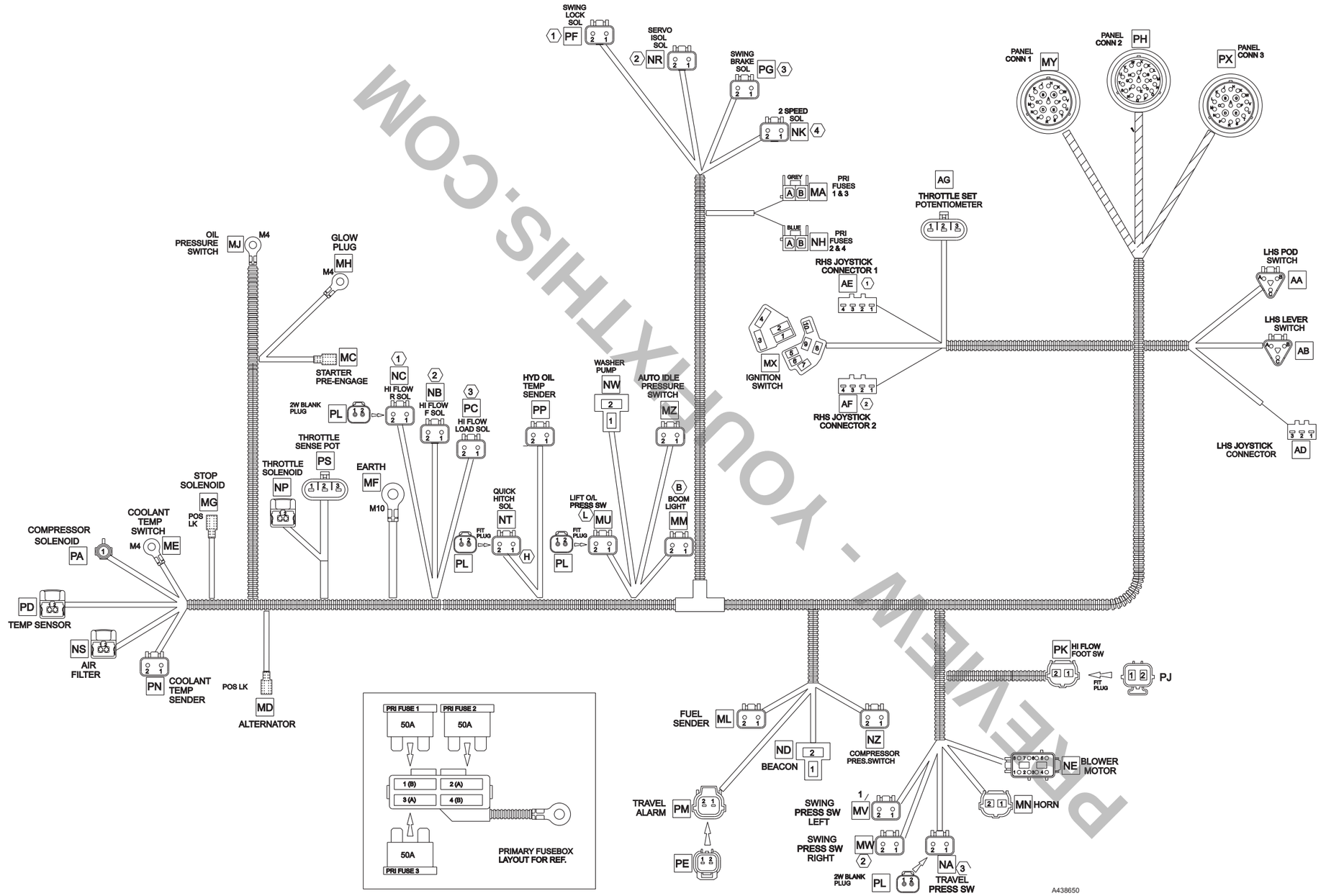
Slewpan Harness



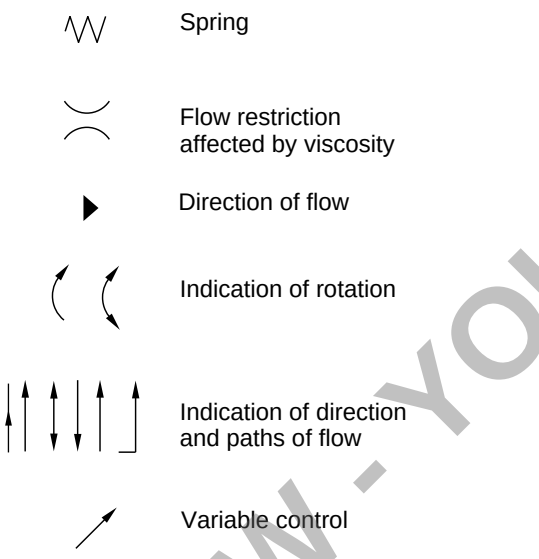
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Complex hydraulic components and circuits can be described to the engineer by using graphical symbols. The following pages illustrate and give a brief description for some of the more common symbols used.

There are many symbols in use and it would be impossible to include them all here. However it should be noted that most are only variations or refinements on the basic principles explained here. If more detailed information is required you are recommended to obtain a copy of BS2917 or IS01219.

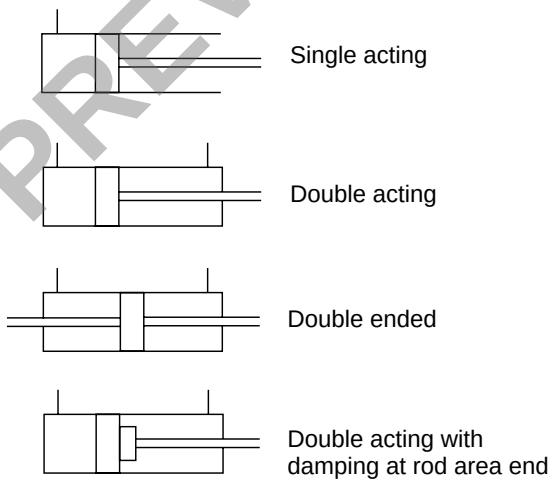
Once familiar with the symbols, the engineer can use hydraulic circuit diagrams as an aid to fault finding. It will be possible to see the complete hydraulic circuit and decipher the relationship between hydraulic components.

General (Basic & Functional Symbols)



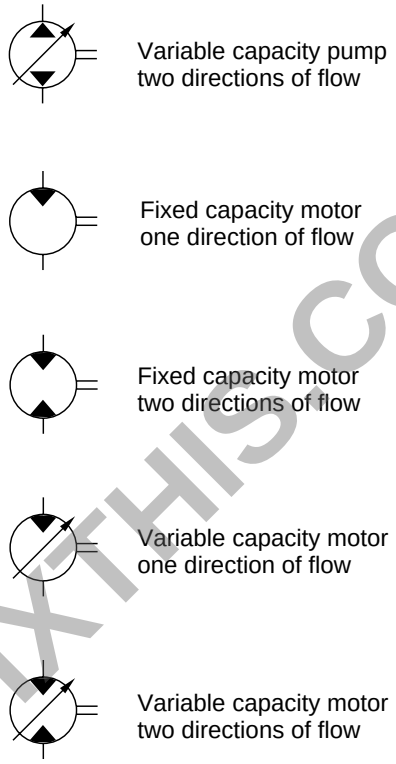
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Rams



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Pumps & Motors

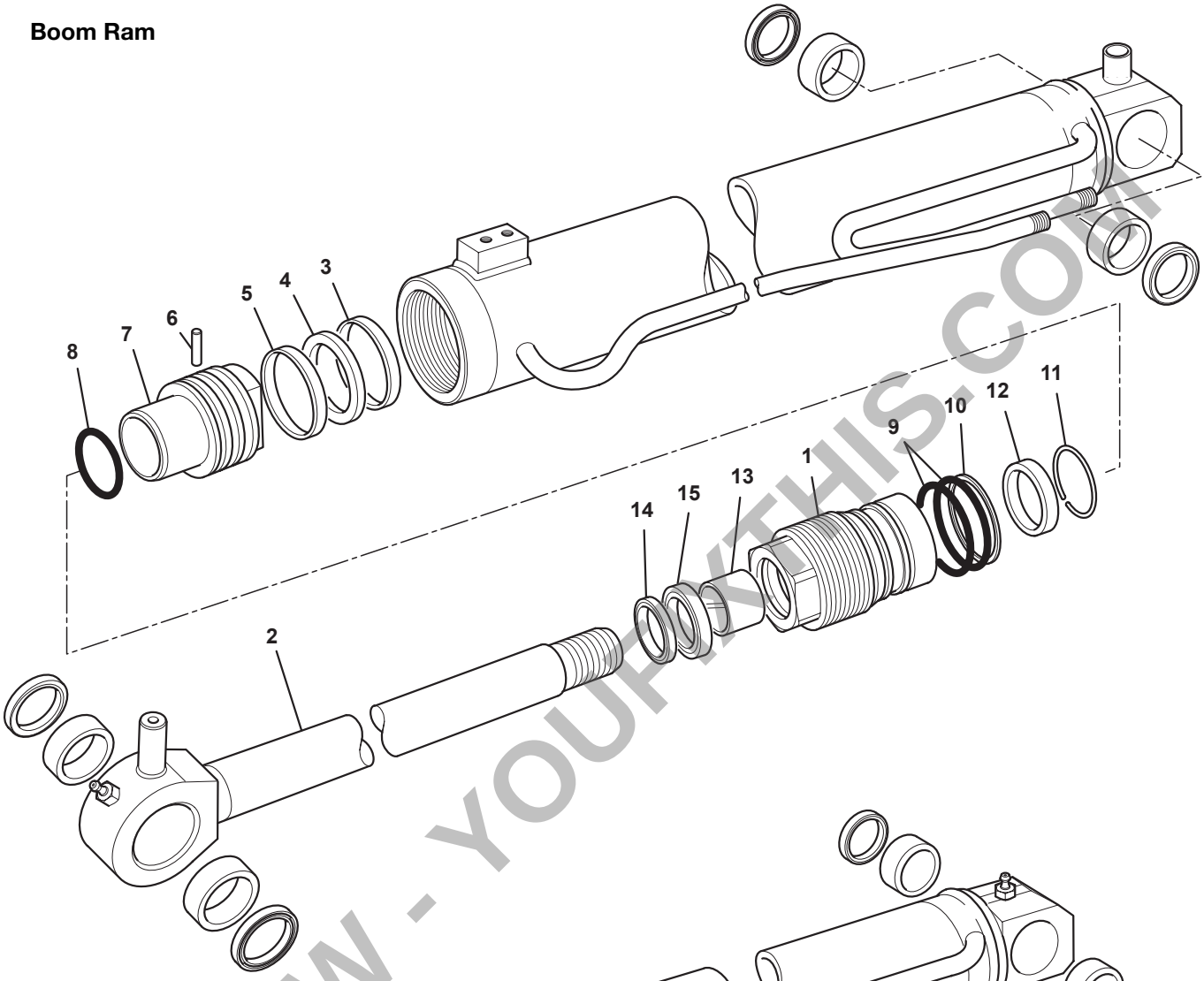


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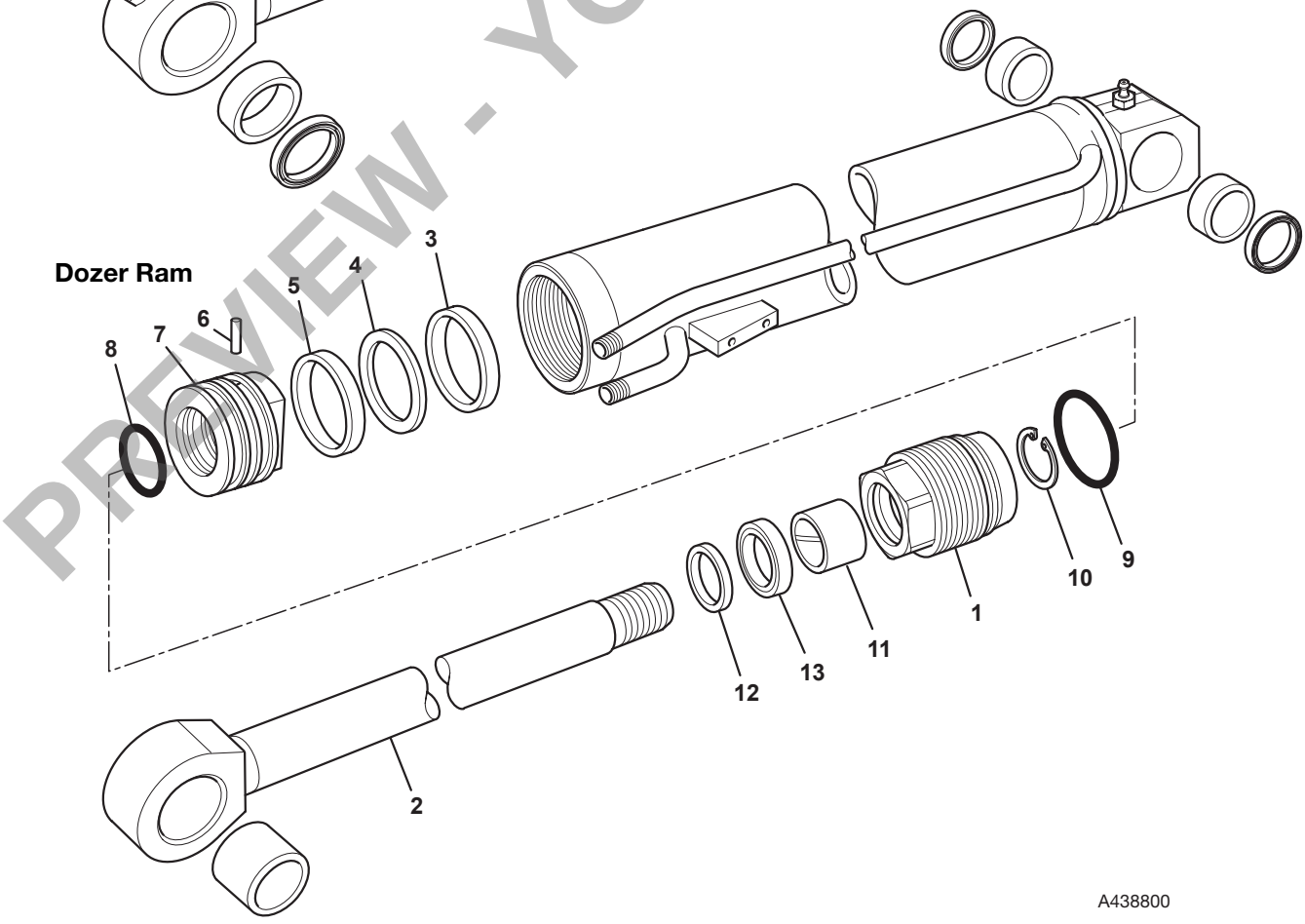
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Boom Ram



Dozer Ram



A438800

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Only use following when no setting is specified in text of manual.

CAUTION: All bolts used on JCB equipment are high tensile and must not under any circumstances be replaced with bolts of a lesser tensile specification.

Metric Grade 8.8 Bolts

Bolt Size (mm)		Hexagon (A/F) mm	Torque settings Nm	kgf m	lbf ft
M5	(5)	8	7	0.7	5
M6	(6)	10	12	1.2	9
M8	(8)	13	28	3.0	21
M10	(10)	17	56	5.7	42
M12	(12)	19	98	10	72
M16	(16)	24	244	25	180
M20	(20)	30	476	48	352
M24	(24)	36	822	84	607
M30	(30)	46	1633	166	1205
M36	(36)	55	2854	291	2105
Slew Ring to Undercarriage			260	26.5	191.8
Slew Ring to Superstructure			280	28.5	206.5
Kingpost Pivot Pin Retaining Bolts			98	10	72

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Error Codes

The following table shows the error codes for this system. If an error code is active, the message will be display right away and a log will be entered by the ECU-MIDI. If the error is removed, the message will also clear.

If the "ACK" button is pressed to acknowledge the error, then the message will become a repetitive message. If more then one error is active, then the error messages should be entered into their own repetitive message queue until they are acknowledged.

Errors associated with optional features are disabled if the feature is not selected for the vehicle.

The errors are organised according to the type of error. Open circuit errors are given 1XX numbers. Short circuit errors are given 2XX numbers. System errors are given 3XX numbers. The XX number will depend on the function with the error.

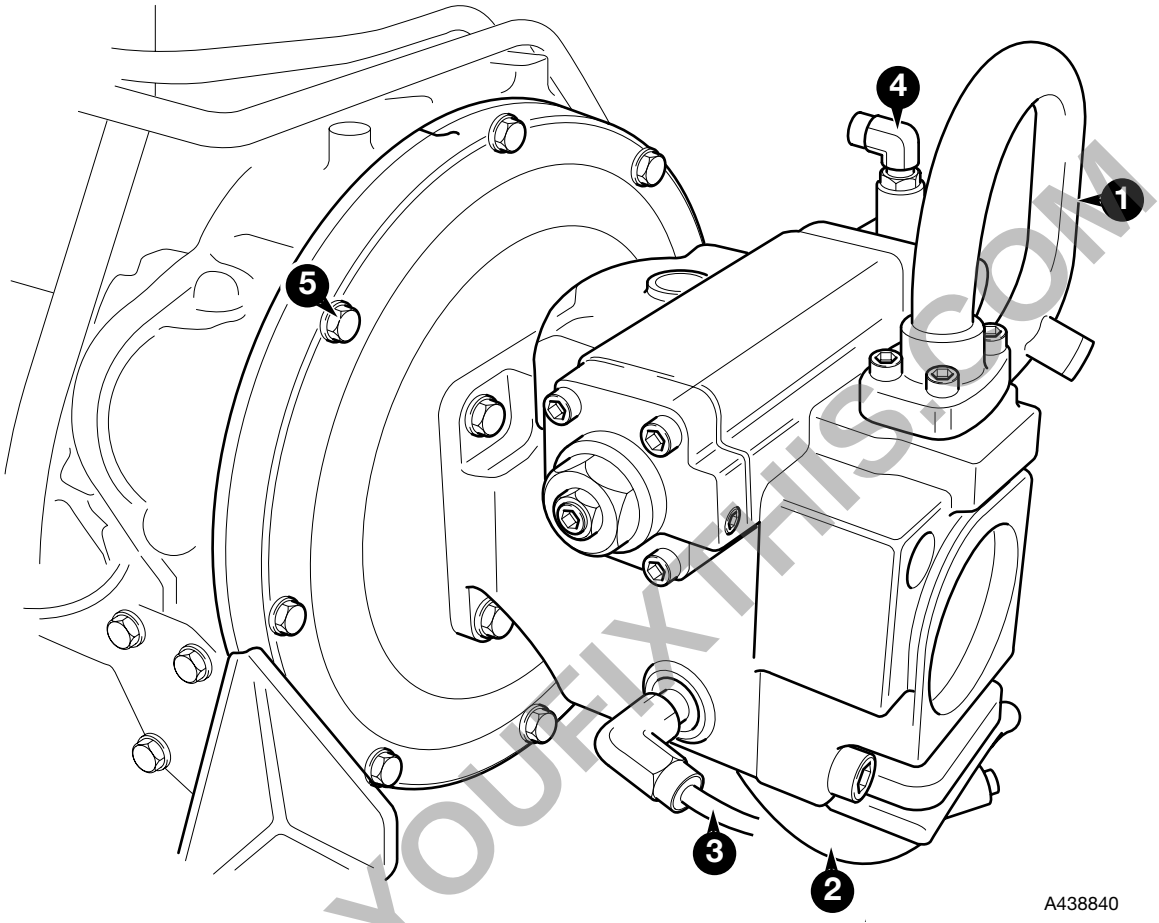
Example: The Horn error number is 15. Therefore if the horn is open circuit the error number will be 115 and if the horn is short circuit the error number will be 215.

MESSAGE	ERR #	DESCRIPTION
101 CRANK	1	A crank signal was not seen by the ECU-MIDI.
102 ALT ERR	2	The alternator is reading high when the engine is off and is therefore open circuit.
103 OIL SW	3	The oil pressure switch is open circuit.
108 THR SOL	8	The throttle solenoid is open circuit as detected in the OFF condition.
109 SENS PT	9	The throttle sense pot is measuring a ground (<0.5?) and is therefore open circuit.
110 SET PT	10	The throttle set pot is measuring a ground and is therefore open circuit.
111 ESOS	11	The ESOS output is open circuit.
112 SERVO	12	The servo solenoid output is open circuit.
113 WIPER	13	The wiper output is open circuit.
114 WASHER	14	The washer output is open circuit.
115 HORN	15	The horn output is open circuit.
116 TRAVEL	16	The travel alarm output is open circuit.
117 SWG BRK	17	The slew brake output is open circuit.
118 SWG LCK	18	The swing lock output is open circuit.
119 TRAVEL	19	The travel speed output is open circuit.
120 FLOW F	20	The high flow F solenoid is open circuit.
121 FLOW LD	21	The high flow load solenoid is open circuit.
122 FLOW R	22	The high flow R solenoid is open circuit.
123 LOW TAB	23	The low flow TAB changeover solenoid is open circuit.
124 LH LT	24	The LH work lamps output is open circuit.
125 RH LT	25	The RH work lamps output is open circuit.
126 BOOM	26	The boom work lamps output is open circuit.
127 REAR LT	27	The rear work lamps output is open circuit.
128 FUEL	28	The fuel level is reading more than 200 Ohms and is therefore open circuit.
129 EN TEMP	29	The engine temperature input is open circuit.
130 HYD TMP	30	The engine temperature input is open circuit.
132 Q HITCH	32	The quick hitch output is open circuit.
133 REFUEL	33	The refuelling pump output is open circuit.
202 ALT ERR	2	The alternator output is shorted to ground.
208 THR SOL	8	The throttle solenoid is short circuit as detected in the ON condition.
209 SENS PT	9	The throttle sense pot is measuring 5V (>4.5?) and is therefore shorted to power.
210 SET PT	10	The throttle set pot is measuring 5V and is therefore shorted to power.
211 ESOS	11	The ESOS output is short circuit.
212 SERVO	12	The servo solenoid output is short circuit.
213 WIPER	13	The wiper output is short circuit.
214 WASHER	14	The washer output is short circuit.
215 HORN	15	The horn output is short circuit.
216 TRAVEL	16	The travel alarm output is short circuit.

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Removal and Replacement



WARNING

Hydraulic Pressure

Hydraulic fluid at system pressure can injure you. Before disconnecting or connecting hydraulic hoses, stop the engine and operate the controls to release pressure trapped in the hoses. Make sure the engine cannot be started while the hoses are open.

INT-3-1-11/1

Removal

1 Make sure that the machine is correctly parked, with the excavator end lowered to the ground. With the engine stopped but the starter switch at 'on' operate the controls to relieve hydraulic pressure.

2 Drain the hydraulic tank into a clean container, and * store for re-use.

3 Disconnect the hydraulic hoses and pipes **1** - **4**. Cap exposed connections to prevent ingress of dirt and moisture.

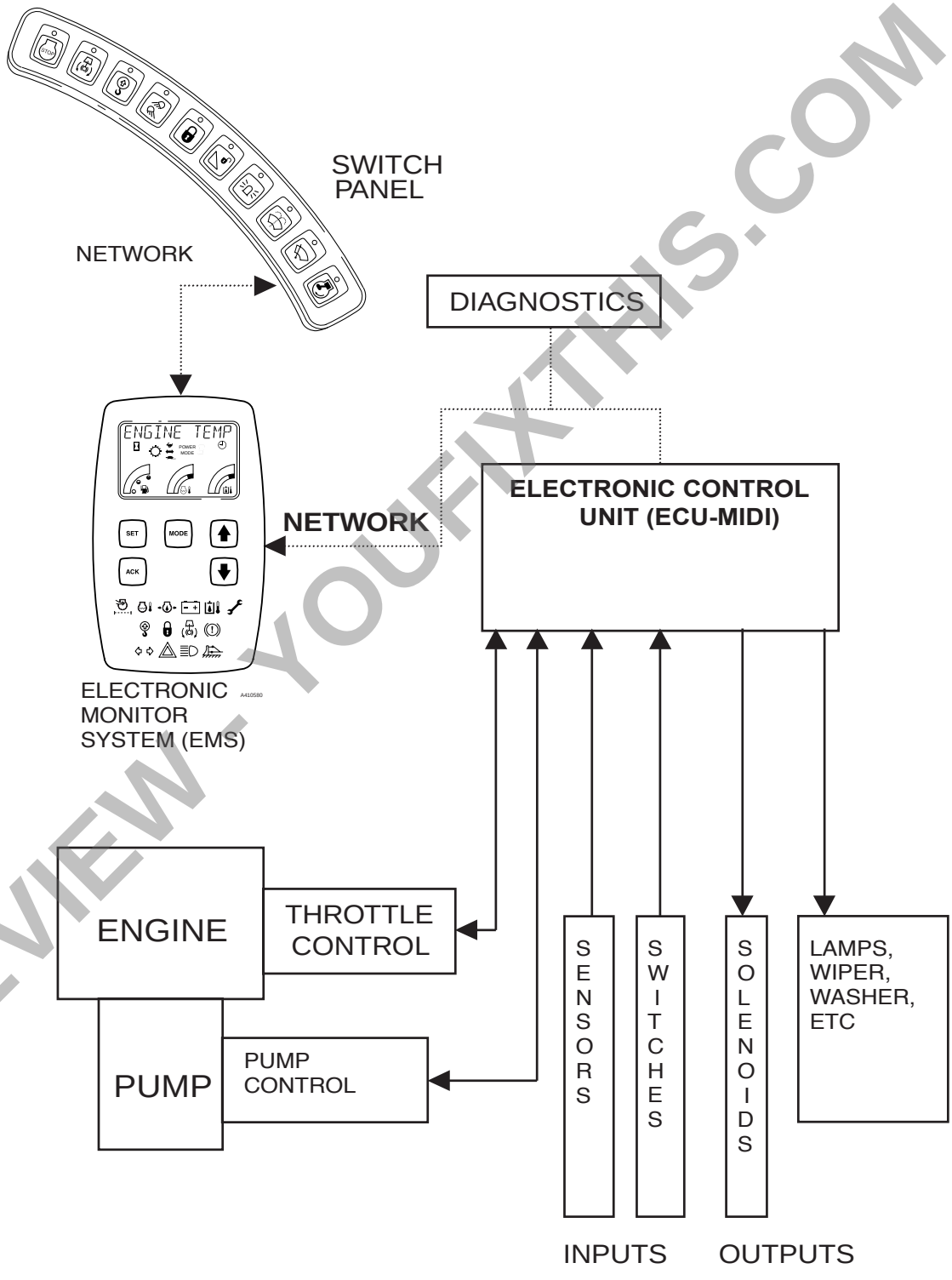
4 Remove the screws and washers **5** which secure the pump to the flywheel housing. Remove the pump.

Replacement

Replacement is the reverse of the removal procedure.

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Some problems which may occur in the hydraulic system are listed below, either for the system as a whole or for individual components

Symptom	Possible Cause	Action
1 Hydraulic System		
a The hydraulic system is defective or does not operate at all.	1 The pump is defective.	Check pump pressure and renew if defective.
	2 Dirt is clogging the inside of the relief valve.	Dismantle and clean the relief valve.
	3 The relief valve is defective.	Strip and check the relief valve.
	4 A ram is worn.	Repair or renew the ram.
	5 Negative pressure is low.	Check circuit pressure.
	6 A valve is cracked.	Renew the valve.
	7 A spool is not operating over its full stroke.	Check the movement of the spool or the operational linkage.
	8 The oil level in the tank is too low.	Replenish the oil.
	9 Circuit filters are clogged.	Clean or renew filters.
	10 The circuit pipes are restricted.	Check the piping.
2 Hydraulic Pump		
a Oil is not discharged from the pump.	1 The tank strainer or intake pipe is blocked.	Clean the strainer and clean the intake pipe.
	2 The end of the inlet pipe is above the tank oil level.	Replenish the oil tank.
	3 One or more of the pump major components is damaged or the input shaft or coupling are defective.	Dismantle and inspect pump. Renew damaged components and reassemble the pump. Renew shaft or coupling.
b Pump output is low. Hydraulic pressure does not increase.	1 The pressure does not increase because of problems with the hydraulic pump or control valve.	Check hydraulic pump and control valve. Renew as required.
	2 Internal leakage within the hydraulic pump with excessive fluid drain from pump drain port.	Strip and inspect the hydraulic pump, paying particular attention to sliding surfaces. Repair or renew as necessary. Reassemble the pump.
	3 Air is being drawn into the pump from the inlet side.	Check tank oil level and strainer for clogging. Correct as necessary. If OK, check tightness of pump inlet connection.
	4 Inlet resistance causing cavitation.	Check correct oil . Check pump low pressure inlet pipe for collapse. Renew as required.
c The pump makes an abnormal noise.	1 Oil level is low and the pump is drawing in air.	Check and replenish oil level. Run the pump under no load to bleed air from the hydraulic system.

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A variable flow load sensing system with flow on demand and servo operated, multi-function open centre control.

Pumps

Main pumps	Variable displacement axial piston type.
Maximum flow	170 l/min (37.4 gal/min) @ 2300 rev/min = approx. cc. per rev 74/75

Control Valve — A nine spool control valve with auxiliary service spool as standard (2nd auxiliary optional).

Relief Valve Settings

Boom/Arm/Bucket	300 bar (4351 lbf/in^2).
Swing circuit	226 bar (3278 lbf/in^2).
Travel circuit	300 bar (4351 lbf/in^2).
Pilot control	40 bar (580 lbf/in^2).

Hydraulic Cylinders — Double acting type, with screwed end caps and hardened steel bearing bushes. All rams are fully end damped.

Filtration — The hydraulic components are protected by a high standard of filtration to ensure long hydraulic fluid and component life.

In tank	125 micron.
Main return line	First fit 3 micron, thereafter 10 micron.

Cooling — Air blast cooler.

Controls

Excavator	All servo lever operated, to ISO control pattern.
Tracks	Individually servo operated by foot pedal or hand lever.
Speed selection	Via button on joystick.
Auxiliary	RH joystick switch or floor switch.
Low flow	RH pedal on floor.
Controls isolation	Gate lock lever at cab entrance, via LH console and a console mounted switch.
Engine Speed	Dial type throttle control plus servo lever mounted one-touch idle control and fascia panel mounted auto-idle control.
Engine stop	Ignition key operated.
Horn	Operated via a servo lever mounted button.
Dozer	Via dedicated lever.

Service Capacities

Hydraulic system	105 litres (23 UK gal; 27.7 US gal).
Hydraulic tank	56.5 litres (12.4 UK gal; 14.9 US gal).

Swing System

Swing motor	Axial piston type.
Swing brake	Hydraulic braking plus automatic spring applied disc type parking brake.
Final drive	Planetary reduction.
Swing speed	9.5 rev/min.
Swing gear	Large diameter, internally toothed.
Swing lock	Multi-position hydraulic.

Excavator End
Mono boom
Cast tipping link
Boom up end damped, dipper out end damped
Swing end damped both directions

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Every 10 Operating Hours or Daily

Whichever occurs first

1 Clean
- **a** Machine generally.

2 Grease
(If operating in very wet or severe conditions)
- **a** All excavator end pivot points.

3 Check (Engine Stopped)
- **a** Generally for damage.
- **b** For oil and coolant leakage.
- **c** Security of bolts and nuts ††.
- **d** For disconnected or shorted wiring, loose terminals.
- **e** Hydraulic fluid level.
- **f** Engine oil level.
- **g** Track tension.
- **h** Windscreen washer fluid level.
- **j** Fuel system for leaks.

†† Tapping with a hammer will identify any loose nuts and bolts which should then be tightened to the specified torque.

4 Check (Engine Running)
- **a** Operation of warning lights and audible alarm.
- **b** Operation of other electrical equipment.
- **c** Exhaust for excessive smoke.
- **d** Excavator operation.
- **e** Transmission operation.
- **f** Operation of track and slew brakes.
- **g** Operation of hour meter.

Every 50 Operating Hours or Weekly

Whichever occurs first

1 Do the daily jobs plus:

2 Clean
- **a** Drain water and sediment from fuel tank.
- **b** Drain fuel water separator.

3 Grease
- **a** All pivot pins.

Every 100 Operating Hours or 2-Weekly

Whichever occurs first

1 Do a 50 hour service plus:

2 Clean
- **a** Battery terminals.

3 Change
- **a** Engine oil main filter element †.
- **b** Engine oil †.
- **c** Return filter element†.
- **d** Track gearbox oil†.
- **e** Fuel filter element†.

4 Check (Engine Stopped)
- **a** Hoses and pipework for chafing or damage.
- **b** Condition of ram piston.
- **c** Track and running gear.
- **d** Top and bottom track rollers for oil leaks †.
- **e** Track idler wheels for oil leaks †.
- **f** Security of major unit mounting bolts and nuts†. If loose, tighten to specified torque.
- **g** Wiring for chafing.
- **h** Fan belt adjustment†.
- **j** Compressor belt adjustment.
- **k** Accumulator operation.
- **l** Radiator for damage.
- **m** Oil cooler for damage.
- **n** Battery electrolyte level†.
- **p** Exhaust system security†.
- **r** Teeth and sidecutters†.
- **ss** Condensor for damage.

5 Check (Engine Running)
- **a** Operation of throttle system†.
- **b** Operation of overload warning†.
- **c** Operation of stop control†.

† These procedures are only to be carried out after the first 100 hours use of a new machine. Thereafter they are to be carried out as detailed in the following periodic checks.

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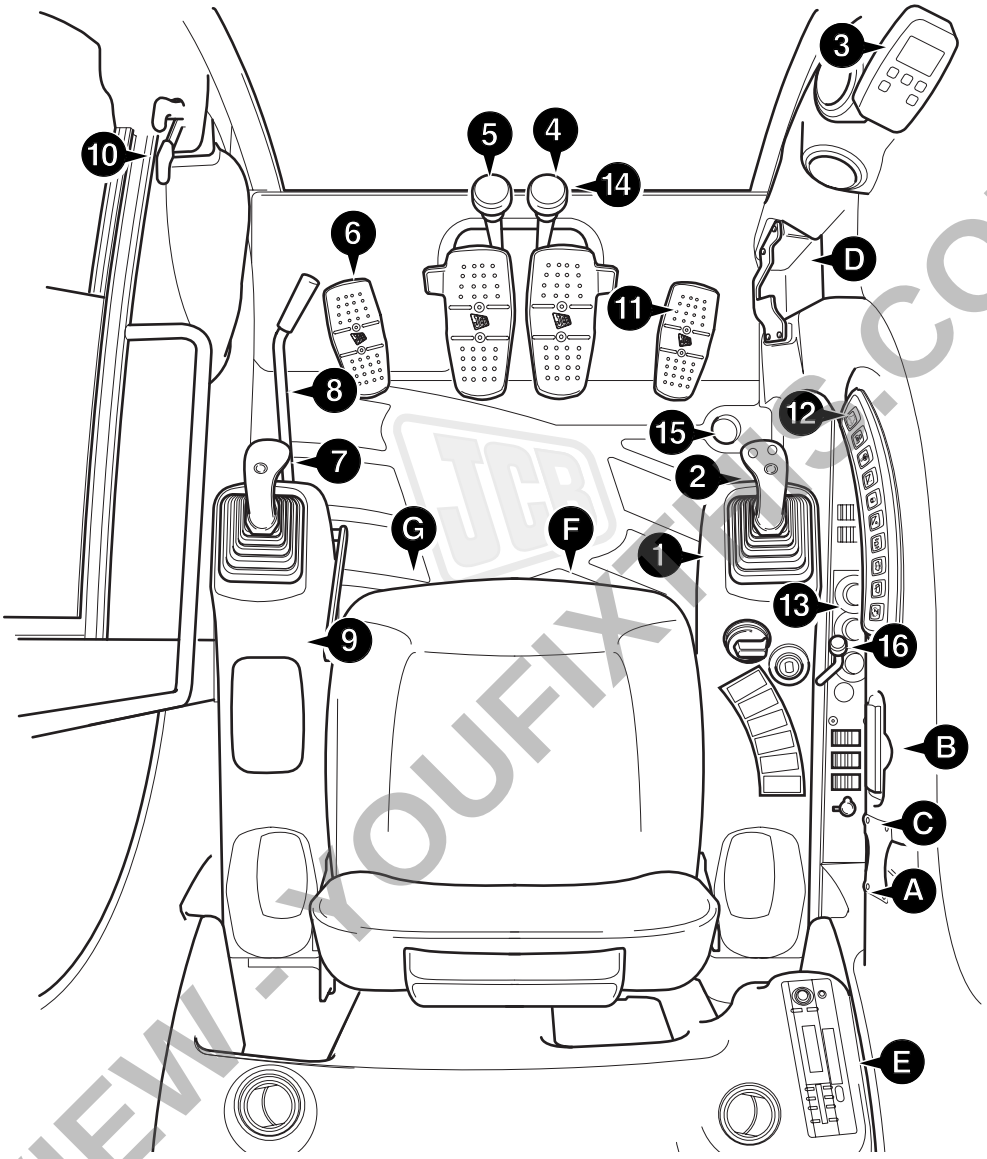
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Location of Controls and Components



1 **Right Console** (see **Switches and Controls**)

2 **Right Excavator Joystick Control** (see **Excavating Controls**)

3 **Electronic Monitor System (EMS)** (see **Switches and Controls**)

4 **Right Hand Track Control** (see **Switches and Controls**)

5 **Left Hand Track Control** (see **Switches and Controls**)

6 **Swing Control** (see **Excavating Controls**)

7 **Left Excavator Joystick Control** (see **Excavating Controls**)

8 **Control Lock Lever** (see **Switches and Controls**)

9 **Left Console** (see **Switches and Controls**)

10 **Door Lock Release Lever** (see **Doors and Windows**)

11 **Optional Circuit Pedal (if fitted)** (see **Operating Attachments**)

OR **Optional TAB Boom Control (if fitted)** (see **Triple Articulating Boom**)

12 **Facia Panel** (see **Switches and Controls**)

13 **Air Cond./Heater Controls** (see **Switches and Controls**)

14 **2-Speed Tracking Switch** (see **Switches and Controls**)

15 **High Flow Auxiliary Switch** (see **Operating Attachments**)

16 **Dozer Operating Lever** (see **Switches and Controls**)

A **Mobile Phone Holder**
B **Ashtray**
C **Cigarette Lighter/ Mobile Phone Charger**
D **Cup Holder**
E **Radio**
F **Tool Box**
G **Cool Box**

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All construction and agricultural equipment can be hazardous. When a JCB Midi excavator 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.

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

GEN-1-6

As well as the warnings on the following pages, specific warnings are given throughout the book. This section is designed to give a safety code for use of the machine generally and for operation and maintenance practices.

Note: This section includes a certain amount of operating safety information. But remember that whenever you drive the machine or operate its controls you are in effect a machine operator. Therefore you should read and understand the information given in the Operator Handbook before driving the machine or operating its controls.

General Safety

⚠ 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.

INT-1-3-6

⚠ 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.

⚠ WARNING

Do not use this Excavator as a ‘Crane’. Consult National Lifting Regulations.

⚠ 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.

HOP3

⚠ WARNING

Raised Attachments

Raised attachments can fall and injure you. Do not walk or work under raised attachments unless they are safely supported.

HOP6

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Types of Fuel

Use good quality diesel fuel to get the correct power and performance from your engine. The recommended fuel specification is given below.

Cetane Number:	45 (minimum)
Viscosity:	2.5/4.5 centistokes at 40°C (104°F)
Density:	0.836/0.866 kg/litre (1.046/1.084 lb/pint)
Sulphur:	0.5% of mass (maximum)
Distillation:	85% at 350°C (662°F)

Cetane Number
Indicates ignition performance. Fuel with a low cetane number can cause cold start problems and affect combustion.

Viscosity
This is the resistance to flow. If this is outside limits, the engine performance can be affected.

Density
Lower density will reduce engine power. Higher density will increase both engine power and exhaust smoke.

Sulphur
High sulphur content can cause engine wear. (High sulphur fuel is not normally found in North America, Europe or Australia). If you have to use a high sulphur fuel you must also use a highly alkaline engine lubricating oil, or change the normal oil more frequently.

Distillation
This indicates the mixture of different hydrocarbons in the fuel. A high ratio of lightweight hydrocarbons can affect the combustion characteristics.

Low Temperature Fuels
Special winter fuels may be available for engine operation at temperatures below 0°C (32°F). These fuels have a lower viscosity. They also limit wax formation in the fuel at low temperatures. (Wax forming in the fuel can stop the fuel flowing through the filter.)

Flow improvers may also be available. These can be added to the fuel to reduce wax formation.

Fatty Acid Methyl Ester Fuels as a replacement for Diesel Fuels

Fuel resources such as Rape Methyl Ester and Soybean Methyl Ester, collectively known as Fatty Acid Methyl Esters are being used as alternatives and extenders for mineral oil.

Fatty Acid Methyl Esters must conform to certain standards to be of acceptable quality, just as mineral oils do at present.

Consult your JCB distributor for advice about the use of Fatty Acid Methyl Ester fuels, as improper application may impair engine performance.

Advice

Consult your fuel supplier or JCB distributor concerning the suitability of any fuel you are not sure about. If you have to use non-standard fuels, contact your JCB distributor for advice on engine adjustments and oil change periods.

Petrol

⚠ WARNING

Do not use petrol in this machine. Do not mix petrol with the diesel fuel, in storage tanks the petrol could rise to the top and form flammable vapours.
INT-3-1-6

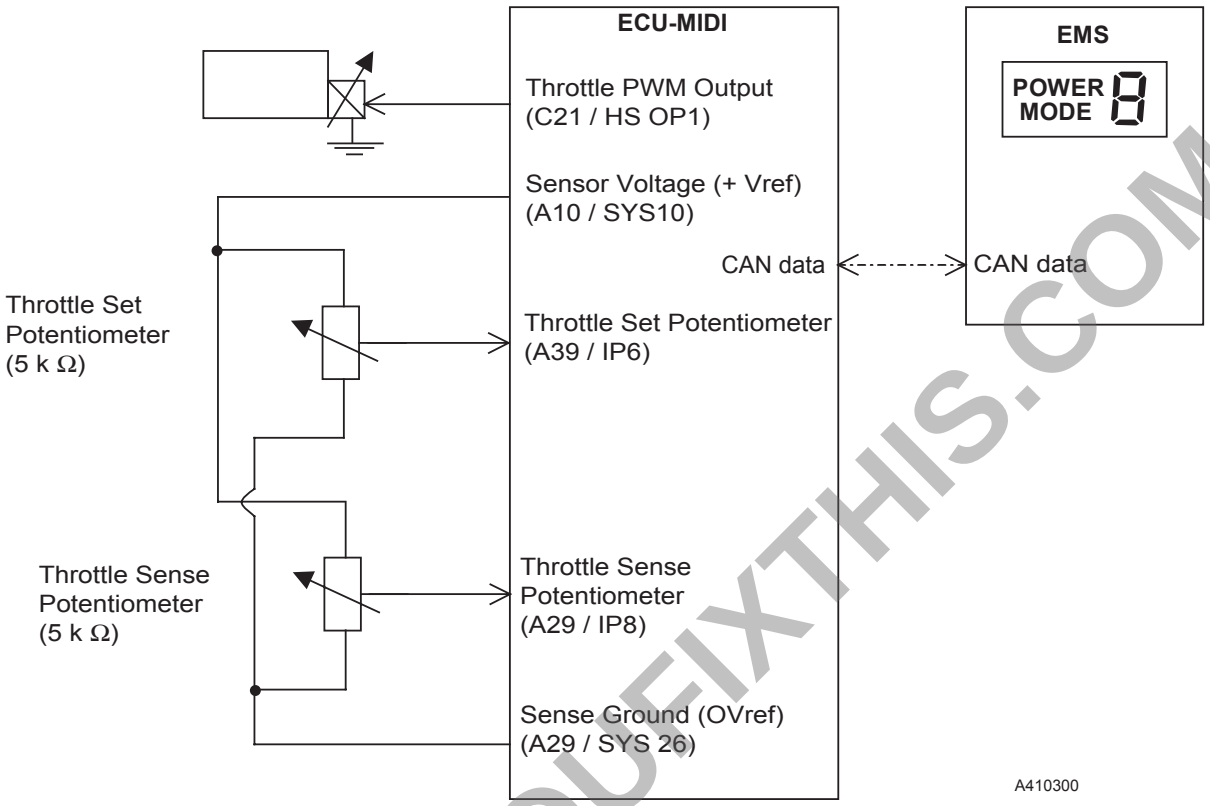
Filling the Tank

Refer to **Refuelling** in Section 1.

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Throttle Control



Operation

The vehicle's diesel engine speed is controlled by the position of its throttle, which in turn is determined by a proportional hydraulic cylinder. The cylinder position is determined by the duty cycle of a switched PWM electrical signal to the cylinder solenoid. Thus, the PWM duty cycle controls the throttle position and the (unloaded) engine speed.

Based on this mechanism, the ECU-MIDI is able to control the throttle position by varying the duty cycle of its throttle PWM output. The components of the throttle control system are:

- 5K linear potentiometer that is set by the operator to select a desired throttle position. This is the Throttle Set Potentiometer (Throttle Dial).
- 5K linear potentiometer on the throttle linkage that indicates the actual position of the throttle; used as feedback to the ECU-MIDI. This is the Throttle Sense Potentiometer.
- The hydraulic cylinder that moves the throttle mechanism.
- The ECU-MIDI, which reads the two potentiometers, and sets the duty cycle of the PWM signal to the hydraulic cylinder.

Note: This process controls the throttle position, and not the engine rev/min. It is normal for the engine rev/min to vary for a fixed throttle position, depending on the load on the engine, which itself depends on the "work" that the hydraulic system is doing. The vehicle operator uses the varying sound of the engine as feedback when operating the various hydraulic functions of the excavator.

When the vehicle engine is first started, the throttle is set to its minimum (idle), regardless of the setting of the Throttle Dial. This avoids having the engine start off at high rev/min's unexpectedly. The operator must turn the Throttle Dial back to the idle position before the EMS will allow non-idle throttle settings. The throttle control system operates only when the engine is in a * running state. If the system is not in a running state, the throttle output is turned off.

The throttle control system has a self-check to guard against electrical or mechanical problems with the system. When the operator sets a throttle position, the Throttle Sense Potentiometer reading must come to within a certain tolerance of the target value in 20 seconds. If this does not happen, the ECU-MIDI will attempt to set the throttle to idle, and the EMS will display a "NO THROTTLE" error message.

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Starter Motor

Starting Circuit Test

Before carrying out the voltmeter tests, check the battery condition (see **Battery Testing**) and ensure that all connections are clean and tight.

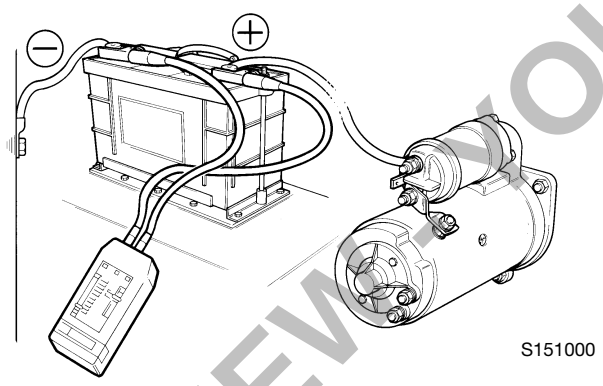
To prevent the engine starting during the tests ensure that the engine stop fuse is removed, (refer to **Fuse Identification** page).

Check the readings in the following sequence using a voltmeter. Unless otherwise stated, the readings must be taken with the starter switch held in the 'start' position ('HS') and the transmission forward/reverse selector in neutral.

Note: Do not operate the starter motor for more than 20 seconds at one time. Let the starter motor cool for at least two minutes between starts.

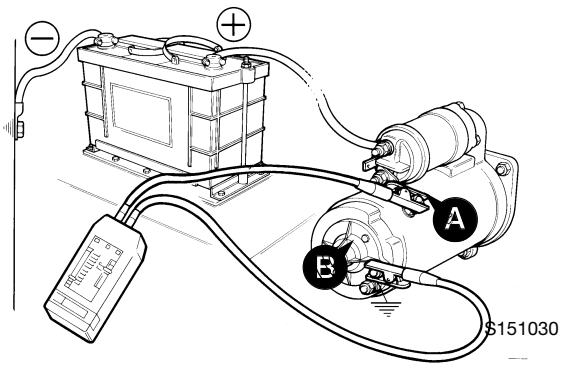
Test 1
Connect the voltmeter across the battery terminals. Reading in 'start' position: 10.0V approximately. Minimum permissible reading in 'start' position 9.5V.

A low reading probably indicates a fault in the starter motor.



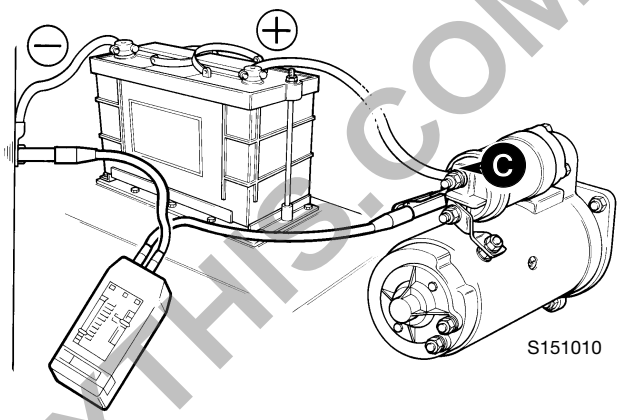
Test 2
Connect the voltmeter between the starter main terminal **A** and the commutator end bracket **B**. In the 'start' position, the reading should not be more than 0.5V below the reading obtained in Test 1. Minimum permissible reading in 'start' position 9.0V.

If the reading is within this limit, continue to Test 3. If the reading is outside the limit, proceed to Tests 4 and 5.



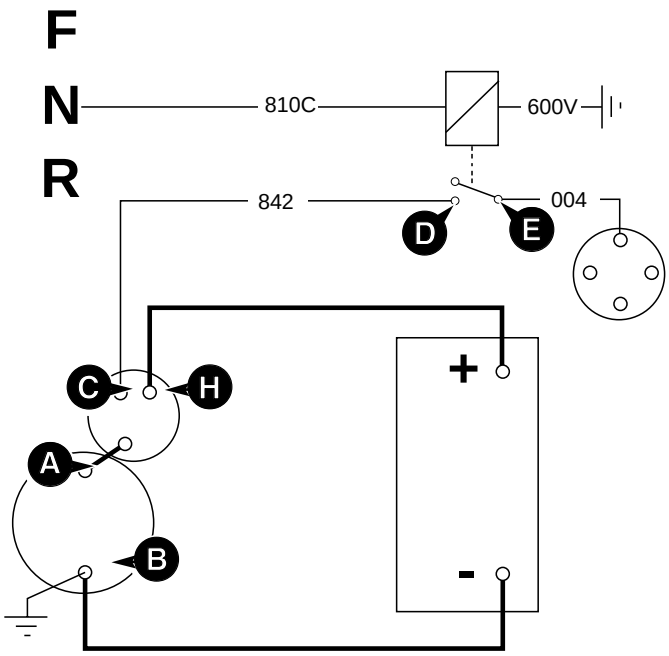
Test 3

Connect the voltmeter between the solenoid terminal **C** and a good earth. Minimum permissible reading in 'start' position: 8.0V.



Test 3a

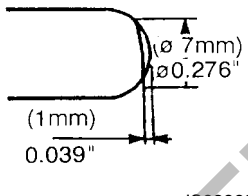
If the reading is less than specified, connect the voltmeter between the neutral start relay terminal **D** and earth. An increase in reading to 8.0V indicates a fault in the wiring from the start relay to the solenoid.



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Maintenance Specification

Maintenance Item	Standard	Note
Leakage Amount	Replace if the leakage exceeds 1.0 litre/min (0.22 gal/min) with the handle in the neutral position or 2.0 litre/min (0.44 gal/min) during operation.	Condition: Primary pressure 29 bar (30 kgf/cm^2 426.5 lbf/in^2). Oil viscosity 23 cSt.
Spool	Replace when the sliding contact faces are worn more than 0.01 mm (0.0004 in) or more than the non-sliding contact faces.	The conditions are approximately the same as for the leakage above.
Push rods **11/12**	 JS02060 Replace if the tip is worn more than 1 mm (0.039 in).	
Loose movement in the operating controls.	Replace the parts if the wear in the pin and joint lead to loose movement of more than 2 mm (0.079 in).	
Actuation stability.	Investigate if abnormal noises, jerky operation or drops in primary pressure are experienced during operation. Replace the valve if the problem cannot be solved.	

Note: Ensure that 'O'-rings and other seals are renewed during reassembly. If the screw **5** is loosened, always replace the Seal washer **3**.

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