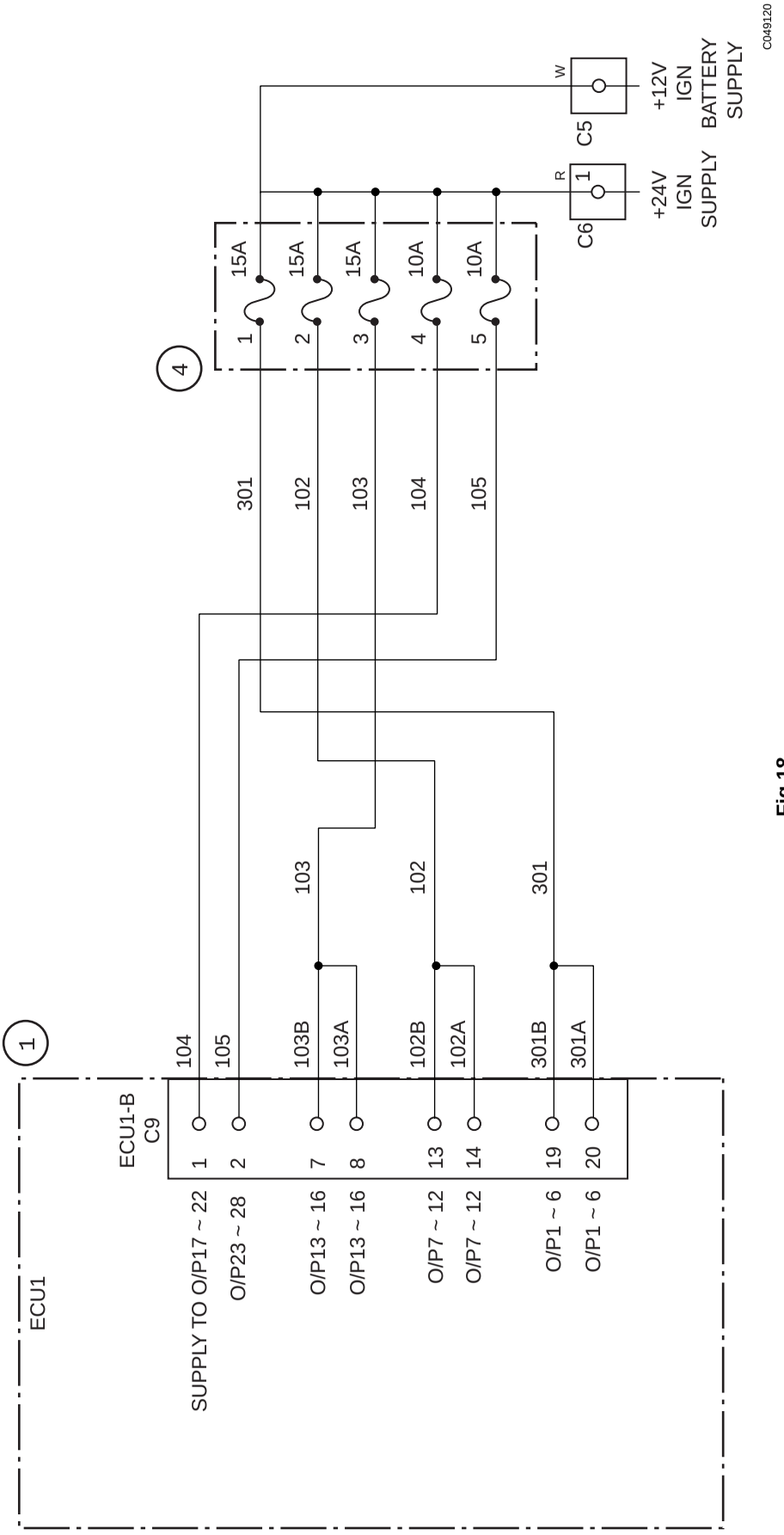


Fig 18.

Engine Throttle Control

Operation

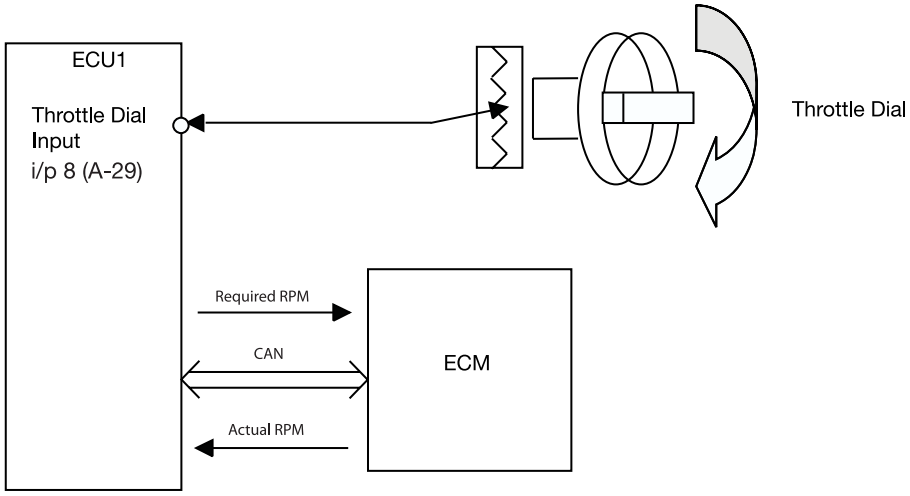


Fig 19.

The maximum rev/min value for each mode is specified in software. The maximum rev/min value is used as A mode maximum. E mode maximum is 100 rev/min less than A mode maximum. P & L mode maximum is 200 rev/min less than A mode maximum ⇨ ***Fig 20. (🗋 C-19)***.

During calibration the ECU noted the maximum and mini - mum positions of the throttle position sensor. The maximum point became A mode maximum When the working mode is selected the ECU will scale the full deflection of the throttle dial (0~5v) to adjust the engine speed between the idle position and the maximum speed for the particular mode selected.

Pump Control for Each Mode

Operation

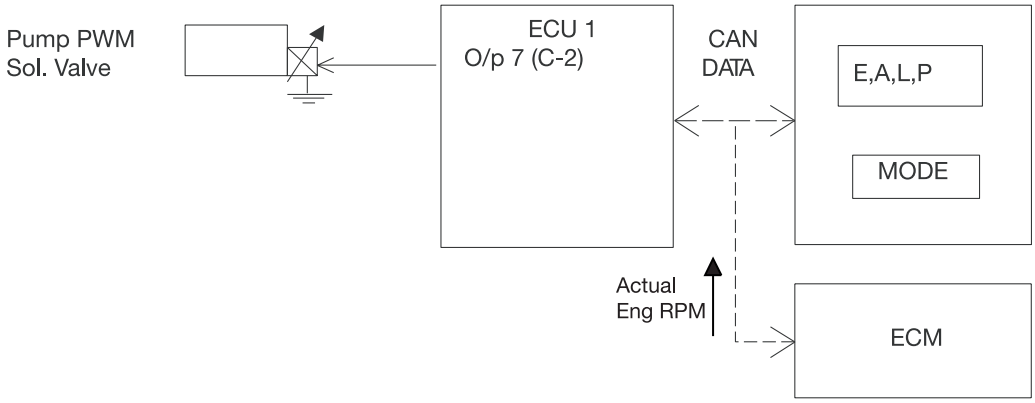


Fig 23.

The machine can operate in four different modes, depending upon the type of work required ⇨ ***Engine Throttle Control (C-18)***. The pump output horsepower is varied by means of a PWM signal to the pump control solenoid valve which varies for each mode.

Tier III machines are required to reduce the "range band" "**X** to **Y**" (pump milliamps) ⇨ ***Fig 25. (C-24)***, to improve engine stability dependant on specific factors which include:

- Barometric Pressure
- Fuel Temperature
- Air Intake Temperature
- Air Conditioning
- Engine and Hydraulic Temperature

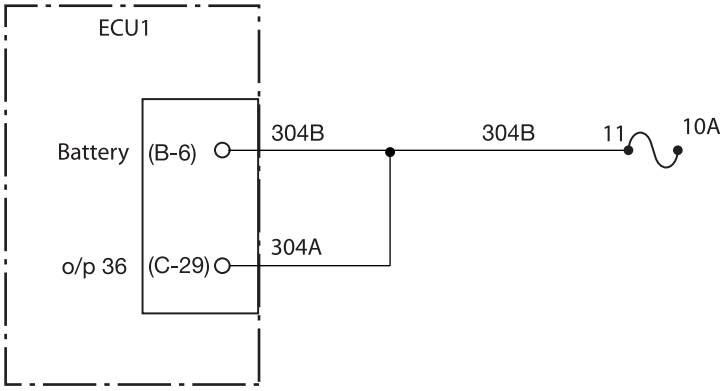
These conditions are monitored by ECU1. Engine power and pump power are then varied to suit the operating conditions.

Each of the above factors has a value calculated by ECU1 of between 0 and 1. All values are then calculated to give a dynamic control factor (DCF) of 0 to 1 which will determine the pump output power and will vary the pump mA to suit.

Hardware Sensing

TC-012_2

Operation



C049900-2

Fig 29.

Due to changes in operation of some machine systems and harness from January 06 the ECU1 needs to know what system is fitted to operate the correct outputs. To sense this, machines built from January 06 have permanent live feed to the ECU1 o/p 36 (C-29). This can be viewed on the 5 second menu on "HARNESS TYPE, NEW". Machines previous to January 06 will not have this input.

All machines described in this manual will have this input fitted.

Auto Boost Pressure

Operation

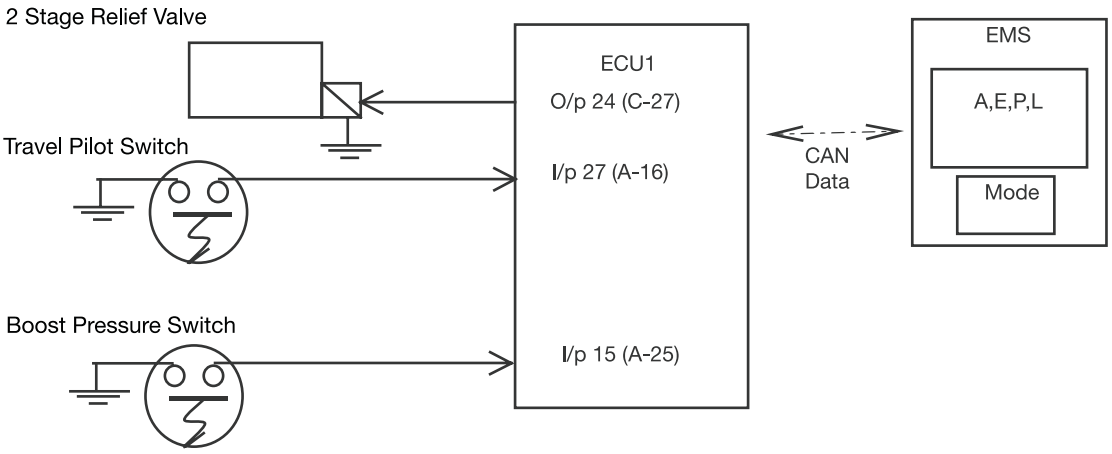


Fig 30.

The auto pressure boost function is only available when the excavator is in auto mode. By default it is not available in precision and economy mode and is permanently on (although not indicated on the EMS) in lifting mode.

In auto mode, when the boost pressure switch is closed the 2 stage relief valve, ECU1 o/p 24 (C-27) is energised (according to the logic diagram, ⇨ *Fig 31. (📄 C-28)*). This allows a pressure increase in the excavating hydraulic circuit thus generating extra digging force.

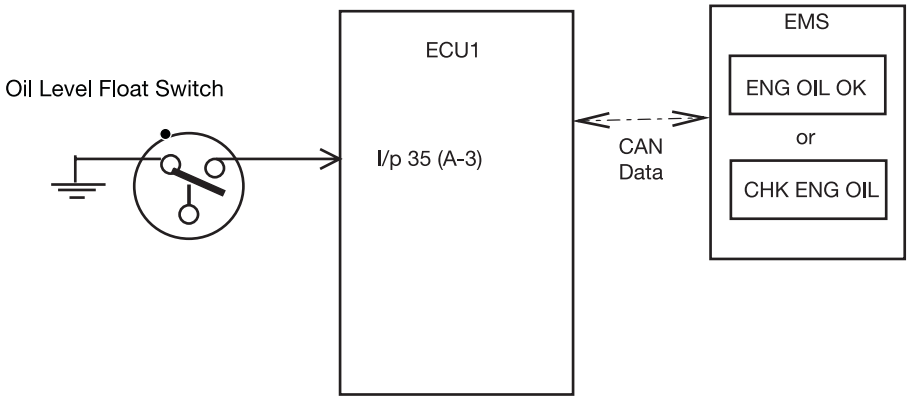
If the boost pressure switch is seen for less than 1.5 seconds then the 2 stage relief valve is energised until the boost pressure switch is de-energised, then the logic sequence is reset and will allow the sequence to be started over again.

If the boost pressure switch is seen for more than 1.5 seconds then the 2 stage relief valve should stay open for a further 1.5 seconds. The valve cannot be re-energised for 9 seconds after the end of the last activation

However during travel operation (denoted by the travel pilot switch input) the 2 stage relief valve is energised. If the boost pressure switch is closed when the travel pressure switch is valid, the solenoid will remain energised

Engine Oil Level Warning

Operation



C049930-1

Fig 33.

The oil level float switch is positioned in the side of the engine.

When the engine oil level is at an acceptable level, the float switch is closed, applying an earth to the ECU1 i/p 35 (A-3)

When the engine oil level drops below the acceptable level, the float switch is opened, removing the earth from the i/p.

The i/p is only checked on machine ignition on.

The oil level check should occur before other machine or engine faults are raised.

When the EMS receives a CAN message from the ECU1 indicating that the oil level is OK, the EMS displays the message "ENG OIL OK" for 5 seconds.

When the EMS receives a CAN message from the ECU1 indicating that the oil level is low, the EMS displays the message "CHK ENG OIL" for 5 seconds and the buzzer sounds for 1.5 seconds.

Engine Pre Heat (Glow plugs)

Operation

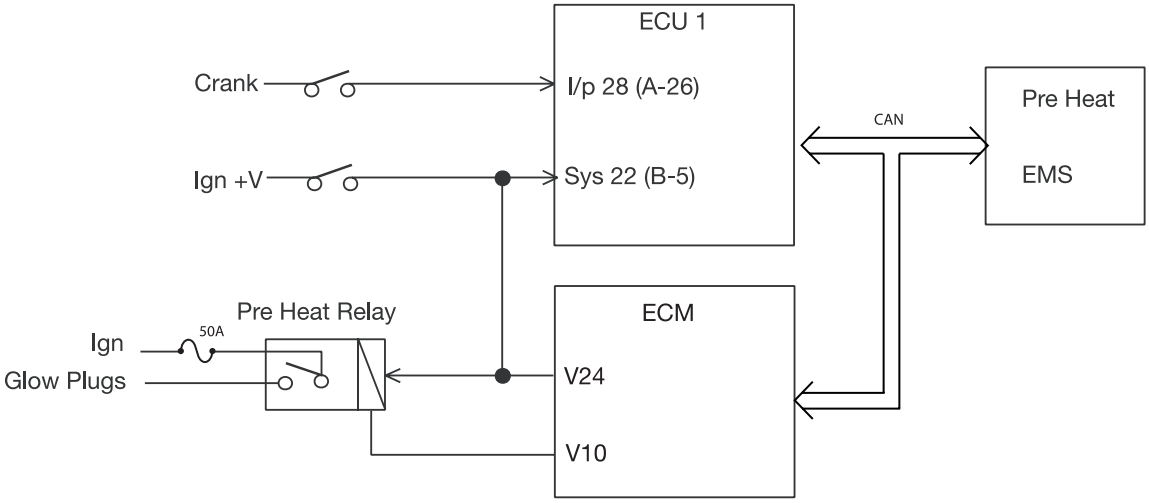


Fig 35.

This feature allows the engine cylinders to be pre-heated, before engine cranking to assist cold start performance.

When the key switch is turned to the `Ignition' position the ECM detects the temperature to determine whether and for how long preheat is required. The ignition provides a positive feed to the Preheat relay and an input to the ECM at i/p V24.

When preheat is required, the ECM gives a ground to the heat relay coil from o/p V10. The relay energises, which then allows battery voltage to cross the heat relay to the glow plugs.

The ECM sends a `glow signal' message via the CAN bus to the EMS which displays the message "PREHEAT".

When the key switch is turned to the `crank' position the ECU1 sends a message via the CAN bus to the ECM to start the engine.

Engine Automatic Warm Up

Operation

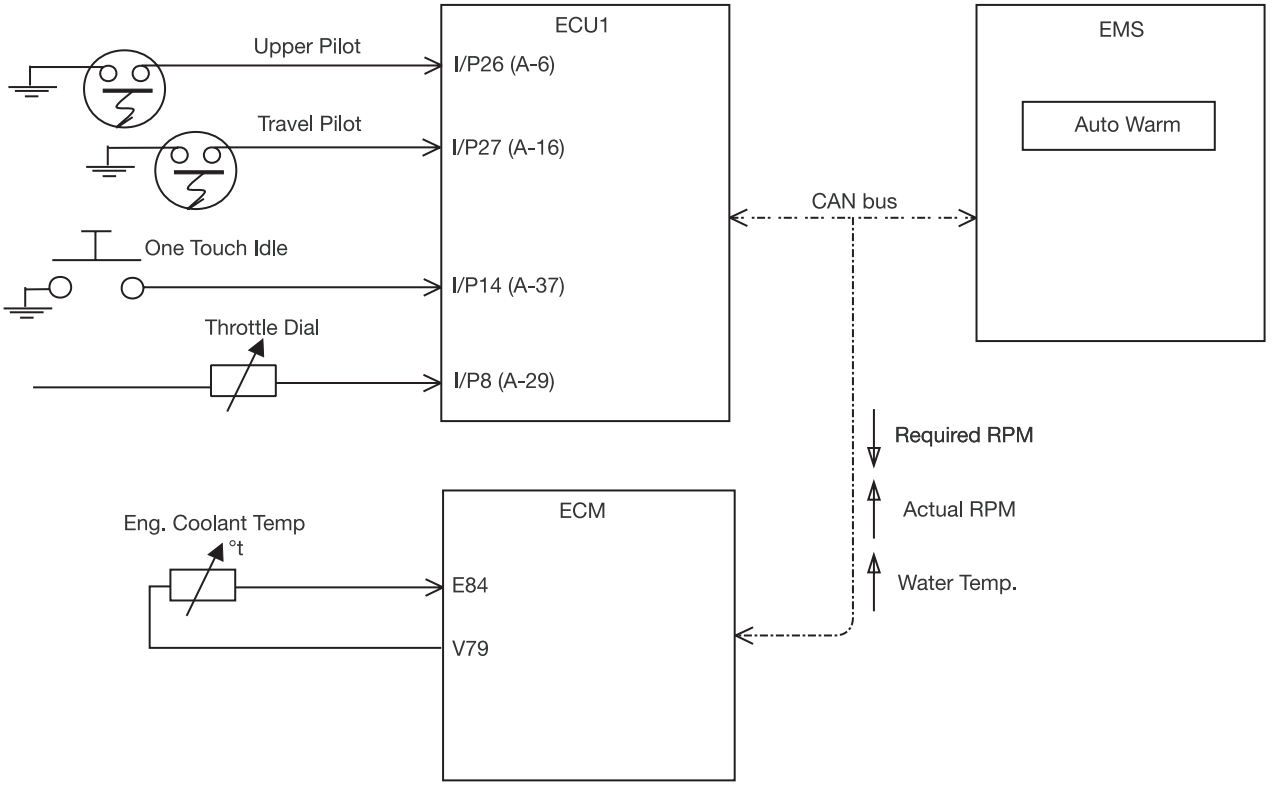


Fig 37.

This feature allows the engine to quickly warm up to normal operating temperature if the vehicle is not being used.

Automatic warm up will only be performed 15 seconds after the engine is started and provided the following conditions are satisfied:

1 Water temperature is less than 50 ºC (engine coolant temperature is sent from the ECM via the CAN bus).

2 Upper pilot pressure switch is off (excavator services not selected) i/p28 (A-6).

3 Travel pilot pressure switch is off (travel service not selected) i/p27 (A-16).

4 If the throttle volume input changes during auto warm up then the auto warm up function is cancelled.

When auto warm is activated the EMS will display the message "AUTO WARM".

The ECU1 will send a RPM target message to the ECM so that the engine will run at the throttle dial setting for 5 minutes, the engine revs are then increased in 300 rev/min. steps in 3 minute intervals up to the maximum of 1800 rev/min.

After 3 minutes of running at 1800 rev/min. the engine revs will return to the throttle dial setting. If during the automatic warm up sequence any of the required conditions change i.e. engine water temperature reaches 50 ºC or the

Engine Automatic Idle

Operation

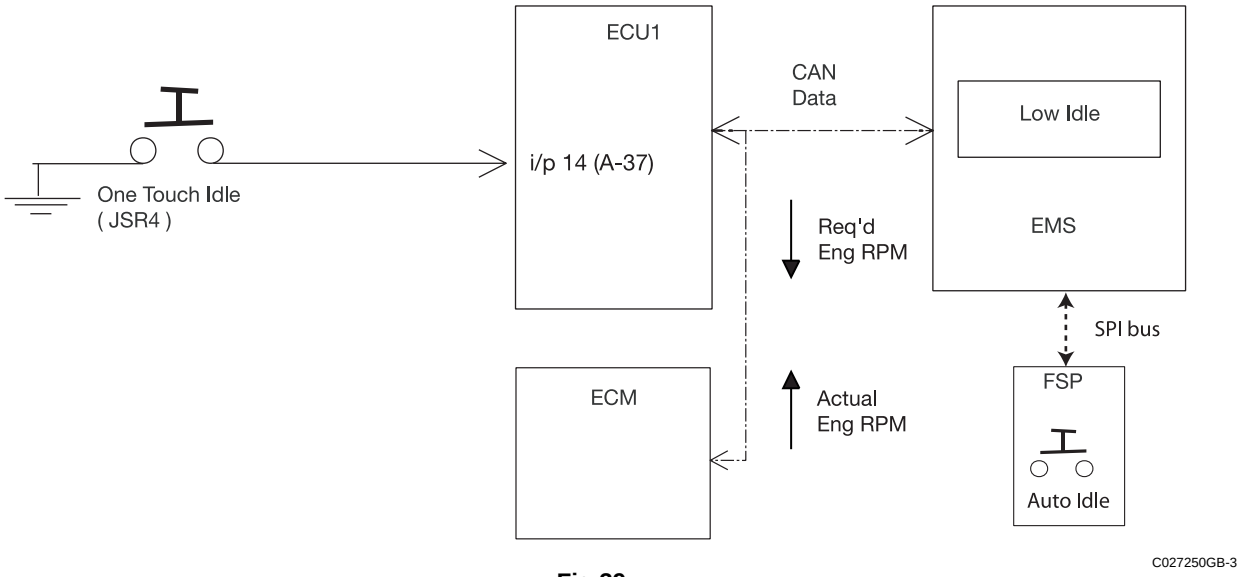


Fig 39.

When auto idle function has been selected via the switch on the Facia Switch Panel (FSP) the engine will return automatically to the auto idle setting if no services have been selected for 5 seconds (default). This time can be varied between 5 and 30 seconds via the SET menu on the EMS.

A second press of this switch will disable the function. If the upper, travel and boom lower pilot switches have been inactive for the pre-set time period, the auto idle function will operate and the engine revs will drop to the auto idle value. The EMS will display the message "LOW IDLE".

The engine revs can be increased by pressing the auto idle switch on the facia panel, or by the change of state of the pilot switches (i.e. if excavator/travel service is selected). When released from auto idle the engine revs return to the setting of the throttle dial. By default auto idle is off.

The auto idle function is permanently active in auto mode. The auto idle switch FS10 is disabled when in auto mode.

Note: *One-touch idle overides auto idle*

Engine One Touch Idle

Operation

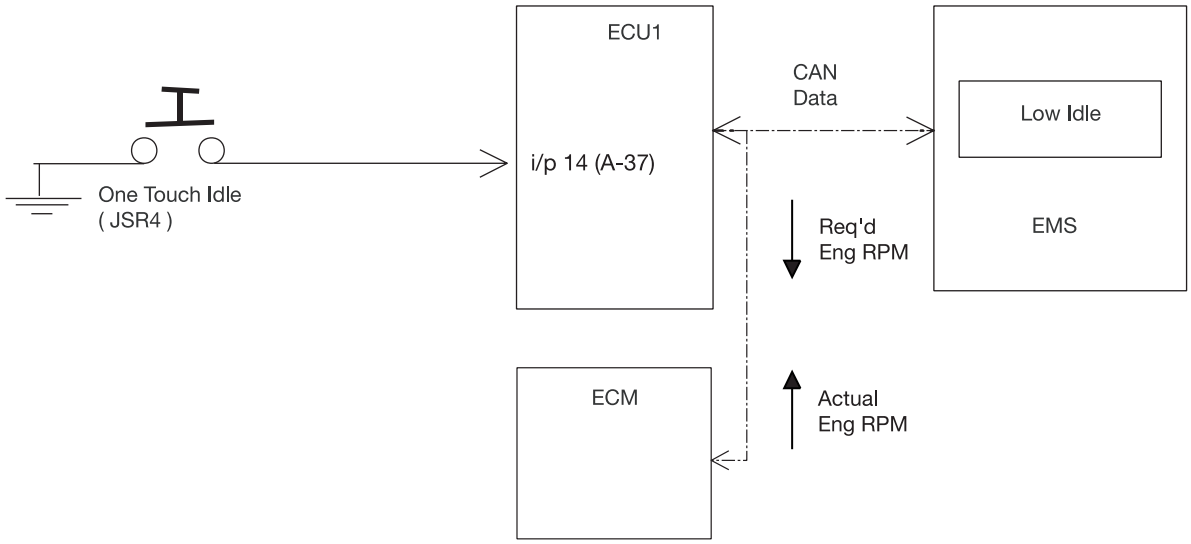


Fig 40.

When one-touch idle is selected via the button on the right hand controller the engine will return to the low idle setting, regardless of any other input, the EMS will display the "LOW IDLE" message to confirm selection.

A second press of this switch will disable the function and the engine revs will return to the setting of the throttle dial.

The status of the one touch idle is retained when switching the ignition off (e.g. If one touch idle is selected and the ignition turned off, when the vehicle is started again one touch idle is automatically activated).

Engine Start/Stop

Operation

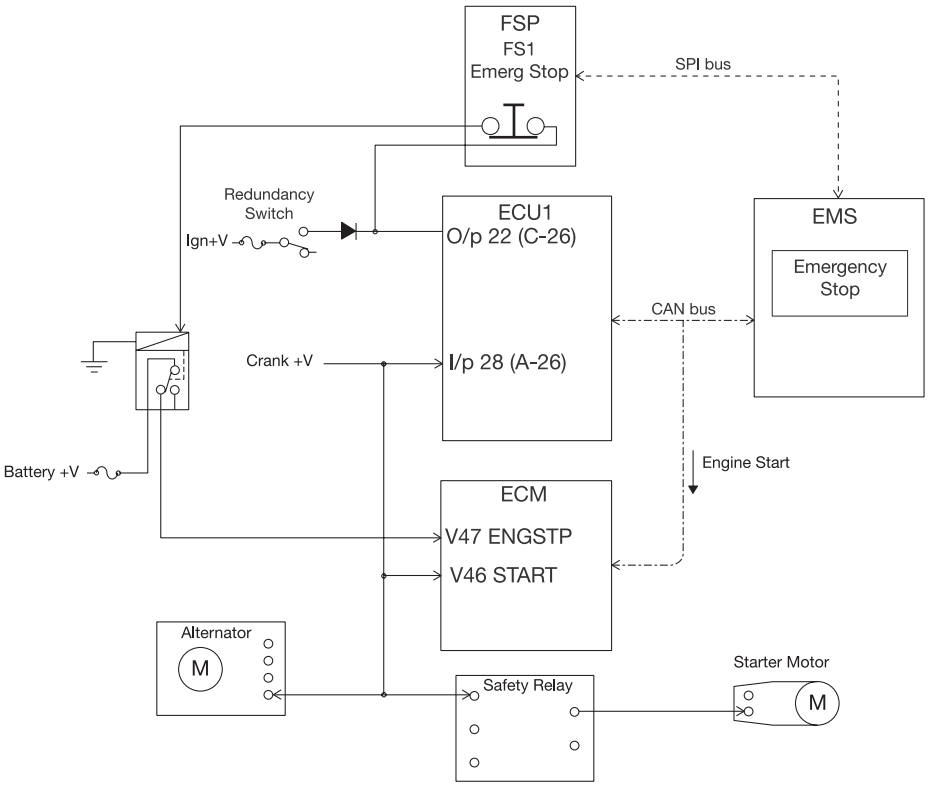


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Fig 42.

Starting/Stopping the engine

When the ignition key is turned to the crank position, 24v is fed to:

- the ECU on i/p 28, (A-26) - Crank,
- the ECM on i/p V46 - START,
- the Safety Relay.

The ECU provides 24v from o/p 22 (C-26), through the closed contacts of the Emergency Stop button on the FSP to the coil of the emergency stop selay. The relay is energized, removing 24v from the ECM i/p V47 - ENGSTP.

The safety relay provides an output to the starter motor, and the ECM starts the engine.

When the engine is running, if the ignition key is switched off, the 24v from ECU o/p 22 (C-26) to the emergency stop relay is removed. The relay is de-energized, feeding 24v from the battery to the ECM i/p V47 - ENGSTP, and the engine is stopped.

Pressing the Emergency Stop Button

If the emergency stop button on the FSP is pressed whilst the engine is running, the 24v from ECU o/p 22, (C-26) to the Emergency Stop Relay is stopped. The relay is de-energized, feeding 24v from the battery to the ECM i/p V47 - ENGSTP, and the engine is stopped.

At the same time the EMS will display the message 'EMER STOP'. If the ignition is switched off and then back on, the system retains the emergency stop function until the emergency stop button on the FSP is pressed again.

Engine start is disabled unless the lever lock arm is raised. if the ignition is switched on and the lever lock arm is raised, the emergency stop remains off and the engine will not start. If cranking is attempted while the lever lock arm is down, the LIFT_LEVER message is displayed on the EMS and the servo isolator LED will flash on the EMS for the duration of the cranking.

Limp Mode system

Operation

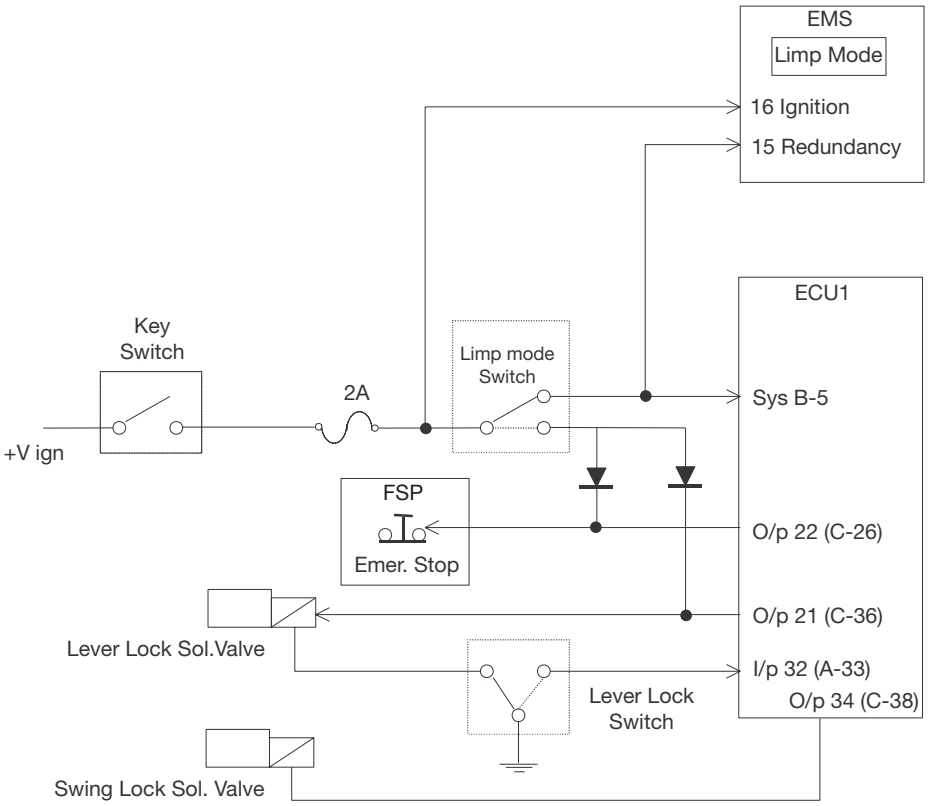

Fig 44.

In the event of a ECU1 failure, the redundancy switch allows the function of:

1 Lever lock

2 Swing lock

3 Emergency shutdown

In the normal position, the redundancy switch feeds the ignition voltage to the ECU1 and the redundancy i/p of the EMS.

In the "redundancy" position, the ignition voltage is fed to the "emergency stop" switch in the facia switch panel, via a diode.

The emergency stop switch in the facia switch panel is fed from the ECU1 o/p 22 (C-26). The lever lock and swing lock functions are fed from the ECU1 o/p 21 (C-36).

The lever lock and swing lock functions are fed from the redundancy switch via a diode.

The EMS will permanently display a "LIMP HOME" message and all bar graph bars will illuminate together and flash on/off at half second intervals. The buzzer will sound, this can be cancelled by pressing the ACK button.

The engine will run at the default engine speed (approx. 1600 rpm).

Servo Isolator

Operation

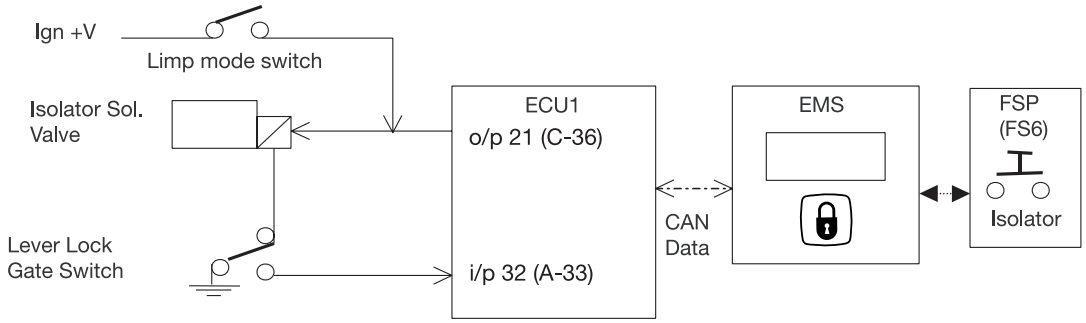

Fig 47.

The operator has the ability to isolate the excavator controls by pressing the isolator switch on the facia switch panel.

When the Isolator switch is pressed both the warning lamp and the switch status indicator are illuminated. ECU1 now de-energises the output to the isolator solenoid valve o/p 21 (C-36).

A second press of the isolator switch extinguishes both the warning lamp and the switch status indicator. ECU1 now energises the isolator output o/p 21 (C-36) and provided the lever lock is in the correct position, operation of the excavator controls is possible

Wiper

Operation

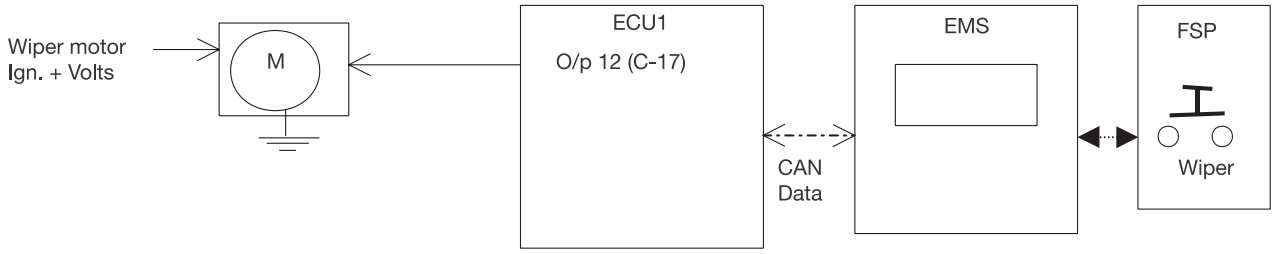

Fig 49.

The wiper has three modes of operation, intermittent, permanently on and off. Timing for the intermittent function is performed by ECU1, and can be varied via the set menu on the EMS.

When the wiper switch on the Facia Switch Panel (FSP) is pressed once o/p 12 (C-17) on ECU1 is pulsed for 0.5 seconds to start the wiper stroke. A hold on contact within the motor assembly retains power for the return stroke of the blade. A time delay of variable seconds is activated before the output is energised again, thus giving intermittent operation.

A second press of the switch enables the wiper to operate continuously and the output is permanently energised.

A third press of the switch disables wiper operation.

Lower Wiper (option)

Operation

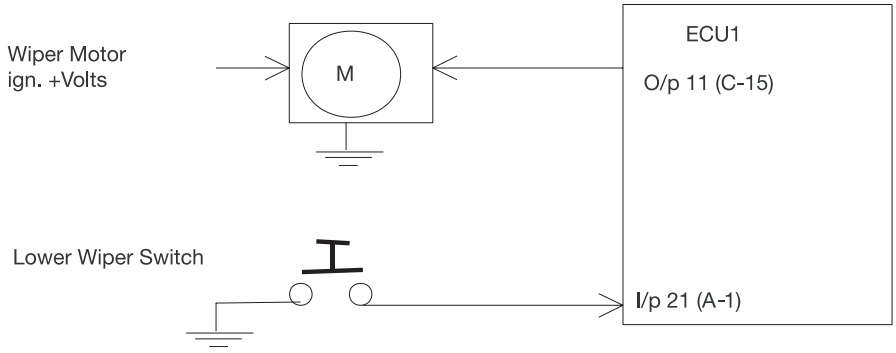

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Fig 51.

The lower wiper is a customer selected option and is fitted to the lower glass panel at the front of the operator's cab.

The wiper has three modes of operation intermittent, continuous and off. Timing for the intermittent function is performed by ECU1. The same timer as utilised for the standard wiper is used to synchronise both wipers together.

When the lower wiper button is operated the ECU1 output number o/p 11 (C-15) is energised to start the wiper stroke. A hold on contact within the motor assembly retains power for the return stroke of the blade. A time delay equal to that set for the main wiper is activated before the output is energised again, giving intermittent operation.

A second press of the switch enables the wiper to operate continuously and the output is permanently energised.

A third press of the switch disables wiper operation.

Note: *If the upper (main) wiper is energised then the lower wiper output is energised at the same time, synchronising both wipers.*

Washer

Operation

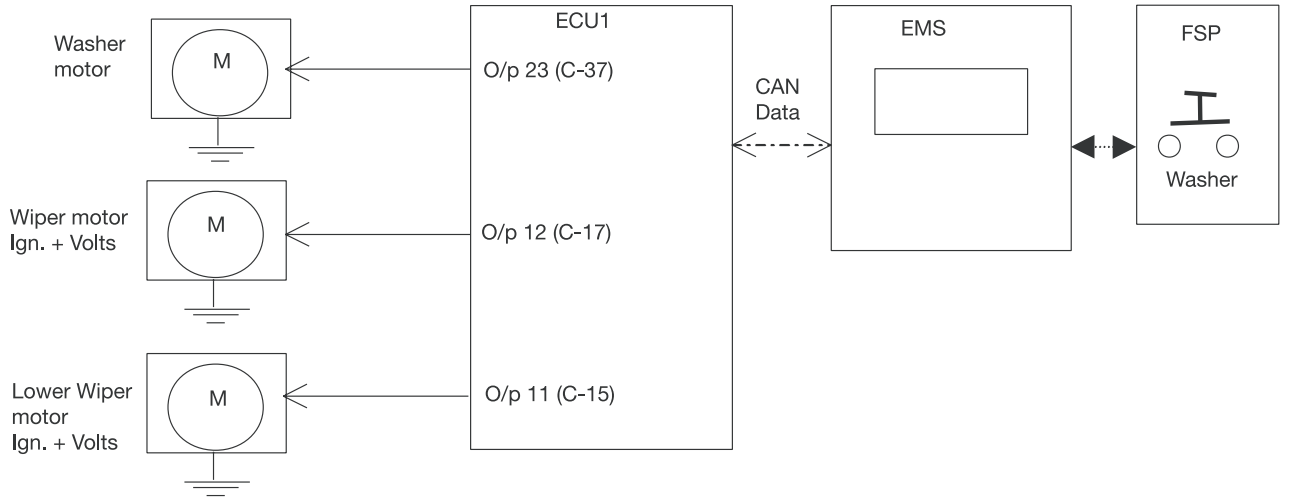


Fig 53.

When the washer switch on the facia switch panel is pressed the ECU1 operates the output o/p 23 (C-37) to the washer pump. The ECU output is only energised whilst the facia switch is pressed.

Whenever the washer output is energised the wiper output ECU1 o/p 12 (C-17) is also energised. When the washer switch is released the wiper will do three additional strokes and then turn itself off.

If the lower wiper has been selected as an option, when the washer button is pressed, both the upper and lower wipers are energised.

Horn

Operation

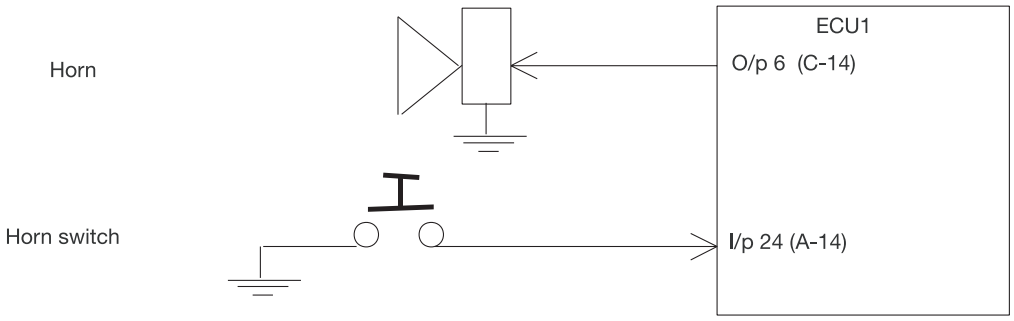


Fig 55.

When the left joystick rear button is pressed, input ECU1 i/p 24 (A-14) is selected the horn output ECU1 o/p 6 (C-14) is energised whilst the button is pressed.

Travel Alarm

Operation

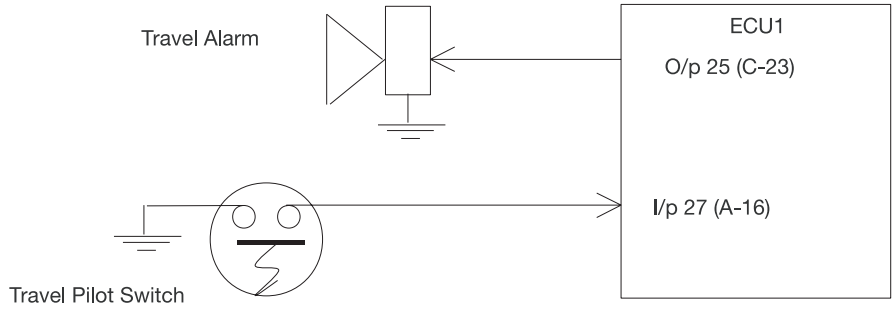


Fig 57.

The travel alarm is available as an option on the tracked machines. Whenever travel movement is requested travel pressure switch ECU1 i/p 27 (A-16) is selected. When this input is grounded the travel alarm output ECU1 o/p 25 (C-23) is energised.

Soft/Hard (Cushion)

Operation

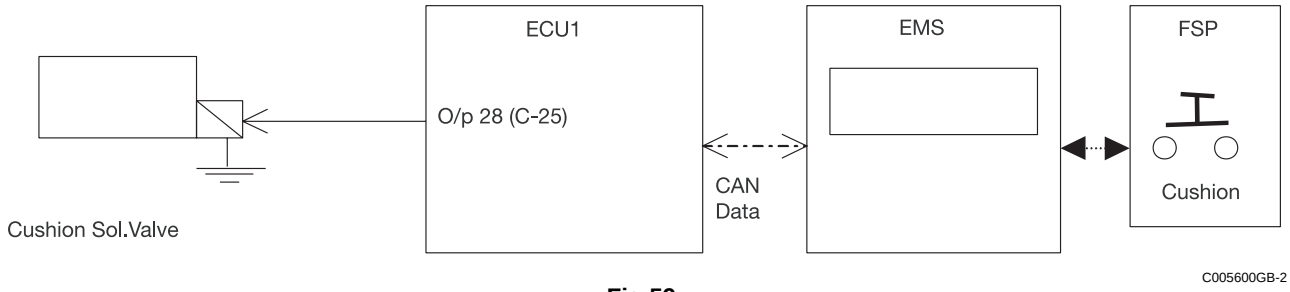


Fig 59.

The soft/hard mode allows the operator to select the response of the hydraulic circuits, soft being controlled and hard being fierce when de-selecting boom and dipper functions. Soft mode is the default setting when starting the machine.

To change to hard mode the operator must select the option by pressing cushion switch on the facia switch panel. Cushion solenoid output ECU o/p 28 (C-25) is energised.

The hard mode is cancelled either by turning the ignition off, or by pressing the cushion switch for a second time.

Slew Brake (100%)

Operation

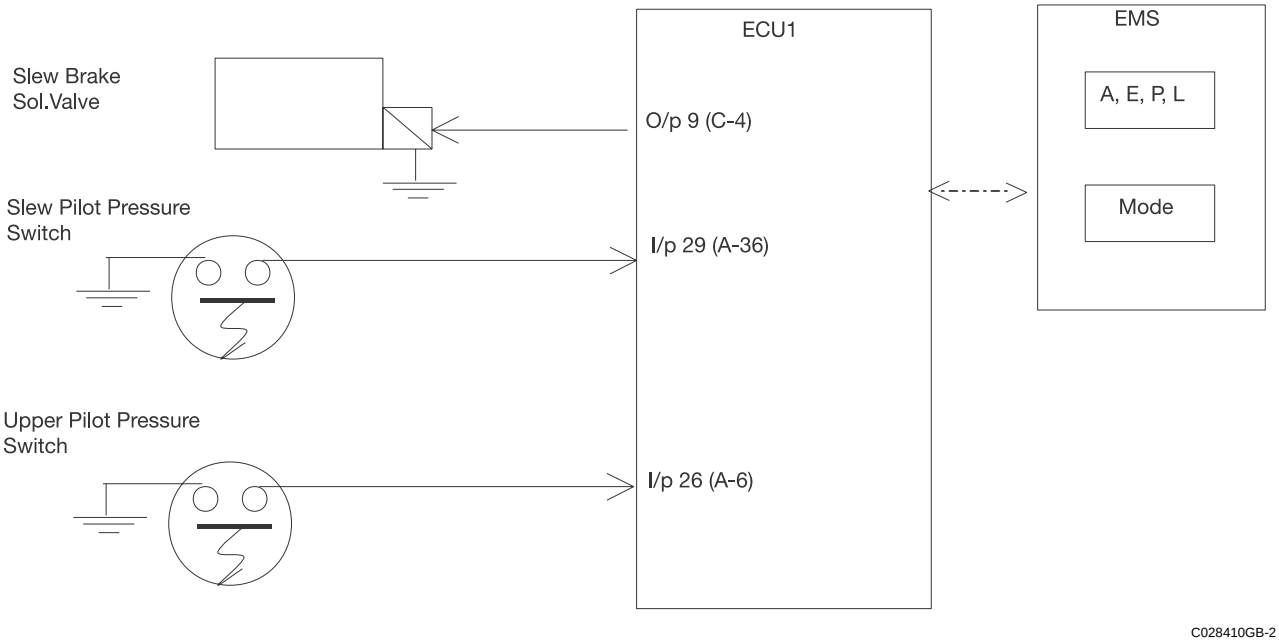


Fig 61.

The slew parking brake holds the current slew position of the machine and prevents slew drift.

This is the default operation with the engine running.

The operator signals for slew movement by moving the left hand joystick. This results in the slew pilot pressure switch being activated. This signals the ECU1 to energise the slew parking brake solenoid valve, thus enabling slew.

The slew pilot pressure switch is de-activated, by returning the joysticks to neutral, and the upper structure comes to a stop using a hydrostatic brake (cross lines relief valve). If this condition exists for 5 seconds then the slew parking brake solenoid is de-energised. Thus applying the slew brake.

To prevent any damage to the slew brake occurring when excavating the slew brake solenoid will remain energised and the slew brake remain off, if the upper pilot pressure switch is activated or re-activated within 5 seconds of the slew pressure switch closing.

If however the upper pilot pressure switch remains de-activated for 5 seconds or longer, the slew brake solenoid will de-energise (brake on). The slew brake solenoid will remain de-energised until the slew pilot pressure switch is activated.

When L mode (lifting) is selected, the upper pilot pressure switch is ignored and 100% brake applied. When the slew pilot switch is energised the slew parking brake is lifted.

By Default Slew parking brake is automatically applied at start up.

Slew lock (100% Slew Brake)

Operation

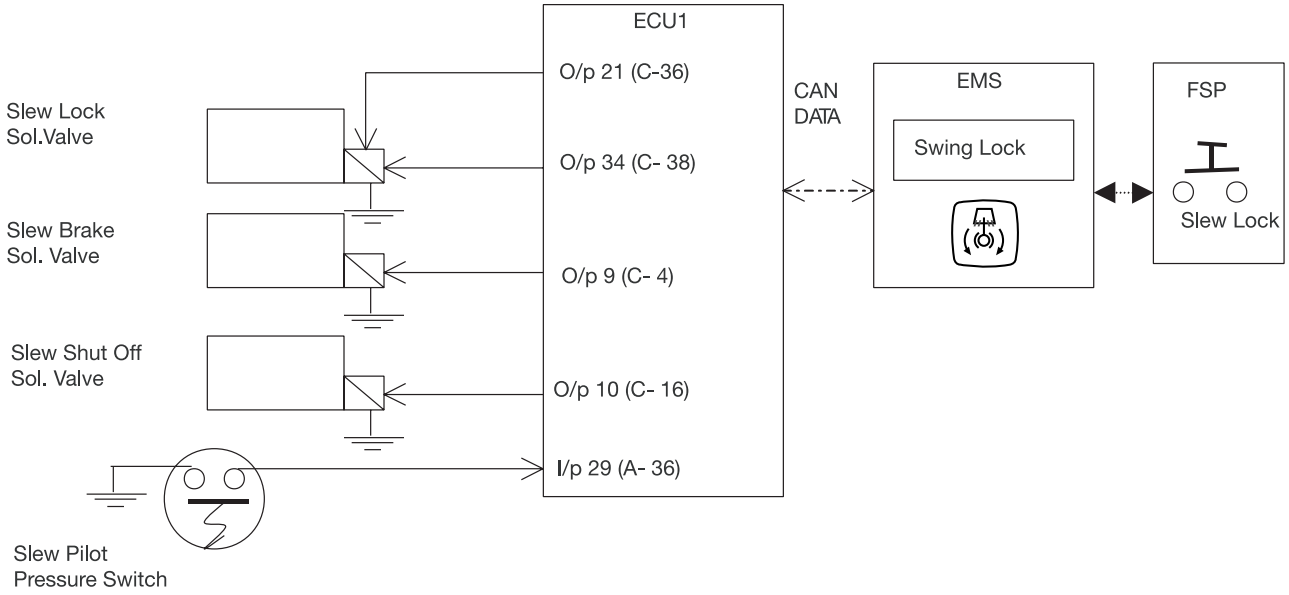


Fig 63.

The slew lock prevents any slew operation of the machine, even if the LH joystick is moved. It acts as 100% slew parking brake and disables the slew pilot circuit, by applying equal pressure on either side of the slew spool in the main valve block (slew shut off).

The lock is operated by pressing the slew lock switch on the fascia switch panel. When pressed the status indicator illuminates. The EMS displays the message "SWING LOCK", and the warning light illuminates. The EMS transmits the slew lock request to the ECU1 via the CAN communications link. The slew shut off solenoid is energised (effectively isolating the joysticks) and slew parking brake solenoids is left de-energised by the ECU1.

5 seconds after the Slew Lock button is pressed the slew lock solenoid is energised, opening the slew brake cylinder to tank and applying 100% braking force.

The slew lock is de-activated by a second press of the fascia switch. This causes the switch status indicator and the EMS warning lamp to be extinguished. The ECU1 de-energises the slew lock and slew shut off solenoid valves. The slew parking brake will not be re-energised until an input from the slew pilot pressure switch is seen.

By Default upon start slew lock is automatically disengaged.

Swing Lock	**Swing Pilot Psw**	**Swing Lock Sol Valve**	**Swing Parking Brake Sol Valve**	**Swing shut off Sol Valve**
FS2	i/p29(A-36)	o/p8 (C-3)	o/p9 (C-4)	o/p10 (C-16)
✘	✓	✘	✓	✘
✓	✶	✘	✘ (=100% brake)	✓
✓ + 5 Sec	✶	✓	✘ (=100% brake)	✓

Slew Brake Solenoid Valve Failure

Operation

In the event of slew brake solenoid or the slew pressure switch failing, the slew brake will still operate. The pilot signal from the hand controller passes through the shuttle block and enters the slew brake valve via port A. When the pressure overcomes the slew brake shuttle, the signal passes through the slew brake valve via port B and is directed to the slew brake. When sufficient pressure is raised the slew brake is lifted.

The slew operation will tend to be notchy, as the brake on and off timing will depend upon the position of the slew joystick.

Note: *This operation is only to be used to make the machine safe i.e. to slew the machine into a safe position, for transportation to a place where an appropriate repair can be carried out.*

3-Speed Travel

Operation

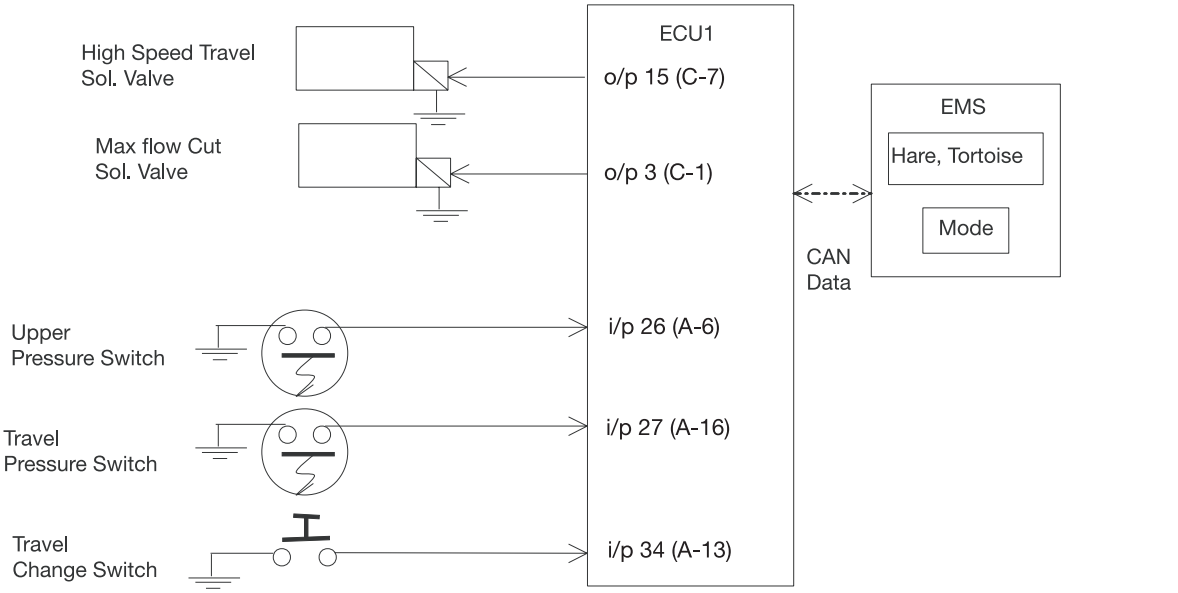


Fig 65.

Using a combination of two solenoids (high speed travel solenoid and max flow cut solenoid), pump flow and swash plate position of the travel motor are used to give three travel speeds. The selected travel speed is indicated on the EMS as either a Hare (High), double arrow (Middle), or Tortoise (Low) and is changed by successive presses of the travel change switch. The current operating mode of the machine alters the logic in which the solenoids operate.

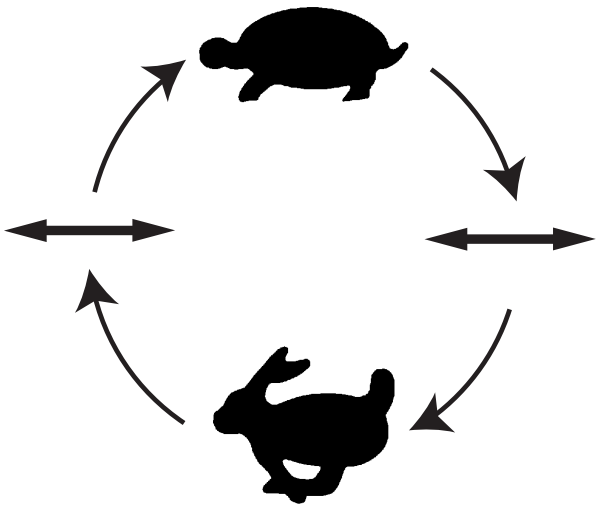


Fig 66.

Work Lamps

Operation

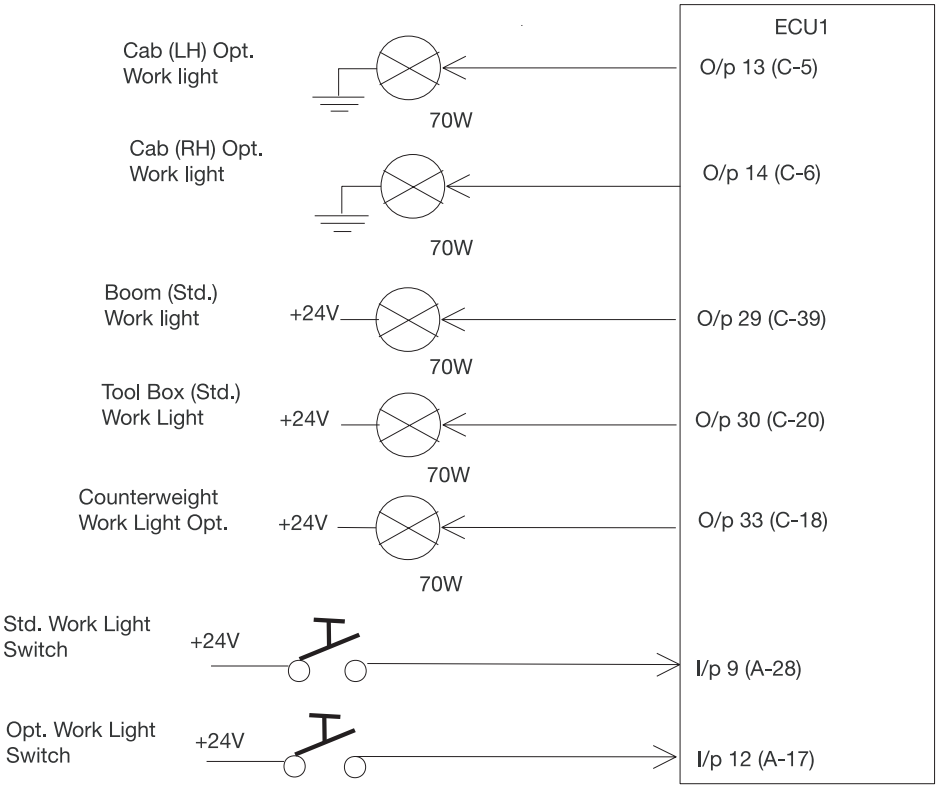


Fig 68.

Work lamps are located on the boom and front body (tool box) of the machine. An optional set of three additional work lamps can be fitted to the cab and counter weight.

When the work light switch is moved to the first position, the input i/p 9 (A-28) to the ECU1 is selected. This in turn enables outputs to be turned on to the Boom, ECU1 o/p 29 (C-39) and lower front body (Tool Box), ECU1 o/p 30 (C-20).

A second press of the same switch selects ECU1 i/p 12 (A-17) and i/p (A-28) which in turn energises the second optional set of cab work lamps, ECU1 o/p 13 (C-5) and o/p 14 (C-6) and counter weight, ECU1 o/p 33 (C-18), if they are fitted and provided that these options have been selected in the machine setup tool.

The switch is returned by pressing in the reverse direction boom and tool box work lamps and the optional work lamps are extinguished.

Viscous Fan

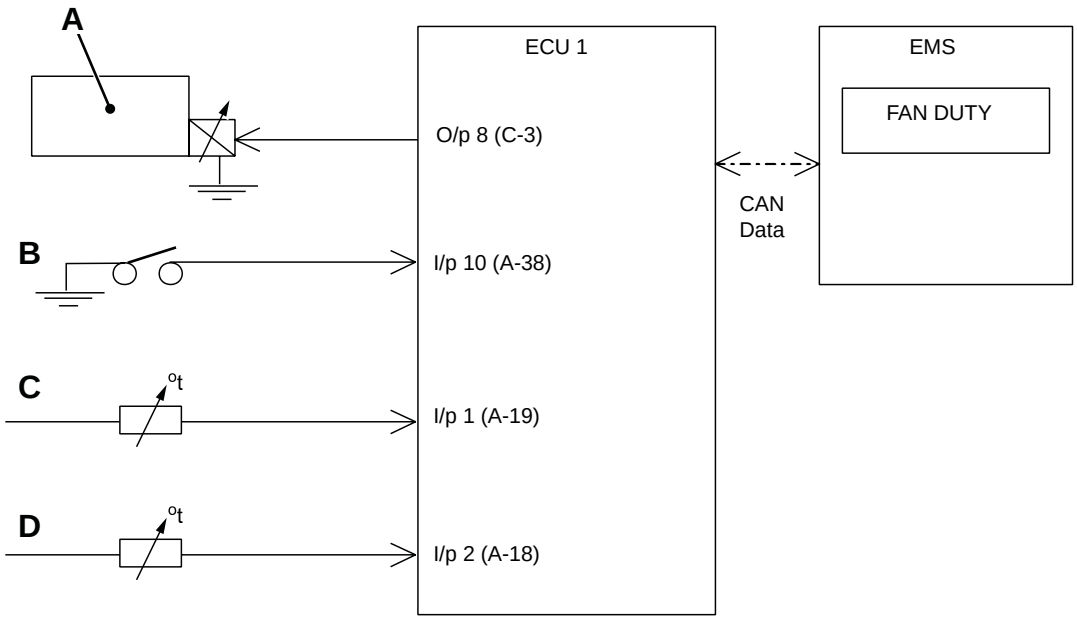


Fig 70.

A	Viscous fan solenoid
B	A/C switch
C	Hydraulic oil temperature
D	Engine coolant temperature

Operation

The cooling pack temperature is controlled by an electromagnetically controlled viscous coupling fan. The electromagnetic clutch which drives the fan speed is controlled by a PWM signal from the ECU1.

Engine water and hydraulic oil temperature are monitored by the ECU1. As their temperatures change, the ECU1 will vary the PWM signal to the electromagnetic clutch. This changes the speed of the fan. As the temperature increases the PWM signal will decrease to drive the fan faster. If the PWM signal is lost to the electromagnetic clutch the fan will run at full speed.

The output PWM signal will drive the fan RPM to that set by the highest temperature as determined by the graph. ⇒ *Fig 71. (C-74)*.

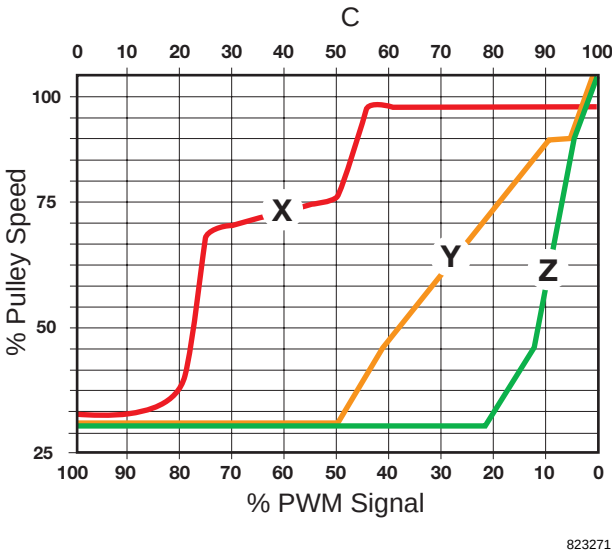


Fig 71.

X = Fan Speed +/-50rpm.

Y = Oil Temperature.

Z = Water Temperature.

Fuel Level Sensor/Warning

Operation

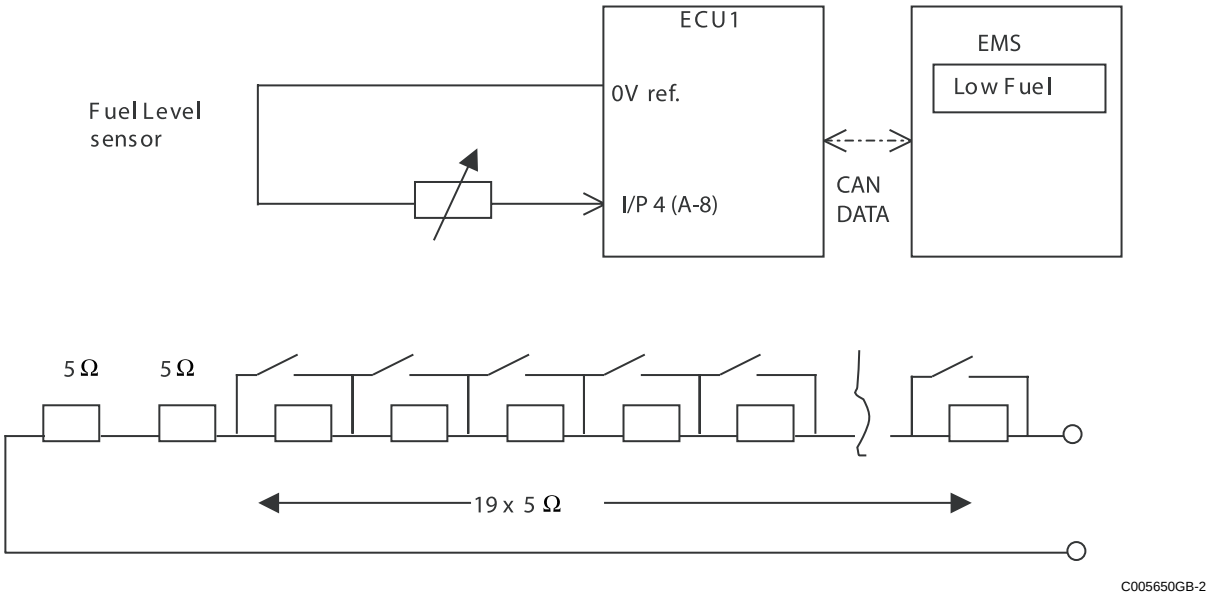


Fig 72.

A float sensor is fitted to the fuel tank to measure the level of fuel in the tank. A magnetic float rises up a tube containing a series of 5 ohm resistors with switches in parallel. The fuel level is displayed to the operator by means of a bar graph gauge. The actual values can be displayed via the EMS SET+MODE menu. Both the actual value and bar graph values should be an average of consecutive readings to provide a degree of dampening to prevent false readings

Text warnings are provide for both reserve fuel and low fuel conditions. Low fuel is also backed up by a flashing bar graph.

The low fuel condition must be present for one consecutive minute before the "LOW FUEL" warning is displayed.

The reserve fuel condition must be present for one consecutive minute before the "RES FUEL" warning is displayed.

Engine Temperature Sensor/Warning

Operation

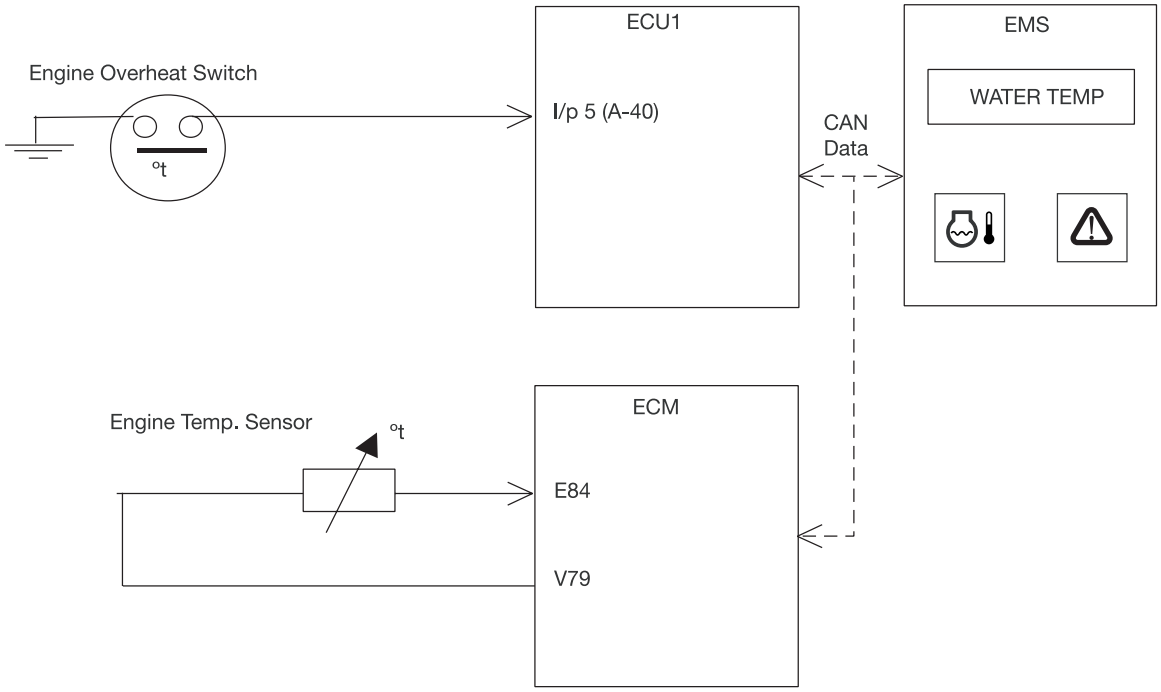


Fig 74.

The engine is fitted with a thermistor sensor and thermal switch to measure the water temperature. The engine temperature (in ºC) is sent from the ECM to the ECU1 via the CAN bus. The temperature is displayed to the operator by means of a bar graph gauge. The actual values can be displayed via the EMS's SET+MODE menu.

- When the temperature rises to 101 ºC the water temp LED is illuminated on the EMS.
- At above 130 ºC the operating mode changes to "E" if in "A".
- At above 105 ºC the bar graph will flash on-off, the audible alarm will sound, and the "WATER TEMP" will be displayed on the EMS. The audible warning can be cancelled by pressing ACK button on the EMS.
- At above 108 C the caution LED will illuminate and "LOW POWER" will be displayed on the EMS. This indicates that the ECM has limited engine output to 50% of maximum.

The over heat switch is included as a safety measure in case of the thermistor failure. If this input is grounded then the EMS will illuminate the water temp LED, the bar graph will flash on-off, the audible alarm will sound, "WATER TEMP" will be displayed on the EMS and the mode changes to "E" if in "A". The audible warning can be cancelled by pressing the "ACK" button on the EMS.

The engine water temperature bar graph gauge operates as follows, ⇨ *Table 3. (C-80)*.

Coolant Level Warning

Operation

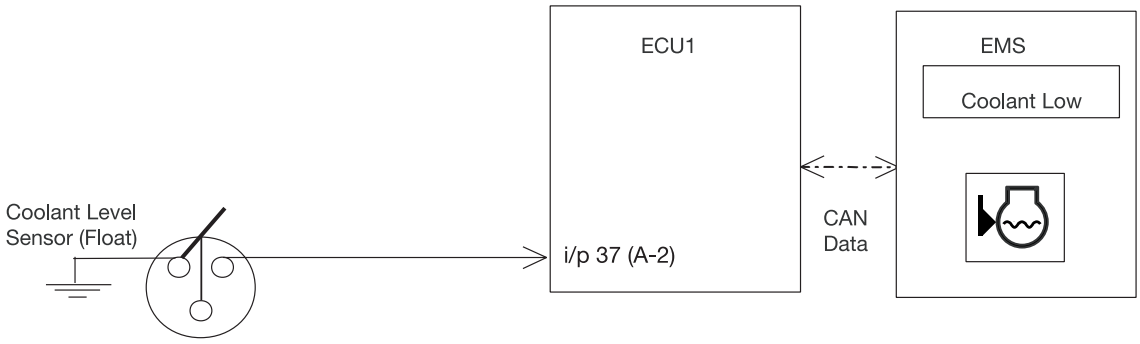


Fig 77.

A float switch is fitted to the engine coolant reservoir. When the reservoir is empty the float switch ECU1 i/p 37 (A-2) is connected to ground. This causes the EMS to alarm. The buzzer sounds for 1.5 seconds, a "COOLANT LOW" message is displayed on the EMS and flashing low coolant level LED illuminates for 5 seconds. This is followed by a repetitive message and constant LED on.

Air Filter Blocked Warning

Operation

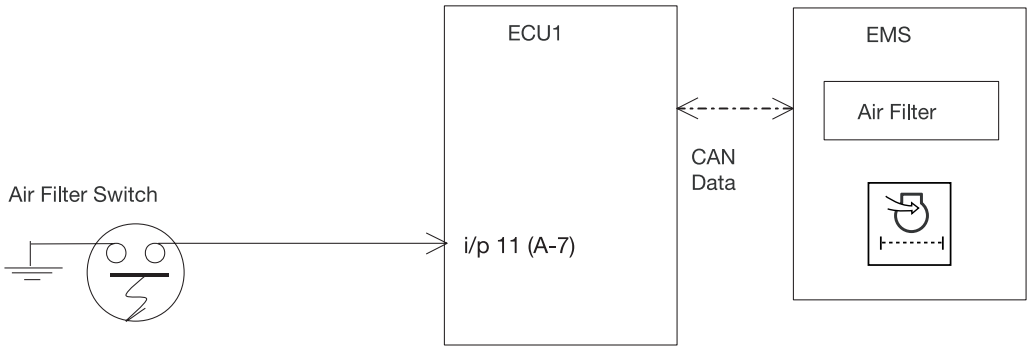


Fig 78.

A pressure switch is fitted to the engine air filter. When the filter is blocked the pressure increases, thus triggering the switch and the ECU1 i/p 11 (A-7) is connected to ground. This causes the EMS to alarm. The buzzer sounds for 1.5 seconds, a "AIR FILTER" message is displayed on the EMS and a flashing engine air filter blocked LED illuminates for 5 seconds. This is followed by a repetitive message and constant LED on.

Hydraulic Temperature Sensor/Warning

Operation

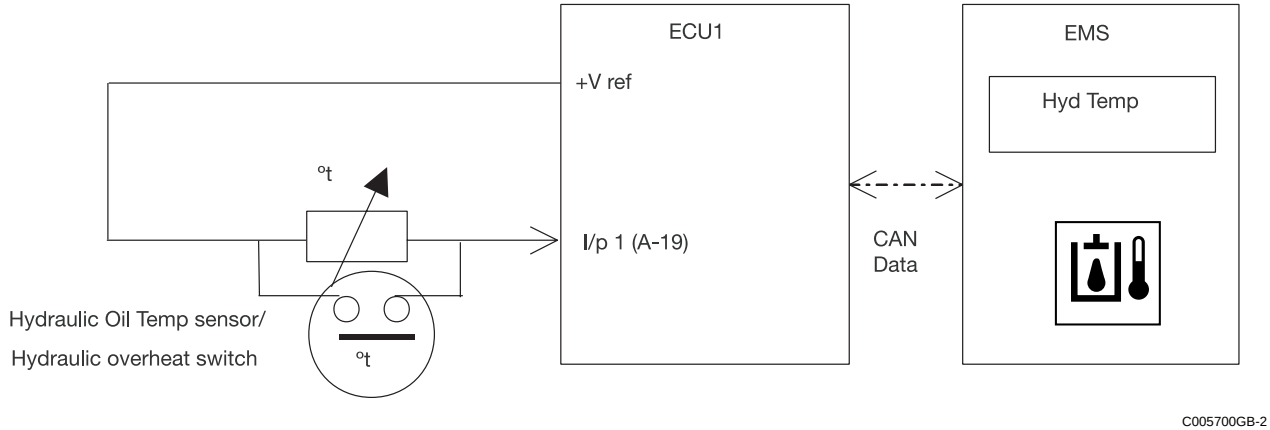


Fig 80.

The hydraulic system is fitted with a thermistor and a thermal switch to measure temperatures. The temperature is displayed to the operator by means of a bar graph gauge. The actual values can be displayed via the EMS's SET and MODE menu.

When the hydraulic oil temperature reaches 97ºC the EMS will illuminate the warning lamp. If the temperature continues to rise the bar graph will flash on-off and an audible warning and "HYD.TEMP" message will be given. The audible warning can be cancelled by pressing the "ACK" button on the EMS.

The overheat switch is included as a safety measure in case of the thermistor failure. If this input is grounded then the EMS will illuminate the warning lamp, sound the audible alarm and display the overheat message. The audible warning can be cancelled by pressing the "ACK" button on the EMS.

Note: *When the temperature reaches 98°C the pump should be lowered to E mode.*

Alternator/No Charge Warning

Operation

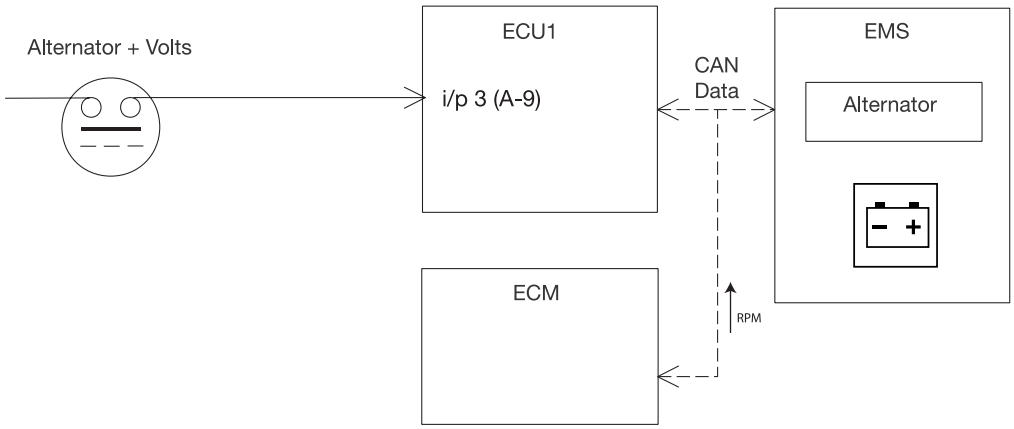


Fig 82.

The output of the alternator is monitored by the ECU1 and a warning alarm sounded if the output voltage falls below a set value.

When the value of the alternator input, ECU1 i/p 3 (A-9) falls below 23 volts or above 32 volts, the ECU1 sends a CAN message to the EMS which in turn illuminates the warning lamp.

If the engine is running, as detected by the RPM message from the ECM, then the internal buzzer on the EMS is sounded and the message "ALTERNATOR" is displayed in addition to the warning light.

Quick hitch (option)

Operation

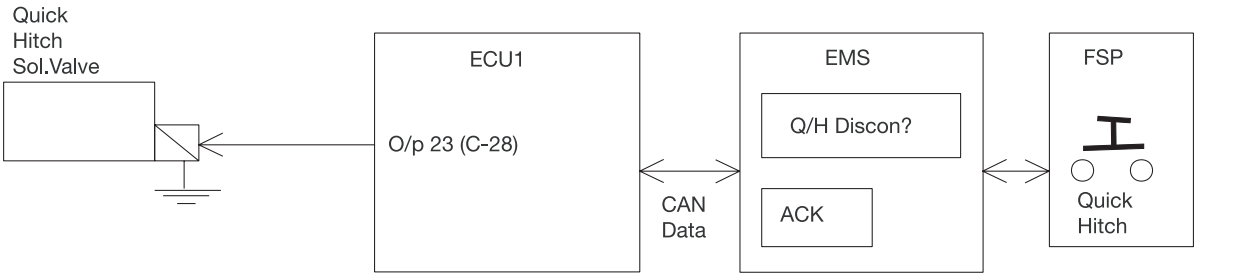


Fig 84.

⚠ WARNING

When using Quick Hitch Type 2, the attachment can become unexpectedly disengaged from the Quick Hitch, when any of the following occurs:

Power failure to the Electronic Control Unit (ECU).

When the redundancy switch is engaged.

If an electrical component in the Quick Hitch system should fail.

0178

The Quick hitch option allows the operator to quickly change the attachment from within the cab.

There are two types that can be fitted and they operate in different ways.

Quick hitch type 1	Q/H off = output is switched on
	Q/H on = output is switched off
Quick hitch type 2	Q/H off = output is switched off
	Q/H on = output is switched on

The system can be enabled and switched between types via the SET + MODE (20 seconds) menu:

SET + MODE (20 secs)	Scroll to Q/H option
QH ENABLE?	ACK
QH ON	Scroll up/down to toggle between ON and OFF, ACK
QH TYPE?	ACK
QH TYPE 1	Scroll up/down to toggle between type 1 and 2 ACK

When the quick hitch switch is activated the EMS will display the "Q/H DISCON?" message to verify the switch operation and the switch status indicator will illuminate.

If the "ACK" switch on the EMS is not pressed within 5 seconds then the display reverts to normal and the switch status indicator is extinguished.

The solenoid valve will only be energised/de-energised once the "ACK" button on the EMS is activated. This is included as a safety feature to prevent accidental operation of the quick hitch system.

Once the "ACK" button is pressed the EMS displays the message "Q/H DISCON" and the ECU1 o/p 23 (C-28) is de-energised (type 1) or energised (type 2). The buzzer is sounded while the quick hitch is disconnected.

To reconnect quick hitch press "ACK". The EMS will display "Check Q/H" instructing the operator to visually check the quick hitch attachment is securely connected. Press "ACK" again to switch off buzzer.

Overload Caution (option)

Operation

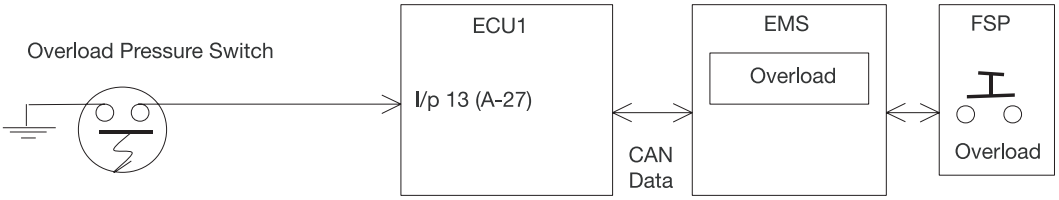


Fig 86.

Overload caution is used as a warning to the operator that the machine is lifting a mass which is exceeding the safe load capacity of the machine. An overload is indicated after the overload pressure switch, ECU1 i/p 13 (A-27) has been activated.

By default the overload override option is not enabled in A (Auto), E (Economy) & P (Precision) modes until the overload switch is selected. When selecting the overload switch on the facia switch panel the EMS displays the acknowledge message "OVERLOAD ON" and the staus LED illuminates. A second press of the switch disables the overload override function and the status LED is extinguished.

When entering L (Lifting) Mode, the overload override warning system is automatically activated. The status indicator for FS6 illuminates. The operation of overload switch will cancel the overload warning system.

If a overload condition is reached whilst the overload function is selected, the EMS will display "OVERLOAD" and the buzzer will sound.

Beacon

Operation

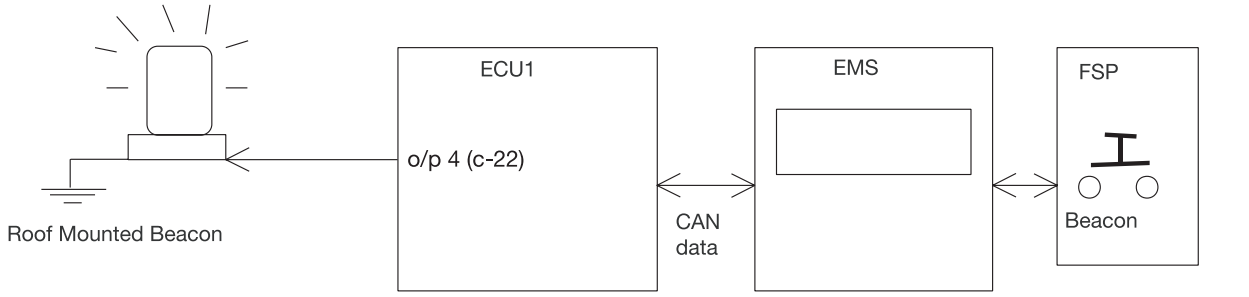


Fig 88.

Beacon is activated by pressing the beacon switch on the facia switch panel and ECU1 o/p 4 (C-22) is switched on.

Beacon operation is cancelled by a second press of the facia switch thus disabling the ECU1 output and extinguishing the status LED.

Hammer Only

Operation

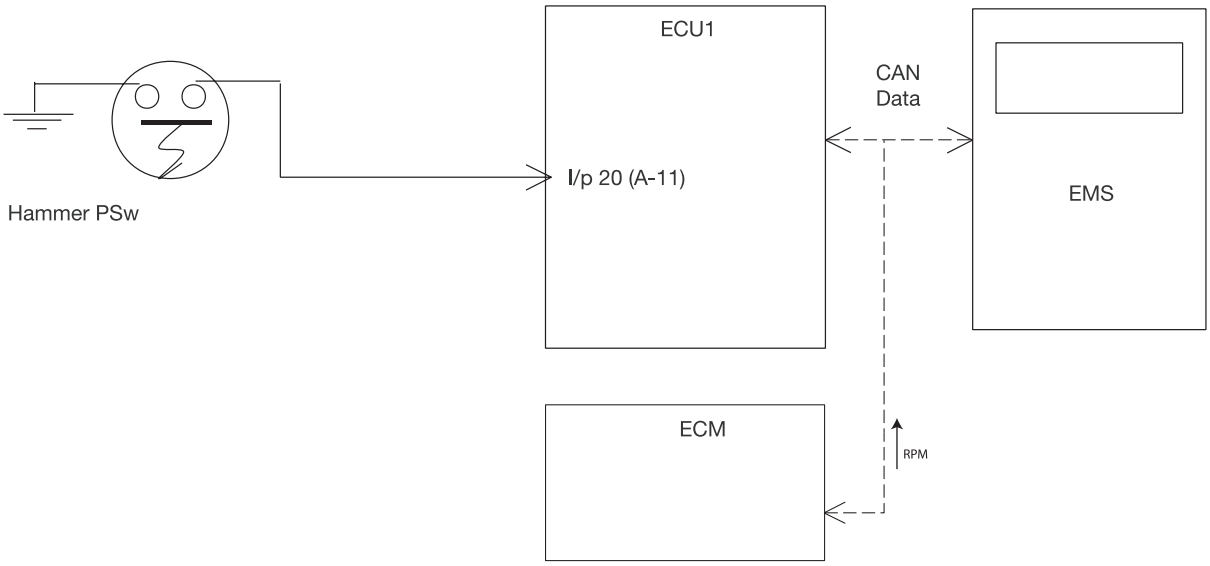


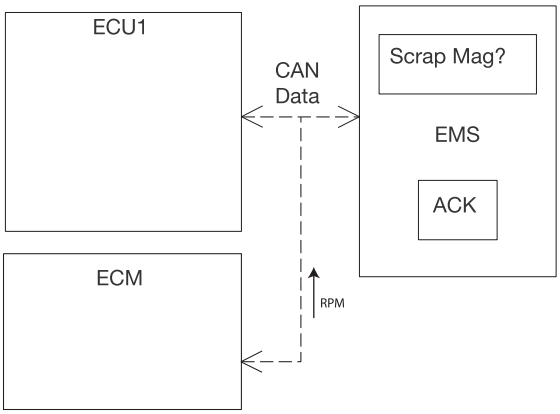
Fig 90.

The hammer is operated by pressing the foot pedal forward which supplies a pilot pressure signal to close the pressure switch and operate the option spool in the main control valve (MCV). When the pressure switch is closed, ECU 1 i/p 20 (A-11) senses the grounding of the pressure switch, which reduces the engine rpm to a level preset in the SET menu.

The throttle potentiometer normally increases/decreases the engine rpm from idle to max engine speed but will not exceed the preset hammer value, regardless of its position. The maximum "hammer revs" (engine rpm) can be set by the operator via the SET menu on the EMS. The up and down buttons will increase/decrease the rev/min value, by 25 rpm for each press. Whatever value is set by the operator is stored and becomes the new default value. The original default value for "Hammer RPM" is 1200 rev/min.

Scrap Magnet Option

Operation



C030460GB-2

Fig 93.

When a scrap handling magnet attachment is fitted to the machine, the high voltage required for its operation is supplied by an engine driven generator. If the minimum engine rpm is too low, the supply voltage to the magnet may decrease to the point where any material on the magnet may drop off. To prevent this the machine has the capability to set the minimum engine speed so that it doesn't fall below a predetermined level whilst the scrap magnet is being used.

The feature can be switched on or off and the minimum rpm set via the SET menu of the EMS by the "SCRAP MAG" option. When this feature is enabled the throttle volume potentiometer is re-scaled so that in the minimum position the engine rpm is that pre-set through the following procedure.

Set the Minimum Engine RPM for Scrap Magnet Use

Press the SET and MODE buttons on the EMS for 5 seconds then use the scroll buttons until "SCRAP MAG" is displayed.

Press the ACK button (this will alternate the function on/off). Set the display to "ON", the display will change between "MAG ON" and "MAG OFF").

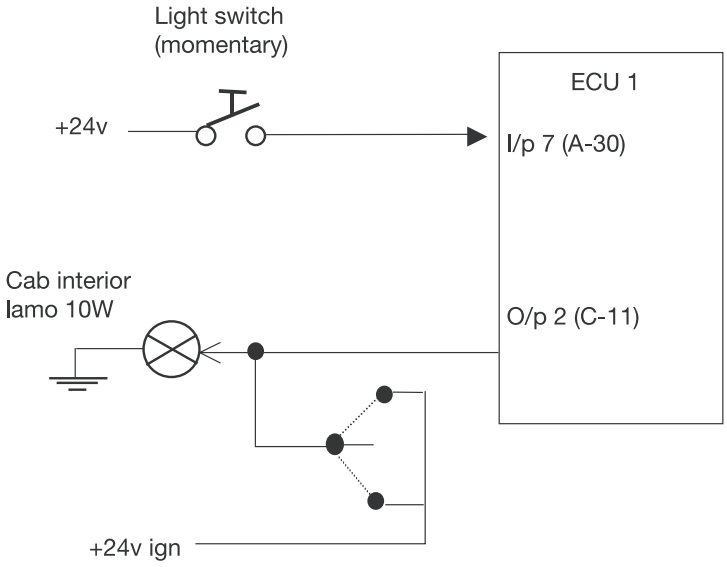
Press the 'ACK' button, the display will change to "RPM 1000". Pressing the scroll buttons will then change the rpm. value in 50 rpm. increments (allowable range to be the low idle setting to S mode full engine speed setting for the particular model). The default setting for the minimum engine speed is 1000 rpm.

The rpm setting of this feature is stored and is used each time the machine is used whilst the scrap magnet function is enabled. The scrap magnet option is switched off through the EMS SET menu.

If a target value less than the machines idle rpm is selected, then the machine will default to the original Idle setting.

Cab Interior Lamp

Operation



C005790GB-2

Fig 94.

A switch near the cab door can be pressed to switch on the cab interior light for access to the machine in the dark. The input i/p 7 (A-30) activates the ECU1 when the ignition is switched off. When the light switch is pressed the cab light will be switched on for 5 minutes or until a second press of the light switch within the 5 minute period.

The cab interior light has an integral override switch to switch on the lamp independently of the ECU1.

Refuelling Pump

Operation

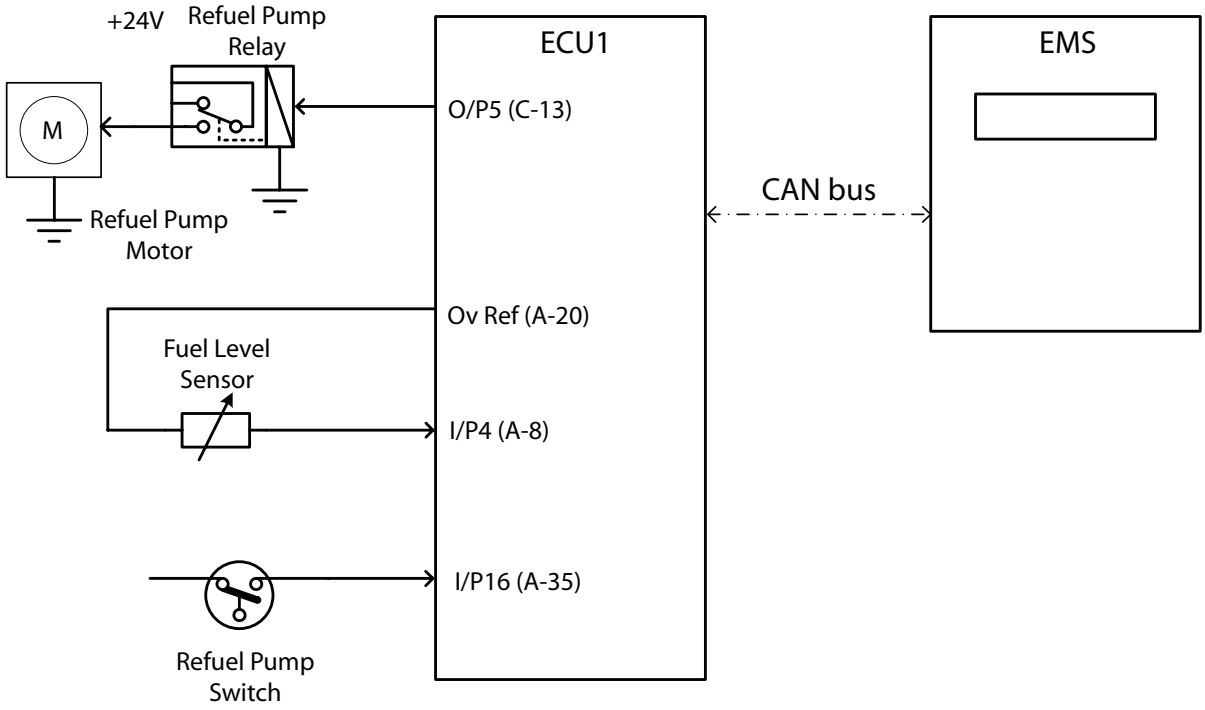


Fig 96.

ECU1 Requirements

A refuelling pump can also be installed on the machine. This pump can be used in two different modes: automatic or manual.

Note: *The refuel pump feature is only present when the machine is fitted with a new harness. If the machine is not fitted with a new harness the input and output pins used for this feature are assigned to other functions*

Automatic Mode

A short press of the fuel pump momentary switch is used to turn on and off the fuel pump's automatic mode. When the refuelling pump switch is pressed, a high (+Vbatt) is measured at the input to the ECU1. When the button is released, the input is open circuit and a `low' will be measured by the ECU1. If the button is held for less than 2 seconds, then this falling edge will trigger the refuelling pump feature into automatic mode. While in automatic mode, the output to the refuelling pump relay is energized. The fuel level input is monitored during this functionality. When the fuel level reaches the Max Refuel Level, the fuel pump output is turned off. The filtering that is normally used to smooth out fuel level readings is not used in this case so that there is no delay in the fuel level reading.

If a second falling edge is detected on the fuel pump input, then the feature is de-activated and the fuel pump output is turned off.

Note: *If any errors are present on the fuel level sensor, then the refuel pump's automatic mode is not allowed.*

Air Conditioning

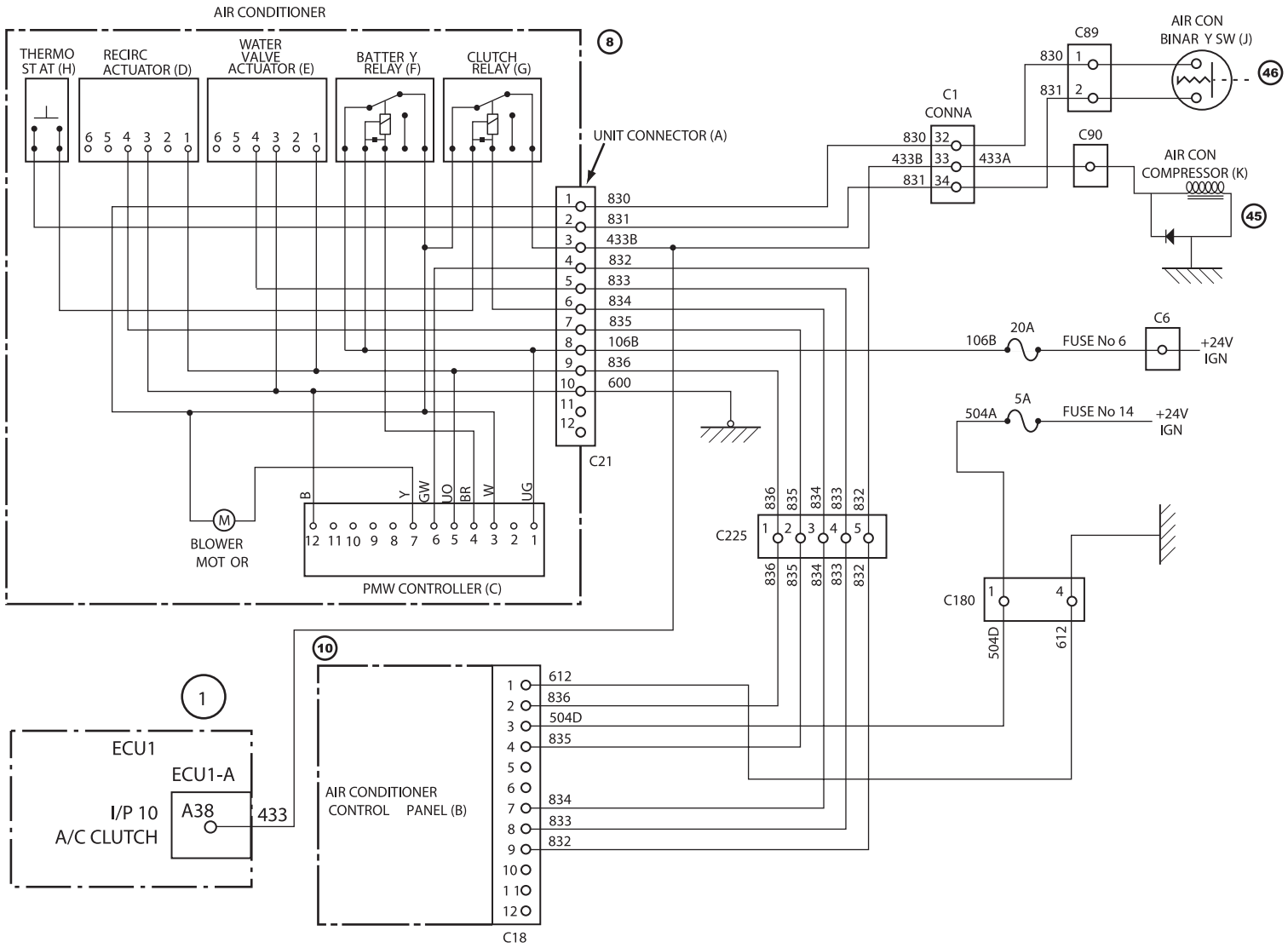
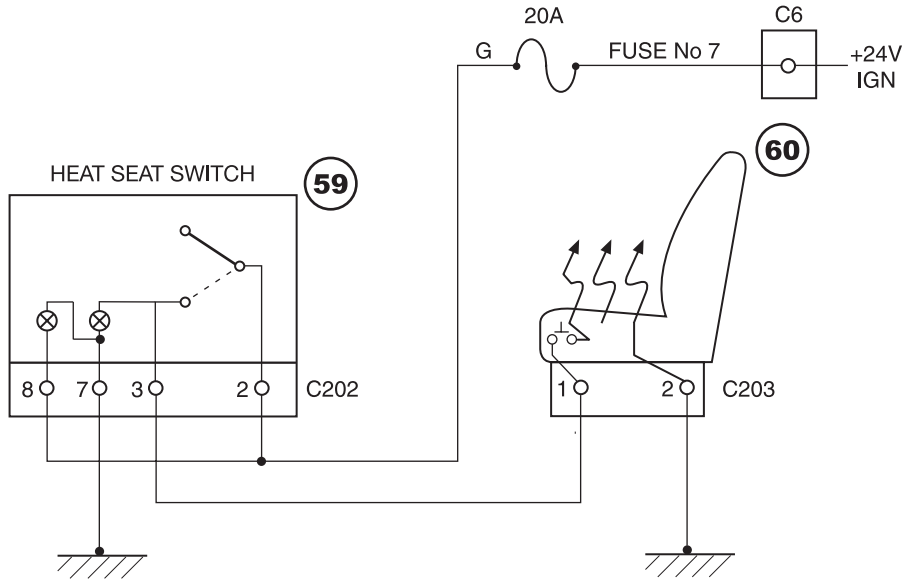


Fig 98.

C049830-2

Heated Seat

Operation



C030500GB-2

Fig 99.

When the heated seat switch is selected, an electrical current passes over the seat thermostat to the heating element. The element will then warm the seat.

The thermostat is set to 20°C - ON and 30°C - OFF.

On initial starting when the heated seat switch is selected, the heated seat element will turn on only if the thermostat is below 30°C. Once the thermostat reaches 30°C the heater will turn off. The element will only be re-heated if the thermostat temperature falls below 20°C.

Radio and Cigar Lighter

Operation

Radio

The radio has a permanent 12-volt supply from pin 4 of the voltage converter to pin 5 of the radio. The permanent supply is to retain the memory in the radio.

The 12-volt switched supply to power the radio is fed from pin 5 of the voltage converter to pin 2 of the radio via a rocker switch (Mute button) in the right hand console of the cab. Operating the mute button simply turns off the power supply to the radio.

Cigar lighter

The cigar lighter/phone charger, is fed from the switched feed only.

Service Required Warning

Operation

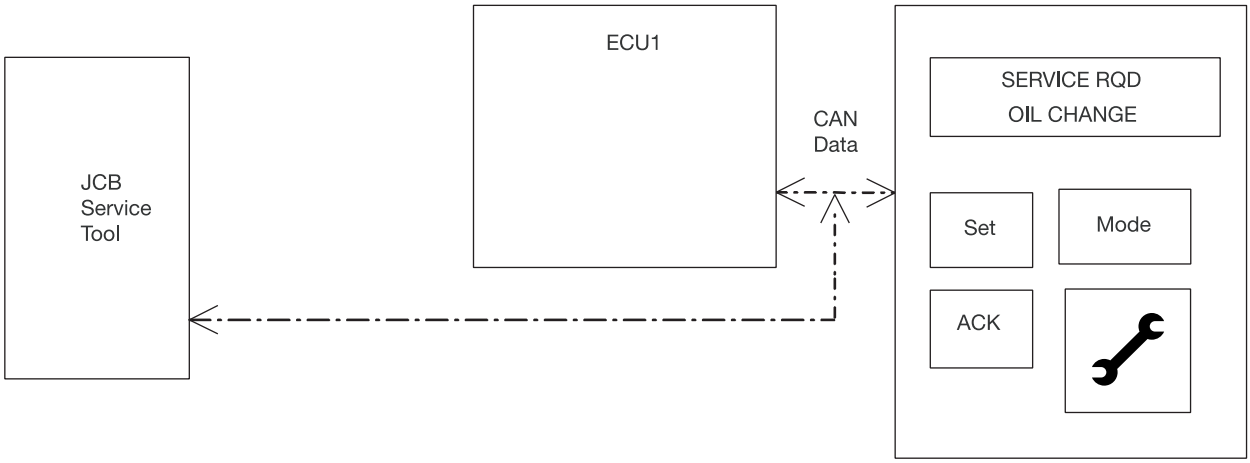


Fig 101.

The service warning LED in the EMS will illuminate (no buzzer) when the next service or oil change is due, according to the service schedule. The EMS also displays "SERVICE RQD" and/or "OIL CHANGE". The total elapsed time will be decided by the recorded hours on the hour meter.

Oil change intervals can be set to 250 or 500 hour intervals in "vehicle setup":

Oil change intervals can be set to 125, 250 or 500 hour intervals in the EMS SET+MODE (20 sec) Menu.

125 hours	the oil change message is displayed at 125 hours and at every subsequent 125 hour intervals including minor and major service points.
250 hours	the oil change message is displayed at minor and major service points.
500 hours	the oil change message is only displayed at major service points.

Minor service intervals occur every 250 hours with the first occurring at 250 hours. At the minor service intervals the service warning LED will flash and a "SERVICE RQD" message will be displayed on the EMS until the ACK button is pressed. Once the operator has pressed the "ACK" button, the EMS will set the time for the next minor service event to 500 hours from the time when the "ACK" button was pressed. When the oil change interval is set for 125 or 250 hours, and additional repetitive "OIL CHANGE" message is displayed and cancelled as above.

Major service intervals occur every 500 hours with the first occurring at 500 hours. At the major service intervals the service warning LED will flash and a "SERVICE RQD" message will be displayed on the EMS from 20 hours before the preset 500 hour time has been reached. The warning can be cleared by the operator by pressing the "ACK" button but will re-occur every time the ignition is switched ON until reset by JCB service engineer. 20 hours after the 500 hour pre-set time has been reached an error is written to the error log indicating that the service has been missed. An additional repetitive "OIL CHANGE" message is displayed and cancelled as below.

The major service warning can be cancelled in one of two ways:

1 Through the JCB approved service tool.

2 Through the EMS Set + Mode (20 sec) menu

EMS Set Menu.

When the SET button on the EMS is pressed a sub menu structure appears, enabling the operator to customise the machine operations and confirm the local time/date. The following functions are available: The up/down arrows scroll through the menu and the item is selected by pressing the "ACK" button. Pressing "SET" at any time will return the operator to the normal display.

INT WIPER S	X	Intermittent wiper speed. Scroll keys to increase/decrease the delay between strokes time. "ACK" to accept new value.
LANGUAGE		Language can be changed between one and up to four languages, the languages are installed at machine set up.
DATE	**XX-XX-XXXX**	The current date. Use the scroll keys to increase the value. "ACK" to move to the month section. Repeat until the year is entered "ACK" to return to menu.
CLOCK	**12/24? 24**	Clock format the arrow keys select 12/24 hour format. "ACK" to accept format then the current time is displayed.
	XX:XX	Use the scroll keys to set the current time. "ACK" to accept value.
HAMMER HOUR	**XXXXX - - XXXX**	The total hours that the hammer pressure switch has been activated is displayed on the left of the display (Up to 99,999 Max.) and the digits on the right which flash represent the hours accumulated since the last hammer service (up to 9,999 max.) The four flashing digits can be reset by pressing the "ACK" button.This Item will only be displayed if previously selected in set up tool Reset Hrs? A further press of the "ACK" button will set the hours since service to zero.
HAMMER RPM	**RPM XXXX**	The maximum hammer revs allowed. Use the scroll keys to set the desired rpm. Increments/decrements in 50 rev/min. "ACK" to accept the new value.
REFUEL LVL	XX	Allow the fuel tank to be filled with fuel to a preset percentage, 50-100%
AUTO IDLE T	XX	Auto idle delay time. Scroll keys increase/decrease the delay time. "ACK" to accept new delay time.

EMS Set + Mode Menu

When the SET and MODE buttons on the EMS are pressed together a sub menu appears, enabling the technician to view more detailed data on the machine and to set option configurations. The following functions are available:

MODEL NAME	Displays the model type.
HRDWARE VER	Displays the hardware version
SFTWARE VER	Displays the software version.
SCRAP MAG	The current status of the scrap magnet function is displayed. The up arrows changes the status to "ON" and the down arrows change it to "OFF". If the "ACK" is pressed the display shows the scrap magnet rev/min.
SENSOR VOLT	Displays the sensor circuit voltage in volts.
BATT VOLTS	Displays the battery voltage in volts.
ALT VOLTS	Displays the alternator output voltage in volts.
THRTTLE POT	Displays the throttle volume dial value in Ohms
FUEL LEVEL	Displays the fuel level sensor value in%
FAN DUTY	Displays the current duty cycle of the fan control solenoid in %." On machines with a Viscous Clutch Fan, this menu item shows the duty cycle (in %) of the PWM output from the ECU1 to the fan, 100% = idling and 0% = fully on.
BAROMETER	Displays the current barometric pressure in kPa
WATER TEMP	Displays the current engine coolant temperature in °C
HYD TEMP	Displays the current hydraulic oil temperature in °C
PILOT SWTCH	Displays the status of the pressure switches. Use the scroll keys to go through the following switches, the current status will be displayed: **TRAVEL** Travel Pressure switch status **AUTO** Auto mode Pressure switch status **BOOST** Boost Pressure switch status **BOOM** Boom Pressure switch status **UPPER** Upper Pressure switch status **SLEW** Slew Pressure switch status **HAMMER**(1) Hammer Pressure switch status
PUMP AMPS	Displays the current duty cycle of the pump control solenoid in mA
RPM VALUE	Displays the current value of the engine speed in RPM.
SERIAL NO	Displays the serial number.

(1) If enabled

EMS Set+Mode (20 sec) Menu.

When the SET and MODE buttons on the EMS are pressed together for 20 seconds a sub menu structure appears, enabling JCB trained personnel to cancel the intermediate service warning, calibrate the throttle and override the engine speed sensor input to energise solenoids for testing purposes. The up/down arrows scrolls through the menu and the item is selected by pressing the "ACK" button. Pressing "SET" at any time will return the operator to the normal display.

SERVICE OFF	The intermediate service warning can be cancelled by entering this menu
OIL CHG INT	The oil change interval can be set to "0", "1" or "2". 0 = 500 hour oil change (less than 0.2% sulphur), 1 = 250 hour oil change (0.2% - 0.4% sulphur), 2 = 125 hour oil change (more than 0.4% sulphur).
FAN TEST?	When selected this menu option will cause the fan to run at a fixed (predetermined) speed regardless of machine temperatures.
OVERRIDE?	When selected this function enables outputs to solenoids even when the engine is off, for testing purposes.
KEROSEN ENG	Press ACK. Use the scroll buttons to turn either "ON" or "OFF". Press ACK.
QH ENABLE? QH TYPE?	Up or down arrows enable/disable function. "ACK" enters a configuration menu. Up or down arrows change between type 1 or type 2. "ACK" to accept selection and return.
HRSEPWR MON	When selected this function will log information on engine speed, pump milliamps and mode over a selectable period up to 15 mins and display the data as a graph.
CALIBRATION	Throttle calibration. The throttle calibration should be performed on every new machine, when the throttle linkage parts are replaced or when the "NO THROTTLE" warning appears on the EMS.
HAM WARNING(1)	The hammer warning can be set "ON" or "OFF"

(1) Only When enabled

Fault Finding

JCB Servicemaster

TC-010

Introduction

Servicemaster is a gateway application allowing a large number of vehicle support applications to be linked using one familiar interface. The interface acts as a graphical tool for selecting the target vehicle from a database of vehicle families and triggering the particular service tool application desired. This removes the need for a user to 'remember' every individual service tool available and select which one is intended for a particular machine.

The interface also provides several key features that will accompany all JCB projects, a multi language editing tool that provides a means of individual text string translation for all JCB applications and the means to select a localised language translation for each JCB application.

The contents of this document aim to explain to you, the user, how to operate this application and to make most of its functionality.

C065910

Fig 1.

Fault Finding Without Using the JCB Servicemaster Diagnostic Tool

TC-015

Introduction

The AMS system is designed so that all of the components that are connected to the system are able to communicate with each other. This means not only are the machine hours displayed on the Electronic Monitor (EMS) but also they are recorded in the Electronic Control Unit 1 (ECU-1).

Changing Machine Components

Under such circumstances where fault diagnosis is not possible by using the JCB Servicemaster diagnostic tool then the following actions must be taken in circumstances where a change of the Electronic Control Unit 1 (ECU-1) and/or the Electronic Monitor System (EMS) is unavoidable.

1 If either a new ECU-1 or new EMS. is fitted to either a new or old machine, the machines working hours will pass automatically to the new units and upgrade them when the machines ignition is switched on.

Note: *This includes stock machines with over 1 hour recorded by the AMS system.*

2 Only under extreme circumstances should either the ECU-1 or the EMS be transferred to a machine with lower working hours than the donor machine. The effect of this would be to automatically transfer the higher hours information to the recipient machine.

Note: *This process is not reversible.*

3 When either an ECU-1. or EMS is changed on a machine, the machine system must be set up again using the Set Up Service Tool. Without this action some options previously active would not function and the throttle system would not be calibrated.

4 To remove the EMS unit, carefully pull the unit away from the facia panel. The unit is held in place by a retaining seal only and is a tight fit, do not attempt to lever the unit out as this could cause damage to the the E.MS and the facia panel. Re-assembly is a reversal of this procedure.

5 To access the ECU-1,remove the seven panel screws from the panel behind the seat and remove panel.

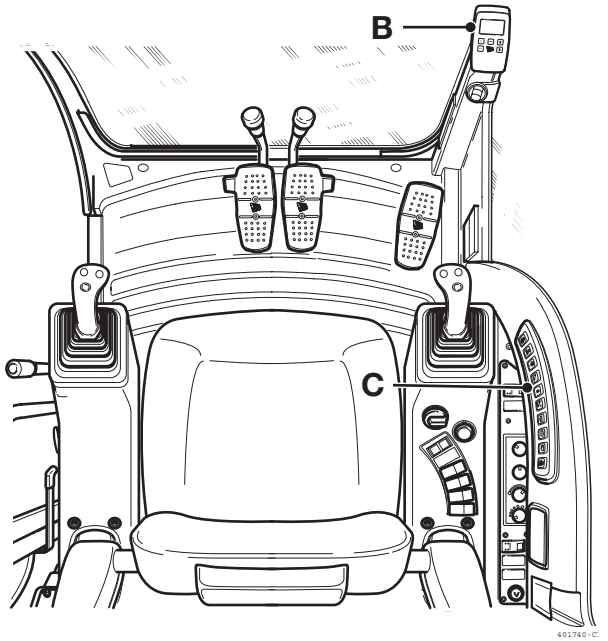
6 To remove the ECU-1, remove the three Allen screws which fasten the computers to a frame. To remove the machine harnesses from the computers, undo the Allen screw integral to each connector. Re-assembly is a reversal of this procedure.

Note: *On the ECU-1 the identification letters for the individual harness connectors and the fixed harness connections on the computer itself, are the cast letters (A,B,C) on the body of the computer.This is vital when identifying connectors and pins during fault diagnosis.*

7 The Facia Switch Panel (FSP) is not affected by any changes of other components.

The system comprises of the following main electronic components:

69-A	Electronic Control Unit -1 (ECU-1)
68-B	Electronic Monitoring System (EMS)
68-C	Fascia switch panel (FSP).



401741-C1

Fig 68.

Service Procedure

Testing of ECU Inputs + Outputs

TC-014_2

Remove panel behind drivers seat, for access to the ECU **A**.

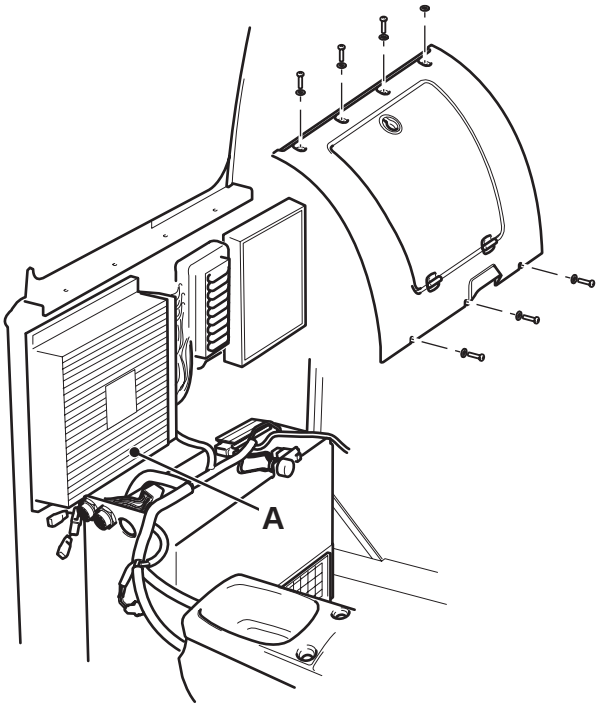


Fig 1.

Care should be taken when testing the inputs + outputs of the ECU to ensure that correct test method is used to determine if the ECU is functioning normally.

Note: *Inputs/outputs should be checked with engine running or in solenoid override mode, refer to* ***Section C, EMS Set+Mode (20 sec) Menu.***

Testing Low Side Input

With the switch open the meter will read 0v.

With the switch closed the meter will read 24-28v.

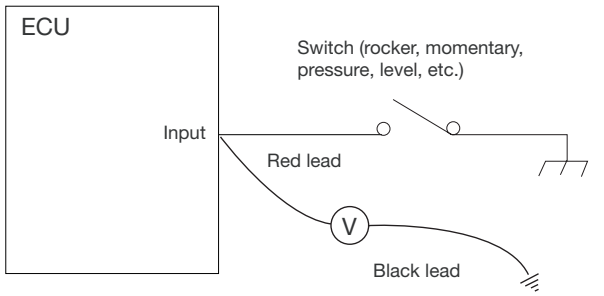


Fig 2.

Testing High Side Input

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With the switch closed the meter will read 24-28v.

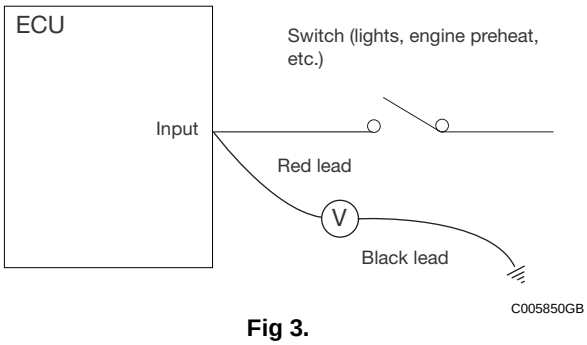

Fig 3.

Service Procedure

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TC-014_2

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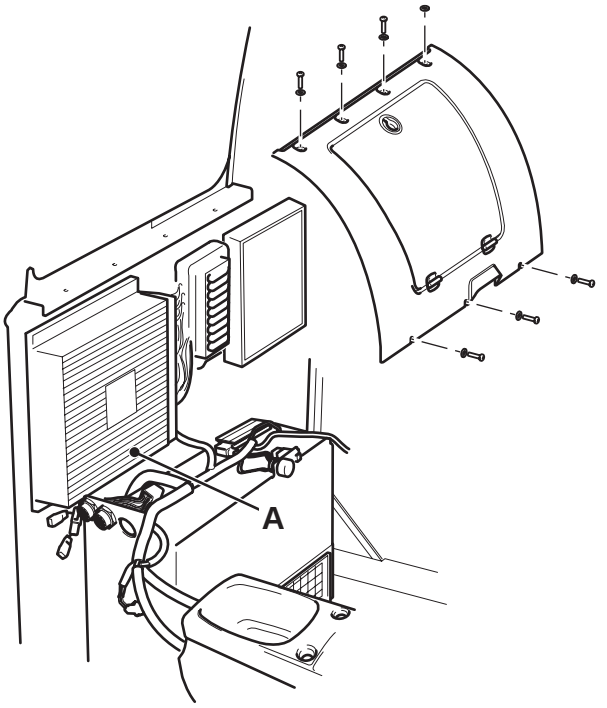

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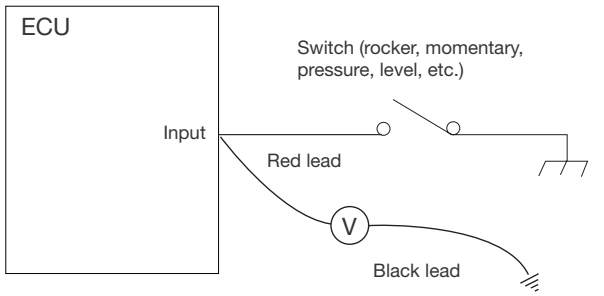

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Testing High Side Input

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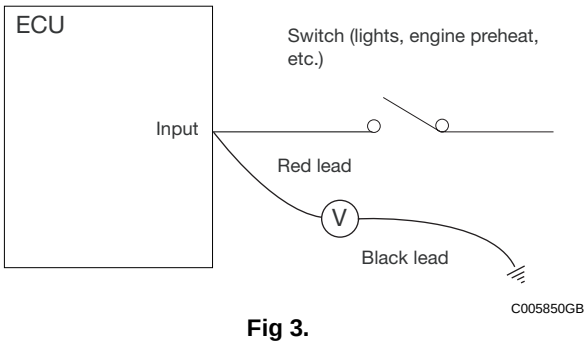

Fig 3.

Using a Multimeter

TC-002

In order to obtain maximum benefit from the fault finding information contained in Section C it is important that the technician fully understands the approach to fault finding and the use of the recommended test equipment, in this case a FLUKE 85 or AVO 2003 digital multimeter, or a moving pointer (analogue) multimeter. The approach is based on a fault finding check list. In tracing the fault from the symptoms displayed you will be directed to make measurements using a multimeter.

These instructions are intended to cover the use of the recommended multimeters.

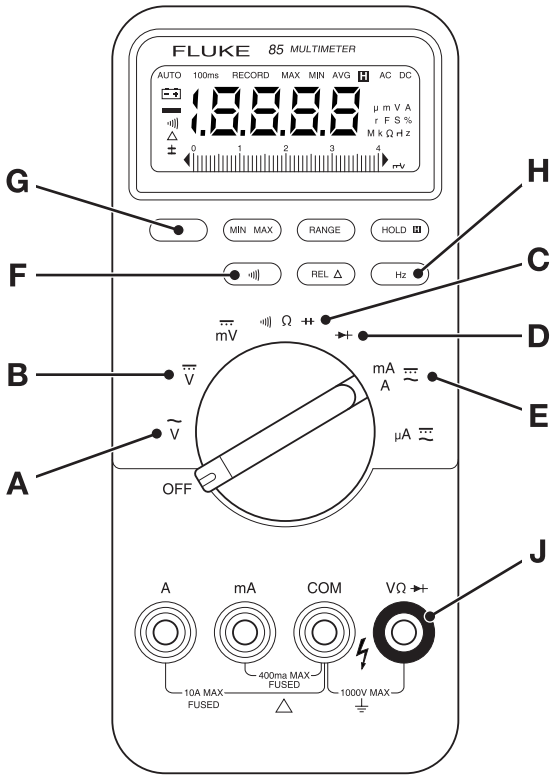

Fig 7. FLUKE 85

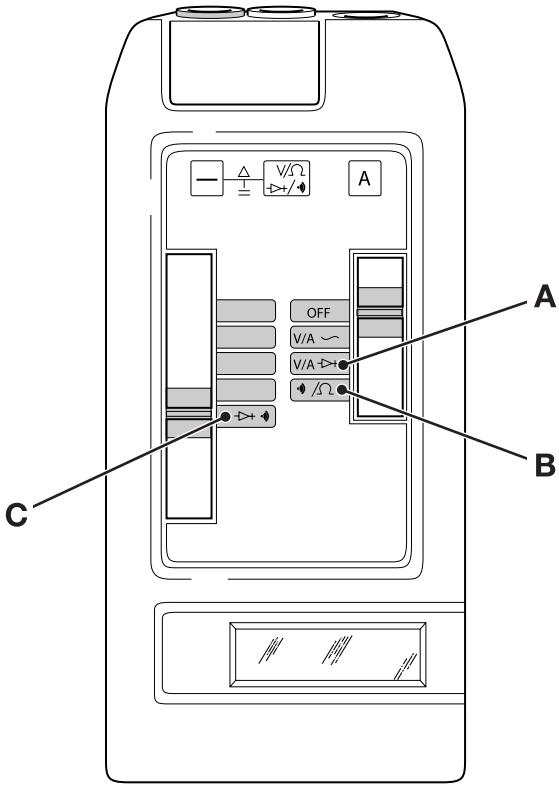

Fig 8. AVO 2003

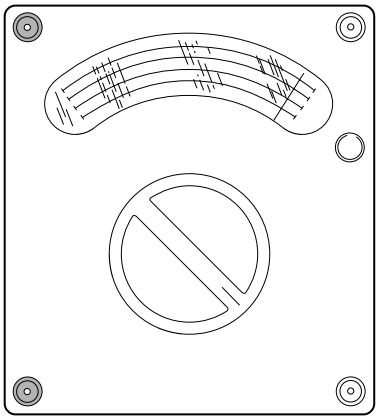

Fig 9. A Typical Analogue Meter

1 Make sure that the test leads are plugged into the correct sockets. The black test lead should be

Using a Multimeter

TC-002

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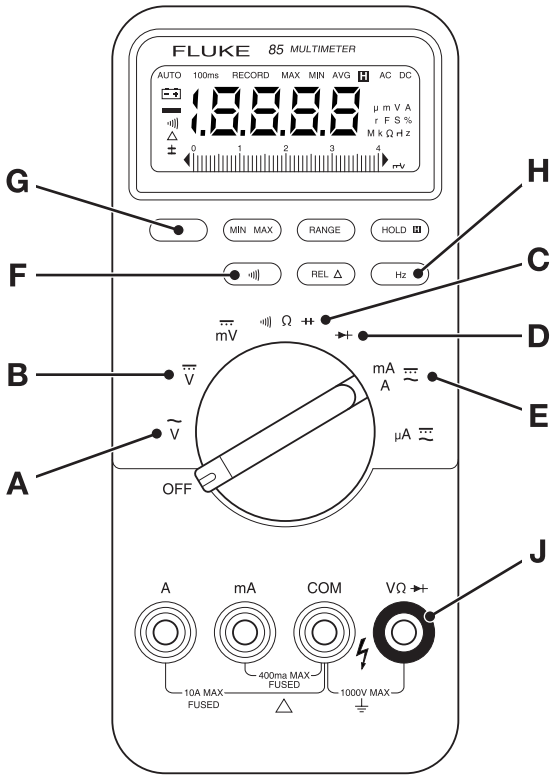

Fig 7. FLUKE 85

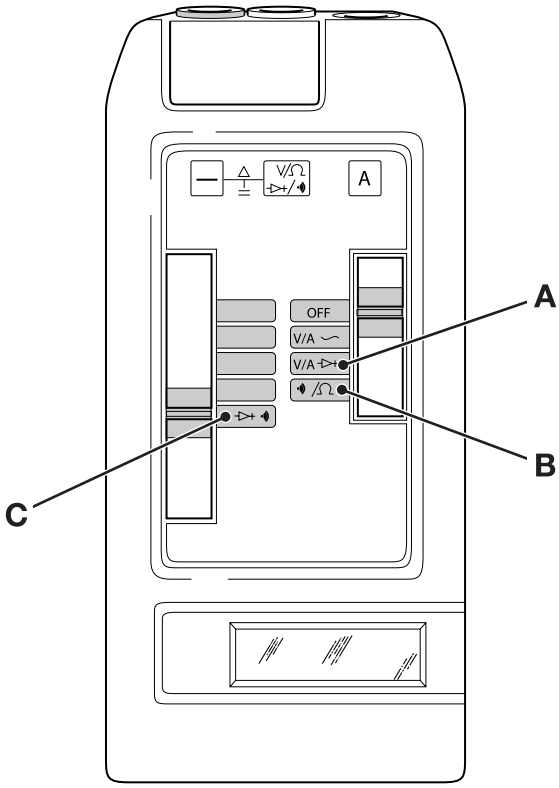

Fig 8. AVO 2003

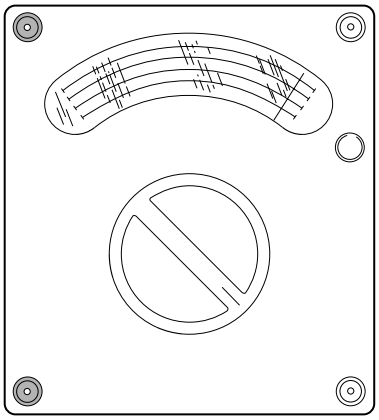

Fig 9. A Typical Analogue Meter

1 Make sure that the test leads are plugged into the correct sockets. The black test lead should be

Battery

TC-001_4

Maintenance

To ensure that the battery provides optimum performance the following steps should be observed:

1 Make sure that the electrical connections are clean and tight. Smear petroleum jelly on connectors to prevent corrosion.

2 When applicable - never allow the electrolyte level to fall below the recommended level - 6 mm (1/4 in) above the plates. Use only distilled water for topping up.

3 Keep the battery at least three quarters charged, otherwise the plates may become sulphated (hardened) - this condition makes recharging the battery very difficult.

Extra precautions must be taken when bench charging maintenance free batteries, they are more prone to damage by overcharging than the standard type of battery:

- Never boost-charge a maintenance free battery.
- Never charge a maintenance free battery at a voltage in excess of 15.8 Volts.
- Never continue to charge a maintenance free battery after it begins to gas.

⚠ WARNING

Batteries give off an explosive gas. Do not smoke when handling or working on the battery. Keep the battery away from sparks and flames.

Battery electrolyte contains sulphuric acid. It can burn you if it touches your skin or eyes. Wear goggles. Handle the battery carefully to prevent spillage. Keep metallic items (watches, rings, zips etc) away from the battery terminals. Such items could short the terminals and burn you.

Set all switches to OFF before disconnecting and connecting the battery. When disconnecting the battery, take off the earth (-) lead first.

Re-charge the battery away from the machine, in a well ventilated area. Switch the charging circuit off before connecting or disconnecting the battery. When you have installed the battery in the machine, wait five minutes before connecting it up.

When reconnecting, fit the positive (+) lead first.

5-3-4-12

Testing

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 vehicle.

Connect up the battery tester as follows:

1 Set the CHECK/LOAD switch **10-A** to OFF.

2 Set rocker switch **10-B** to the battery voltage (12V).

3 Connect the red flying lead to the battery positive (+) terminal and the black flying lead to the battery negative (-) terminal.

Wiring Harness Repair

TC-004

Introduction

Instances do occur where it is necessary to incorporate auxiliary electrical components into existing electrical circuits and, although unlikely with present wiring harnesses, repair or replace specific individual wires within a harness. This will also apply to other machines in addition to those of manufacture.

To ensure that either the inclusion of an auxiliary electrical component or a repair within a harness is completed to an acceptable standard it is strongly recommended that the following tools, equipment and procedures are always used. Note that JCB harnesses have an International Protection rating of 67 (I.P.67).

The sheath covering of the recommended splice is heat shrunk onto the original wire insulation. This results in a seal and corresponding joint to IP 67 specifications.

⚠ CAUTION

When installing Auxiliary Electrical Components always ensure that the additional load rating is suitable for that particular circuit. It is unacceptable to simply increase the fuse rating as this can cause overloading and consequential failure of wiring, along with failure of integral circuit components, which the fuse is protecting.

ELEC-2-1

⚠ WARNING

In addition to the warnings incorporated into this procedure, extreme care should be taken when handling the gas heating tool to ensure that the flame does not damage or set fire to any items in the vicinity of the repair, i.e. other wires, floor panels, floor mats, sound proofing, paintwork, etc. This tool should not be used in any restricted location prohibiting the use of "Naked Flames" or where risk of explosive gas or similar safety parameters apply. No other heat source should be used to attempt a sealed joint.

ELEC-2-2

⚠ CAUTION

When the heater is in use, the reflector and the air coming out are extremely hot. Keep away to avoid accidental burns. Do not touch the reflector until it has had time to cool down after switching off. If flame reappears at the reflector when the heater is in use, the catalytic element is damaged or used up. Stop work immediately and replace the heater.

ELEC-2-3

Repair Procedure

Table 3. Tools Required

Part No.	Description	Qty
892/00350	Butane Heater assembly	1
892/00349	Crimp tool	1
892/00351	Splice 0.5-1.5 mm (Red)	50
892/00352	Splice 1.5-2.5 mm (Blue)	50
892/00353	Splice 3.0-6.0 mm (Yellow)	50

1 Cut the wire and remove the protective insulation for a suitable distance dependent upon the size of wire and splice to be used. For the splices detailed in ⇨ *Table 3. (C-174)*, the dimension is 7mm.

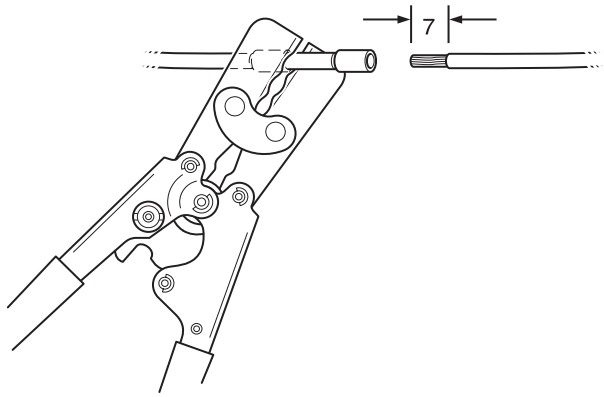

Fig 11.

2 Using the correct sized splice, attach the new section of wire required or auxiliary flying lead to the existing harness and secure using the crimp tool. ⇨ *Fig 11. (C-174)*. Note that each of the splices detailed is colour-coded to make size and range

Harness Data

Harness Interconnection

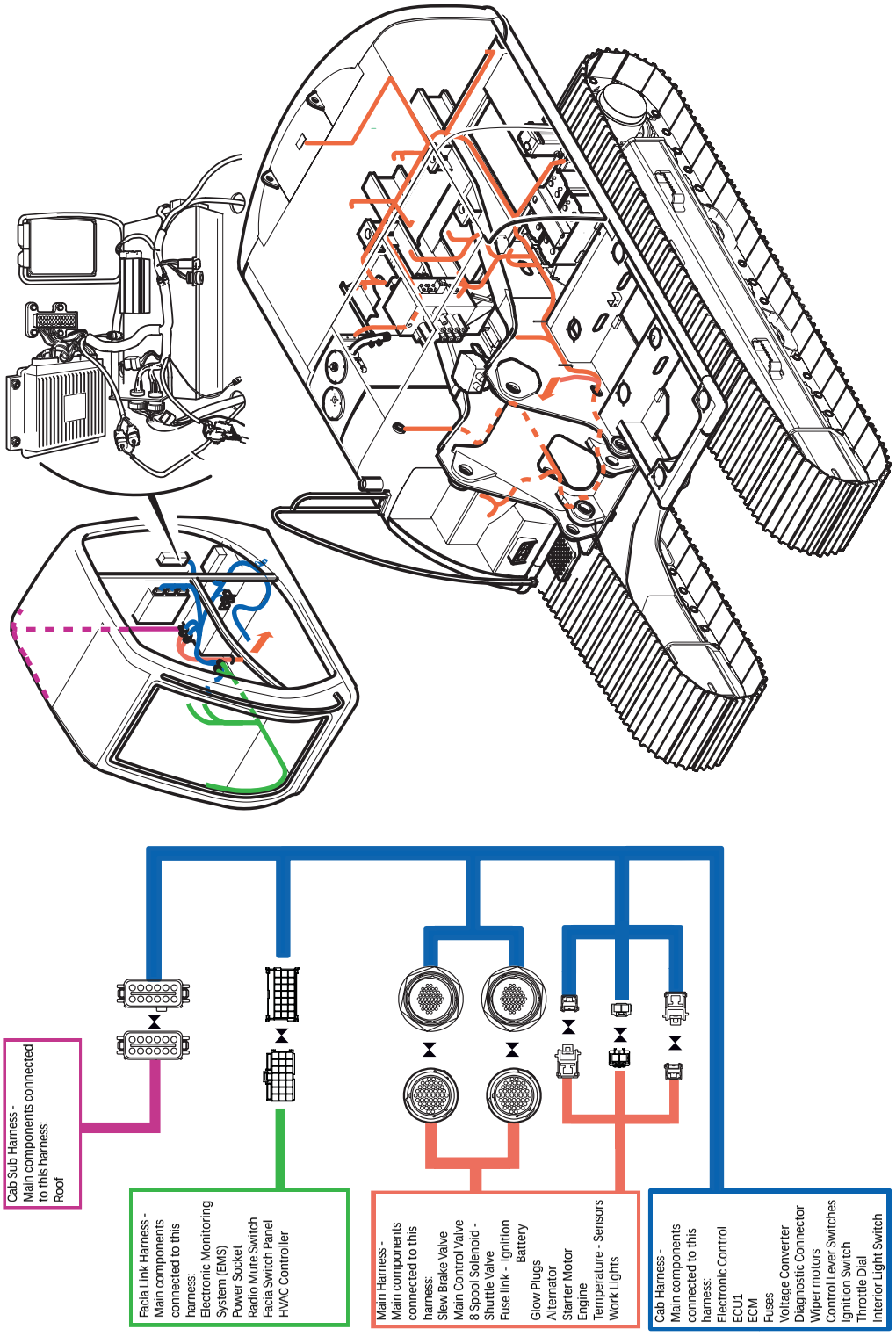

Fig 1. Harness Location and Interconnection (Type 2 Fascia Harness and Type C Cab Harness Shown)

Main Harness

Connector Location

For connector identification ⇨ *Table 1. (C-181)*

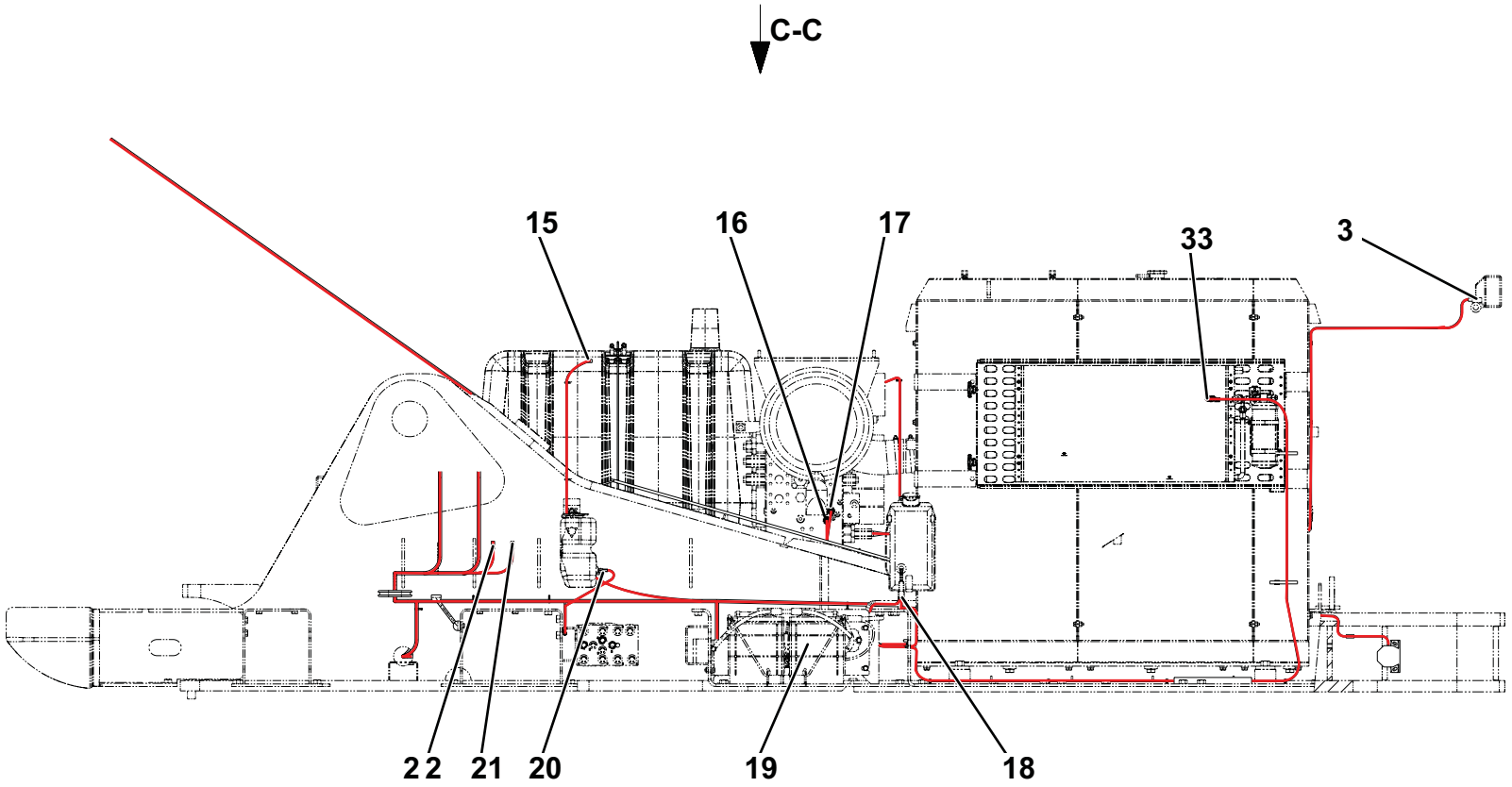

Fig 2. Figure B-B

Fascia Link Harness - Type 1

TC-016

Connector Location

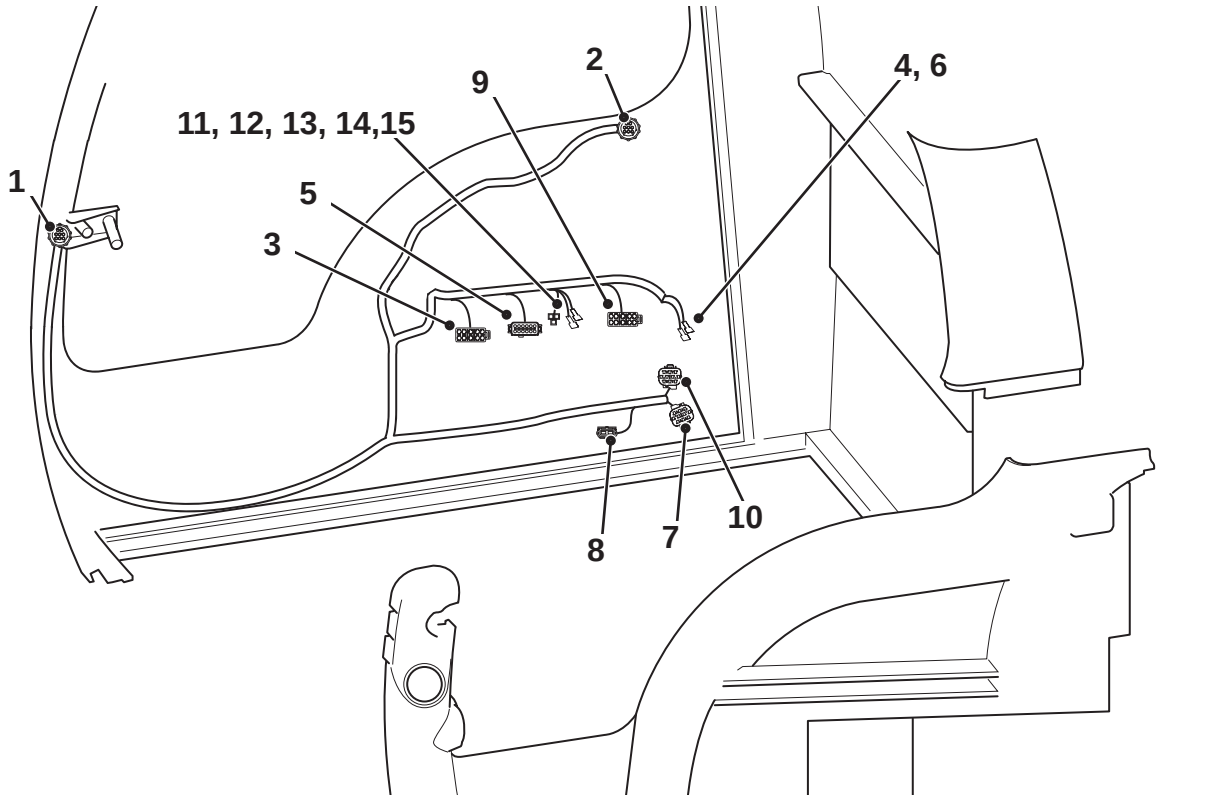

Fig 11.

Connector Identification

Table 2.

Item	Connector	Function	Location
1	C14	Monitor EMS	⇨ *Fig 12. (C-190)* & ⇨ *Fig 13. (C-191)*
2	C15	Facia Switch Panel	⇨ *Fig 12. (C-190)* & ⇨ *Fig 13. (C-191)*
3	C24	Worklamp Switch	⇨ *Fig 12. (C-190)* & ⇨ *Fig 13. (C-191)*
4	C309	Cigar Lighter	⇨ *Fig 12. (C-190)* & ⇨ *Fig 13. (C-191)*
5	C49	Road Light Switch (Red Marker -Tape)	⇨ *Fig 12. (C-190)* & ⇨ *Fig 13. (C-191)*
6	C159	Cigar Lighter Illumination	⇨ *Fig 12. (C-190)* & ⇨ *Fig 13. (C-191)*
7	C180	Cab 1 (Cab Harness connection)	⇨ *Fig 12. (C-190)* & ⇨ *Fig 13. (C-191)*
8	C181	Wheeled Harness	⇨ *Fig 12. (C-190)* & ⇨ *Fig 13. (C-191)*
9	C223	Radio Mute switch	⇨ *Fig 12. (C-190)* & ⇨ *Fig 13. (C-191)*
10	C225	Cab 3 (Cab harness connection)	⇨ *Fig 12. (C-190)* & ⇨ *Fig 13. (C-191)*
11	430	Panel Illumination	⇨ *Fig 13. (C-191)* (heater only)
12	410	Fresh/Recirc. 2	⇨ *Fig 13. (C-191)* (heater only)
13	420	Fresh/Recirc. 1	⇨ *Fig 13. (C-191)* (heater only)
14	380	Water Valve	⇨ *Fig 13. (C-191)* (heater only)
15	370	Blower Speed Switch	⇨ *Fig 13. (C-191)* (heater only)

Fascia Link Harness - Type 2

Connector Location

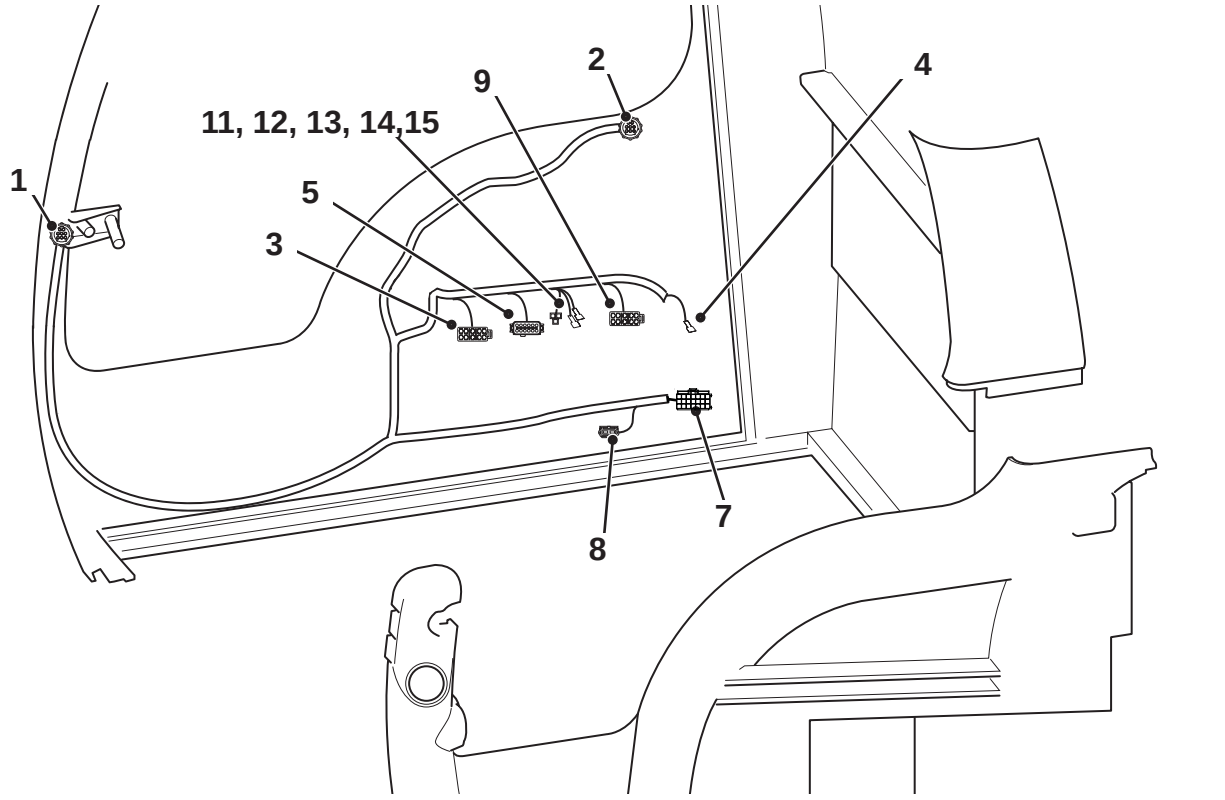

Fig 14.

Connector Identification

Table 3.

Item	Connector	Function	Location
1	C14	Monitor EMS	⇨ *Fig 15. (C-193)* & ⇨ *Fig 16. (C-194)*
2	C15	Facia Switch Panel	⇨ *Fig 15. (C-193)* & ⇨ *Fig 16. (C-194)*
3	C24	Worklamp Switch	⇨ *Fig 15. (C-193)* & ⇨ *Fig 16. (C-194)*
4	C309	Power Socket	⇨ *Fig 15. (C-193)* & ⇨ *Fig 16. (C-194)*
5	C49	Road Light Switch (Red Marker -Tape)	⇨ *Fig 15. (C-193)* & ⇨ *Fig 16. (C-194)*
7	C180	Cab 1 (Cab Harness connection)	⇨ *Fig 15. (C-193)* & ⇨ *Fig 16. (C-194)*
8	C181	Wheeled Harness	⇨ *Fig 15. (C-193)* & ⇨ *Fig 16. (C-194)*
9	C223	Radio Mute switch	⇨ *Fig 15. (C-193)* & ⇨ *Fig 16. (C-194)*
11	430	Panel Illumination	⇨ *Fig 16. (C-194)* (heater only)
12	410	Fresh/Recirc. 2	⇨ *Fig 16. (C-194)* (heater only)
13	420	Fresh/Recirc. 1	⇨ *Fig 16. (C-194)* (heater only)
14	380	Water Valve	⇨ *Fig 16. (C-194)* (heater only)
15	370	Blower Speed Switch	⇨ *Fig 16. (C-194)* (heater only)

Cab Harness - Type A

TC-017

Connector Location

For connector identification ⇨ *Table 4. (C-196)*

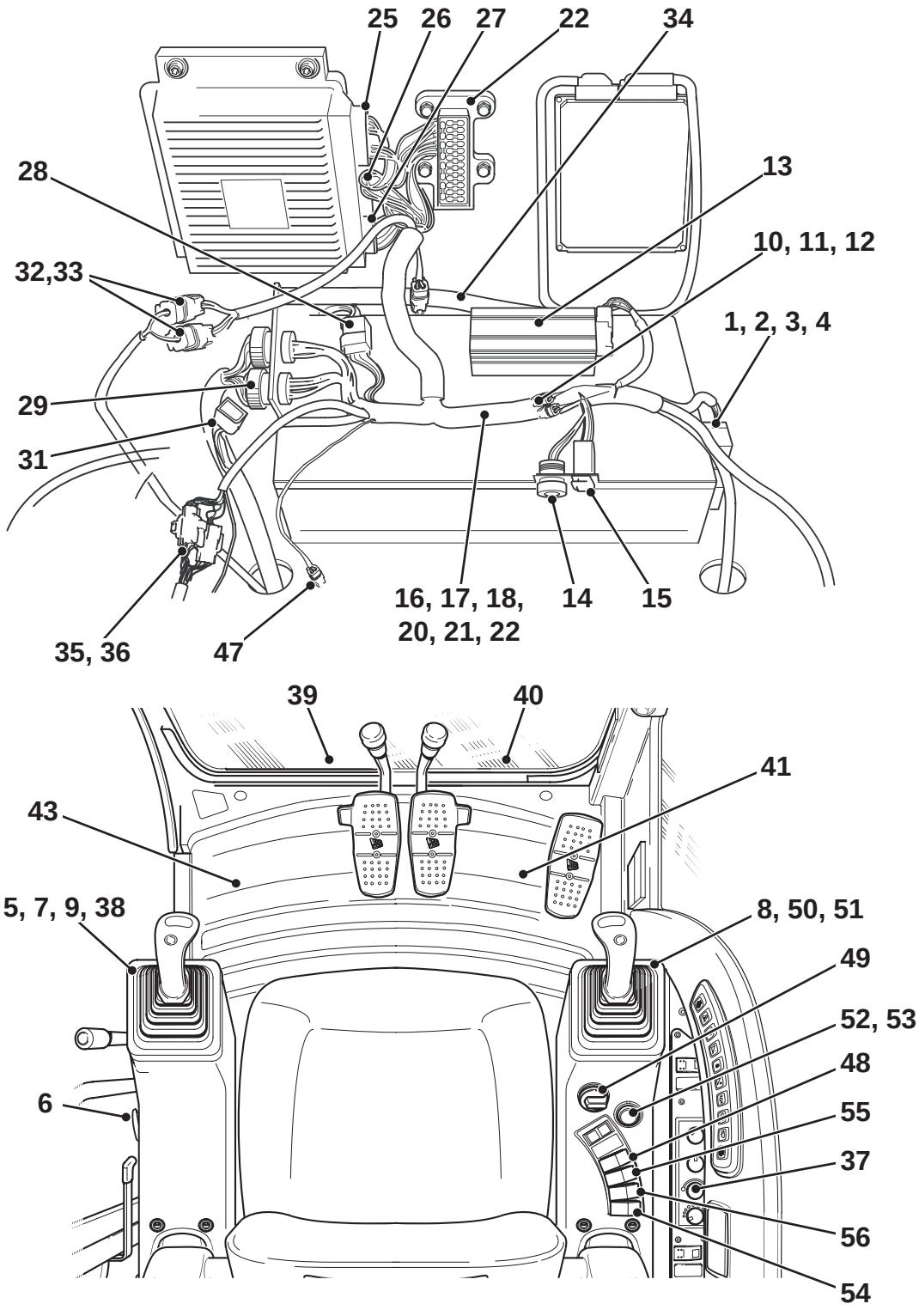

Fig 17.

Cab Harness (includes Engine Harness) - Type B

Connector Identification

Table 6.

Item	Connector	Function
1 - 10 ⇨ *Cab Harness `A' 332/J3663 - Issue 1 (C-209)*		
1	C0173	Earth Header
2	C0174	Earth Header
3	C0175	Earth Header
4	C0176	Earth Header
5	C115	Lever Limit Switch
6	C222	Interior Lamp Switch
7	C33	(Dozer On Switch (wheeled only))
8	C32	Lever Hammer Switch
9	C34	Horn Switch
10	EH	Earth Header
11 - 25 ⇨ *Cab Harness `B' 332/J3663 - Issue 1 (C-210)*		
11	C219	Auxiliary 1
12	C226	Auxiliary 2
13	C224	Voltage Converter
14	C11	Diagnostic Connector
15	C13	Redundancy Switch
16	C228	Lower Wiper
17	C227	Wiper 2
18	C110	Diode 1 Washer
19	C161	Diode 5
20	C155	Diode 3 Redundancy 1
21	C156	Diode 4 Redundancy 2
22	C320	Int Lamp Diode
23	C0256	ECM Engine
24	C0009	Auto Fan
25	C318	Qualcom Tracking
26 - 33 ⇨ *Cab Harness `C' 332/J3663 - Issue 1 (C-211)*		
26	C296	Fuse Box
27	C254	Lift Pump
28	C230	Refuel Pump Relay
29	C271	Emergency Stop
30	C0251	Main Relay
31	C0257	ECM Engine
32	C263	Barometric
33	C252	Teir III Link

Item	Connector	Function
34 - 39 ⇨ *Cab Harness `D' 332/J3663 - Issue 1 (C-212)*		
34	C258	Cab Connector C
35	C1	Connector A
36	C0218	HVAC Unit Connector
37	C8	ECU Connector A
38	C164	Earth Connector
39	C4	Wheeled Option Cab
40 - 47 ⇨ *Cab Harness `E' 332/J3663 - Issue 1 (C-213)*		
40	C180	Fascia Link 1
41	C811	Fascia Link 3
42	C10	ECU Connector C
43	C9	ECU Connector B
44	C6	24V Supply
45	C5	24V Supply (battery)
46	C0250	
47	C0214	Cab Roof Harness
48 - 62 ⇨ *Cab Harness `F' 332/J3663 - Issue 1 (C-214)*		
48	C112	Breaker Pilot Switch
49	C172	Blanking Connection
50	C0232	Merge Flow Solenoid B
51	C167_1	Plug
52	C163	Merge Solenoid Valve C
53	C163_1	Plug
54	C169	Ham/Aux/Sol V C
55	C169_1	Plug
56	C204	Boom Up Pressure Switch
57	C71_1	Plug
58	C73	Swing Pilot Switch
59	C221	Auto Mode Pressure Switch
60	C57	Boom Priority
61	C201	Lower Wiper
62	C201_1	Plug
63 - 72 ⇨ *Cab Harness `G' 332/J3663 - Issue 1 (C-215)*		
63	C22	Throttle Dial
64	C0027	Lever Switch
65	C30	Grab CCW/CW
66	C184	Key Switch A
67	C43	Boom Priority Switch
68	C202	Heated Seat Switch

Cab Harness (includes Engine Harness) - Type C

Connector Identification

Table 7.

Item	Connector	Function
1 - 10 ⇨ *Cab Harness `A' 332/J3254 - Issue 3 (C-218)*		
1	C0173	Earth Header
2	C0174	Earth Header
3	C0175	Earth Header
4	C0176	Earth Header
5	C115	Lever Limit Switch
6	C222	Interior Lamp Switch
7	C33	(Dozer On Switch (wheeled only))
8	C32	Lever Hammer Switch
9	C34	Horn Switch
10	EH	Earth Header
11 - 25 ⇨ *Cab Harness `B' 332/J3254 - Issue 3 (C-219)*		
11	C219	Auxiliary 1
12	C226	Auxiliary 2
13	C0253	Tech 2
14	C11	Diagnostic Connector
15	C13	Redundancy Switch
16	C214	Lower Wiper
17	C228	Wiper 2
18	C110	Diode 1 Washer
19	C161	Diode 5
20	C155	Diode 3 Redundancy 1
21	C156	Diode 4 Redundancy 2
22	C320	Int Lamp Diode
23	C0256	ECM Engine
24	C224	Volt Dropper
25	C318	Qualcom Tracking
26 - 30 ⇨ *Cab Harness `C' 332/J3254 - Issue 3 (C-220)*		
26	C254	Lift Pump
27	C230	Refuel Pump Relay
28	C271	Emergency Stop
29	C0257	ECM Engine
30	C0263	Barometric
31 - 34 ⇨ *Cab Harness `D' 332/J3254 - Issue 3 (C-221)*		
31	C252	Tier 3 Link
32	C296	Fusebox
33	C349	Beacon Relay
34	C251	Main Relay
35 - 39 ⇨ *Cab Harness `E' 332/J3254 - Issue 3 (C-222)*		
35	C1	Connector A
36	C0218	HVAC Unit Connector
37	C8	ECU Connector A
38	C164	Earth Connector
39	C4	Wheeled Option Cab
40 - 46 ⇨ *Cab Harness `F' 332/J3254 - Issue 3 (C-223)*		
40	C180	Fascia Link 1
41	C0214	Cab Roof Harness
42	C10	ECU Connector C
43	C9	ECU Connector B
44	C6	24V Supply
45	C5	24V Supply (battery)
46	C0250	
47 - 62 ⇨ *Cab Harness `G' 332/J3254 - Issue 3 (C-224)*		
47	C0214	Cab Roof Harness
48	C112	Breaker Pilot Switch
49	C172	Blanking Connection
50	C0232	Merge Flow Solenoid B
51	C167_1	Plug
52	C163	Merge Solenoid Valve C
53	C163_1	Plug
54	C169	Ham/Aux/Sol V C
55	C169_1	Plug
56	C204	Boom Up Pressure Switch
57	C71_1	Plug
58	C73	Swing Pilot Switch
59	C221	Auto Mode Pressure Switch
60	C57	Boom Priority
61	C201	Lower Wiper
62	C201_1	Plug
63 - 72 ⇨ *Cab Harness `H' 332/J3254 - Issue 3 (C-225)*		
63	C22	Throttle Dial
64	C0027	Lever Switch
65	C30	Grab CCW/CW
66	C184	Key Switch A
67	C43	Boom Priority Switch

Technical Data

General Data

Valve Block

Table 1.

Type	Hydraulic Pilot System
Operating System	Set pressure relief
Main Relief Pressure:	
Standard	319 bar (4626 lb/in²) at 220 litre/min (48 UK gal)
Pressure Raising	343 bar (4975 lb/in²) at 240 litre/min (53 UK gal)
Overload Relief Pressure:	
Bucket open/close	363 bar (5264 lb/in²) at 20 litre/min (4.4 UK gal)
Dipper	363 bar (5264 lb/in²) at 20 litre/min (4.4 UK gal)
Boom Raising	363 bar (5264 lb/in²) at 20 litre/min (4.4 UK gal)
Boom Lowering	245 bar (3553 lb/in²) at 20 litre/min (4.4 UK gal)
Aux	300 bar (4351 lb/in²) at 20 litre/min (4.4 UK gal)
TAB	363 bar (5264 lb/in²) at 20 litre/min (4.4 UK gal)
Function	Travel priority, Slew priority, Boom and Dipper holding valves, Boom and Dipper 2-Speed internal confluence

Slew Motor

Table 2.

Displacement	210.1 cc/rev
Pressure Relief	284 bar @ 305 l/min
Rated Speed	840 rpm
Brake Torque	1050 Nm
Release Pressure	24 bar
Max Release Pressure	49 bar
Oil Quantity	approx 1.5 litres
Dry Weight	77kg

Slew Gearbox

Table 3.

Ratio	23.17:1
Output Torque	19649 Nm
Output Speed	60.2 rpm
Oil Quantity	approx 16 litres
Dry Weight	approx 300 kg

Basic System Operation

Component Identification

Table 1.

Item	Description
A	Main Control Valve
B	Swing Motor/Swing Gearbox
C	Plexus Filter
D	Servo Return Filter
E	Shuttle Valve
F	Cushion Valve
G	Swing Shut-off Valve
H	In Line Filter
J	Strainer
K	Return Filter
L	8 Station
M	Tank Return Manifold
N	Servo Feed Filter
P	Cab Manifold

Introduction to Hydraulic Schematic Symbols

TE-001

General (Basic and Functional Symbols)

Complex hydraulic components and circuits can be described to the engineer by using graphical symbols. The following pages illustrate and give a brief description for some of the more common symbols used.

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Table 2. General

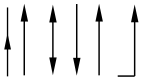
	Spring
	Flow restriction affected by viscosity
	Direction of flow
	Indication of rotation
	Indication of direction and paths of flow
	Variable control

Table 3. Rams

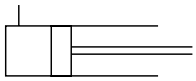
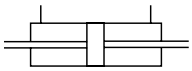
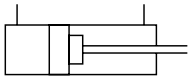
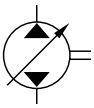
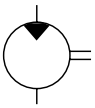
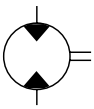
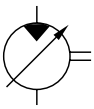
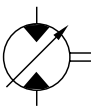
	Single acting
	Double acting
	Double ended
	Double acting with damping at rod area end

Table 4. Pumps and Motors

	Variable capacity pump two directions of flow
	Fixed capacity motor one direction of flow
	Fixed capacity motor two directions of flow
	Variable capacity motor one direction of flow
	Variable capacity motor two directions of flow

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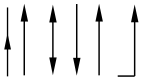	Indication of direction and paths of flow
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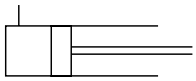
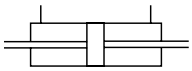
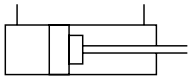
Table 3. Rams

	Single acting
	Double acting
	Double ended
	Double acting with damping at rod area end

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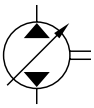
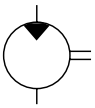
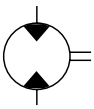
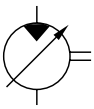
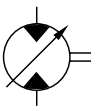
	Variable capacity pump two directions of flow
	Fixed capacity motor one direction of flow
	Fixed capacity motor two directions of flow
	Variable capacity motor one direction of flow
	Variable capacity motor two directions of flow

Circuit Descriptions

Hydraulic Schematic

JS360

The item numbers in the following table are identified on the Hydraulic Schematic diagrams. ⇒ *Fig 1. (E-17)*

Table 1. Component identification

Item	Part number	Description	Location
1	20/952286	Slew Motor	Centre Section of Machine
2	332/J2616	Rotary Coupling	Centre Section of Machine
3	332/J0120	Dipper Ram	On the Dipper
4	332/J8194	Dipper HBCV	On the Dipper Ram
5	05/204600	Travel Motor	Running Gear
9	45/910500	Coupling Male 1/2”	End of Dipper Pipework
10	45/910400	Coupling Female 1/2"	End of Dipper Pipework
11	25/223448	TAB Cylinder	On the TAB
12	332/J8195	Boom/TAB HBCV	On the TAB Cylinder
13	332/J0121	Bucket Cylinder	On the Dipper
14	25/223447	Main Control Valve	Centre Section of Machine
16	332/J0119	Boom Cylinder	On the Boom
17	JSJ0083	L/F DCV Closed Centre	
19	332/J2697	HBCV Manifold	Front A Frame
20	JRJ0344	L/F DCV Open Centre	
22	701/80199	Pressure Switch	
24	25/223448	TAB Valve	
25	JSV0352	Shut Off Valve	
26	25/222594	Hammer/Aux Valve	
27	25/222595	Hammer/Aux Valve	
28	KSJ2390	Check Valve 1 Bar	
29	32/925741	Hammer Return Filter	
31	30/927019	GA Cooling Pack ABI	Engine Bay
32	25/223600	Check Valve 5 Bar	
34	KNJ0287	Drain Filter	On Hydraulic Tank
35	32/925692	Air Breather	On Top of Hydraulic Tank
36	JRJ0238	Plexus Filter	Rear Side of Pump Bay
37	215/12552	Hydraulic Tank ABI	Right Hand Side of Machine

Main Servo/Pilot Line

Components

1 Cab Manifold

2 8 Station

3 Shuttle Valve

4 Travel pedal

5 Slew Lock Solenoid

6 Cushion Valve

7 Main Control Valve

- **a** Dipper 2
- **b** Boom 1
- **c** Bucket
- **d** Travel Right hand
- **e** Dipper 1
- **f** Boom 2
- **g** Slew
- **h** Option
- **i** Travel Left hand

8 Tank Return

Hose Colour

BL	Blue
BR	Brown
CI	Colourless
G	Green
GR	Grey
LB	Light Blue
O	Orange
P	Pink
R	Red
V	Violet
W	White
Y	Yellow
LG	Light Green
DG	Dark Green

Cab Servo/Pilot Line

Components

1 Right Joystick

2 Travel pedal

3 Left Joystick

4 Cab Manifold

5 Shuttle Valve

Hose Colour

BL	Blue
BR	Brown
CI	Colourless
G	Green
GR	Grey
LB	Light Blue
O	Orange
P	Pink
R	Red
V	Violet
W	White
Y	Yellow
LG	Light Green
DG	Dark Green

Servo/Pilot Pressure and Return Line

Components

1 Slew Motor

2 Rotary coupling

3 8 Station

4 Cushion Valve

5 Tank Manifold

6 Main Pump

7 Main Control valve

8 Cab Manifold

9 Servo Filter

Hose Colour

BL	Blue
BR	Brown
CL	Colourless
G	Green
GR	Grey
LB	Light Blue
O	Orange
P	Pink
R	Red
V	Violet
W	White
Y	Yellow
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Neutral Circuit

For Schematic, ⇨ *Fig 8. (🗋 E-31)*.

With all the controls in the neutral position, flow from pump **1** enters the main control valve **14** at port P2 and flow from pump **2** enters the main control valve **14** at port P1.

Oil is allowed to flow across all of the spools via the neutral gallery when all controls are in the neutral position. Oil from pump **1** exits port Ps2 and oil from pump **2**, exits port Ps1 at the top of the main control valve.

Both flows of oil meet a separate restrictor and relief valve. Some oil will pass through the restrictor above 40 bar and back to tank, creating back pressure in the line. Oil is exhausted across the negative controls relief valves at 40 bar (580 Ib in^2). The back pressure created is sent to ports Pi1 and Pi2 negative control ports on the pumps to keep the pumps at minimum flow.

Straight Line Travel

For individual travel and boom circuits, ⇒ *Fig 9. (E-33)*.

To demonstrate the linear travel, both travel spools and boom up spool have been selected, refer to individual circuits.

Servo pressure enters the main control valve **14** at Pa1 to select LH travel spool. This pressure is seen at the travel pressure switch **51** and also selects the linear travel (1) spool (LT1)

Servo pressure enters main control valve **14** at Pa6 to select RH travel spool. The pressure is also seen at the travel pressure switch **51** and also passes through the selected LT1 spool to select linear travel (2) spool (LT2)

Servo pressure has entered the main control valve **14** at Pa8 to select the boom up spool. This pressure is also seen at the upper pressure switch **52** and passes through LT2 to select liner travel spool (3) (LT3)

Oil from pump 1 enters the main control valve **14** at port P2 and is used at the boom 1 spool. This also passes over the selected LT3 spool to supply the boom 2 spool. The oil from both boom spools 1 and 2 merges and exits the main control valve **14** at A8 to raise the boom.

Oil from pump 2 enters the main control valve **14** at port P1 and is available at the LH travel spool and the RH travel spool via LT3.

Travel - Middle Speed

For schematic, ⇒ *Fig 10. (E-35)*.

When both tracks are selected forward, servo pressure from port 2 (LH travel lever), and port 4 (RH travel lever) **35** enters the main control valve **14** at Pa6 and Pa1 respectively, selecting the left and right hand travel spools.

Flow from pump 2 is available at the RH travel spool and is directed to the RH travel motor via port A1 of the main control valve **14**, through the rotary coupling and in to port P1 on the RH travel motor. Exhaust oil from the motor enters the main control valve **14** at port B1 and is directed by the LH travel spool to the tank port.

Flow from pump 1 is available at the LH travel spool and is directed to the LH travel motor via port A6 of the main control valve **14**, through the rotary coupling and in to port P2 on the LH travel motor. Exhaust oil from the motor enters the Main control valve **14** at port B6 and is directed by the LH travel spool to the tank port.

Servo pressure at ports Pa6 and Pa1 is also available at travel pressure switch **51** via the shuttle valves.

Pressure is lost on both negative control ports Ps1 and Ps2, which is sensed at the pumps which come into full flow.

Boom Up

For schematic, ⇒ *Fig 11. (E-37)*.

Servo pressure from the hand controller **48** enters the servo shuttle valve **46** at port A3 and is distributed to:

1 Boom up pressure switch **45** at port S2

2 Auto mode pressure switch **43** at port C9

3 Port B3 to the cushion control valve **49** at port F and exits at port H, to the main control valve **14** at port Pa8 to select both boom (1), boom (2) spools and upper pilot pressure switch **52**.

4 Port C1 to port Pi2 on the main control **14** valve to operate boom over bucket priority spool valve **BBV**.

Flow from pump 2 is stopped by the Boom (1) spool and is diverted via the parallel working passage to the boom (1) spool. The oil passes through the spool and merges with the flow from pump 1. Flow from pump 2 in the neutral gallery is stopped by the Boom (2) spool and is diverted via the parallel working passage to the boom (2) spool. The oil passes through the spool and merges with the flow from pump 1.

The pressure lifts the boom holding valve BHV off it's seat allowing oil to leave the main control valve at port A8 to enter the hose burst protection valve (HBPV) **12** (if fitted) and the boom rams **16**.

Exhaust oil from boom rams **16** enters the main control valve **14** at port B8 and crosses the boom (1) spool to tank.

Pressure is lost on both negative control ports Ps1 and Ps2, which is sensed at the pumps, which comes on full flow.

Dipper Out

For schematic, ⇒ *Fig 13. (E-41)*

Servo pressure from the hand controller **50** is sent to port A5 of the shuttle valve **46** and is distributed to:

1 Port C9 to activate the auto mode pressure switch **43.**

2 Port B5 to port B of the cushion valve **49**, through the valve leaving at port D. The signal is sent to port Pa5 on the Main control valve **14** selecting the dipper.(1) spool, Dipper (2) spool and the upper pressure switch.

Flow from pump 2 is available at the dipper (1) spool via the left hand neutral passage and the linear travel spool via the parallel working passage. Flow from pump 1 is blocked at the dipper (2) spool and merges with the flow from pump 2 before the dipper (1) spool.

Exhaust oil from the ram **3** enters the main control valve **14** at port B5 and has a path to tank via the dipper (1) and dipper (2) spools.

Dipper In

For schematic, ⇒ *Fig 14. (E-43)*

Servo pressure from the hand controller **50** is sent to port A6 of the servo shuttle valve **46** and is distributed to:

1 Port C9 to activate the auto pressure switch **43**.

2 Port B6 to port A on the cushion valve **49**, through the valve leaving at port C (if machine is fitted with HBCV, pressure is also sent via port A1 to port P on the HBCV to allow trapped oil in the ram to exit). From port C to port Pb5 on the main control valve **14** to the dipper (1) spool, dipper (2) spool, dipper holding valve the upper pressure switch.

Flow from pump 2 enters main control valve **14** at P1 and is available at the dipper (1) spool via the left hand neutral gallery, or after passing over the straight line travel spool via the parallel working passage. At the dipper (1) spool the flow is diverted to the dipper ram **3**. Pressure is sensed at the regeneration spool **RGS** and moves it to the lesser restricted position.

Flow from pump 1 is blocked at the dipper (2) spool and joins the flow of pump 2 before the dipper (1) spool. The pressure from both pumps is now cut off from the negative control ports Ps1 and Ps2. This reduced pressure is sensed at both pumps which now come into full flow.

Exhaust oil from the ram passes (through the HBCV if fitted) to the main control valve **14** at port A5 through the dipper hold check valve DHV (that has been released by servo pressure) to the dipper (1) spool.

Exhaust oil from the dipper ram **3** can be at a "higher" pressure than the feed oil due to the effect of gravity on the dipper arm when first selected. This causes the regeneration check valve **RG** to open, feeding a proportion of exhaust oil into the feed side. The remaining exhaust oil returns to tank passing over the regeneration spool **RGS**. The regeneration spool has two restrictors, one more restricted than the other. The restrictors cause back pressure encouraging the regeneration check valve to open. As the pressure drops the regeneration spool moves across to the less restricted position. When the feed pressure is greater than the exhaust pressure the regeneration check valve will move to the unrestricted position allowing return oil to free flow to tank.

Bucket Opening

For schematic, ⇒ *Fig 15. (E-45)*.

Servo pressure from port **1** of the hand controller **48** selects the bucket open spool position via the pilot shuttle block **46**, port A8 and B8. Servo pressure at port Pa7 then selects the bucket spool and upper pressure switch.

Flow from pump 2 is available to the bucket spool via the parallel working gallery and boom over bucket priority valve **BBV**.

At the spool the flow is diverted to port A7 of the main control valve **14** to the bucket ram **13**.

Returning oil enters the main control valve **14** at port B7 and is diverted by the bucket spool to the tank port.

Pressure in the neutral circuit drops after the selected bucket spool, this is sensed at the port Ps2 and at the pump bringing it into full flow.

Priority Valves

For schematic, ⇒ *Fig 17. (E-49)*.

Boom over Slew Priority (A)

This is selected by the operator via switch in the right hand console.

When operated the boom priority solenoid on the 8 spool block **60** is energised sending a signal via port C6 to the main control valve **14** at port Pi1. This selects the boom over slew priority. Oil now being fed to the slew spool is restricted to give priority to the boom.

Slew over Dipper Priority (B)

This is a non-selectable function automatically carried out within the main control valve **14** when slew is used.

When Slew is selected a signal is sent from the servo Shuttle valve **46** via port C8 to the main control valve **14** at port Pc3. This selects slew over dipper priority valve **B** and limits the flow to the dipper from pump P2 only. This makes it possible to have maximum slew torque with high slew pressure when the dipper is used at the same time.

Boom Priority over Bucket (C)

This a non-selectable function automatically carried out within the Main control valve **14** when Boom up is selected.

When boom up is selected a signal is sent from port C1 on the servo shuttle valve **46** to the main control valve port Pi2. This selects the boom over bucket priority valve **C**. Oil now flowing to the bucket spool is restricted and gives priority to boom up.

Slew Circuit

For schematic, ⇒ *Fig 18. (E-51)*.

Circuit description is for swing left.

Servo pressure from the hand controller **50** enters the Servo shuttle valve **46** at port A2 and is distributed to:

1 Port C7 to port A on 8 station solenoid valve **60**.

2 Port C8 to port Pc3 in main control valve to the slew over dipper priority spool SDV.

3 Port S1 to the slew pressure switch **45**.

4 Port B2 via the slew shut off solenoid **44** to the slew spool at port Pa3 on the main control valve **14** to move spool across.

When the pressure switch **45** closes, a signal is sent from the ECU1 to energise CT1 on the 8 station solenoid valve **60**. This allows 40 bar (580 lb/in^2) to cross the solenoid then cross the shuttle CT10 and the slew lock solenoid CT3 to release the slew brake.

When the slew pressure switch **45** opens, the solenoid remains energised for 5 seconds to allow the slew to come to a standstill before the brake is applied. If the pressure switch fails, there is an override device fitted. Servo pressure from the hand controller **50** passes through the shuttle valve **46** and exits at C7. This signal is sent to the 8 station solenoid valve **60** to port A, crosses the shuttle CT10 and the slew lock solenoid CT3 and releases the slew brake.

Note: *When the override is in operation, the slew may become very harsh.*

Flow from pump 2 travels through the neutral gallery to the slew spool. The flow is restricted allowing reduced pressure at port ps1 which is sensed at pm2 of pump 2 allowing the pump to come to full flow. The flow passes through into the parallel working passage to the slew spool. The flow is then directed via port A3 to the slew motor **1**. Exhaust oil enters the main control valve **14** at B3 through the slew spool to the tank line.

Slew over Dipper Priority (A)

This is a non-selectable function automatically carried out within the main control valve **14** when slew and dipper are used together.

When slew is selected a signal is sent from the servo shuttle valve 46 via port C8 to the main control valve **14** at port Pc3. This selects slew over dipper priority valve B and limits the flow to the dipper from pump A2 only. This makes it possible to have maximum slew torque with high slew pressure when the dipper is used at the same time.

100% Slew Lock

For schematic, ⇒ *Fig 19. (E-53)*.

When the slew lock button is operated in the cab, the ECU1 give two outputs:

1 To the 2 slew shut off solenoids **44**. This puts either side of the slew spool to tank and prevents operation of the circuits.

2 To the CT3 solenoid on the 8 Station solenoid valve **60**, allowing any pressure in the slew brake to drain to tank.

3 The CT1 slew brake solenoid is de-energised as soon as the slew lock button is pressed.

Note: *The CT3 solenoid is energised either, 5 seconds after the button is operated, or 5 seconds after the slew pressure switch opens, depending on which is last to operate. This allows the slew to come to a standstill on the cross line relief valves, before the brake is applied.*

Merged Flow

For schematic, ⇒ *Fig 20. (E-55)*.

This option allows the flow of both pumps to come together where the attachment requires high oil flow.

When the merged option is selected, using the rocker switch in the cab and the auxiliary pedal **53** is operated, the hammer/auxiliary switch **45** is closed.

Once the pressure switch is closed the ECU1 will energise solenoid **A**, **B** and **C**. Pilot pressure from the pedal will select the auxiliary spool via port pa2 or pb2 depending on the direction selected. Pilot pressure from the pedal also crosses solenoid **B** which is now energised and sends a signal to port pcc of the main control valve and selects the merge spool.

Solenoid **A** is selected and allows pressure from the cab manifold to cross and select the merge valve **47**.

Solenoid **C** is selected and allows the spools of the hammer/auxiliary changeover valve **27** to drain to tank and select the auxiliary position.

Oil flow from pump 1 is available at the now selected auxiliary spool. Flow from pump 2 is blocked at the merge spool. Pump 2 oil then exits the valve block at **P3**. It crosses the selected merge valve **47**, enters the valve block at P4 and merges with oil flow from pump 1. Both pump flows cross the selected hammer/auxiliary changeover valve **27** to operate the attachment.

Hammer Circuit

For Schematic, ⇨ *Fig 21. (E-57)*

The hammer function only works when the hammer pedal **53** is pressed in a forward direction. In this position pilot pressure from the foot pedal closes the hammer pressure switch **45**. The ECM then selects the pre-set hammer RPM on the engine.

Pilot pressure from the pedal **53** selects the auxiliary spool via port pa2.

The hammer/auxiliary solenoid **B** remains de-energised in hammer mode allowing pilot pressure to select the hammer/auxiliary changeover valve **27** to select hammer mode.

Flow from pump 2 crosses the selected hammer spool and exits the valve block at port A2. At the changeover valve **27** the pressure to the hammer is regulated by the hammer ARV which is now in circuit via the selected valve **27**.

Returning oil is diverted direct to tank via the hammer filter through the changeover valve **27**.

Pilot pressure from the hammer pedal **53** is also available to the upper pilot pressure switch **52**.

Main Control Valve

Description

Table 1. Torque Settings

Item[1]	**Torque**
Bolts - Main Control Valve to Frame	275 Nm
SAE split flange bolts - Main control valve to bucket/arm line	M10, 42 +/-5 Nm
SAE split flange bolts - Main control valve to rotary joint	M12, 62 +/-6 Nm
SAE split flange bolts - Main control valve to slew motor	
SAE split flange bolts - Main control valve to return lines and oil cooler	M14, 93 +/-8 Nm
SAE split flange bolts - Main control valve to pressure lines	

(1) Apply threadlock

Port Identification

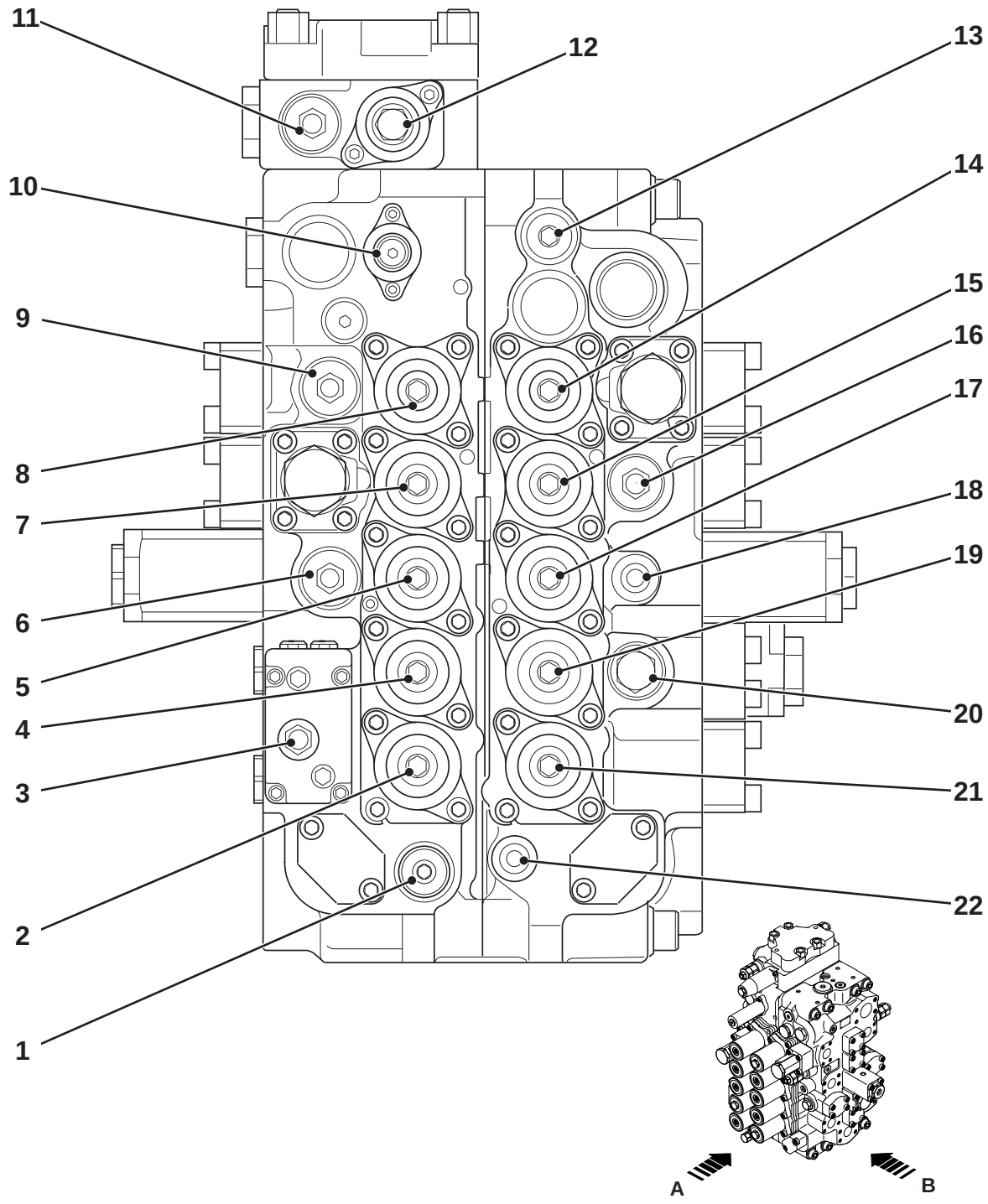


Fig 4. Main Control Valve viewed in Direction of Arrow A

For port location, ⇨ *Table 2. (E-65)*.

Hydraulic Pump/Regulator

Hydraulic Pump Operation

Hydraulic Pump Regulation

For this description pump **A2** has been used. For schematic, ⇒ *Fig 1. (E-17)*

On start up, the swash plate piston **F** is held in the maximum flow position by the spring **A**.

Once oil as passed through the valve block a 37 bar (537 Ib in^2) negative control signal enters port Pi2 and is available to the negative control piston **D**. This acts against spring **A** to move the spool across allowing pump pressure to cross the spool and pressurise the large diameter side of the swash plate piston **F**. Pressure is now available to both sides of the swash piston **F**, but due to the difference in surface areas the piston moves to the minimum flow position.

When a service is selected the negative control pressure drops. Piston **D** now moves back due to the spring pressure. This allows the oil in the larger area side of the swash plate piston **F** to vent to tank, but pump pressure oil is still available to the smaller diameter side so the pump moves over to the maximum flow position.

As the pump pressure increases, the pressure seen at the small diameter end of the swash plate piston **F** is also seen at the piston **C**. At the same time any pressure generated at pump A1 is also seen at pump A2 at the piston **C**. As the pressure increases at piston **C** via line **B** it starts to push against spring **A**. When the pressure has increased to approximately 200 bar (2900Ib in^2) the spool will start to select. This will now allow pump pressure to the large diameter side of the swash plate piston **F** which will proportionally start to select minimum flow.

When L mode is selected a 40 bar (580 Ib in^2) signal from the Max flow cut solenoid on the 8 spool solenoid is sent to Pm2 of the pump. This prevents the pump from selecting 100% flow and limits it to 60% flow.

In A mode the secondary pressure drops to approximately 10 bar (145Ib in^2). This reduction in secondary pressure at piston **D** has to be made up for by higher pump pressure at pistons **C** and **E** before the Sumater spool starts to select, hence more hydraulic horsepower.

The regulator on pump A1 works the same as above.

If Q max cut is selected a 40 bar servo pressure signal from the 8 spool solenoid block enters the pump at port Pm2. This will partly select the Q max cut piston **J**. which pushed the piston against spring A and reduces the pump to 60% maximum flow.

Hydraulic Pump Dismantling and Assembly

The working environment must be clean and the workbench covered with a cloth or rubber sheet to prevent damage to the components.

The illustration shows both halves of the double axial piston pump. The regulators and the gear pump are not shown. ⇨ *Fig 14. (E-85)*

Note: *1 The components from one pump section must not be mixed up with the corresponding components from the other section and should be returned to the section from which they came.*

The item numbers called up in the following procedures correspond with those in the exploded view.

Dismantling

Before dismantling, the pump ports should be plugged and the external surfaces thoroughly cleaned to prevent the ingress of dirt into the pump mechanism.

1 Remove from pump casing **1** the breather plug **2** and drain plug **3**. Drain the oil into a suitable receptacle.

2 As an aid to re-assembly, match mark the mating flanges of the regulators and pump casing **1**. Remove the mounting screws and lift off the regulators. Put to one side.

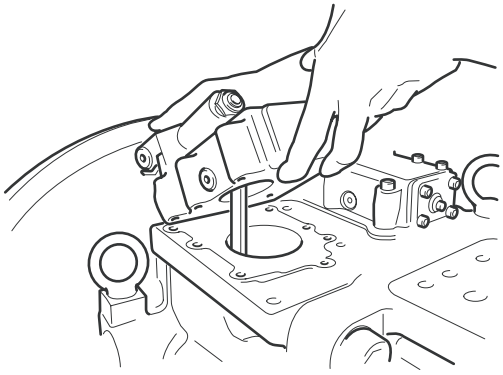


Fig 4.

3 Remove the gear pump from pump casing **1**.

4 Remove booster cover **4**, booster **5** and cover **6**.

5 Remove socket head screws **7**, **8**, **9** to release valve cover **10**.

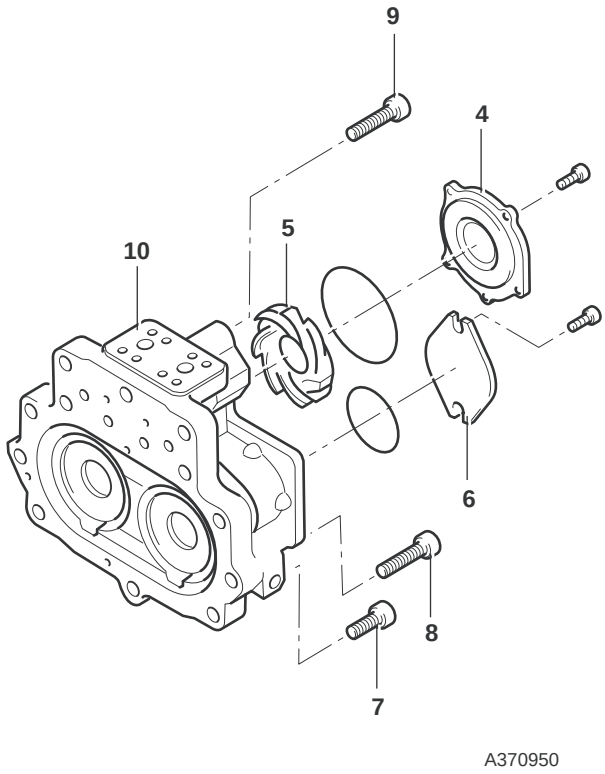


Fig 5.

6 Position the pump assembly on the bench with the regulator mounting flanges uppermost. Fit lifting eyes to the top of valve cover **10** and use a crane to support the weight of the unit ⇨ *Fig 6. (E-81)*.

7 There are two tight fitting locating pins **10A** between pump casing **1** and valve cover **10**. To separate the two units gently tap the valve cover with a plastic hammer, all the while making sure that it remains at right angles to drive shaft **11** and driven shaft **12**. At the same time take care not to damage the mounting flanges of the two units.

As the two units actually separate, avoid dropping valve plates **13**, **14**, check-valve sub-assemblies **15**, **16**, **17**, O-rings **18**, **19**, **20** and flange seal **21**.

Coupling

TE-031

Assembly

1 Secure the coupling plate/flywheel **A** to the engine with bolts **B**.

Note: *The mating faces of the coupling plate/flywheel and engine must be clean.*

2 Position the 4 x aluminium inserts **C** onto the coupling plate/flywheel. Ensure the dowels are installed correctly and the inserts are flush with the coupling/ flywheel. Secure the inserts to the coupling plate/ flywheel with bolts **D**.

Important: *Apply a small amount of grease under head prior to tightening.*

3 Install the cylindrical hub **E** onto the splined pump shaft and secure with the bolts **F**.

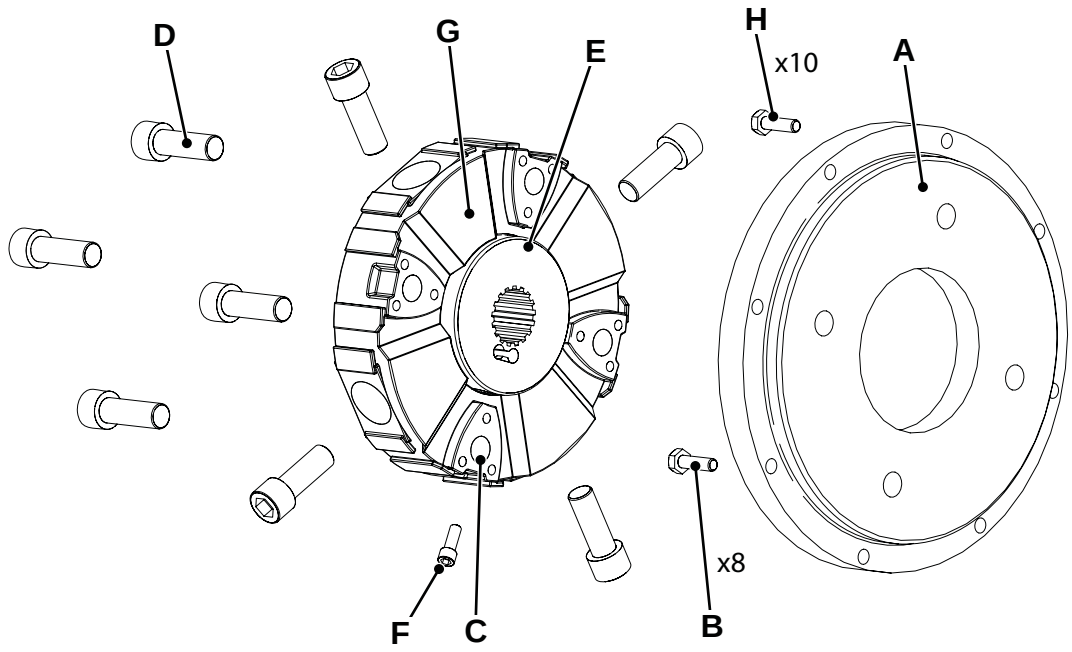
Note: *The hub must be installed with the recess closest to the pump.*

Note: *The hub surface must be flush with the end of the pump shaft.*

Note: *The radial aluminium inserts are already installed on the hub.*

4 Push the flexible element **G** over the aluminium inserts on the hub.

5 Push the pump and engine assemblies together to engage the mesh and secure with bolts **H**.



T022490-1

Fig 42.

Table 2.

Item	Torque Nm (lbf ft)							
	M10x30	**M12x20**	**M12x35**	**M14x40**	**M16x50**	**M18x55**	**M20x50**	**M20x55**
D	50	120	90	140	220	300	600	600
	M10	**M12**	**M14**	**M16**	**M20**			
F	30	50	70	120	200			

Remote Control Valve (Hand Control)

Operation

TE-008

The remote control valve is a pressure reduction valve used to control the servo pressure operated system. Four pressure reduction valves used to control the servo pressure are located in the main housing. Direction of the output servo pressure is controlled by selective movement of the control lever. The valves and control levers are mounted in the arm rests on both sides of the operator's seat.

The pressure reduction unit is comprised of spools **17**, pressure control springs, return springs and spring seats **13**. The spools **17** are held against the plungers **11** by the return springs **15**. When the control handle is tilted, the plungers **11** move down, depressing the return spring seats **13**, simultaneously compressing the pressure control springs moving the spool, allowing hydraulic oil to flow to the designated pilot port.

The lower end of the main body contains the main inlet port **P**, outlet port **T** to tank and the servo pressure outlet ports **1**, **2**, **3** and **4**.

The servo pressure controls the stroke and direction of the main control valve spools. This is achieved by providing a spring at one end of the main control valve spools and applying pilot pressure to the opposite end. (In some cases, pilot pressure is applied to both ends of the control valve spool.)

Function

Oil supplied by the hydraulic servo pump enters at port **P** and the function of the spools **17** is to direct oil from the inlet port **P** to the output ports **1**, **2**, **3** and **4** or alternatively, to the exhaust port **T** to tank. The pressure control springs act on the spools **17** to determine pressure at each port. Plungers **11** slide in the guides to vary the compression in the springs. The control handle, fixed to the adjusting nut **24** and circular rocker plate **25** is operated to move the plungers **11**. The control handle is able to rotate 360° around the knuckle joint **26**.

The return springs operate between the casing and the seats **13**, regardless of the outlet pilot pressure, returning the plungers **11** to their outer positions, ensuring the spools **17** return to their neutral (closed) positions. The springs also provide a resistive force, giving the operator a `tactile feel' of the controls.

The control handles contain electrical push button and rocker switches which are used to operate auxiliary services.

Removal and Replacement

⚠ 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

⚠ WARNING

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear protective glasses and gloves. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

INT-3-1-10_3

Removal

1 Lower dipper and place bucket on the ground

2 Turn off engine.

3 Operate both control joysticks back and forth and side to side to vent residual pressure.

4 Remove the two screws **A** from each side, and loosen screws **B** (one either side of the arm rest). Remove front panel **C**.

5 Disconnect electrical connection to remote control valve.

6 Disconnect all hydraulic hoses and pipes from the remote control valve and plug all orifices to prevent ingress of dirt. Label each hose before disconnecting, this will ensure correct position when refitting.

7 Remove the two screws **D**, two screws **E** and loosen the two screws **F**. Remove panel **G**.

8 Lift up gaiter **H** and remove the fours bolts holding the valve to the arm rest.

9 Lift the remote control valve clear of the arm rest.

Note: *Care should be taken when removing right arm rest, remove switches, using a thin flat bladed screw driver and disconnect electrical connections.*

Replacement

Replacement is the reversal of the removal sequence.

Note: *All hydraulic adapters that are installed together with a bonded sealing washer must also have JCB Threadseal applied to the threads of the adapter.*

Dismantling and Assembly

Dismantling

Note: *All parts are precision made and require the utmost care when being handled.*

Note: *During dismantling, do not use excessive force to separate components which could cause scratches or burrs on bearing surfaces. Failure to observe this instruction will cause oil leaks leading to poor performance.*

Note: *Label all parts during dismantling, to ensure correct assembly.*

Note: *Storing the valve when dismantled could cause rusting of parts. Ensure they are suitably protected by anti-rust treatment.*

Note: *Refer to the illustration for part number identification* ***⇒ Fig 4. (E-107)***.

1 Push down upper section of gaiter **19** and remove roll pin **20**.

2 Remove control handle from mounting knuckle **3**.

Note: *Take care when removing handle to avoid damage to wiring loom and switches. These should be removed by separating the line connectors in the control handle and below the valve body.*

3 Remove gaiter **19** from valve housing.

4 Slacken locknut **22** and remove mounting knuckle **23**.

5 Slacken and remove joint nut **24** and rocker plate **25**.

⚠ WARNING

Always wear safety glasses when dismantling assemblies containing components under pressure from springs. This will protect against eye injury from components accidentally flying out.

GEN-6-2

Note: *The return spring **15**, retaining plate **18** and plunger **11** will rise when knuckle joint **26** is loosened.*

6 Using a jig, slacken and unscrew knuckle joint **26**, releasing retaining plate **18**.

Note: *Ensure retaining plate moves freely to prevent sudden release due to spring pressure beneath.*

7 Clean the valve exterior using approved solvent and using soft metal pads for protection, clamp the valve body into a vice.

8 If the return springs **15** are weak, the sliding resistance of the seal **9** will cause the guides **8** to stick in the casing. Using a screw driver, carefully ease out the guides **8** and plungers **11**.

Note: *Care must be taken to prevent damage to the guides when removing. Ensure the guides do not fly out due to the force of the return springs.*

9 Remove spring seats**13**, split washers **12**, return springs **15**, pressure control springs **14** and spools **17**.

Note: *Identify each set of parts and their locations for assembly.*

10 Loosen the two hex bolts **27** on the base of the valve. Remove the base plate and `O'-ring **30** from the valve casing.

11 Slacken and remove body assembly screw **6**. Remove and discard `O'-ring **7**.

12 Separate upper and lower body sections **1** and **2** and remove dowel pins **5**.

13 Remove and discard `O'-rings **3** and **4**.

Note: *The surface of spool **17** and spring **13** can be damaged by mis-handling. Take care not to damage the surface of the spool during removal and do not push the spring seat down more than 6mm (0.24 in).*

14 Hold spools **17** firmly on the work bench and depress spring seat **13** and remove split washers **12**.

Note: *Avoid scratching the surface of the spools. Do not depress the spring seats more than 6 mm (0.24 in).*

15 Separate spools **17**, spring seats **13**, springs **14** and **15** and shims **16**.

16 Remove plungers **11** from guides**8**.

Travel Pedal Valve

Dismantling and Assembly

TE-007

Note: *Parts can be damaged by use of excessive force. Parts can be damaged by corrosion caused by humidity and dust if left in un-assembled.*

Note: *For part number identification for the Travel Pedal Valve,* ⇨ *Fig 2. (E-112)*.

Dismantling

1 Clean the valve exterior using an de-greasing agent and using soft metal pads for protection, clamp the valve body into a vice.

2 Remove the gaiter **1** from the cover **2**.

3 Loosen the 5mm hex screw **3**.

⚠ WARNING

Always wear safety glasses when dismantling assemblies containing components under pressure from springs. This will protect against eye injury from components accidentally flying out.

GEN-6-2

Note: *Take care that push rod **4** does not fly out under spring tension.*

4 Remove pin **5** using a 7mm punch and remove cam and steel balls **6**.

Note: *Take care that push rod **4** and plug **7** are not thrown out by damping spring **8** pressure.*

5 Loosen hex bolt **9** and remove cover. Making a note of the relative positions of the cover **2** and the casing **10**. The plug **7** will remain in casing **10** due to friction of the `O'-ring **11**.

6 Remove casing **10** and fix in vice using soft metal pads for protection.

7 Pull push rod **4** from plug **7** noting the relative positions of plugs and push rods to the casing **10**.

8 Remove plug **7** with the grease cap **12**, packer **13** and `O'-ring attached.

9 Remove piston **14** and damping spring **8** from the casing.

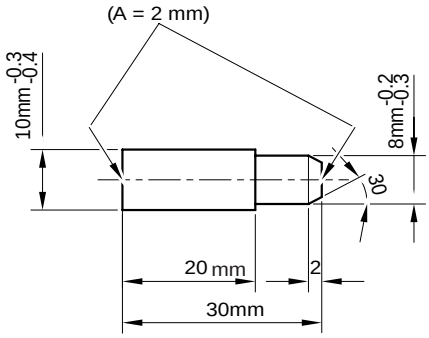
10 Remove spring washer **16** from the casing **10** using tweezers etc.

11 Remove steel balls **17** using a magnet.

12 Fix the lower casing assembly in a vice and remove the `O'-rings **18**, **19** from casing **20**.

13 Remove pressure reduction valve assembly and return spring **21** from casing **20**.

14 Place cover **2** flat on a flat bench, apply special jig, ⇨ *Fig 1. (E-111)* to bush **23** and tap with a hammer to remove the bush



A406320-1

Fig 1.

A Central Hole (2mm maximum)

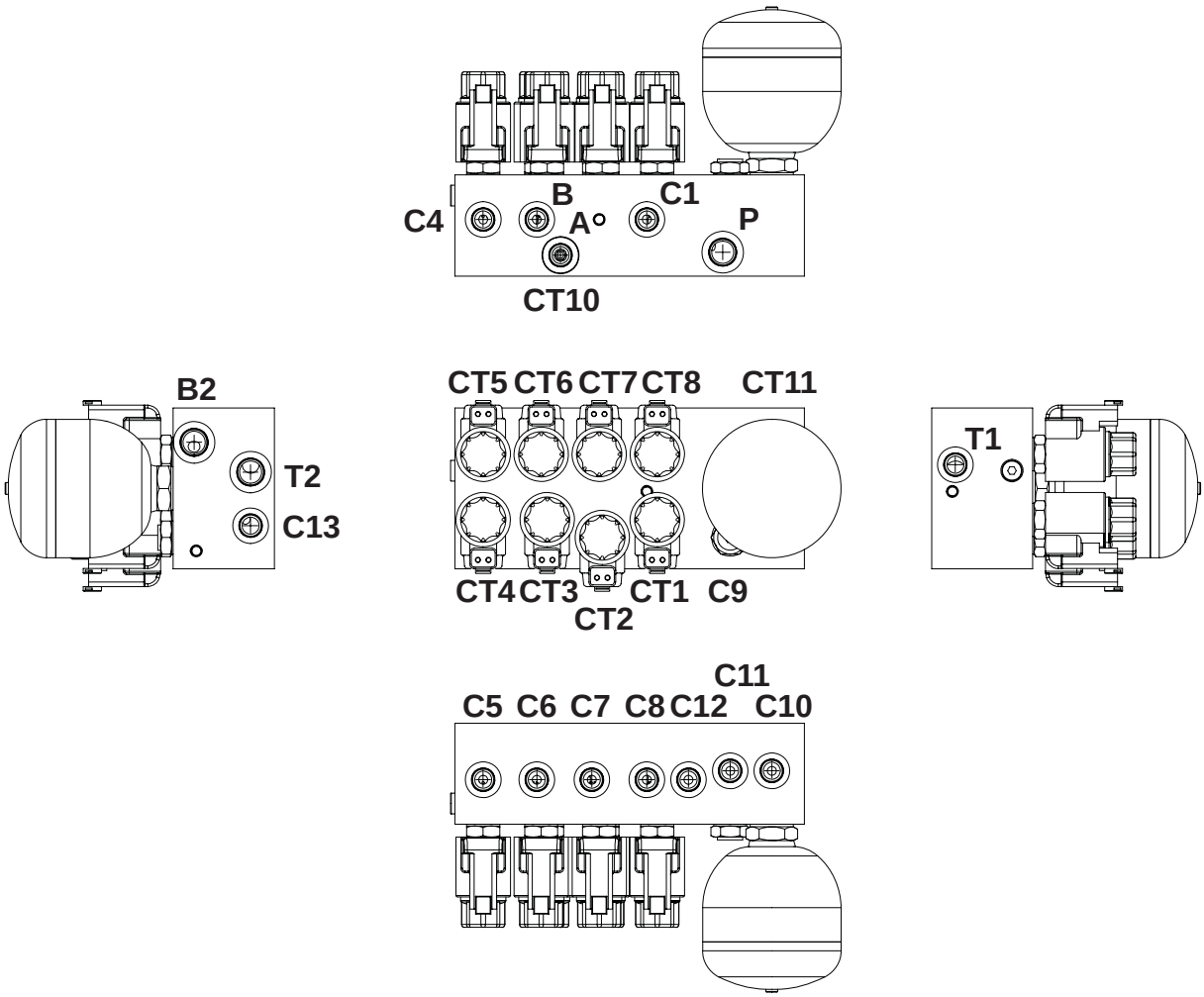
15 For disassembly of the pressure reduction valve, press in spring washer **24**, slide the spring washer sideways, bending secondary pressure spring **25**, then remove spool **26** from the larger hole.

16 Separate spool **26**, secondary pressure setting spring **25**, shim **27** and washer **28**.

Solenoid Valve (8 Station)

Operation

TE-026



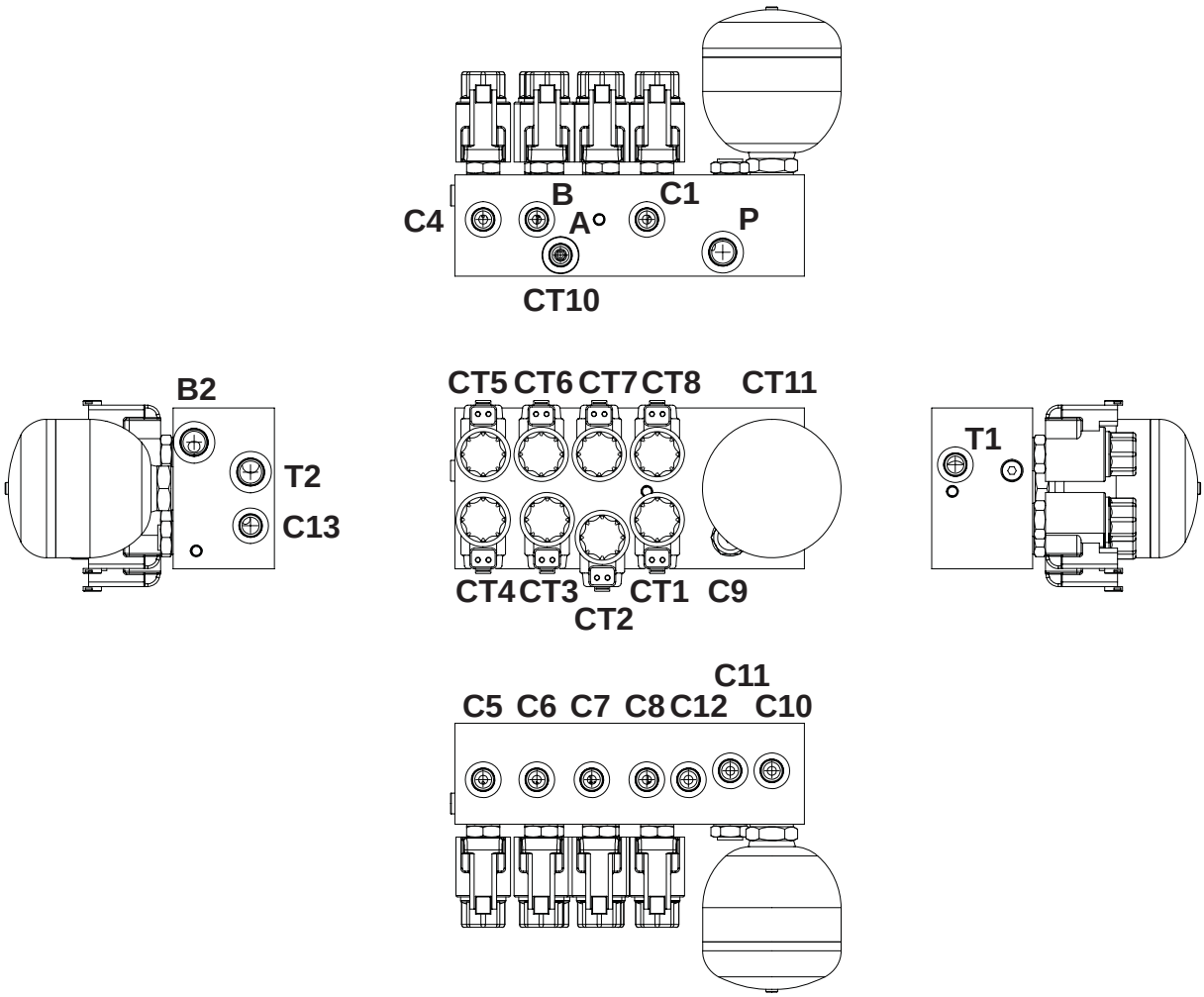
T023420

Fig 1.

Solenoid Valve (8 Station)

Operation

TE-026



T023420

Fig 1.

Removal and Replacement

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

WARNING

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear protective glasses and gloves. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

INT-3-1-10_3

Removal

1 Make the machine safe, refer to ***Service Procedures, Section E***.

2 Disconnect all the electrical connections to the solenoids **B**, labelling which connector goes to which solenoid. ⇨ ***Fig 2. (E-119)***.

3 Disconnect all hydraulic pilot hoses from the valve and plug all orifices to prevent ingress of dirt. The hoses should be labelled, if not label each hose before disconnecting, this will ensure correct position when refitting.

4 Remove the four M8 bolts from rear of valve and remove valve from machine.

Replacement

Replacement is a reversal of the removal sequence.

Note: *All hydraulic adapters that are installed together with a bonded sealing washer must also have JCB Threadseal applied to the threads of the adapter.*

Dismantling and Assembly

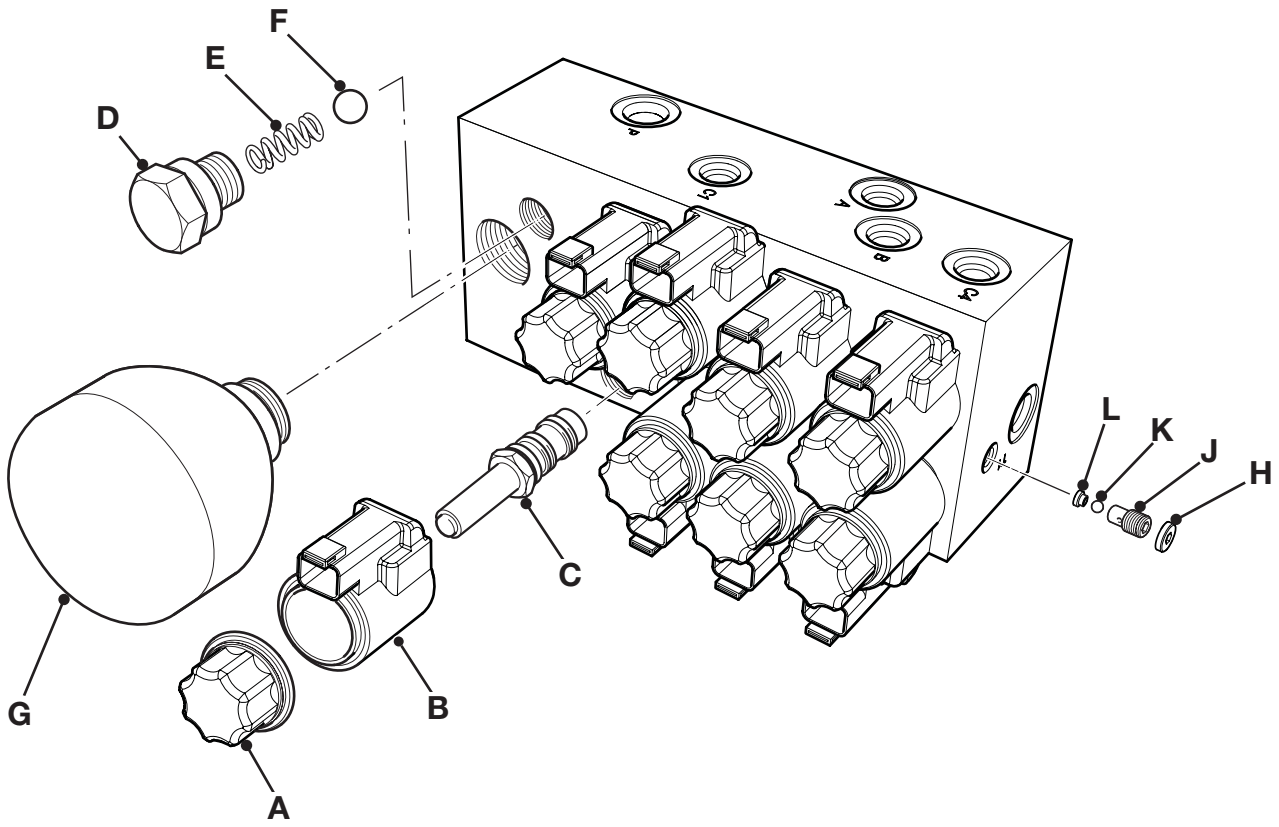


Fig 2.

Dismantling

1 Unscrew cap **A** from solenoid valve.

2 Slide solenoid **B**, away from the main control valve.

3 Loosen spool **C** and extract spool from the main control valve.

4 Repeat steps 1-3 to remove all solenoid valves from the valve.

5 Remove plug **D** and extract spring **E** and ball **F**.

6 Unscrew accumulator **G** and remove from valve.

7 Remove hex pug **H**.

8 Using a 5mm Allen key remove valve **J**, ball **K** and seat **L**.

Inspection

Before assembling the solenoid valve make sure that a thorough inspection of all the components is carried out. Remember that although a failed component may be easy to identify, the cause may be less easy to trace. It is also possible that a failed component may have caused damage to other areas of the valve.

1 Carefully clean all components using a suitable degreasing agent.

2 Carefully inspect all components for signs of excessive wear or damage. If wear or damage is evident, components must be renewed.

Shuttle Valve

Removal and Replacement

TE-025

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

WARNING

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear protective glasses and gloves. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

INT-3-1-10_3

Removal

1 Make the machine safe, refer to ***Service Procedures, Section E***.

2 Disconnect the electrical connections to the pressure switches. Label each connector to ensure correct position when refitting.

3 Disconnect all hydraulic hoses from the valve and plug all orifices to prevent ingress of dirt. The hoses should be labelled, if not, label each hose before disconnecting, this will ensure correct position when refitting.

4 Remove the four M10 bolts from rear of valve and remove valve from machine.

Replacement

Replacement is a reversal of the removal sequence.

Note: *All hydraulic adapters that are installed together with a bonded sealing washer must also have JCB Threadseal applied to the threads of the adapter.*

Dismantling and Assembly

Dismantling

⇒ *Fig 1. (E-123)*

1 Remove the pressure switches **1** and plug all orifices to prevent ingress of dirt .

2 Remove plugs **2** from valve.

3 Using a 5mm Allen key remove valve **3**, ball **4** and seat **5**.

4 Repeat steps 2 to 3 to remove the remaining three shuttle valves.

Inspection

Before assembling the solenoid valve make sure that a thorough inspection of all the components is carried out. Remember that although a failed component may be easy to identify, the cause may be less easy to trace. It is also possible that a failed component may have caused damage to other areas of the valve.

1 Carefully clean all components using a suitable degreasing agent.

2 Carefully inspect all components for signs of excessive wear or damage. If wear or damage is evident, components must be renewed.

Note: *Check condition of `O'-rings before assembly.*

Assembly

Assembly is a reversal of the dismantling sequence.

1 Lubricate valve **3**, ball **4** and seat **5** with clean hydraulic oil.

2 Apply JCB Threadseal to plugs **2**.

3 Tighten components to specified torque. ⇒ *Table 2. Hoses (E-122)*

Table 1. Pressure Switches

Port	Function	Harness Tape Colour
S1	Slew Pressure Switch	Red
S2	Boom Up Pressure Switch	Yellow
S3		
C9	Auto Mode Pressure Switch	Green

Table 2. Hoses

Port	Function	Hose Colour	Torque (Nm)
A1	Swing Right	Violet	47
A2	Swing Left	Orange	47
A3	A3 Multi SH Valve	Blue	47
A4	A4 Multi SH Valve	Red	47
A5	Dipper Out	Light Green	47
A6	Dipper In	Pink	47
A7	A7 Multi SH Valve	Yellow	47
A8	A8 Multi SH Valve	Green	47
B1	Swing Right	Violet	47
B2	Swing Left	Orange	47
B3	Boom Up	Blue	47
B4	Boom Down	Red	47
B5	Dipper Out	Light Green	47
B6	Dipper In	Pink	47
B7	Bucket Close	Yellow	47
B8	Bucket Open	Green	47
C1	Boom Priority Bucket	Light Blue/ Blue	34
C2	Boom Load Hold	Red/Green	34
C3	Dipper Out	Light Green/ Violet	34
C4	Dipper	Pink/Violet	34
C5	Arm Load Hold	Pink/Green	34
C6			34
C7	Swing Lock	Orange	34
C8	Swing Priority	Orange/ Green	34

Cushion Valve

Operation

TE-024

The machine defaults to cushioned mode on start up. The following descriptions describe only the `dipper in' function but, `dipper out', `boom in' and `boom out' circuits all operate in the same way.

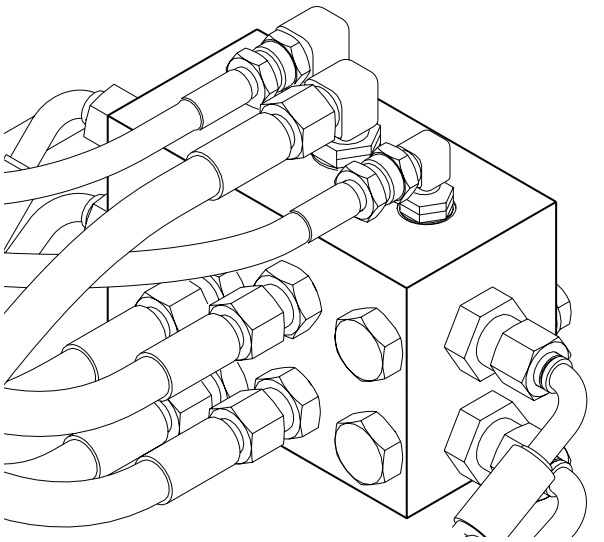


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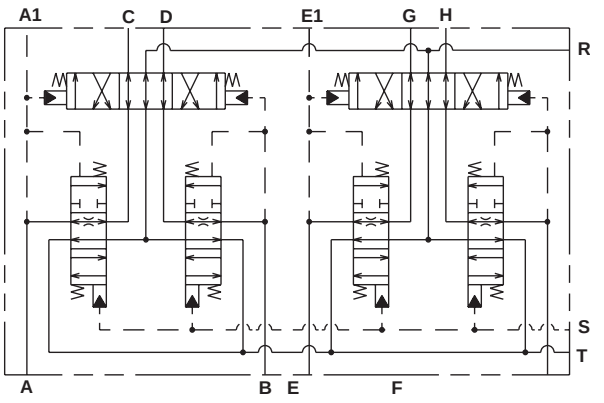
Fig 1.



A406700

Fig 2.

Removal and Replacement

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

WARNING

Fluid Under Pressure

Fine jets of fluid at high pressure can penetrate the skin. Keep face and hands well clear of fluid under pressure and wear protective glasses and gloves. Hold a piece of cardboard close to suspected leaks and then inspect the cardboard for signs of fluid. If fluid penetrates your skin, get medical help immediately.

INT-3-1-10_3

Removal

1 Make the machine safe, refer to ***Service Procedures, Section E***.

2 Disconnect all hydraulic hoses from the valve and plug all orifices to prevent ingress of dirt. The hoses should be labelled, if not, label each hose before disconnecting, this will ensure correct position when refitting.

3 Remove the four M8 bolts from rear of valve and remove valve from machine.

Replacement

Replacement is a reversal of the removal sequence.

Note: *All hydraulic adapters that are installed together with a bonded sealing washer must also have JCB Threadseal applied to the threads of the adapter.*

Dismantling and Assembly

Dismantling

⇨ Fig 7. (E-132).

1 Remove adapter **A** and `O'-ring **B** from valve.

2 Extract spring **C**, spool **D** and spring **E**.

3 Remove adapter **F** from valve and repeat step 2.

Inspection

Before assembling the solenoid valve make sure that a thorough inspection of all the components is carried out. Remember that although a failed component may be easy to identify, the cause may be less easy to trace. It is also possible that a failed component may have caused damage to other areas of the valve.

1 Carefully clean all components using a suitable degreasing agent.

2 Carefully insect all components for signs of excessive wear or damage. If wear or damage is evident, components must be renewed.

Assembly

Assembly is a reversal of the dismantling sequence. *⇨ Fig 7. (E-132)*.

1 Lubricate spool **D**, springs **C** and **E** with clean hydraulic oil.

Table 1. Hydraulic Connections

Port	Hose Colour
A	Pink
B	Green
C	Pink
D	Green
E	Red
F	Blue
G	Red
H	Blue
R	White/Yellow
S	Green
T	Clear

Slew Motor

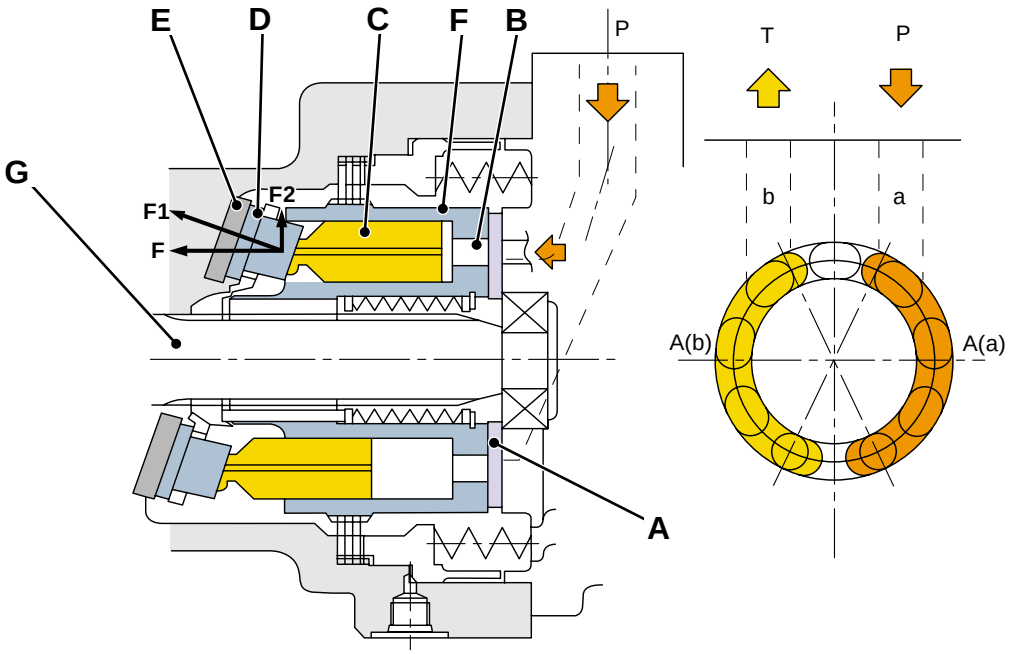
Motor Operating principles

The following detailed description explains the operating cycle of an individual piston.

High pressure hydraulic fluid **P** from the pump flows via input port a and control valve **A** into cylinder **B** when it is aligned with the input side **A**(a) of the control plate. The force **F** against piston **C** generates a force **F2** (shown vectorially) which acts on piston shoe **D**. The piston shoe moves against stationary swash plate E, causing cylinder block **F** and hence drive shaft **G** to rotate. This situation exists for 180° of rotation of the cylinder block i.e. until the cylinder aligns with the output side **A** (b) of the control plate. For the next 180° of rotation of the cylinder block the piston expels low pressure hydraulic fluid **T** via the output side **A**(b) of the control plate, port b and back to tank. Driving force **F2** varies according to the flow rate of the high pressure hydraulic fluid input.

There are nine pistons equally spaced around the cylinder block. As each one in turn goes through the cycle described, a continuous even rotation of the output shaft is produced.

By reversing the hydraulic fluid flow direction i.e. high pressure feed into port b, the motor rotation is reversed.



C075110

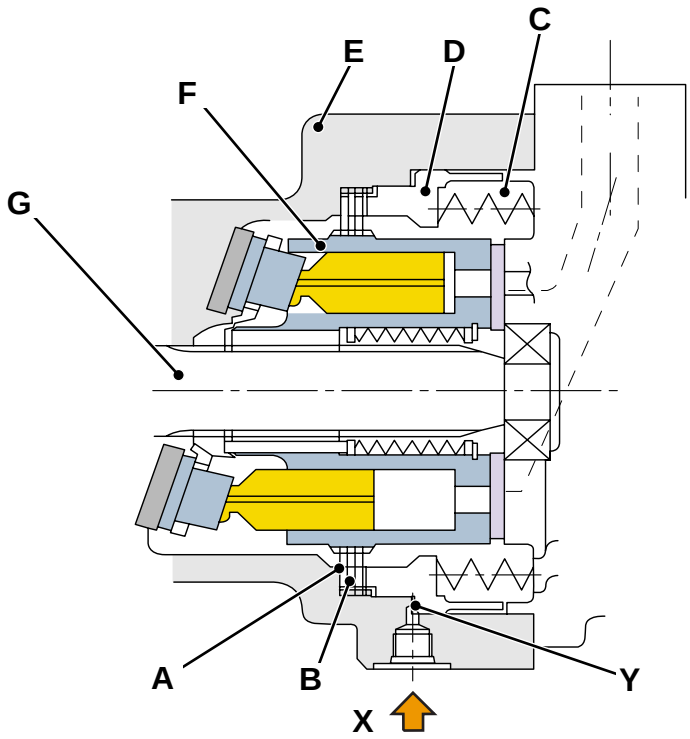
Fig 1.

Slew Brake Operation

Cylinder block **F** is splined to output shaft **G**. Two friction plates **A** are splined to the outer edge of the cylinder block and are interleaved between three counter plates **B** which are fixed to the slew motor casing **E**.

The brakes are applied when the hydraulic pressure at port **X** is zero. Spring **C** pressure forces piston **D** down to press the friction plates and the counter plates together, thereby locking cylinder block **F** and casing **E** and preventing rotation.

The brakes are released when hydraulic pressure is applied to port **X**. Oil enters chamber **Y** and pushes brake piston **D** up, against the pressure of spring **C**, to release the previously locked friction plates **A** and counter plates **B**. Cylinder block **F** is now free to rotate within casing **E**.



C075120

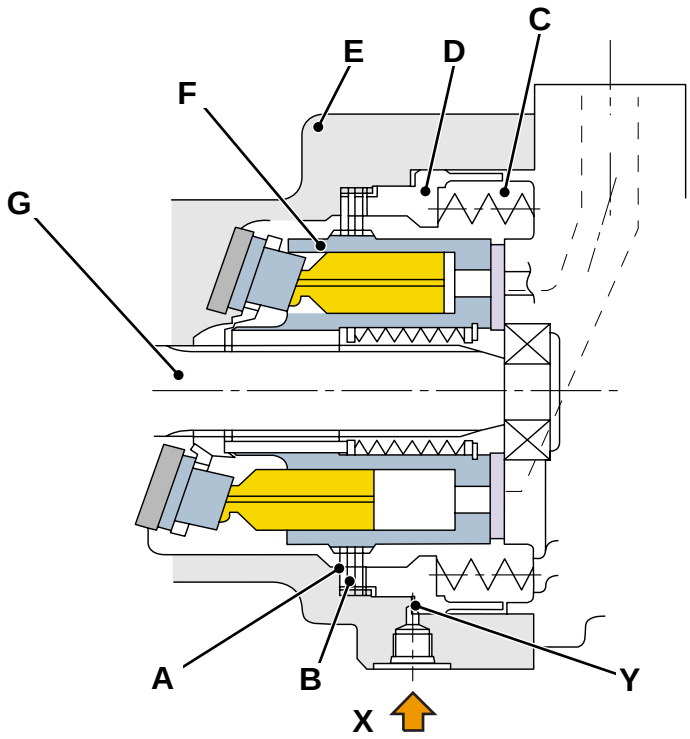
Fig 2.

Slew Brake Operation

Cylinder block **F** is splined to output shaft **G**. Two friction plates **A** are splined to the outer edge of the cylinder block and are interleaved between three counter plates **B** which are fixed to the slew motor casing **E**.

The brakes are applied when the hydraulic pressure at port **X** is zero. Spring **C** pressure forces piston **D** down to press the friction plates and the counter plates together, thereby locking cylinder block **F** and casing **E** and preventing rotation.

The brakes are released when hydraulic pressure is applied to port **X**. Oil enters chamber **Y** and pushes brake piston **D** up, against the pressure of spring **C**, to release the previously locked friction plates **A** and counter plates **B**. Cylinder block **F** is now free to rotate within casing **E**.



C075120

Fig 2.

Fault Finding

Motor Does Not Rotate

Symptom	Cause	Remedy
The pressure is low.	The relief valve is not set correctly.	Set to the correct value.
	The relief valve does not work properly. Plunger sticking. Plunger orifice contaminated.	 Repair or renew the plunger. Dismantle and clean.
	Plunger not seating correctly.	Renew the plunger seat.
The pressure is correct but no rotation.	Overload protection operating.	Remove the cause of overload.
	The moving part is burnt.	Check and repair the piston/shoe, cylinder/valve plate, etc.
	No release pressure acting on the rake.	Check and repair the circuit.
	The brake piston is sticking.	Dismantle and clean/repair.
	The brake friction plate is burnt and sticking to counter plate.	Dismantle and renew the damaged parts.

Motor Rotates in the Reverse Direction

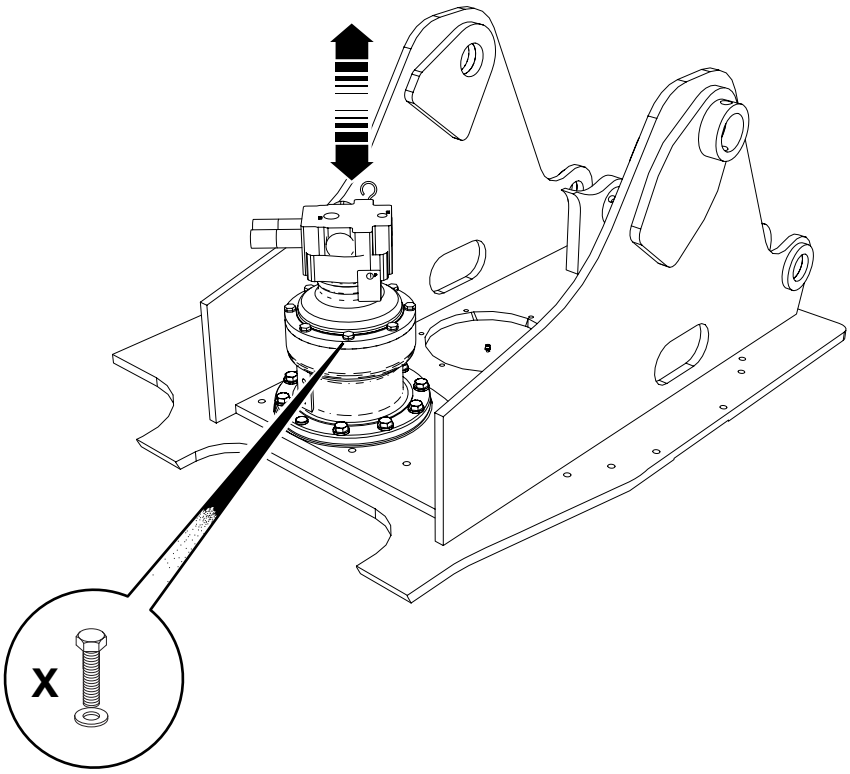
Symptom	Cause	Remedy
Reverse rotation.	The motor has been incorrectly assembled.	Check step 16 of the Assembly procedure to verify that the valve housing 303 and main housing 301 are in their correct relative positions. Rectify if necessary.
	Inlet/outlet hoses reversed.	Re-locate hoses.

Motor Speed is Low

Symptom	Cause	Remedy
Slow rotation.	The oil flow volume is low.	Check the pump output and the circuit to the motor.
	The temperature is high and leakage is serious.	Check the oil cooling circuit.
	The sliding parts are worn out or broken.	Renew suspect parts.

Removal and Replacement

TE-027



C078320

Fig 3.

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 Make the machine safe, refer to ***Section E, Service Procedures***.

2 Disconnect all hydraulic hoses from the slew motor and plug all orifices to prevent ingress of dirt. Label each hose before disconnection.

3 Make an alignment line across the gearbox and motor mounting flanges, to provide a reference during assembly.

4 Remove bolts **X**.

5 Using suitable lifting equipment carefully lift slew motor until clear of machine, refer to ***Section E, Technical Data***.

Dismantling and Assembly

Hydraulic Motor Components

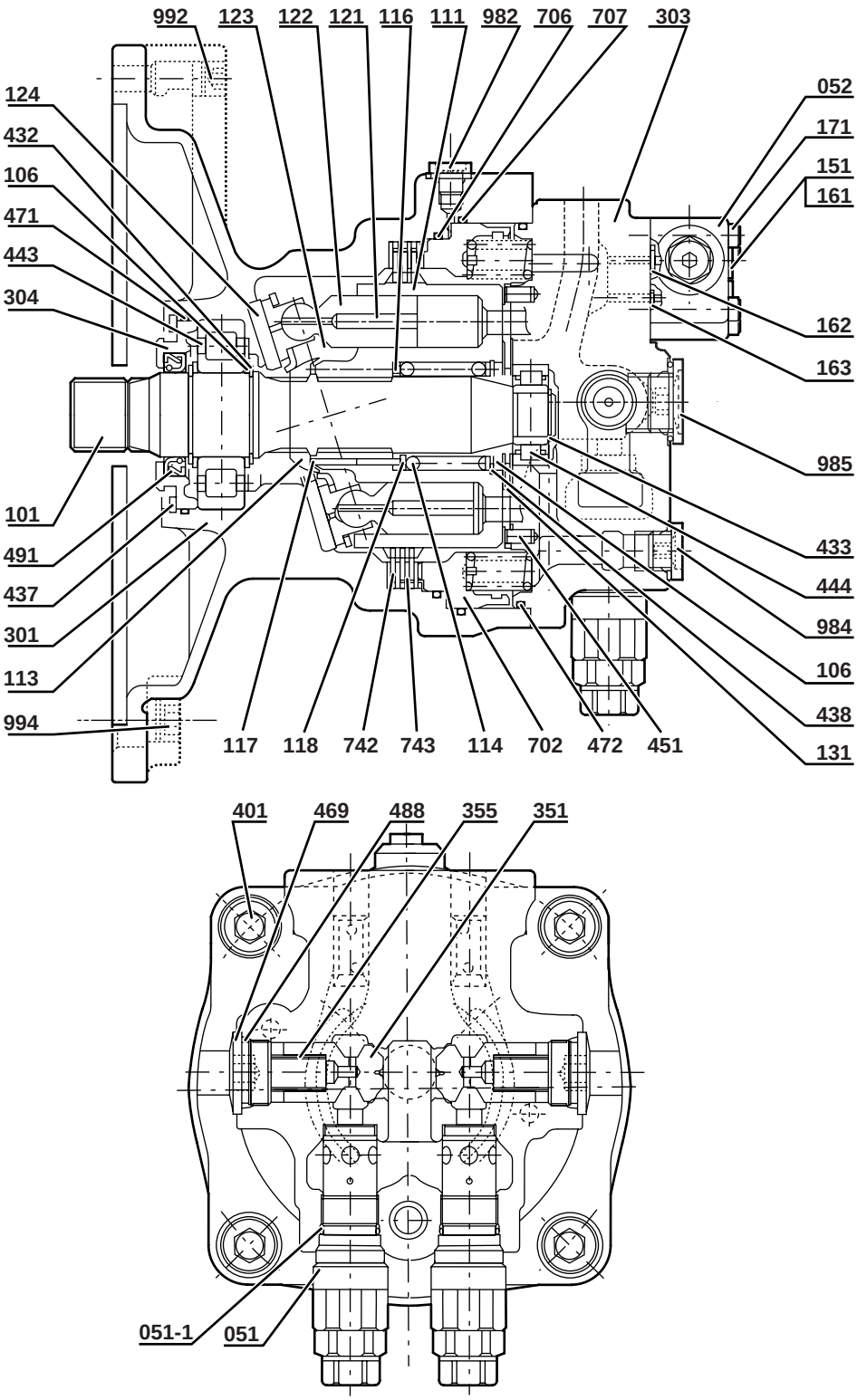
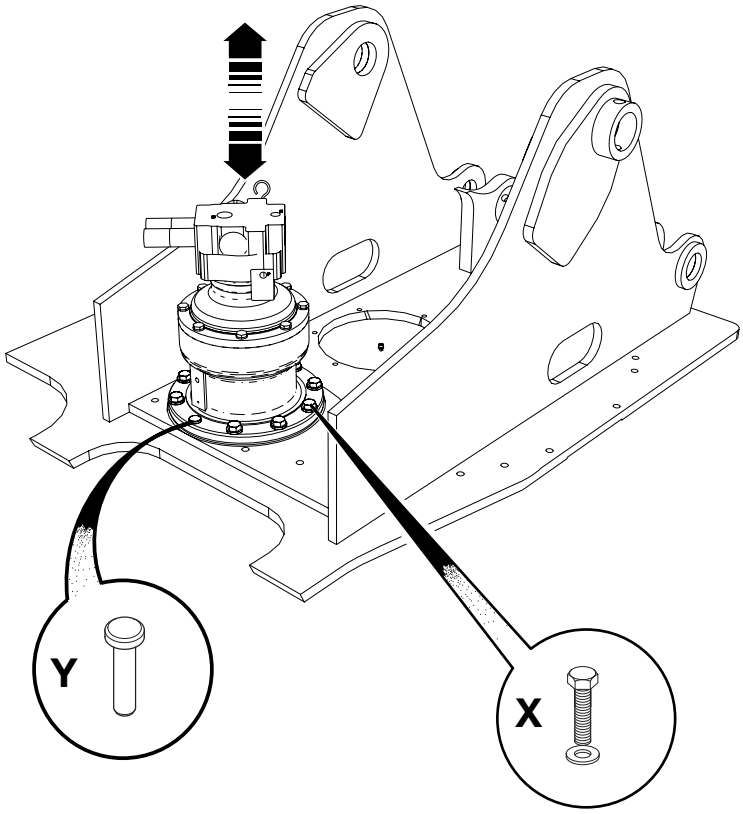


Fig 4.

Slew Motor Reduction Gear Assembly

Removal and Replacement

TE-028



C077990

Fig 1.

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 Make the machine safe, refer to ***Section E, Service Procedures***.

2 Remove slew motor, refer to ***Section E, Slew Motor***.

3 Disconnect all hydraulic hoses from the slew gearbox and plug all orifices to prevent ingress of dirt. Label each hose before disconnection.

4 Remove bolts **X** and reference pin **Y**.

5 Using suitable lifting equipment carefully lift slew gearbox until clear of machine, refer to ***Section E, Technical Data***.

Dismantling and Assembly

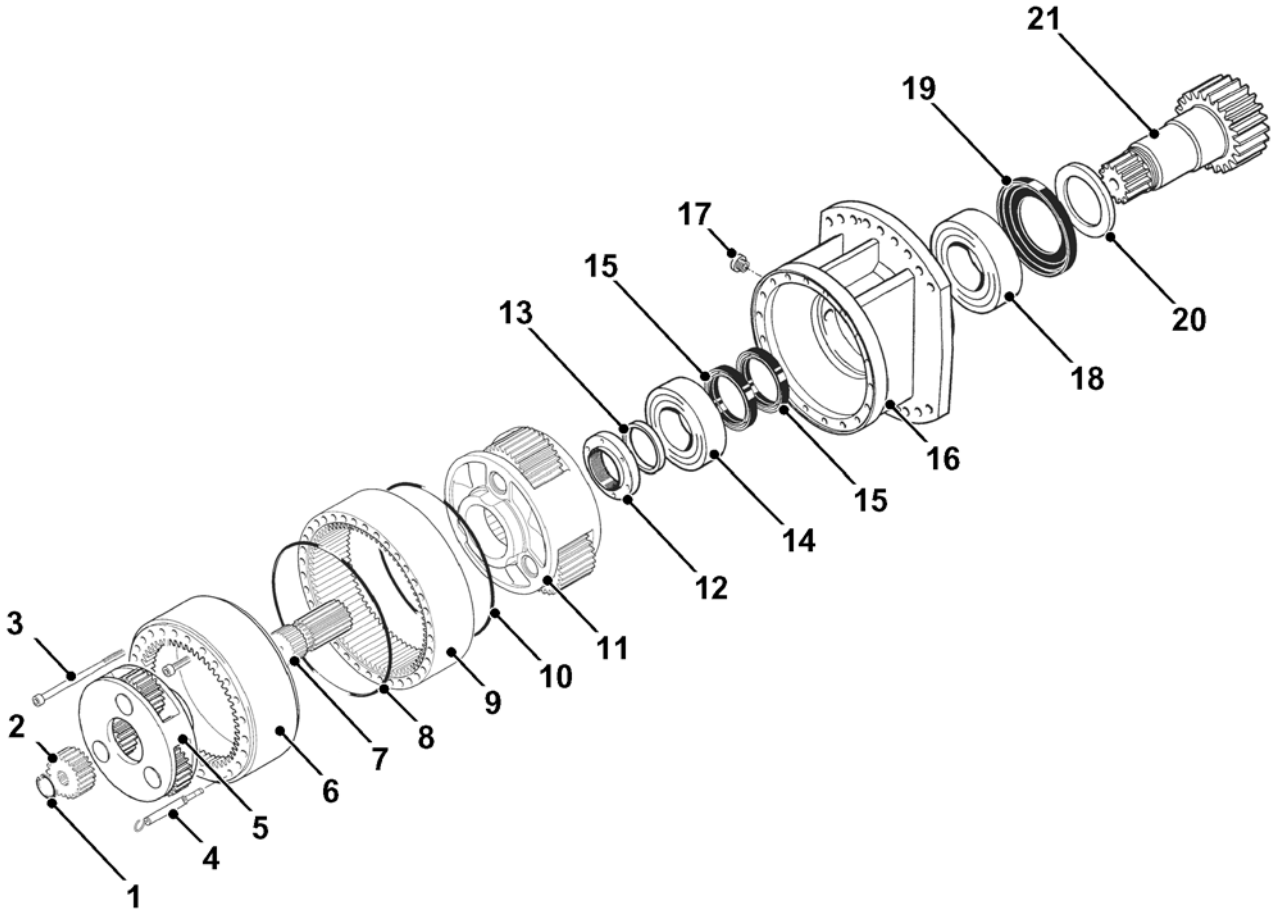


Fig 2.

Component Identification

1	Circlip	**8**	O-ring	**15**	Seal ring
2	1st Reduction Sun Gear	**9**	Ring gear	**16**	Gearbox housing
3	Bolt	**10**	O-ring	**17**	Drain plug
4	Oil breather and level plug	**11**	2nd Reduction planet gear	**18**	Bearing
5	1st Reduction planet gear	**12**	Ring nut	**19**	Nylon ring
6	Cover	**13**	Spacer	**20**	Spacer
7	2nd Reduction sun gear	**14**	Bearing	**21**	Pinion shaft

Rotary Coupling

Operation

The coupling is located in the centre of the machine between the lower and upper sections and rotates around the slew centreline. The supply and return oil flow to the coupling, piped from the upper to the lower section, is not affected by the rotational movement and allows the machine to slew 360° in both directions.

The rotary coupling consists of the inner axle 11 and outer rotor 13 with packing rings, 'O'-rings, thrust plate and cover. In the axle and rotor there are pairs of ports and oil passages, each pair being sealed from the others by packing rings and 'O'-rings. Both the axle and rotor can rotate and the oil can flow freely through the oil grooves.

Item	Part Name
11	Axle
12	V-ring
13	Rotor
14	O-ring
15	Packing ring
16	Thrust plate
17	Socket head screw
18	O-ring
19	Cover
20	Socket head screw

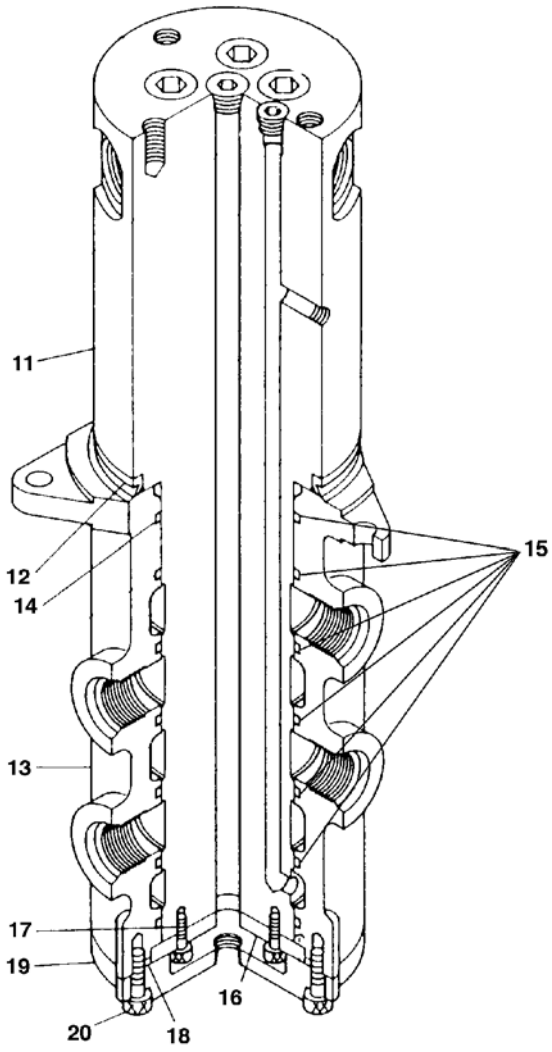


Fig 1.

Removal and Replacement

Removal

1 Jack up the machine by pressing the boom/dipper on the ground. Install wooden blocks under the tracks. ⇒ *Fig 2. (E-172)*.

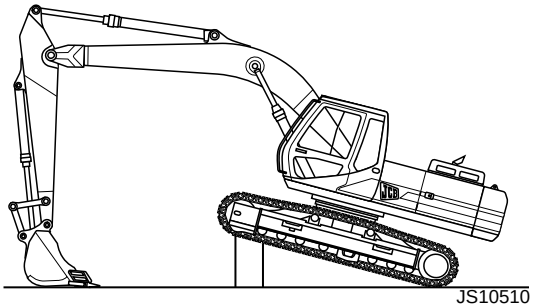


Fig 2.

2 Stop the engine and release hydraulic system pressure (see ***Section3, Releasing Hydraulic Pressure***).

3 Remove the belly plates.⇒ *Fig 3. (E-172)*

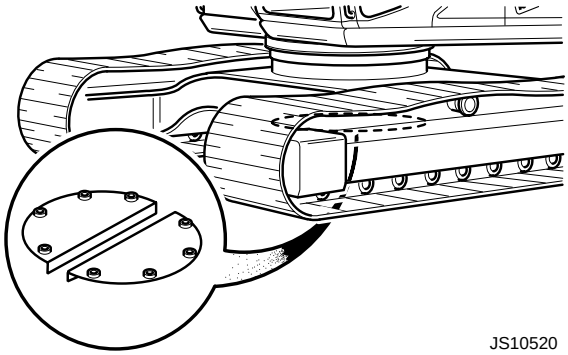


Fig 3.

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

WARNING

Do not go underneath the machine with the engine running. Switch off the engine, apply the park brake and block both sides of all wheels before going underneath the machine.

TRANS-2-1

4 Attach identification tags to the rotary coupling hoses for reconnection purposes. Remove the hoses and install blind plugs and caps to prevent contamination.

5 Remove the three screws/washers **4-A** and lift off locking bar **4-B**.

Dismantling

as a guide to the dismantling and assembly procedures refer to the sectional illustration, ⇒ *Fig 1. (E-171)*.

1 Remove the bolt **5-B** and cover **5-A**.

2 Remove the 'O'-ring **5-C**.

Do not reuse the 'O'-ring **5-C**.

3 Remove bolts **5-D** and the thrust plate **5-E**.

4 Remove seal **5-F**.

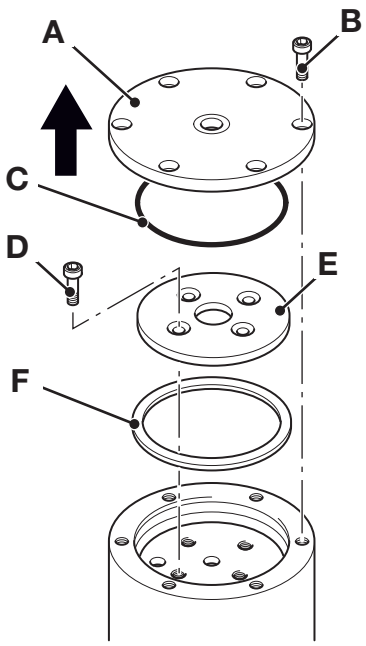


Fig 5.

5 Using a jig push off the axle **6-G** from the rotor **6-H**.

Do not hit with a hammer.

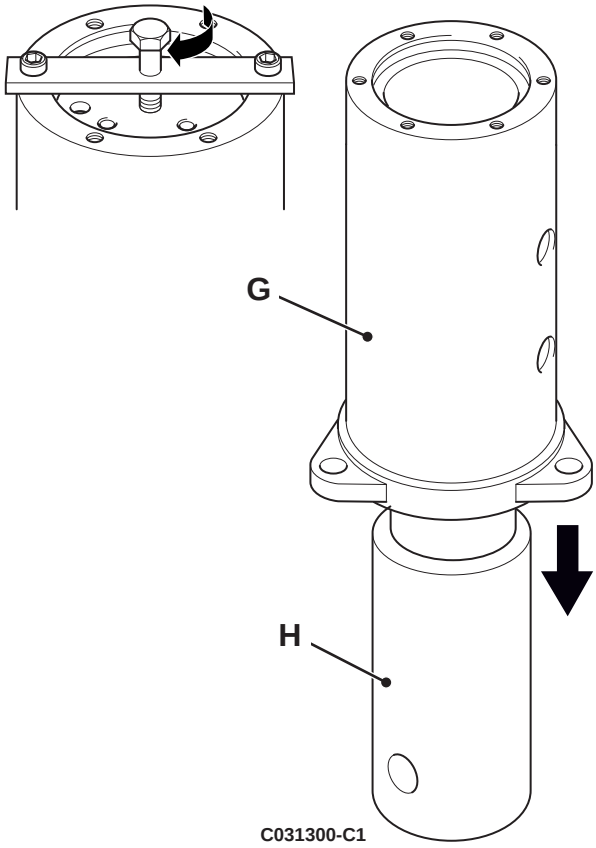


Fig 6.

6 Remove the V-ring **7-J** and nylon ring **7-K** from the axle **7-H**.

Note: *Do not reuse the V-ring **J** and nylon ring **K**.*

Assembly

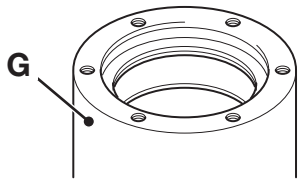
Inspect the parts for signs of wear, pitting, scratching, discolouration etc. Polish out scratches using a fine grade oil stone.

Before assembly, thoroughly clean all parts using a suitable solvent: Do NOT use solvents on 'O'-rings, backup rings and seals.

Fit new 'O'-rings, backup rings and seals.

Lubricate all 'O'-rings, backup rings and seals, with clean hydraulic fluid before fitting.

1 Clean the rotor **10-G** with cleaning fluid or compressed air.



716660-C1

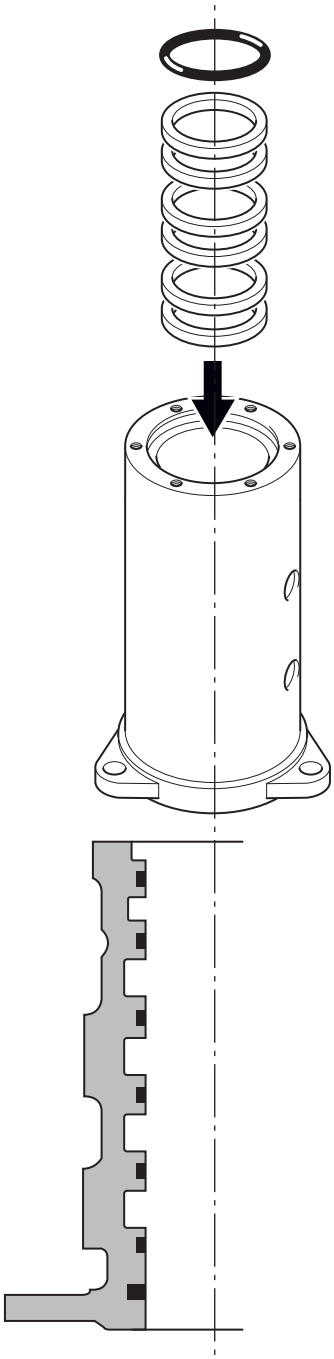
Fig 10.

After cleaning, check to see if there are any scratches or roughness on the inner side of the rotor or grooves.

2 Check the number of packing rings and 'O'-rings. Coat with Vaseline and install in the order below.

a Set one packing ring in each groove starting from the 2nd groove from the top.

b Set the 'O'-ring in the top groove.



C716700-C1

Fig 11.

Hydraulic Rams

Precautions During Use

TE-006

Installation

1 Precautions when installing the ram on the machine.

a When installing and removing from the machine, suspend the ram safely.

b Suspending the ram by the piping is not only dangerous, but can also cause damage to the cylinder.

c Secure the piston rod with a band. It is very dangerous if the rod extends unexpectedly. Also, the rod can be damaged and become unusable.

2 Welding after installing the ram may result in damage.

a If electric welding is done even at a point away from the ram, there may be sparking inside the ram and it will become necessary to replace the ram with a new one.

3 When painting the machine, mask the ram.

a If paint adheres to the rod surface or to the wiper ring and the ram is operated, the wiper ring will not function properly and foreign matter and paint can easily enter the ram. This will cause damage to the seals, drastically shortening the life of the ram.

4 Install the ram only when it is clean.

Caution During Use

1 Use only under designated conditions.

a If hydraulic oil other than the designated oil is used, the seals quickly degenerate and become damaged. If the relief valve is set at a value higher than specified, it may cause ram damage and is dangerous.

b In high temperature environments (approx. 90°C and above) or low temperature environments (below -20°C), seals quickly become damaged. Special seal materials are necessary so check to see if the ram that you are using is suitable or not.

c The number one cause of ram oil leakage is rod damage. Be careful not to damage the rod.

2 Warm up sufficiently before beginning work.

a In cold conditions the rod seals may be frozen, so if the ram is operated at maximum pressure and maximum speed, the seals will be damaged.

b There is a large amount of air in a new ram or one which has been left for a long time, so the ram will not operate smoothly. Also, if pressure is applied suddenly without bleeding the air, high temperatures will be generated due to adiabatic compression and the seals may burn.

c Before beginning work, always move the ram at full stroke with no load and expel air from the cylinder.

3 When stopping or storing, do it at a safe and fixed position.

a The installed ram cannot maintain the same position for a long period of time, because the oil inside the ram may leak and the hydraulic oil volume decreases as it cools. Stop or store the machine in a safe and fixed position.

Maintenance, Inspection Points

1 Carry out daily maintenance and inspection.

a The key point for correct long-term ram function is daily maintenance and inspection. Carry out maintenance and inspection so that the ram functions fully at all times. Always remove any mud, water, dust or oil film adhering to the rod and keep it in normal condition. However, when cleaning the wiper ring and seals, do not get them wet with water but wipe clean with a rag. To prevent rust forming during storage, the amount of exposed ram piston rod should be kept to a

Removal and Replacement

Typical Bucket Ram

P11-E001_2

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

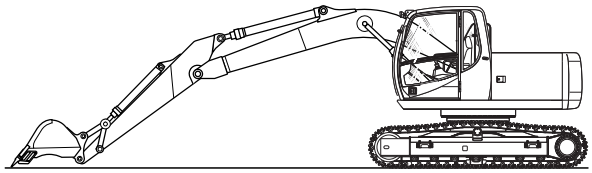
WARNING

Lifting Equipment

You can be injured if you use faulty lifting equipment. Make sure that lifting equipment is in good condition. Make sure that lifting tackle complies with all local regulations and is suitable for the job. Make sure that lifting equipment is strong enough for the job.

INT-1-3-7

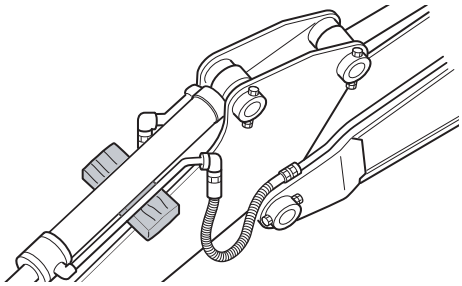
1 Lower the attachment to the ground.



709670

Fig 1.

2 Place a wooden block under the bucket ram.

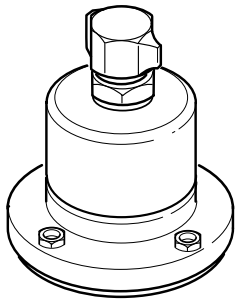


803090

Fig 2.

3 Stop the engine, remove the key.

Release the tank pressure, see ***Releasing the Tank Pressure***.



709600

Fig 3.

4 Remove the nuts and bolts from the rod end of the ram.

Dismantling and Assembly

TE-023

Dismantling the Piston Rod from the Cylinder Tube

Refer to ***Section 1, Service Tools.***

Before starting work, clean all surfaces with a suitable solvent and dry with compressed air.

Each part is precision made, so handle with care. Do not force any part as this may cause damage.

Protect the dismantled parts if they are to be left for a period of time.

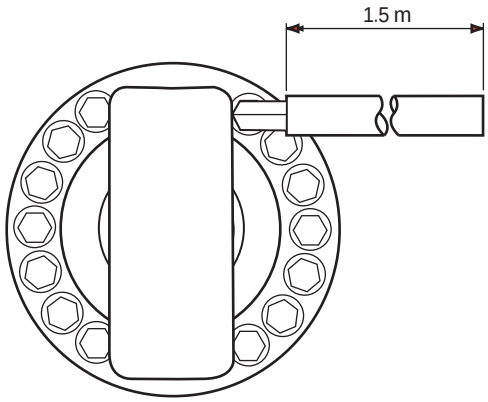
1 Drain the oil.

2 Disconnect the external piping.

3 Secure the ram.

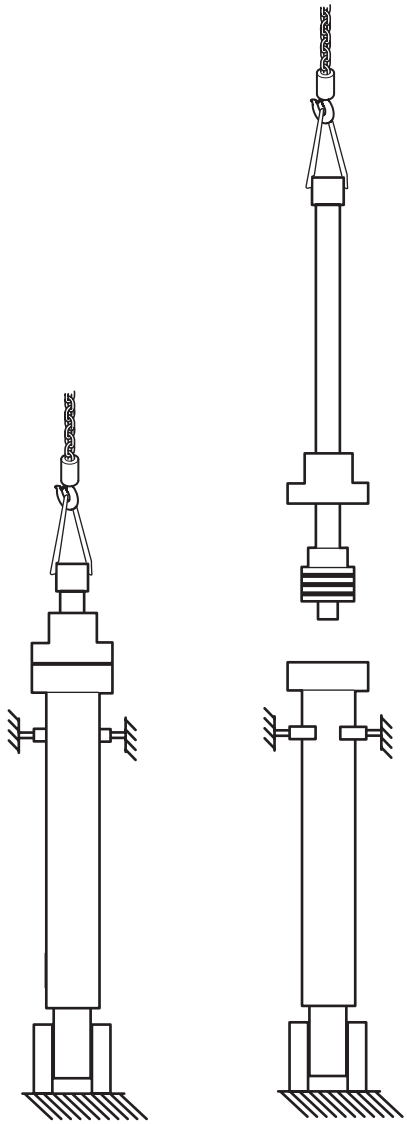
Note: *Fix the ram in a vertical or horizontal position. The vertical position is more favourable for dismantling/re-assembly work. Use the bottom pin hole for preventing the ram from turning on its axis and for fixing the ram in the axial position.*

Remove the cylinder head cap screws (14 off) with an Allen wrench. Use an extension pipe such as shown in the figure below to facilitate bolt loosening.



C027380

Fig 61.



C027430

Fig 62.

Maintenance Specifications

In order to ensure long life of the hydraulic ram, carry out inspection and maintenance regularly. If an abnormal point is found, repair as soon as possible referring to the troubleshooting chart.

Table 5.

Inspection, Maintenance Point	Inspection, Maintenance Contents	Daily	Monthly	Annually	Note
Appearance	Is the ram kept clean (especially the rod sliding part)?	O			
	Is there oil leakage from piping installation and fixing points?		O		
	Is there any peeling paint, separation or rust?	O			
Operation	Are the movements smooth and are there any abnormal sounds?	O			
	Is the response good?	O			
	Is there oil leakage from the sliding parts?	O			
	Is there internal leakage?			O	
	Is the working pressure normal?		O		
	Is the set pressure for the overload relief valve normal?		O		
Hydraulic Oil	Is the hydraulic oil dirty or deteriorated?		O		
	Is the hydraulic oil replaced periodically?			O	
	Are the filters inspected periodically?		O		
Installation with Main Body	Is the pin greasing sufficient?		O		
	Is the pin greasing sufficient?	O			
	Is there backlash or wear in the pins?	O			
	Is the pin seal normal?		O		
	Are the installation screws loose or missing?	O			
	Tightening of the installation screws?			O	
Piston Rod	Are the sliding parts worn?			O	When the rod sliding part is exposed for a long period of time apply anti-rust oil to the rod.
	Are there scratches or dents on the sliding parts?	O			
	Is there coating separation on the sliding parts?	O			
	Are the sliding parts bent?		O		
	Are there cracks in the welding or other damage?	O			

Service Procedures

Make the Machine Safe

TE-009

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

You must make the machine safe before you complete any service procedures.

1 Park the machine on firm level ground.

2 Apply the parking brake (if fitted).

3 Lower the equipment or, raise and fit the applicable safety strut.

4 Stop the engine.

5 Turn the ignition to the `ON' position.

6 Operate the hand controllers to release pressure in the hydraulic system.

7 Turn the ignition to the `OFF' position.

8 Remove the starter key

9 Disconnect the battery (if necessary).

10 Release the hydraulic oil tank pressure.

11 Chock the wheels/tracks as applicable.

12 If the machine is raised from the ground make sure it is securely chocked. NEVER WORK UNDER A MACHINE RAISED ON STABILISERS OR JACKS.

13 If you wish to arc weld the machine disconnect the alternator and electronic control units (if fitted).

Pressure Testing - General

Confirmation of the Oil Temperature

Confirm the oil temperature is between 45°C - 55°C using the self check function. If the temperature is low use the following warm-up procedure.

Warming-up Procedure

1 Turn the throttle control to mid-range and make sure the work mode is set to E.

2 Run the engine until the coolant temperature gauge reads within the normal (green) range.

3 Set the servo isolator switch to ON to enable the hydraulic servo controls to be operated.

4 Operate the bucket control slowly until it reaches one end of its travel and leave it there for 10 seconds.

5 Operate the bucket control slowly to the other end of its travel and leave it there for 10 seconds.

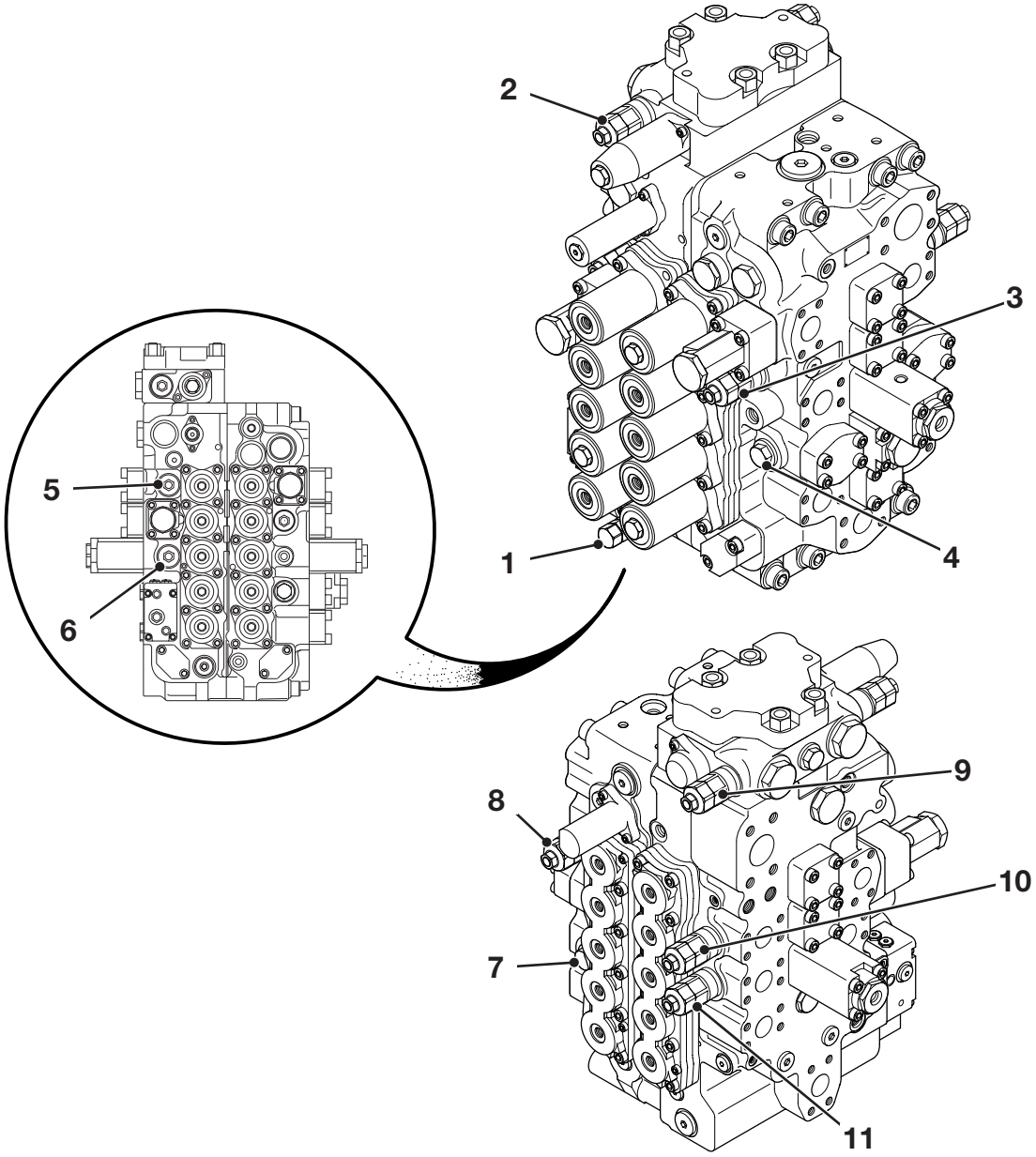
6 Repeat steps 4 and 5 for 10 minutes to warm up the hydraulic circuit.

7 Operate the excavating controls three to five times in each direction to distribute warm hydraulic oil around the system.

Note: *All pressure testing to be carried out with the engine set at minimum engine revs unless otherwise stated.*

Pressure Relief Valve Location

TE-011



C047240-C1>

Fig 2.

⇨ *Table 2. (E-220)*

Main Relief Valve (MRV) Pressure

TE-012

1 Prepare the Machine

a Operate the dipper out and lower the boom to set the bucket on the ground.

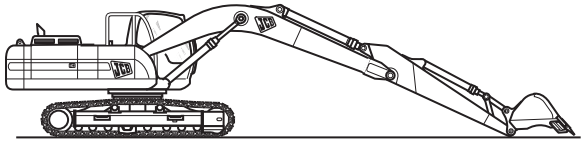


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Fig 3.

b Make the machine safe, refer to ***Section E, Service Procedures.***

c Install a 0 - 400 bar (0 - 6000 lb/in^2) pressure gauge in **TP1** or **TP2**.

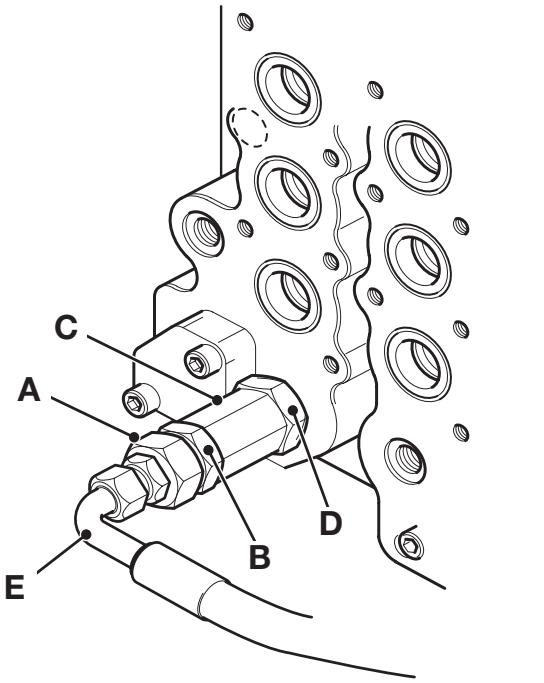
d Start the engine, and confirm that the engine is at its maximum no-load speed and it is in the E mode to test standard pressure and L mode to test power boost pressure.

e Raise the boom and then operate the dipper out control. Read the pressure gauge with the dipper ram stalled at the end of its stroke.

f If it is outside the limits, stop the engine and adjust the MRV as below.

Note: *For accurate setting, the pressure should be adjusted up to the required level.*

2 High Pressure Setting (Power Boost)



A406580-C1

Fig 4.

a Make the machine safe, refer to ***Section E, Service Procedures.***

b Remove servo hose **E** and plug hose.

c Start the engine, and confirm that the engine is at its maximum no-load speed and it is in the E mode.

d Stall the dipper.

e Hold nut **C** and release lock nut **B** and screw the low pressure setting nut **A** clockwise all the way in.

f Hold nut **C** and slacken nut **D**. Screw nut **C** in, to increase pressure or out to decrease pressure.

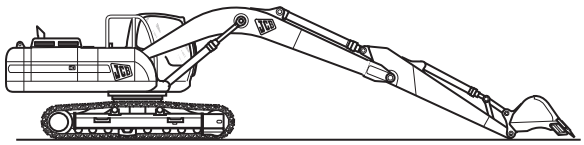
g Once required pressure is achieved on the pressure gauge, hold nut **C** and lock nut **D** back up.

3 Low Pressure Setting (Standard)

Servo Relief Pressure

1 Prepare the Machine

a Operate the dipper out and lower the boom to set the bucket on the ground.



C030150-1

Fig 5.

b Make the machine safe, refer to ***Section E, Service Procedures.***

2 Before testing the Pilot Relief valve **C** ⇒ ***Fig 6. (E-223)***, connect a 0-100 bar (0-1500 lb/in²) pressure gauge to test point **TP3**.

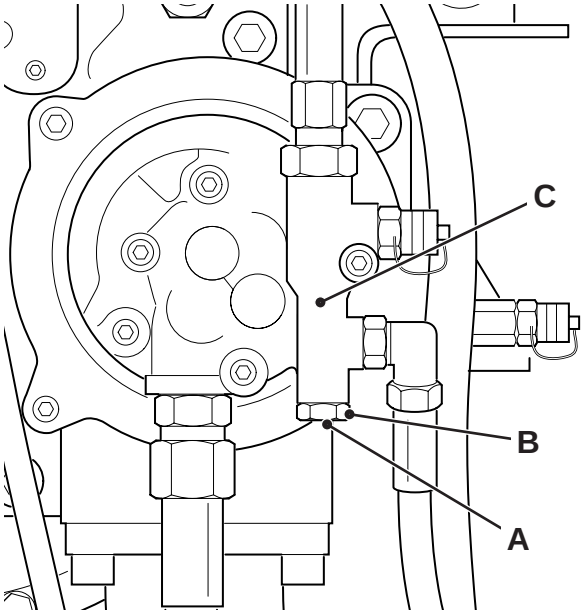


Fig 6.

Note: *For accurate setting, the pressure should be adjusted up to the required level.*

3 Start the engine and confirm that the engine is at its minimum no-load speed and it is in the E mode. The pressure gauge reading should be compared to the technical data at the start of this section. If it is outside the limits adjust the pilot relief valve as below.

4 Loosen the lock nut **B** of the pilot Relief Valve.

5 The valve is adjusted by turning relief valve adjusting screw **A** (one turn of the adjustment screw equals 39.2 bar, (568.5 lb in²).

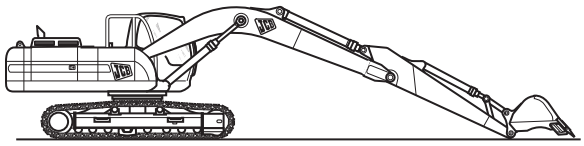
6 Tighten lock nut B to 17 Nm (12. lbf ft), check the relief pressure again.

Slew Motor Pressure Relief

TE-015

1 Prepare the machine

a Operate the dipper out and lower the boom to set the bucket on the ground.



C030150-1

Fig 7.

b Make the machine safe, refer to ***Section E, Service Procedures.***

2 Connect a 0-400 bar (0 - 6000 lb/in^2) pressure gauge and adaptor to test point **TP2**.

3 Initiate slew lock procedures.

a Remove the water-proof connector on the slew lock solenoid valve.

b Press the slew lock switch which is on the right hand console inside the cab, and confirm that the slew lock symbol appears on the monitor.

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c Start the engine, (error codes may appear for disconnected solenoid) and operate the engine at around 1000 rpm, then operate the slew lever slowly. Listen to confirm that the relief sound is heard and that the machine does not slew.

d Run the engine at minimum no-load speed and in the E mode.

e Operate the slew lever.

4 The pressure gauge reading should be compared to the technical data at the start of this section. If it is outside the limits adjust the slew motor relief valve as below.

Note: *If the water-proof slew lock solenoid valve is not removed. Full slew pressure can not be read.*

Note: *Pressure measurement is also possible on the slew motor, upper section.*

5 If the readings are outside the limits, continue as below.

6 Pressure Adjustment

a Make the machine safe, refer to ***Section E, Service Procedures.***

b Remove relief valve to be adjusted.

c The difference between the set pressure and the present pressure determines the number of shims **E** required for adjustment.

7 Remove the relief valve assembly from the slew motor.

Note: *If both relief valves are removed at the same time, mark them left and right to facilitate re-assembly in the correct position.*

8 Disassembly

a Place the relief valve in a vice and remove the cap **A** with a 14 mm hexagonal socket, take out the piston **C**, liner **B** poppet **E**, spacer **D**, shims **E** and spring **F**.

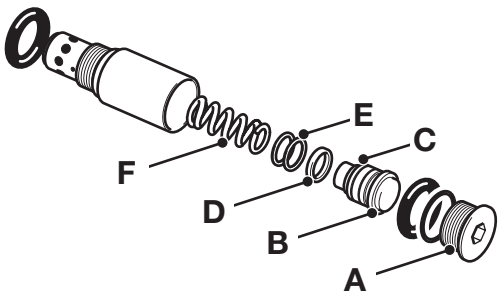

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Fig 8.

b Add shim to increase pressure. Remove shim to decrease pressure.

Auxiliary Relief Valves

TE-014_2

General

1 Prepare the machine

a Operate the dipper out and lower the boom to set the bucket on the ground.

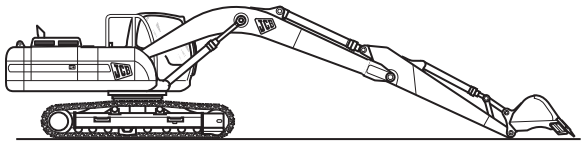

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Fig 9.

b Make the machine safe, refer to ***Section E, Service Procedures.***

2 Increase MRV Pressure, refer to ***Section E, Service Procedures***.

3 Test the ARVs with the engine at idle using the appropriate test points.

4 Restore Original MRV Pressure, refer to ***Section E, Service Procedures***.

Travel Motor Relief Pressure

TE-016

1 Prepare the Machine

a Operate the dipper out and lower the boom to set the bucket on the ground.

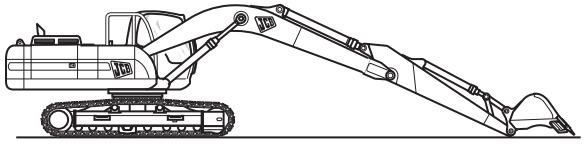

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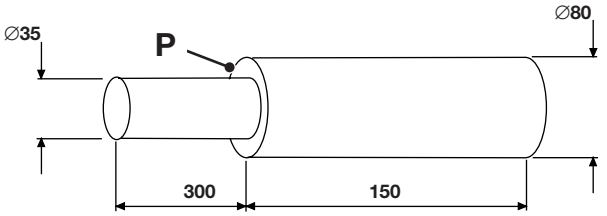
Fig 25.

b Make the machine safe, refer to ***Section E, Service Procedures.***

c Connect a 0 - 400 bar (0 - 6000 lb/in^2) pressure gauge to test point **TP1** or **TP2**.

2 Increase MRV Pressure, refer to ***Section E, Service Procedures***.

3 Insert a lock pin **P** between the drive sprocket to be measured and the side frame.



TOOL-C1

Fig 26.

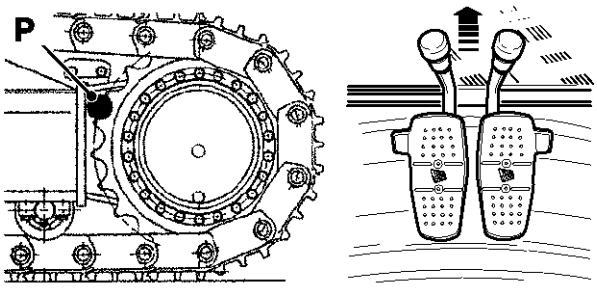


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Fig 27.

4 Start the engine, select MID speed travel, lower the gate lock lever and run the engine at minimum no-load speed in the E mode.

5 Slowly engage the locked travel motor and measure the pressure in forward and reverse.

6 The pressure gauge reading (travel motor) should be compared to the technical data at the start of the section. If it is outside the limits, adjust relief valve pressure.

Note: *For accurate setting, the pressure should be adjusted up to the required level. Release lock nut **A**. Adjust setting screw **B** to indicate a pressure below the required level and then bring the pressure back up for final setting. Tighten lock nut **A**.*

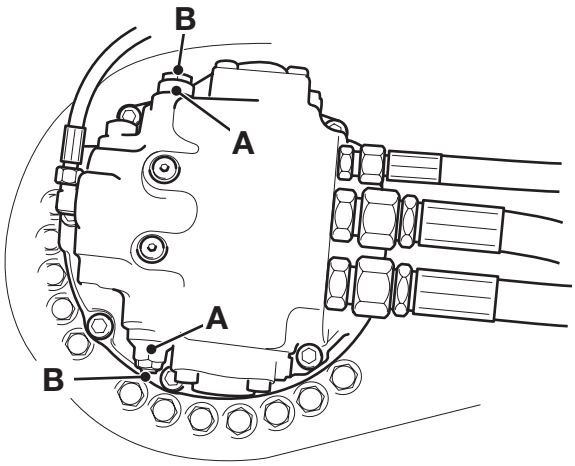

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Fig 28.

7 Restore Original MRV Pressure, refer to ***Section E, Service Procedures***.

Fault Finding

Hydraulic Contamination

TE-002_3

Hydraulic Fluid Quality

This machine uses a large volume of fluid in the hydraulic system for power transmission, equipment lubrication, rust prevention and sealing. According to a survey conducted by a pump manufacturer, seventy per cent of the causes of problems in hydraulic equipment were attributable to inadequate maintenance of the quality of the hydraulic fluid. Therefore, it is obvious that control of the quality of the hydraulic fluid helps prevent hydraulic equipment problems and greatly improves safety and reliability. Furthermore from an economic angle it extends the life of the hydraulic fluid if quality is maintained.

Effects of Contamination

Once inside the system, hydraulic circuit contaminants greatly effect the performance and life of hydraulic equipment. For example, contaminants in a hydraulic pump develop internal wear to cause internal leakage and hence lower discharges. Wear particles generated will circulate with the hydraulic fluid to cause further deterioration in the performance of this and other equipment. Contaminants also enter principal sliding sections of the equipment causing temporary malfunction, scuffing, sticking and leakage and can lead to major problems.The main contaminants can be classified as follows:

1 **Solid Particles** - sand, fibres, metallic particles, welding scale, sealing materials and wear particles etc.

2 **Liquid** - usually water and incompatible oils and greases.

3 **Gases** - Air, sulphur dioxide etc. which can create corrosive compounds if dissolved in the fluid.

These contaminants can appear during manufacture, assembly and operation.

Cleaning Operation

The purpose of cleaning oil is to remove contaminants of all types and sludge by filtering hydraulic fluid through a cleaning unit. ⇨ *Fig 1. (E-233)*. General Bulletin 011 also refers.

Procedure

Connect the cleaning unit in place of the hydraulic filter. ⇨ *Fig 1. (E-233)*. Run the system for sufficient time to pump all the hydraulic fluid through the unit. Disconnect the cleaning unit and reconnect the filter. Top up the system with clean hydraulic fluid as required.

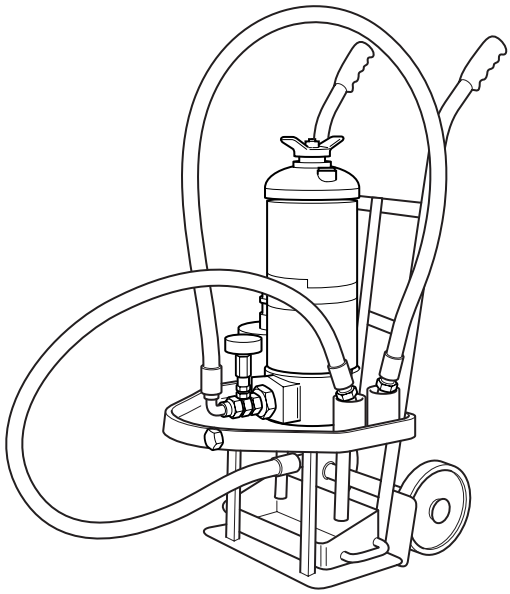

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Fig 1. Cleaning Unit

Main Control Valve

Table 1.

Symptoms	Possible Causes	Countermeasures
Spool sticking	1. Oil temperature is abnormally high.	Remove the obstruction.
	2. Hydraulic oil is dirty	Replace the hydraulic oil and clean the circuit at the same time.
	3. Port connector is tightened too much	Check the torque.
	4. Valve housing is deformed due to Installation	Loosen the installation bolt and check.
	5. Pressure is too high	Attach pressure gauge to pump port and ram port and check the pressure.
	6. Spool is bent	Replace the valve assembly.
	7. Return spring is damaged	Replace the damaged parts.
	8. Spring or cap is not on straight	Loosen the cap and after aligning, tighten.
	9. Temperature inside valve is not even.	Warm up the circuit.
Spool does not stroke	1. Valve is clogged inside with dirt	Remove the dirt (flushing).
Load cannot be maintained	1. Oil leakage from the ram	Check the ram.
	2. Oil is by-passing from the valve spool	Replace the valve assembly.
	3. Oil leakage from the port relief valve	Remove the port relief from the housing and clean the housing seat and relief valve seat.
	4. Oil leakage from the lock valve	Disassemble the lock valve and clean the poppet seat and sleeve, plug seat. If the seat is damaged, replace the poppet, or lap the poppet and seat.
When the spool is selected from neutral to raise position, the load falls.	1. Foreign matter in load check valve	Disassemble the check valve and clean.
	2. Check valve poppet or seat damaged	Replace the poppet or lap the poppet and seat part.

Relief Valve

Table 2.

Symptoms	Possible Causes	Countermeasures
Pressure does not rise at all	1. The main poppet, sleeve or pilot poppets are sticking open or foreign matter is in the valve seat.	**1** Check whether foreign matter is in each poppet. **2** Check whether each part is sliding smoothly. **3** Clean all the parts.
Relief pressure is unstable	1. The pilot poppet seat is damaged.	Replace the damaged parts.
	2. The piston is sticking to the main poppet.	Remove the surface scratches. Clean all the parts.
Relief pressure is out of control	1. Wear due to foreign matter.	Replace the worn parts
	2. Lock nut and adjuster are loose.	Reset the pressure and tighten the lock nut to the rated torque.
Oil leakage	1. Damaged seat or worn O-ring.	Replace damaged or worn parts. Check whether each part is sliding smoothly.
	2. Parts are sticking due to foreign matter.	Check for scratches, cuts or foreign matter. Clean all the parts.

Hydraulic System

Table 3.

Symptoms	Possible Causes	Countermeasures
The hydraulic system is not working well or not at all	1. Pump problem.	Check the pressure or replace the pump.
	2.Foreign matter clogging inside the relief valve.	Disassemble the relief valve and clean.
	3. Relief valve trouble.	Check according to the maintenance procedures.
	4. Ram trouble.	Repair or replace.
	5. Load is too heavy.	Check the circuit pressure.
	6. Crack in the valve.	Replace the valve assembly.
	7. Spool does not stroke fully.	Check the spool movement and operation link.
	8. Oil level too low.	Replenish hydraulic oil.
	9. Filters inside circuit are clogged.	Clean filter or replace.
	10. Hose runs are kinked.	Check the hoses.

Slew Motor

Table 4.

Symptom	Cause	External Inspection	Countermeasure	Repair
Motor does not run	Internal damage to the motor.	Measure the oil drain volume.	High possibility of damage to the sliding surfaces if the supply volume is approximately equal to the drain volume. Dismantle and inspect.	⇒ *Table 5. (E-239)*.
	Internal damage to the motor.	Open the motor inlet and outlet ports and apply 20 kgf/cm^2 (284 lbf/in^2) pilot pressure to the brake release port. Try to rotate the shaft with a torque of approx. 39 Nm (29 lbf ft).	High possibility of internal damage to the motor if the supply shaft does not rotate smoothly when this torque is applied. Dismantle and inspect.	Renew damaged parts or renew the motor assembly.
	Relief valve in circuit not set correctly.	Measure pressure.	Reset to the prescribed setting.	
Excessive slip	Wear or damage to the motor sliding surfaces or to the high-pressure seal.	Measure the oil drain volume.	Leakage is too high if the oil drain volume exceeds 5 l/min (1.1 gal/min). Dismantle and inspect.	⇒ *Table 5. (E-239)*.
	Oil hot and excessive parts or circuit.	Measure the oil temperature.	Reduce the oil temperature.	⇒ *Table 5. (E-239)*.
Abnormal heating	Seizure of motor sliding parts or circuit.	Check for any metallic matter deposited in motor drain oil or drain filter. Apply a 30 kgf/cm^2 (427 lbf/in^2) pilot pressure to the brake release port and try to rotate the shaft with a torque of approx.39 Nm (29 lbf ft).	If metallic matter is discovered or the supply shaft does not rotate smoothly when torque is applied, there is a high possibility of internal damage to the motor. Dismantle and inspect.	Repair or renew the damaged parts. Renew the motor assembly.
Leakage from oil seals	Damage or wear to oil seal lip.			Renew the oil seals.
	Damage or wear of the shaft seal.			Repair the problem or renew the motor assembly.
	Abnormal pressure in the casing.	Check the pressure in the casing and measure the drain volume.	Set the pressure in the casing below 3 kg/cm^2. (43 lbf/in^2) Dismantle and inspect if drain volume is excessive.	Renew the oil seal. Repair or renew the damaged parts. Renew the motor assembly.

Hydraulic Pump

Often the regulator and attendant valves or pump are combined which makes it very difficult to discover the reason for the trouble. Inspect the following categories which will assist in discovering the abnormal point.

1 **Filter and Drain Oil Inspection.** Inspect the filter element. Check to see whether there is an abnormally large amount of foreign matter. There will be a small amount of metallic powder due to wear of the shoe or cylinder, but if there is a large amount of metallic powder in the filter, it may be due to trouble with the shoe. Also check the drain oil in the pump casing.

2 **Abnormal Vibration and Sound.** Check to see if there is any abnormal vibration or sound in the pump main body. Check to see if it is like the regular frequency sound of the regulator's working or attendant valve relief working. If it is an abnormal vibration or sound, it is possible that there is damage or cavitation inside the pump.

3 **Measure Pressure of Each Part.** When it is a control problem, do not unnecessarily open ports for inspection purposes, measure the pressure for each section and find the abnormal item.

Table 6. Prime Mover Overload

Cause	Treatment	Note
Are the revolutions - pressure higher than pre-determined values?	Set to pre-determined value.	
Is the regulator torque setting too high?	Re-inspect regulator.	Refer to regulator instructions.
Seizure or damage of pumps internal parts	Replace damaged parts.	Check the filter or drain oil for signs of abnormal wear.
Wrong regulator hose connection.	Correct hose lines.	

Table 7. When pump flow is extremely low, delivery pressures does not increase

Cause	Treatment	Note
Regulator breakdown	Repair the regulator	Refer to regulator instructions
Seizure or damage of pump internal parts.	Replace damaged parts.	Check filter, drain oil.
Pump breakdown.	Replace damaged parts.	Remove pump and inspect shaft coupling.
Attendant valve breakdown.	Inspect attendant valve.	
Incorrect regulator hose connection.	Correct hose lines.	

Table 8. Abnormal Sound and Vibration

Cause	Treatment	Note
Cavitation.	Prevent cavitation. Check to see if hydraulic oil is white and cloudy.	Boost pressure is low. Pump is broken. Air is sucked by suction pipe. Suction resistance is high.
Damage of shoe caulking part.	Replace piston, shoe, shoe plate.	
Crack in cylinder.	Replace cylinder	
Bad installation of pump.	Correct installation.	
Relief valve bouncing.	Repair relief valve.	Refer to relief valve instructions.

Hydraulic Rams

Hydraulic Ram Faults and Remedies

It is often not easy to find the part causing the fault. In the table possible problems are listed. ⇨ *Table 9. (E-241)*. Repair is difficult, refer to the estimated cause and treatment listed in the table. The general phenomenon, estimated causes and treatment are shown. ⇨ *Table 10. (E-242)*. However, machine trouble is most often caused, not by just one faulty part, but its relationship with other parts. Not all of the possible causes and treatments are listed in the tables therefore, it may be necessary for the person responsible for repairs to make further investigations to find the cause of the trouble.

Table 9.

Item	Symptoms
1	Oil leakage from piston rod sliding part
2	Oil leakage from cylinder head meeting part
3	Oil leakage from cylinder head meeting part
4	Faulty operation

Fault Finding Tests

Slow or Underpowered:

- boom up operation
- bucket service operation
- dipper service operation
- slew service operation

Carry out the following tests:

Test 001	Testing negative control signal
Test 002	Testing max flow cut signal
Test 003	Testing main pump pressures
Test 004	Testing horsepower control
Test 005	Testing operation of main hydraulic spool
Test 006	Testing operation of pressure switches
Test 007	Testing engine speed settings
Test 008	Testing machine cycle times
Test 016	Testing Pump Flow

Harsh Operation When Selecting:

- boom down
- slew service

Carry out the following tests:

Test 001	Testing negative control signal (Boom down only)
Test 011	Testing operation of Slew brake (Slew only)
Test 006	Testing operation of pressure switches

Tracking Off Line

Carry out following tests:

Test 001	Testing negative control signal
Test 003	Testing main pump pressures
Test 012	Testing track motor relief valve settings
Test 013	Testing track motor drain line rates
Test 008	Testing track motor speeds

Additional information

Measure the amount of deviation over a 20 metre (165.6 ft) distance and record ground conditions.

Deviation limit = 1m (39.4 in) deviation in 20m (165.6 ft) of travel

If machine is fitted with priority valve in pump line (this valve usually feeds low flow / weedcutter circuit) try connecting the two main service hoses together that are connected to the valve. Does this change the fault?

Swap the two main hoses on the hydraulic pump. Does the problem change direction?

Poor Tractive Effort

Carry out the following tests:

Test 001	Testing negative control signal
Test 003	Testing main pump pressures
Test 012	Testing track motor relief valve settings
Test 013	Testing track motor drain line rates

Additional Information

What travel gear is the machine operating in when the problem occurs?

Loss of Creep Speed

Carry out the following tests:

Test 012	Testing max flow cut signal
Test 008	Testing track motor speeds
Test 006	Testing pressure switches

Additional information

When creep speed tracking is selected is `tortoise' symbol displayed on monitor? yes / no

Test 001: Testing Negative Control Signal

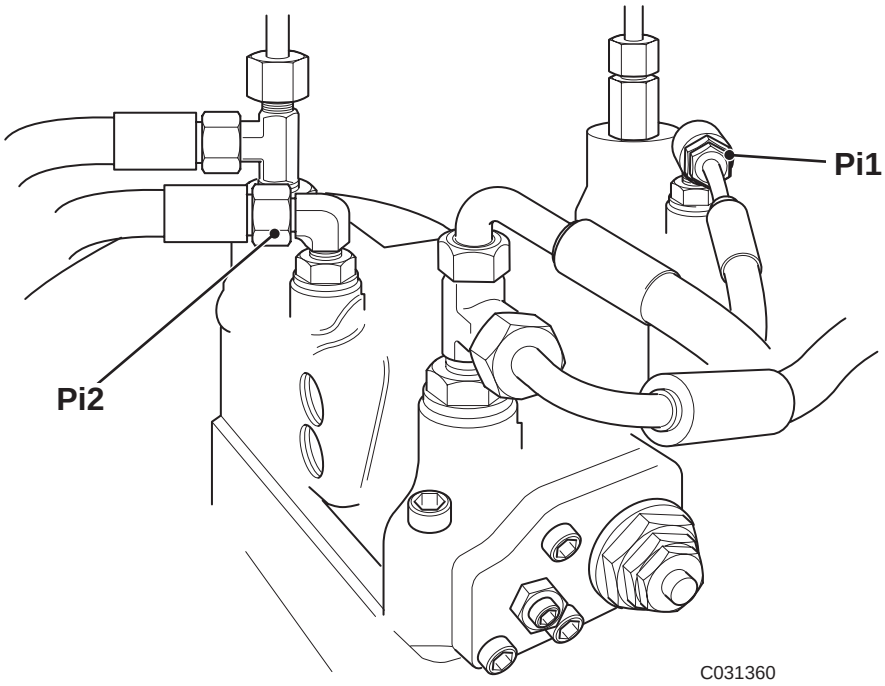

Fig 2.

1 Fit test gauges (0 - 60 bar, 10 - 1000lb in^2) into hose connections to ports **Pi1** + **Pi2** with tee piece adapter

2 Warm up machine hydraulic temperature to 50 °c (122 °f)

3 ⇒ *Table 11. (E-249)*

Test 002: Test Max Flow Signal

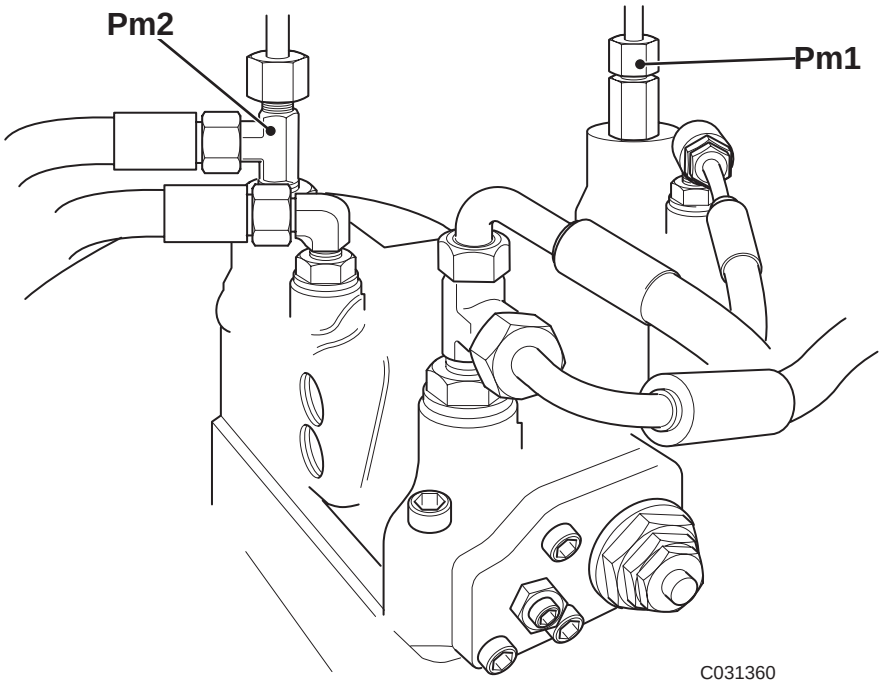

Fig 3.

1 Fit test gauges 0 - 60 bar (10 - 1000 lb in²) into hose connections to ports **Pm1** + **Pm2** with tee piece adapter

2 Warm up machine hydraulic temperature to 50 °c (122° f)

3 ⇨ *Table 12. (E-250)*

Table 12.

	(expected Pressures)	
	Port Pm1	**Port Pm2**
With max engine rpm's and no services selected record max flow cut control pressure in E mode	0 - 1.5 bar	0 - 1.5 bar
Select L mode and record pressure	40 bar	40 bar
Select standard mode, select low speed tracking (tortoise on monitor) then select track service record pressure	40 bar	40 bar

Note: *40 bar = 80 lb in², 1.5 bar = 21.75lb in²*

Test 003: Testing Main Pump Pressure

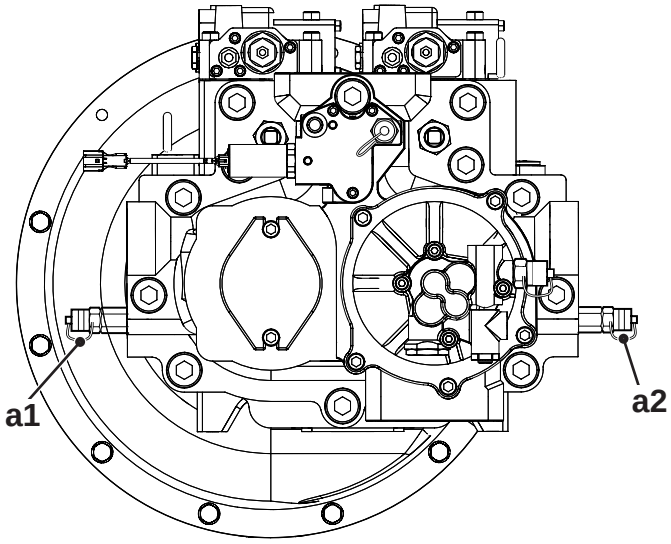

Fig 4.

1 Fit test gauges 0 - 600 bar (8700 lb in^2) into ports **a1 + a2**.

2 Warm up machine hydraulic temperature to 50°c (122 °F).

3 *⇨ Table 13. (E-253)*