ORGINAL INSTRUCTIONS

ST10 Site Dumper

MAINTENANCE INSTRUCTION MANUAL

NC ENGINEERING (HAMILTONSBAWN) LTD
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Tel: 028 38871970 Fax: 028 38870362
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REVISION-D

Dear Customer

Even if you have operated this type of equipment before, it is very important that your new equipment operations and instructions are explained to you by a Dealer Representative following delivery of your equipment.

This will explain the operating controls and enable you to gain maximum productivity from your new dumper.

Foreword

This manual has been produced to provide information on the correct operating and maintenance procedures for the NC Dumper

The procedures in this publication relate specifically to the NC Dumper

All information, specifications and illustrations used in this manual are correct at the time of issue. NC reserves the right to make changes in this manual at any time without prior notice.

Contents

Engineering (Hamiltonsbawn) Ltd.

Manufacturers of Agricultural and Industrial Equipment

2 Killyrudden Road, Hamiltonsbawn,
Richhill, Co. Armagh.
Northern Ireland.
8T619SF

Tel: 028 38871970
Fax: 028 3887 0362
E.mail: info@nc engineering.com
www.nc-engineering.com

EC – DECLARATION OF CONFORMITY

Machine description	:	Site Dumper
Make		NC
Type		ST10
Manufactured by		NC Engineering (Hamiltonsbawn) Ltd
Address:		2 Killyrudden Road, Hamiltonsbawn Richhill, Co. Armagh. BT61 9SF

This machinery has been designed and manufactured in accordance with the following European Standards: -

2006/42/CE: Machinery Directive

Measured Sound Power Level: 104 dB LWA

Guaranteed Sound Power Level: 104 dB LWA

Net Installed Power: 97kW

A technical construction file for this machine is retained at the above address.

Declaration 

Signed: _____

Name: David Wilson CEng; MSc; MIAgrE

Being the responsible person appointed by the manufacturer (or nominated representative of the manufacturer established in the EC) and employed by:

NC Engineering (Hamiltonsbawn) Ltd

This declaration of Conformity complies with Regulation 22 of The Supply of Machinery (Safety) Regulations 1992

Noise Level Declaration

The noise levels are measured according to ISO6395:1998

The noise level of this machine is

L_{WA} 104dB (A)

L_{PA} 85dB (A)

L_{WA} :- A - Weighted sound power level.

L_{PA} :- A - Weighted sound pressure level.

Vibration Declaration.

The absence of a harmonised test code together with variable conditions under which this equipment may be used allows only representative figures to be quotes.

Whole Body Vibration Level : a_w (m/s^2) = 0.25

Hand / Arm : a_{ha} (m/s^2) ≤ 2.4

The above figures are for reference purposes only. It is the responsibility of the employer to access vibration exposure based on the actual site conditions and operating practices at the point of use. Employers should not rely solely on published vibration figures when undertaking risk assessments. Depending on the site conditions cycle times may need to be adjusted in order to reduce operator exposure levels.

Technical Specifications

FOURWHEEL DRIVE DUMPER

CAPACITY:

Max. safe load:	10000 kg
Heaped:	5070L
Struck:	4140L
Water:	2400L

ENGINE:

JCB444T 4 cylinder Turbo with After Cooling

Displacement:	4.4 L
Max. power:	97KW/130bhp @ 2200 rpm
Max. torque:	525Nm @ 1300 rpm
Emissions:	Euro 3 compliant

TRANSMISSION:

Torque converter c/w 4 speed forward and reverse power shuttle transmission
Permanent 4 wheel drive

DRIVE CHARACTERISTICS:

Forward / Reverse	1st	0-4.9 km/h (0-3.1 mph)
	2nd	0-7.0 km/h (0-4.9 mph)
	3rd	0-16.9 km/h (0-10.6 mph)
	4th	0-32 km/h (0-20 mph)
Steering angle:	+/- 30°	
Turning circle:	12.85m	
Grade-ability:	50%	
Tyres:	500/60 R22.5 (traction Profile)	
Steering:	Priority load sensing hydrostatic centre pivot	
Working brakes:	Multi-plate oil immersed discs mounted on both axles	
Park brake:	Hand operated, locking on dry disc acting on gearbox	

NOISE LEVELS:

LWA	104dB(A)
LPA	85dB(A)

TANK CAPACITIES:

Fuel:	70L
Hydraulic:	70L

SKIP:

Manufactured from higher tensile steels
Hydraulically operated skip tipping to over 90°
Heavy duty fully welded skip with 8mm thick steel base, reinforced upper side walls for greater strength
Operated by a multi axis joystick for increased performance

ELECTRICAL:

Heavy duty 60045 Battery: 12V, 185Ah 1000CCA
Wiring harness in protective sleeving
Reversing alarm

HYDRAULICS:

Hydraulic test points fitted as standard
Easy access return oil filter on top of tank
Easy access pressure filter

SEATING & CONTROLS:

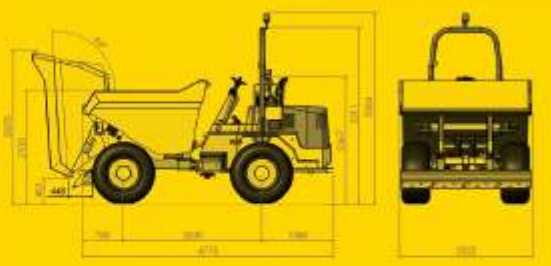
Adjustable suspension seat accessible from both sides
Clear access across dumper via galvanised steps
Extra wide brake pedal
Super bright warning lights on fully featured display instrument
Steel constructed centre console for extra leg protection
Operator level gear selection lever with integrated clutch button
Column mounted directional control lever
Heater vent at foot level
Anti-slip floor
Horn operable from joystick

SERVICE ACCESS:

Easy access for service maintenance
Lockable hinged engine cover
Battery mounted in lockable step compartment
Lockable tool box compartment on step
Separate lockable fuel & hydraulic filler flaps

We reserve the right to change the above specifications without prior notice

ST10



FEATURES

- Unrivalled operator accessibility and comfort
- Excellent rough terrain performance from permanent 4-Wheel drive
- Heavy duty construction; skip manufactured from 8mm steel plate and reinforced around top
- Column operated forward and reverse directions with acceleration by foot pedal
- Simple and safe operation; drive direction on the steering column
- Heavy duty centre console for leg protection
- Simple instrument panel including fuel gauge, hourmeter, warning lights for parking brake, oil temperature, oil pressure, engine temperature
- Folding ROPS as standard
- Easy access to engine compartment for service and maintenance
- Recovery brackets as standard
- 130 HP engine /97 Kw
- Excellent power to weight ratio
- Theft deterrent Cesar Data Tag System as standard
- Ample ground clearance
- Superior turning circle
- Reversing alarm standard
- Handbrake safety device - will not move until released
- Lockable toolbox and battery compartment, both fully galvanised
- Separate fuel and hydraulic filler compartment
- Adjustable steering column
- Adjustable suspension seat
- Skip tips over 90°
- Electronic drive by wire throttle system
- Skip manufactured from higher tensile steels
- Flashing beacon

OPTIONAL EQUIPMENT

- Road Light Kit
- Spare Wheel
- Biodegradable Hydraulic Oil
- FOPS Roof
- Skip manufactured from Hardox
- Cab
- Shovel, spade and brush holders

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Web: www.nc-engineering.com

Technical Specifications

Engine Variants	
- SE	Turbocharged with Intercooler
Emission compliance	US-EPA Tier 3, EU Stage IIIA
Rated speed	2200rpm
Weight (Dry):	
- SE	475 kg (1007 lb)(1)
Number of cylinders	4
Nominal bore size	103mm (4.055 in)
Stroke	132mm (5.16 in)
Cylinder arrangement	In line
Combustion Cycle	4 - stroke
Firing order	1-3-4-2
Displacement	4.40 litres
Compression ratio	
- SE	17.1:1
Engine Compression	See Note(2)
Direction of rotation (Viewed from front {crankshaft pulley} end)	Clockwise
Valves	4 per cylinder
Valve clearances measured at the pushrod end of the rockers (measured cold):	
- Inlet	0.24 to 0.29mm (0.009 to 0.011 in)
- Exhaust	0.44 to 0.49mm (0.017 to 0.019 in)
Lubricating oil pressure(3)	6 bar (87 lb in²)
Combustion system	Common rail direct injection
High pressure fuel pump	Piston type, high pressure with electronically controlled fuel delivery.

(1) Dry weight. No cooling fan drive.
(2) Compression variance between each cylinder should be no greater than 3.5bar (50 lb in2)
(3) Engine at normal operating temperature and maximum revs.

Technical Specifications

Torque + Angle Explanation

Insufficient preload of a bolted joint can cause major problems, such as cylinder head wrap, leaking gasket joints etc. There are several methods of achieving an accurate preload of a bolted joint, the main methods used on the JCB 444 engine are:

1) Torque Control Tightening

2) Angle Control Tightening

1 Torque Control Tightening

Using a torque meter to control the torque is the most popular means of controlling preload and in the majority of instances this method is adequate. It should be noted that with this process, the majority of the torque is used to overcome friction, therefore slight variations in the frictional conditions can lead to large changes in the bolt preload.

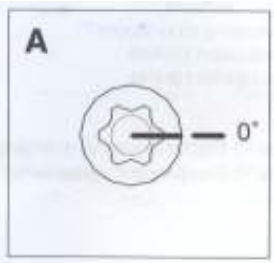
2 Angle Control Tightening

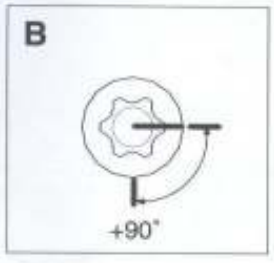
Where a more precise preload is required, the 'torque + angle' tightening method is used. The bolt is tightened to a predetermined torque (this may be done in stages), and then as a final sequence, the bolt I s tightened to a predetermined angle - this method of tightening the bolts results in a smaller variation in the final preload.

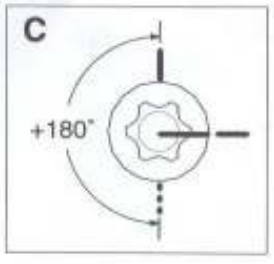
It is critical that the predetermined tightening angle is accurately achieved, failure to tightening accurately to the specific angle could result in the bolt preload being Incorrect - this will lead to eventual failures. It is good practice to replace all bolts that have tightening using the torque + angle procedure.

Torque + Angle Tightening Procedure

The following example explains the recommended torque + angle procedure. A torque angle gauge should be used for accuracy, but as a visual check, the bolts can be match marked as described below.







1 Tighten the bolt to the specified torque (specified torque values will be detailed in the relevant sections).

2 Mark a line across the centre of the bolt and a second line on the part to be clamped - the two lines should be aligned as shown at **A**.

3 Mark a third line at the specified torque angle - in this instance the additional torque angle is 90°. This line must be marked the specified angle in a clockwise direction (to further tighten the bolt), as shown in **B**.

4 In some instances, angle torque tightening can be specified in two stages, for instance in this example, the first angle quoted is 90° (shown at **B**), and then a second angle of 180° angle is from the LAST tightened position - as shown at **C**.

5 Tighten the bolt so that the line on the bolt aligns with the angle(s) marked on the item to be clamped - remember, to ensure complete accuracy an angle gauge should be use

Technical Specifications

Engine Torque Figures

Item	Nm	Lb ft	Angle
Oil cooler drain plug	35-40	26-29	-

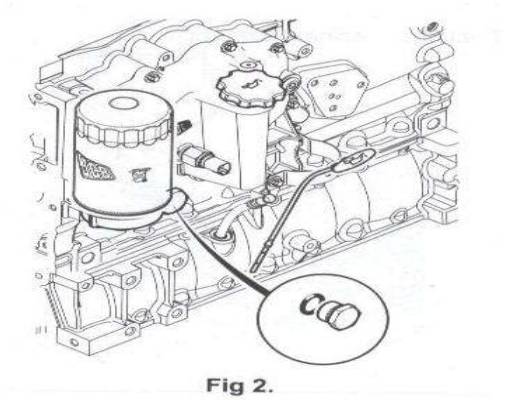


Fig 2.

Item	Nm	Lb ft	Angle
Oil sump retaining bolts **A**	22-26	16-19	-
Oil sump plug **B**	40-60	30-44	-

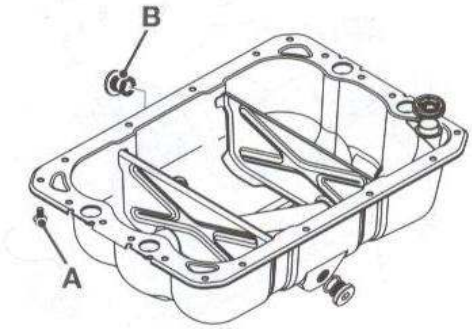


Fig 3.

Technical Specifications

Engine Torque Figures

Item	Nm	Lb ft	Angle
Fuel filter retaining strap bolt	22-26	16-19	-

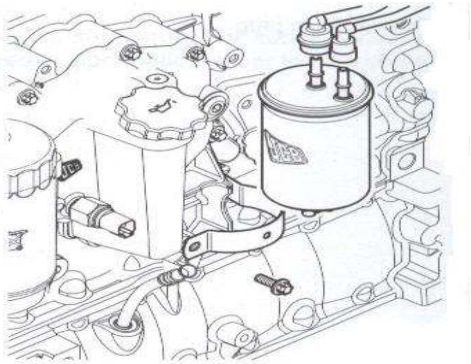


Fig 4.

Item	Nm	Lb ft	Angle
Fan belt tensioner retaining bolts	22-26	16-19	-

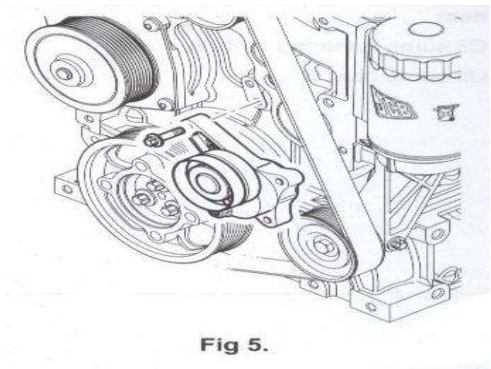


Fig 5.

Technical Specifications

Engine Torque Figures

Item	Nm	Lb ft	Angle
Thermostat housing retaining bolts	22-26	16-19	-

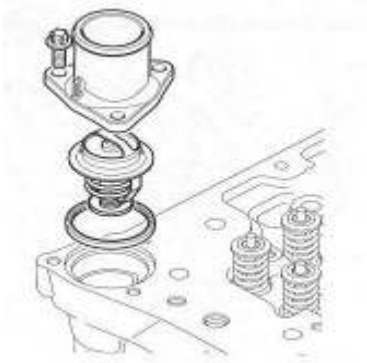


Fig 6.

Item	Nm	Lb ft	Angle
Water inlet connector retaining bolts	22-26	16-19	-

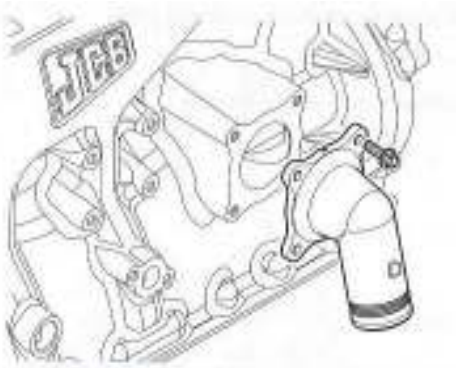


Fig 7.

Technical Specifications

Engine Torque Figures

Item	Nm	Lb ft	Angle
Water temperature sender / switch	16	12	-

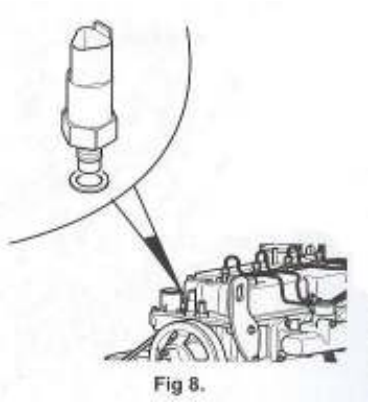


Fig 8.

Item	Nm	Lb ft	Angle
Exhaust manifold retaining bolts			
- first stage	25	19	-
- final stage angle torque			+90°

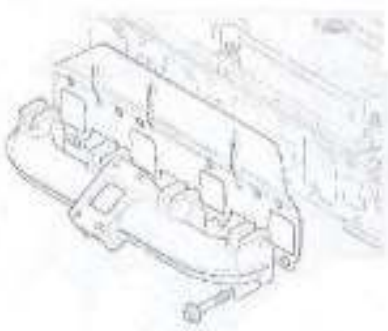


Fig 9.

Item	Nm	Lb ft	Angle
Inlet manifold retaining bolts	22-26	16-19	-

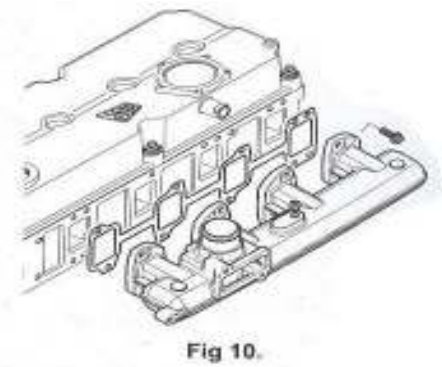


Fig 10.

Technical Specifications

Engine Torque Figures

Item	Nm	Lb ft	Angle
Power take off (PTO) pump bolts			
- SAE 'A' - M10 bolts	43-51	32-38	-
- SAE 'B' - M12 bolts	73-89	54-66	-

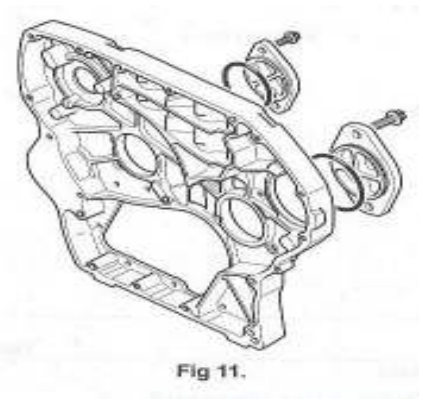


Fig 11.

Item	Nm	Lb ft	Angle
Lifting bracket retaining bolts	43-51	32-38	-

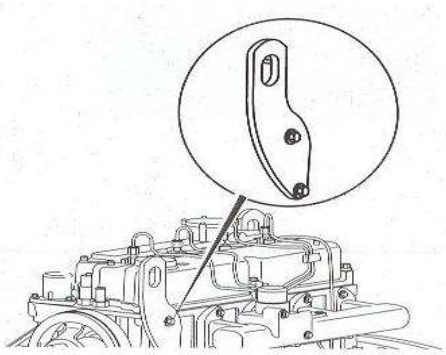


Fig 12.

Technical Specifications

Engine Torque Figures

Item	Nm	Lb ft	Angle
Alternator retaining bolts	47	34.7	-

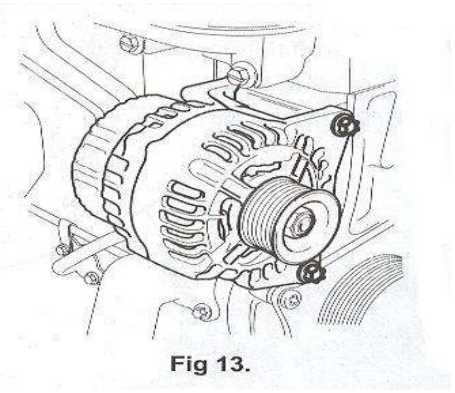


Fig 13.

Item	Nm	Lb ft	Angle
Starter motor retaining bolts	43-51	32-38	-

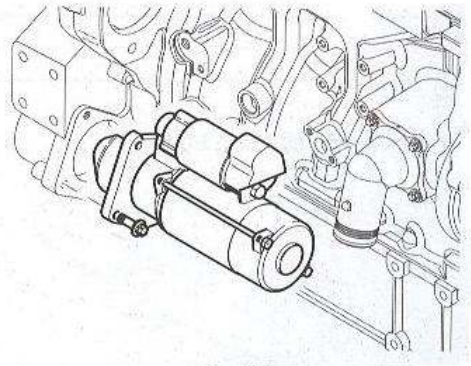
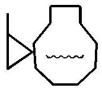
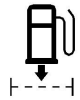
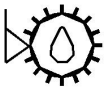
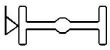
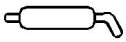
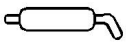
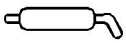
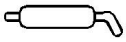
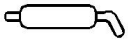


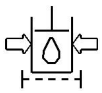
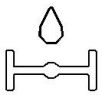
Fig 14.

Maintenance Decal Descriptions

The machine is fitted with a maintenance decal. It is important that before using the machine the decal is understood and all the checks have been carried out. The decal must be clean and readable at all times. If the decal needs to be replaced it can be obtained from the NC Spares department.

Ref No.	Symbols	Description.
1		Engine Oil Level.
2		Engine Coolant Level.
3		Fuel and Water Sedimentor.
4		Transmission Oil Level.
5		Axle Service Points.
6		Axle Oil Level.
7		Hydraulic Return to Tank Filter.
8		Air Filter Restriction Indicator.
9		Grease Point - Skip Pivot Pins.
10		Grease Point - Tipping Ram Pins
11		Grease Point - Centre Point Articulation.
12		Grease Point - Steering Ram.
13		Grease Point - Drive Shafts.
14		Transfer Box Oil Level.

Maintenance Decal Descriptions

Ref No.	Symbols	Description.
15		Transmission Oil Filter.
16		Oil Pressure Filter.
17		Axle Oil.
18		Engine Oil Filter.
19		Fuel Filter.
20		Check Drive Shaft Bolts.
21		Air Filter Element.
22		Transmission Oil.
23		Transfer Box Oil.
24		Fuel Filter (Engine Mounted)
25		Engine Coolant.
26		Engine Checks.

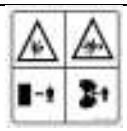
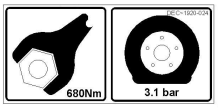
Safety Decals and Descriptions

SAFETY DECALS

The Machine is fitted with a number of safety decals placed in areas to draw the attention of the users. It is important that before using the machine theses decals are read and understood. The decals must be clean and readable at all times, if they need to be replaced they can be obtained from NC spares department.

Part No.	Symbol.	Descriptions.
DEC~1920-002		Hydraulic Oil.
DEC~1920-003		Fuel.
DEC~1920-004		Stay clear of tipping area.
DEC~1920-006		Visibility / No passengers / Towing / Transport / Read manual.
DEC~1920-010		Ignition.
DEC~1920-011		Gear locations.
DEC~1920-012		Seat belt must be worn.
DEC~1920-014		Recommended brake fluid.
DEC~1920-015		Recommended brake fluid (Circular)
DEC~1920-016		No repairs to ROPS.

Safety Decals and Descriptions

Part No.	Symbol.	Descriptions.
DEC~1920-017		Stay clear of pinch points.
DEC~1920-018		Read manual / Apply handbrake before leaving dumper / Release handbrake before moving dumper.
DEC~1920-019		Caution moving parts / Do not open when hot.
DEC~1920-020		Forward and Reverse.
DEC~1920-023		Tyre pressure and wheel nut torque (Rear)
DEC~1920-024		Tyre pressure and wheel nut torque (Front)
DEC~1920-025		Sound levels.
DEC~1920-026		Safe gradients / No tipping on a gradient / Lower skip before moving.
DEC~1920-027		Fit skip prop before access.
DEC~1920-028		Don’t operate controls without reading the operators manual.
DEC~1920-029		Skip controls.
DEC~1920-030		Maintenance decal.
DEC~1920-031		Battery.

ST10 Maintenance Manual

The following maintenance sections are provided to ensure safe working practices. The procedures in this booklet should be followed. No attempt should be made to shortcut any of the steps.

You or others could be killed or seriously injured if the machine is not correctly prepared and maintained.
Maintenance must be carried out by suitably qualified personnel only

To ensure the best performance of the machine ensure the service tasks are carried out at the correct intervals (see service schedules)

If the machine is working in adverse conditions, then the service intervals should be reduced. Examples of adverse conditions are:

- Operating with low quality fuel (See **Fluids & Lubricants** section for more information)
- Operating in a very dusty environment
- Operating continuously at high engine load
- Operating in an environment with lots of chaff
- Operating in an extremely hot or cold environment
- Operating continuously on slopes
- Operating continuously at high altitude
- Operating in an environment with high humidity

Service Record Sheet

First 50 Hr. Date…… Hour Reading……..		**First 5000 Hr.** Date…… Hour Reading……..	
First 100 Hr. Date…… Hour Reading……..		**First 5500 Hr.** Date…… Hour Reading……..	
First 500 Hr. Date…… Hour Reading……..		**First 6000 Hr.** Date…… Hour Reading……..	
First 1000 Hr. Date…… Hour Reading……..		**First 6500 Hr.** Date…… Hour Reading……..	
First 1500 Hr. Date…… Hour Reading……..		**First 7000 Hr.** Date…… Hour Reading……..	
First 2000 Hr. Date…… Hour Reading……..		**First 7500 Hr.** Date…… Hour Reading……..	
First 2500 Hr. Date…… Hour Reading……..		**First 8000 Hr.** Date…… Hour Reading……..	
First 3000 Hr. Date…… Hour Reading……..		**First 8500 Hr.** Date…… Hour Reading……..	
First 3500 Hr. Date…… Hour Reading……..		**First 9000 Hr.** Date…… Hour Reading……..	
First 4000 Hr. Date…… Hour Reading……..		**First 9500 Hr.** Date…… Hour Reading……..	
First 4500 Hr. Date…… Hour Reading……..		**First 10000 Hr.** Date…… Hour Reading……..	

Note: It may be essential to change the engine Oil and Filter, Air Filter(s) and Fuel Filter(s) more frequently. Check machine service schedule and applications requirements.

Service Schedules

CALENDAR EQUILIVANTS

50 Hours = Weekly
100 Hours = Fortnightly
500 Hours = Six Months
1000 Hours= Yearly
2000 Hours= 2 Years

Service checks should be carried out at which ever interval occurs first. Do not use a machine which is due for a service. Make sure any defects found during the regular maintenance are rectified immediately.

ENGINE **Service Points & Fluid Levels**	**Operation**	**10 Hr**	**50 Hr**	**500 Hr**	**1000 Hr**	**2000 Hr**	**6000 Hr**
Oil level	Check	●					
Coolant Quality / Level	Check	●					
Coolant or Oil Leaks	Check	●					
Fuel Filter & Water Sedimentor	Check for contamination & Drain	●					
Fuel Filter [1] on dumper adjacent to radiator	Change			●			
Oil & Filter [2] [3] [4]	Change			●			
All Hoses—Condition	Check			●			
Radiator [5]	Clean			●			
Fan Belt Condition	Check			●			
Fuel Filter (engine mounted)	Change				●		
Air Cleaner Outer Element [5]	Change				●		
Crankcase Ventilation Filter [6]	Change				●		
Air Cleaner Inner Element	Change					●	
Valve Clearances [7]	Check & Adjust					●	
Oil Filler & Dipstick O Rings	Change					●	
Cooling System	Drain & Fill					●	
Rocker Cover Seal & Injector Seals	Change					●	
Fan Belt	Change						●
Injectors [7]	Change						●
Injector(s) Leak-Off Rail [7]	Change						●
High Pressure Fuel Lines	Change						●

[1] Check & change if noticeable performance related problems due to fuel restrictions.
[2] If operating under arduous conditions do an oil flush & change the engine oil & filter every 250 hours.
[3] The oil service interval will be affected if there is a high sulphur content in the fuel. Refer to fuels & lubricants section.
[4] When engine is operated with 20% bio-diesel change the engine oil & filter every 250 hours. Refer to fuels & lubricants section re operating with bio-diesel.
[5] If operating in dusty adverse conditions do these jobs more frequently.
[6] Will require changing if operating in arduous applications. (Only fitted until serial No. 032067)
[7] These jobs must be done by a qualified engineer.

Service Schedules

AXLE **Service Points & Fluid Levels**	**Operation**	**10 Hr**	**50 Hr**	**100 Hr**	**1000 Hr**	**2000 Hr**
Hubs	Check for Leaks	●		●	●	●
Axle Oil Level (incl. Hubs when applicable)	Check	●		●	●	●
Axle Oil	Change			●	●	●
Tightness of Mounting bolts	(Torque to 970Nm / 715lbf ft)	●	●	●	●	●
Tightness of Wheel Rim Nuts	(Torque to 680Nm / 500lbf ft)	●	●	●	●	●

GEARBOX **Pre-start Cold Checks**	**Operation**	**10 Hr**	**50 Hr**	**100 Hr**	**500 Hr**	**1000 Hr**
Transmission oil level	Check	●	●	●	●	●
Transmission Oil	Change					●
Transmission Filter	Change			●	●	●
Transmission Strainer	Clean					●
Drive Shafts	Security				●	●
Functional Test						
Forward & Reverse Gear Change operation	Check			●	●	●
Transmission Main Line Pressure	Check				●	●
Clutch Disconnect	Check			●	●	●
Neutral Start Operation	Check			●	●	●
Clutch Back Pressures	Check			●	●	●
BRAKES						
Parking Brake Operation	Check	●	●	●	●	●

TRANSFER BOX **Service Points & Fluid Levels**	**Operation**	**10 Hr**	**50 Hr**	**100 Hr**	**1000 Hr**	**2000 Hr**
Oil Leaks	Check	●				
Oil Level	Check		●			
Oil	Change				●	

Note: First 10 Hr Service only.
Note: First 100 Hr Service only.
Note: Indicates jobs which should only be undertaken by a specialist.

Service Schedules

DUMPER CHASSIS **Grease Points**	**Operation**	**10 Hr**	**50 Hr**	**100 Hr**	**500 Hr**	**1000 Hr**
Skip Pivot Pins (2 No Pins)	Top up		●			
Tipping Ram Pins (1 No Pins)	Top up		●			
Centre Point Articulation (3 No Points)	Top up		●			
Steering Ram (2 No Points)	Top up		●			
Drive Shafts (3 No Points)	Top up		●		●	

Note: First 50 Hr Service only.

HYDRAULICS SYSTEM **Service Points & Fluid Levels**	**Operation**	**10 Hr**	**100 Hr**	**500 Hr**		
Inspect return to tank filter indicator	Check	●				
Return to tank filter element	Change		●	●		
Pressure filter element *	Change		●	●		
Suction strainer (wash with paraffin if necessary)	Check		●	●		

Note: First 100 Hr Service only.
Note: Every 10 hours.
* only valid to Serial No: 032067

AIR INDUCTION SYSTEM	**Operation**	**10 Hr**				
Check air filter restriction indicator	Check	●				

Note: Every 10 hours.

Torque Settings

Use these torque settings only where no torque setting has been specified in the text. Values are for dry threads and may be within 3% of the figures stated. For lubricated threads the values should be reduced by one third.

UNF Grade "S" Bolts				
Bolt Size		Hexagon (A/F)	Torque Settings	
in	(mm)	in	Nm	lbf ft
1/4	6.3	7/16	14	10
5/16	7.9	1/2	28	20
3/8	9.5	9/16	49	36
7/16	11.1	5/8	78	58
1/2	12.7	3/4	117	87
9/16	14.3	13/16	170	125
5/8	15.9	15/16	238	175
3/4	19	1 1/8	407	300
7/8	22.2	1 5/16	650	480
1	25.4	1 1/2	970	715
1 1/4	31.7	1 7/8	1940	1430
1 1/2	38.1	2 1/4	3390	2500
METRIC Grade "8.8" Bolts				
		Hexagon (A/F) mm		
M5	5	8	7	5
M6	6	10	12	9
M8	8	13	28	21
M10	10	17	56	42
M12	12	19	98	72
M16	16	24	244	180
M20	20	30	476	352
M24	24	36	822	607
M30	30	46	1633	1205
M36	36	55	2854	2105
METRIC Grade "12.9" Bolts				
M8	8	13	48	35
M10	10	17	94	69
M12	12	19	166	122
M14	14	22	320	236
M16	16	24	400	295

Note: All bolts are of high tensile strength and must not be replaced by bolts of a lesser tensile specification.

Fluids & Lubricants

ENGINE LUBRICATING OIL

New engines do not require a running-in period. The dumper should be used in a normal work cycle immediately. Glazing of the piston cylinder bores, resulting in excessive oil consumption, could occur if the engine is gently run in. Under no circumstance should the engine be allowed to idle for extended periods (e.g. warming up without load)

A minimum API CJ-4 grade of must be used. Superior grades of oil may be more appropriate for heavy duty applications (such as sustained high loads operating at elevated temperatures*) Lower standards of oil do not have the soot or temperature carrying capacity required for Dieselmax common rail engines and must not be used.

Oil Viscosity	Minimum Temperature °C	Maximum Temperature °C
SAE 0W30	-40	+30
SAE 0W20	-40	+10
SAE 5W20	-30	+10
SAE 5W40	-30	+40
SAE 10W30	-20	+40
SAE 15W40	-15	+50

NC recommend Fuchs Lubricants, the dumper comes pre-filled with SAE 15W40 oil
If you are in any doubt as to the correct grade of oil to use contact NC*** If a diesel particulate filter is fitted a low ash type oil must be used to prevent the filter clogging.**

ENGINE OIL CAPACITY

Choose the grade of oil to suit the temperature range as detailed in the table above. The engine oil capacity, including filter and clean sump is 11.5 L MIN and 14L MAX mark on the dipstick.

COOLANT MIXTURES

Anti-freeze can be harmful. Obey the manufacturers instructions when handling neat or diluted antifreeze.

NC recommends “JCB High Performance” anti-freeze . If another anti-freeze is used refer to the manufacturers instructions and ensure a corrosion inhibitor is included. Must conform to standard **ASTM D6210** and must be ethylene glycol based. DONOT use Organic Acid Technology (OAT) antifreeze. Do not use solutions of more than 60% or less than 50%; or damage to the cooling system will occur.
50% solution: maintains circulation down to –33°C and protects against damage to –40°C
The strength of the anti-freeze solution should be checked at least once a year, preferably at the beginning of a cold period. It is an advantage to leave the anti-freeze in all year round as it gives continued protection against corrosion. Always renew anti-freeze every two years. A 50% anti-freeze mixture is required even if frost protection is not required, as this raises the coolants boiling point.

Fluids & Lubricants

FUEL SPECIFICATION

The quality and grade of fuel can seriously affect the lubrication and overall service life of the fuel injection pump. It is vitally important that the correct grade of fuel is used. Pre-filters and water separators must be checked daily and cleaned if necessary. Fuel cleanliness is extremely important.

ACCEPTABLE FUELS

No warranty liability whatsoever will be accepted for failure of injection equipment where the failure is attributed to the quality and grade of fuel used.

Only the following types of fuel are considered acceptable by NC

- EN590 Diesel fuel types (Auto/C0/C1/C2/C3/C4)
- ASTM D975-91 Class 2, US DF1, US DF2, US DFA
- JIS K2204 (1992) Grades 1, 2, 3 and Special Grade 3
- BS2869 Class A2

Biodiesel use & Service Requirements

B20 Biodiesel (RME content blended with mineral derived diesel (20% maximum) ASTM D6751, DIN 51606, ISO 14214 may be used.

- Do not leave unused B20 Biodiesel in the tank for extended periods (top up each day).
- Make sure that 1 in 5 fuel tank fills is of standard EN590 specification diesel to help reduce gumming.
- Make sure regular oil sampling is carried out to look for unburnt fuel, water or wear particles. Use sample bottles Part Number LUB~1895-500 available from NC.
- Change the engine oil & filter more frequently (as a minimum at half the recommended intervals on page 7 or sooner if there are engine performance related issues).
- Change the fuel filters more frequently (as a minimum at half the recommended intervals on page 7 or sooner if there are engine performance related issues).
- Make sure the fuel is stored correctly, care must be taken to make sure no water enters the machine fuel tank (or storage tanks) Water will encourage micro-bacterial growth.
- Make sure that the fuel pre-filter is drained DAILY.
- Use heater kits in low ambient temperature territories.
- Biodiesel must meet the following standards: ASTM D6751, DIN 51606, ISO 14214

If performance related issues are to be reported to NC and the engine has been run on biodiesel, then the fuel system must be filled with standard EN590 diesel (at least 2 tank fills)

Failure to follow the additional recommended service requirements may lead to a warranty claim being rejected. Failures resulting from incorrect use of biodiesel or other fuel additives will not be supported by NC Warranty.

Fluids & Lubricants

Checklists

Common Rail (Tier 3) Specific

In addition to the general safety notices and general good workshop practices issued in this section and throughout the manual, there are specific points to note when completing maintenance on Tier 3 equipment.

Diesel Fuel Quality

Important : The potential for engine damage due to the use of incorrect or contaminated fuel is much greater with common rail injection technology than with mechanical injection systems.

Effects of Contamination

Once inside the system, fuel circuit contaminants greatly effect the performance and life of the fuel injection equipment. For example, contaminants in the fuel pump will develop internal wear to cause internal leakage and hence lower discharges. Use of poor quality fuels and poor maintenance could also lead to contaminants entering the fuel injectors. There is a possibility of catastrophic equipment failure if debris should prevent the injectors from fully closing. The main contaminants can be classified as follows: These contaminants can appear during manufacture, assembly and operation.

- Solid Particles - sand, fibres, metallic particles, welding scale, sealing materials and wear particles etc.
- Liquid - usually water and incompatible oils and gases.
- Gases - air, sulphur dioxide etc. which can create corrosive compounds if dissolved in the fluid.

It is critical that the machine is thoroughly cleaned prior to completing any maintenance work. The main filter is rated at 2 micron = 0.002mm (0.0007874in).

Listed are a few typical comparisons of micron size:

- Red Blood Cell = 8 Microns (0.008mm, 0.000315 in).
- Human Hair = 70 microns (0.07mm, 0.00275 in).
- Grain of Salt = 100 microns (0.1mm, 0.00394 in).
- The smallest particle visible to the naked eye is 40microns (0.00157 in) approximately.

Fluids & Lubricants

Common Rail Safety Checklist

The following safety checklist is intended to help remind you of safety procedures and practices relating to a common rail engine.

SAFETY IS YOUR RESPONSIBILITY

- Do make sure the engine and surrounding area has been thoroughly cleaned prior to completing any maintenance tasks.
- Do complete all work in accordance with the Service Manual procedures.
- Do disconnect both the battery positive (+) and battery negative (-) cables prior to completing any welding on the machine.
- Do use the recommended grade of fuel (EN590). The fuel injection pump, injector or other parts of the fuel system can be damaged if you use a fuel or fuel additives not recommended by JCB.
- Do make sure all the necessary new parts are available before starting any maintenance work.
- Do not 'crack' the injector high pressure fuel lines to bleed the fuel system. The system operates at pressure in excess of 1200 bar (17400lbs/in²).
- Do not steam clean the electronic control unit (ECU) or the ECU connectors.
- Do not touch the ECU connector pins, this will eliminate the possibility of damage caused by electrostatic discharge.
- Do not leave any fuel connections 'open' for any extended period of time.
- Do not open any new parts packaging until the part is ready to be fitted. Unnecessary exposure will increase the risk of contamination.
- Do not reuse high pressure fuel pipes. Reusing the pipes will lead to potential fuel leaks.
- Do not attempt to remove and replace the rail pressure sensor or high pressure valve. It is not possible to refit these components without the risk of fuel leaks. If the valve or sensor is diagnosed as faulty then a new common rail assembly must be fitted.

Fluids & Lubricants

Usage and Effects of Fuels

Note : The information that follows does not indicate types of fuel that are acceptable or unacceptable.

1. Low Sulphur Diesel

   In its basic form because of the process of reducing sulphur by removal of sulphur containing compounds (which contribute to mechanical lubrication) an increase in the wear rate of the fuel injection equipment could occur. In view of this, the major fuel producers add suitable lubricity improvers to enable the FIE to run satisfactorily, with no acceleration in wear rate. They must ensure that the lubricity improvers do not themselves create residual deposits that could block the fuel system eg. Filter, injectors etc.

2. Ultra Low Sulphur Diesel

   Also known as 'city diesel'. Available throughout the UK and some parts of Europe since March 1999. This fuel has a maximum sulphur content of 0.005% by weight and a further reduction in the natural lubricity and aromatic content than experienced with low sulphur diesel. Major oil producers will add lubrication improvers and also maintain the total aromatic content to an acceptable level.

3. Unmodified Vegetable Oils

   Burned in diesel engines neat or used as an extender to mineral derived fuel. When these are subjected to heat in the fuel injection system they form sticky deposits that can be found inside the fuel pump and a hard lacquer in the injectors where exposure to even higher temperatures takes place.

4. Chemically Modified Vegetable Oils (FAME/VOME)

   These fuels have been derived from a wide range of vegetable oils and animal fats, resulting in better stability, viscosity and cetane number tan those produced from unmodified vegetable oils, but it is recognised with the finished fuel characteristics. These oils are less stable than mineral oil derived fuels when stored and they will readily degrade producing fatty acids, methanol and water, none of which are desirable in the FIE. These effects are known to be accelerated when the fuel is sorted in the presence of air and water together.

   An extract 'common statement' from the FIE manufactures specifies that "The fuel injection equipment manufacturers can accept no liability whatsoever for failure attributable to operating their products with fuels for which the products were not designed, and no warranties or representations are made as to the possible effects of running these products with such fuels".

The three most common Fame types are RME - Rapeseed methyl ester (preferred crop in Europe), SME - Soyabean methyl ester (preferred crop in USA). Less common FAME's can be derived from animal fats (eg. Modified beef extracts) and reclaimed cooking oils.

5. B20 Biodiesel

Biodiesel refers to pure fuel before it is blended with diesel fuel. When biodiesel is blended with diesel fuel it is referred to as B5, B20 etc., where the number indicates the percentage of biodiesel in the fuel, for example B5 contains 5% biodiesel.

Biodiesel has different characteristics than mineral based fuels in that it is able to mix with water and therefore will have a high water retention capacity, this could lead to seals swelling, fuel system corrosion and seal damage.

Biodiesels will 'cloud' at higher temperatures than mineral based fuels. To explain Cloud Point—the lowest temperature at which fluid can flow and performs its functions is referred to as Pout Point. Just prior to reaching its Pour Point the diesel fluid becomes 'cloudy' due to crystallization of waxy constituents—this is know as Cloud Point. Using diesel at temperature below its cloud point can result in filter clogging. To prevent this happening preheating will be required.

Using B20 biodiesel can result in unburnt fuels accumulating in the engine oil, ultimately this can affect the engine oil efficiency and lead to engine damage (with standard diesel any unburnt fuel evaporates off the lubricating oil). Biodiesels must be stored to exclude water absorption and oxidation.

The natural properties of biodiesel make it a good medium for micro bacterial growth, these microbes can cause fuel system corrosion and early fuel filter blocking. It will be necessary to consult and seek advice from your fuel supplier, the effectiveness of conventional antibacterial additives when used in biodiesel is still being investigated in the fuel industry. A high percentage biodiesel mixture (>20%) can lead to fuel gelling and filter blocking in low temperature operation, it may also effect the power and performance of the engine.

To minimise the risk of engine damage when using a B20 mix, there are additional service requirements.

- The engine oil must be a grade CH4 as minimum specification.
- Do not leave unused B20 biodiesel in the fuel tank for extended periods (top up each day)
- Make sure that 1 in 5 fuel tank fills use standard diesel to EN590 specification, this will help to prevent 'gumming'
- Make sure regular oil sampling is completed (look for excessive unburnt fuel content, water or wear particles).
- Change the engine oil and filter more frequently (as a minimum half the recommended intervals), or as indicated by oil sampling.

- Change the fuel filters more frequently (as a minimum half the recommended intervals), or if there are engine performance related issues.
- Make sure the fuel is stored correctly, care must be taken to make sure no water enters the machine fuel tank (or the storage tank). Water will encourage micro bacterial growth.
-Make sure that the fuel pre-filter is drained DAILY (not every week as currently advised).
- Only JCB Engines built after jan. 2007 are applicable (i.e. engines with 07 on the end of their serial number and factory filled with CH4 oil) - this is not approved with other manufacturers.
- Use heater kits in low ambient temperature territories.
- The biodiesel must meet the following standards: ASTM D6751, DIN 51606, ISO 14214

Note: If necessary use a test kit to confirm the fuel specification. Testing kits are available (not from JCB currently), use the internet as a source for the kits.

Note: If performance related issues are to be reported to JCB Service, and the engine has been run on biodiesel, then the fuel system must be filled with standard diesel (at least 2 x tank fills) to EN590 specification and relevant stall speeds recorded prior to making the report.

Warranty

JCB have shown a commitment to support the environment by approving the use of biodiesel blended fuels.

Failure to follow the additional recommended service requirements may lead to a warranty claim being declined.

Failures resulting from the incorrect use of biodiesels or other fuel additives are not defects of the JCB Dieselmax engine workmanship and therefore will not be supported by JCB Warranty.

If the recommended actions are not taken there may be the following consequences:- low temperature filter clogging– injectors lacquering / sticking deterioration of seals and rubber hoses - corrosion of metal parts in the fuel system - engine performance problems. These risks will be increased if the fuel has been poorly stored, that is deteriorated through oxidation and / or water absorption.

Sulphur Content

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 high sulphur fuel you must change the engine oil more frequently.

Fluids & Lubricants

Low sulphur fuels must have the appropriate fuel lubricity additives, these lubricity improvers must not create residual deposits that block the fuel system, e.g. Injectors, filters etc. Contact your fuel supplier.

Percentage of Sulphur in the fuel (%)	Oil Change Interval
Less than 0.5	Normal
0.5 to 1.0	0.75 of normal
More than 1.0	0.50 of normal

A combination of water and sulphur will have a corrosive chemical effect on fuel injection equipment. It is essential that water is eradicated from the fuel system when high sulphur fuels are used.

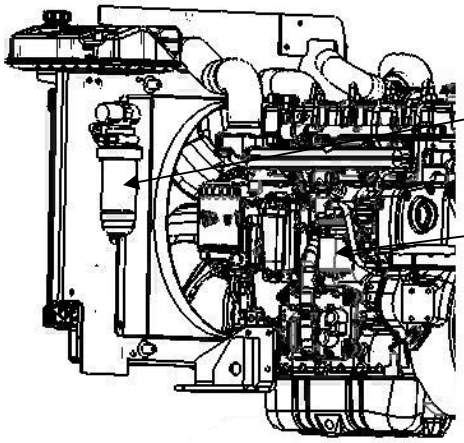
EFFECT OF FUEL CONTAMINANTS

DIRT: A severely damaging contaminant. Finely machined and mated surfaces such as delivery valves and distributor rotor are susceptible to the abrasive nature of dirt particles. Increased wear will almost certainly lead to greater leakage, uneven running and poor fuel delivery.
This machine uses a 5 micron pre-filter with a 2 micron main filter. Only use genuine high quality filters available from NC.

WATER: Water can enter the fuel through poor storage or careless handling and will condense in fuel tanks. The smallest amounts of water can result in effects that are just as disastrous to the fuel injection pump as dirt, causing rapid wear, corrosion, and in severe cases even seizure. It is vitally important that water is prevented from reaching the fuel injection equipment. The filter/water trap must be inspected daily and drained if necessary. The pre-filter is fitted with an electronic water in fuel sensor linked to the instrument display.

FILTERS: The pre-filter element locks in position using a "Key-Track" system which ensures only genuine high quality filter replacements are used. The existing Dieselmax Tier 2 (30 micron) filter element will not fit. If there appears to be a problem when fitting filters always check the part numbers.

FUEL SYSTEM PARTS & CLEANINESS: It is critical the engine is thoroughly cleaned prior to removing any part of the fuel injection system. The fuel filtration system has been designed to remove contaminants from the fuel supply, however contamination during service / maintenance work is a significant risk to fuel injection equipment failure. Any work carried out which involves disturbing the fuel delivery system will require the machine to be cleaned thoroughly before any work in commenced. Consult NC for areas to be cleaned. High pressure pipes MUST be replaced with new ones if loosened or removed. When initially installed the fuel pipes create a seal, re-using old pipes will not guarantee a good seal and increase the risk of contamination.



If water trap is full of water, the main fuel filter must also be drained.

WAX: Wax is precipitated from diesel fuel when the ambient temperature falls below that of the fuels cloud point, causing a restriction in fuel flow, resulting in rough engine running. Special winter fuels may be available for engine operation at temperatures below 0°C. These fuels have a lower viscosity and limit wax formation.

EFFECT OF FUEL CONTAMINANTS

INJECTOR CALIBRATION: Although the injector operating components are by necessity very small, even the most advanced manufacturing techniques do not ensure consistent injection cycle characteristics between injectors.

Small variations in the metering orifice sizes will alter the time duration for the start & stop of the injection. For this reason it is necessary to individually test & record the operating characteristics of each inject assembly at the factory. The results of the test are printed on the side of the injector as a code (known as C2I codes)

The codes for each injector fitted to the engine are programmed into the ECU. The operating software in the engine ECU uses the data to adjust the control of the injector solenoid coil accordingly. The injector is therefore effectively calibrated to the ECU.

It follows that if injectors are removed they must always be refitted in their original positions. If new injectors are fitted the engine ECU must be reprogrammed with the new injector codes.

BLEEDING THE FUEL SYSTEM: The engine features an electrically operated fuel lift pump. The system is designed to bleed automatically when the lift pump is operated. Make sure that as much air as possible is REMOVED from the system before starting the engine.

The system can be bled by simply turning the started switch to ON (not start) position, the pump can be heard operating. Note the pump will turn off after a pre-determined period of time. IMPORTANT: Do not attempt to bleed the high pressure fuel system by loosening the high pressure pipe connections even when the engine is not running. To bleed the fuel system follow the correct procedure. Call NC if in doubt.

WARNING

DO NOT open the high pressure fuel system with the engine running. Engine operation causes high fuel pressure. High pressure fuel spray can cause serious injury or death.

Fluids & Lubrication

GEARBOX OIL

NC recommend Fuchs Titan T04HD10 (*Up to 30°C Ambient)*
Alternative Suppliers [1] :
Shell Spirax CX10, Mobil Trans HD10, BP Autran 4 10

NC recommend *T04HD30 (For Temperatures above 30°C Ambient*)
Alternative Suppliers [1] :
Shell Spirax CX30, Mobil Trans HD30, BP Autran 4 30.

TRANSFER BOX

NC recommend Mobile HP222 Grease
Alternative Suppliers [1]:
Shell Gadus S3 V220C 2, Fuchs Renolit LX-EP 2, BP Energrease LC2.

NC recommend Mobilube HD90 (International Specification API GL5) 1Litre
Alternative Suppliers [1]:
Shell Spirax MB90, Titan Gear HYP SAE90, BP Energear Hypo 90.

AXLE OIL

NC recommend Mobil 424 (International Specification API GL4, M2C-41B/134D, JD20C) 23 Litres
Alternative Suppliers [1]:
Shell Spirax S4 TXM, BP Tractran 10.

NC recommend Mobile HP222 Grease
Alternative Suppliers [1]:
Shell Gadus S3 V220C 2, Fuchs Renolit LX-EP 2, BP Energrease LC2.

NC recommend Fuchs Renolin HVZ15 Brake system (International Specification ISO VG15)
Alternative Suppliers [1] :
Shell Tellus S2V, Velocite SM15, BP Bartran HV15.

HYDRAULIC OIL

NC recommend Fuchs Renolin CL32
Alternative Suppliers [1] :
Shell Tellus S2 M32, Mobil DTE24, BP Auto Hydraulic 32

GENERAL GREASE POINTS

Multi purpose grease

[1] Do not mix different type of oils / grease as they may react with each other. If topping up use the same type of oil or fully drain oil before using a new type of oil.

FOR YOUR SAFETY

IF THE DUMPER DEVELOPS A FAULT

- Park the machine in a safe area if possible. If this is not possible take measures to warn others of the machine position.
- Remove the start switch key.
- Contact a qualified person to rectify the fault.
- Do not place any part of the body in any area of the machine where there is a hydraulic leak while the system is pressurised.

THE REPAIR AREA

- The repair area should be level, clean, dry, well ventilated and have adequate lighting
- Keep the floor clean, wipe up spilt oil and grease.
- Always use the correct tool for the job, keep tool in good condition.
  NEVER IMPROVISE TOOLS.
- Jacks, hoists, lifting chains and ropes should be checked before use. Do they have sufficient lifting capacity and are they properly certified.
- Do not attempt to lift heavy objects on your own.

WHEN REPAIRING

- Safety prop tipped skips.
- Always wear eye protection.
- Always wear ear protectors when in a noise environment.
- Release any pressure from the hydraulic system before carrying out repairs.
- If the machine is lifted or suspended always support the machine on suitable blocks.
- Always remove the start switch key to prevent accidental starting.
- Never work with the engine running unless absolutely necessary.
- Never start the engine unless in a well ventilated area. Carbon Monoxide fumes can KILL.
- Always exercise extreme caution when welding, grinding or burning against risk of fire. Keep suitable fire extinguishers near by.
- Never smoke or leave the engine running when refuelling.
- Always use genuine spares from NC Engineering.
- Always check and test the machine thoroughly before putting it back to work.

Observing these points will help to ensure the repair of the dumper is as safe as possible. Only trained persons should carry out repairs.

Maintenance

BEFORE YOU START

- Clean the machine before starting any maintenance.
- Allow the machine to cool.
- Ensure strict cleanliness is observed at all times.
- Do not smoke near any fluids.
- Beware of scalding from hot oils, check oil temperature before draining.
- When checking fluid levels on dumper, ensure the machine is switched off, positioned on firm stable ground, with the handbrake applied. The area should be well ventilated, and free from all sources of possible contamination (i.e. quarry dust, grinding sparks or similar). Never check fluid levels near naked flames or hot surfaces.

CLEANING

- When cleaning it is preferable to use a biodegradable cleaner.
- Do not use solvents or similar products, which can damage rubber and plastics.
- Take care to clean the oil and fuel tank filler necks.
- Areas around drain plugs should also be cleaned.
- Never direct a pressurised water jet on electrical equipment.

CHANGING OILS

- Ensure the machine is on solid level ground.
- Only carry out lubrication tasks in a clean area free of contamination of the air.
- Draining of oils is best carried out when they are warm NOT HOT.
- Clean up spilt oil immediately.
- Use only fresh oils of the recommended type and grade.
- Contaminated water / Fluids / Oils / Filters must be disposed of in an environmentally safe way.

WORKING ON THE HYDRAULIC SYSTEM

Never attempt to tighten or loosen hydraulic fittings when the engine is running. Hydraulic oil leaks at high pressure can easily penetrate the skin. If the skin is penetrated with hydraulic oil, seek expert medical attention immediately.

BRAKE FLUID

Under NO circumstances must conventional brake fluid be used or added to the brake system. This will cause damage to the rubber sealing components and may cause the brakes to fail.

ALL COVERS AND PANELS MUST BE FITTED BEFORE DUMPER IS USED.

Maintenance

BATTERY LOCATION

The battery is located in the left-hand footstep assembly. It is accessed by turning the key lock (A) on the side and then hinging the step (B) towards the wheel.

BATTERY

- Always wear safety glasses when working on the battery.
- Always disconnect the Negative (-) battery lead (C) before disconnecting the Positive (+) battery lead (D).
- Always connect the Positive (+) battery lead (D) first when reconnecting the battery.
- Never allow a metal object to touch both battery terminals at the same time or allow them to touch the positive (+) terminal (D) and the vehicle chassis simultaneously.
- When charging the battery hydrogen gas is produced. Ensure the area is well ventilated to prevent risk of explosion from a build up of hydrogen. Do not smoke, weld, cut, grind etc in the vicinity of a battery being charged.
- If the skin is exposed to battery electrolyte, the affected skin must immediately be washed with running water.
- If eyes are exposed to battery electrolyte, wash the eyes with running water and obtain immediate professional medical attention.
- To remove the battery, disconnect the leads and undo the nuts & bolts (E) holding the clamping bar. Always use the lifting handles when moving a battery

BATTERY ISOLATOR

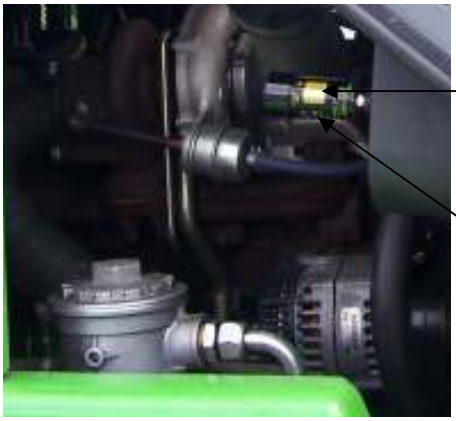
The battery isolator must always be used when carrying out service or maintenance work would be dangerous if the engine was to be started or the electrical system activated.

When major maintenance work is being carried out, always disconnect the battery removing the negative battery lead first.

When the battery isolator lever is in the ON (F) position the machine electrical circuit is fully activated. The battery isolator lever may be removed when in the OFF position (G) and may be used for anti theft protection.

Maintenance

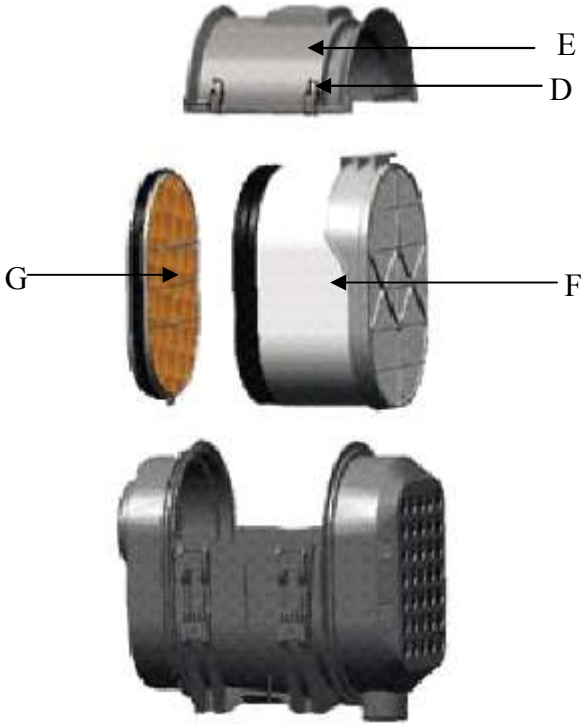
AIR CLEANER SERVICING



The air cleaner needs serviced when the red line on the visual indicator line (A) reads 75 kpa, the box on the indicator labelled service when red (B) will also be filled. This should be one of the daily machine checks. Maximum protection for the engine against dust is possible only if the air cleaner is serviced correctly. The only way to determine if an air cleaner requires cleaning or replacing is to check.

Never run the engine with the filtration elements removed from the air cleaner.

- Squeeze the solids ejector (C) to remove material from the pre cleaner drop tube.
- To service the air cleaner, first clean its surrounding area and then release the 4 retention latches (D) lift off the top lid (E).
- Remove the primary filter (F) by pulling it out from the main filter body, this will expose the inner safety filter (G). Either renew or clean these elements. Clean by using compressed air to carefully blow dust out of the filter.
- Reassemble by reversing the above procedures .



Maintenance

CHECKING COOLANT LEVEL

Always check the coolant level when engine is cold
This is a pressurised cooling system
To prevent scalding NEVER remove the filler cap when the coolant is hot
Hot coolant will burn you. Always check the engine is cool before checking the coolant level or draining the system.

- When the engine is cold if the coolant level is below the minimum level (C), remove the filler cap (A) and add coolant until the coolant is just below the maximum level line (B)
- Replace the expansion tank filler cap (A).

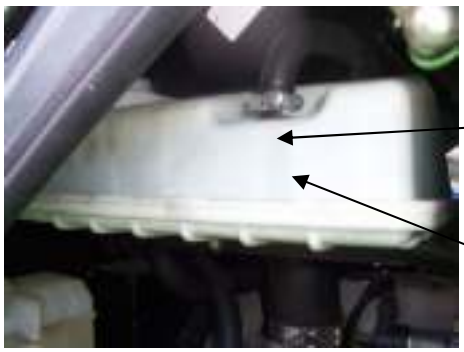
DRAINING THE COOLING SYSTEM

- Ensure the engine is cold carefully undo the expansion tank filler cap (A) to release any built up pressure escape, Remove the cap when all the pressure is released.
- Undo the hose clip on the bottom radiator hose and pull it off the radiator.
- Allow the coolant to drain into a suitable container.
- Flush the system by pouring clean water into the expansion tank filler neck.
- Refit the bottom hose and tighten the clip.

Dispose of used coolant in an environmentally safe way

REFILLING THE COOLING SYSTEM

- Ensure the engine is cold.
- Remove the expansion tank cap and add coolant mix to the maximum level mark (B) on the tank, allowing time for the coolant to settle as necessary. Replace the filler cap. (see **Fluids & Lubricants** section regarding coolant mix).
- Start the engine and allow it to run for approximately 2 minutes ensuring the coolant doesn't drop below the minimum level (C) mark.
- With the engine stopped and the cool, remove the filler cap and top up as necessary to just below the maximum level mark. Repeat the above process and toping up again until the level remains steady. This will ensure all the air has been expelled from the system.



Always ensure the coolant level is just below the maximum level line as this will give the best cooling performance.

Maintenance

CHECKING ENGINE OIL LEVEL

Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice immediately. 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 in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

- Clean away all dirt from around the dipstick and tube.
- Ensure the engine oil is warm (NOT HOT) and dumper is positioned on firm, level ground.
- Pull the dipstick (A) from the engine, wipe the oil off the dipstick using clean paper roll.
- Put the dipstick back into its tube and push it firmly down. Remove the dipstick and check oil level.
- Check the oil level is between the two marks on the dipstick.
- If necessary add recommended oil through the filler point (B)

If the oil is below the recommended level DO NOT use the dumper until sufficient oil has been added to bring it up to the required level

ADDING OIL

- Unscrew the engine oil filler cap (B) and add clean fresh oil of the correct grade (see technical specification). Ensure the oil is from an clean source and the container is clean.
- Check the oil level frequently when adding oil: too much oil can damage the engine. Allow time for the oil to drain to the sump before checking the level.
- When the oil level is up to the full mark on the dipstick, refit the engine oil filler cap and ensure the dipstick has been firmly pushed back into the dipstick pipe.

Maintenance

DRAINING ENGINE OIL

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.

- Ensure the oil is warm but not hot as contaminants held in suspension will be drained with the oil. This will also allow the oil to drain quicker and more thoroughly.
- Place a suitable receptacle under the engine drain plug 15 to 20L capacity

Oil will gush from the hole when the drain plug is removed. Hot oil and engine components can burn you. Keep to one side when you remove the plug.

- Remove the drain plug (A) and its "O" ring. Let the oil drain out, then clean and refit the drain plug with a new "O" ring. Torque tighten the drain plug to 40-60Nm (30-44lbf ft).
- Loosen and remove the filter housing drain plug (B). Let the oil drain out, then clean and refit the drain plug with a new "O" ring. Torque tighten the drain plug to 35-40Nm (26-30lbf ft).
- The engine oil filter (C) MUST be changed when the engine oil is renewed. Unscrew the filter canister using a chain wrench if necessary.
- Clean the seal face of the filter head.
- Smear the seal on the new filter canister with clean engine oil, screw the filter on until it just contacts the filter head. Turn the filter at least another 3/4 of a turn.

<u>NOTE:</u> use only genuine filters from NC. The engine oil filter is designed with a drain down valve. Using non genuine parts may result in loss of engine oil pressure and subsequent engine damage.

- Through the filler point, fill the engine with the recommended oil to the MAX mark on the dipstick. Wipe up any spilt oil and replace the filler cap ensuring it is secure.
- Operate the engine until the "Low Oil Pressure" warning LED goes out. Check for oil leakage. When the oil has cooled check oil level again and if necessary top up with clean engine oil. **DO NOT OVERFILL.**

Maintenance

Oil is toxic. If you swallow any oil, do not induce vomiting, seek medical advice immediately. 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 in warm soapy water. Do not use petrol, diesel fuel or paraffin to clean your skin.

GEARBOX LUBRICATION

To ensure proper lubrication and operating temperatures it is important that the appropriate lubricants are used and the correct oil level maintained. This level should be checked daily. NC recommend Fuchs Titan T04 HD10.

GEARBOX OIL LEVEL CHECKING

Ensure the engine is stopped and the transmission oil is cool. Ensure the oil cooler is full by running the oil cooler a few seconds prior to checking the oil level. In this condition the oil level should be between the maximum and minimum marks on the dipstick. Gearbox oil level should be checked daily, and topped up if necessary. Check the oil level using the dipstick .
At normal running temperatures the oil on the dipstick will rise above the maximum mark. Do not overfill the transmission as this may result in oil breakdown due to excessive heat and aeration from the churning action of the gears. Early breakdown of the oil will result in heavy sludge deposits that block oil ports and build up on splines and bearings. Overfilling may cause oil leaks.

TRANSMISSION OIL FILL PROCEDURE

It is extremely important to follow the correct oil fill procedure to prevent internal damage to the transmission.

- With the engine stopped fill the transmission with Fuchs Titan T04 HD10 oil to dipstick maximum mark. Fill point (A).
- Start the engine and run slowly for a period not exceeding five minutes. This allows the oil to fill the filter, pump, torque converter, oil cooler and hoses.
- Stop the engine and wait approximately one minute, recheck the oil level and fill to dipstick maximum level.

Maintenance

CHANGING GEARBOX OIL

- When changing the oil it is essential to renew the oil filter and clean out the suction strainer.
- Ensure the transmission oil is cool but warm to allow it to flow easily.
- Drain the oil by removing the strainer (B).
- Oil will gush out, keep clear of hot oil as it can cause serious burns.
- Clean strainer using a suitable solvent, when refitting the strainer renew the gasket and apply Loctite 242 to bolts (A). Torque to 10Nm (7.4lbf ft).
- Unscrew and discard the filter element (C).
- Smear the seal of the filter with transmission oil, Screw the filter on until it contacts the filter head, then to be tightened a minimum of 3/4 turn (equal to 15Nm or 11lbf ft torque)
- Fill the system as per the Transmission Oil Fill Procedure above.

Maintenance

TOWING PROCEDURE

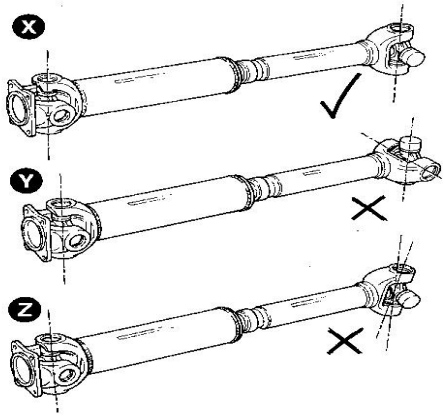
If there is no transmission damage the dumper may be towed for a distance of approximately 1.5 kilometres (1 mile). Always use a rigid tow bar and ensure the gear lever is in neutral. Restrict the towing speed to 25km/h (15mph)
If it is necessary to tow the dumper for distances in excess of 1.5 kilometres (1mile) the drive shafts to each axle must be disconnected To prevent oil starvation and possible seizure of the transmission. Failure to observe this precaution may result in extensive damage to the transmission.

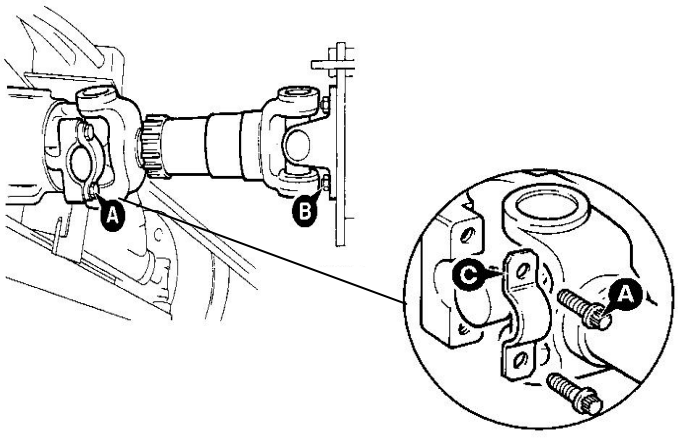
Removal or disconnection of the drive shafts will disable the parking brake. It is essential that the following procedure is adopted.

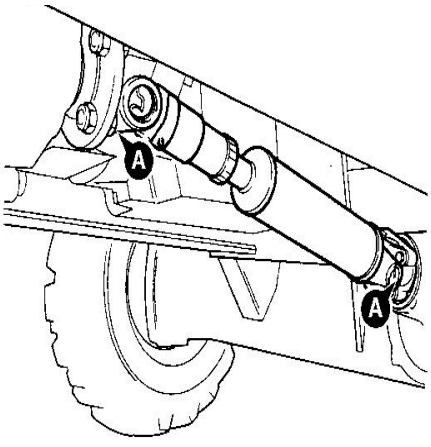
- Position the machine on firm level ground and block the wheels securely to prevent any movement. Select Neutral and release the parking brake.
- Disconnect and remove the drive shafts completely from the dumper.
- Connect the towing vehicle via the rigid tow bar before removing the wheel blocks
- When towing is complete, block the wheels securely BEFORE removing the tow bar and reconnecting the drive shafts.

RECONNECTING DRIVE SHAFTS

The propshafts must have both ends on exactly the same plane as shown in X. The yokes must not be at right angles as in Y or at an intermediate angle as shown in Z. When reconnecting always apply Loctite 242 to the threads of all flange bolts. The retraining straps (C) should always be replaced with new ones as they will stretch over time.
Torque item (A) to 75-85 Nm and (B) to 118 Nm







Maintenance

BRAKE SYSTEM

The brake system is filled with high grade hydraulic oil.
DO NOT USE CONVENTIONAL BRAKE FLUID.
This will cause serious damage to the dumper and degrades the brake performance to dangerous levels. NC recommend Fuchs Renoil HVZ15

The brake system is filled via a fluid reservoir which is remotely mounted from the brake master cylinder. The reservoir is located under the bonnet on the rear anti recirculation baffle.
Normally, adjustment of the brakes is not required due to the automatic compensation which is built into the axle brake design. But bleeding of the system may be necessary on occasions if pipe work is damaged causing system leakage. A LED is provided on the display to indicated if the brake fluid becomes low

The brakes on this dumper provide means of effective braking with minimum maintenance. However it is vital during maintenance on the dumper that the general condition of the system i.e. pipe work, pedal operation, fluid level and general tightness is checked and deficiencies corrected immediately. FAILURE TO DO SO COULD RESULT IN SERIOUS INJURY OR DEATH.

BRAKE SYSTEM BLEEDING

- Position the machine on firm level ground and ensure the park brake is engaged and that one pair of wheels is blocked on each side.
- Ensure the skip is in the lowered position and locked in the forward position.
- Ensure the brake fluid reservoir is full and that during bleeding its level does not fall below the ADD level (B) mark.
- Attach a tube to the brake bleed screw (C) ensuring that the free end of the tube is immersed in fluid contained in a suitable container.
- Open the brake bleed screw and apply full brake pedal strokes of the brake pedal until all air is expelled.
- Close the brake pedal screw with the pedal fully depressed.
- Repeat the procedure using the opposite bleed screw
- Top up the reservoir to the MAX level (A) mark.

Maintenance

TRANSMISSION PARKING BRAKE

The parking brake is mounted on the transmission gearbox and can be accessed from the underside of the dumper. Wear can occur either by stretching of the handbrake cable, or wear on the disc pads themselves, causing a reduction in efficiency. Brake pads generate dust which if inhaled, may endanger health. Wash off the calliper assembly before commencing work. Clean hands thoroughly after work.

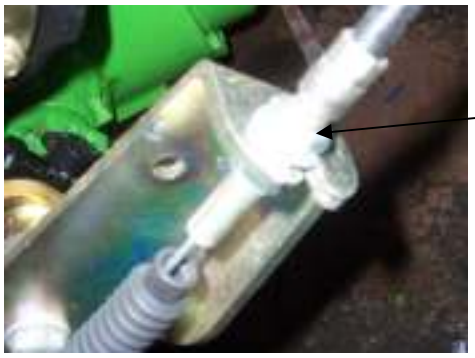
ADJUSTING THE PARKING BRAKE

TAKE UP THE CABLE SLACK

- Disengage the parking brake (A) (lever horizontal) and turn the handle grip clockwise half a turn.
- Test the parking brake.
- If the brake fails the test, repeat the procedure.

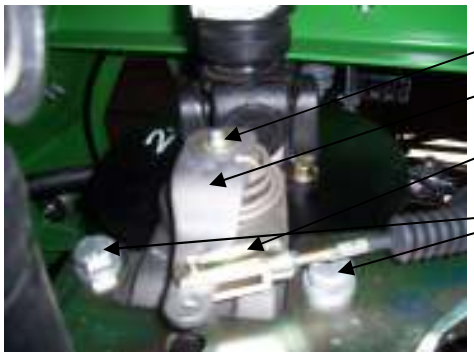
CHECK THE PADS

- Use feeler gauges to check the gap between the brake disc (B) and the face of the brake calliper housing (C).
- The gap should be greater than 1mm (0.04 in). If gap is less than 1mm renew the pads.



RENEW THE BRAKE PADS

- Disengage the parking brake (A) (lever horizontal).
- Slacken the nuts (D) and unhook the clevis (E).
- Loosen and remove bolts (F) and remove the calliper assembly.
- Remove the old brake pads from the calliper assembly and fit the new pads. Align the flat across the top of the pads with the calliper housing.
- Refit the calliper assembly to the gearbox, torque bolts (F) to 244Nm (180lbf ft).
- Refit clevis (E).
- Adjust the cables effective length so that the park brake is fully engaged with the lever (A) vertical.
- Adjust at (D) and or at the clevis (E) & tighten nuts.
- If more adjustment is required this can be done at the park brake mounting position.
- In the event of insufficient adjustment remove screw (G), the anti-rotation clip and adjust the lever (H) on the spline. Rotate the lever by one spline and refit the assembly. Torque the screw to 12.5Nm - 15.5Nm (9.2 - 11.5lbf ft).
- Test the parking brake.



ADJUSTING THE PARKING BRAKE (continued)

On this machine the parking brake when fully engaged disconnects the transmission drive. The machine is prevented from driving with the park brake engaged. To complete the test move the park brake lever fractionally forward until the warning light is extinguished; hold the lever in this position for the duration of the test. DO NOT move the lever too far forward, otherwise the park brake will not be fully operational.

- With the parking brake engaged select third gear.
- Make sure the brake pedals are engaged, push down hard on the brake pedal and select forward drive.
- If the dumper starts to move forward during the test, immediately apply the foot brake and reduce the engine speed.
- Slowly release the brake pedals, if the dumper has not moved use the accelerator to gradually increase the engine speed **(ABOUT HALF WAY UP REV RANGE).** The dumper should not move. **DO NOT** test for longer than 20 seconds.
- If the dumper moved inspect the calliper/pads and reset as described in the text.

DO NOT use a machine with a faulty parking brake.
Non approved modifications to axle ratios, machine weight or wheel and tyre sizes may adversely affect the performance of the parking brake.

Maintenance

AXLES

The axles have totally enclosed & sealed multi-plate brakes and compensate automatically for brake wear. As the brakes wear ensure the fluid reservoir is kept topped up to the MAX level.

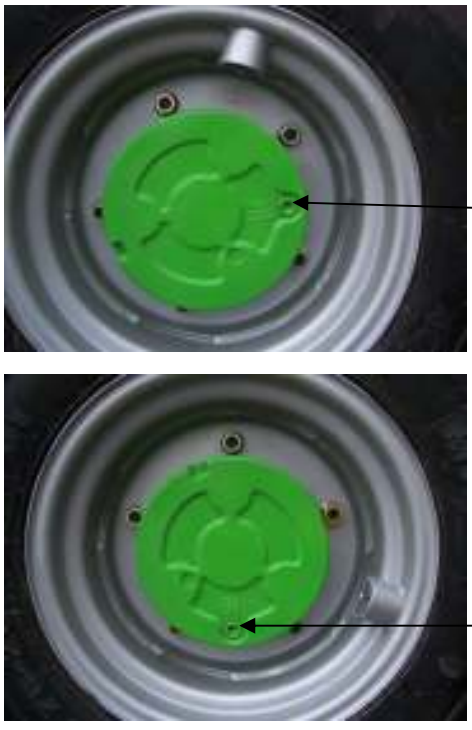
Over a period of time wear may necessitate replacement of the friction discs and / or the slave cylinder seals. These parts should be replaced as required and the system bled in accordance with the brake bleeding instructions.

A badly maintained axle 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 axle in a safe and efficient working condition.

CHECK OIL LEVEL

- Ensure the machine is parked on level ground to ensure accurate oil level checking.
- At the drive head casing remove fill/level plug (A). Oil should be level with the bottom of the fill/level hole.
- If necessary top up with the recommended axle oil. Clean and refit fill/level plug (A).

CHANGING AXLE OIL



- Set the machine level with the tyres just clear of the ground. Manually rotate both wheels of the axle to bring the OIL LEVEL mark on the hubs to the vertical position, with the fill/level plug (D) at the bottom.
- Remove the fill/level plug (D) from the hubs and the drain plug (B) from the drive head casing. Allow time for the oil to drain out.
- Clean and refit drain plug (B).
- Set both hub OIL LEVEL marks to the horizontal (C).
- Fill the axle with the specified quantity of oil through the drive head casing fill/level plug (A) (see the **Fluids & Lubricants section**). If the machine has been set level, oil should just dribble out of both hubs fill/level points.
- Clean and refit both hub fill/level plugs (C) and fill/ level plug (A).

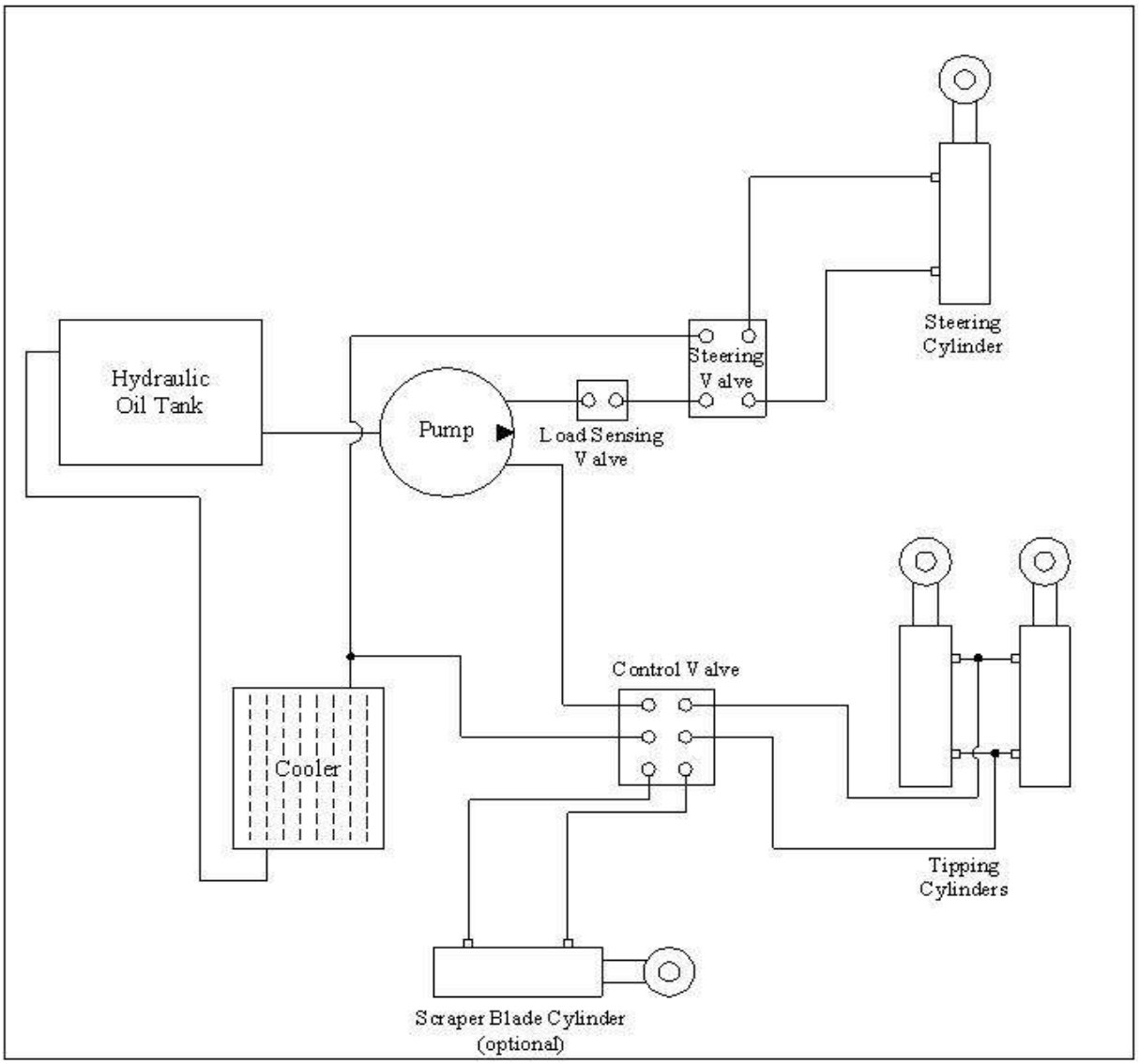
Maintenance

HYDRAULIC SYSTEM

The hydraulic system provides power to the steering, skip tip and scraper blade (optional extra) functions.

The hydraulics consists of an engine driven pump drawing oil from a tank. In the tank there is a suction strainer, filter and breather cap fitted, the tank is made from a transparent material and the level of oil can be seen through the side of it, a max and min decal shows the operator the correct level. The pump incorporates a load sensing valve for the steering, and also has two outlets one for the steering and one for the main system. A return to tank filter is fitted and is of the replaceable cartridge type.

Steering of the dumper is by means of a double acting hydraulic cylinder, mounted at each end on the two half's of the chassis with the centre point articulation this cylinder when open and closed will provide the steering lock to lock operation. The supply of oil is governed by a steering valve unit.



Maintenance

HYDRAULICS

During any hydraulic maintenance extreme care should be taken to ensure cleanliness of the hydraulic circuit. By observing strict hydraulic cleanliness the machine will benefit from fewer hydraulic failures through contamination.

ALWAYS

- Thoroughly clean the machine before any maintenance.
- Use fresh, clean hydraulic oil from a sealed container.
- Ensure old gasket particles and excess sealing compound etc do not enter the system, if they do drain them out.
- Ensure new parts and fittings are kept in sealed bags etc, and they are stored away from any contamination.
- Remove any flaking paint from around the area being maintained.
- Use paper roll not rags to wipe parts
- Inspect the inside of new tanks for debris.

NEVER

- Fit new hoses if both ends do not have a plastic cap fitted to seal them.
- Fit new valves, pumps, motors, filters, etc if all the ports have not been plugged.
- Use dirty containers for oil storage.
- Use dirty containers or funnels for filling the hydraulic system.
- Store hydraulic components on the floor or in areas where welding or grinding is done or in a dirty environment.

HYDRAULIC FILTERS

The system components are maintenance free other than the following:

- Tank Suction Strainer
- Tank Return Line Filter
- Steering Line Pressure Filter

When renewing these filters, the area around the filter should be thoroughly cleaned before removing the old filters to prevent the ingress of dirt into the hydraulic system.

When removing these parts it is recommended the system is drained and refilled with clean, new hydraulic oil as specified in the **Fluids & Lubricants** section.

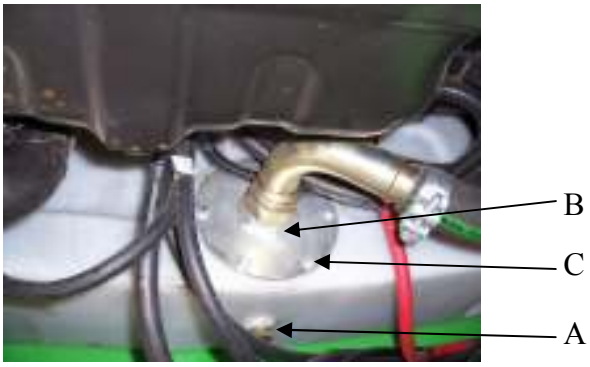
ADDING HYDRAULIC OIL

Remove tank filler cap and add oil. Do not fill oil level higher than approx 50mm (2”) below the horizontal top. Replace filler cap immediately after filling.

Maintenance

DRAINING HYDRAULIC OIL

Before draining the hydraulic tank ensure the hydraulic oil is warm NOT HOT and the skip is fully lowered.



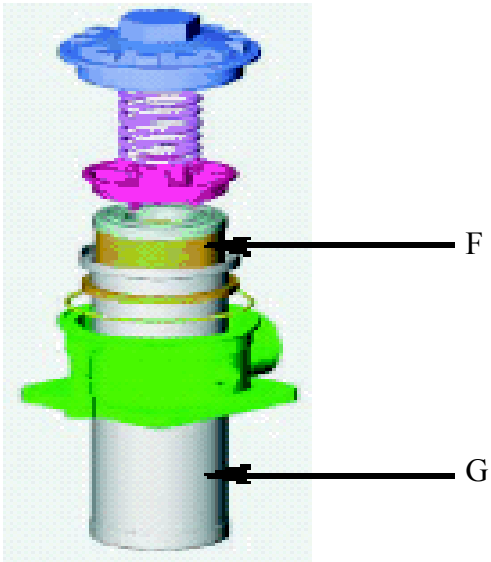
- Place a suitable container under the tank and remove the drain plug (A) allowing the oil to fully drain.
- Remove the blanking plate (B) and ensure inside the tank is free of debris.
- Replace the blanking plate (B). Torque bolts (C) to 7Nm.
- Replace the drain plug (A). Torque to 5Nm.

SUCTION STRAINER FILTER

- Empty the tank according to the above procedure.
- The suction strainer is mounted on the inside of the blanking plate. Unscrew and replace element.
- Replace the blanking plate (B) as per the above procedure.

RETURN TO TANK FILTER

- Inspect indicator (D) daily. When indicator is red the filter element needs replacing.
- Unscrew cap (E) to remove the old filter element (F). The filter element is replaced inside the re-useable chimney (G).



STEERING LINE PRESSURE FILTER

- Unscrew the bowl (H) and pull out the filter element.
- Replace the filter element and refit the bowl.

REPLACING FILTER ELEMENTS

Always use replacement filters supplied by NC other filters may be of lesser quality and lead to increased wear in the hydraulic components resulting in oil leaks.

Maintenance

STORAGE

If the dumper is to be stored for a long period of time the following procedures should be applied.

- Thoroughly wash down the exterior of the machine and remove any build-up of material.
- Grease all greasing points.
- Start the engine to warm it up. Drain the engine oil and refill with clean fresh oil to the correct specification. Also drain the coolant from the system and replace with fresh coolant of the correct mix & specification.
- Check hydraulic oil level and top up as required.
- Fill the fuel tank to prevent condensation forming inside the tank and contaminating the fuel.
- Store the machine on flat level ground which is not liable to flooding, standing water or airborne contamination.
- Smear any exposed metal parts with grease & rams.
- Remove the battery and store in a safe, well ventilated area. DO NOT store the battery on a concrete floor. It is best to place a rubber mat between the battery and the floor.
- Securely chock the wheels or the dumper may be lifted clear of the ground and placed on suitable axle stands to prevent damage to the tyres. In either case leave the parking brake off.

Maintenance

ELECTRICS

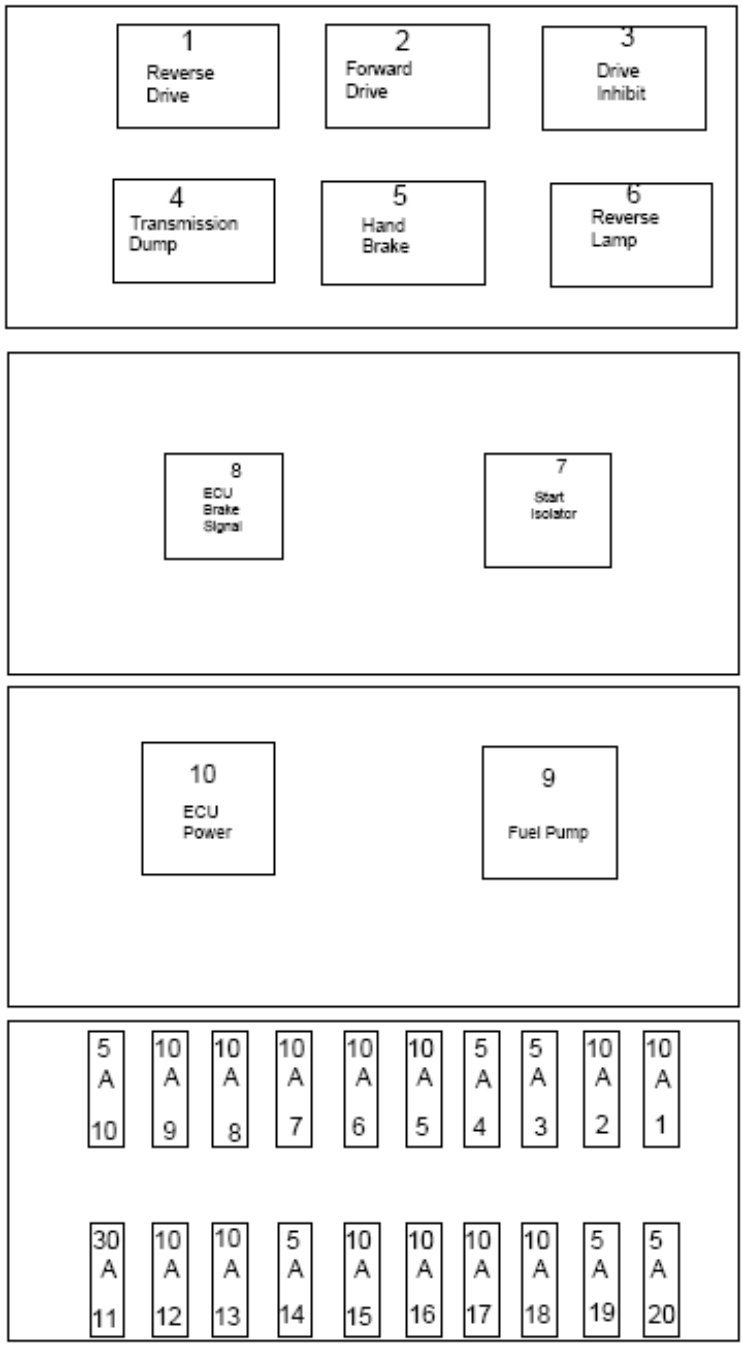
Description	Specification
Battery	Heavy Duty 600 45 Battery : 1000CCA, 185Ampere-Hour Capacity
Alternator	95A Belt driven

The alternator is very sensitive to temperature. High temperatures will affect the performance of the alternator and may eventually cause damage to it. Never remove the exhaust lagging as this is a temperature resistant material.
If the exhaust is to be removed always ensure it is refitted with lagging of the following minimum specification.

Must be able to withstand temperatures of 800°C

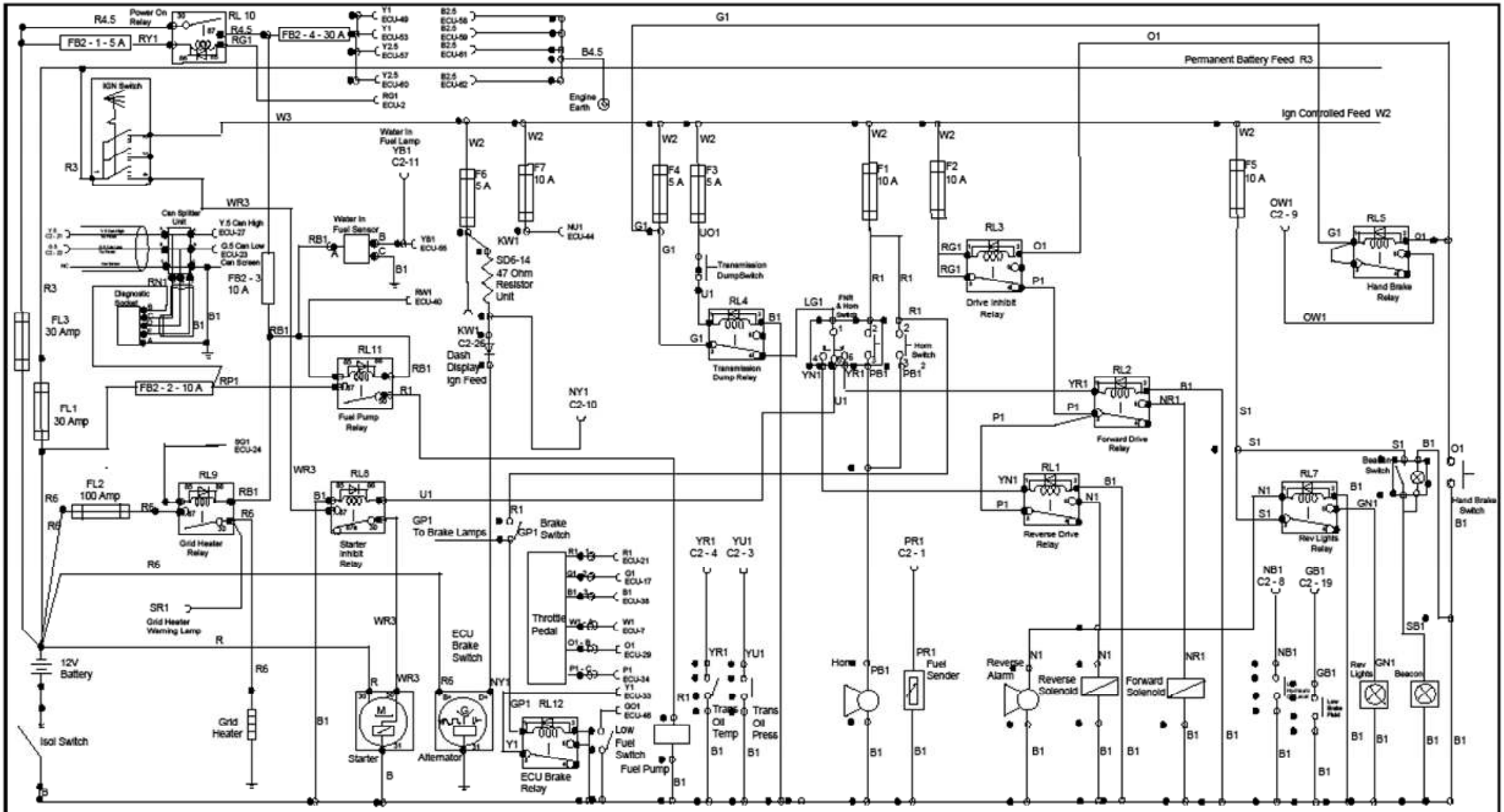
ELECTRICS (cont'd)

Main Fuse & Relay Box



Fuses

1. Horn & Brake Lights
2. Drive
3. Dump Switch
4. FNR Switch
5. Beacon
6. Instruments
7. IGN on to ECU
8. Indicators
9. Hazard
10. Rear Fog
11. ECU Power
12. Fuel Pump Relay
13. Fuel Pump
14. ECU Power Hold Relay
15. LH Main Beam
16. RH Main Beam
17. LH Dip
18. RH Dip
19. LH Side Tail
20. RH Side Tail



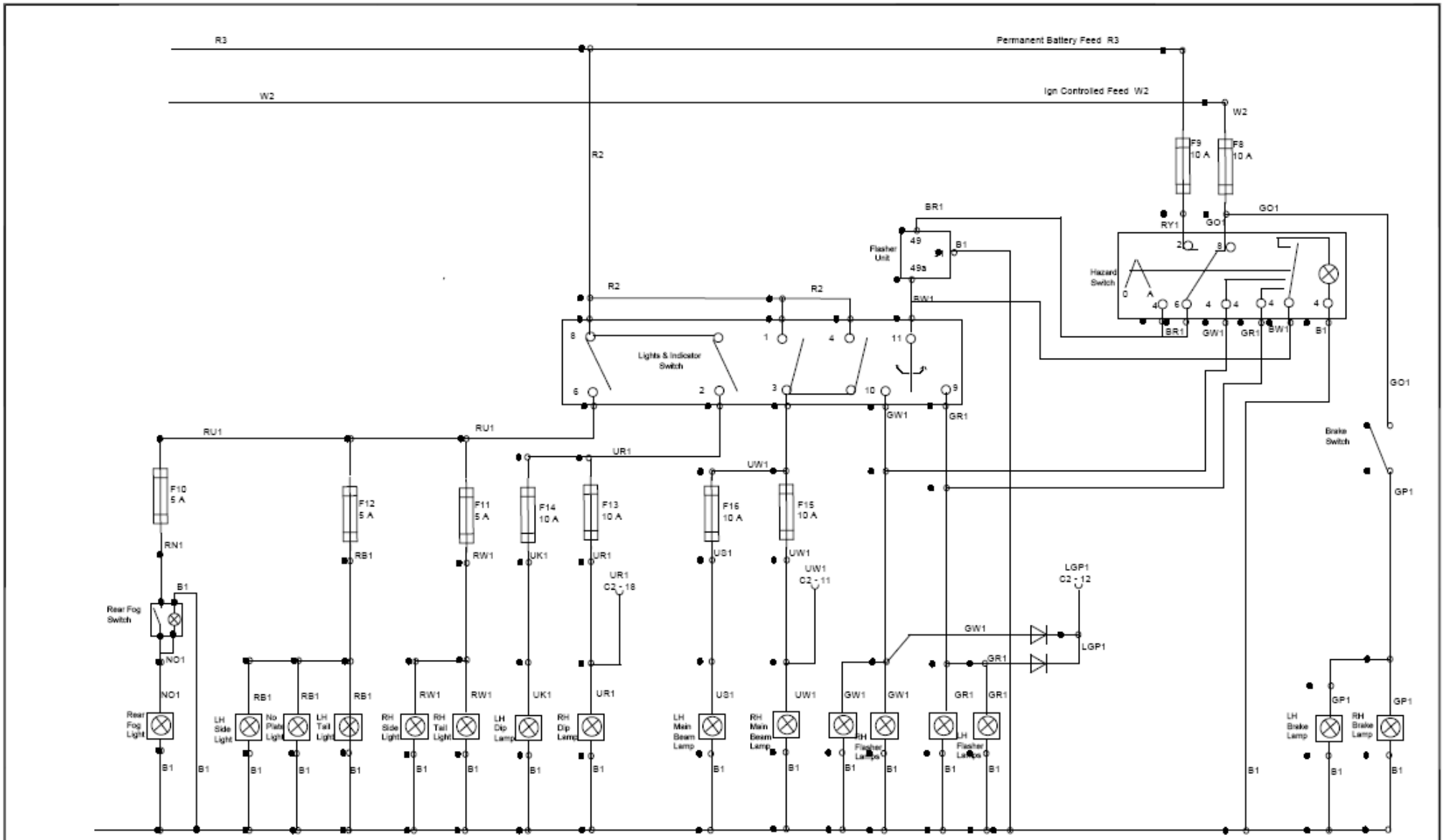
All Measurements Shown In mm.

KEY

C2 = Dash Panel Display Conns

PARKINSON HARNESS TECHNOLOGY MARSH LANE BOSTON , PE21 7FP TEL 01205 363008 AUTO MOTIVE , MARINE & INDUSTRIAL HARNESS MANUFACTURE	REV	AMENDMENTS	DATE
	1	Drawn R Tuplin	6/3/07

Customer	NC ENGINEERING
Part no.	SD9 Dumper
Rev no. 1	Sheet no.
Description	SD9 Chassis Scematic



KEY

C2 = Dash Panel Display Conns

PARKINSON HARNESS TECHNOLOGY
MARSH LANE
BOSTON , PE21 7FP
TEL 01205 363008
AUTO MOTIVE , MARINE & INDUSTRIAL
HARNESS MANUFACTURE

REV	AMENDMENTS	DATE
0	Drawn R Tuplin	12/9/06

Customer NC ENGINEERING
Part no. SD6 Dumper
Rev no. 0 Sheet no.
Description SD6 Lights Scematic

Fault Finding

INTRODUCTION

The dumper must be correctly parked and prepared. Maintenance personnel must be suitably qualified and trained. Failure to observe these this notice could result in serious injury of yourself or others

The fault finding procedures are given in the form of flow charts each one dedicated to a particular fault category.

The charts are designed to identify possible causes by performing checks and where applicable specific tests on the dumper. Having identified a cause the suggested remedy is given. The charts are designed to identify causes through a process of elimination, starting with the simplest and most easily rectified faults.

There are many reasons why the dumper may malfunction. Due to the level of effort involved in tracing a fault it is recommended this guide is followed.

- Do not make assumptions.
- If possible talk to the operator for a description of the fault. Also check if any recent maintenance or repair has been carried out on the dumper.
- Start with the simplest things i.e. no/low fuel, fuses etc.
- Systematically work through each of the possible causes.
- Confirm your diagnosis before dismantling and assembling.
- Follow the recommended repair procedures in the manual.

Some of the tasks in this guide must only be carried out by suitably qualified and competent personnel. For example, fuel injection pump removal and replacement. If you are unsure DO NOT attempt the task.

ELECTRONIC FAULT CODES

The engine fuel injection system is electronically controlled. The electronic control unit records some system faults as code. The codes can be accessed by connection of the correct computer diagnostic software to the machine CAN system.

Access the fault codes to help identify engine faults. Fault code data is given in this manual. Refer to Section Electronic Fault Codes.

Fault code data is also included with the ServiceMaster DieselMax diagnostics software.

Fault Finding

ENGINE WARRANTY INFORMATION

1. All fuel system parts replaced during the warranty period must be returned to NC Engineering.
2. Warranty claims not supported with the returned part will be declined
3. To prevent removed part contamination, an allowance time of 1 hour is given for cleaning the engine (jet wash / dry) prior to removing any of the fuel system components. The removed components should be capped & bagged. Caps kits are available from NC Engineering.
4. Any parts that are not cleaned and not capped and bagged, or have evidence of external contamination will result in the subsequent warranty claim being rejected.
5. If a fault is diagnosed using Service Master (i.e. a sensor) then a screen dump of the error code should be taken (use Ctrl + Print Screen key combination) the screen dump should be attached to an email with the dumper serial number also included.
6. An allowance of 1 hour has been allowed for diagnosis of the fuel system using Service Master.
7. ECU's should not be replaced without prior authorisation from NC. Before replacing a ECU the following points should be noted: ECU connectors removed & inspected & re-flash ECU with Service Master. Only after this and with approved authorisation should the ECU be changed
8. Any service issues diagnosed as an external engine concern, e.g. fuel hoses, filter, lift pump, alternator etc can be rectified in the field as normal.

Fault Finding

CHART A1—Dumper will not start or difficult to start (no exhaust smoke)

Cause	Remedy
Electrical isolator not turned on.	Turn isolator on.
Not in Neutral.	Check the FNR lever is in the NEUTRAL position.
No fuel in tank.	Check the level in the fuel tank and replenish as required.
Display gauge not powering up.	• Check battery. • Check main line fuses 30A & 100A. • Check fuses in fuse box behind the steering column plate.
Display powering up but not starting engine.	Check the start inhibit relay behind the steering column plate.
Fuel filter blocked with water or other contamination.	Drain fuel/water separator or replace fuel filter.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump is operating and delivering fuel to the injection pump.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Check the fuel inlet restriction.	Maximum inlet restriction to the fuel transfer pump must not exceed 100mm Hg (4” Hg).
Air intake or exhaust system is blocked.	Visually check the air intake and exhaust intake for blockage or obstruction, remove as required. Check the air filter elements for signs of blocking, replace as required.
Fuel drain return line blocked or not connected properly.	Verify that the fuel return line is not obstructed and connected to the top of the fuel tank.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
Worn or malfunctioning high pressure fuel pump.	Check the electronic fault codes. Do all the necessary fault finding checks before removal of the high pressure fuel pump . Refer to NC for assistance for removal & replacement procedures.

Fault Finding

CHART A2—Dumper will not start or difficult to start (exhaust smoke)

Cause	Remedy
Cold starting aid not working (if fitted).	Check for the correct operation of the cold start advance.
Air intake system blocked or restricted.	Visually check the air intake and exhaust intake for blockage or obstruction, remove as required. Check the air filter elements for signs of blocking-replace as required.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump is operating and delivering fuel to the injection pump.
Fuel is contaminated or incorrect grade of diesel used.	STOP THE ENGINE Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Refer to **Fluids & Lubricants** section for recommended diesel fuels. If the fuel is suspect, verify by operating the engine with clean fuel from a temporary tank. WARNING: Dirty fuel will cause damage to the high pressure fuel pump & injectors.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s). Check fuel lines for restriction.
Fuel drain return line blocked or not connected properly.	Verify that the fuel return line is not obstructed and connected to the top of the fuel tank.
Check the fuel inlet restriction.	Maximum inlet restriction to the fuel transfer pump must not exceed 100mm Hg (4” Hg).
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
Engine compression low in one or more cylinders.	Check the engine compression.
Cranking speed too slow.	Refer to **Chart A3** for possible low cranking speed faults.
Worn or malfunction high pressure fuel pump	Check the electronic fault codes. Do all the necessary fault finding checks before removal of the high pressure fuel pump . Refer to NC for assistance for removal & replacement procedures.

Fault Finding

CHART A3—Engine will not crank or cranks slowly

Cause	Remedy
Starting electrical connections loose or corroded.	Clean and tighten connections.
Battery charge low.	Check battery voltage, charge the battery or replace as required. Make sure that the alternator is functioning correctly and charging the battery.
No electrical connection to the starter solenoid.	Check voltage to solenoid.
Crankshaft rotation restricted.	Manually turn the engine and check for any severe rotational resistance.
Solenoid or starter motor fault.	Replace starter motor.
Starter motor operating but not cranking.	Remove the starter motor and check for broken teeth on the ring gear or broken starter motor spring.

Fault Finding

CHART A4—Engine starts then stops

Cause	Remedy
No fuel supply in tank.	Check the level in the fuel tank and replenish as required.
Engine starting under load.	Check for added loading form malfunctioning accessories or driven units, brakes dragging and other changes in the vehicle loading. Disengage the hydraulic controls.
Air intake or exhaust system is blocked.	Visually check the air intake and exhaust intake for blockage or obstruction-remove as required. Check the air filter elements for signs of blocking, replace as required.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump is operating and delivering fuel to the injection pump.
Fuel is waxing due to extremely cold weather.	Verify by inspecting the fuel filter. Clean the filter and use acclimatised fuel.
Fuel is contaminated or incorrect grade of diesel used.	STOP THE ENGINE Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Refer to **Fluids & Lubricants** section for recommended diesel fuels. If the fuel is suspect, verify by operating the engine with clean fuel from a temporary tank. WARNING: Dirty fuel will cause damage to the high pressure fuel pump & injectors.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s). Check fuel lines for restriction.
Fuel drain return line blocked or not connected properly.	Verify that the fuel return line is not obstructed and connected to the top of the fuel tank.

Fault Finding

CHART A5—Engine poor running

Cause	Remedy
Condition occurs only at idle.	Refer to **Chart A6** for possible poor running at idle faults.
Engine is cold. Coolant temperature sensor fault.	Check the electrical connection at the coolant sensor. Check the correct electrical wires for open or short circuits. Check the electronic fault codes. Test the coolant sensor. If engine will not reach operating temperature refer to **Chart D?.**
Fuel injection lines leaking	Replace defective high pressure fuel lines. **WARNING:** DO NOT repair defective fuel lines. If there is a fuel leak remove and discard the necessary components and install new ones. **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.
Fuel is aerated	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate)	Check that the lift pump operates and delivers fuel to the high pressure fuel pump. Check the correct electrical wires for open or short circuits.
Fuel filter(s) blocked, fuel supply restricted	Check/replace the fuel filter(s). Check fuel lines for restriction.
Fuel is contaminated or incorrect grade of diesel used	STOP THE ENGINE Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Refer to **Fluids & Lubricants** section for recommended diesel fuels. If the fuel is suspect, verify by operating the engine with clean fuel from a temporary tank. WARNING: Dirty fuel will cause damage to the high pressure fuel pump & injectors.
Inlet and exhaust valve clearances set incorrectly	Set the valve clearances to the recommended clearances.
Engine compression low in one or more cylinders	Check the engine compression.
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
Worn or malfunctioning high pressure fuel pump.	Check the electronic fault codes. Do all the necessary fault finding checks before removal of the high pressure fuel pump . Refer to NC for assistance for removal & replacement procedures.
Camshaft or tappets damaged	Inspect camshaft & tappets

Fault Finding

CHART A6—Engine poor running at idle

Cause	Remedy
Coolant temperature sensor fault.	Check the electrical connection at the coolant sensor. Check the correct electrical wires for open or short circuits. Check the electronic fault codes. Test the coolant sensor. If engine will not reach operating temperature refer to **Chart D?.**
Engine mounts over-tightened, damaged or loose.	Verify the condition of the mounts, and replace/adjust as necessary.
Fuel injection lines leaking.	Replace defective high pressure fuel lines. **WARNING:** DO NOT repair defective fuel lines. If there is a fuel leak remove and discard the necessary components and install new ones. **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.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump operates and delivers fuel to the high pressure fuel pump. Check the correct electrical wires for open or short circuits.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s). Check fuel lines for restriction.
Fuel is contaminated or incorrect grade of diesel used.	STOP THE ENGINE Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Refer to **Fluids & Lubricants** section for recommended diesel fuels. If the fuel is suspect, verify by operating the engine with clean fuel from a temporary tank. WARNING: Dirty fuel will cause damage to the high pressure fuel pump & injectors.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.
Engine compression low in one or more cylinders.	Check the engine compression.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
Worn or malfunctioning high pressure fuel pump.	Check the electronic fault codes. Do all the necessary fault finding checks before removal of the high pressure fuel pump . Refer to NC for assistance for removal & replacement procedures.

Fault Finding

CHART A7—Engine excessive noise

Cause	Remedy
Drive belt squeal, insufficient tension or abnormally high loading.	Check the tensioner and inspect the drive belt for deterioration. Make sure the water pump, tensioner pulley, fan and alternator turn freely. Check for paint/oil or other materials on the pulleys. Check the tension of the accessory drive belts.
Coolant temperature sensor fault.	Check the electrical connection at the coolant sensor. Check the correct electrical wires for open or short circuits. Check the electronic fault codes. Test the coolant sensor. If engine will not reach operating temperature refer to **Chart D?.**
Air intake or exhaust leaks.	Refer to **Charts A13 & A14.**
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
Fuel is contaminated or incorrect grade of diesel used.	STOP THE ENGINE Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Refer to **Fluids & Lubricants** section for recommended diesel fuels. If the fuel is suspect, verify by operating the engine with clean fuel from a temporary tank. WARNING: Dirty fuel will cause damage to the high pressure fuel pump & injectors.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances. Make sure the are not bent or the rocker levers are not severely worn.
Turbocharger noise.	Check turbocharger impeller and turbine wheel for housing contact.
Inlet and exhaust valve springs broken.	Check and fit new valve springs.
Worn crank/connecting rod bearings (knocking under load).	Check/replace rod and main bearings.
Excessive camshaft bearing wear.	Check bearings (engine overhaul required).
Worn or damaged pistons and or piston rings.	Check piston assemblies (engine overhaul required).
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
Gear train noise.	Visually inspect and measure gear backlash. Replace gears as required.

Fault Finding

CHART A8—Engine compression knocks

Cause	Remedy
Fuel is aerated.	Check the low pressure fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel is contaminated or incorrect grade of diesel used.	STOP THE ENGINE Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Refer to **Fluids & Lubricants** section for recommended diesel fuels. If the fuel is suspect, verify by operating the engine with clean fuel from a temporary tank. WARNING: Dirty fuel will cause damage to the high pressure fuel pump & injectors.
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
Inlet and exhaust valve springs broken.	Check and fit new valve springs.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
Coolant operating temperature incorrect.	Refer to **Charts D2 & D3.**

Fault Finding

CHART A9—Engine reduced power output

Cause	Remedy
No fuel supply in the tank.	Check the level in the fuel tank and replenish as required.
Oil level incorrect.	Check oil level.
Engine overloaded.	Check for added loading from malfunctioning accessories or driven units, brakes dragging and other changes in vehicle loading. Disengage the hydraulic controls.
Throttle position sensor (TPS) system defective	Check the throttle assembly. Check electronic fault codes.
Fuel is contaminated or incorrect grade of diesel used.	STOP THE ENGINE Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Refer to **Fluids & Lubricants** section for recommended diesel fuels. If the fuel is suspect, verify by operating the engine with clean fuel from a temporary tank. WARNING: Dirty fuel will cause damage to the high pressure fuel pump & injectors.
Turbocharger boost control pipe leaking or damaged, or waste-gate diaphragm ruptured.	Check boost control pressure. Inspect and tighten fittings, repair pipes, replace waste-gate assembly.
Fuel injection lines leaking.	Replace defective high pressure fuel lines. **WARNING:** DO NOT repair defective fuel lines. If there is a fuel leak remove and discard the necessary components and install new ones. **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.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s). Check fuel lines for restriction.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump operates and delivers fuel to the high pressure fuel pump. Check the correct electrical wires for open or short circuits.
Air intake or exhaust system is blocked.	Visually check the air intake and exhaust intake for blockage or obstruction-remove as required. Check the air filter elements for signs of blocking-replace as required.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
Exhaust leak at the manifold or turbocharger (if applicable).	Check/correct leaks in the manifold or turbocharger gaskets. Look for a cracked manifold.
Extra injector sealing washer installed under injector.	Remove extra injector sealing washer.
Inlet and exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.

Fault Finding

CHART A9—Engine reduced power output (continued)

Cause	Remedy
Worn or malfunctioning high pressure fuel pump.	Check the electronic fault codes. Do all the necessary fault finding checks before removal of the high pressure fuel pump . Refer to NC for assistance for removal & replacement procedures.
Engine compression low in one or more cylinders.	Check the engine compression.

Fault Finding

CHART A10—Engine will not reach maximum rpm

Cause	Remedy
Tachometer faulty (if fitted).	Verify the engine speed with a hand held tachometer. Measure on the fan drive pulley and this will be the engine rpm.
Engine overloaded.	Verify high idle speed without load. Investigate operation to ensure correct gear is being used.
Throttle position sensor (TPS) system defective	Check the throttle assembly. Check electronic fault codes.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
Fuel lift pump not operating correctly (fuel supply inadequate).	Check that the lift pump operates and delivers fuel to the high pressure fuel pump. Check the correct electrical wires for open or short circuits.
Fuel is contaminated or incorrect grade of diesel used.	STOP THE ENGINE Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Refer to **Fluids & Lubricants** section for recommended diesel fuels. If the fuel is suspect, verify by operating the engine with clean fuel from a temporary tank. WARNING: Dirty fuel will cause damage to the high pressure fuel pump & injectors.
Fuel filter(s) blocked, fuel supply restricted.	Check/replace the fuel filter(s). Check fuel lines for restriction.
Turbocharger waste-gate actuator diaphragm ruptured.	Repair or replace turbocharger.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
Worn or malfunctioning high pressure fuel pump. .	Check the electronic fault codes. Do all the necessary fault finding checks before removal of the high pressure fuel pump . Refer to NC for assistance for removal & replacement procedures.

Fault Finding

CHART A11—Engine rpm surges

Cause	Remedy
Fuel level low.	Check/fill fuel tank.
Throttle position sensor (TPS) system defective	Check the throttle assembly. Check electronic fault codes.
Fuel injection lines leaking.	Replace defective high pressure fuel lines. **WARNING:** DO NOT repair defective fuel lines. If there is a fuel leak remove and discard the necessary components and install new ones. **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.
Fuel tank cap vent/breather blocked.	Inspect & rectify as required. Replace cap if necessary.
Fuel is aerated.	Check the fuel system for loose connections and possible air ingress points. Rectify and bleed the fuel system.
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
Worn or malfunctioning high pressure fuel pump. .	Check the electronic fault codes. Do all the necessary fault finding checks before removal of the high pressure fuel pump . Refer to NC for assistance for removal & replacement procedures.

Fault Finding

CHART A12—Engine excessive vibration

Cause	Remedy
Engine not running smoothly/missing.	Refer to **Chart A5.**
Oil level over full.	Check oil level.
Fan damaged or accessories faulty.	Check/replace the vibrating component. Refer to correct installation procedure and torque figures.
Fan hub faulty.	Inspect/replace the fan hub. Refer to correct installation procedure and torque figures.
Engine mounts loose or broken.	Check/replace the engine mounts. Refer to correct installation procedure and torque figures.
Inlet & exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.
Engine compression low in one or more cylinders.	Check the engine compression.
Alternator bearing worn or damaged.	Check/replace the alternator.
Flywheel housing misaligned.	Check/replace the flywheel alignment.
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
Drive line components worn or unbalanced.	Check and inspect drive line components, such as prop-shafts. Refer to Page 23 of this manual.

Fault Finding

CHART A13—Engine exhaust smoke excessive (Black smoke)

Cause	Remedy
Engine being lugged down.	Use appropriate gear for the task.
Air intake or exhaust system is blocked.	Visually check the air intake and exhaust intake for blockage or obstruction-remove as required. Check the air filter elements for signs of blocking-replace as required.
Air leak between turbocharger and the intake manifold.	Check/correct leaks in the air crossover tube, hoses, or through holes in the manifold cover.
Intercooler faulty.	Check for blocked cooler matrix.
Exhaust leak at the manifold or turbocharger.	Check/correct leaks in the manifold or turbocharger gaskets. Look for a cracked manifold.
Turbocharger waste-gate faulty.	Repair or replace waste-gate.
Turbocharger malfunction.	Replace turbocharger.
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
Engine compression low in one or more cylinders.	Check the engine compression.

Fault Finding

CHART A14—Engine exhaust smoke excessive (White/Blue smoke)

Cause	Remedy
Improper starting procedure.	Verify the starting procedure.
Fuel is contaminated or incorrect grade of diesel used.	STOP THE ENGINE Replace the fuel filters. Operate the engine with a temporary supply of the correct grade of clean fuel. Refer to **Fluids & Lubricants** section for recommended diesel fuels. If the fuel is suspect, verify by operating the engine with clean fuel from a temporary tank. WARNING: Dirty fuel will cause damage to the high pressure fuel pump & injectors.
Oil level incorrect.	Check oil level.
Diesel or hydraulic oil in sump.	Check oil consistency. If oil contamination is suspected check hydraulic oil pump for leaks past the seal into the engine. Drain, flush and fill with clean oil.
Coolant temperature too low (over cooling). Light blue or white, high speed/light load.	Refer to **Chart D3.**
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
One or more injector worn or malfunctioning. White/blue smoke at operating temperature.	Check the electronic fault codes. Check the electrical connections at the injectors.
Coolant leaking into combustion chamber.	Refer to **Chart D1.**
Leaking valve stem seals. Evident after long idle period then acceleration.	Replace valve seals.
Piston rings not sealing. Evident with persistent blue smoke at all speeds/loads.	Check the engine compression.

Fault Finding

CHART A15—Engine will not shut off

Cause	Remedy
Stop switch or stop switch electrical system failure.	Check the operation of the stop switch. Check the correct electrical wires for open or short circuits.

Fault Finding

CHART B1—Fuel consumption excessive

Cause	Remedy
Additional load on engine.	Check/repair accessories and vehicle components.
Operator technique.	Review operation for correct gear shifts, deceleration and idling.
Fuel Leaks.	Check for external leaks at the fuel tank, fuel lines, filters and lift pump. Replace defective high pressure fuel lines. **WARNING:** DO NOT repair defective fuel lines. If there is a fuel leak remove and discard the necessary components and install new ones. **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.
Intake air or exhaust leaks.	Refer to **Charts A13 & A14.**
Engine compression low in one or more cylinders.	Check the engine compression.
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
Inlet & exhaust valve clearances set incorrectly.	Set the valve clearances to the recommended clearances.

Fault Finding

CHART B2—Fuel/Oil leaking from exhaust manifold

Cause	Remedy
Operating for extended periods under light or no load.	Review operation for correct gear shifts, deceleration and idling.
Intake air or exhaust leaks.	Refer to **Charts A13 & A14.**
Turbocharger lubricating oil drain line obstructed.	Check/clean line.
Exhaust leak at the manifold or turbocharger.	Check/correct leaks in the manifold or turbocharger gaskets. Look for a cracked manifold.
Valve guide seals are leaking.	Replace valve guide stem seals as required.
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.

Fault Finding

CHART C1—Lubricating Oil consumption excessive

Cause	Remedy
Oil leaks.	Inspect the engine for visible signs of leaks. Pay particular attention to the seals, gaskets, oil cooler and external connections.
Oil level over full.	Check oil level.
Incorrect lubricating oil. (specification of viscosity).	Make sure the correct lubricating oil is being used, Refer to **Fluids & Lubricants** section. Look for reduced viscosity from dilution with fuel. Fuel dilution in lubricating oil can originate from fuel injection pump driveshaft seal or fuel transfer pump. Review/reduce the lubricating oil change intervals.
Crank case ventilation (CCV) system blocked	Check the breather tube area for signs of lubricating oil loss. Check and if necessary replace the CCV filter.
Lubricating oil cooler leak.	Check for lubricating oil in coolant.
Turbocharger leaking lubricating oil into the air intake or exhaust.	Inspect the air crossover tube for evidence of lubricating oil transfer.
Valve guide seals are leaking.	Replace valve guide stem seals as required.
Piston rings not sealing. Lubricating oil being consumed by the engine. (Blue smoke from the exhaust).	Check engine compression.
Worn cylinder bores. Lubricating oil being consumed by the engine. (Blue smoke from the exhaust).	Check engine compression.
Glazed cylinder bores.	De-glaze bores as required.

Fault Finding

CHART C2—Lubricating Oil contaminated

Cause	Remedy
Coolant in the lubricating oil, internal engine component leaks.	Refer to **Chart D1.**
Lubricating oil sludge excessive.	Change oil & filter. Review/reduce the lubricating oil change intervals. If operating in arduous conditions change oil more frequently. Make sure the correct lubricating oil is being used, Refer to **Fluids & Lubricants** section.
Fuel in the lubricating oil, engine operating too cold.	Review the operation for excessive idling resulting in the engine running below normal temperature.
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.
	Have an oil sample analysed. Repair engine as required

Fault Finding

CHART C3—Lubricating Oil pressure low

Cause	Remedy
Oil level incorrect.	Check oil level.
Incorrect lubricating oil. (specification of viscosity).	Make sure the correct lubricating oil is being used, Refer to **Fluids & Lubricants** section. Look for reduced viscosity from dilution with fuel. Fuel dilution in lubricating oil can originate from fuel injection pump driveshaft seal or fuel transfer pump. Review/reduce the lubricating oil change intervals.
Pressure switch or gauge fault.	Verify the pressure switch is functioning correctly.
Lubricating oil filter blocked.	Change lubricating oil filter. Review/reduce the lubricating oil change intervals. If operating in arduous conditions change oil more frequently.
Lubricating oil filter drain down valve not fitted.	Change lubricating oil filter.
Suction tube loose or broken seal leaking.	Check/replace seal.
Oil pump pressure relief valve stuck open.	Replace oil pump assembly
Lubricating oil pump worn.	Replace oil pump assembly

Fault Finding

CHART C4—Lubricating Oil pressure high

Cause	Remedy
Incorrect lubricating oil. (specification of viscosity).	Make sure the correct lubricating oil is being used, Refer to **Fluids & Lubricants** section. Look for reduced viscosity from dilution with fuel. Fuel dilution in lubricating oil can originate from fuel injection pump driveshaft seal or fuel transfer pump. Review/reduce the lubricating oil change intervals.
Pressure switch or gauge fault.	Verify the pressure switch is functioning correctly.
Engine running too cold.	Refer to **Chart D3.**
Oil pump pressure relief valve stuck closed.	Replace oil pump assembly.

Fault Finding

CHART D1—Coolant loss

Cause	Remedy
Incorrect coolant level.	Check the level.
Coolant leaking from engine radiator.	Visually inspect the radiator hoses and connections to locate the leak. If oil is present in the coolant, check for an engine oil cooler leak.
External engine coolant leak.	Visually inspect the engine and components for seal, gasket or hose connection leaks. Make sure all hose clips are in good condition and torqued to the recommended figure.
Overheating or compression gasses leaking, resulting in loss through the radiator overflow.	Refer to **Chart D2.**
Lubricating oil cooler leak.	Check/replace the oil cooler. Look for coolant in the oil.
Cylinder head gasket leak.	Check/replace the head gasket.
Cylinder head cracked or porous.	Check/replace the head.
Cylinder block coolant passages leaking.	Check/replace the cylinder block.

Fault Finding

CHART D2—Coolant over temperature

Cause	Remedy
Incorrect coolant level.	Check the level. Ensure low level is not a result of a coolant leak. Refer to **Chart D1.**
Radiator matrix blocked with dirt or chaff.	Clean radiator matrix.
Air flow to the radiator restricted	Clean the mesh grill on the bonnet. Check/repair the fan shroud, anti recirculation sealing. Check fan blades replace if necessary.
Coolant pump or fan drive belts loose.	Check/correct the belt tension.
Radiator hose collapsed, restricted or leaking.	Check/replace hose.
Oil level over full.	Check oil level.
Cooling system pressure cap incorrect or faulty.	Check/replace cap.
Over concentration of antifreeze.	Remove some of the coolant from the system and replace with water.
Temperature gauge sensor faulty.	Verify that the gauge and temperature sensor are correct.
Thermostat faulty, incorrect or missing.	Check/replace thermostat.
Air or combustion gasses in the cooling system.	Make sure the fill rate is not exceeded and the correct vented thermostat is installed. If aeration is continued check for a compression leak through the head gasket.
Coolant pump faulty.	Check routing and operation of vent line.
Vent line from engine and or radiator blocked or incorrectly routed. (sudden overheating).	Check routing and operation of vent line.
Cooling passages in radiator, cylinder head, head gasket or block blocked.	Flush the system and fill with clean coolant.
ECU or electrical sensor fault.	Check the electronic fault codes. Check the electrical connections at the ECU and sensors.
One or more injector worn or malfunctioning.	Check the electronic fault codes. Check the electrical connections at the injectors.

Fault Finding

CHART D3—Coolant under temperature

Cause	Remedy
Air flow across radiator excessive.	Check/repair the louvers grill on the bonnet. Check/repair the fan shroud, anti recirculation sealing. Check fan blades replace if necessary.
Temperature gauge sensor faulty.	Verify that the gauge and temperature sensor are correct.
Thermostat faulty, open (not sealing)	Check/replace thermostat.
Coolant not flowing by temperature sensor. A total coolant loss may result in the gauge showing a low temperature initially.	Check coolant level. Check/clean coolant passages.

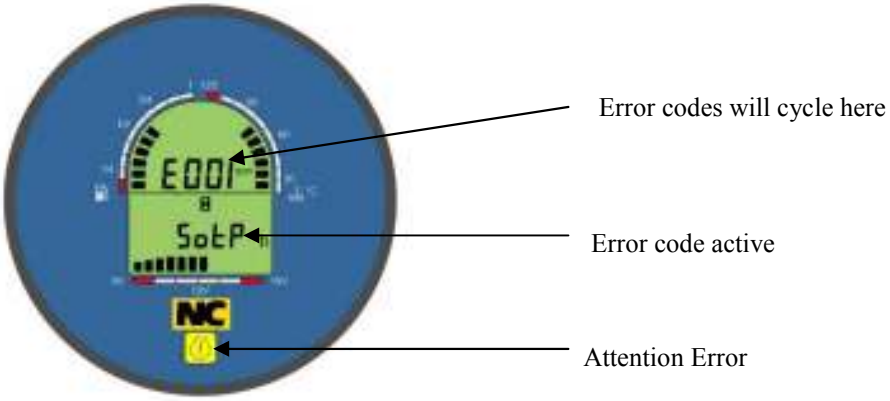
CHART D4—Coolant contaminated

Cause	Remedy
Coolant rusty, operating without the correct mixture of antifreeze and water.	Drain and flush the cooling system. Fill with the correct mixture of antifreeze and water. Review the coolant interval change.
Engine oil cooler, or cooler housing allowing cross contamination of coolant with engine oil.	Remove the oil cooler assembly and check relevant sealing elements for damage.
Lubricating oil leaks from lubricating oil cooler, head gasket, head and cylinder block.	Refer to **Chart D1.**

Fault Finding

Electronic Fault codes

The dumper is fitted with a CAN enabled instrument display unit. If an electronic fault occurs this information with be visible on the instrument. If an ECU sends an error message the attention light at the bottom of the display will be illuminated, the hour meter will rear StoP and the error codes will be cycled up to a maximum of 10 codes at 1 second intervals.



All codes can be accessed via a suitable laptop computer running the applicable diagnostics software. The computer must be connected to the dumper via the CANbus socket (located under the floor panel) using the correct Data Link Adapter (DLA).

The ECU incorporates a data logging feature, so should faults occur they will be logged into the ECU memory.

CHART E1— Fault codes

Fault Code	Description
E001	Engine ECU warning
E002	Engine speed (crankshaft position) sensor - data erratic (target disc tooth signal missing)
E004	Fuel timing pressure sensor (ECU) circuit fault - voltage below normal or shorted low
E008	Inlet manifold air pressure sensor (TMAP) fault - voltage above normal or shorted high
E009	Inlet manifold air pressure sensor (TMAP) fault - voltage below normal or shorted low
E010	Throttle pedal position sensor fault - voltage above normal or shorted high
E011	Throttle pedal position sensor fault - voltage below normal or shorted low
E012	Hand throttle position sensor fault - voltage above normal or shorted high
E013	Hand throttle position sensor fault - voltage below normal or shorted low
E017	Engine coolant temperature sensor fault - voltage above normal or shorted high
E018	Engine coolant temperature sensor fault - voltage below normal or shorted low
E023	Inlet manifold air temperature sensor (TMAP) fault - voltage above normal or shorted high
E024	Inlet manifold air temperature sensor (TMAP) fault - voltage below normal or shorted low
E027	Sensor supply voltage circuit fault - voltage below normal or shorted low

Fault Finding

CHART E1— Fault codes (continued)

Fault Code	Description
E047	Fuel temperature sensor fault - voltage above normal or shorted high
E049	Fuel temperature sensor fault - voltage below normal or shorted low
E051	High pressure fuel solenoid valve number 1 fault - voltage below normal or shorted low
E052	High pressure fuel solenoid valve number 1 fault - voltage above normal or shorted high
E055	High pressure fuel solenoid valve number 1 fault - valve not responding correctly
E068	Engine control module (ECU) internal temperature sensor fault - voltage above normal or shorted high
E069	Engine control module (ECU) internal temperature sensor fault - voltage below normal or shorted low
E076	Injector solenoid valve fault, cylinder 1 - current above normal or grounded circuit
E078	Injector solenoid valve fault, cylinder 3 - current above normal or grounded circuit
E080	Injector solenoid valve fault, cylinder 2 - current above normal or grounded circuit
E082	Injector solenoid valve fault, cylinder 4 - current above normal or grounded circuit
E083	Injector solenoid valve fault, cylinder 1 - current below normal or open circuit
E085	Injector solenoid valve fault, cylinder 3 - current below normal or open circuit
E089	Injector solenoid valve fault, cylinder 2 - current below normal or open circuit
E090	Injector solenoid valve fault cylinder 4 - current below normal or open circuit
E091	Engine ECU fault - data erratic
E095	Sensor supply voltage 1 (+5V) fault - voltage below normal or shorted low
E096	Fuel pump control module fault - voltage above normal or shorted high
E097	Fuel pump control module fault - voltage below normal or shorted low
E098	Fuel pump control module CAN fault - pump not responding correctly
E104	Fuel pump control module idle fault - data erratic
E111	Inlet manifold heater - relay enable fault
E114	Sensor supply voltage 1 (+5V) fault - voltage above normal or shorted high
E119	Water in fuel detected - no fault data only
E122	Water in fuel indicator fault - voltage above normal or shorted high
E123	Water in fuel indicator fault - voltage below normal or shorted low
E126	Inlet manifold air pressure sensor (TMAP) fault - data erratic
E127	Power supply fault - data erratic
E129	Battery voltage fault - data below normal level
E130	Battery voltage fault - data above normal level
E133	High pressure fuel pump mechanical system not responding
E134	Injector metering rail pressure sensor fault - voltage above normal or shorted high
E135	Injector metering rail pressure sensor fault - voltage below normal or shorted low

Fault Finding

CHART E1— Fault codes (continued)

Fault Code	Description
E138	Fuel pump calibration trim circuit fault - calibration fault
E142	Fuel metering solenoid fault
E159	Cylinder power imbalance - data erratic
E700	High pressure fuel pump delivery pressure low - data below normal level
E701	High pressure fuel solenoid valve number 1 fault - data erratic
E702	High pressure fuel pump mechanical system not responding
E703	High pressure fuel pump delivery pressure low - data above normal level
E704	Engine knock sensor fault - abnormal pulse width or frequency
E705	Minimum injector drive pulse drift - cylinder 2 - injector not responding correctly
E706	Minimum injector drive pulse drift - cylinder 1 - injector not responding correctly
E707	Minimum injector drive pulse drift - cylinder 3 - injector not responding correctly
E708	Engine control module main relay fault - relay not responding correctly
E709	Engine coolant temperature validity - no fault temperature sensor data is plausible
E715	Boost pressure validity - no fault, air pressure sensor data is plausible
E716	Throttle pedal position sensor fault - data erratic
E718	Engine position sensor fault (camshaft sensor) - abnormal pulse width or frequency
E719	Engine speed (crankshaft position) sensor fault - no signal
E720	Engine speed (crankshaft position) sensor - data erratic (target disc gap signal missing)
E725	Wiring harness resistance too high or too low, cylinder 4
E726	Wiring harness resistance too high or too low, cylinder 2
E727	Wiring harness resistance too high or too low, cylinder 1
E728	Wiring harness resistance too high or too low, cylinder 3
E729	Engine injector bank 1 (cylinders 2 and 4) - ECU fault
E730	Engine injector bank 2 (cylinders 1 and 3) - ECU fault
E737	Engine knock sensor fault
E738	Hand throttle position sensor fault - data erratic
E745	Minimum injector drive pulse drift - cylinder 4 - injector not responding correctly

Make a note of the occurring fault code(s) and contact NC for further assistance.

Fault Finding

DUMPER GEARBOX

Before commencing any checks make sure that the correct type of transmission fluid has been used and that it is at the correct level.

CHART F1 Lack of Power

Cause	Remedy
1. Poor Engine condition	Check & if necessary repair engine
2. Low oil level	Top up system
3. Worn pump	Check flow and if necessary repair or renew pump
4. Torque converter damage	Check and if necessary repair or renew torque converter
5. Low main line pressure	See fault “Low main line pressure”
6. Clutches slipping	See fault “Low clutch pressure”
7. Internal leakage	Check internal cored galleries and castings for porosity Check condition of seals
8. High stall speeds	See fault “High stall speeds”
9. Low stall speeds	See fault “Low stall speeds”
10. Overheating	See fault “Overheating”

CHART F2 Low Mainline Pressure (in neutral)

Cause	Remedy
1. Worn pump	Check flow and if necessary repair or renew pump
2. Blocked suction strainer	Clean suction strainer
3. Pressure maintaining valve sticking / leaking	Free off or renew valve
4. Oil aerated (foaming)	Internal leaking in cored galleries:- inspect repair transmission Dirty suction strainer:- clean strainer High oil level:- drain to correct level Incorrect grade of oil:- drain then refill with correct oil

CHART F3 High Stall Speeds (in Forward & Reverse)

Cause	Remedy
1. Damaged converter blades	Check and if necessary renew converter
2. Clutches slipping	See fault “Low clutch pressure”
3. Internal leakage	Check internal cored galleries and castings for porosity Check condition of seals

Fault Finding

DUMPER GEARBOX

CHART F4 Low Stall Speeds (in Forward & Reverse)

Cause	Remedy
1. Poor engine condition	Check and if necessary repair engine
2. Torque converter reaction member clutch slipping	Check and if necessary renew torque converter

CHART F5 Low Converter Out Pressure

Cause	Remedy
1. Low mainline pressure	See fault “Low mainline pressure”
2. Converter internal leakage	Check and if necessary renew converter
3. Converter relief valve faulty	Check and if necessary repair relief valve
4. Restriction in converter feed	See fault “Overheating” point 10

CHART F6 Low Pump Flow

Cause	Remedy
1. Low oil level	Top up system
2. Blocked suction strainer	Clean suction strainer
3. Worn Pump	Repair or renew pump

CHART F7 High Converter Out Pressure

Cause	Remedy
1. Oil cooler / lines blocked	Clean cooler / free blockage
2. Converter in pressure incorrect	Check converter in pressure correct
3. Converter relief valve faulty	Check and if necessary repair relief valve

Fault Finding

DUMPER GEARBOX

CHART F8 Low Lubricant Pressure

Cause	Remedy
1. Low mainline pressure	See fault “Low mainline pressure”
2. Oil cooler / lines blocked	Clean cooler / free blockage
3. Ruptured lubrication line	Repair line
4. Converter internal leakage	Check & if necessary renew converter
5. Converter relief valve faulty	Check & if necessary repair or renew relief valve
6. Leak at pump to case joint (indicated by low cooler flow)	Check and if necessary repair or replace
7. Restriction in converter feed	See fault “Overheating” point 10

CHART F9 Low Clutch Pressure and/or Clutch Slipping

Cause	Remedy
1. Low mainline pressure	See fault “Low mainline pressure”
2. Worn Pump	Check flow and if necessary repair or renew pump
3. Blocked restrictor orifice in F/R solenoid valve block (both F/R clutches will indicate low pressure	Remove F/R solenoid and clear restriction in solenoid valve block
4. Clutch seals worn	Confirm with a clutch leak test, if required renew clutch seals
5. Clutch piston rings worn	Confirm with a clutch leak test, renew piston rings
6. Mechanical failure	Strip & rebuild clutch, renew parts as required

CHART F10 Low Cooler Flow

Cause	Remedy
1. Converter relief valve faulty	Check & if necessary repair or renew relief valve
2. Leak at pump to case joint	Check and if necessary repair or replace
3. Worn pump	Check flow and if necessary repair or renew pump
4. Internal leakage	Check internal cored galleries and castings for porosity Check condition of seals
5. Restriction in converter feed	See fault “Overheating” point 10

Fault Finding

DUMPER GEARBOX

CHART F11 Overheating

Cause	Remedy
1. Low oil level	Top up system
2. High oil level	Drain to correct level
3. Trapped or kinked hoses in cooler system	Renew or repair hoses
4. Low converter out pressure and flow rate	Repair or renew the converter relief valve
5. Oil cooler blocked	Clean cooler
6. Operating in wrong gear range	Select correct gears to suit working conditions
7. Water system overheating	Rectify water system problems, e.g. radiator, cooler lines, low water level, etc
8. Oil aerated (foaming	See fault “Low main line pressure” point 4
9. Clutch pistons sticking on return stroke	Check repair clutch piston(s) and seal(s)
10. Cored galleries on front housing pump mounting face wrong depth. (indicated by excessively low pressure and flow on converter out cooling line)	Replace front housing or rectify existing housing
11. Leakage across pump mounting face and front case	Check for damaged surface on both components and loose pump mounting bolts

Fault Finding

CHART G1—Dumper gearbox

Cause	Remedy
Dumper will not drive forward/reverse.	Check handbrake released. Check FNR lever engaged. Check fuses. Check drive inhibit relay. Check forward & reverse relays Check operation of solenoid valve on top of the gearbox Check selector lever is engaging the gears on the gearbox turret Check handbrake sensor switch Check transmission oil level

A If the transmission is noisy start at check 1
B If the transmission is overheating start at check 4
C If the transmission will not pull start at check 12
D If there is no drive in one or both directions start at check 17
E If the transmission is jumping out of gear start at check 29
F If the transmission is sticking in gear start at check 39
G If the rations are crash changing start at check 41

	Check	Action
1	Is there noise when selecting direction?	YES: Check 3 NO: Check 2
2	Is there noise when running with direction selector in neutral and ratio selector in 1st?	YES: Check 9 NO: Check 19
3	Is there air in the hydraulic system?	YES: continue running to expel air NO: Check 4
4	Is the fluid level correct?	YES: Check 5 NO: Check level only when machine is cold & top up as required
5	Are the oil passages restricted?	YES: Clear the restriction NO: Check 6
6	Is the suction strainer restricted?	YES: Remove & clean strainer NO: Check 7
7	Is pump pressure as specified?	YES: Check 9 NO: Check clutch pressure maintenance valve is free to operate
8	When flow testing pump is output low?	YES: Renew pump NO: Check converter sprag clutch for wear or slip

Fault Finding

CHART G1—Dumper gearbox (continued)

	Check	Action
9	Does the noise continue when the direction selector is in forward or reverse?	YES: Check 10 NO: Check 11
10	Is the transmission misaligned?	YES: Renew mountings and check position. NO: Check "converter out" pressure and flow.
11	Are the pump brushes worn?	YES: Renew NO: Check converter for wear & cooler for restriction to flow.
12	Is the transmission not pulling in one direction only?	YES: Check 16 NO: Check 13
13	Is the transmission not pulling in both forward & reverse?	YES: Stall test machine & Check 14. NO Check 16
14	Is converter pressure as specified?	YES: Check 15 NO: Inspect converter relief valve for damage . Check cooler bypass valve pressure setting.
15	Is pump being driven by converter?	YES: Check pump pressure. NO: Renew damaged parts.
16	Are clutch sealing rings damaged?	YES: Tap pressure gauge into clutch feed lines to monitor pressure. NO: Check clutch plates for damage.
17	Is there drive in one direction only?	YES: Check 19 NO: Check 18
18	Is the start switch in the run position and supplying current to the neutral start relay?	YES: Check 19 NO: Rectify
19	Is the fault only when the transmission is hot?	YES: Dismantle solenoid and check components. NO: Check micro-switches, relays and wiring loom.
20	Is the noise a growl, hum or grinding?	YES: Check gears for damage/wear. NO: Check 21
21	Is the noise a hiss, thump or bumping?	YES: Check bearings for damage/wear NO: Check 22
22	Is the noise a squeal?	YES: Check free running gears for seizure. NO: Check 23
23	Is the noise present when in neutral or when in gear	NEUTRAL: Check 24 IN GEAR: Check 27

Fault Finding

CHART G1—Dumper gearbox (continued)

	Check	Action
24	Is the counter shaft or it bearings worn or damaged?	YES: Renew damaged parts. NO: Check 25
25	Is there excessive backlash in the gears?	YES: Adjust by checking shaft end float. NO: Check 26
26	Is the main shaft pilot bearing worn?	YES: Renew. NO: Check gear teeth for scuffing.
27	Is the main-shaft rear bearing worn?	YES: Renew NO: Check 28
28	Are the sliding gear teeth worn or damaged?	YES: Renew gears NO: Check 29
29	Are the selector forks loose?	YES: Tighten screws NO: Check 30
30	Are the selector fork pads or grooves in gears worn?	YES: Renew worn parts NO: Check 31
31	Are dog teeth gear worn?	YES: Renew NO: Check 32
32	Are selector rod detent springs broken?	YES: Renew NO: Check 33
33	Are the selector rods worn or broken?	YES: Renew NO: Check 34
34	Are the selector fork pads out of position?	YES: Reposition or renew. (check interlock) NO: Check 35
35	Is there excessive end float in gears or shafts?	YES: Adjust NO: Check thrust washers and mating faces.
36	Is the synchroniser bronze worn?	YES: Renew synchro pack. NO: Check 37
37	Are steel chips embedded in the bronze?	YES: Continue using, chips will either embed blow bronze or be rejected NO: Check 38
38	Are the synchroniser components damaged?	YES: Renew NO: Check free running gears for seizure or damage.
39	Are the sliding gears tight on the splines?	YES: Free or renew NO: Check 40

Fault Finding

CHART G1—Dumper gearbox (continued)

	Check	Action
40	Are chips wedged between splines of shaft or gear?	YES: Remove chips NO: Ensure that clutch is disengaged when dump pedal is pressed.
41	Are steel chips embedded in the bronze?	YES: Continue using, chips will either embed blow bronze or be rejected. NO: Check 42
42	Are the synchroniser spring pins damaged?	YES: Renew synchro. NO: Check 43
43	Is the synchroniser bronze worn?	YES: Renew synchro. NO: Check block pins.

Fault Finding

Transmission Oil Contaminated with water

Carefully inspect the gearbox for signs of water contamination. Contaminated oil will contain water droplets or be visibly emulsified. Water droplets may be visible on the dipstick or inside the filler tube. For oil analysis purposes the maximum permissible water content of the oil is 0.10%

If the transmission has be contaminated with water, faults or damage to the gearbox may be apparent as a result. Before remedying, thoroughly investigate and rectify the cause of the water contamination.

CHART H1— Transmission Oil Contaminated with water

Cause	Remedy
1. Water ingress during filling topping up.	Carry out flushing procedure. Refill with the recommended grade of oil.
2. Missing / Incorrect dipstick or damaged filler tube.	Renew missing / incorrect / damaged components. Carry out flushing procedure. Refill with the recommended grade of oil.
3. Machine operated in deep water.	Carry out flushing procedure. Refill with the recommended grade of oil.
4. Gearbox casings damaged.	Inspect & renew damaged components. Carry out flushing procedure. Refill with the recommended grade of oil.
5. Gearbox oil circuit pipes / hoses damaged.	Inspect & renew damaged components. Carry out flushing procedure. Refill with the recommended grade of oil.

Gearbox faults caused typically by water contamination and other factors related to the transmission oil..

Fault	Possible Cause	Remedy
Pressurisation of gearbox casing– dipstick blows out / oil leaking from dipstick tube.	Water in oil combined with heat from torque converter causes steam.	Replace / renew dipstick. Carry out flushing procedure. Refill with recommended grade of oil.
	Gearbox overfilled with oil.	Drain the oil level to the correct level See page 23
Clutch failure—Friction lining separation.	Water ingress.	Renew friction plates. Carry out flushing procedure. Refill with recommended grade of oil.
	Overheating transmission oil.	See fault finding table E11.
Badly worn / noisy bearings.	Water ingress.	Fit new bearings. Carry out flushing procedure.
	Insufficient lubrication.	Refill with recommended grade of oil.

Fault Finding

Transmission Oil Contaminated with water (continued)

If the transmission cooler becomes contaminated due to the ingress of water, stop the engine immediately. Drain oil from the transmission sump and external cooler circuit into a suitable container.

Caution: The oil could be hot, avoid contact with the skin to prevent scalds

INSPECTION

Inspect the transmission generally for visible means of water entry into the system.

Disconnect the transmission cooler circuit and clean thoroughly. The transmission cooler is a possible source of water contamination and should be tested for a possible failure as follows;

COOLER TEST PROCEDURE

1. Remove the cooler from its mounting.
2. Drain the remaining oil/water from the cooler.
3. Connect an air supply to the transmission oil inlet connection and plug & seal the outlet.
4. Submerge the cooler in a tank of water and apply air pressure to test for leakage. If bubbles are visible the integrity of the cooler has broken down and the cooler should be scrapped. **(NOTE: air pressure not to exceed 6 Bar)**
5. It the cooler is not damaged, it should be cleaned and dried ready for reassembly into the transmission.

After refilling the transmission with new oil, and the engine and transmission have returned to normal working temperatures, the operator should periodically stall the torque converter for up to 5 second intervals to remove trapped water. To stall the torque converter see below.

STALLING THE TORQUE CONVERTER

1. Apply the foot brake firmly. If necessary set the machine against a fixed obstruction.
2. Select 4th gear forward and open the throttle fully.

Caution: DO NOT stall the converter for more than 10 seconds maximum. If contamination is severe (oil still visibly emulsified) repeat the drain/fill procedure before returning the machine to service.

Fault Finding

Transmission Oil Contaminated with water (continued)

FLUSHING PROCEDURE

1. Reconnect the hoses on the cooler. Ensure the joints are clean and leak-proof.
2. Renew the oil filter.
3. Refill the transmission circuit with the recommended grade of oil.
4. Start the engine and continue running for several minutes to reach normal operating temperature.
5. Stall the torque converter for 5 seconds.
6. Continue running the engine for 5 minutes.
7. Repeat the torque converter stall for 5 seconds.
8. Continue this procedure for a period of up to 30 minutes, if possible during machine operation.
9. Drain the oil & fit a new filter. Test the oil for contamination.
10. Refill the transmission circuit with the recommended grade of oil.

NOTE: If the oil drained at step 9 is clean and free from water contamination - return the dumper to working operations. If not repeat the flush and fill procedure.

GENERAL PROCEDURE

Between 50 & 100 hours operating time after cooler failure, drain the transmission cooler circuit and refill with the recommended grade of oil and renew the oil filter.
Oil should no longer show evidence of water contamination. Further sampling should be carried out if in doubt.