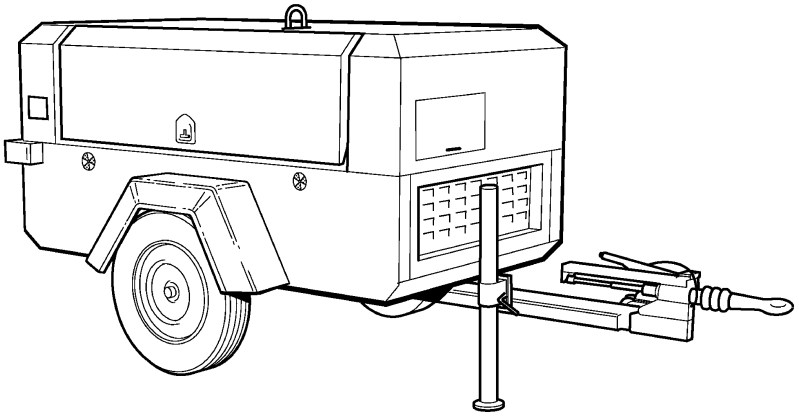
Doosan Infracore
Portable Power

7/71, 12/56

OPERATION AND MAINTENANCE MANUAL

Original Instruction



This manual contains important safety information and must be made available to personnel who operate and maintain this machine.

7/71, 12/56	SERIAL No :	520560 –>

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1 CONTENTS

2 FOREWORD

3 WARRANTY

6 DECALS

9 SAFETY

12 GENERAL INFORMATION
Dimensions
Data

14 OPERATING INSTRUCTIONS
Commissioning
Prior to starting
Starting
Stopping
Emergency stopping
Re−starting
Monitoring during operation
Decommissioning

18 MAINTENANCE
Routine maintenance
Lubrication
Speed & pressure regulation
Torque settings table
Compressor lubrication

30 MACHINE SYSTEMS
Electrical system
Piping & instrumentation system

35 FAULT FINDING

37 OPTIONS

Lubricator.
Safety.
General Information.
Operating Instructions.
Maintenance.
Fault Finding.

Generator.
Safety.
General Information.
Operating Instructions.
Maintenance.
Fault Finding.

45 ENGINE INSTRUCTION MANUAL

ABBREVIATIONS & SYMBOLS

####	Contact Doosan for serial number
–>####	Up to Serial No.
####–>	From Serial No.
*	Not illustrated
†	Option
AR	As required
BR	Brazil
CN	China
DE	Germany
DK	Denmark
ES	Spain
FI	Finland
FR	France
GB	Great Britain (English)
HA	High ambient machine
IT	Italy
NL	Holland
NO	Norway
PT	Portugal
SE	Sweden
US	United States
F.H.R.G.	Fixed height running gear
V.H.R.G.	Variable height running gear

The contents of this manual are considered to be proprietary and confidential and should not be reproduced without the prior written permission of the company.

Nothing contained in this document is intended to extend any promise, warranty or representation, expressed or implied, regarding the products described herein. Any such warranties or other terms and conditions of sale of products shall be in accordance with the standard terms and conditions of sale for such products, which are available upon request.

This manual contains instructions and technical data to cover all routine operation and scheduled maintenance tasks by operation and maintenance staff. Major overhauls are outside the scope of this manual and should be referred to an authorised service department.

The design specification of this machine has been certified as complying with EC directives. As a result:

(a) Any machine modifications are strictly prohibited, and will invalidate EC certification.

(b) A unique specification for USA/Canada is adopted and tailored to the territory.

All components, accessories, pipes and connectors added to the compressed air system should be:
. of good quality, procured from a reputable manufacturer and, wherever possible, be of a type approved by the company.
. clearly rated for a pressure at least equal to the machine maximum allowable working pressure.
. compatible with the compressor lubricant/coolant.
. accompanied with instructions for safe installation, operation and maintenance.

Details of approved equipment are available from the company service departments.

The use of repair parts / lubricants / fluids other than those included within the approved parts list may create hazardous conditions over which the company has no control. Therefore the company cannot be held responsible for equipment in which non–approved repair parts are installed.

The company reserves the right to make changes and improvements to products without notice and without incurring any obligation to make such changes or add such improvements to products sold previously.

The intended uses of this machine are outlined below and examples of unapproved usage are also given, however the company cannot anticipate every application or work situation that may arise.

IF IN DOUBT CONSULT SUPERVISION.

This machine has been designed and supplied for use only in the following specified conditions and applications:
. Compression of normal ambient air containing no known or detectable additional gases, vapours. or particles
. Operation within the ambient temperature range specified in the *GENERAL INFORMATION* section of this manual.

. Generation of electricity at 110v (1ph) with centre tap earth, 230v (1ph), 230v (3ph) and 400v (3ph) / 230v (1ph) nominal at 50 Hertz.

The use of the machine in any of the situation types listed in table 1:–
a) Is not approved,
b) May impair the safety of users and other persons, and
c) May prejudice any claims made.

TABLE 1
Use of the machine to produce compressed air for: a) direct human consumption b) indirect human consumption, without suitable filtration and purity checks.
Use of the machine outside the ambient temperature range specified in the *GENERAL INFORMATION SECTION* of this manual.
This machine is not intended and must not be used in potentially explosive atmospheres, including situations where flammable gases or vapours may be present.
Use of the machine fitted with non approved components / lubricants / fluids.
Use of the machine with safety or control components missing or disabled.
Use of the machine for storage or transportation of materials inside or on the enclosure except when contained within the toolbox.
GENERATOR
Use of the generator to supply load(s) greater than those specified.
Use of unsafe or unserviceable electrical equipment connected to the generator.
Use of electrical equipment: (a) Having incorrect voltage and/or frequency ratings. (b) Containing computer equipment and/or similar electronics.

The company accepts no responsibility for errors in translation of this manual from the original English version.

The company, through its distributor, warrants that each item of equipment manufactured by it and delivered hereunder to the initial user will be free of defects in material and workmanship for a period of three (3) months from initial operation or six (6) months from the date of shipment to the initial user, whichever occurs first.

With respect to the following types of equipment, the warranty period enumerated below will apply in lieu of the foregoing warranty period.

A. **Aftercoolers** – The earlier of nine (9) months from date of shipment to or six (6) months from start up by initial user.

B. **Portable Compressors, Portable Generator Sets – 9 Kva through to 550 Kva, Portable Light Towers and Air Dryers** – The earlier of twelve (12) months from shipment to or the accumulation of 2,000 hours of service by the initial user.

2.5 Kva Through to 8 Kva – The earlier of twelve (12) months from shipment to or the accumulation of 2,000 hours of operation by the initial user.

The company will provide a new part or repaired part, at it's sole discretion, in place of any part which is found to be defective in material or workmanship during the period described above. Labor cost to replace the part is the responsibility of the initial user.

C. **Portable Compressor Air Ends** – The earlier of twenty–four (24) months from shipment to or the accumulation of 4,000 hours of service by the initial user. For Air Ends, the warranty against defects will include replacement of the complete Air End, provided the original Air End is returned assembled and all original seals are intact.

C1. **Portable Compressor Airend Limited Extended Warranty** – The earlier of sixty (60) months from shipment to or the accumulation of 10,000 hours of operation by the initial user. This extended warranty is limited to defects in design or defective material or workmanship in rotors, housings, bearings and gears and provided all the following conditions are met:

The original air end is returned assembled and all original seals are intact.

Continued use of genuine Doosan parts, fluids, oils and filters.

Maintenance is performed at prescribed intervals by authorized and properly trained service engineers.

D. **Generator Alternator – 9 Kva through to 550 Kva.** The earlier of twenty–four (24) months from shipment to or the accumulation of 4,000 hours of operation by the initial user.

2.5 Kva Through to 8 Kva – The earlier of twelve (12) months from shipment to or the accumulation of 2,000 hours of operation by the initial user.

E. **Portable Light Tower Alternator** – The earlier of twelve (12) months from shipment to or the accumulation of 2,000 hours of operation by the initial user. Light Source model only, the earlier of twenty–four (24) months from shipment to or the accumulation of 4,000 hours of operation by the initial user.

F. **Platinum Drive Train Extended Warranty** – Platinum drive train warranty is available for the following compressor types.

European built
7/20–7/26E–7/31E–7/41–7/51–7/71–12/56–P65–P90
7/120–9/110–14/85–10/105–14/115–10/125–7/170–12/150

USA built

Model	Serial Code**
P185WJD–T4I	D75
P185WYM–T4I	D76
C185WKUB–T2	D80
P250WJD–T3	D81
P260/HP220WYM–T3	D82
C185SKUB–T2	E04
C185WKUB–T4I	D95

P425–XP375–HP350–P600–HP450–VHP400 WIR (John Deere engines only)

1. The original airend is returned assembled and unopened.
2. Continued use of genuine Doosan parts, fluids, oil and filters.
3. Maintenance is performed at prescribed intervals by authorized and properly trained service engineers.

The company shall be provided with such information as it requires to confirm that these conditions have been complied with.

G. **Construction Tools, (Portable Power range only)** – Twelve (12) months from shipment to initial user. The company will provide a new part or repaired part, at it's sole discretion, in place of any part which is found to be defective in material or workmanship during the period described above. Labour cost to replace the part is the responsibility of the initial user.

H. **Spare Parts** – Six (6) months from date of shipment to the initial user.

The company will provide a new part or repaired part, at its sole discretion, in place of any part that is found to be defective in material and workmanship during the period described above. Such parts will be repaired or replaced without charge to the initial user during normal working hours at the place of business of a distributor authorized to sell the type of equipment involved or other establishment authorized. User must present proof of purchase at the time of exercising warranty.

The above warranties do not apply to failures occurring as a result of abuse; misuse, negligent repairs, corrosion, erosion and normal wear and tear, alterations or modifications made to the product without express written consent; or failure to follow the recommended operating practices and maintenance procedures as provided in the product's operating and maintenance publications.

Accessories or equipment furnished by the company, but manufactured by others, including, but not limited to, engines, tires, batteries, engine electrical equipment, hydraulic transmissions, carriers, shall carry only the manufacturers warranty, which the company can lawfully assign to the initial user.

THE ABOVE WARRANTIES ARE IN LIEU OF ALL OTHER WARRANTIES EXPRESSED OR IMPLIED, (EXCEPT THAT OF TITLE), AND THERE ARE NO WARRANTIES OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.

GENERAL WARRANTY INFORMATION – ESA

			COMMENTS
PORTABLE COMPRESSOR	PACKAGE	12 MONTHS / 2,000 HOURS	COVERS CONTROLS, SWITCHES, SHEET METAL, RADIATOR, OIL COOLER, RECEIVER, PIPEWORK, ELECTRICAL CIRCUIT ETC.
	AIREND	24 MONTHS / 4,000 HOURS	60 MONTHS / 10,000 HOURS. EXTENDED LIMITED WARRANTY AVAILABLE ON MAJOR COMPONENTS. REFER TO OPERATOR'S MANUAL.
	ENGINE	SEE BELOW	

2.5kVA – 8kVA GENERATORS	PACKAGE	12 MONTHS / 2,000 HOURS	CONTACT THE COMPANY FOR WARRANTY (PARTS ONLY NO LABOUR).
	ALTERNATOR	12 MONTHS / 2,000 HOURS	CONTACT THE COMPANY FOR WARRANTY (PARTS ONLY NO LABOUR).
	ENGINE	SEE BELOW	

9kVA – 550kVA GENERATORS	PACKAGE	12 MONTHS / 2,000 HOURS	COVERS CONTROLS, SWITCHES, SHEET METAL, ELECTRICAL CIRCUIT ETC.
	ALTERNATOR	24 MONTHS / 4,000 HOURS	CONTACT THE COMPANY FOR WARRANTY.
	ENGINE	SEE BELOW	

LIGHT TOWER	PACKAGE	12 MONTHS / 2,000 HOURS	COVERS CONTROLS, SWITCHES, SHEET METAL, ELECTRICAL CIRCUIT ETC.
	ALTERNATOR	12 MONTHS / 2,000 HOURS	EXTENDED WARRANTY OF 24 MONTHS / 4,000 HRS. FOR LIGHTSOURCE INTRODUCED 8/16/99.
	ENGINE	SEE BELOW	

ENGINES			
	MONTHS	**HOURS**	**COMMENTS**
CATERPILLAR	12	UNLIMITED	EXTENDED WARRANTY PROVIDED VIA ENGINE SUPPLIER'S OWN APPROVED NETWORK AT TIME OF PURCHASE.
CUMMINS	24	2,000	EXTENDED WARRANTY PROVIDED VIA ENGINE SUPPLIER'S OWN APPROVED NETWORK AT TIME OF PURCHASE.
JOHN DEERE (IN COMPRESSORS)	24	2,000	
(IN GENERATORS)	24	2,000	24 MONTHS / 4,000 HRS. AVAILABLE FROM THE COMPANY WITH USE OF GENUINE DOOSAN PARTS AND OILS AT PRESCRIBED SERVICE INTERVALS. CONTACT THE COMPANY NETWORK.
KUBOTA (North America only)	24	2,000	EXTENDED WARRANTY OF 36 MONTHS / 3,000 HRS. ON MAJOR COMPONENTS, PARTS ONLY, AVAILABLE FROM KUBOTA.
(Western Europe and Oceania)	24	2,000	NO EXTENDED WARRANTY AVAILABLE.
(Central and South America, Asia, Middle East and Africa)	12	1,000	NO EXTENDED WARRANTY AVAILABLE.
YANMAR	24	4,000	PLATINUM EXTENDED DRVETRAIN WARRANTY AVAILABLE UNDER CONDITIONS (SEE PAGE 3)

PARTS			
	MONTHS	**HOURS**	**COMMENTS**
DOOSAN	6	UNLIMITED	PARTS ONLY AVAILABLE FROM THE COMPANY NETWORK.

AIREND EXCHANGE			
	MONTHS	**HOURS**	**COMMENTS**
AIREND	24	4,000	60 MONTHS / 10,000 HRS. AVAILABLE UNDER CONDITIONS.

CONSTRUCTION TOOLS			
	MONTHS	**HOURS**	**COMMENTS**
CONSTRUCTION TOOLS	12	N/A	

NOTE: Actual warranty times may change.
Consult the Manufacturer's warranty policy as shipped with each new product.

Extended Limited Airend Warranty

All machines have the standard airend warranty, – *The earlier of 24 months from shipment to, or the accumulation of 4000 hours of service by the initial user.*

The warranty against defects will include replacement of the complete Airend, provided the original Airend is returned assembled and unopened.

The optional limited warranty is the earlier of 60 months from shipment to, or the accumulation of 10,000 hours of service. The optional warranty is limited to defects in major components (rotors, housings, gears and bearings), and is automatically available when the following conditions are met:

1. The original airend is returned assembled and unopened.

2. Submissions of proof that Doosan fluid, filters and separators have been used. Refer to the Operation and Parts manual for the correct fluids, filters and separator elements required.

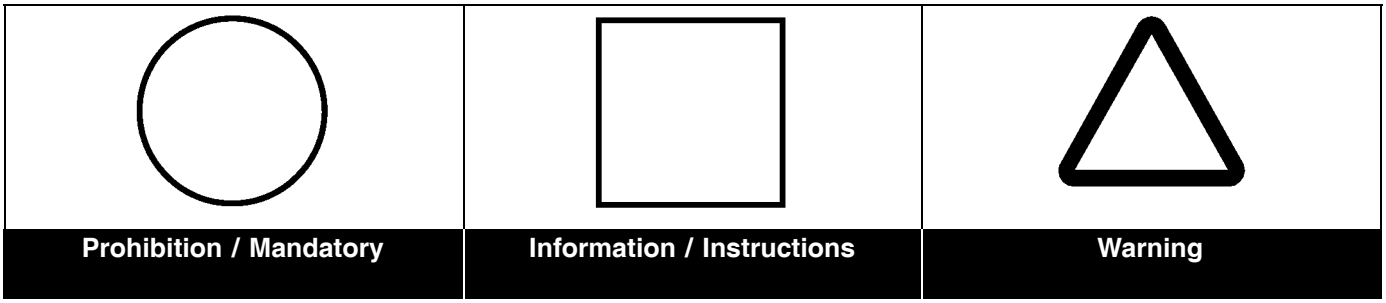
3. Submissions of proof that maintenance intervals have been followed.

WARRANTY	TIME	*BARE AIREND	**AIREND COMPONENTS
STANDARD	2YRS / 4,000HRS	100% PARTS & LABOUR	100% PARTS & LABOUR
OPTIONAL	5YRS / 10,000HRS	100% PARTS & LABOUR	0%

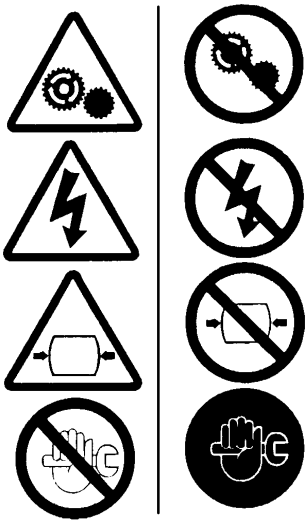
*BARE AIREND – pertains to major airend parts (rotors, housings, gears and bearings).

**AIREND COMPONENTS – pertains to auxiliary attachments to the bare airend (seals, pumps, valves, tubes, hoses, fittings and filter housing).

GRAPHIC FORM AND MEANING OF ISO SYMBOLS



Prohibition / Mandatory	Information / Instructions	Warning
WARNING: Electrical shock risk.	WARNING – Pressurised component or system.	WARNING – Hot surface.
WARNING – Pressure control.	WARNING – Corrosion risk.	WARNING – Air/gas flow or Air discharge.
WARNING – Pressurised vessel.	WARNING – Hot and harmful exhaust gas.	WARNING – Flammable liquid.
WARNING – Maintain correct tyre pressure. (Refer to the **GENERAL INFORMATION** section of this manual).	WARNING – Before connecting the tow bar or commencing to tow consult the operation and maintenance manual.	WARNING – For operating temperature below 0°C, consult the operation and maintenance manual.



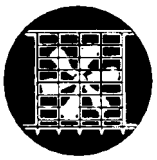
WARNING – Do not undertake any maintenance on this machine until the electrical supply is disconnected and the air pressure is totally relieved.

WARNING – Consult the operation and maintenance manual before commencing any maintenance.

Do not breathe the compressed air from this machine.

Do not remove the Operating and Maintenance manual and manual holder from this machine.

Do not stack.



Do not operate the machine without the guard being fitted.

Do not stand on any service valve or other parts of the pressure system.

Do not operate with the doors or enclosure open.

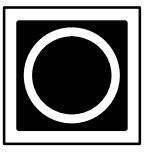
Do not use fork lift truck from this side.

Do not exceed the trailer speed limit.

No naked lights.

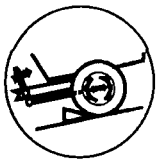
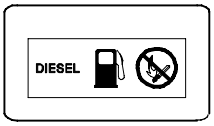
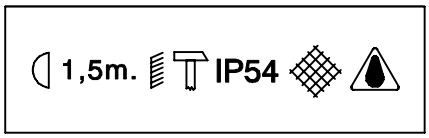
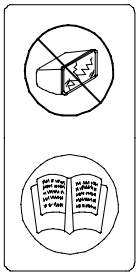
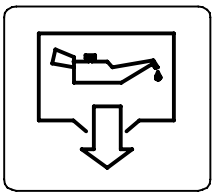
Do not open the service valve before the airhose is attached.

Use fork lift truck from this side only.



Emergency stop.

Tie down point

 Lifting point.	 On (power).	 Off (power).
 Read the Operation and Maintenance manual before operation or maintenance of this machine is undertaken.	 When parking use prop stand, handbrake and wheel chocks.	 Compressor oil filling
 Diesel fuel No open flame.	 Parking brake.	 Rough Service Designation. Wet Location Operation.
 Replace any cracked protective shield.	 Oil drain.	

FREE SAFETY DECALS!

Safety Decals are available **free** of charge.

Decal part numbers are on the bottom of each decal and are also listed in the compressor's parts manual. Submit orders for Safety Decals to the **Doosan Portable Power EMEA Aftermarket Department**. The no charge order should contain only Safety Decals. Help promote product safety! Assure that decals are present on the machines. Replace decals that are not readable.

WARNINGS
Warnings call attention to instructions which must be followed precisely to avoid injury or death.

CAUTIONS
Cautions call attention to instructions which must be followed precisely to avoid damaging the product, process or its surroundings.

NOTES
Notes are used for supplementary information.

General Information

Never operate unit without first observing all safety warnings and carefully reading the operation and maintenance manual shipped from the factory with this machine.

Ensure that the operator reads and *understands* the decals and consults the manuals before maintenance or operation.

Ensure that the Operation and Maintenance manual, and the manual holder, are not removed permanently from the machine.

Ensure that maintenance personnel are adequately trained, competent and have read the Maintenance Manuals.

Make sure that all protective covers are in place and that the canopy/doors are closed during operation.

The specification of this machine is such that the machine is not suitable for use in flammable gas risk areas. If such an application is required then all local regulations, codes of practice and site rules must be observed. To ensure that the machine can operate in a safe and reliable manner, additional equipment such as gas detection, exhaust spark arrestors, and intake *(shut–off)* valves may be required, dependant on local regulations or the degree of risk involved.

A weekly visual check must be made on all fasteners/fixing screws securing mechanical parts. In particular, safety–related parts such as coupling hitch, drawbar components, road–wheels, and lifting bail should be checked for total security.

All components which are loose, damaged or unserviceable, must be rectified without delay.

Air discharged from this machine may contain carbon monoxide or other contaminants which will cause serious injury or death. Do not breathe this air.

This machine produces loud noise with the doors open or service valve vented. Extended exposure to loud noise can cause hearing loss. Always wear hearing protection when doors are open or service valve is vented.

Never inspect or service unit without first disconnecting battery cable(s) to prevent accidental starting.

Do not use petroleum products (solvents or fuels) under high pressure as this can penetrate the skin and result in serious illness. wear eye protection while cleaning unit with compressed air to prevent debris from injuring eye(s).

Rotating fan blade can cause serious injury. Do not operate without guard in place.

Use care to avoid contacting hot surfaces (engine exhaust manifold and piping, air receiver and air discharge piping, etc.).

Ether is an extremely volatile, highly inflammable gas. When it is specified as a starting aid, use sparingly. DO NOT USE ETHER IF THE MACHINE HAS GLOW PLUG STARTING AID OR ENGINE DAMAGE WILL RESULT.

Never operate unit with guards, covers or screens removed. Keep hands, hair, clothing, tools, blow gun tips, etc. well away from moving parts.

Compressed air

Compressed air can be dangerous if incorrectly handled. Before doing any work on the unit, ensure that all pressure is vented from the system and that the machine cannot be started accidentally.

Ensure that the machine is operating at the rated pressure and that the rated pressure is known to all relevant personnel.

All air pressure equipment installed in or connected to the machine must have safe working pressure ratings of at least the machine rated pressure.

If more than one compressor is connected to one common downstream plant, effective check valves and isolation valves must be fitted and controlled by work procedures, so that one machine cannot accidentally be pressurised / over pressurised by another.

Compressed air must not be used for a direct feed to any form of breathing apparatus or mask.

High Pressure Air can cause serious injury or death. Relieve pressure before removing filler plugs/caps, fittings or covers.

Air pressure can remain trapped in air supply line which can result in serious injury or death. Always carefully vent air supply line at tool or vent valve before performing any service.

The discharged air contains a very small percentage of compressor lubricating oil and care should be taken to ensure that downstream equipment is compatible.

If the discharged air is to be ultimately released into a confined space, adequate ventilation must be provided.

When using compressed air always use appropriate personal protective equipment.

All pressure containing parts, especially flexible hoses and their couplings, must be regularly inspected, be free from defects and be replaced according to the Manual instructions.

Avoid bodily contact with compressed air.

The safety valve located in the separator tank must be checked periodically for correct operation.

Whenever the machine is stopped, air will flow back into the compressor system from devices or systems downstream of the machine unless the service valve is closed. Install a check valve at the machine service valve to prevent reverse flow in the event of an unexpected shutdown when the service valve is open.

Disconnected air hoses whip and can cause serious injury or death. Always attach a safety flow restrictor to each hose at the source of supply or branch line in accordance with OSHA Regulation 29CFR Section 1926.302(b).

Never allow the unit to sit stopped with pressure in the receiver–separator system.

Materials

The following substances *may* be produced during the operation of this machine:
. brake lining dust
. engine exhaust fumes

AVOID INHALATION

Ensure that adequate ventilation of the cooling system and exhaust gases is maintained at all times.

The following substances are used in the manufacture of this machine and *may* be hazardous to health if used incorrectly:

. compressor lubricant
. engine lubricant
. preservative grease
. rust preventative
. diesel fuel
. battery electrolyte

AVOID INGESTION, SKIN CONTACT AND INHALATION OF FUMES.

Should compressor lubricant come into contact with the eyes, then irrigate with water for at least 5 minutes.

Should compressor lubricant come into contact with the skin, then wash off immediately.

Consult a physician if large amounts of compressor lubricant are ingested.

Consult a physician if compressor lubricant is inhaled.

Never give fluids or induce vomiting if the patient is unconscious or having convulsions.

Safety data sheets for compressor and engine lubricants should be obtained from the lubricant supplier.

Never operate the engine of this machine inside a building without adequate ventilation. Avoid breathing exhaust fumes when working on or near the machine.

This machine may include such materials as oil, diesel fuel, antifreeze, brake fluid, oil/air filters and batteries which may require proper disposal when performing maintenance and service tasks. Contact local authorities for proper disposal of these materials.

Battery

A battery contains sulphuric acid and can give off gases which are corrosive and potentially explosive. Avoid contact with skin, eyes and clothing. In case of contact, flush area immediately with water.

DO NOT ATTEMPT TO SLAVE START A FROZEN BATTERY SINCE THIS MAY CAUSE IT TO EXPLODE.

Exercise extreme caution when using booster battery. To jump battery, connect ends of one booster cable to the positive (+) terminal of each battery. Connect one end of other cable to the negative (–) terminal of the booster battery and other end to a ground connection away from dead battery (to avoid a spark occurring near any explosive gases that may be present). After starting unit, always disconnect cables in reverse order.

Radiator

Hot engine coolant and steam can cause injury. Ensure that the radiator filler cap is removed with due care and attention.

Do not remove the pressure cap from a HOT radiator. Allow radiator to cool down before removing pressure cap.

Generator sets

The generator set is designed for safety in use. However, the responsibility for safe operation rests with those who install, use and maintain it. The following safety precautions are offered as a guide, which, if conscientiously followed, will minimise the possibility of accidents throughout the useful life of this equipment.

Emergency Stop Controls

Important Note:– In addition to the key operated emergency stop control on the main control panel, a second control is provided at the socket control panel in the event of electrical hazards associated with generator operation. Use this second control to immediately isolate all electrical power to all sockets, then use the key control to stop the engine.

Operation of the generator must be in accordance with recognised electrical codes and local health and safety codes.

The generator set should be operated by those who have been trained in its use and delegated to do so, and who have read and understand the operator's manual. *Failure to follow the instructions, procedures and safety precautions in the manual may increase the possibility of accidents and injuries.*

Do not start the generator set unless it is safe to do so. Do not attempt to operate the generator set with a known unsafe condition. Fit a danger notice to the generator set and render it inoperative by disconnecting the battery and disconnecting all ungrounded conductors so others who may not know of the unsafe condition will not attempt to operate it until the condition is corrected.

An earth point is provided beneath the socket outlets.

The generator set should only be used with the earth point connected directly to the general earth/ground mass. An earth spike kit is available as an optional extra for this purpose (refer to the *parts catalogue*).

WARNING: DO NOT OPERATE THE MACHINE UNLESS IT HAS BEEN SUITABLY EARTHED.

Generator sets must be connected to the load only by trained and qualified electricians who have been delegated to do so, and when required by applicable regulations, their work should be inspected, and accepted by the inspection agency having authority, prior to attempting to operate the generator set.

Do not make contact with electrically energised parts of the generator set and/or interconnecting cables or conductors with any part of the body or with any non–insulated conductive object.

Make sure the generator set is effectively grounded in accordance with all applicable Regulations prior to attempting to make or break load connections and prior to attempting operation.

Do not attempt to make or break electrical connections to generator sets standing in water or on wet ground.

Prior to attempting to make or break electrical connections at the generator set, stop the engine, disconnect the battery and disconnect and lock out the ungrounded conductors at the load end.

Keep all parts of the body and any hand–held tools or other conductive objects, away from exposed live parts of the generator set engine electrical system. Maintain dry footing, stand on insulating surfaces and do not contact any other portion of the generator set when making adjustments or repairs to exposed live parts of the generator set engine electrical system.

Replace the generator set terminal compartment cover as soon as connections have been made or broken. Do not operate the generator set without the terminal cover secured firmly in place.

Close and lock all access doors when the generator set is left unattended.

Do not use extinguishers intended for Class A or Class B fires on electrical fires. Use only extinguishers suitable for class *BC* or class *ABC* fires.

Keep the towing vehicle or equipment carrier, generator set, connecting cables, tools and all personnel at least 3 metres from all power lines and buried power cables, other than those connected to the generator set.

Attempt repairs only in clean, dry, well lighted and ventilated areas.

Connect the generator set only to loads and/or electrical systems that are compatible with its electrical characteristics and that are within it's rated capacity.

Transport

When loading or transporting machines ensure that the specified lifting and tie down points are used.

When loading or transporting machines ensure that the towing vehicle, its size, weight, towing hitch and electrical supply are all suitable to provide safe and stable towing at speeds either, up to the legal maximum for the country in which it is being towed or, as specified for the machine model if lower than the legal maximum.

Ensure that the maximum trailer weight does not exceed the maximum gross weight of the machine (by limiting the equipment load), limited by the capacity of the running gear.

Note:
Gross mass (on data plate) is for the basic machine and fuel only, excluding any fitted options, tools, equipment and foreign materials.

Before towing the machine, ensure that:–

. the tyres and towing hitch are in a serviceable condition.
. the canopy is secure.
. all ancillary equipment is stored in a safe and secure manner.
. the brakes and lights are functioning correctly and meet necessary road traffic requirements.
. break-away cables/safety chains are connected to the towing vehicle.

The machine must be towed in a level attitude (the maximum permissible drawbar angle is between 0° and +5° from horizontal) in order to maintain correct handling, braking and lighting functions. This can be achieved by correct selection and adjustment of the vehicle towing hitch and, on variable height running gear, adjustment of the drawbar.

To ensure full braking efficiency, the front (towing eye) section must always be set level.

When adjusting variable height running gear:–

Ensure front (towing eye) section is set level

When raising towing eye, set rear joint first, then front joint.

When lowering towing eye, set front joint first, then rear joint.

After setting, fully tighten each joint by hand and then tighten further to the next pin. Refit the pin.

When parking always use the handbrake and, if necessary, suitable wheel chocks.

Make sure wheels, tyres and tow bar connectors are in safe operating condition and tow bar is properly connected before towing.

Safety chains / connections and their adjustment

The legal requirements for the joint operation of the breakaway cable and safety chains are as yet unidentified by 71/320/EEC or UK regulations. Consequently we offer the following advice / instructions.

Where brakes only are fitted:

a) Ensure that the breakaway cable is securely coupled to the handbrake lever and also to a substantial point on the towing vehicle.

b) Ensure that the effective cable length is as short as possible, whilst still allowing enough slackness for the trailer to articulate without the handbrake being applied.

Where brakes and safety chains are fitted:

a) Loop the chains onto the towing vehicle using the towing vehicle hitch as an anchorage point, or any other point of similar strength.

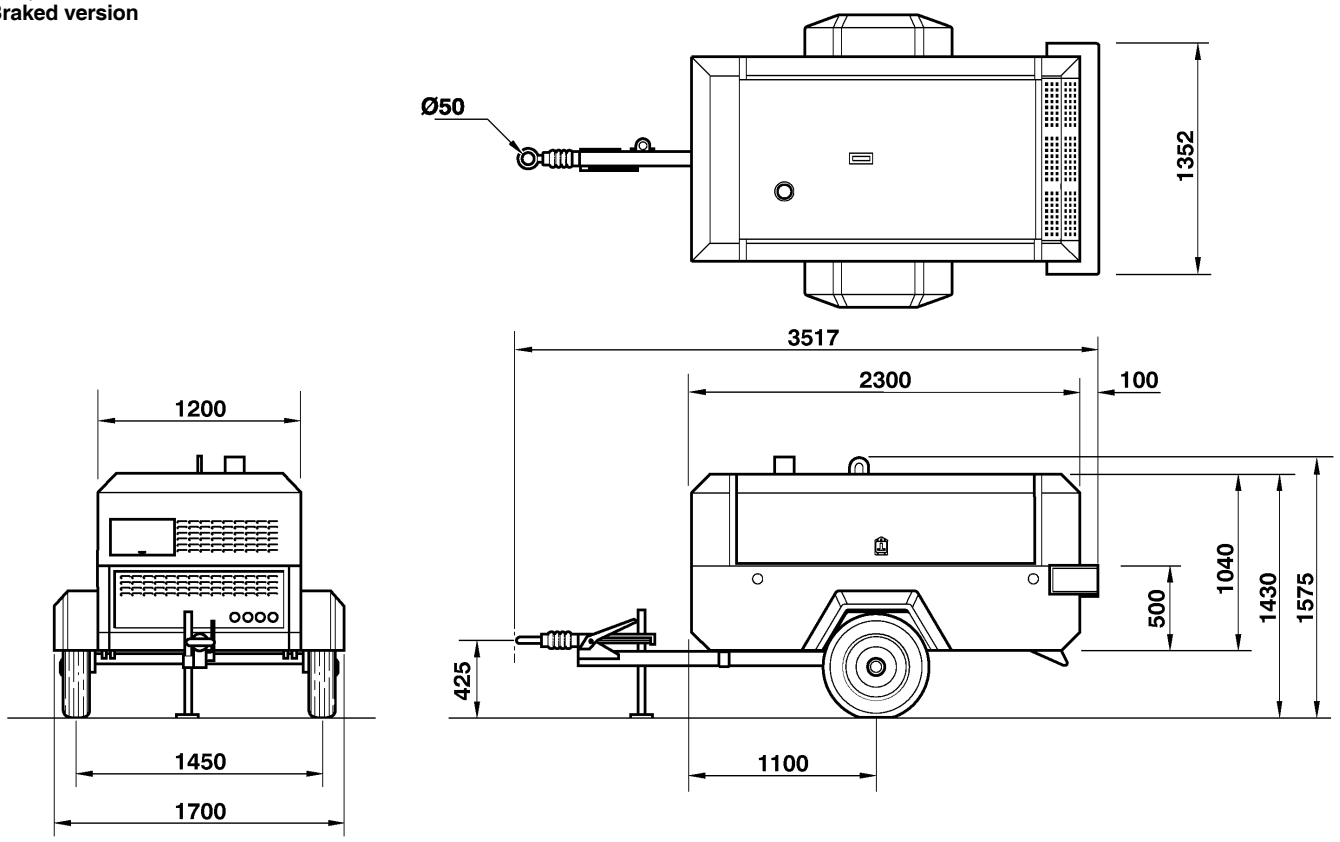
b) Ensure that the effective chain length is as short as possible whilst still allowing normal articulation of the trailer and effective operation of the breakaway cable.

Where safety chains only are fitted:

a) Loop the chains onto the towing vehicle using the towing vehicle hitch as an anchorage point, or any other point of similar strength.

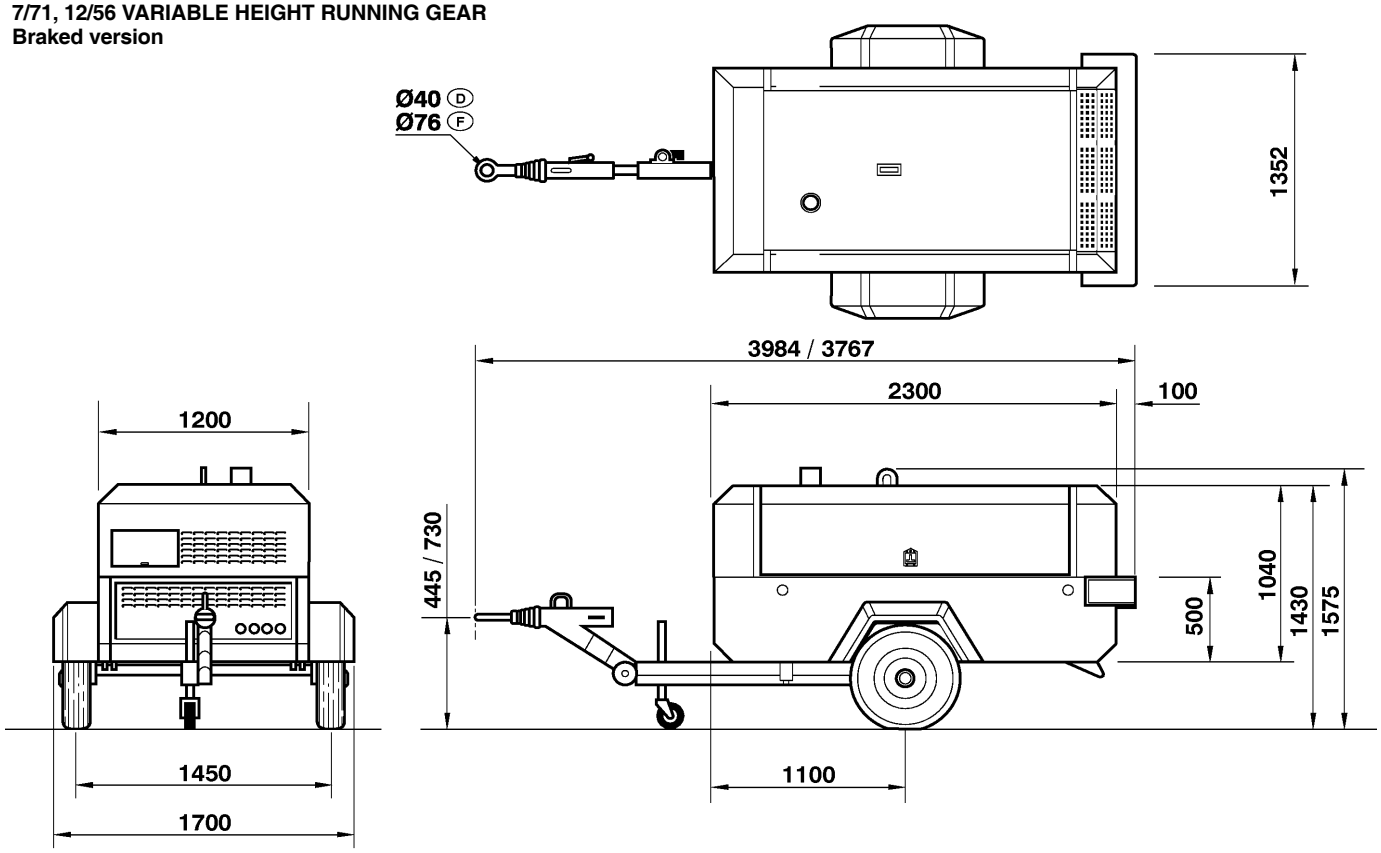
b) When adjusting the safety chains there should be sufficient free length in the chains to allow normal articulation, whilst also being short enough to prevent the towbar from touching the ground in the event of an accidental separation of the towing vehicle from the trailer.

7/71, 12/56 FIXED HEIGHT RUNNING GEAR
Braked version



T1812
Revision 01
09/00

7/71, 12/56 VARIABLE HEIGHT RUNNING GEAR
Braked version



T1813
Revision 01
09/00

COMPRESSOR

Actual free air delivery. (7/71)	7,1 m^3 min^{-1} (250 CFM)
Actual free air delivery. (12/56)	5,6 m^3 min^{-1} (200 CFM)
Normal operating discharge pressure. (7/71)	7 bar (100 PSI)
Normal operating discharge pressure. (12/56)	12 bar (175 PSI)
Maximum allowable pressure. (7/71)	8,6 bar (125 PSI)
Maximum allowable pressure. (12/56)	13 bar (190 PSI)
Safety valve setting. (7/71)	10 bar (145 PSI)
Safety valve setting. (12/56)	13,5 bar (200 PSI)
Maximum pressure ratio (absolute). (7/71)	7,5 : 1
Maximum pressure ratio (absolute). (12/56)	11,5 : 1
Operating ambient temperature.	
Whisperised	−10°C TO +46°C (14°F TO 115°F)
Standard	−10°C TO +52°C (14°F TO 126°F)
Maximum discharge temperature.	120°C (248°F)
Cooling system.	Oil injection
Oil capacity. (7/71, 12/56)	12,5 litres
Maximum oil system temperature.	120°C (248°F)
Maximum oil system pressure. (7/71)	8,6 bar (125 PSI)
Maximum oil system pressure. (12/56)	13,0 bar (190 PSI)

LUBRICATING OIL SPECIFICATION
(for the specified ambient temperatures).

ABOVE −23°C(−9°F)
Recommended: PRO−TEC
Approved: SAE 10W, API CF−4/CG−4

PRO−TEC compressor fluid is factory−fitted, for use at all ambient temperatures above −23°C(−9°F).

NOTE: Warranty may be extended only by continuous use of PRO−TEC and Doosan oil filters and separators.

No other oil/fluids are compatible with PRO−TEC.

No other oils/fluids should be mixed with PRO−TEC because the resulting mixture could cause damage to the airend.

In the event that PRO−TEC is not available and / or the end user needs to use an approved single grade engine oil, the complete system including separator / receiver, cooler and pipework must be flushed clear of the first fill fluid and new Doosan oil filters installed.
When this has been completed, the following oils are approved:

for ambient temperatures above −23°C (−9°F),
SAE 10W, API CF−4/CG−4

Safety data sheets can be obtained on request from your Doosan dealership.

For temperatures outside the specified ambient range, consult the company.

ENGINE
7/71, 12/56

Type/model.	4IRD5N
Number of cylinders.	4
Oil capacity.	9,0 litres
Speed at full load.	2300 revs min^{-1}
Speed at idle.	1700 revs min^{-1}
Electrical system.	12V negative earth
Power available at 2300 revs min^{-1}	59kW
Fuel tank capacity	118 litres
Oil specification	Refer engine section
Coolant capacity	11,5 litres

FIXED HEIGHT RUNNING GEAR
Braked version
7/71, 12/56

Shipping weight.	1489kg (3300 lbs)
Maximum weight.	1600kg (3520 lbs)
Maximum horizontal towing force.	1492 kgf (3288 lbs)
Maximum vertical coupling load (nose weight).	100 kgf (220 lbs)

VARIABLE HEIGHT RUNNING GEAR
Braked version
7/71, 12/56

Shipping weight.	1509kg (3565 lbs)
Maximum weight.	1600kg (3520 lbs)
Maximum horizontal towing force.	1492 kgf (3288 lbs)
Maximum vertical coupling load (nose weight).	100 kgf (220 lbs)

WHEELS AND TYRES

Number of wheels. **7/71, 12/56**	2 x $5^1/_2$ J
Tyre size. **7/71, 12/56**	7,50 14C, 185 R14
Tyre pressure. **7/71, 12/56**	4,5 bar (65 PSI)

Further information may be obtained by request through the customer services department.

COMMISSIONING

Upon receipt of the unit, and prior to putting it into service, it is important to adhere strictly to the instructions given below in *PRIOR TO STARTING.*

Ensure that the operator reads and *understands* the decals and consults the manuals before maintenance or operation.

Ensure that the position of the *emergency stop* device is known and recognised by its markings. Ensure that it is functioning correctly and that the method of operation is known.

Running gear drawbar – Machines are shipped to some areas with the drawbar removed. Fitting involves four nuts / bolts to secure the drawbar to the axle and two bolts to fit the drawbar to the front of the machine with the saddle and spacer block.

Support the front of the machine, fit the wheel chocks to stop the machine moving and attach the drawbar. Refer to the torque value table in the *MAINTENANCE* section of this manual for the correct torque values.

CAUTION:
This is a safety critical procedure. Double check the torque settings after assembly

Fit the propstand and coupling. Remove the supports and set the machine level.

Before towing the unit, ensure that the tyre pressures are correct (refer to the *GENERAL INFORMATION* section of this manual) and that the handbrake is functioning correctly (refer to the *MAINTENANCE* section of this manual). Before towing the unit during the hours of darkness, ensure that the lights are functioning correctly (where fitted).

Ensure that all transport and packing materials are discarded.

Ensure that the correct fork lift truck slots or marked lifting / tie down points are used whenever the machine is lifted or transported.

When selecting the working position of the machine ensure that there is sufficient clearance for ventilation and exhaust requirements, observing any specified minimum dimensions (to walls, floors etc.).

Adequate clearance needs to be allowed around and above the machine to permit safe access for specified maintenance tasks.

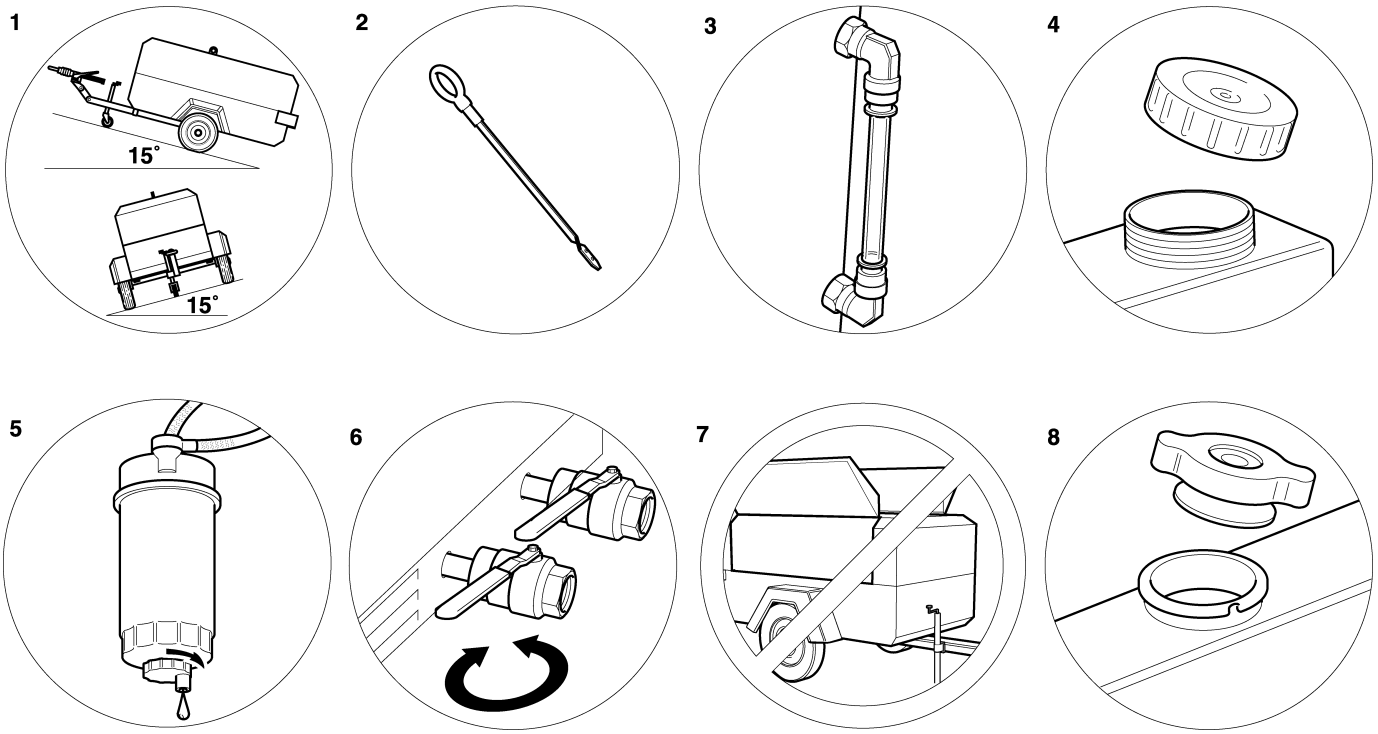
Ensure that the machine is positioned securely and on a stable foundation. Any risk of movement should be removed by suitable means, especially to avoid strain on any rigid discharge piping.

Attach the battery cables to the battery(s) ensuring that they are tightened securely. Attach the negative cable before attaching the positive cable.

WARNING: All air pressure equipment installed in or connected to the machine must have safe working pressure ratings of at least the machine rated pressure, and materials compatible with the compressor lubricant (refer to the *GENERAL INFORMATION* section).

WARNING: If more than one compressor is connected to one common downstream plant, effective check valves and isolation valves must be fitted and controlled by work procedures, so that one machine cannot accidently be pressurised / over pressurised by another.

WARNING: If flexible discharge hoses are to carry more than 7 bar pressure then it is recommended that safety retaining wires are used on the hoses.



T1816B
Revision 00
02/03

PRIOR TO STARTING

1. Place the unit in a position that is as level as possible. The design of the unit permits a 15 degree lengthways and sideways limit on out of level operation. It is the engine, not the compressor, that is the limiting factor.

When the unit has to be operated out of level, it is important to keep the engine oil level near the high level mark (with the unit level).

CAUTION: *Do not overfill either the engine or the compressor with oil.*

2. Check the engine lubrication oil in accordance with the operating instructions in the *Engine Operator's Manual.*

3. Check the compressor oil level in the sight glass located on the separator tank.

4. Check the diesel fuel level. A good rule is to top up at the end of each working day. This prevents condensation from occurring in the tank.

CAUTION: *Use only a No. 2–D diesel fuel oil with a minimum octane number of 45 and a sulphur content not greater than 0,5%.*

CAUTION: *When refuelling:–*
- *switch off the engine.*
- *do not smoke.*
- *extinguish all naked lights.*
- *do not allow the fuel to come into contact with hot surfaces.*
- *wear personal protective equipment.*

5. Drain the fuel filter water separator of water, ensuring that any released fuel is safely contained.

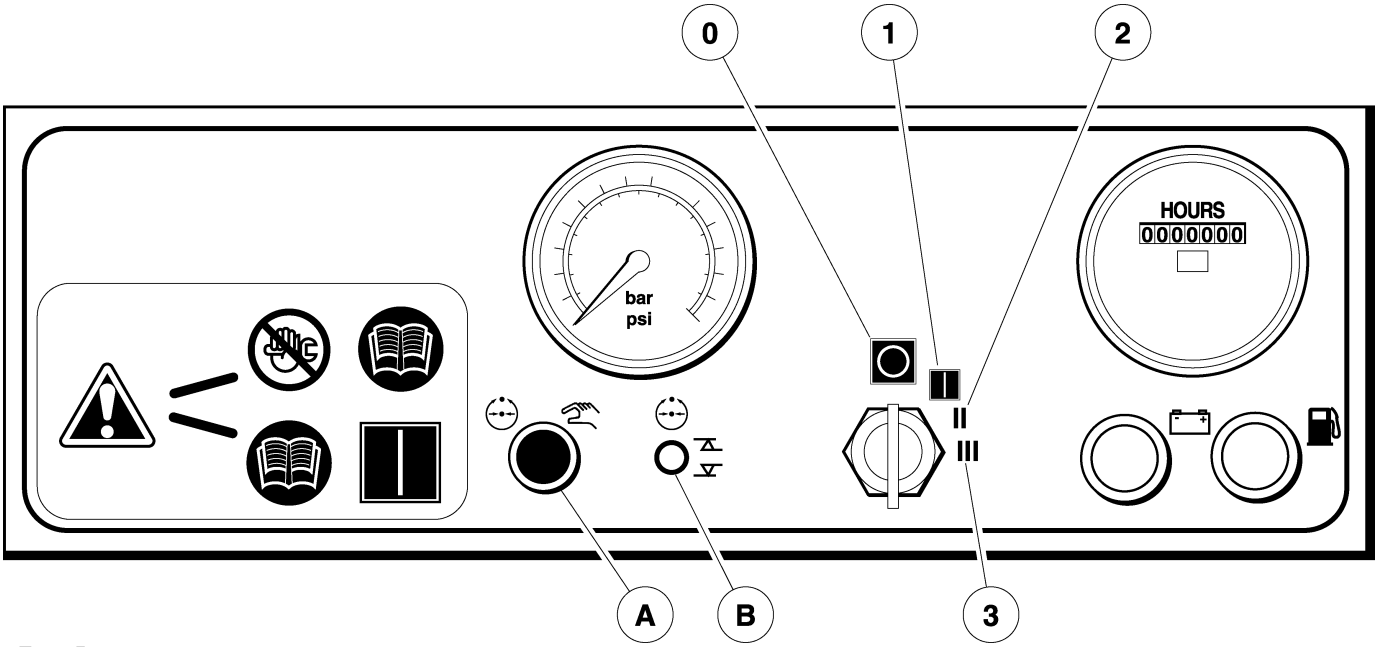
6. Open the service valve(s) to ensure that all pressure is relieved from the system. Close the service valve(s).

7. ***CAUTION:*** *Do not operate the machine with the canopy/doors in the open position as this may cause overheating and operators to be exposed to high noise levels.*

8. Check the radiator coolant level (with the unit level).

Check the air restriction indicator(s). Refer to the *MAINTENANCE* section of this manual.

When starting or operating the machine in temperatures below or approaching 0°C, ensure that the operation of the regulation system, the unloader valve, the safety valve, and the engine are not impaired by ice or snow, and that all inlet and outlet pipes and ducts are clear of ice and snow.



T1814B
Revision 00
01/03

STARTING THE MACHINE

WARNING: Under no circumstances should volatile liquids such as Ether be used for starting this machine.

All normal starting functions are incorporated in the key operated switch.

. Turn the key switch to position *3* (engine start position).

. Release to position *2* when the engine starts.

. Release to position *1* when the alternator charge light is extinguished.

At temperatures below 0°C or if there is difficulty starting first time:

. Open the service valve fully, with no hose connected.

. Complete starting sequence above.

. Close service valve as soon as engine runs freely.

. Do not allow machine to run for long periods with service valve open.

. Allow the engine to reach its operating temperature – then press the button (**A**).

. At this point in the operation of the machine it is safe to apply full load to the engine.

NOTE: Wear hearing protection at all times when the engine is started with the service valve open and air is flowing from the valve.

DUAL PRESSURE WHEN FITTED

Machines which operate in excess of 7 bar can optionally be fitted with a dual pressure switch (B). This switch selects between 7 bar and the machine rated pressure, cfm remains nominally constant.

Starting and stopping are unaffected by the selection and during normal running the selector switch may be safely operated. Precaution must be taken to ensure that downstream equipment is rated to suit the available pressure.

The pressure guage indicates which setting has been selected.

STOPPING THE MACHINE

. Close the service valve.

. Allow the machine to run unloaded for a short period of time to reduce the engine temperature.

. Turn the start switch to the *0* (off) position.

NOTE: As soon as the engine stops, the automatic blowdown valve will relieve all pressure from the system.

If the automatic blowdown valve fails to operate, then pressure must be relieved from the system by means of the service valve(s).

CAUTION: *Never allow the machine to stand idle with pressure in the system.*

EMERGENCY STOPPING

In the event that the unit has to be stopped in an emergency, **TURN THE KEY SWITCH LOCATED ON THE INSTRUMENT PANEL TO THE *0* (OFF) POSITION.**

RE–STARTING AFTER AN EMERGENCY

If the machine has been switched off because of a machine malfunction, then identify and correct the fault before attempting to re–start.

If the machine has been switched off for reasons of safety, then ensure that the machine can be operated safely before re–starting.

Refer to the *PRIOR TO STARTING* and *STARTING THE UNIT* instructions earlier in this section before re–starting the machine.

MONITORING DURING OPERATION

Should any of the safety shut-down conditions occur, the unit will stop. These are:

. Low engine oil pressure

. High air discharge temperature

. High engine water temperature

CAUTION: *To ensure an adequate flow of oil to the compressor at low temperature, never allow the discharge pressure to fall below 3,5 bar.*

DECOMMISSIONING

When the machine is to be permanently decommissioned or dismantled, it is important to ensure that all hazard risks are either eliminated or notified to the recipient of the machine. In particular:–

. Do not destroy batteries or components containing asbestos without containing the materials safely.

. Do not dispose of any pressure vessel that is not clearly marked with its relevant data plate information or rendered unusable by drilling, cutting etc.

. Do not allow lubricants or coolants to be released into land surfaces or drains.

. Do not dispose of a complete machine without documentation relating to instructions for its use.

MAINTENANCE SCHEDULE

	Initial 500 miles /850 km	Daily	Weekly	Monthly	3 Monthly. 250 hrs.	6 Monthly. 500 hrs	12 Monthly. 1000 hrs
Compressor Oil Level		C					
Engine Oil Level		C					
*Radiator Coolant Level		C					
Gauges/Lamps		C					
*Air Cleaner Service Indicators		C					
Fuel Tank (Fill at end of day)		C				D	
*Fuel/Water Separator Drain		C					
Oil Leaks		C					
Fuel Leaks		C					
Drain Water From Fuel Filters		D					
Coolant Leaks		C					
Radiator Filler Cap		C					
Air Cleaner Precleaner Dumps			C				
Fan/Alternator Belts			C				
Battery Connections/Electrolyte			C				
Tire Pressure and Surface			C				
*Wheel Lug Nuts				C			
Hoses (Oil, Air, Intake, etc.)				C			
Automatic Shutdown System				C			
Air Cleaner System				C			
Compressor Oil Cooler Exterior				C			
*Engine Rad/Oil Cooler Exterior				C			
Fasteners, Guards					C		
Air Cleaner Elements						R/WI	

*Disregard if not appropriate for this particular machine.

(1) or 3000 miles/5000km whichever is the sooner

(2) or as defined by local or national legislation

C = Check (adjust, clean or replace as necessary)

CBT =check before towing.

CR = Check and report

D = Drain

G = Grease

R=Replace

T = Test

W I =or when indicated if earlier.

Refer to specific sections of the operator's manual for more information.

	Initial 500 miles /850 km	Daily	Weekly	Monthly	3 Monthly. 250 hrs.	6 Monthly. 500 hrs	12 Monthly. 1000 hrs	18 Monthly. 1500 hrs
*Fuel/Water Separator Element						R		
Compressor Oil Filter Element						R		
Compressor Oil						R		
Engine Oil Change						R		
Engine Oil Filter						R		
*Water Pump Grease.							R	
*Wheels (Bearings, Seals, etc.)						C		
*Engine Coolant						C	R	
Fuel Filter Element						R		
*Injection Nozzle Check								C
Shutdown Switch Settings							T	
Scavenger Orifice & Related Parts							C	
Oil Separator Element							R	
*Feed Pump Strainer Cleaning.							C	
Coolant Replacement							R	
*Valve Clearance Check							C	
Lights (running, brake, & turn)		CBT						
Pintle Eye Bolts		CBT						
*Brakes	C				C			
*Brake linkage	C							
Emergency stop		T						
Fasteners		C						
Running gear linkage				G				
Safety valve					C			
Running gear bolts(1)					C			

*Disregard if not appropriate for this particular machine.

(1) or 3000 miles/5000km whichever is the sooner

(2) or as defined by local or national legislation

C = Check (adjust, clean or replace as necessary)

CBT =check before towing.

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G = Grease

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T = Test

W I =or when indicated if earlier.

Refer to specific sections of the operator's manual for more information.

	Initial 500 miles /850 km	Daily	Weekly	Monthly	3 Monthly. 250 hrs.	6 Monthly. 500 hrs	12 Monthly. 1000 hrs
Scavenge line						C	
Pressure system						C	
Engine breather element							C
Pressure gauge							C
Pressure regulator							C
Separator tank (2) exterior							CR
Lubricator (Fill)		C					

	2 Yrs	4 Yrs	6 Yrs				
Safety valve	C						
Hoses		R					
Separator tank (2) interior			C				

*Disregard if not appropriate for this particular machine.

(1) or 3000 miles/5000km whichever is the sooner

(2) or as defined by local or national legislation

C = Check (adjust, clean or replace as necessary)

CBT =check before towing.

CR = Check and report

D = Drain

G = Grease

R=Replace

T = Test

W I =or when indicated if earlier.

Refer to specific sections of the operator's manual for more information.

ROUTINE MAINTENANCE

This section refers to the various components which require periodic maintenance and replacement.

The *SERVICE/MAINTENANCE CHART* indicates the various components' descriptions and the intervals when maintenance has to take place. Oil capacities, etc., can be found in the *GENERAL INFORMATION* section of this manual.

For any specification or specific requirement on service or preventative maintenance for the engine, refer to the *Engine Manufacturer's Manual*.

Compressed air can be dangerous if incorrectly handled. Before doing any work on the unit, ensure that all pressure is vented from the system and that the machine cannot be started accidentally.

If the automatic blowdown fails to operate, then pressure must be gradually relieved by operating the manual blowdown valve. Suitable personal protective equipment should be worn.

Ensure that maintenance personnel are adequately trained, competent and have read the Maintenance Manuals.

Prior to attempting any maintenance work, ensure that:–

. all air pressure is fully discharged and isolated from the system. If the automatic blowdown valve is used for this purpose, then allow enough time for it to complete the operation.

. the discharge pipe / manifold area is depressurised by opening the discharge valve, whilst keeping clear of any airflow from it.

MINIMUM PRESSURE VALVE – WHEN FITTED

NOTE: Pressure will always remain in the part of the system between the minimum pressure valve and the discharge valve after operation of the auto blowdown valve.

This pressure must be relieved by carefully:

(a) Disconnecting any downstream equipment.

(b) Opening the discharge valve to atmosphere.

(Use hearing protection if necessary).

. the machine cannot be started accidently or otherwise, by posting warning signs and/or fitting appropriate anti–start devices.

. all residual electrical power sources (mains and battery) are isolated.

Prior to opening or removing panels or covers to work *inside* a machine, ensure that:–

. anyone entering the machine is aware of the reduced level of protection and the additional hazards, including hot surfaces and intermittently moving parts.

. the machine cannot be started accidently or otherwise, by posting warning signs and/or fitting appropriate anti–start devices.

Prior to attempting any maintenance work on a *running* machine, ensure that:–

. the work carried out is limited to only those tasks which require the machine to run.

. the work carried out with safety protection devices disabled or removed is limited to only those tasks which require the machine to be running with safety protection devices disabled or removed.

. all hazards present are known (e.g. pressurised components, electrically live components, removed panels, covers and guards, extreme temperatures, inflow and outflow of air, intermittently moving parts, safety valve discharge etc.).

. appropriate personal protective equipment is worn.

. loose clothing, jewellery, long hair etc. is made safe.

. warning signs indicating that *Maintenance Work is in Progress* are posted in a position that can be clearly seen.

Upon completion of maintenance tasks and prior to returning the machine into service, ensure that:–

. the machine is suitably tested.

. all guards and safety protection devices are refitted.

. all panels are replaced, canopy and doors closed.

. hazardous materials are effectively contained and disposed of.

PROTECTIVE SHUTDOWN SYSTEM

Comprises:

. Low engine oil pressure switch

. High discharge air temperature switch

. High engine water temperature switch

. Alternator/drive belt failure circuit.

. Low engine fuel level switch.

Low engine oil pressure switch.

At three month intervals, test the engine oil pressure switch circuit as follows:

. Start the machine.

NOTE: Do not press the load button.

. Remove a wire from one terminal of the switch. The machine should shutdown.

At twelve month intervals, test the engine oil pressure switch as follows:

. Remove the switch from the machine.

. Connect it to an independent low pressure supply (either air or oil).

. The switch should operate at 1,0 bar.

. Refit the switch.

Temperature switch(es).

At three month intervals, test the temperature switch circuit(s) as follows:

. Start the machine.

NOTE: Do not press the load button.

. Disconnect each switch in turn. The machine should shutdown.

. Re–connect the switch.

High discharge air temperature switch(es).

At twelve month intervals, test the air discharge temperature switch(es) by removing it from the machine and immersing in a bath of heated oil. The switch should operate at 120°C. Refit the switch.

High water temperature switch

At twelve month intervals, test the water temperature switch by removing it from the machine and immersing in a bath of heated oil. The switch should operate at 105°C. Refit the switch.

Alternator/drive belt failure circuit.

At twelve month intervals test the alternator drive belt failure circuit as follows:

- Remove the drive belt from the machine.
- Turn the key switch to position *1*, the alternator charge light will illuminate.
- Turn the key switch to position *3* (engine start position).
- The machine should shutdown when the key switch is returned to position *1*.

Low engine fuel level switch.

At three month intervals, test the low engine fuel level switch circuit as follows:

- Start the machine.

NOTE: Do not press the load button.

- Disconnect the switch, the machine should shutdown.
- Re–connect the switch.

At twelve month intervals, test the low engine fuel level switch by removing and operating the float manually.

CAUTION: *Never remove or replace switches when the machine is running.*

SCAVENGE LINE

The scavenge line runs from the combined orifice/drop tube in the separator tank, to the orifice fitting located in the airend.

Examine the orifice, check valve and hoses at every service or in the event of oil carryover into the discharge air.

It is good preventative maintenance to check that the scavenge line and tube are clear of any obstruction each time the compressor lubricant is changed as any blockage will result in oil carryover into the discharge air.

COMPRESSOR OIL FILTER

Refer to the *MAINTENANCE CHART* in this section for the recommended servicing intervals.

Removal

WARNING: Do not remove the filter(s) without first making sure that the machine is stopped and the system has been completely relieved of all air pressure. (Refer to *STOPPING THE UNIT* in the *OPERATING INSTRUCTIONS* section of this manual).

Clean the exterior of the filter housing and remove the *spin–on* element by turning it in a counter–clockwise direction.

Inspection

Examine the filter element.

CAUTION: *If there is any indication of the formation of varnishes, shellacs or lacquers on the filter element, it is a warning that the compressor lubricating and cooling oil has deteriorated and that it should be changed immediately. Refer to LUBRICATION later in this section.*

Reassembly

Clean the filter gasket contact area and install the new element by screwing in a clockwise direction until the gasket makes contact with the filter housing. Tighten a further $^{1}/_{2}$ to $^{3}/_{4}$ of a revolution.

CAUTION: *Start the machine (refer to PRIOR TO STARTING and STARTING THE UNIT in the OPERATING INSTRUCTIONS section of this manual) and check for leakage before the machine is put back into service.*

COMPRESSOR OIL SEPARATOR ELEMENT

Normally the separator element will not require periodic maintenance provided that the air and oil filter elements are correctly maintained.

If, however, the element has to be replaced, then proceed as follows:

Removal

WARNING: Do not remove the filter(s) without first making sure that the machine is stopped and the system has been completely relieved of all air pressure. (Refer to *STOPPING THE UNIT* in the *OPERATING INSTRUCTIONS* section of this manual).

Disconnect all hoses and tubes from the separator tank cover plate. Remove the drop–tube from the separator tank cover plate and then remove the cover plate. Remove the separator element.

Inspection

Examine the filter element. Examine all hoses and tubes, and replace if necessary.

Reassembly

Thoroughly clean the orifice/drop tube and filter gasket contact area before reassembly. Install the new element.

WARNING
Do not remove the staple from the anti–static gasket on the separator element since it serves to ground any possible static build–up. Do not use gasket sealant since this will affect electrical conductance.

Reposition the cover plate, taking care not to damage the gasket, and replace the cover plate screws tightening in a *criss–cross* pattern to the recommended torque (refer to the *TORQUE SETTING TABLE* later in this section).

Engage the adaptor in the cover plate with the drop–tube integral with the filter, reconnect all hoses and tubes to the separator tank cover plate.

Replace the compressor oil (refer to *LUBRICATION* later in this section).

CAUTION: *Start the machine (refer to PRIOR TO STARTING and STARTING THE UNIT in the OPERATING INSTRUCTIONS section of this manual) and check for leakage before the machine is put back into service.*

COMPRESSOR OIL COOLER AND ENGINE RADIATOR

When grease, oil and dirt accumulate on the exterior surfaces of the oil cooler and radiator, the efficiency is impaired. It is recommended that each month the oil cooler and radiator be cleaned by directing a jet of compressed air, (carrying if possible a non–flammable cleaning solvent) over the exterior core of the cooler/radiator. This should remove any accumulation of oil, grease and dirt from the exterior core of the cooler so that the entire cooling area can radiate the heat of the lubricating and cooling oil/water into the air stream.

WARNING: Hot engine coolant and steam can cause injury. When adding coolant or antifreeze solution to the engine radiator, stop the engine at least one minute prior to releasing the radiator filler cap. Using a cloth to protect the hand, slowly release the filler cap, absorbing any released fluid with the cloth. Do not remove the filler cap until all excess fluid is released and the engine cooling system fully depressurised.

WARNING: Follow the instructions provided by the antifreeze supplier when adding or draining the antifreeze solution. It is advisable to wear personal protective equipment to prevent skin and eye contact with the antifreeze solution.

AIR FILTER ELEMENTS

The air filter should be inspected regularly (refer to the *SERVICE/MAINTENANCE CHART*) and the element replaced when the restriction indicator shows red or every 6 Months (500 hours), whichever comes first. The dust collector box(es) should be cleaned daily (more frequently in dusty operating conditions) and not allowed to become more than half full.

Removal

CAUTION: *Never remove and replace element(s) when the machine is running.*

Clean the exterior of the filter housing and remove the filter element by releasing the nut.

Inspection

Check for cracks, holes or any other damage to the element by holding it up to a light source, or by passing a lamp inside.

Check the seal at the end of the element and replace if any sign of damage is evident.

Reassembly

Assemble the new element into the filter housing ensuring that the seal seats properly.

Reset the restriction indicator by depressing the rubber diaphragm.

Assemble the dust collector box parts, ensuring that they are correctly positioned.

Before restarting the machine, check that all clamps are tight.

VENTILATION

Always check that the air inlets and outlets are clear of debris etc.

CAUTION: *NEVER clean by blowing air inwards.*

COOLING FAN DRIVE

Periodically check that the fan mounting bolts in the fan hub have not loosened. If, for any reason, it becomes necessary to remove the fan or re–tighten the fan mounting bolts, apply a good grade of commercially available thread locking compound to the bolt threads and tighten to the torque value shown in the *TORQUE SETTING TABLE* later in this section.

The fan belt(s) should be checked regularly for wear and correct tensioning.

FUEL SYSTEM

The fuel tank should be filled daily or every eight hours. To minimise condensation in the fuel tank(s), it is advisable to top up after the machine is shut down or at the end of each working day. At six month intervals drain any sediment or condensate that may have accumulated in the tank(s).

FUEL FILTER WATER SEPARATOR

The fuel filter water separator contains a filter element which should be replaced at regular intervals (see the *SERVICE/MAINTENANCE CHART*).

HOSES

All components of the engine cooling air intake system should be checked periodically to keep the engine at peak efficiency.

At the recommended intervals, (see the *SERVICE/MAINTENANCE CHART*), inspect all of the intake lines to the air filter, and all flexible hoses used for air lines, oil lines and fuel lines.

Periodically inspect all pipework for cracks, leaks, etc. and replace immediately if damaged.

ELECTRICAL SYSTEM

WARNING: Always disconnect the battery cables before performing any maintenance or service.

Inspect the safety shutdown system switches and the instrument panel relay contacts for evidence of arcing and pitting. Clean where necessary.

Check the mechanical action of the components.

Check the security of electrical terminals on the switches and relays i.e. nuts or screws loose, which may cause local hot spot oxidation.

Inspect the components and wiring for signs of overheating i.e. discolouration, charring of cables, deformation of parts, acrid smells and blistered paint.

BATTERY

Keep the battery terminals and cable clamps clean and lightly coated with petroleum jelly to prevent corrosion.

The retaining clamp should be kept tight enough to prevent the battery from moving.

PRESSURE SYSTEM

At 500 hour intervals it is necessary to inspect the external surfaces of the system (from the airend through to the discharge valve(s)) including hoses, tubes, tube fittings and the separator tank, for visible signs of impact damage, excessive corrosion, abrasion, tightness and chafing. Any suspect parts should be replaced before the machine is put back into service.

TYRES/TYRE PRESSURE

See the *GENERAL INFORMATION* section of this manual.

RUNNING GEAR/WHEELS

Check the wheel nut torque 20 miles (30 kilometres) after refitting the wheels. Refer to the *TORQUE SETTING TABLE* later in this section.

Lifting jacks should only be used under the axle.

The bolts securing the running gear to the chassis should be checked periodically for tightness (refer to the *SERVICE/MAINTENANCE CHART* for frequency) and re–tightened where necessary. Refer to the *TORQUE SETTING TABLE* later in this section.

BRAKES

Check and adjust the brake linkage at 500 miles (850Km) then every 3000 miles (5000Km) or 3 months (whichever is the sooner) to compensate for any stretch of the adjustable cables. Check and adjust the wheel brakes to compensate for wear.

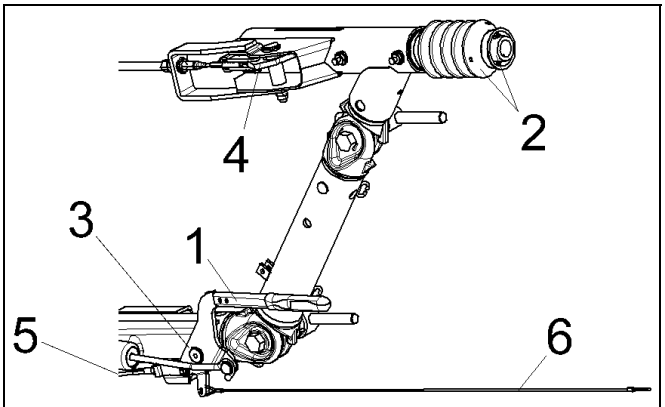
ADJUSTING THE OVERRUN BRAKING SYSTEM

1: Preparation

Jack up the machine

Disengage the handbrake lever [1].

Fully extend the draw bar [2] on the overrun braking system.



1 Handbrake lever
2 Draw bar and bellows
3 Handbrake lever pivot
4 Transmission lever
5 Brake cable
6 Breakaway Cable

Requirements:

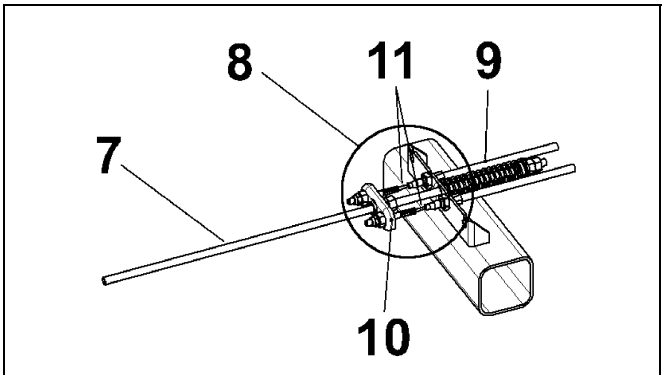
During the adjustment procedure always start with the wheel brakes.

Always rotate the wheel in the direction of forward movement.

Ensure that an M10 safety screw is fitted to the handbrake pivot.

The brake actuators must not be pre–tensioned – if necessary loosen the brake linkage [7] on the brake equalisation assembly [8].

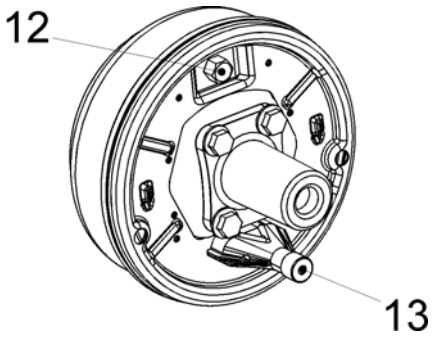
Check that brake actuators and cables [11] operate smoothly.



7 Brake linkage
8 Equalisation assembly
9 Compression spring
10 Equaliser plate
11 Cable

CAUTION
The compression spring [9] must only be lightly pre–tensioned and when operating must never touch the axle tube.
Never adjust the brakes at the brake linkage [7].

2. Brake Shoe Adjustment



12 Adjusting screw

13 Cable entry

Width across flats of adjusting screw [12]

Brake size	Key width
160x35 / 200x50	SW 17
250x40	SW 19
300x60	SW 22

Tighten adjusting screw [12] clockwise until the wheel locks.

Loosen adjusting screw [12] anti–clockwise (approx. ½ turn) until the wheel can be moved freely.

Slight dragging noises that do not impede the free movement of the wheel are permissible.

This adjustment procedure must be carried out as described on both wheel brakes.

When the brake has been adjusted accurately the actuating distance is approximately 5–8mm on the cable [11]

3: Compensator assembly adjustment

Variable Height models

Fit an M10 safety screw to the handbrake pivot.

Disconnect the handbrake cable [5] at one end.

Pre–adjust brake linkage [7] lengthways (a little play is permissible) and re–insert the cable [5], adjusting it to give a small amount of play.

Remove the M10 safety screw from the handbrake pivot.

All Models

Engage the handbrake lever [1] and check that the position of the equaliser plate [10] is at right angles to the pulling direction. If necessary correct the position of the equaliser plate [10] on the cables [11].

The compression spring [9] must only be slightly pre–tensioned and when engaged must not touch the axle tube.

4: Brake linkage adjustment

Adjust the brake linkage [7] lengthways without pre–tension and without play in the transmission lever [4].

Readjustment

Engage the handbrake lever [1] forcefully a number of times to set the brake.

Check the alignment of the equalisation assembly [8], this should be at right angles to the pulling direction

Check the play in the brake linkage [7]

If necessary adjust the brake linkage [7] again without play and without pre–tensioning

There must still be a little play in cable [5] (Variable Height Only)

Check the position of the hand brake lever [1]. The start of resistance should be approximately 10–15mm above the horizontal position.

Check that the wheels move freely when the handbrake is disengaged.

Final test

Check the fastenings on the transmission system (cables, brake equalisation system and linkage).

Check the handbrake cable [5] for a small amount of play and adjust if necessary (Variable height only)

Check the compression spring [9] for pre–tensioning.

Test run

If necessary carry out 2–3 test brake actions.

Test brake action

Check the play in brake linkage [7] and if necessary adjust the length of brake linkage [7] until there is no play.

Apply the handbrake while rolling the machine forward, travel of the handbrake lever up to 2/3 of maximum is allowed.

RE–ADJUSTING THE OVERRUN BRAKING SYSTEM

Re–adjustment of the wheel brakes will compensate for brake lining wear. Follow the procedure described in *2: Brake Shoe Adjustment*.

Check the play in the brake linkage [7] and re–adjust if necessary.

Important
Check the brake actuators and cables [11]. The brake actuators must not be pre–tensioned.
Excessive operation of the handbrake lever, which may have been caused by worn brake linings, must not be corrected by re–adjusting (shortening) the brake linkage [7]

Re–adjustment

The handbrake lever [1] should be engaged forcefully several times to set the braking system.
Check the setting of the brake equalisation assembly [8], which should be at right angles to the pulling direction.
Check the play in the brake linkage [7] again, ensuring that there is no play in the brake linkage and that it is adjusted without pre–tension
Check the position of the hand brake lever [1], cable [5] (with little play) and the compression spring [9] (only slight pre–tension). The start of resistance of the handbrake lever should be approximately 10–15mm above the horizontal position.

Final test

Check the fastenings on the transmission system (cables, brake equalisation system and linkage)

Apply the handbrake while rolling the machine forward, travel of the handbrake lever up to 2/3 of maximum is allowed.

Check the handbrake cable [5] for a small amount of play and adjust if necessary (Variable height only)

Check the compression spring [9] for slight pre–tensioning.

CAUTION: *Check the wheel nut torque 20 miles (30 kilometres) after refitting the wheels (Refer to the TORQUE SETTING TABLE later in this section).*

LUBRICATION

The engine is initially supplied with engine oil sufficient for a nominal period of operation (for more information, consult the Engine section of this manual).

CAUTION: *Always check the oil levels before a new machine is put into service.*

If, for any reason, the unit has been drained, it must be re–filled with new oil before it is put into operation.

ENGINE LUBRICATING OIL

The engine oil should be changed at the engine manufacturer's recommended intervals. Refer to the Engine section of this manual.

ENGINE LUBRICATING OIL SPECIFICATION

Refer to the Engine section of this manual.

ENGINE OIL FILTER ELEMENT

The engine oil filter element should be changed at the engine manufacturer's recommended intervals. Refer to the Engine section of this manual.

COMPRESSOR LUBRICATING OIL

Refer to the *SERVICE/MAINTENANCE CHART* in this section for service intervals.

NOTE: If the machine has been operating under adverse conditions, or has suffered long shutdown periods, then more frequent service intervals will be required.

WARNING: DO NOT, under any circumstances, remove any drain plugs or the oil filler plug from the compressor lubricating and cooling system without first making sure that the machine is stopped and the system has been completely relieved of all air pressure (refer to *STOPPING THE UNIT* in the *OPERATING INSTRUCTIONS* section of this manual).

Completely drain the receiver/separator system including the piping and oil cooler by removing the drain plug(s) and collecting the used oil in a suitable container.

Replace the drain plug(s) ensuring that each one is secure.

NOTE: If the oil is drained immediately after the machine has been running, then most of the sediment will be in suspension and will therefore drain more readily.

CAUTION: *Some oil mixtures are incompatible and result in the formation of varnishes, shellacs or lacquers which may be insoluble.*

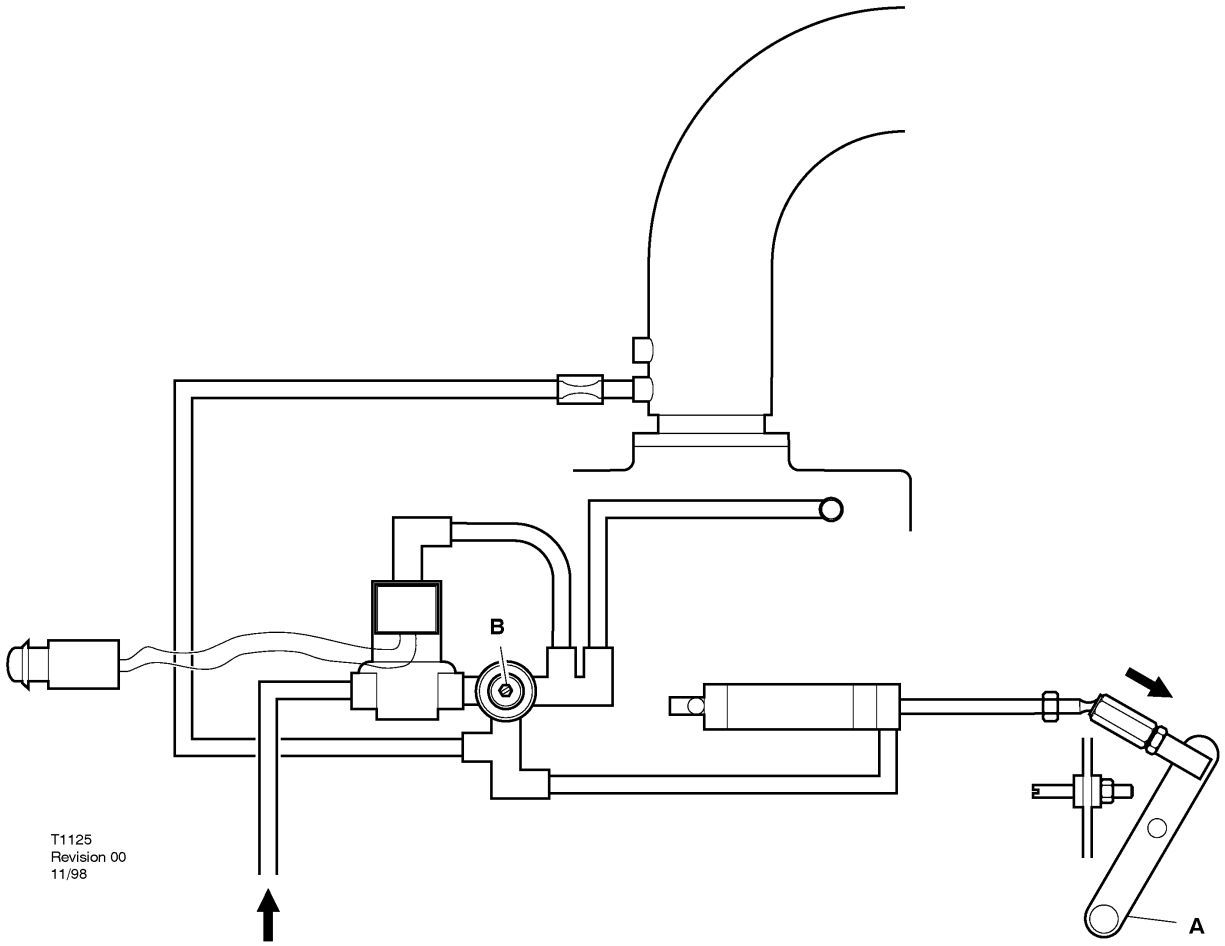
NOTE: Always specify PRO–TEC oil for use at all ambient temperatures above –23°C.

COMPRESSOR OIL FILTER ELEMENT

Refer to the *SERVICE / MAINTENANCE CHART* in this section for service intervals.

RUNNING GEAR WHEEL BEARINGS

Wheel bearings should be packed with grease every 6 months. The type of grease used should conform to specification *MIL–G–10924.*



SPEED AND PRESSURE REGULATION ADJUSTMENT

Normally, regulation requires no adjusting, but if correct adjustment is lost, proceed as follows:

Refer to the diagram above.

A: Throttle arm
B: Adjusting screw

Start the machine (Refer to *STARTING INSTRUCTIONS* in the *OPERATING INSTRUCTIONS* section of this manual*).*

Inspect the throttle arm on the engine governor to see that it is extended in the full speed position when the engine is running at *full–load* speed and the service valve is fully open. (Refer to the *GENERAL INFORMATION* section of this manual).

Adjust the service valve on the outside of the machine to maintain 7 bar without the throttle arm moving from the full speed position. If the throttle arm moves away from the full speed position before 7 bar is attained, then turn the adjusting screw clockwise to increase the pressure. Optimum adjustment is achieved when the throttle arm just moves from its full speed position and the pressure gauge reads 7,2 bar (12 bar for 12/56).

Close the service valve. The engine will slow to idle speed.

CAUTION: *Never allow the idle pressure to exceed 8,6bar (13 bar for 12/56) on the pressure gauge, otherwise the safety valve will operate.*

TORQUE VALUES

	ft lbf	Nm
Airend to engine	29–35	39–47
Air filter to bracket	16–20	22–27
Autella clamp to exhaust	9–11	12–15
Baffle to frame	9–11	12–15
Blowdown solenoid valve	21–26	28–35
Discharge manifold to frame	29–35	39–47
Drive pins to engine flywheel	57–69	77–93
Drop Leg	53–63	72–85
Engine/airend to chassis	54–58	73–78
Euro–Loc adaptor to separator tank	58–67	78–91
Exhaust flange to manifold	17–21	23–28

	ft lbf	Nm
Fan guard	9–11	12–15
Fan to hub	12–15	16–20
Lifting bail bracket to engine	29–35	39–47
Oil pipe (–12jic)	71–88	96–119
Radiator/Cooler to baffle	9–11	12–15
Running gear front to chassis	63–69	82–93
Running gear rear to chassis	63–69	82–93
Running gear drawbar to axle	29–35	39–47
Separator tank cover	40–50	54–68
Separator tank to frame	18–22	24–30
Service pipe (–20jic)	106–133	143–180
Sight glass	40–50	54–68
Wheel nuts	62–70	85–95

COMPRESSOR LUBRICATION

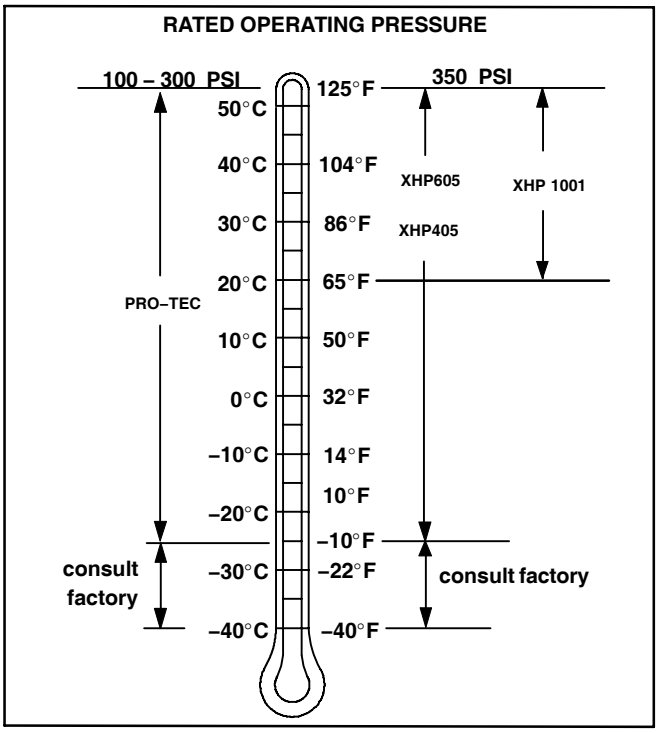
Portable Compressor Fluid Chart

Refer to these charts for correct compressor fluid required. Note that the selection of fluid is dependent on the design operating pressure of the machine and the ambient temperature expected to be encountered before the next oil change.

Note: Fluids listed as "preferred" are required for extended warranty.

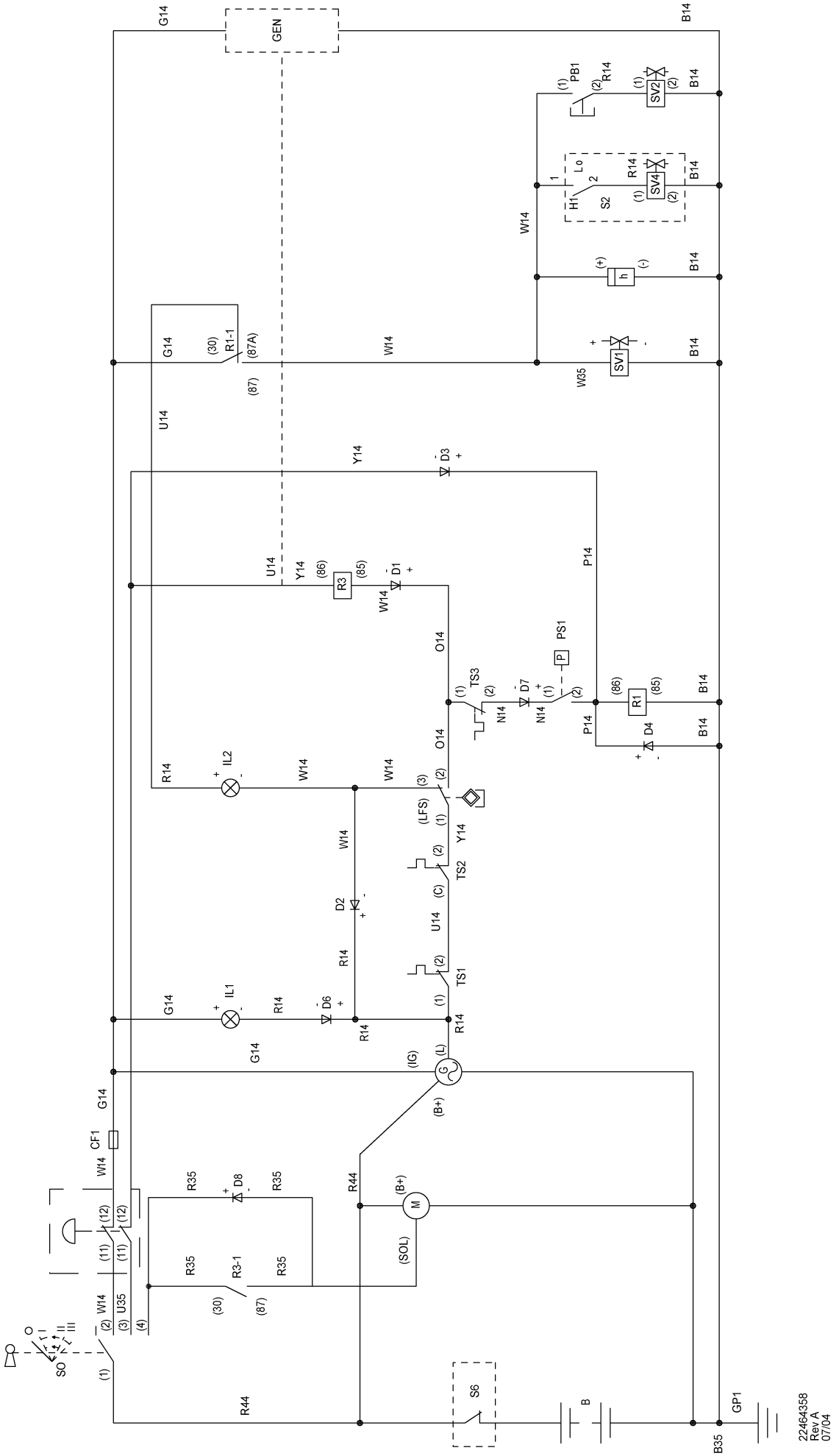
Compressor oil carryover (oil consumption) may be greater with the use of alternative fluids.

Design Operating Pressure	Ambient Temperature	Specification
100 psi to 300 psi	–10°F to 125°F (–23°C to 52°C)	Preferred: **PRO–TEC** Alternate: ISO Viscosity Grade 46 with rust and oxidation inhibitors, designed for air compressor service
350 psi	–10°F to 125°F (–23°C to 52°C)	Preferred: **XHP 605** Alternate: **XHP 405** ISO Viscosity Grade 68 Group 3 or 5 with rust and oxidation inhibitors designed for air compressor service.
	65°F to 125°F (18°C to 52°C)	Preferred: **XHP 605** **XHP1001**



Preferred Doosan Fluids – Use of these fluids with original Doosan branded filters can extend airend warranty. Refer to operator's manual warranty section for details or contact your Portable Power representative.

Doosan Preferred Fluids	1 gal. (3.8 Litre)	5 gal. (19.0 Litre)	55 gal. (208.2Litre)	220 gal. (836 litre)
PRO–TEC	–	89292973	89292981	22082598
XHP 605	–	22252076	22252050	22252068
XHP 1001	–	35612738	35300516	–
XHP 405	–	22252126	22252100	22252118


G14
GEN
B14
PB1
R14
SV2
H1
Lo
S2
SV4
W14
h
SV1
W35
R1-1
(30)
(87A)
(87)
U14
Y14
D3
R3
(86)
(85)
D1
P14
PS1
O14
TS3
D7
R1
D4
IL2
(LFS)
TS2
(C)
D2
IL1
D6
TS1
(IG)
(L)
(B+)
CF1
D8
R35
R44
M
(SOL)
R3-1
U35
SO
S6
B
GP1
B35
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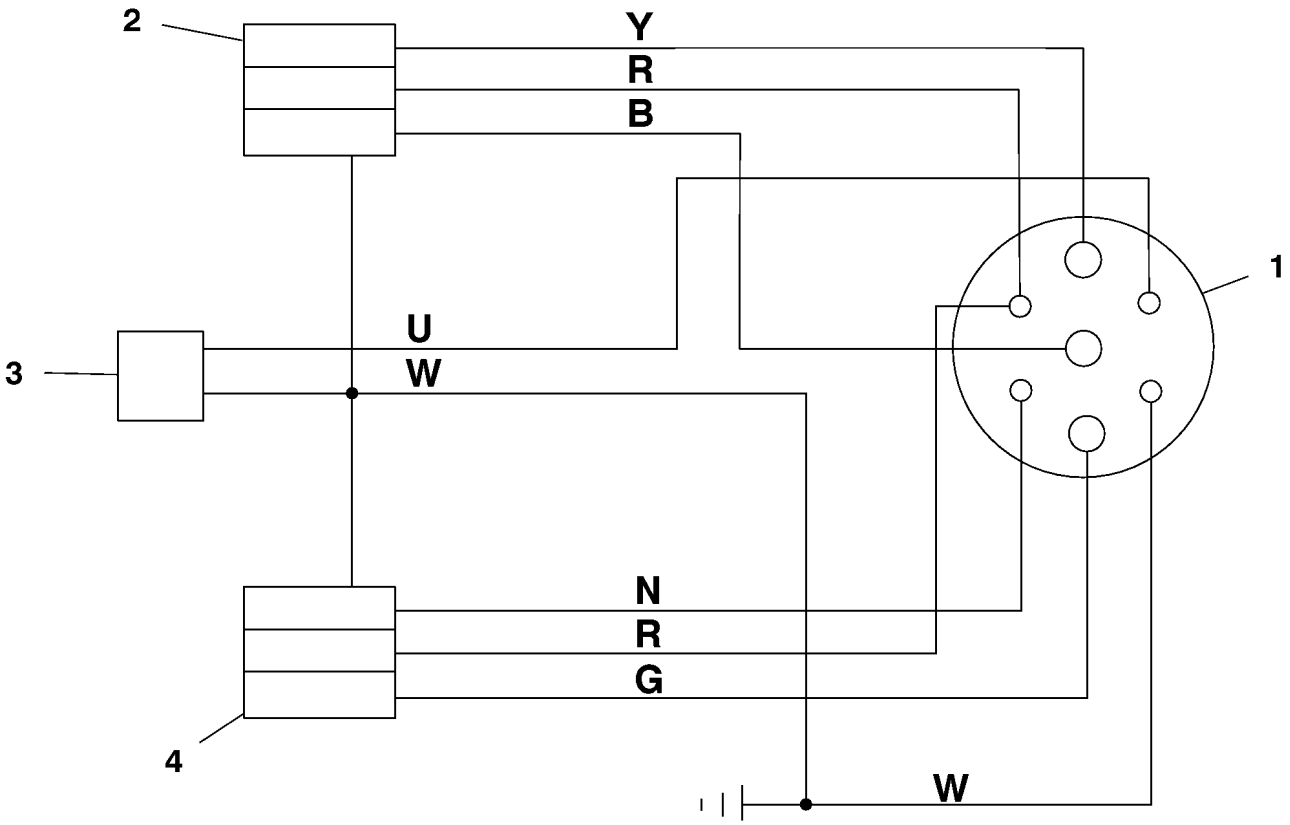
Rev A
07/04

KEY

B	Battery 12V
CF1	Control fuse 5A
D1–8	Diode, blocking
G	Alternator 12V
GEN	Generator (Option)
GP1–4	Glow plugs
h	Hourmeter
IL1	Lamp, No – charge (Option)
IL2	Lamp, low fuel (Option)
LFS	Switch, low fuel level
M	Starter motor
PB1	Pushbutton, load / unload (Option)
PS1	Engine oil pressure switch
R1	Relay, safety shut-down (24V)
R3	Relay, start inhibit (24V)
R6	Relay, glowplug
SO	Key–switch
S1	Compressor / generator switch, (Option)
S2	Dual pressure switch (Option)
SV1	Solenoid, fuel
SV2	Solenoid, load / unload (Option)
SV3	Solenoid, generator speed (Option)
SV4	Dual pressure solenoid (Option)
TS1	High air temperature switch (airend)
TS2	High air temperature switch (discharge) (Option)
TS3	High water temperature switch (engine)

B	Black
G	Green
K	Pink
LG	Light green
N	Brown
O	Orange
P	Purple
R	Red
S	Grey
U	Blue
W	White
Y	Yellow



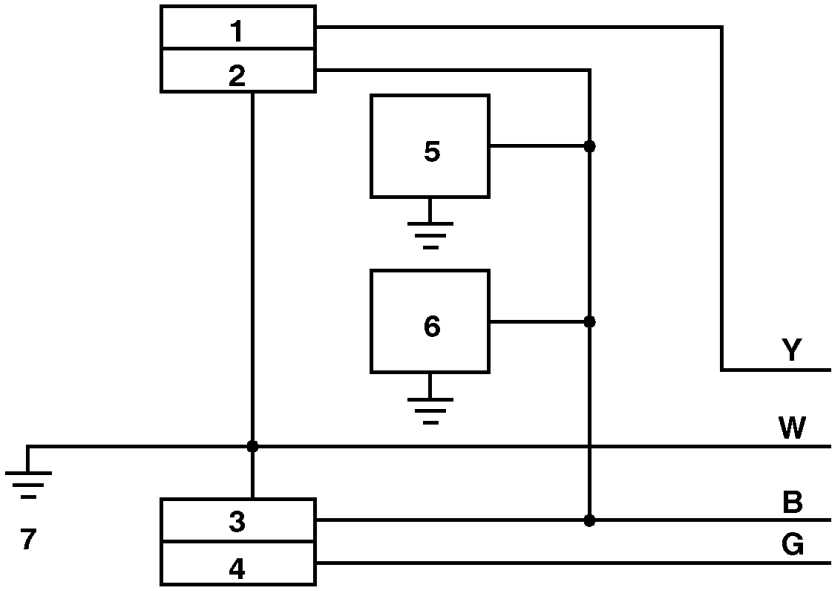
T1599
Revision 00
02/94

SCHEMATIC DIAGRAM FOR EUROPEAN CE LIGHTING SYSTEM

KEY

1	Plug
2	Light (right hand)
3	Fog light
4	Light (left hand)

B	Black
G	Green
K	Pink
N	Brown
O	Orange
P	Purple
R	Red
S	Grey
U	Blue
W	White
Y	Yellow



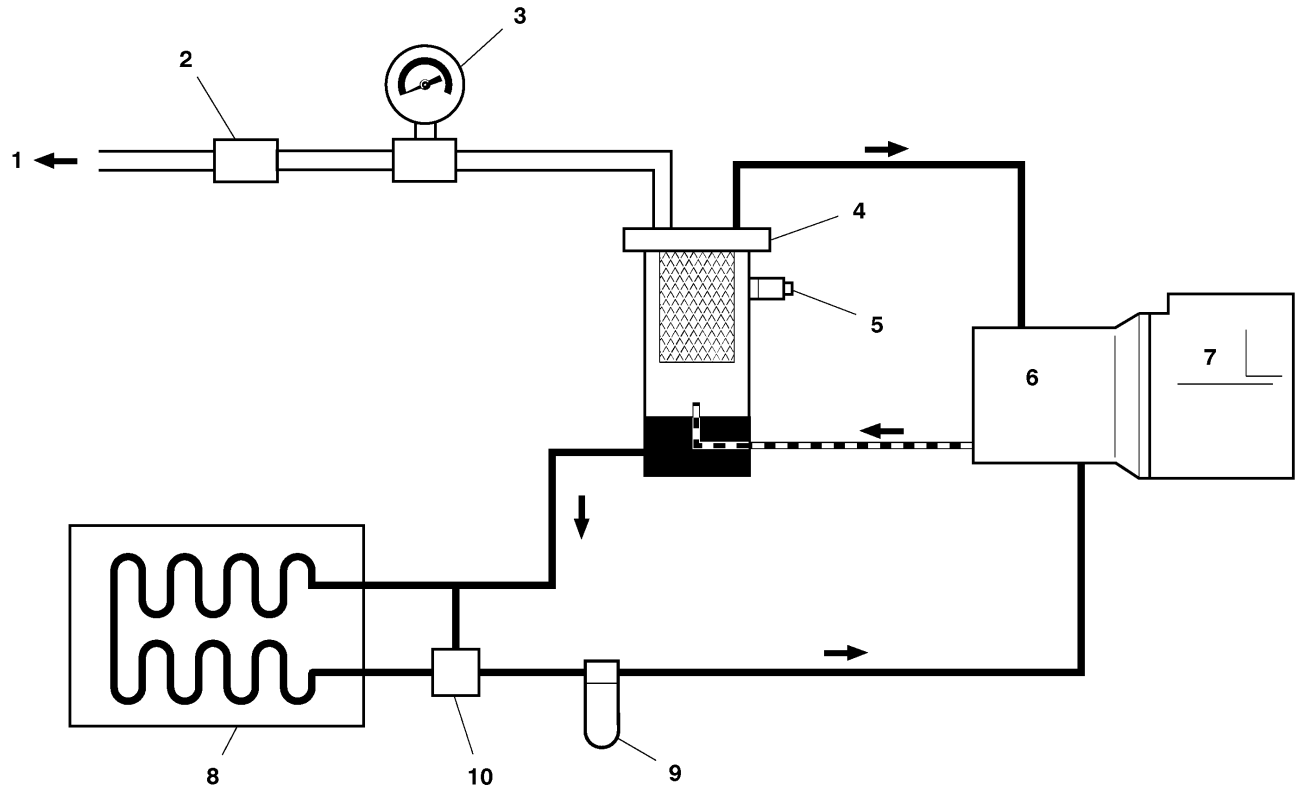
T1357
Revision 00
05/00

SCHEMATIC DIAGRAM FOR AMERICAN SAE LIGHTING SYSTEM

KEY

1	Stop / turn (left hand)
2	Tail (left hand)
3	Stop / turn (right hand)
4	Tail (right hand)
5	Front side marker (left hand)
6	Front side marker (right hand)
7	Ground / earth

B	Black
G	Green
K	Pink
N	Brown
O	Orange
P	Purple
R	Red
S	Grey
U	Blue
W	White
Y	Yellow



T1815
Revision 00
07/00

KEY

1	Air discharge	**8**	Oil cooler
2	Sonic orifice (restricts flow)	**9**	Oil filter
3	Pressure gauge	**10**	Thermostatic valve (Where fitted)
4	Separator tank		
5	Safety valve		Air
6	Compressor		Oil
7	Engine		Air/oil

FAULT	CAUSE	REMEDY
Engine fails to start.	*Low battery charge.*	Check the fan belt tension, battery and cable connections.
	Bad earth connection.	Check the earth cables, clean as required.
	Loose connection.	Locate and make the connection good.
	Fuel starvation.	Check the fuel level and fuel system components. Replace the fuel filter if necessary.
	Relay failed.	Replace the relay.
	Engine control not in 'run' position.	Check the speed cylinder and stop position.
Engine starts but stalls when the switch returns to position *I*.	*Electrical fault*	Test the electrical circuits.
	Low engine oil pressure.	Check the oil level and the oil filter(s).
	Faulty relay	Check the relays.
	Faulty key–switch	Check the key–switch.
Engine starts but will not run or engine shuts down prematurely.	*Electrical fault.*	Test the electrical circuits.
	Low engine oil pressure.	Check the oil level and oil filter(s).
	Safety shut-down system in operation.	Check the safety shut-down switches.
	Fuel starvation.	Check the fuel level and fuel system components. Replace the fuel filter if necessary.
	Switch failure.	Test the switches.
	High compressor oil temperature.	Check the compressor oil level and oil cooler. Check the fan drive.
	Water present in fuel system.	Check the water separator and clean if required.
	Faulty relay.	Check the relay in the holder and replace if necessary.
Engine Overheats.	*Reduced cooling air from fan.*	Check the fan and the drive belts. Check for any obstruction inside the cowl.
Engine speed too high.	*Incorrect throttle arm setting.*	Check the engine speed setting.
	Faulty regulator valve.	Check the regulation system.

FAULT	CAUSE	REMEDY
Engine speed too low.	*Incorrect throttle arm setting.*	Check the throttle setting.
	Blocked fuel filter.	Check and replace if necessary.
	Blocked air filter.	Check and replace the element if necessary.
	Faulty regulator valve.	Check the regulation system.
	Premature unloading.	Check the regulation and the operation of the air cylinder.
Excessive vibration.	*Engine speed too low.*	See "*Engine speed too low*"
Refer also to the *engine section of this manual.*		
Air discharge capacity too low.	*Engine speed too low.*	Check the air cylinder and air filter(s).
	Blocked air cleaner.	Check the restriction indicators and replace the element(s) if necessary.
	High pressure air escaping.	Check for leaks.
	Incorrectly set regulation system.	Reset the regulation system. Refer to *SPEED AND PRESSURE REGULATION ADJUSTMENT* in the *MAINTENANCE* section of this manual.
Compressor overheats.	*Low oil level.*	Top up the oil level and check for leaks.
	Dirty or blocked oil cooler.	Clean the oil cooler fins.
	Incorrect grade of oil.	Use Doosan recommended oil.
	Recirculation of cooling air.	Move the machine to avoid recirculation.
	Faulty temperature switch.	Check the operation of the switch and replace if necessary.
	Reduced cooling air from fan.	Check the fan and the drive belts. Check for any obstruction inside the fan cowl.
Excessive oil present in the discharge air.	*Blocked scavenge line.*	Check the scavenge line, drop tube and orifice. Clean and replace.
	Perforated separator element.	Replace the separator element.
	Pressure in the system is too low.	Check the minimum pressure valve or sonic orifice.

FAULT	CAUSE	REMEDY
Safety valve operates.	*Operating pressure too high.*	Check the setting and operation of the regulator valve piping.
	Incorrect setting of the regulator.	Adjust the regulator.
	Faulty regulator.	Replace the regulator.
	Inlet valve set incorrectly.	Refer to *SPEED AND PRESSURE REGULATION ADJUSTMENT* in the *MAINTENANCE* section of this manual.
	Loose pipe/hose connections.	Check all pipe/hose connections.
	Faulty safety valve.	Check the relieving pressure. Replace the safety valve if faulty. **DO NOT ATTEMPT A REPAIR.**

FAULT	CAUSE	REMEDY
Oil is forced back into the air filter.	*Incorrect stopping procedure used*	Always employ the correct stopping procedure. Close the discharge valve and allow the machine to run on idle before stopping.
	Faulty inlet valve.	Check for free operation of the inlet valve(s).
	Faulty discharge check valve.	Remove the valve from the discharge pipe and check the operation.
Machine goes to full pressure when started.	*Inlet valve set incorrectly.*	Refer to *SPEED AND PRESSURE REGULATION ADJUSTMENT* in the *MAINTENANCE* section of this manual.
Machine fails to load when the load button is pressed.	*Faulty load solenoid.*	Replace the solenoid. Check the electrical circuit by feeling for movement whilst depressing the load button.

LUBRICATOR

SAFETY

WARNING: Ensure that the lubricator filler cap is re–tightened correctly after replenishing with oil.

WARNING: Do not replenish the lubricator oil, or service the lubricator without first making sure that the machine is stopped and the system has been completely relieved of all air pressure (Refer to *STOPPING THE UNIT* in the *OPERATING INSTRUCTIONS* section of this manual).

CAUTION: *If the nylon tubes to the lubricator are disconnected then ensure that each tube is re–connected in its original location.*

GENERAL INFORMATION

Oil capacity: 2 litres

Oil specification:
Refer to the *Tool Manufacturer's Manual*.

OPERATING INSTRUCTIONS

COMMISSIONING

Check the lubricator oil level and fill as necessary.

PRIOR TO STARTING

Check the lubricator oil level and replenish as necessary.

MAINTENANCE

Check the lubricator oil level and replenish as necessary.

FAULT FINDING

FAULT	CAUSE	REMEDY
No oil flow.	*Incorrect connection.*	Reverse the nylon tube connections to the lubricator.

GENERATOR
(WDG)

SAFETY

Refer to the *SAFETY SECTION* in this manual.

GENERAL INFORMATION

Rated output.	4,8 kW @ 0,8 Power factor (PF) lagging
Rated voltage	110V 1ph or 230V 1ph or 230V 3ph or 400V 3ph + 230V 1ph @ 3000 revs min^{-1}
Voltage regulation	+/– 6%
Maximum continuous output	6 kVA @ 0,8 PF
Rotor type	Brushless (110/230V 1ph)
Rotor type	Rotating armature with sliprings (230V 3ph / 400V 3ph + 230V 1ph)

De–rating factors at 0.8 pf continuous load:

Air in temp 20°C	Continuous
Air in temp 30°C	5,7 KVA @ 0.8 p.f continuous
Air in temp 46°C	4,5 KVA @ 0.8 p.f continuous

De–rating factors for intermittant load:

Air in temp 20–35°C,55 mins/hr @ 0.8, 5 mins off load
Air in temp 35–40°C,50 mins/hr @ 0.8, 10 mins off load
Air in temp 40°C + ,45 mins/hr @ 0.8, 15 mins off load

Socket outlets:

110V 1ph & 230V 1ph	1 x 32 amperes 2 x 16 amperes
230V 3ph	1 x 16 amperes
400V 3ph + 230V 1ph	400V 3ph = 1 x 16 amperes 230V 1ph = 2 x 16 amperes

Earth leakage protection is provided by a single residual current device. Miniature circuite breakers (MCB) are fitted to provide both overcurrent and short circuit protection for the generator.

Each socket outlet is protected by a spring loaded weather-proof cover.

OPERATING INSTRUCTIONS

A mode selector switch is provided to switch the machine between compressor and generator mode.

CAUTION: *Do not start or stop the machine with the compressor/generator mode switch in the* ***Generator*** *position.*

When the switch is in the *Generator* position the normally–open solenoid valve switches to the closed position and air in the line to the engine speed control cylinder vents to the atmosphere via the solenoid exhaust port. This causes the cylinder to move to its maximum speed position. The engine will now maintain maximum speed as the air line from the pressure regulator valve to the solenoid valve is now closed.

When the switch is returned to the *Compressor* position, the solenoid valve is de–energised thus returning it to its normally open position. The engine speed cylinder would then respond via the pressure regulator valve according to the air demand.

When connecting electrical equipment to any of the socket outlets, it is recommended that the appropriate MCB is in the *OFF* position before making the connection, switching the MCB to the *ON* position immediately prior to using the equipment.

PRIOR TO STARTING (GENERATOR)
(WDG)

If the generator should become exposed or saturated with moisture/water deposits, it must be safely dried off before attempting to make any part or conductor electrically live. This should be done by wiping away excess water, then running the engine with no electrical loads connected, until the generator is completely dry.

Ensure all persons concerned are suitably competent with electrical installations.

Ensure that there is a safe working procedure which has been issued by supervisory personnel, and that it is understood by all persons concerned with the operation of the generator.

Ensure that the safety procedure to be applied is based on the appropriate national regulations.

Ensure that the safety procedure is followed at al times.

Ensure that suitable guidance codes are available to indicate safe working practices, and any hazards to avoid.

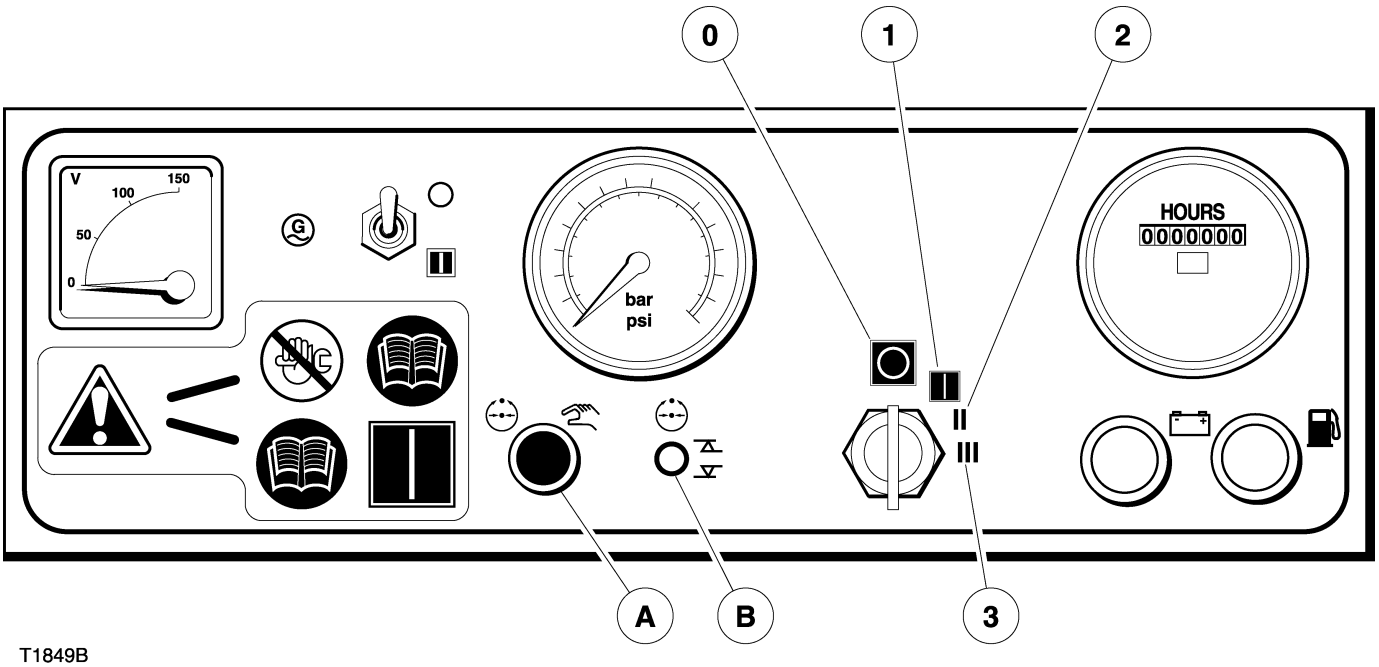
Before starting the engine and switching in the generator load, ensure that :–

. The system has been inspected and earthed.

. No persons are in a hazardous position.

. Any warnings necessary have been suitably displayed (where applicable).

Ensure compressor / generator mode switch is set to compressor.



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Revision 00
01/03

STARTING THE MACHINE

WARNING: Under no circumstances should volatile liquids such as Ether be used for starting this machine.

CAUTION: *Do not start or stop the machine with the compressor/generatormode switch in the* ***Generator*** *position.*

All normal starting functions are incorporated in the key operated switch.

. Turn the key switch to position *1*, the alternator charge light will illuminate.

. Turn the key switch to position *3* (engine start position).

. Release to position *2* when the engine starts.

. Release to position *1* when the alternator charge light is extinguished.

At temperatures below 0°C or if there is difficulty starting first time:

Push and release button 'A'.

. Allow the engine to reach operating temperature.

. At this point in the operation of the machine it is safe to apply full load to the engine.

NOTE: Wear hearing protection at all times when the engine is started with the top open and air is flowing from the valve.

STOPPING THE MACHINE

. Close the service valve.

. Allow the machine to run unloaded for a short period of time to reduce the engine temperature.

. Turn the start switch to the *0* (off) position.

NOTE: As soon as the engine stops, the automatic blowdown valve will relieve all pressure from the system.

If the automatic blowdown valve fails to operate, then pressure must be relieved from the system by means of the service valve(s).

CAUTION: *Never allow the machine to stand idle with pressure in the system.*

EMERGENCY STOPPING

In the event that the unit has to be stopped in an emergency, **TURN THE KEY SWITCH LOCATED ON THE INSTRUMENT PANEL TO THE *0* (OFF) POSITION.**

RE–STARTING AFTER AN EMERGENCY

If the machine has been switched off because of a machine malfunction, then identify and correct the fault before attempting to re–start.

If the machine has been switched off for reasons of safety, then ensure that the machine can be operated safely before re–starting.

Refer to the *PRIOR TO STARTING* and *STARTING THE UNIT* instructions earlier in this section before re–starting the machine.

MONITORING DURING OPERATION

Should any of the safety shut-down conditions occur, the unit will stop. These are:

- Low engine oil pressure
- High air discharge temperature
- High engine oil temperature.
- Alternator/drive belt failure circuit.
- Low engine fuel level.

CAUTION: *To ensure an adequate flow of oil to the compressor at low temperature, never allow the discharge pressure to fall below 3,5 bar.*

DECOMMISSIONING

When the machine is to be permanently decommissioned or dismantled, it is important to ensure that all hazard risks are either eliminated or notified to the recipient of the machine. In particular:–

- Do not destroy batteries or components containing asbestos without containing the materials safely.
- Do not dispose of any pressure vessel that is not clearly marked with its relevant data plate information or rendered unusable by drilling, cutting etc.
- Do not allow lubricants or coolants to be released into land surfaces or drains.
- Do not dispose of a complete machine without documentation relating to instructions for its use.

MAINTENANCE

General

Ensure all electrical equipment is properly maintained and controlled.

Ensure all earth connections are secure and regularly maintained.

Earth leakage circuit breaker (ELCB)

The earth leakage circuit breaker must be mechanically tested daily by pushing the test button with the machine in its *no load* condition. The ELCB should trip to the *off* (down) position.

The earth leakage circuit breaker should also be tested every 3 months. A proprietary test meter should be used to induce live to earth preset flow at each socket outlet. This current flow will produce the required earth fault check. The test should be conducted in accordance with appropriate national standards.

Instruments and controls

A Voltmeter is provided to indicate the output voltage.

Miniature circuit breakers provide over–current protection. In the event of excess current the appropriate circuit breaker will trip to the *OFF* position.

Note: The current trip rating is quoted at a nominal 40°C ambient temperature.

An earth leakage circuit breaker provides additional protection in the event of a leakage to earth in excess of 30 milliamperes on the connected appliance or in the connections to the generator.

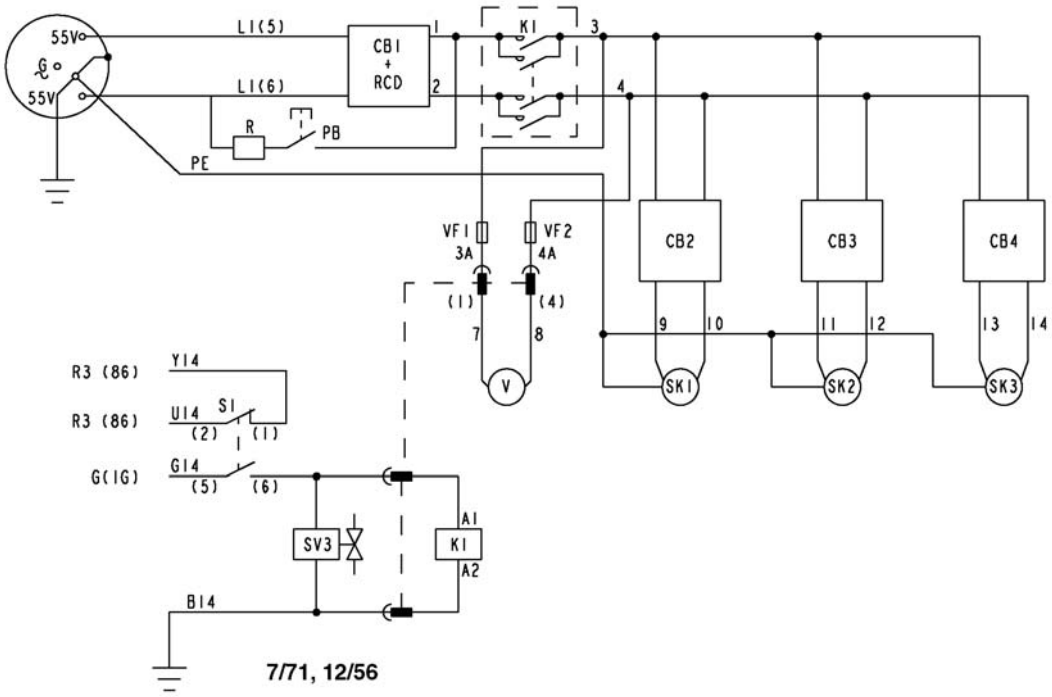
For alternator maintenance refer to Mecc Alte operation and maintenance manual.

FAULT FINDING

FAULT	CAUSE	REMEDY
No output.	*Load plugs not fitted into socket outlets correctly.*	Ensure that the load plugs are fitted correctly into the socket outlets.
No output.	*Loose connection.*	Remove end cover and terminal box lid and check for loose connections. Rectify the fault as necessary.
	Faulty rectifier.	Check the rectifier bridge which is located inside the rear housing.
	Faulty capacitor.	Check the capacitors.
	The No load voltage is low but increases when a load is applied.	Check the capacitors and associated wiring.
	The No load voltage falls when a load is applied.	Check the capacitors and associated wiring.
	Loss of residual magnetic field	Refer to Mecc Alte maintenance manual
No output.	*Output winding(s) damaged.*	Measure the voltage across the winding(s). Replace the generator if damaged.
	Field winding damaged.	Replace the generator.
Generator fails to provide maximum output.	*Engine is not running at full speed.*	Check the engine speed with a tachometer. Consult Doosan if the engine is found to be running slow (Refer to section 4 *General Information*).
	Drive belt is not tensioned correctly.	Re–tension the drive belt.
	Drive pulley is loose on the drive shaft.	Check the drive pulley and tighten as required.

FAULT	CAUSE	REMEDY
The output voltage collapses when a load is connected.	*Overload condition.*	Check and reset each circuit breaker. If the condition persists then investigate the cause and rectify the fault as necessary. (see also '*Circuit breaker trips*')
	Short circuit.	Check for a short circuit and rectify the fault as necessary.
	Incorrect wiring.	Check the wiring and rectify the fault as necessary.
Circuit breaker trips.	*Overload condition.*	Check and reset each circuit breaker. If the condition persists then investigate the cause and rectify the fault as necessary. (see also '*Circuit breaker trips*')
	Short circuit.	Check for a short circuit and rectify the fault as necessary.
	Fault in appliance.	Check the appliance and rectify the fault as necessary.
A circuit breaker fails to re–set whilst the machine running.	*Circuit breaker latching mechanism faulty.*	Repair or replace as necessary.
Refer to *Engine Manufacturer's manual* and *Mecc Alte manufacturer's manual*		

A.C. Electrical Power Schematic Diagram. 115V 1 – phase.

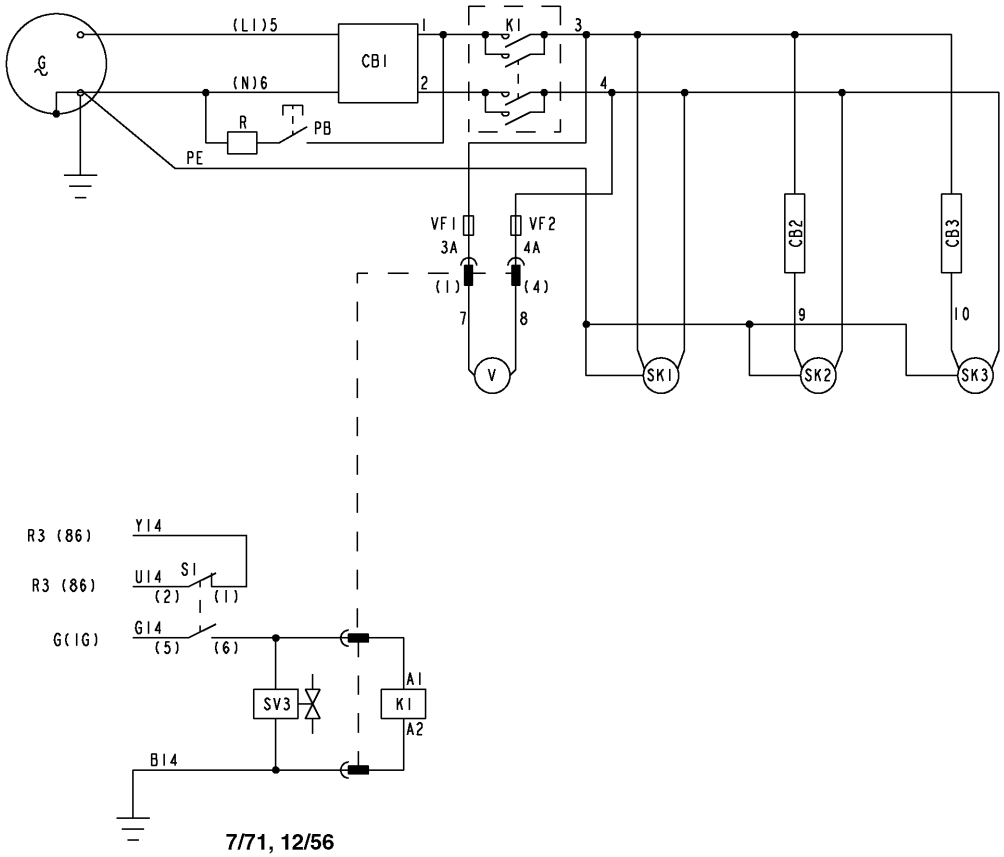


89231781
REV C

KEY

CB1	Circuit breaker 63A
CB2	Circuit breaker 32A
CB3	Circuit breaker 16A
CB4	Circuit breaker 16A
G	Alternator
K1	Contactor
PB	Pushbutton
R	Resistor
S1	Switch, start
SK1	Socket outlet 32A
SK2	Socket outlet 16A
SK3	Socket outlet 16A
SV3	Valve, solenoid
V	Voltmeter
VF1	Fuse Voltmeter
VF2	Fuse Voltmeter

A.C. Electrical Power Schematic Diagram. 230V 1 – phase.

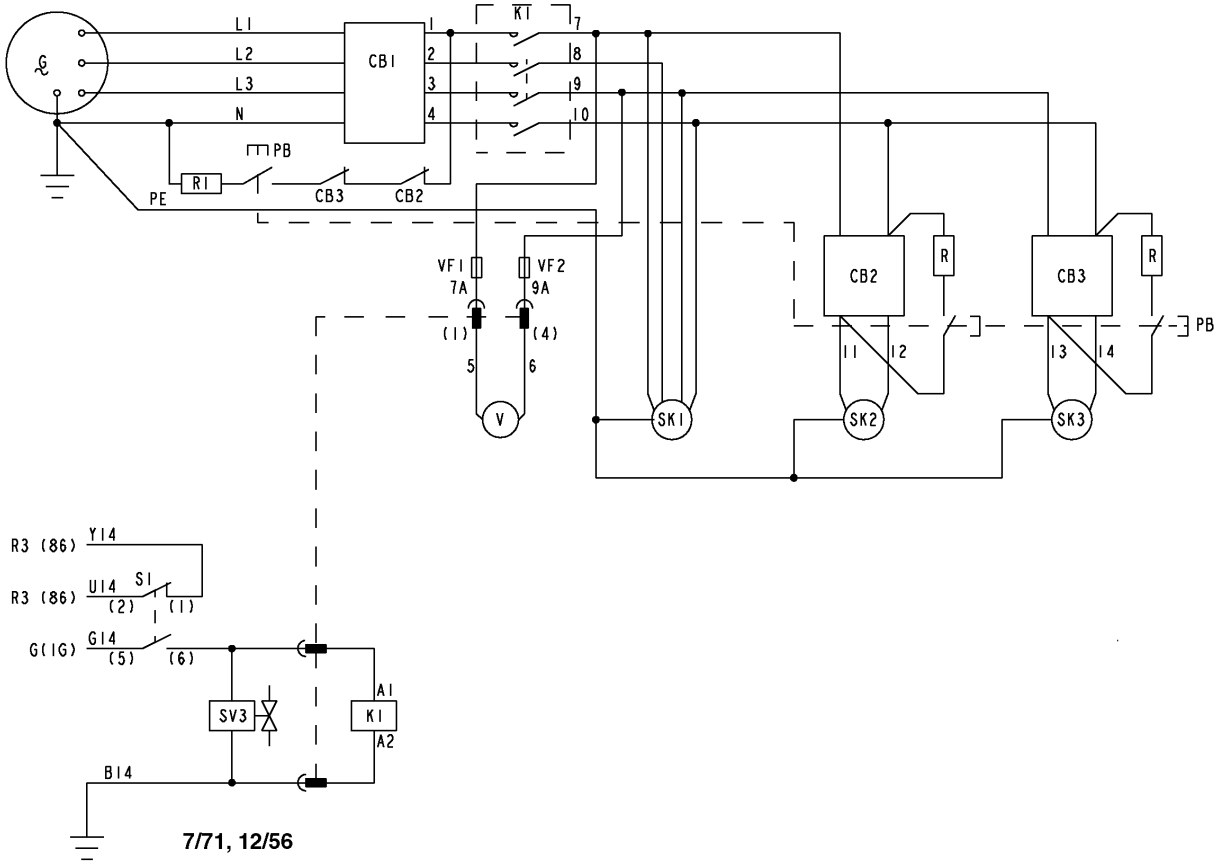


89231773
REV C

KEY

CB1	Circuit breaker 32A
CB2	Circuit breaker 16A
CB3	Circuit breaker 16A
G	Alternator
K1	Contactor
PB	Pushbutton
R	Resistor
S1	Switch, start
SK1	Socket outlet 32A
SK2	Socket outlet 16A
SK3	Socket outlet 16A
SV3	Valve, solenoid
V	Voltmeter
VF1	Fuse Voltmeter
VF2	Fuse Voltmeter

A.C. Electrical Power Schematic Diagram. 400/230V 3 – phase.



89230510
REV C

KEY

CB1	Circuit breaker 16A
CB2	Circuit breaker 10A
CB3	Circuit breaker 10A
G	Alternator
K1	Contactor
PB	Pushbutton
R	Resistor
R1	Resistor
S1	Switch, start
SK1	Socket outlet 16A
SK2	Socket outlet 16A
SK3	Socket outlet 16A
SV3	Valve, solenoid
V	Voltmeter
VF1	Fuse Voltmeter
VF2	Fuse Voltmeter

4IRD5N ENGINE

CONTENTS

46 **FOREWORD**

47 **EXTERNAL VIEWS: 4IRD5N**

GENERAL INFORMATION: 4IRD5N

Main data and specifications

Engine identification

After sales support

EMISSION CONTROL LABEL

49 **FUEL, LUBRICANT, AND COOLANT**

Fuel

Lubricant

Coolant

51 **OPERATION**

Check before operation

Check and operation after start– up

Operation and care of a new engine

54 **PERIODICAL INSPECTION AND MAINTENANCE**

Lubricating system

Cooling system

Fuel system

Air intake system

Routine maintenance

59 **COLD WEATHER OPERATION**

60 **MAINTENANCE SCHEDULE**

63 **TROUBLESHOOTING**

ENGINE – General Information

In order to get the fullest use and benefit from your engine, it is important that you operate and maintain it correctly. This Manual is designed to help you do this.

Please read this Manual carefully and follow its operating and maintenance recommendations. This will ensure many years of trouble−free and economical engine operation.

Should your engine require servicing, please contact your nearest branch or distributor.

All information, illustrations, and specifications contained in this Manual are based on the latest product information available at the time of publication.

The company reserves the right to make changes in this Manual at any time without prior notice.

DIESEL ENGINE Engine External View – Model 4IRD5N

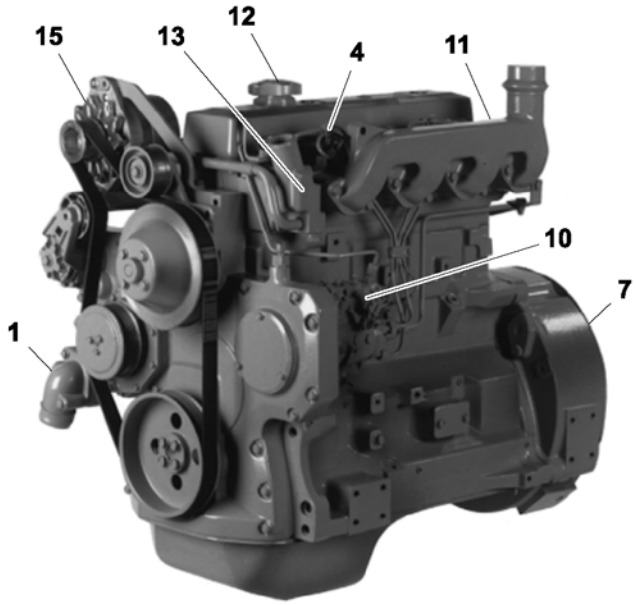


Fig. 1 (Left–hand Side)

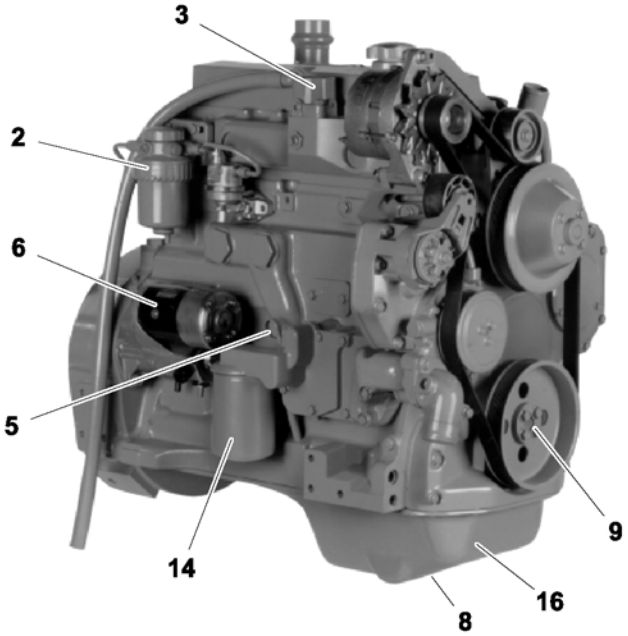


Fig. 2 (Right–hand Side)

(1) Water pump
(2) Secondary fuel filter
(3) Inlet manifold
(4) Injection nozzle
(5) Oil dipstick
(6) Starter motor
(7) Flywheel
(8) Oil drain plug
(9) Crank shaft pulley
(10) Injection pump
(11) Exhaust manifold
(12) Oil filler cap
(13) Thermostat housing
(14) Oil filter
(15) Alternator
(16) Oil pan

EPA CERTIFIED ENGINE DATA and SPECIFICATIONS

Model: 4IRD5N

Engine model name		4IRD5N
Engine type		Water–Cooled, four cycle, in–line overhead valve type
Combustion type		Direct injection
No. of cylinders – bore x stroke. mm (in)		4–106 x 127 (4.19 x 5.0)
Engine displacement L(cid)		4.5 (276)
Compression ratio		17.6:1
Firing order		1–3–4–2
Exhaust emission control system		Engine modification
Governor		Mechanical type
Injection nozzles		Multi–hole type
Specified fuel		Diesel fuel (ASTM D975 No. 2–D)
Starter (V–kW)		12 – 2.2
Alternator (V–A)		12 – 50
Specified engine oil (API grade)		CG – 4
Coolant volume (Engine only) L (qts)		4.5 (4.8)
Engine dry weight kg (lb)		387 (851)
Engine dimensions	Overall length mm (in)	861 (33.9)
	Overall width mm(in)	598 (23.5)
	Overall height mm(in)	854 (33.6)
Valve clearance (cold) mm(in)		
Nozzle injection pressure MPa (psi)		
Injection timing B.T.D.C.		

ENGINE IDENTIFICATION

Serial No Location

The engine serial number is stamped on a plate located on the rear right of the cylinder body, near the fuel filter

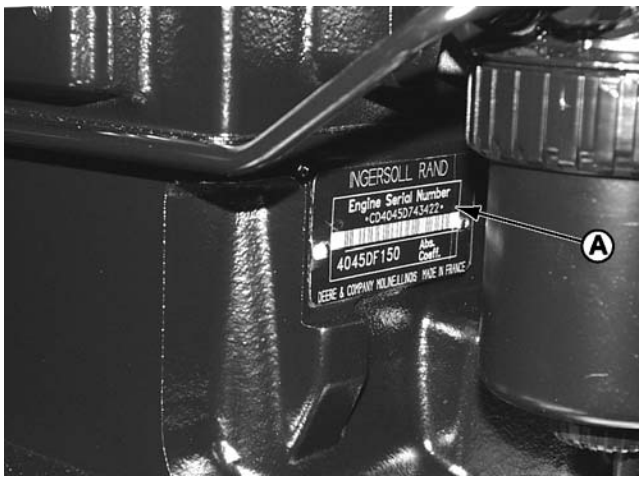


Fig. 3

A. Engine serial number

Confirmation of Engine Number

It is advisable to quote the engine serial number together with the machine serial number, as it is required when you contact the company branch or distributor for repair, service or parts ordering.

CAUTION: Conduct confirmation of engine serial number with the engine stopped. To avoid being injured, do not check it, while the engine is still hot.

ENGINE AFTER SERVICE

Please feel free to contact your dealer for periodical inspection and maintenance.

Doosan Genuine Parts

Genuine Doosan parts are identical with those used in the engine production, and accordingly, they are warranted.

Genuine Doosan parts are supplied by your branch or distributor.

Please ensure that only genuine Doosan parts, lubricants and fluids are used for service and/or repair.

FUEL

Fuel Selection

The following properties are required of the diesel fuel.

Must have high cetane value., (45 or greater)

The sulfur content must not exceed 0.5% by volume. A higher sulfur content fuel may cause sulfuric acid corrosion in the cylinders of the engines.

NEVER mix kerosene, used engine oil, or residual fuels with the diesel fuel.

Water and sediment in the fuel should not exceed 0.05% by volume.

Keep the fuel tank and fuel–handling equipment clean at all times.

Poor quality fuel can reduce engine performance and/or cause engine damage.

Fuel additives are not recommended. Some fuel additives may cause poor engine performance. Consult your Portable Power representative for more information.

Ash content not to exceed 0.01% by volume.

Carbon residue content not to exceed 0.35% by volume. Less than 0.1% is preferred.

Total aromatics content should not exceed 35% by volume. less than 30% is preferred.

PAH (polycyclic aromatic hydrocarbons) content should be below 10% by volume.

Metal content of Na, Mg, Si, and Al should be equal to or lower than 1 mass ppm. (Test analysis method JPI–5S–44–95).

Lubricity: Wear mark of WS1.4 should be Max. 01018 in (460 um) at HFRR test.

Diesel fuel should comply with the specifications listed in the table below. The table lists several worldwide specifications for diesel fuels.

Diesel Fuel Specification	Location
No. 2–D, No. 1–D, ASTM D975–94	USA
EN590:96	European Union
ISO 8217 DMX	International
BS (BRITISH STANDARD) BS2869–A1 or A2	United Kingdom
JIS K2204 Grade No. 2	Japan
KSM–2610	Korea
GB252	China

FUEL REQUIREMENTS

Notice: The fuel injection pump, injector or other parts of the fuel system and engine can be damaged if you use any fuel or fuel additive other than those specifically recommended by Doosan.

NOTE: If any fuel other than the one specified is used, engine operation will be impaired. Engine failure or malfunction resulting from use of such improper fuel will not be warranted by Doosan.

To help avoid fuel system or engine damage, please read the following:

Do not use diesel fuel which has been contaminated with engine oil. Besides causing engine damage, such fuel can also affect emission control. Before using any diesel fuel, check with the fuel supplier to see if the fuel has been mixed with engine oil.

Your engine is designed to use either Number 1–D or Number 2–D diesel fuel. However, for better fuel economy, use Number 2–D diesel fuel whenever possible. At temperatures less than –7°C, (20°F), Number 2–D fuel may pose operating problems (see “Cold Weather Operation” which follows). At colder temperatures, use Number 1–D fuel (if available) or use a “winterized” Number 2–D (a blend of Number 1–D and Number 2–D). This blended fuel is usually called Number 2–D also, but can be used in colder temperatures than Number 2–D fuel which has not been “winterized.”

Check with the fuel supplier to be sure you get the properly blended fuel.

NOTICE: Do not use home heating oil or gasoline in your diesel engine; either may cause engine damage.

Handling of the Fuel.

Any fuel containing dust particles or water might cause engine failure.

Therefore, the following must be observed.

Take care to protect the fuel from ingress of dust particles or water when filling the fuel tank.

If refueling is done from an oil drum directly, ensure that it has been kept stationary to allow any dust, sediment or water to settle at the bottom. Do not draw fuel direct from the bottom of the drum to prevent pickup of any settled foreign material.

Always fully fill the fuel tank. Drain the sedimented particles in the fuel tank frequently.

Water in Fuel

During refueling, it is possible for water (and other contaminants) to be pumped into your fuel tank along with the diesel fuel. This can happen if a fuel provider does not regularly inspect and clean its fuel tanks, or receives contaminated fuel from its supplier(s). To protect your engine from contaminated fuel, there is a fuel filter system on the engine which allows you to drain excess water.

CAUTION: *The water/diesel fuel mixture is flammable, and could be hot. To avoid personal injury and/or property damage, do not touch the fuel coming from the drain valve, and do not expose the fuel to open flames or sparks.*

Be sure you do not overfill the fuel tank. Heat (such as from the engine) can cause the fuel to expand. If the tank is too full, fuel could be forced out. This could lead to a fire and the risk of personal injury and/or equipment damage.

Biocides

In warm or humid weather, fungus and/or bacteria may form in diesel fuel if there is water in the fuel.

NOTICE: Fungus or bacteria can cause fuel system damage by plugging the fuel lines, fuel filters or injector. They can also cause fuel system corrosion.

If fungus or bacteria has caused fuel system problems, you should have your authorized dealer correct these problems. Then, use a diesel fuel biocide to sterilize the fuel system (follow the biocide manufacturer‘s instructions). Biocides are available from your dealer, service stations, parts stores and other automotive places. See your authorized dealer for advice on using biocides in your area and for recommendations on which biocides you should use.

Smoke Suppressants

The use of a smoke suppressant additive is not allowed because of the greater possibility of stuck rings and valve failure, resulting from excessive ash deposits.

LUBRICANT.

The quality of engine oil can affect engine performance, startability and engine life.

Use of unsuitable engine oil will result in piston ring, piston and cylinder seizure and accelerate surface wear causing increased oil consumption, lowered output and, finally engine failure. To avoid this, use the specified engine oil.

1) Engine Oil Selection
PRO–TEC

2) Oil Viscosity

Engine oil viscosity affects engine startability, performance, oil consumption, wear and the potential for seizure, etc. Always ensure that lubricants with the correct viscosity for the operating temperature are used. Refer to fig 12.

NOTE

Using a mixture of different brands or quality of oils will adversely affect the original oil quality; therefore, never mix different brand or different type oils.

Do not use API, CA, CB grade and reconstituted engine oil.

Engine damage due to improper maintenance, or using oil of the improper quality and/or viscosity, is not covered by the warranty.

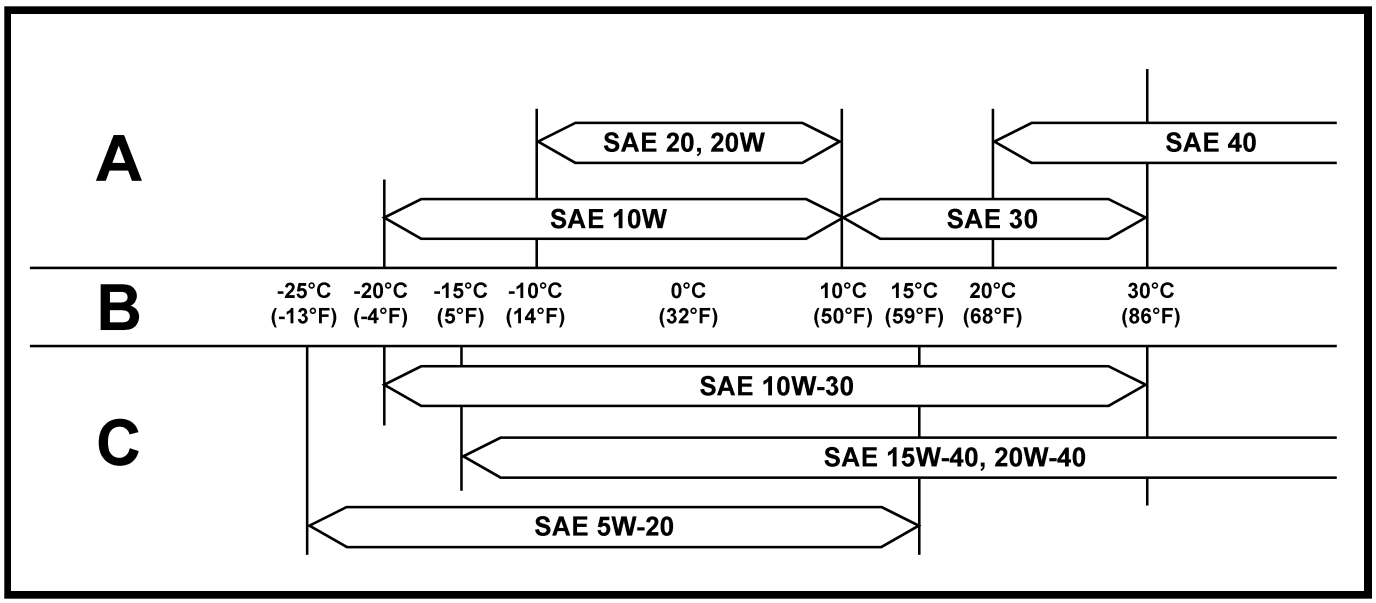


Fig. 12

A. (Single – grade)

B. Ambient Temperature

C. (Multi – grade)

COOLANT

All Doosan portable compressor engines are factory filled with a 50/50 Ethylene glycol base antifreeze/water mix. which provides protection to –33°C (–27°F).

IMPORTANT:

- *Be sure to add Long Life Coolant Antifreeze (LLC) to soft water. In cold season, the LLC is especially important. Without LLC, cooling performance will decrease due to scale and rust in the cooling water line. Without LLC, cooling water will freeze and expand to break the cooling line.*
- *Be sure to use the mixing ratios specified by the LLC manufacturer for your temperature range.*
- *Do not mix different types (brand) of LLC, chemical reactions may make the LLC useless and engine trouble could result.*
- *Replace the cooling water every once a year.*

***CAUTION**: When handling Long Life Coolant Antifreeze, wear protective rubber gloves not to contact with it. If contact with the eyes or skin should occur, wash with clean water.*

ENGINE OPERATION

Engine Exhaust Gas Caution (Carbon Monoxide)

CAUTION

Do not breathe exhaust gas because it contains carbon monoxide, which by itself has no color or odor. Carbon monoxide is a dangerous gas. It can cause unconsciousness and can be lethal.

Do not run the engine in confined areas (such as garages or next to a building). Keep the exhaust tailpipe area clear of snow and other material to help reduce the buildup of exhaust gases under the equipment. This is particularly important when parked in blizzard conditions.

CHECK BEFORE OPERATION

CAUTION: For safety reasons, conduct the inspection with the engine stopped.

Engine Oil Level.

Place the engine or the machine on a level surface

Remove the dipstick, wipe it with a cloth. Insert it fully and take it out gently again.

Check the oil level against the marks on the dipstick. The oil level must be between the ”Max” level mark and the ”Min” level mark as illustrated.

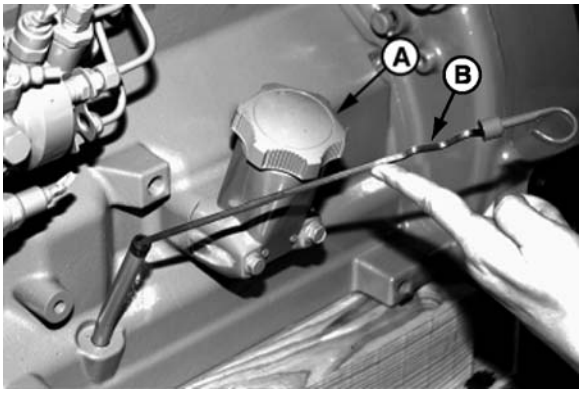


Fig. 5

A Oil filler cap

B Dipstick

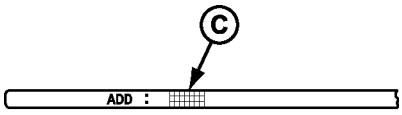


Fig. 6

Oil level within area C is acceptable

Also check the sample oil on the dipstick for contamination and viscosity.
Take care not to add too much engine oil

Oil can be poured either through the oil filler at the front of the cylinder head cover or through the oil filler on the right side of the timing gear case.

A certain period of time is required before the engine oil completely flows down from the oil filler to the crankcase. Wait at least ten minutes before checking the oil level.

NOTE: Take care to avoid engine oil being splashed on the fan drive belt because it causes belt slippage or slackness.

CAUTION: When adding oil, take care not to spill it. If you spill oil on the engine or equipment, wipe it properly, to prevent the risk of fire and personal injury and/or equipment damage.

Fan Belt Check

Check the fan belt for tension and abnormalities.

When the belt is depressed 8 – 10 mm with the thumb (about 100 N [10 kg] pressure) midway between the fan pulley and alternator pulley, the belt tension is correct.

If the belt tension is too high, it will result in alternator failure.

A loose belt will cause belt slippage which may result in a damaged belt, abnormal noise, poor battery charging and engine overheating.

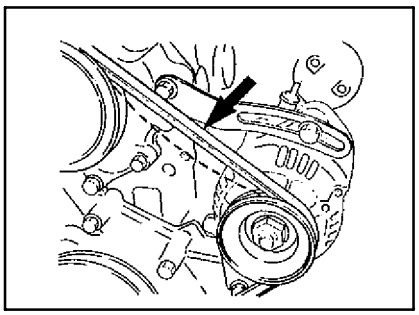


Fig. 7

Coolant Level Check

The coolant level must be between “MAX COLD” and “MIN” marks on the reserve tank depending on the temperature of the engine. Check and ensure that the level is correct.

CAUTION: When removing the radiator filler cap, while the engine is still hot, cover the cap with cloth, then turn it slowly to gradually release the internal steam pressure. this will prevent anyone from being scalded by hot steam spurting out from the filler neck.

Add coolant mixed to the correct ratio: 50/50 ethylene glycol/water.

Radiator Cap Condition

After the replenishment of the coolant, install the radiator filler cap. Make sure the cap is securely installed.

Battery Cable Connection

Check the battery cable connections for looseness or corrosion. A loosened cable connection will result in hard engine starting or insufficient battery charge. The battery cables must be tightened securely. Never reverse “+” and “–” terminals when reconnecting cables after disconnection. Even a short period of reverse connection will damage the electrical parts.

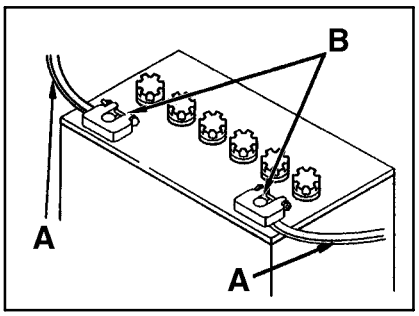


Fig. 8

A Battery cable

B Connections

Battery Electrolyte level

The amount of electrolyte in the batteries will be reduced after repeated discharge and recharge. Check the electrolyte level in the batteries, replenish with a commercially available electrolyte such as distilled water, if necessary. The battery electrolyte level checking procedure will vary with battery type. NOTICE: Do not replenish with dilute sulfuric acid in the daily service.

CAUTION:

When inspecting the batteries, be sure to stop the engine first.

As dilute sulphuric acid is used as electrolyte, be careful not to contaminate your eyes, hands, clothes, and metals with the electrolyte. If it gets in your eye, wash with a large amount of water at once, then seek medical advice.

As highly flammable hydrogen gas is released from the batteries, do not create a spark or allow any naked flame near the batteries.

When handling such metallic articles as tools near the batteries, be sure not to contact the "+" terminal because the compressor body is "–" and a dangerous short circuit might result.

When disconnecting the terminals, start with "–" terminal. When connecting them, connect the "–" terminal last.

CHECKS AND OPERATION AFTER START–UP

Check after the Engine Start–up

Check the following items in the engine warming–up operation.

Engine oil pressure –

The engine oil pressure gauge readings (where fitted) may vary depending on ambient temperature and type of oil. The gauge should register around 55 to 85 psi in the warming–up period.

Engine noise and exhaust smoke color –

Listen to the engine and, if any abnormal noise is heard, check to determine the cause.

Check the fuel combustion condition by observing the exhaust smoke color. The exhaust smoke color after engine warm–up and at no–load condition should be colorless or light blue.

Black or white smoke indicates incorrect combustion.

Note: *After start–up from cold the engine might be noisier and the exhaust smoke color darker than when it has warmed up. However this condition will disappear after warm up.*

Leakage in the systems –

Check the following items:

Lubrication oil leakage –

Check the engine for oil leaks, paying particular attention to oil filter and oil pipe joints.

Fuel leakage –

Check the fuel injection pump, fuel lines and fuel filter for leakage.

Coolant leakage – Check the radiator and water pump hose connections and the water drain cock on the cylinder block for leakage.

Exhaust smoke or gas leakage

Checking coolant level

The coolant level could drop because any mixed air is expelled in about 5 minutes after the engine started.

Stop the engine, remove radiator cap, and add coolant.

CAUTION: Hot steam can rush out and you could get burnt if the radiator cap is removed when the engine is hot. Cover the radiator cap with a thick cloth and loosen the cap slowly to reduce the pressure, then remove the cap.

OPERATION AND CARE OF A NEW ENGINE.

Your engine is carefully tested and adjusted in the factory, however, further run–in is necessary. Avoid any harsh engine operation within the initial 100 operating hours.

Do not operate the unit at full load until the engine is warmed–up.

Do not allow the engine to run unloaded for extended periods so as to minimise the risk of cylinder bore glazing.

During operation, pay attention to the following points if the engine shows any sign of abnormalities.

(1) Engine Oil Pressure – The engine oil pressure is monitored by a switch that will stop the engine if the pressure falls below a pre–set value.
If the oil pressure gauge shows below 30 psi or if the reading fluctuates continually, stop the engine and check the oil level. If the level is correct, contact your local Doosan branch or dealer to establish the cause.

(2) Coolant Temperature – The engine performance will be adversely affected if engine coolant temperature is too hot or too cold. The normal coolant temperature is 75 to 85°C (167 to 185°F).

Overheating

CAUTION:

If you see or hear escaping steam or have other reason to suspect there is a serious overheat condition, stop the engine immediately.

If the Engine Coolant Temperature gage (where fitted) shows an overheat condition, or you have reason to suspect the engine may be overheating, take the following step:

- Close the service valve to reduce the load.
- Let the engine run at normal idle speed for two or three minutes. If the engine coolant temperature does not start to drop, turn off the engine and proceed as follows:

CAUTION: To help avoid being burned –

- Do not open the canopy or door if you see or hear steam or engine coolant escaping. Wait until no steam or engine coolant can be seen or heard before opening the engine canopy or door.
- Do not remove the radiator filler cap if the engine coolant in the reserve tank is boiling. Also do not remove the radiator filler cap while the engine and radiator are still hot. Scalding fluid and steam can be blown out under pressure if either cap is taken off too soon.

If no steam or engine coolant can be seen or heard, open the canopy or door. If the engine coolant is boiling, wait until it stops before proceeding. The engine coolant level should be between the “MAX COLD” and “MIN” marks on the reserve tank.

Make sure the fan belt is not broken, or off the pulley, and that the fan turns when the engine is started. If the engine coolant level in the reserve tank is low, look for leaks at the radiator hoses and connections, radiator, and water pump. If you find major leaks, do not run the engine until these problems have been corrected. If you do not find a leak or other problem, WAIT UNTIL THE ENGINE HAS COOLED DOWN then carefully add engine coolant to the reserve tank.

(Engine coolant is a mixture of ethylene glycol antifreeze and water. See “Engine Care in cold season” for the proper antifreeze and mixture.)

CAUTION: To avoid being burned, do not spill antifreeze or engine coolant on the exhaust system or hot engine parts. Under some conditions the ethylene glycol in engine coolant is combustible.

If the engine coolant level in the reserve tank is at the correct level but there is still an indication of an overheat condition and no cause was found, please consult your local Doosan branch or dealer.

Overcooling

Operating the engine at low coolant temperature will not only increase the oil and fuel consumption but also will lead to premature parts wear which may result in engine failure. Ensure that the engine reaches normal operating temperature 75 to 85°C (167 to 185°F) within ten minutes of starting.

(3) Hourmeter

This meter indicates the machine operation hours. Make sure that the meter is always working during engine operation. Periodical machine maintenance is scheduled on the operation hours indicated on the hourmeter.

(4) Liquid and Exhaust Smoke Leakage

Make regular checks for lubricant, fuel, coolant and exhaust smoke leakage.

(5) Abnormal Engine Noise

In the event of any abnormal engine noise, please consult your local Doosan branch or dealer.

(6) State of the Exhaust Smoke

Check for any abnormal exhaust smoke color.

ENGINE STOPPING

(1) Close service valves.

(2) Before stopping the engine, cool down the engine by operating it at reduced load about three minutes. In this period, check the engine noise and the engine oil pressure (where a gage is fitted) for abnormalities.

LONG TERM STORAGE

If the equipment is to be out of operation for an extended period, it should be started at least once per week and run on load for about 15 minutes after it has reached normal operating temperature.

LUBRICATING SYSTEM.

Servicing of the engine oil and oil filter element will affect the engine performance as well as the engine life. Change the engine oil and the oil filter in accordance with the recommended service intervals.

Engine Oil and Oil Filter Element Change.

Engine Oil Change and Oil Filter Element Change must be made simultaneously according to the following change schedule.

Change intervals: Refer to maintenance schedule section.

Engine Oil draining –

CAUTION: To help avoid the risk of being burned, do not drain oil while the engine is still hot.

Wipe clean around the oil filler cap taking care so that no foreign particles enter. Remove the filler cap.

It is advisable that draining be done while the engine is warm to minimize the draining time.

Remove the oil pan drain plug and drain the engine oil completely.

NOTICE: Use a receptacle to catch the drained oil so that the engine and equipment will not be contaminated.

Fig. 9

Remove drain plug arrowed to drain the engine oil completely.

Oil filter element removal

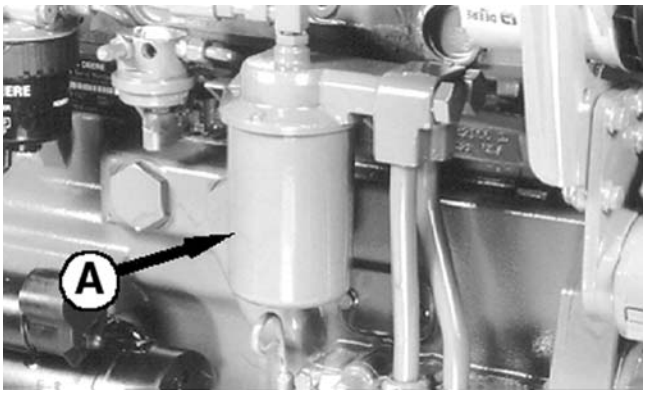


Fig. 10

A Cartridge

Oil filter element installation –

Lightly apply engine oil to the O–ring.

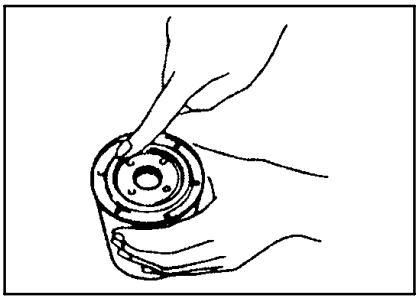


Fig. 11

Screw in the new cartridge hand tight as the O–ring comes in contact with the engine block. Tighten a further $^{3}/_{4}$ to $1^{1}/_{4}$ turns. DO NOT overtighten.

Engine oil refilling.

Reinstall the drain plug.

Fill with new engine oil via the most convenient oil filler port.

Wait at least ten minutes until the oil drains down to the oil pan. Then check the oil level with the dipstick.

Check after Oil and Filter Changes.

Oil leakage check:

Run the unit for five to ten minutes, then visually check for oil leakage.

Oil level recheck:

Stop the engine for at least ten minutes.

Use the dipstick to recheck the oil level. If necessary replenish with engine oil to the specified level

NOTE: When the engine is started, the oil level will slightly drop from the initial level as the oil fills the entire oil circuit.

Engine Oil Additives

Engine oils contain a variety of additives. Your engine should not need any extra additives if you use the recommended oil quality and change intervals.

Used Oil Disposal – Do not dispose of used engine oil (or any other oil) in a careless manner such as pouring it on the ground, into sewers, or into streams or bodies of water. Instead, recycle it by taking it to a used oil collection facility which may be found in your community. If you have a problem disposing of your used oil, it is suggested that you contact your local Doosan branch or dealer. This also applies to diesel fuel which is contaminated with water.

Used Engine Oil

CAUTION: Used engine oil contains harmful contaminants that have caused skin cancer in laboratory animals. Avoid prolonged skin contact. Clean skin and nails thoroughly using soap and water –not mineral oil, fuels, or solvents. Launder or discard clothing, shoes, or rags containing used engine oil.

Discard used engine oil and other oils properly.

COOLING SYSTEM

Checking Belt Wear

The engine is fitted with an automatic belt tensioner, which is designed to operate within the limits provided by fixed stops A & B see fig.12. Inspect position of tension arm; if arm stop C rests on stop B indicating loss of tension, check all mounting brackets and belt length. Replace belt as required

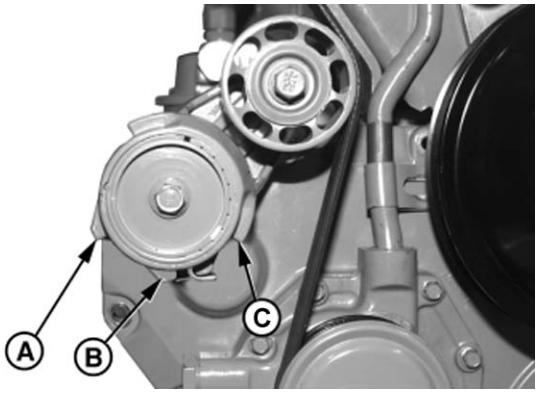


Fig. 12

Checking Tension

Belt tension gauges should not be used to check Automatic tensioners. If necessary the tension provided by the automatic tensioner can be checked as follows.

Remove belt and release all tension

Mark swinging arm (A)

Measure 21mm from A and mark base (B)

Use a torque wrench to measure the torque required to align the marks A & B. (18–22Nm) (refer to fig. 13).

(Note: Thread on belt tensioner roller cap screw is Left Hand thread)

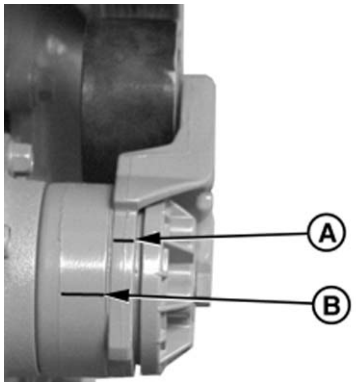


Fig. 13

After the adjustment, operate the engine for about five minutes at a low idle speed, stop the engine and recheck the belt tension. Pay particular attention to this when installing a new belt. Belt tension may vary initially due to the belt bedding in.

Use of Genuine Doosan Fan Belt.

Always use Genuine Doosan fan belts as they provide high driving ability and long operating durability. Use of non–Doosan fan belts could result in premature belt wear or belt elongation leading to engine overheating or excessive belt noise.

Coolant Change

The coolant must be changed at intervals of 2000 hours or twelve months, whichever come first.

If the coolant becomes sludged up it will lead to engine overheating or coolant blow–off from the radiator.

Coolant draining.

WARNING: Hot engine coolant and steam can cause injury. When adding to or draining coolant or antifreeze solution from the engine radiator, stop the engine at least one minute prior to releasing the radiator filler cap. Using a cloth to protect the hand, slowly release the filler cap, absorbing any released fluid with the cloth. Do not remove the filler cap until all excess fluid is released and the engine cooling system fully depressurised.
WARNING: Follow the instructions provided by the antifreeze supplier when adding or draining the antifreeze solution. It is advisable to wear personal protective equipment to prevent skin and eye contact with the antifreeze solution.

Remove the radiator cap.

Slacken the bottom radiator hose clamp to drain the coolant from the radiator.

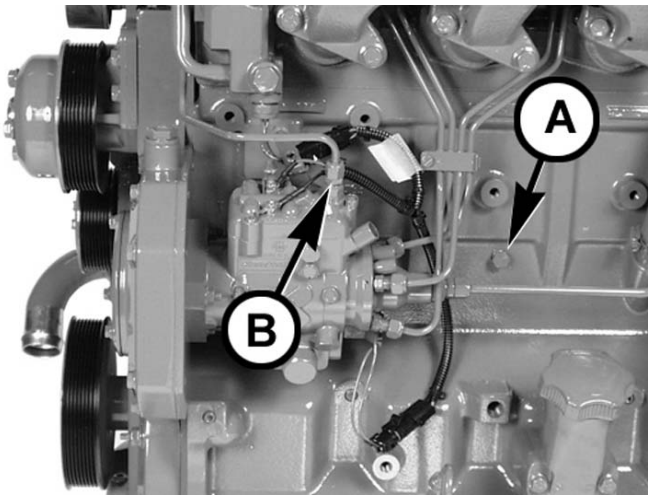


Fig. 14

A Cylinder block water drain plug

Drain the coolant from the engine block by loosening the water drain plug (**A** fig. 26) on the left side of cylinder block behind the alternator.

Filling with coolant

Ensure that the engine is cool.

Close the coolant drain plug and tighten the bottom hose clamp.

Use clean water mixed 50/50 with antifreeze as a coolant. Fill up the radiator with the coolant until the level comes up to the “MAX COLD” mark on the reserve tank.

Fill slowly to prevent air entering the cooling system.

For Coolant volume, refer to ”General Information section”

When the system has been filled, operate the engine about five minutes at a low idle speed, then as the air contained in the coolant circuit is bled off the coolant level will drop.

Stop the engine and replenish with the correct coolant mix.

Cleaning outside of Radiator

Debris, mud or dried grass caught between radiator fins will block the air flow, resulting in lower cooling efficiency. Clean the radiator fins with steam or low pressure (< 5 Bar) compressed air every 250 hours or 3 months (whichever comes first) or more frequently in adverse operating conditions.

Cooling System Circuit Cleaning

When the cooling system circuit is contaminated with water scales or sludge particles, cooling efficiency will be lowered. Periodically clean the circuit interior with a suitable cleaner.

Clean the cooling system circuit every 1000 operating hours or 12 months, whichever comes first.

FUEL SYSTEM

The fuel injection pump and injector nozzles are precisely manufactured, and therefore, using fuel which contains water or dust particles will result in either injection pump plunger seizure or injector nozzle seizure. A fuel filter element blocked with sludge or dust particles will lead to reduced engine output.

Perform inspection and maintenance periodically as follows:

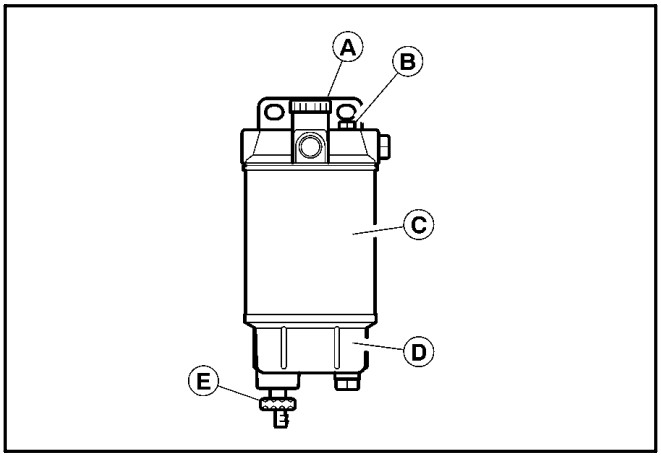


Fig. 15

A Primer pump head

B Vent plug

C Filter element

D Clear bowl

E Drain valve

Draining Water from Fuel Filter/separator.

The fuel filter/separator is provided to allow water to be drained from the fuel system. Water is heavier than fuel so any water contained in the system will collect in the bottom of the bowl.

The clear bowl 'D' should be checked on a daily basis and if water is present, it should be drained from the separator.

Place a suitable container under the separator to prevent any spillage inside the machine.

Slacken the drain valve 'E' until water drains from the vent tube.

When all the water has been evacuated, tighten the drain valve 'E' and follow the "fuel system air bleeding" procedure below.

Fuel filter/separator element change.

***NOTE*:**
The cartridge and bowl contain fuel. Take care not to spill it during disassembly and reassembly.

The fuel filter/separator also provides primary filtration and the element 'C' should be changed every 500 operating hours or 6 months, whichever comes first.

Change procedure:

Unscrew the element 'C' from the head taking care not to spill fuel inside the machine. Drain any fuel within into a suitable container, then unscrew the clear bowl 'D' from the element.

Discard the old element into a suitable container.

Remove the old 'O' ring from the bowl 'D' and install the new one supplied with the element. Apply a light coat of clean engine oil to the 'O' ring and screw the bowl 'D' onto the new element 'C'.

Using a clean cloth, wipe the sealing face of the filter/separator head to ensure correct seating of the sealing ring.

Fill the element/bowl assembly with clean fuel oil then apply a light coat of clean engine oil to the new element seal ring.

Screw the new element onto the head firmly by hand.

Follow the "fuel system air bleeding" procedure below.

Secondary fuel filter

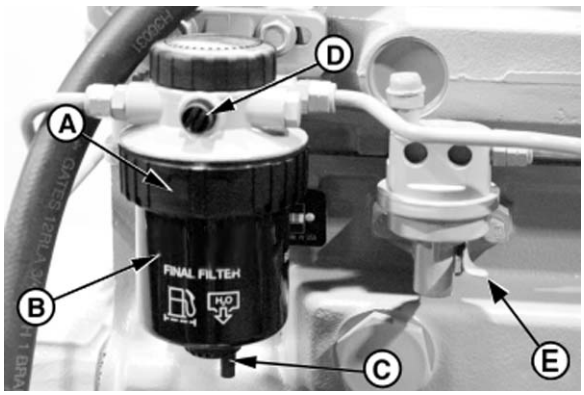


Fig. 16

A Retaining ring

B Cartridge element

C Drain plug

D Bleed plug

E Hand priming lever

The element should be changed every 500 operating hours or 6 months, whichever comes first

Change procedure:

Clean area surrounding fuel filter base.

Loosen drain plug C and empty fuel into suitable container.

Rotate retaining ring A counterclockwise $^1/_4$ turn.

Remove ring and filter cartridge B together.

Install new filter cartridge inside ring and fit to base.

(Note: Top of cartridge has locators which must align with slots in the base.)

Fuel System Air Bleeding

The entry of air into the fuel system will cause difficult engine starting or engine malfunction.

When carrying out service procedures such as emptying the fuel tank, draining the filter/separator, and changing the fuel filter element, be sure to bleed air from the fuel system.

Air bleeding method:

'At fuel filter'

Loosen air bleed screw D (fig. 16).

Operate supply pump priming lever E until fuel flow is free of bubbles.

Tighten bleed screw D, continue operating priming lever until pumping action is not felt.

Start engine and check for leaks

'At injection pump'

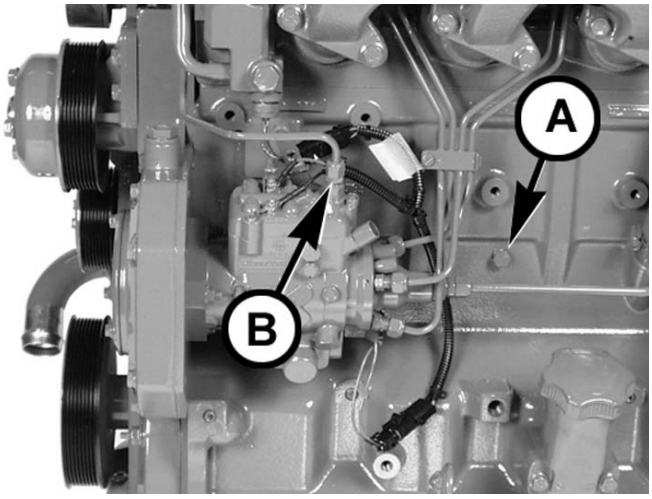


Fig. 17

Slightly loosen fuel return line connector B (fig 17).

Operate supply pump priming lever E until fuel flow is free of bubbles.

Tighten return line connector to 27Nm.

NOTE:
Air can also be bled by use of the primer pump facility in the filter/separator assembly.
By unscrewing the plastic primer pump head 'A' and stroking it up and down, any air bubbles in the system will be purged back to the fuel tank. When this has been completed, the pump head must be screwed back into the filter/separator assembly

Start the engine and visually check the fuel system for leaks.

Governor Control Seals

As the governor is precisely adjusted, most of the controls are sealed, please do not break them. Should any adjustment be necessary, contact your local Doosan branch or distributor.

NOTE: Doosan will not accept any warranty claim on an engine with broken governor seals.

AIR INTAKE SYSTEM

Air cleaner

Engine performance and life vary with the air intake conditions.

A dirty air cleaner element reduces the amount of intake air, causing reduced engine output and possible engine damage.

Also, a damaged element leads to abrasion of cylinders and valves, resulting in increased oil consumption, reduced output and shortened engine life.

The filter element should be changed at 500 hours or 6 months, whichever comes first, or sooner if the restriction indicator shows red. See below.

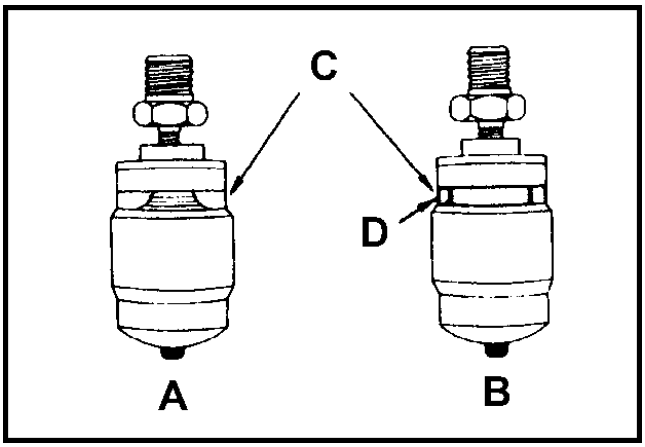


Fig. 18

A Normal

B Clogged

C Indicator

D Red signal

Air cleaner with dust indicator

This indicator is attached to the air cleaner. When the air cleaner element is clogged, air intake resistance becomes greater and the dust indicator signal turns to red indicating the element needs to be changed.

When the signal turns to red, replace the element. Then press the dust indicator button to reset the indication.

ENGINE ELECTRICAL

The Doosan engines uses a 12 volt system and a negative grounding for the electrical system.

Battery Servicing

Battery terminal connections

Check the battery cable connections for looseness or corrosion. Poor cable connections will result in difficult engine starting or insufficient battery charge.

The battery cables must be tightened securely.

Never reverse "+" and "–" terminals when reconnecting cables after removal. Even a short period of reverse connection will damage the electrical parts.

Cleaning of Battery

When the battery terminals are fouled clean them with clean tepid water and wipe with a dry cloth to remove the water. Apply a light coat of vaseline or a grease.

Alternator Servicing

The polarity of the alternator is negative (–) grounding type.

Do not reverse the polarity connection, otherwise a short circuit will occur resulting in alternator failure.

Do not put water directly on the alternator. Entry of water into the alternator creates electrolytic corrosion causing failure.

When the battery is charged from an external source, be sure to disconnect the battery cables.

Wiring Connections

Check all of the electric wiring connections for looseness and damage on a regular basis.

SERVICE AND MAINTENANCE

Please refer to the engine maintenance schedule.

For continued trouble free engine operation throughout its life, the service procedures marked with an asterisk **(*)** need to be carried out by a skilled and trained technician.

Please consult your local Doosan branch or dealer when these procedures become due.

Please also read the note refering to the service items marked with the star ★ symbol.

FUEL SELECTION

In cold weather, the fuel might freeze resulting in difficult engine starting; therefore, select a suitable fuel for such engine operation. Use ASTM 975 No. 2–D fuel if you expect temperature above 20°F (–7°C).

Use Number 1–D if you expect temperatures below 20°F (–7°C).

If Number 1–D is not available, a “winter” blend of 1–D and 2–D is available in some areas during the winter months.

Check with your fuel supplier to be sure you get the correct blended fuel.

COOLANT

Where the ambient temperature falls below freezing point, the cooling system should be drained after engine operation, but to eliminate the need for repeated draining, refilling and to provide all year protection against corrosion, the use of anti–freeze solution throughout the year is highly recommended.

All Doosan portable compressor engines are factory filled with a 50/50 Ethylene glycol base antifreeze/water mix. which provides protection to –33°C (–27°F)

Concentrations over about 65% adversely affect freeze protection, heat transfer rates, and silicate stability which may cause water pump leakage.

CAUTION:

Never exceed a 60/40 antifreeze/water mix.
(which provides protection to about–50°C (–58°F).

NOTE:

Methyl alcohol base antifreeze is not recommended because of its effect on the non–metallic components of the cooling system and because of its low boiling point.

NOTE:

High silicate antifreeze is not recommended because of causing serious silica gelation problems.

NOTE:

Usage and mixing ratio etc. should be followed to the antifreeze manufacture's recommendations.

ENGINE OIL

At low ambient temperatures, engine oil viscocity can affect engine starting. It is important to use the correct grade of oil as recommended in fig 4.

Try to position the compressor where it will not be affected by cold winds when not running.

BATTERY

(1) Always ensure that the batteries are kept fully charged in the cold season. This takes a longer period of running than in warm weather operation.

The electrolyte in a partly discharged battery will freeze easier than when it is fully charged. Try to keep the batterys fully charged and warm in cold weather operation.

(2) Top up the battery with distilled water immediately before starting the engine.

COLD STARTING

When operating in cold ambient conditions, or when starting from cold. If the engine does not start at the first attempt, allow the battery to recover for at least 30 seconds.
Observe the following procedures:

In order to protect the starter, do not engage for longer than 10 seconds during any attempt.

If during cranking, the starter motor repeatedly engages and disengages the battery power could be low. Either recharge the battery or replace it with one that is fully charged.

NOTICE: Do not use starting “aids” in the air intake system. Such aids can cause immediate engine damage.

ENGINE MAINTENANCE SCHEDULE

When performing the following items, the daily inspection items should also be carried out.

No	Description of check and maintenance	Daily	(operation hours)							Remark
			100	250	500	750	1000	1250	1500	
1	Oil level	O								
2	Oil leakage	O								
3	Oil pressure gage reading (where fitted)	O								
4	Oil pressure warning lamp (where fitted)	O								
5	Engine oil replacement		O		O		O		O	
6	Oil filter element replacement				O		O		O	
7	Fuel leakage	O								
8	Draining water in fuel filter/separator	O								See “EXPLANATION OF MAINTENANCE SCHEDULE”
9	Fuel filter element replacement				O		O		O	
10	Injection nozzle check **(*)**								O★	
11	Coolant level	O								
12	Coolant leakage check	O								
13	Radiator filler cap fitting condition	O								
14	Fan belt tension check	O								
15	Coolant temperature gage reading (where fitted)	O								
16	Coolant replacement						O			
17	Radiator external face cleaning			O	O	O	O	O	O	
18	Cooling system circuit cleaning						O			
19	Radiator filler cap function check **(*)**				O		O		O	
20	Electrolyte level check	O								
21	Battery cleaning	O								
22	Battery charge lamp	O								
23	Starter and alternator check and cleaning **(*)**						O			
24	Wiring and connection check		O							
25	Air cleaner element replace				O		O		O	
26	Engine starting conditions and noise conditions	O								
27	Exhaust smoke condition	O								
28	Cylinder compression pressure **(*)**						O			
29	Valve clearance check **(*)**						O			
30	Positive crankcase ventilation valve cleaning								O★	

Note:
1. After every 1500 hours of operation, the service intervals should be repeated in accordance with this check and maintenance schedule.
2. When servicing on the asterisked **(*)** items is necessary, consult your local Doosan branch or distributor.

Note:
★ This is a recommended maintenance. The failure to perform this maintenance item will not nullify the emission warranty or limit recall liability prior to the completion engine useful life. Doosan, however, urges that recommended maintenance service is performed at the indicated intervals.

EXPLANATION OF MAINTENANCE SCHEDULE

The following is a brief explanation of the services listed in the preceding Engine Maintenance schedule.

1.	**Oil level.**	Check that the oil level is within cross hatch area (ref fig. 6) Fill or drain as necessary.
2.	**Oil leakage check**	Replace any damaged or malfunctioning parts which could cause leakage.
3.	**Oil pressure gauge**	Normal oil pressure is 30 to 85 psi. Check and repair the lubrication system if it is abnormal.
4.	**Oil pressure warning lamp**	If it stays on whilst running check and repair the lamp and/or lubrication system.
5.	**Engine oil replacement**	Change at 100 hours, then change at 500 hours or 6 months whichever comes first
6.	**Oil filter element replacement**	Change at 500 hours or 6 months, whichever comes first.
7.	**Fuel leakage**	Replace any damaged or malfunctioning parts which could cause leakage.
8.	**Draining water in fuel filter/separator.**	Drain off water in the fuel filter/separator bowl.
9.	**Fuel filter element replacement**	Replace both primary (filter/separator) and secondary elements at 500 hours or 6 months whichever come first.
10.	**Injection nozzle check**	Check injection opening pressure and spray condition. (This is a recommended maintenance item ★). Consult your local Doosan branch or distributor.
11.	**Coolant level.**	Check coolant level and add coolant if necessary.
12.	**Coolant leakage check**	Replace any damaged or malfunctioning parts which could cause leakage.
13.	**Radiator filler cap fitting condition**	The radiator cap must be installed tightly and sealing correctly.
14.	**Fan belt tension check**	Check and adjust fan belt deflection. Look for cracks, fraying and wear. Replace if necessary.
15.	**Coolant temperature**	Normal running temperature is 75 to 85°C (167 to 185°F). Check and repair the cooling system if temperature is abnormal.
16.	**Coolant replacement**	Change coolant at intervals of 1000 hours or 12 months, whichever comes first.
17.	**Radiator external face cleaning**	Check monthly. Clean at intervals of 250 hours or 3 months, whichever comes first. In very dusty environments, more frequent cleaning might be necessary.
18.	**Cooling system circuit cleaning**	Clean at intervals of 1000 hours or 12 months, whichever comes first.
19.	**Radiator filling cap function check**	Check radiator pressure cap periodically for proper operation. Consult your local Doosan branch or distributor.
20.	**Battery electrolyte level check**	Replenish with distilled water if necessary.

21.	**Battery cleaning**	Clean the terminals.
22.	**Battery charge condition**	If the lamp stays on while engine is running, check charging circuit.
23.	**Starter and generator check and cleaning**	Check wear condition of brush and commutator. Consult your local Doosan branch or distributor.
24.	**Wiring and connection check**	Check for loose terminals/connections and integrity of insulation.
25.	**Air filter element replacement**	Change element at 500 hours or 6 months, whichever come first, or sooner if the restriction indicator shows red.
26.	**Engine starting condition and noise condition**	Check engine stability and noise.
27.	**Exhaust smoke condition**	Check exhaust smoke color.
28.	**Cylinder compression pressure**	Consult your local Doosan branch or distributor.
29.	**Valve clearance check**	Incorrect valve clearance will result in increased engine noise and lower engine output thereby adversely affecting engine performance. Check and adjust every 1000 hours. Consult your local Doosan branch or distributor.
30.	**Positive crankcase ventilation valve cleaning**	Check according to the equipment specifications. Perform the adjustment, cleaning, repair or replacement every 1500 hours. (This is a recommended maintenance item ★). Consult your local Doosan branch or distributor.

This item contains a simple troubleshooting. When a failure takes place on your Doosan engine, diagnose the cause referring this troubleshooting. Should the cause of failure not be detected or you are unable to manage the failure, consult your machine supply source or nearest Doosan engine service outlet.

Engine does not start	Starter does not turn.	Battery discharged	
		Bad cable connections.	
		Starter or starter switch failure.	
		Safety relay failure.	
	Starter turns but engine does not fire.	No fuel injection.	Engine stop solenoid malfunction.
			No fuel in the fuel tank.
			Clogged fuel filter element.
			Air in the fuel system.
			Control rack is stuck at no fuel position.
		Fuel is injected but engine does not fire.	Incorrect preheating operation.
			Glow plug malfunction.
			Incorrect injection timing.
			Low cylinder compression pressure.
			Engine stop solenoid not fully returned.
	Engine fires but stalls immediately.	Air in the fuel system.	
		Incorrect low idle speed adjustment.	

Unstable engine running	Unstable low idling	Crack in injection pipe.	
		Injection nozzle failure.	
		Engine stop solenoid return failure.	
		Uneven compression pressure between cylinders.	
	Incorrect high idle speed adjustment.	Incorrect control lever adjustment.	
		Governor internal malfunction.	
	Engine hunting in medium speed range.	Governor spring deteriorated.	
	Engine malfunction in high speed range.	Insufficient fuel supply.	Air in the fuel system
			Clogged fuel filter element
			Piping failure (squeezed/restricted etc.)
		Uneven fuel injection amount between cylinders.	
		Deteriorated governor spring.	
		Incorrect valve clearance adjustment.	
		Deteriorated valve spring.	
	Engine speed stuck at high idle.	Engine control restriction or seizure.	
Engine overheat.	Cooling system defect	Insufficient coolant volume.	
		Fan belt slippage.	
		Thermostat malfunction.	
		Radiator filler cap malfunction.	
		Cooling system interior fouled.	
		Radiator clogged.	
	Improper servicing	Engine over–loaded.	
		Air cleaner element clogged.	
		Insufficient airflow/restriction.	
		Restricted coolant flow (high concentration of antifreeze, etc.)	
Low oil pressure	Lack of oil	Oil leakage	
		High oil consumption	
	Wrong oil	Wrong type and viscocity.	
	High coolant temperature.	Over heat.	
	Clogged filter and strainer.		
	Worn bearings and oil pump.		
	Faulty relief valve.		

Low engine output	Incorrect injection pump adjustment	Incorrect injection timing	Too far advanced.
			Too far retarded.
		Injection nozzle malfunction	Incorrect injection pressure.
			Incorrect spray condition.
		Insufficient fuel supply to the injection pump	Lack of fuel in tank.
			Air in injection pump.
			Fuel filter clogged.
			Overflow valve malfunction.
		Governor malfunction	Incorrect engine control adjustment.
			Deteriorated governor spring.
	Low cylinder compression pressure	Cylinder compression leakage	Incorrect valve clearance adjustment.
			Injector nozzle misalignment.
			Cylinder bore wear.
		Insufficient air intake volume.	Air cleaner clogged.
			Restricted air flow.
Excessive oil consumption	Incorrect oil	Wrong selection of type and viscosity.	
		Too much oil quantity.	
	Engine burning oil	Faulty piston rings/damaged cylinder bores.	
		Faulty valve stem seal.	
	Oil leakage	Damaged seal / Damaged turbocharger seal	
		Loose joints/gaskets.	
		Improper installation of filter and piping.	
Excessive fuel consumption	Fuel leakage	Damaged seals.	
		Improper component installation or tightening.	
	Excessive injection volume.	Injection pump defective.	
	Excessive mechanical loads		

Improper exhaust	Excessive black smoke	Clogged air cleaner.
		Damaged injector nozzle.
		Wrong injector nozzle.
		Injection timing incorrect.
		Excessive injection volume.
		Incorrect fuel.
	Excessive white smoke	Water mixing in fuel
		Low compression pressure.
		Injection timing incorrect.
		Low coolant temperature
		Faulty turbocharger
Battery overdischarge	Low electrolyte level	Crack in battery body.
		Natural consumption.
	Charging failure	Loose or damaged belt.
		Faulty alternator.
		Damaged wiring or contact failure.
	Excessive electrical loads	Insufficient battery capacity for the application.