Professional Floor Systems

Instructions HTC 2500 iX v2

1	*Starting Procedure*
2	*Maintenance Schedule*
3	*HTC 2500 Manual*
4	*HTC 2500 Education*
5	*Perkins 1104 Engine Manual* *Particle Filter Datasheet*
6	*Generator Manuals*
7	*HTC 86D Manual* *HTC 55C Manual*
8	*Gear Unit Manual*
9	
10	

Professional Floor Systems

Startup procedure
HTC 2500 iX v2

1. Switch on battery power (Battery main switch)
2. Press the start button on the InteliNano generator control panel
   (The engine will start after a few seconds once the button is released)
3. Turn on the ignition key – wait for the control system to boot up
4. Press the “Generator On”-button (Green)
5. The machine is now ready to operate

To power down the machine, follow the above instructions in reverse order

Professional Floor Systems

Maintenance schedule HTC 2500 iX v2

When required

Battery – disconnect ..... HTC 2500 Manual, page 32
Engine – clean ..... Perkins Manual, page 60
Engine air cleaner element clean/replace ..... Perkins Manual, page 61
Engine oil sample – obtain ..... Perkins Manual, page 64
Fuel injector – test/change ..... Perkins Manual, page 68
Fuel system – prime ..... Perkins Manual, page 69
Severe service application – check ..... Perkins Manual, page 75
Machine – clean ..... HTC 2500 Manual, page 47

Daily

Alternator and fan belts – inspect/adjust/replace ..... Perkins Manual, page 53
Cooling system coolant level – check ..... Perkins Manual, page 59
Driven equipment – check ..... Perkins Manual, page 60
Engine air cleaner element - clean ..... Perkins Manual, page 61
Engine oil level – check ..... Perkins Manual, page 64
Fuel system primary filter/water separator – drain ..... Perkins Manual, page 70
Walk-around inpection ..... Perkins Manual, page 77
Grinding heads – inspect ..... HTC 950 RX manual, Chapter 5.5
Hoses – inspect .....
Sock filters – inspect ..... HTC 86D Manual, page 10
Pneumatic system – drain .....
Slide valves – check .....
Electrical cabinets – check fans .....

Every 50 Service hours or weekly

Fuel tank water and sediment – drain ..... Perkins Manual, page 73
RCCDs - test ..... HTC 2500 Manual, page 61
Circuit breakers - exercise ..... HTC 2500 Manual, page 61
Dust extractors – inspect .....
Pre-separators – inspect .....
HEPA filter – inspect ..... HTC 86D Manual, page 11
Machine – clean ..... HTC 2500 Manual, page 47
Grinding heads – inspect ..... HTC 950 RX manual, Chapter 5.6
Grease points – lubricate .....
Gear unit – inspect/clean ..... Gear unit Manual, Chapter 6.1

Every 100 hours or 1 year

Grinding heads – inspect ..... HTC 950 RX manual, Chapter 5.7

Every 250 hours or 1 year

Engine oil and filter – change ..... Perkins Manual, page 65

Every 500 hours or 1 year

Engine air cleaner element – clean/replace ..... Perkins Manual, page 61
Engine ground – inspect/clean ..... Perkins Manual, page 64
Fuel system primary filter (water separator) element – replace ..... Perkins Manual, page 70
Fuel system secondary filter – replace ..... Perkins Manual, page 71
Hoses and clamps – Inspect/replace ..... Perkins Manual, page 74
Radiator – clean ..... Perkins Manual, page 75
Sock filters – replace ..... HTC 86D Manual, page 10
HEPA filter – replace ..... HTC 86D Manual, page 11
Chassie joint – inspect .....
Particle filter – clean ..... DPX Datasheet, page 4

Every 1000 service hours

Engine valve lash – inspect/adjust ..... Perkins Manual, page 67

Every 2000 service hours

Aftercooler core – inspect ..... Perkins Manual, page 52
Alternator – inspect ..... Perkins Manual, page 53
Engine mounts – inspect ..... Perkins Manual, page 64
Starting motor – inspect ..... Perkins Manual, page 76
Turbocharger – inspect ..... Perkins Manual, page 76
Water pump – inspect ..... Perkins Manual, page 78

Every 2 years

Cooling system coolant – change ..... Perkins Manual, page 58

Every 3000 Service hours

Fuel injector – test/change ..... Perkins Manual, page 68

Every 3000 service hours or 2 years

Cooling system coolant – change ..... Perkins Manual, page 55
Gear unit – inspect/oil change ..... Gear unit Manual, Chapter 6.1

Every 4000 service hours

Aftercooler core – clean/test ..... Perkins Manual, page 52

Manual

HTC 2500 iX
industrialized

GB

Introduction

The HTC 2500 iX is the world’s first industrialised grinding machine. A complete, mobile grinding system in one and the same vehicle makes the HTC 2500 iX the world’s most advanced and most efficient grinding machine ever. With a grinding width of an impressive two and a half metres and an automatic dust separation system integrated in the machine, the HTC 2500 iX grinding machine is in a class of its own, an industrialised grinding system for really large areas. The HTC 2500 iX is packed with technology and features, and our designers have done everything possible to optimise the floor grinding work. And with its on-board comforts, the machine is also incomparably more comfortable to operate from an ergonomic perspective than other grinding machines on the market. Congratulations on your purchase of the world’s most efficient and innovative grinding system.

Important information

Read through this manual carefully so that you know how to use and maintain the HTC 2500 iX before using it. For service work other than that described in this manual, contact HTC for parts and service.

Liability

• Even though every effort has been made to make this manual as complete and accurate as possible, we bear no responsibility for incorrect or missing information. HTC reserves the right to change descriptions in this manual without giving prior notice.

• This manual is protected by the Copyright Act and no part of it may be copied or used in any other way without the written approval of HTC.

Trademarks

HTC is a trademark owned by HTC Sweden AB. Other names and products mentioned in this manual may be registered trademarks owned by the relevant companies.
© 2006 HTC Sweden AB. All rights reserved.

Travel and transport on public roads

Always check applicable road traffic provisions before travel and transportation on public roads. During transportation, approved fastening devices must always be used and the machine must be securely anchored.

Contents

Introduction 1
Important information 2
Trademarks 2
Travel and transport on public roads 2
Liability 2
Warranty 7
The manual 8
Safety 9
Vibration and noise 10
Machine name plate 10
On delivery 10
Example of machine name plate 11
Unpacking the machine 12
CE marking 12
Declaration of conformity 13
Introduction to the HTC 2500 iX 14
Technical specification for the HTC 2500 iX 14
The technology and its benefits 15
Safety instructions 16
Operating the machine on a sloping surface 16
Machine description – Front view 17
Description of machine components – Front 18
Machine description – Rear view 19
Description of machine components – Rear 20
Presentation 21
Cab – Location of controls 21
Presentation 22
Cab – Function of controls 22
Presentation 23
System location – Left-hand side 23

Presentation 24
System description 24
Presentation 25
System location – Right-hand side 25
Presentation 26
System description 26
Presentation 27
System description – Interface touch-screen 27
Presentation 28
System description – Interface touch-screen – Service 28
Presentation 29
System description – CanOpen components' status 29
Presentation 30
System description – Interface touch-screen 30
Operation 31
Before starting the engine 31
Operation 32
Starting the engine 32
Operation 33
Operation 34
Operating the machine 34
Operation 35
Driving the machine 35
Operation 36
Operation 37
Grinding heads 37
Operation 38
Grinding 38
Operation 39
Folding up grinding head for tool replacement 39
Operation 40
Tool replacement 40

Operation 41
Operation 41
Mist Cooler System 41
Operation 41
Grinding pressure 41
Presentation 42
Suction system 42
Schematic diagram 43
Suction system 43
Operation 44
Suction system 44
Operation 45
Stopping the engine 45
Operation 46
After stopping the engine 46
Care and maintenance 47
Cleaning the machine 47
Refuelling the diesel engine 47
Error codes in control panel 48
Frequency converter: Error code 0 - 14 48
Error codes in control panel 49
Frequency converter: Error code 15 - 28 49
Error codes in control panel 50
Frequency converter: Error code 29 - 42 50
Error codes in control panel 51
Frequency converter: Error code 43 - 56 51
Error codes in control panel 52
Frequency converter: Error code 57 - 70 52
Error codes in control panel 53
Frequency converter: Error code 71 - 73 53
Control cabinet - AS1 54
Control cabinet - AS1 55

Control cabinet - AS2 ..... **56**
Control cabinet - AS3 ..... **57**
Control cabinet - AS4 ..... **58**
Appendix 1 – Additions to manual for HTC 2500 iX **59**
Appendix 2 – Maintenance intervals for HTC 2500 iX **58**

Warranty

This warranty only covers manufacturing defects. HTC bears no responsibility for damage that arises or occurs during transportation, unpacking or use. In no case and under no circumstances shall the manufacturer be held responsible for damage and defects caused by incorrect use, corrosion or use over and above the prescribed specifications. The manufacturer is not responsible for indirect damage or costs under any circumstances. The manufacturer's warranty period is 24 months from commissioning, although no longer than 18 months from delivery from the factory (General delivery terms NL92).

Local distributors may have special warranty terms specified in their terms of sale, delivery and warranty. If you are unsure regarding warranty terms, please contact your retailer.

The manual

In addition to general functions, this manual deals with areas of application and maintenance for the HTC 2500 iX grinding machine. A number of symbols are used in the manual to highlight the most important sections, see below. In order to avoid both personal injury and material damage as much as possible, it is extremely important to read and understand the text next to these symbols particularly carefully. There are also other symbols indicating practical tips. These tips are there to make it easier to understand the machine and to get maximum benefit from the grinder.

*This symbol means **Warning!** and indicates a risk of personal injury or material damage in the event of incorrect use of the machine or associated equipment.*
If you see this symbol next to a section of text, you must be particularly careful when reading through the text and must not carry out any stages of which you are unsure. This is for your own and other users' safety and to avoid damage to machinery or other equipment.

*This symbol means **Note!** and indicates a potential risk of material damage in the event of incorrect use of the machine or associated equipment.*
If you see this symbol next to a section of text, you must be particularly careful when reading through the text and must not carry out any stages of which you are unsure. This is to avoid damage to the machinery or other equipment.

*This symbol means **Tip!** and indicates that, in the subsequent text, you can get tips and advice on ways to make operating your machine or associated equipment easier, and to avoid wear.*
If you see this symbol next to a text, you should read through the text to make your work easier and to extend the service life of the machine.

Safety

- Appropriate breathing protection must be worn and the cab must be closed during operation.
- The dust collector may not be used when grinding materials that can produce explosive gases, such as epoxy and acrylic.
- If the machine is being operated indoors, the location must be well ventilated.
- The machine may not be operated on slopes in excess of 10°.
- The machine may not be used in environments where there is a risk of falling objects.
- The machine may only be operated or repaired by personnel who have completed the necessary practical and theoretical training, and who have read this manual thoroughly.
- The instructions in this manual must be followed in order for the CE mark to be valid.
- The machine may only be used for grinding and polishing unhewn stone, terrazzo, concrete or other materials specified in this manual.
- The machine may not be used in environments where there is a risk of explosion or fire. Look up and follow the relevant fire safety regulations before starting the grinder.
- Personal protection equipment must be used – safety shoes, hearing protection, a mask, safety glasses and protective gloves.
- The machine must not be started in the folded position. Only start with the rotating discs facing the floor and with the tools applied.
- When replacing grinding tools, pay attention as the grinding tools and the metal discs may be hot.
- When replacing grinding tools, the power must be disconnected from the machine.
- The machine may not be lifted in any way other than that indicated in this manual.
- When removing glue and during wet grinding, always lift up the grinding heads after grinding so that they do not stick to the floor and destroy machine parts and the floor when restarting.
- The machine must always be stored in a warm, dry area when not in use.
- If the machine is stored in a cold environment, it should be left to warm up for at least two hours before use.
- The machine may only be used when the splash guards are fitted.
- Only HTC original tools and spare parts may be used.
- If the mechanical locking of the grinding heads is not working, take care when working with these.
- In the event of a breakdown that prevents the machine being driven under its own power, see page 16 to release operating engines.
- Contact should be made with the machine’s operator before emptying dust waste. Only work directly behind the machine, within sight of the operator’s reversing camera. Take care inside the machine’s safety zone.
- For relevant wiring diagrams, contact HTC Sweden AB.

Vibration and noise

The machine has been tested in accordance with the ISO 8662-4 and ISO 11202 standards for vibration and noise. For vibrations, the average value is 1.01 m/s², which applies when the machine is being accelerated. The sound level at the machine during operation is approx. 105 dBA. This value varies depending on the choice of tool and the type of floor. The sound level in the operator's environment is approx. 76 dBA. Always use hearing protection.

Machine name plate

The model number and serial number for your machine are shown on the machine name plate. This information is required when ordering spare parts for the machine. Use the space below to make a note of the model number and serial number of your machine for future reference.

MODEL NUMBER _____

SERIAL NUMBER _____

KEY NUMBER _____

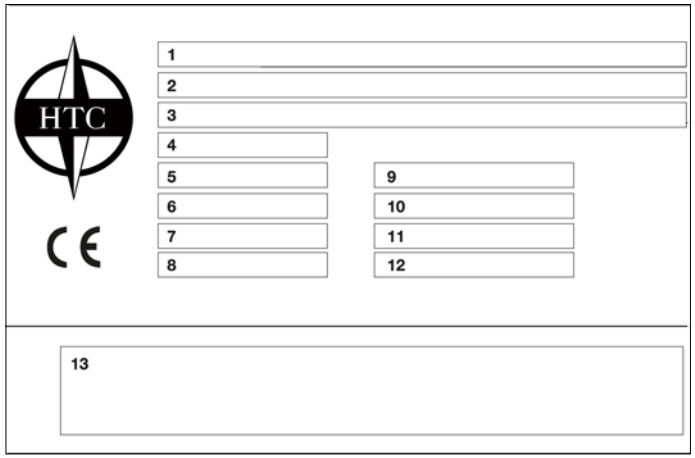
On delivery

The following items will be included in the delivery. Contact your retailer if anything is missing.

- Grinding machine
- Splash guard
- Manual
- Key

Example of machine name plate

The machine name plate is located inside the front hatch, on the right-hand side of the cab. The serial number can also be found inside the left-hand hatch, on the frame above the lifting point.



1: Serial number
2: Engine number
3: Generator number
4: Output
5: Voltage
6: Frequency
7: Current
8: Phases
9: Weight
10: Length
11: Height
12: Width
13. Address field

Unpacking the machine

Check carefully to see if the packaging or machine has been damaged during delivery. If there is any sign of damage, contact your retailer and report it.

Check that the delivery matches the order. If there are any discrepancies, contact your retailer.

You should carefully read through the safety instructions and the manual prior to use.

CE marking

CE marking of a product guarantees its free movement within the EU area in accordance with EU regulations. CE marking also guarantees that the product fulfils various directives (the EMC Directive and other possible requirements in so-called directives for new procedures in accordance with these regulations). The HTC 2500 iX grinding machine carries the CE mark in accordance with the Low Voltage Directive (LVD), the Machinery Directive and the EMC Directive. The EMC Directive states that electrical equipment must not disturb its surroundings with electromagnetic radiation and that it must also be immune to electromagnetic interference in the surroundings.
The Manufacturer’s Declaration of Conformity, which shows that the HTC 2500 iX grinding machine is harmonised with the EMC Directive, can be found on the following pages. The HTC 2500 iX is classified for use in environments such as heavy industry Class A.

Declaration of conformity

In accordance with the Machinery Directive, 98/37/EC, the EMC Directive, 89/336/EEC, the Low Voltage Directive, 73/23/EEC including supplements, and in accordance with the CE Marking Directive, 93/68/EEC

Type of equipment Grinding machine
Make HTC
Trademark HTC 2500 iX

Serial number _____

Manufacturer
HTC Sweden AB
Box 69
SE-614 22 Söderköping

The product was CE marked in 2004.

As the manufacturer, we hereby declare under sole responsibility that the product conforms with the terms of the Directives listed above.

Date: 12.02.2004

Sten Jeansson
CEO

Introduction to the HTC 2500 iX

The HTC 2500 iX entails a new way of looking at floor grinding. An “industrialised grinding” system, incorporating everything from grinding heads, a dust separator and its own drive, all in one. This makes it the first totally integrated, ride-on floor grinding system ever. The machine has been adapted to cope with tough work, and has therefore been provided with extremely robust technology to tackle long shifts on large and demanding surfaces.

Driving comfort has been optimised to ensure maximum control of all the machine’s functions in a safe and easy-to-understand manner. With “ergonomics and maximum grinding capacity” as key philosophies during production, the HTC 2500 iX has been developed to ensure high levels of adaptability and service-friendliness, as well as being supplied with the latest technology for maximum grinding performance. In the cab, which has been insulated against sound and dust particles and adapted to cope with the toughest environmental requirements, the driver sits in comfort, well separated from the harsh environments that often arise in conjunction with grinding work.

The HTC 2500 iX has an enormous capacity. One machine is equivalent to up to ten traditional manned grinding systems and associated dust separators! Once again, HTC has moved the concept of floor grinding a significant step into the future. Welcome on-board the world’s most efficient industrial grinding system, the HTC 2500 iX.

Technical specification for HTC 2500 iX

- Engine: 4 cyl. Perkins Diesel 4.4 litres
- Engine output: 157 hp (117 kW)
- Fuel tank: 210 litres
- Water tank: 55 litres
- Generator: 120 kVA, 400 V, 60 Hz
- Suction system: Automated vacuum cleaner
- Suction effect: 19.5 kW
- Operation: 2x6 kW motors
- Wheel dimensions: 16” and 12”
- Machine weight: 6,300 kg
- Height: 2445 mm
- Length: 5412 mm
- Width: 2490
- Turning radius: 50°
- Tyre pressure: 1.125 – 1.5 Mpa (11.25 kg/m2 – 15.00 kg/m2)

Technical specification for the HTC 2500 iX grinding machine

- Motor output: 3x15 kW
- Current: 32 A
- Weight, grinding head: 3x310 kg
- Pressure, grinding head: Variable adjustment (310 +/- 80 kg)
- Dimensions, grinding disc: 12x270 mm
- Total grinding width: 2400 mm
- Revs/minute: 450 – 1,400 rpm
- Suspension 3D suspension
- Height adjustment: electric

The technology and its benefits

• What does **iX** stand for?
i = Industrialised system, X = Four grinding discs/grinding head

• **The cab** on the HTC 2500 iX is hydrobox-mounted, which counteracts and insulates against vibrations.

• **The large tank** produces an impressive operating time of 20 hours.

• **The particle-filtered diesel engine** makes indoor use possible.

• **The HTC 2500 iX has a modular structure,** which makes the machine service-friendly.

• **Integrated and powerful dust separation system.**

• **The HTC 2500 iX comes under the umbrella of HTC Superfloor approved**
equipment, which means that it is recommended for the production of HTC Superfloor™

• **The grinding capacity** of the HTC 2500 iX is enormous. With an impressive grinding width of two and a half metres, it is possible to grind
up to 500 m² of HTC Superfloor® per day.

• With **variable and adjustable grinding pressure**, the grinding pressure can be adjusted for all the grinding heads.

• **Hydraulically height-adjustable grinding head**s make tool replacement easy and provide good access.

• **The HTC 2500 iX is easy to operate**, with joysticks and a touch-screen integrated in the operator's cab.

• For a **high level of comfort**, air conditioning, a radio, CD player, DVD player and com-radio are available as options.

All of this combines to offer better grinding economy and a good working environment for the user.

Safety instructions

Operating the machine on a sloping surface

Under no circumstances may the machine be operated on surfaces that affect its lateral incline, as there is then a risk of tipping (see figure 1).

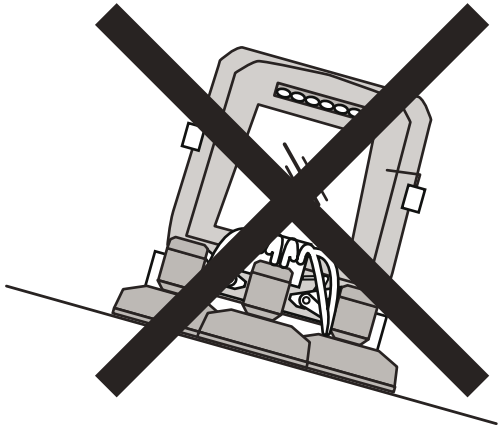
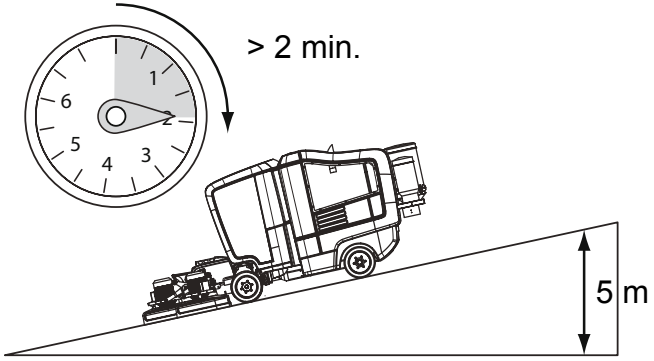


Figure 1. The machine may not be driven such that the machine's lateral incline is other than horizontal.

The machine must not be operated on downhill slopes exceeding 5 vertical metres for 2 minutes. If this is done, the braking resistors can overheat, resulting in damage to the machine.



Driver motors' release lever – when towing

If the machine is to be lifted, this is performed with forks under the machine, and each fork may only be inserted at the indicated points.

If the machine has to be towed, the drive motors' brakes have to be released manually. This is done by pulling in and securing each drive motor's release lever, which are situated beneath the cab and protrude up from the drive box's cover. The levers must be pressed in towards the machine, and can be secured with e.g. a cord (see figure 2).

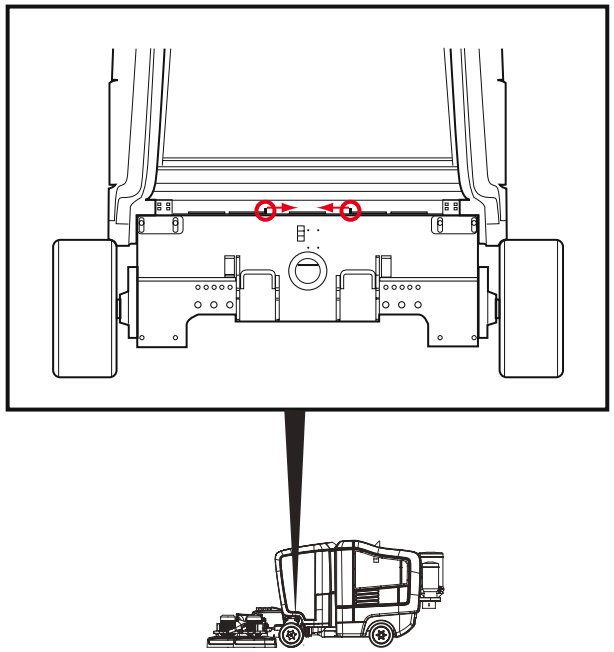


Figure 2. When towing, the drive motors' release levers must be secured in their innermost position. Note that the machine does not have any brakes in this position.

Machine description – Front view

Description of machine components – front

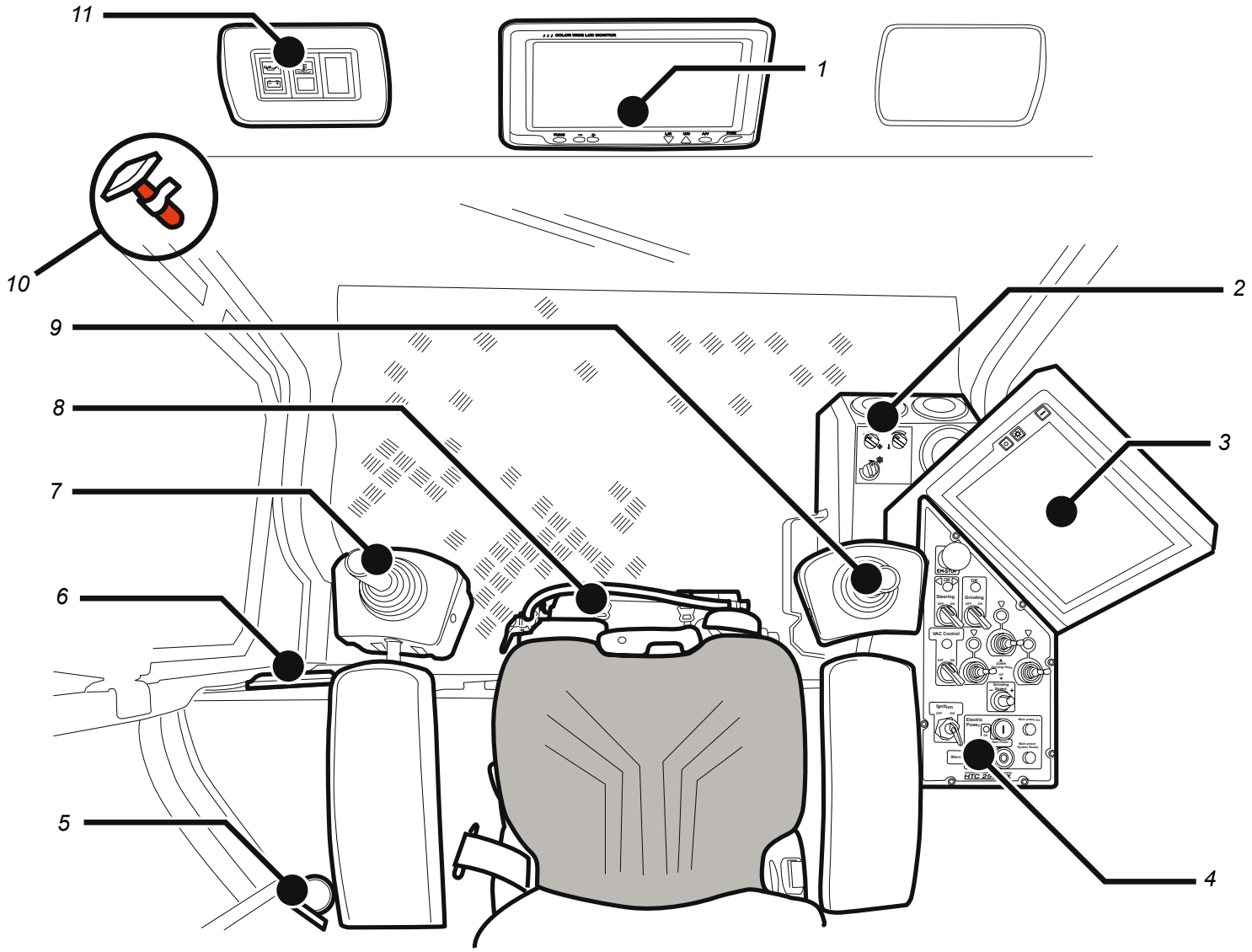
1. Lighting ramp.
2. Entrance to the operator’s cab.
3. Left-hand engine cover.
4. Splash guard.
5. Cover for grinding head.
6. MCS™ (Mist Cooler System).
7. Electric motor for grinding head.
8. Suction hose for dust separator.
9. Operator’s cab.

Machine description – Rear view

Description of machine components – rear

1. Exhaust pipe from diesel engine.
2. Right-hand engine cover.
3. Loading ramp for dust and grinding waste.
4. Dust waste bag. Longopac®.
5. Air cannon/Filter cleaner.
6. Pre-separator.
7. Filter cyclone.

Presentation
Cab – location of controls



1. Reversing monitor and dust waste monitor. Two cameras are installed in the rear part of the machine to monitor dust waste bags from the dust separators and to monitor the machine when e.g. reversing.

2. Air conditioning controls.

3. Surveillance monitor with touch-sensitive screen. This monitor is used to check and control a number of functions, such as the mist cooler system and grinding pressure.

4. Control panel. The control panel is used to regulate the machine's power supply, diesel engine, grinding heads and suction system.

5. Bottle/Drinks holder.

6. Stereo system.

7. Joystick – steering control. This control checks the machine's turning movements to the right and left.

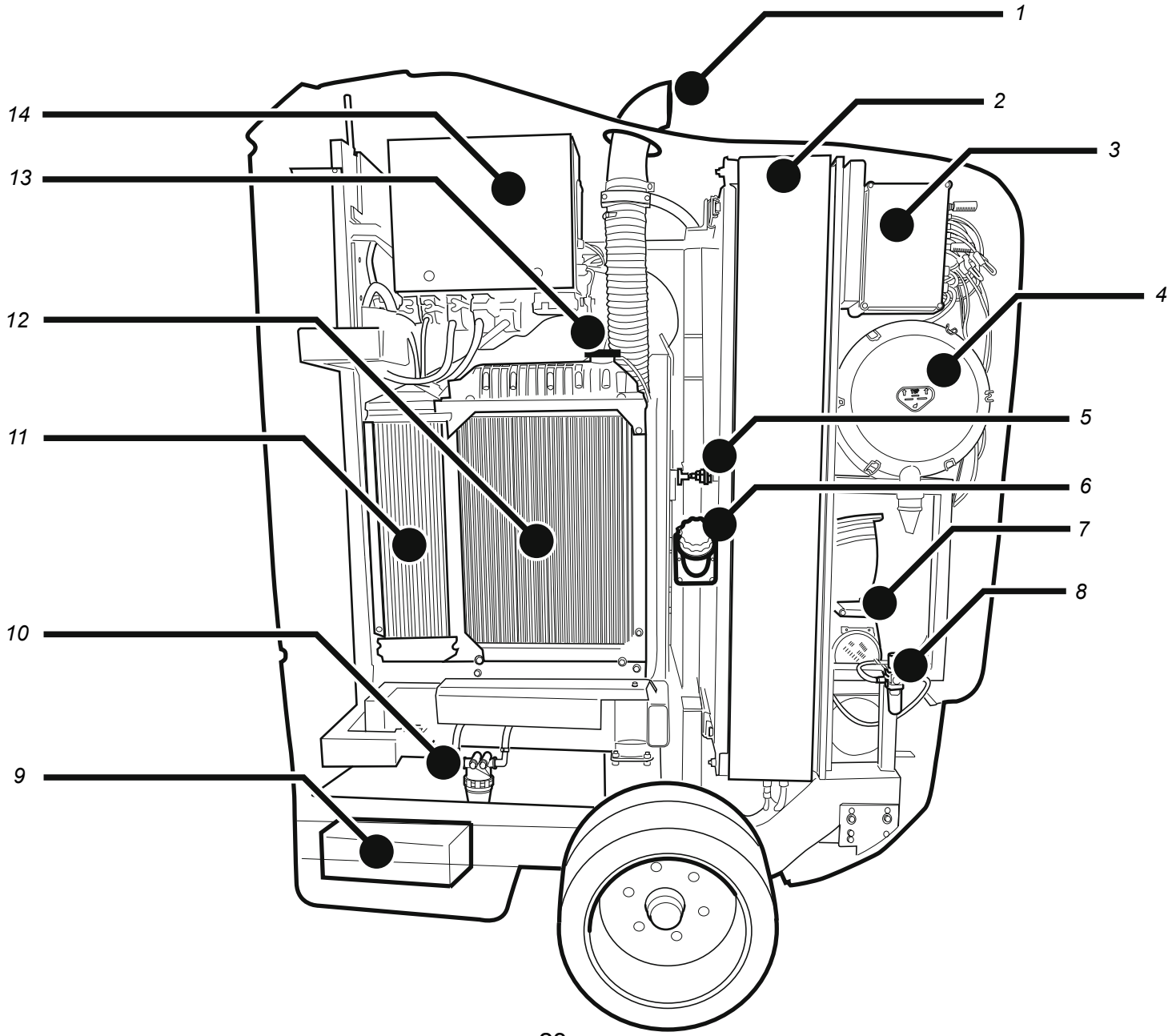
8. Fire extinguisher. Used in an emergency to extinguish fire. Checked regularly in order to safeguard function.

9. Joystick – direction control. This control governs the machine's movements and speed for operation forwards and backwards. Increased deflection of the joystick forwards or backwards increases the speed in the corresponding direction.

10. Emergency hammer. This is only used in an emergency as a tool to break the window glass to allow rapid evacuation of the cab or when the regular evacuation route, the door, is blocked. The hammer is located above the cab's front window to the left.

11. Warning lamps for low oil pressure, low battery voltage and a warning lamp for high coolant temperature in the diesel engine.

Presentation
System location – left-hand side



Presentation
System description

1. Exhaust, dust separator.

2. Control cabinet 2. Frequency converter.

3. Pneumatic box for suction system.

4. Absolute filter for dust separator.

5. Locking pin for control cabinet.

6. Topping up the mist cooler system with water.

7. Compressed air compressor.

8. Compressed air regulator. This regulator controls the compressed air system and checks that it is maintaining the correct pressure.

9. Braking resistor. Note that this surface may be hot. Pay attention in order to minimise the risk of burns. Contains high voltage components, do not touch.

10. Water filter for the mist cooler system.

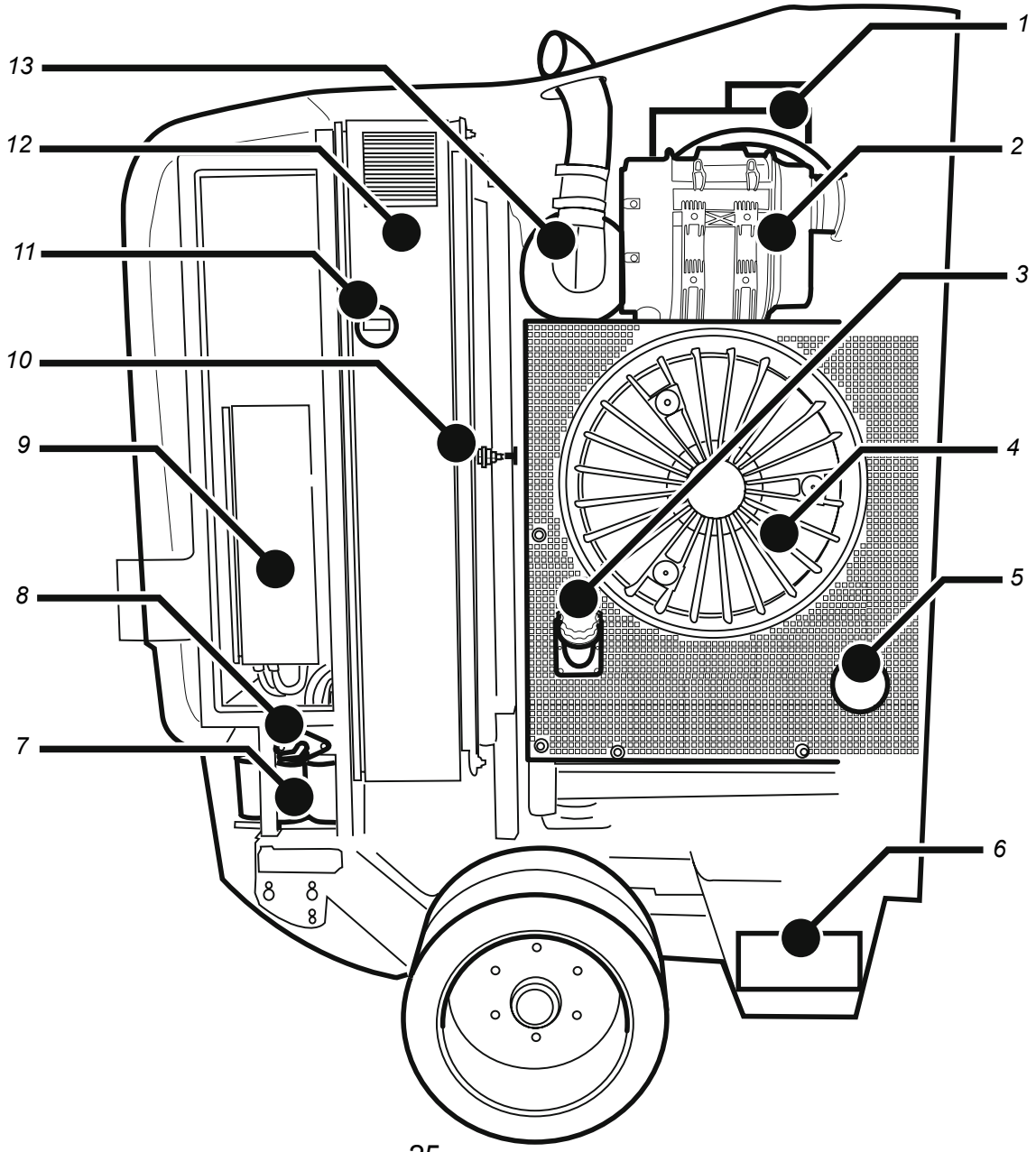
11. Intercooler, the cooler cools the intake air in the supercharged combustion engine. The intercooler impedes the airflow air somewhat, but the improvement in efficiency as a result of the lower temperature of the intake air is significantly greater than the loss from the impeded flow.

12. Diesel engine’s cooling unit.

13. Topping up the cooler water. The cooler water is topped up under the cover. Note that topping up may only take place when the engine is cold, in order to avoid burns as overpressure is created when the engine is hot.

14. Control cabinet no. 3. The cabinet holds fuses for all 12 V systems.

Presentation
System location – right-hand side



Presentation
System description

1. Generator

2. Intake filter

3. Refuelling, diesel.

4. Fan motor for dust separator.

5. Inspection hole for mist cooler pump.

6. Braking resistor. Note that this surface may be hot. Pay attention in order to minimise the risk of burns. Contains high voltage components, do not touch.

7. Batteries

8. Main switch, 12VDC.

9. Control cabinet 4. Low current equipment 24VDC.

10. Locking pin for control cabinet.

11. Operating time indicator for diesel engine.

12. Control cabinet 1. High current fuses.

13. Particle filter. Cleans exhaust fumes from diesel engine.

Presentation

System description – Interface touch-screen

The HTC 2500 iX is equipped with a touch-screen. The machine's systems can be checked and regulated via the screen.
The software version is displayed when the machine is started up. Press "CONTINUE" to come to the "OPERATION MENU".
The "OPERATION" menu displays various measurement values for the machine. Under the heading "GRINDING", the power consumption of each grinding head can been seen, along with the frequency at which grinding is being performed.
In the next field, a yellow symbol indicates that the "Grinding pressure" system or "Mist Cooler System" is activated.
The steering deflection is displayed under "Angle". Restrict steering so that the indicator remains in the green field. If the indicator reaches the yellow field, it is vital to take great care. Within the red field there is a risk of machine damage.

"Speed" – this indicator displays a value indicating the machine's speed. A positive value indicates that the machine is moving forwards, a negative value that the machine is reversing.

"AMP – left" and "AMP – right" indicate the power consumption to the drive motors.

⚠ Ensure that the machine's drive motors only operate within the green fields as regards power consumption.
If the power consumption in the driver motors is too high, this can lead to overheating, which can result in damage to the machine.

Figure 1. Software version number

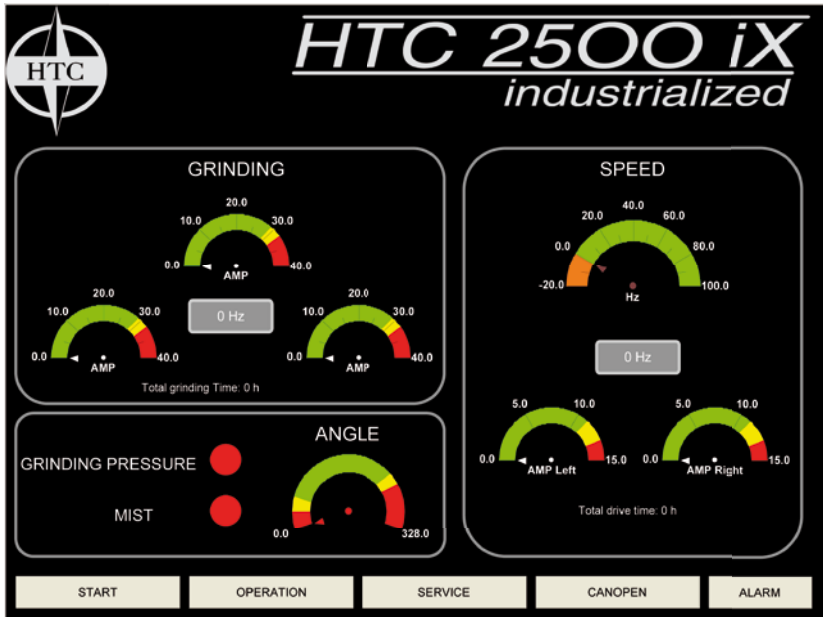


Figure 2. Operation menu

Presentation

System description – Interface touch-screen – Service

Under the “service menu” (see figure 1) there are a number of control buttons, from where some of the machine’s functions are controlled.

In the upper left-hand field there is a button for turning the machine’s headlights on and off. The lighting is activated by pressing the button marked “Light”. When the headlights are lit, this is indicated by the round symbol above the button glowing green. Mist Cooler System is activated by pressing “MIST”. While this system is starting up, the marking is yellow. When the system is activated, the marking glows green. The same procedure applies for “GRINDING PRESSURE”. The system for adjusting the grinding pressure allows the grinding pressure to be increased by up to 80 kg extra per grinding head.

The dust separators are operated in the VAC CONTROL field.
Pressing the EMPTY VAC - LEFT or EMPTY VAC - RIGHT button turns off the suction function for the selected side. When the lamp indicates green beside the button (can take up to 30 seconds), the Longopac® sack can be replaced. In order to reactivate the selected suction, press the same button again on the touch-screen and the display will indicate red again when the suction has been reactivated.

The emptying interval can be regulated by the SOFT GRINDING button indicating red or green, where green indication in the event of HEAVY GRINDING means that emptying takes place at short intervals.

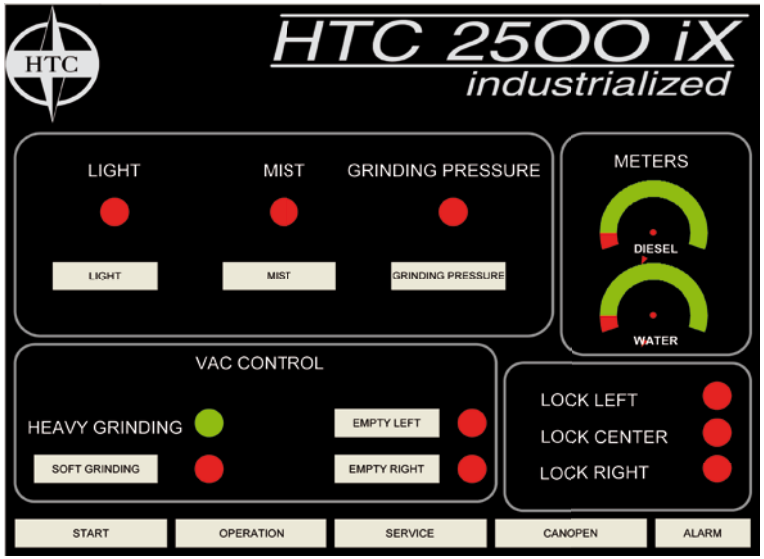


Figure 1. Service menu

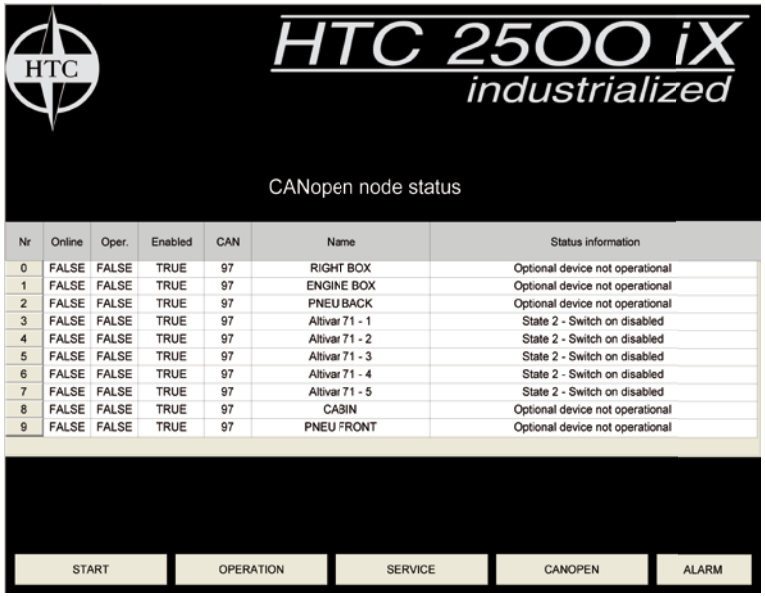
The “METERS” field displays indications of how much fuel or water to the “Mist Cooler System” remains.
The lower right-hand field contains indications which show whether the grinding heads are in their locked positions. A green indication shows that the grinding head is in a locked position and is ready for tool replacement. As long as the indication is red, there is a risk of crushing under the grinding heads.

Presentation

System description – CanOpen components' status

Error messages can be displayed in the "CANOpen" menu. The messages from this menu can be interpreted by authorised service personnel. Contact your retailer for further information.

See the error code overview later in this manual.



The CANOpen menu

Presentation

System description – Interface touch-screen

The ALARM menu contains e.g. a series of indicators that display any faults. The green indicator lights as long as the system in question is in normal mode. Faults are indicated with a red lamp, and may be of the following types:

CHAIR SWITCH: The indicator glows red when the driver is not sitting down on the driver's seat. If the driver leaves the seat while driving, the machine will stop.

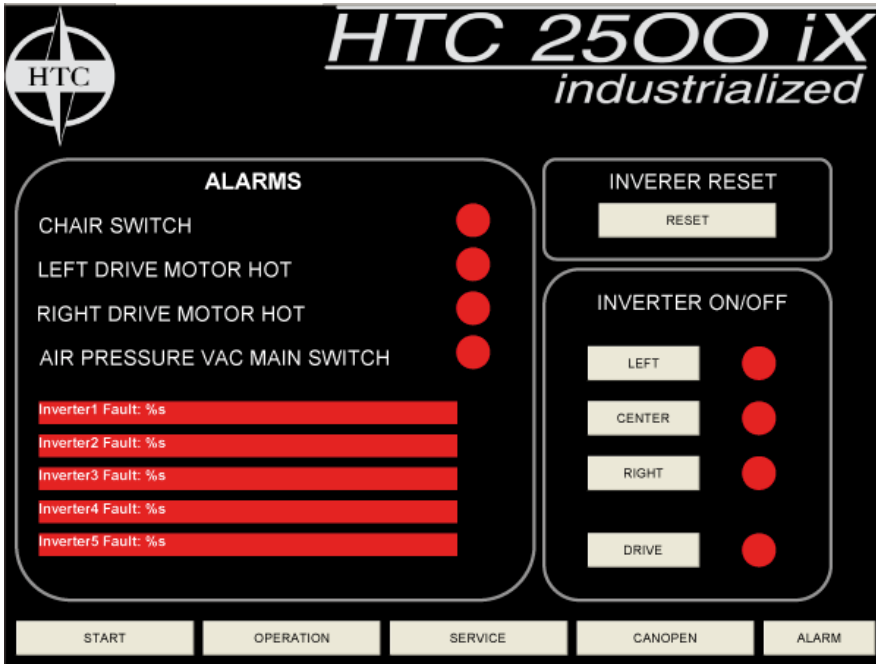
LEFT/RIGHT DRIVE MOTOR HOT: Indicates red when one of the motors for operating the machine is too hot.

AIR PRESSURE VAC MAIN SWITCH: Indicates red when the suction capacity in the dust separator is too low.

Under the heading "INVERTER RESET" there are buttons for resetting the frequency converters.

INVERTER ON/OFF shows whether the converter is turned on or off. They are turned on or off by pressing "LEFT", "CENTER" or "RIGHT".

If "Inverter Fault" is displayed in the ALARM list, the error message can be interpreted with the error code list presented later in this manual.



Operation

Before the starting engine

⚠ **NOTICE:** Only use antifreeze/coolant mixtures recommended in the coolant specifications that are in the Operation and Maintenance Manual. Failure to do so can cause engine damage.

⚠ Before the engine is started, perform the required daily maintenance and any other periodic maintenance that is due. Refer to the Operation and Maintenance Manual, “Maintenance Interval Schedule” for more information.

⚠ For the maximum service life of the engine, perform a thorough inspection within the engine compartment before the engine is started. Look for the following items: oil leaks, coolant leaks, loose bolts, and excessive dirt and/or grease. Remove any excess dirt and grease buildup. Repair any faults that were identified during the inspection.

⚠ Inspect the engine cooling system hoses for cracks and for loose clamps.

⚠ Inspect the engine alternator and accessory drive belts for cracks, breaks, and other damage.

⚠ Check the fuel supply. Drain water from the water separator (if equipped).

⚠ Check the engine lubrication oil level. Maintain the oil level between the “ADD” mark and the “FULL” mark on the engine oil level gauge.

⚠ Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe.

⚠ Inspect the drive belts of the main alternator and vacuum fan for cracks, breaks and other damage.

⚠ Inspect the wiring for loose connections and for worn or frayed wires.

⚠ Ensure that the areas around rotating parts are clear.

⚠ Check the hoses of the vacuum system for cracks, leaks, creases and loose clamps.

⚠ Inspect the vacuum system micro filter. Replace filter if necessary.

⚠ Check the engine air inlet for cracks, leaks, creases and loose clamps.

⚠ Disconnect any battery chargers that are not protected against the high current drain that is created when the starter motor is engaged. Check the electrical cables and check the batteries for poor connections and for corrosion.

⚠ Do not start the engine or move any of the controls if there is a “DO NOT OPERATE” warning tag or similar warning tag attached to the start switch or to the controls.

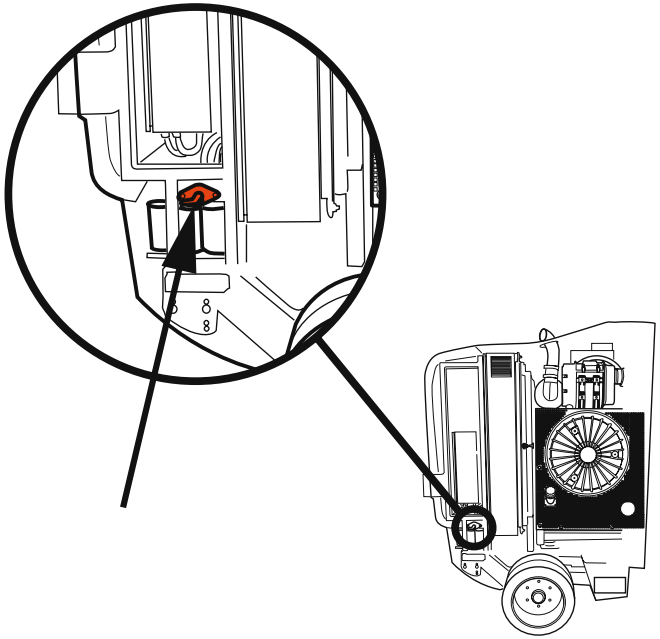
Operation
Starting the engine

⚠ **WARNING:** Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

⚠ **WARNING:** If you need to shut the engine off at any time to avoid injury or damage, use the EMERGENCY STOP button. Simply turning off the key will not stop the engine immediately.

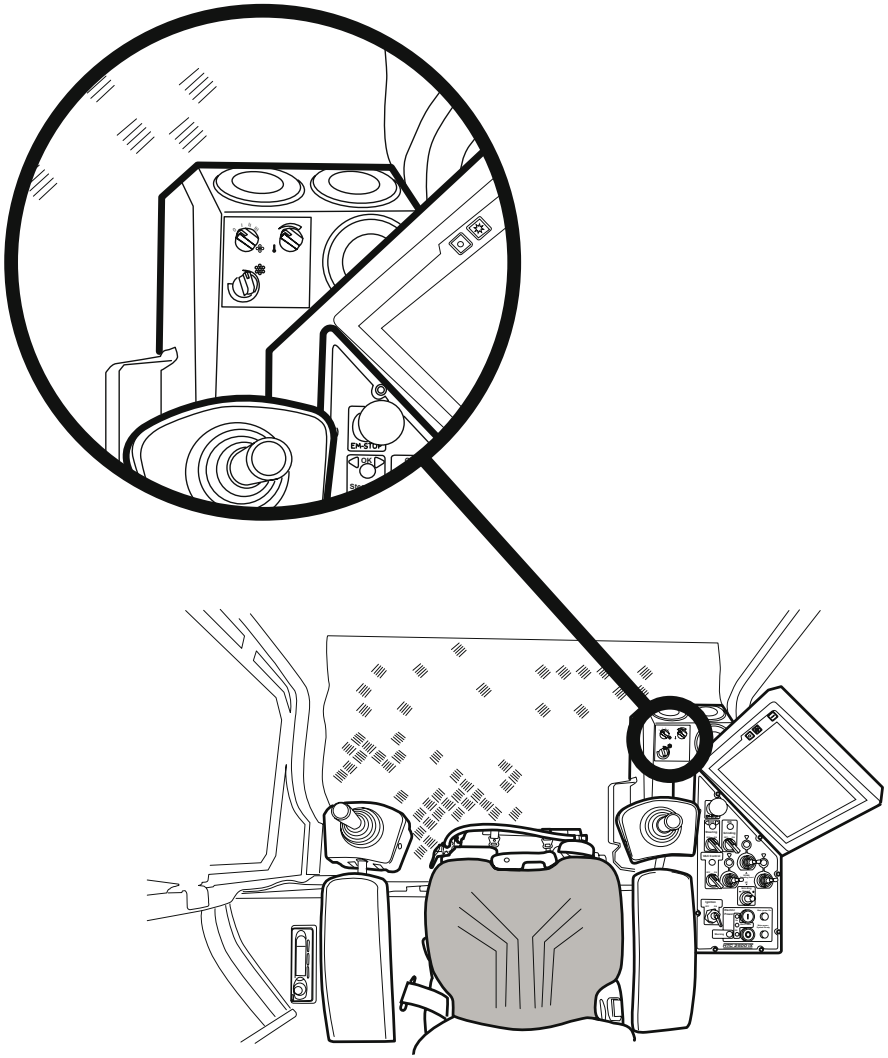
NOTICE: Do not crank the engine for more than 30 seconds. Allow the electric starter motor to cool for two minutes before cranking the engine again.

1. Ensure that the main switch (see figure below) has been engaged for at least 5 seconds.

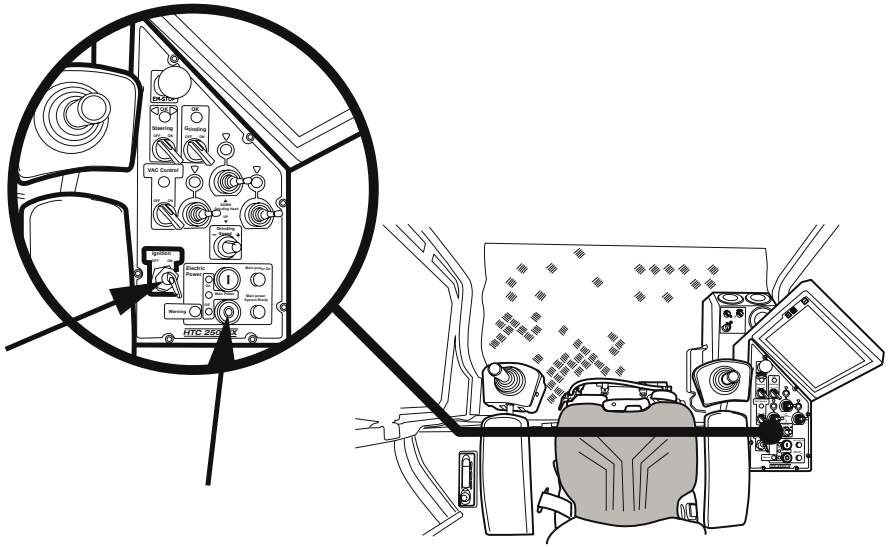


2. Check that the machine's doors and covers are closed and locked so that no personnel can be injured.

3. Turn off the Conditioning (see figure below)



4. Turn the ”Ignition” key fully clockwise and crank the engine until the engine starts.



5. When the engine starts, release the key and allow it to return.

6. If the engine does not start, release the start key and allow the electric starter motor to cool. Then repeat steps 4 and 5.

7. The engine initially runs at idle speed to ensure lubrication for all parts, and automatically speeds up to working rpm after approximately 30 seconds. Let the control display boot until ”CONTINUE” can be seen on screen.

8. Start the dust extractor and reverse driving control monitor. See page 19, pos 1.

9. Position all steering and turning joysticks in neutral

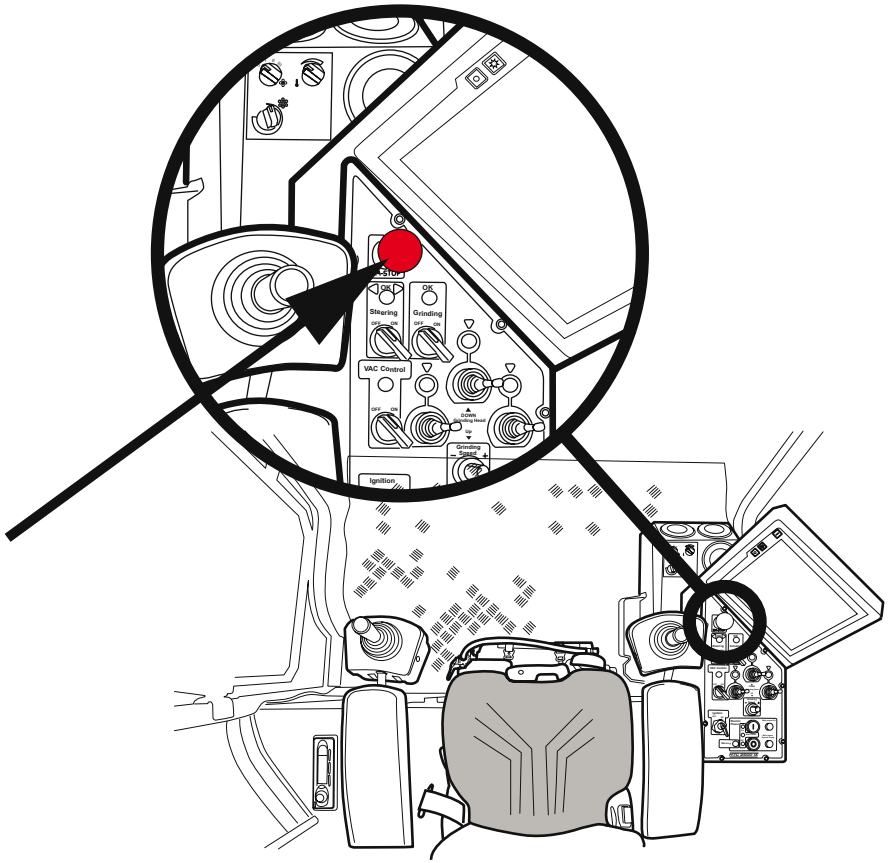
10. Check that the steering, grinding, VAC control and grinding head position controls are in their central, neutral position.

11. Press the ”CONTINUE” button on the control display.

Operation

Operating the machine

⚠ **WARNING:** If you need to shut the engine off at any time to avoid injury or damage, use the EMERGENCY STOP button (see figure below). Simply turning off the key will not stop the engine immediately.



⚠ **WARNING:** If people are to spend time in the vicinity of the machine while the grinding heads are folded up, the grinding heads must be secured with the accompanying safety chain. A falling grinding head can result in serious personal injury.

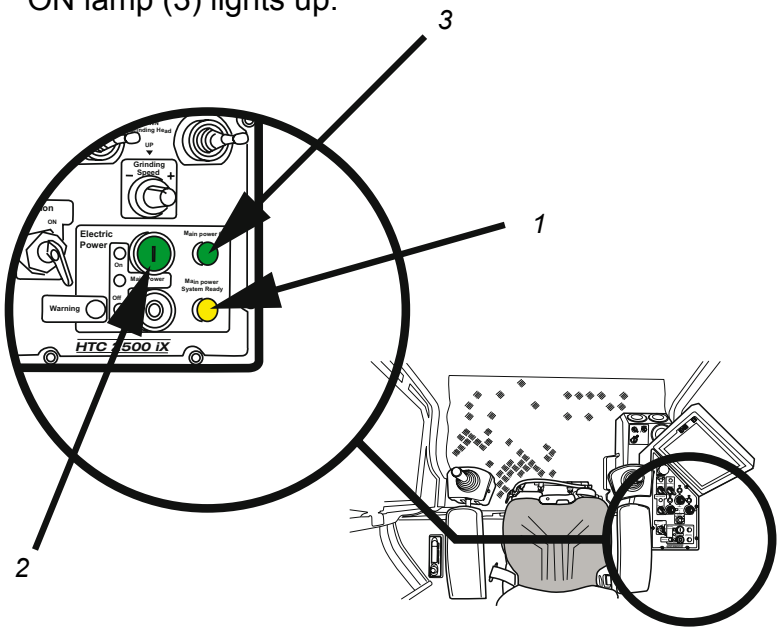
⚠ **WARNING:** If there machine is to be reversed and there is a risk of colliding with people or equipment, a person with a clear view outside the machine must be used as a reversing supervisor.

NOTICE: After the engine has been started, wait for 3 minutes before loading the engine with grinding and/or vacuum cleaner. This is to allow the engine to reach the correct working temperature.

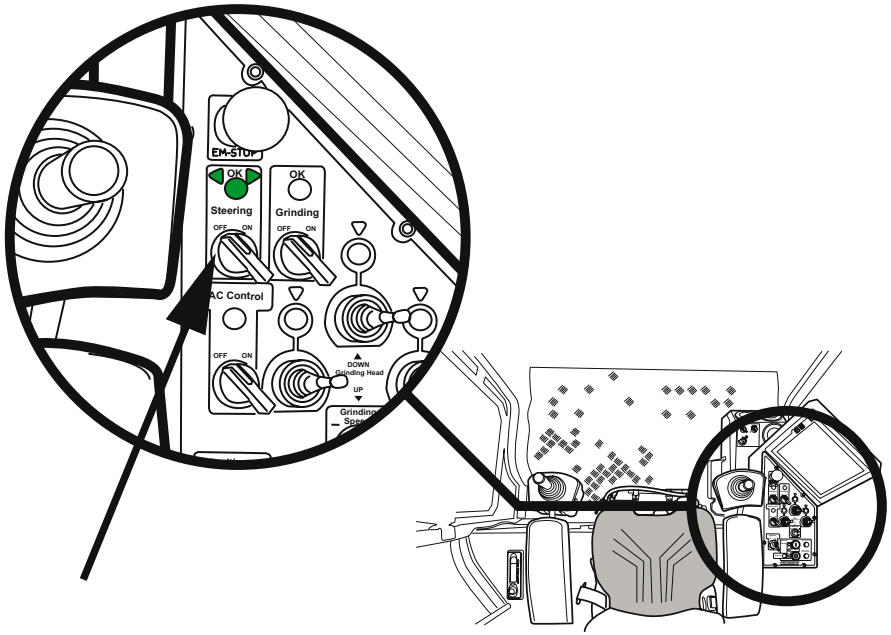
Correct operation and maintenance are key factors in obtaining the maximum life and economy from the machine. If the directions in this manual and the attached manuals are followed, costs can be minimised and component service life can be maximised.

Operation
Driving the machine

The first item to check after starting up the engine is to ensure that the MAIN POWER SYSTEM READY lamp (1) is lit (see figure below). This indicates that the voltage and frequency from the generator are correct, and that the power can be turned on. The power is turned on by pressing in the ELECTRIC POWER ON button (2). When the ELECTRIC POWER ON button has been pressed in, the MAIN POWER ON lamp (3) lights up.



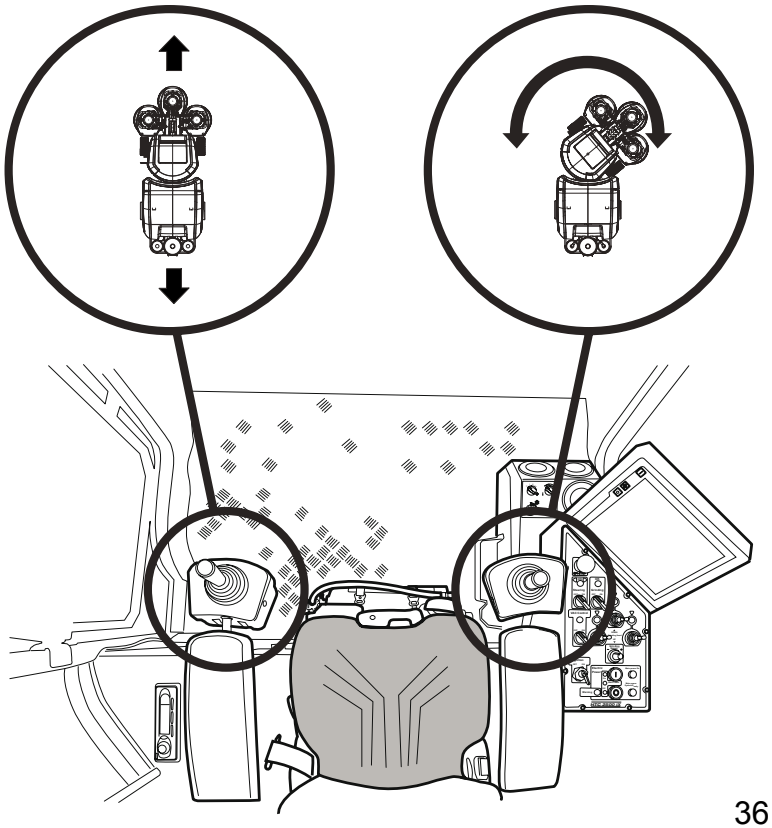
The machine's front wheels are equipped with brakes that are turned on when the STEERING button is in the OFF position (see figure below). As long as the button is in this position, the machine's wheels remain locked. In order to drive the machine, check that the control is in neutral position and set STEERING to the ON position. The machine is now not braked, which is important to known when e.g. starting on an incline. Pay attention to the fact that power load AMP-left or AMP-right will not exceed the recommended power output



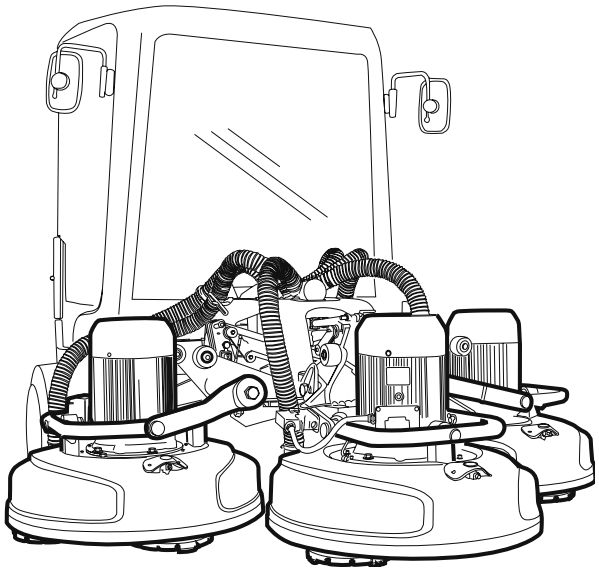
in the OPERATION menu.

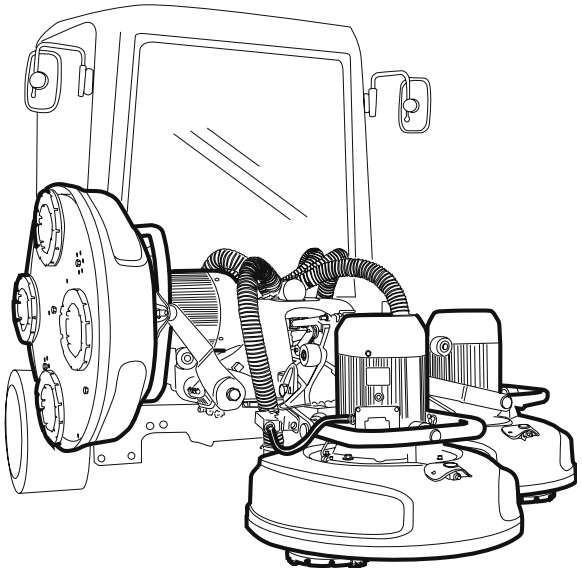
The left-hand control governs the forwards/backwards speed, and the right-hand control turns the machine (see figure below). If the right-hand control is released when driving forwards, the machine will continue straight ahead. If the same control is released when driving backwards, the steering system adjusts the movement so that the articulated joint maintains the same angle until the control is activated again.

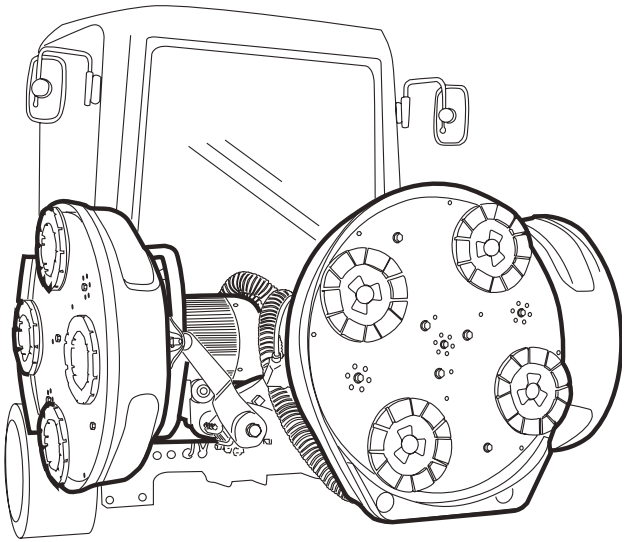
The current angle of the articulated joint can easily be monitored in the display, which makes reversing easier.



Operation
Grinding heads

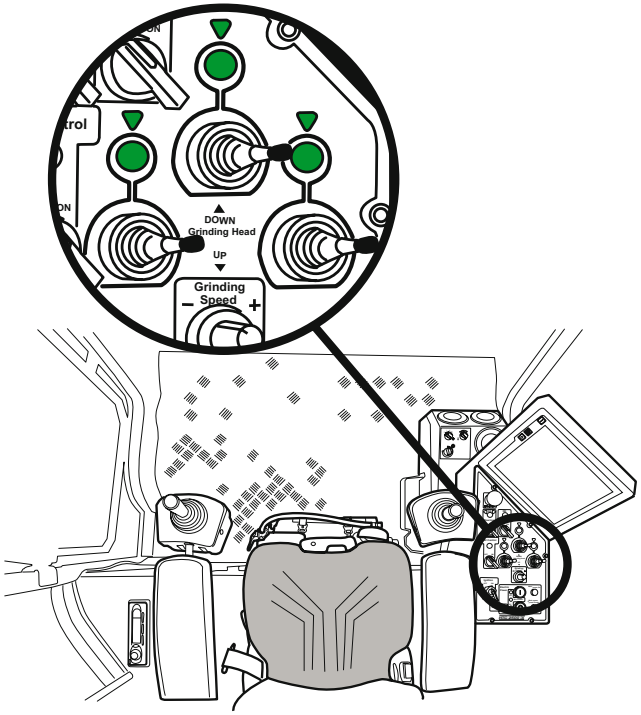


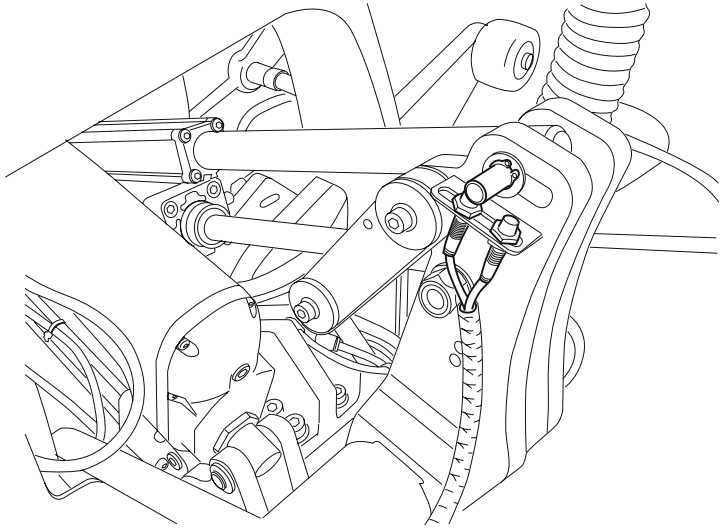




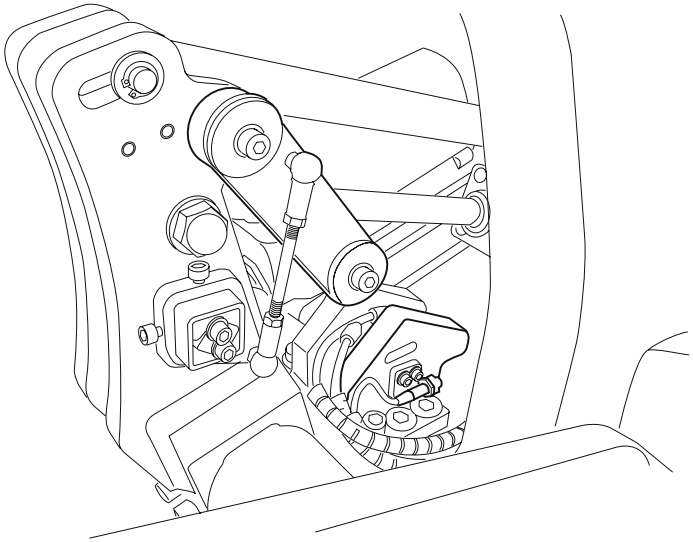
Operation
Grinding

Each grinding head can be folded up and down individually. This is achieved using the GRINDING HEAD POSITION levers (see figure below). If the levers are moved forwards, the grinding heads are folded down, and if they are moved backwards the grinding heads are folded up. During both folding up and folding down, the mechanism stops automatically when the grinding head is in the relevant end position. If the levers are retained in the forwards position when the grinding heads are folded down, the machine automatically adjusts the height of the lifting arms to compensate for any unevenness in the floor. A green lamp in front of the relevant lever indicates that this function is activated. HTC recommends that this function is always used during grinding.





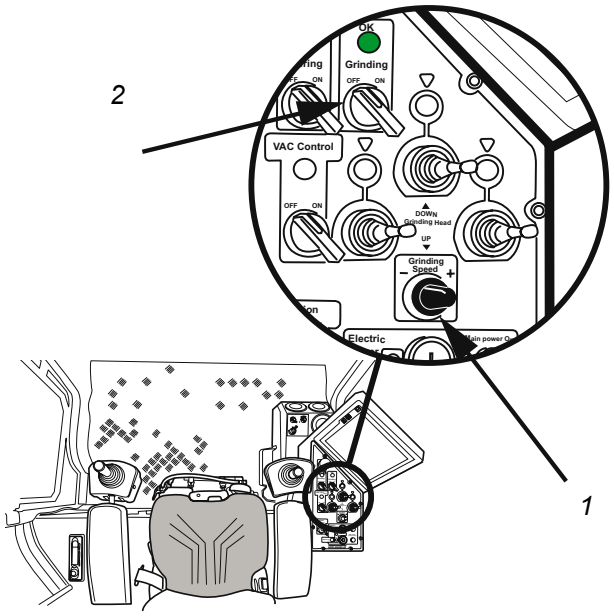
The sensor on the machine's lifting device indicates the position of the grinding head, and ensures that the grinding heads "float" over the floor during grinding.



This figure shows components that are included in the mechanical locking device for the grinding heads. A sensor registers that the head is mechanically locked, which is indicated on the machine's control display.

Check that all three grinding heads are folded down, that the control levers (GRINDING HEAD UP/DOWN) are in the DOWN position and that the driver is sitting on the seat.
If you do not want to use all the grinding heads for some reason, the machine can still grind with the remaining grinding heads. This is achieved by deactivating the head that is not going to be used for grinding in the ALARM menu under INVERTER ON/OFF and then folding it up.

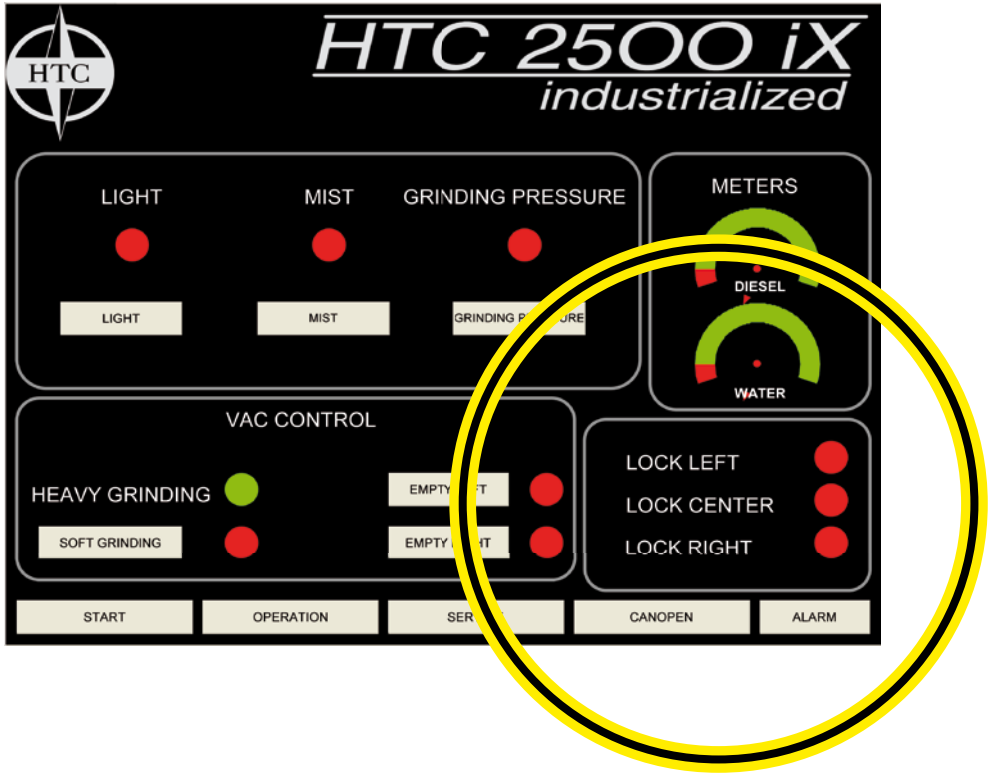
Set the required rotation speed for the grinding heads using the GRINDING SPEED knob (1), set the GRINDING knob to position ON (2) and immediately move the left-hand control lever carefully forwards to move the machine. Then adjust the rotation speed and the forward movement speed as appropriate in the prevailing grinding conditions. Continually check the power supply to the grinding motors under GRINDING in the OPERATION menu. If any of the indicators is within the red field, reduce the grinding speed.



Operation

Folding up grinding head for tool replacement

When replacing tools, grinding must be interrupted. Turn the knob to GRINDING OFF on the control panel, and turn the STEERING knob to OFF. Move the GRINDING HEAD POSITION control backwards to “position up” for the grinding heads that are to be lifted.
When a green indicator (LOCK LEFT, LOCK CENTER, LOCK RIGHT) can be seen under “SERVICE MENYN” in the control panel, this indicates that the grinding head is locked and secured, making it possible to go in underneath and replace the tool. See the chapter on “replacement of tools”.



Operation
Tool replacement

⚠ Remember that the grinding tools may be very hot if the machine has recently performed grinding work. The tools can remain hot for a long period after the machine has been used.

⚠ When replacing a tool, pay attention to the crushing risk when folding the grinding heads up/down.

The HTC 2500 iX is equipped with our new patented tool system with a registered design, EZchange™. This comprises wings bearing diamond grinding tools. These wings are folded down and slid into a tool holder, and then locked in place with a few gentle taps with a non-recoiling rubber mallet.

In order to install the grinding tool, this is moved, tilting forwards slightly, down into the intended slits in the tool holder. After this, the tool is slid forwards, out from the centre of the tool holder, in accordance with Figure 1.

Then lock the tool into the tool holder by giving it a few light taps with a rubber mallet, in accordance with Figure 2.

When releasing grinding tools in conjunction with replacement, the tool is released most easily with a few gentle taps on the grinding tool with a rubber mallet. This is now performed in the opposite direction. Strike the tool until it releases, and then lift it out of its guide slot in the tool holder. See Figure 3.

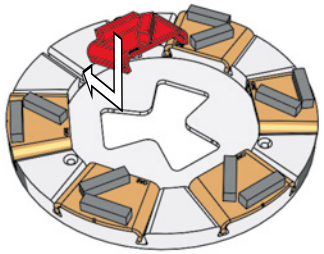


Figure 1. When installing a grinding tool, the tool must first be slid down into the tool holder's guide slot.

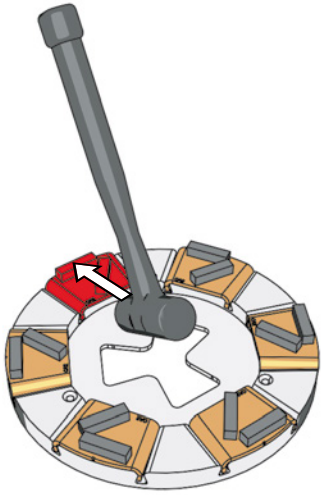


Figure 2. With a few light taps, it is then possible to lock the tool in the tool holder using a rubber mallet.

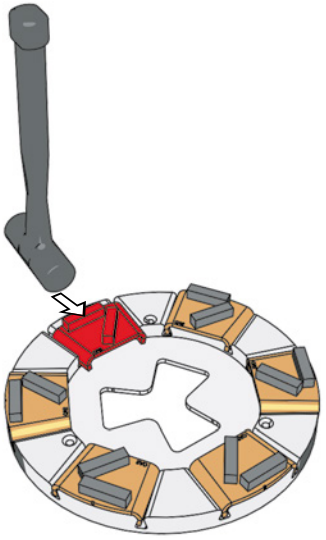
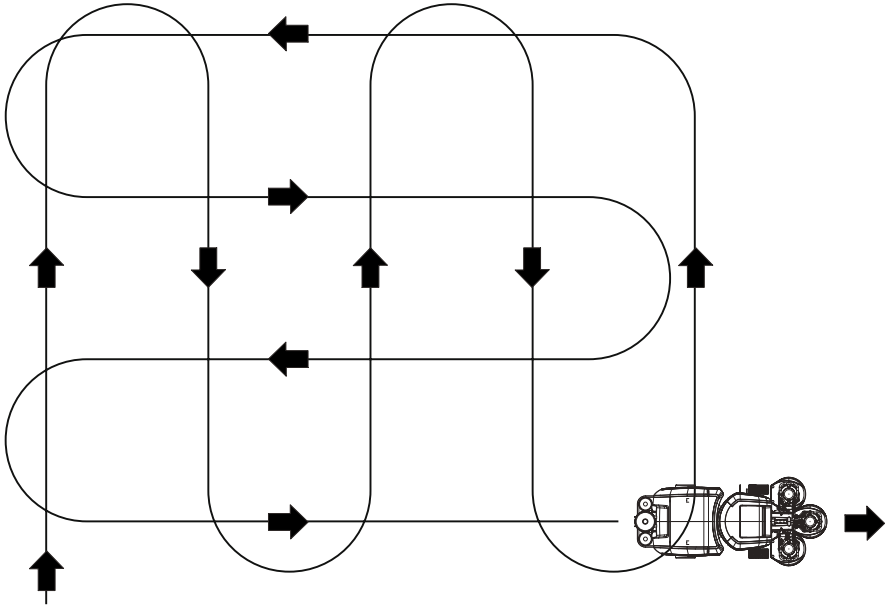


Figure 3. In order to disconnect a tool, tap the tool gently so that its locking devices releases. Then lift it up out if its guide slot.

Operation

A concrete floor should ideally be ground according to the following pattern (see figure below).



Operation
Mist Cooler System

If the mist system is to be used, the pump is activated/ deactivated via the display. Press the MIST button under the SERVICE page. When the Mist Cooler System is being activated, this is indicated with a yellow symbol. When the system is active, this is indicated with a green symbol. The Mist Cooler System only works when the grinding heads are rotating.

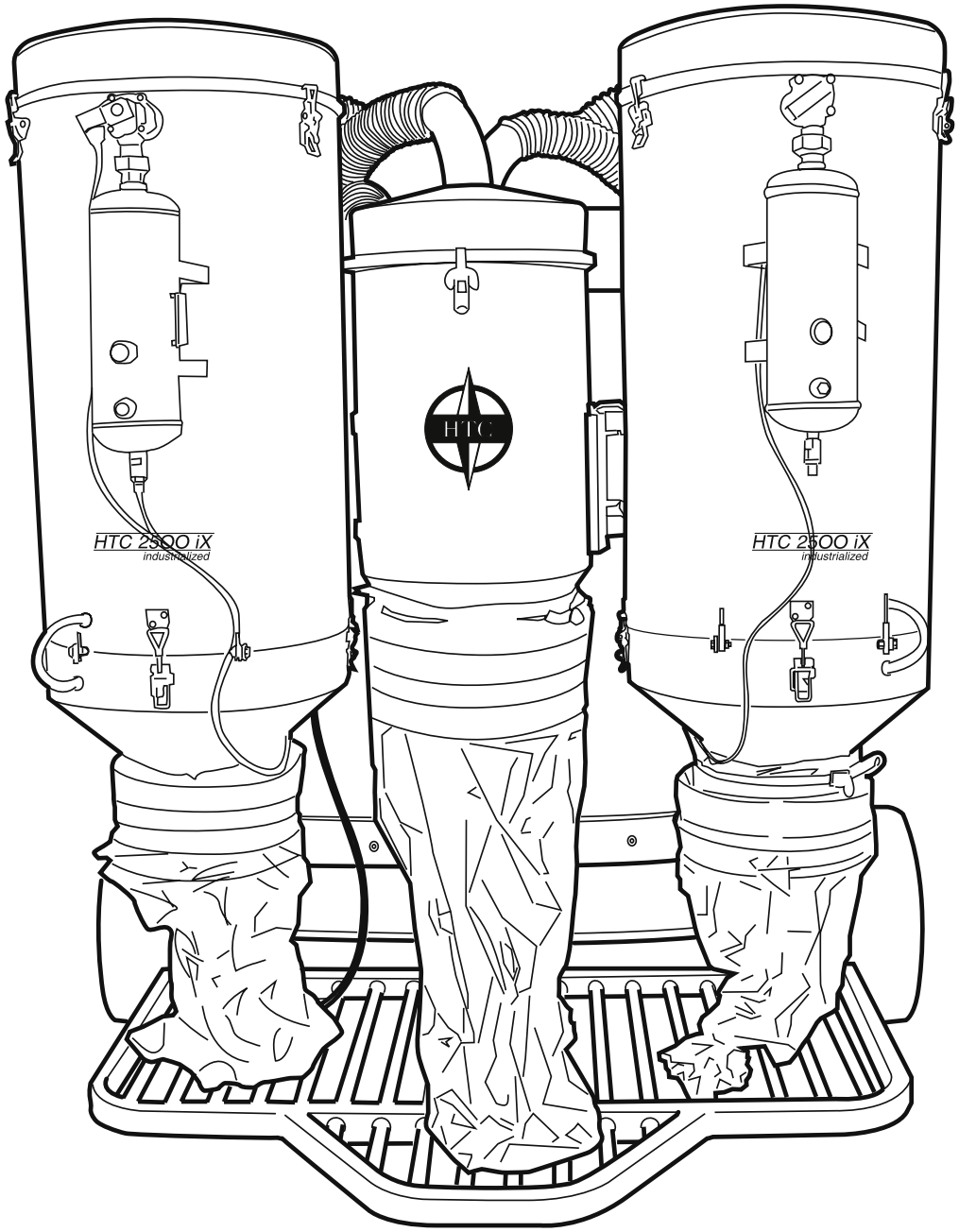
Operation
Grinding pressure

If grinding pressure is required, press the GRINDING PRESSURE button under the SERVICE page in the display. When the function is being activated, the symbol turns yellow. When the system is active, this is indicated with a green symbol. The grinding pressure can be adjusted variably via a pressure limiter, situated by the left-hand front wheel. Test which air pressure is most suitable.
The system only works when the grinding heads are in their lower position.

In order to stop grinding, set the GRINDING knob in the OFF position and move the left-hand control lever to neutral.

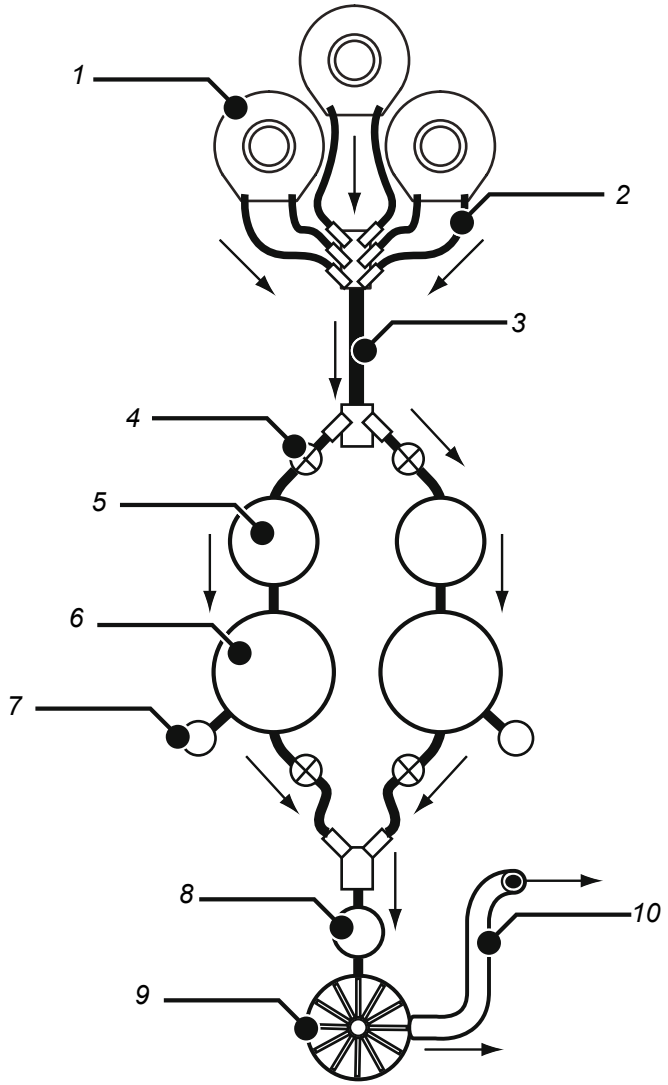
Presentation

Suction system



Schematic diagram

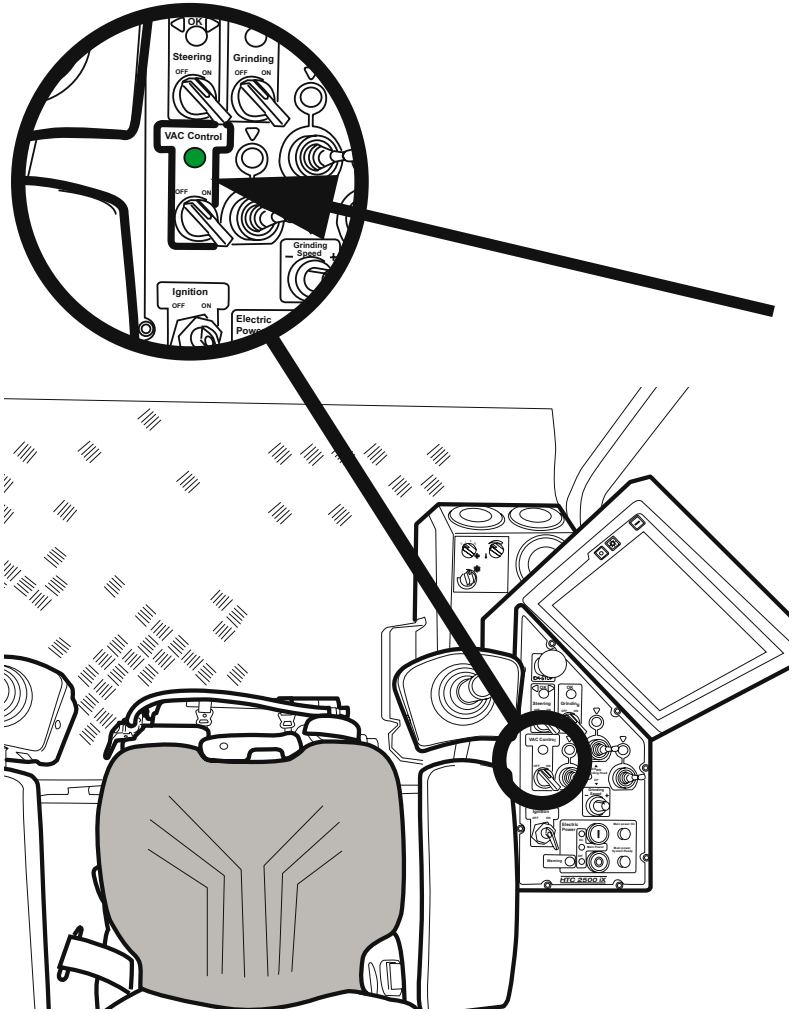
Suction system



No.	Function:
1	Grinding cover. The grinding dust is vacuumed up here.
2	Hose for transporting grinding dust.
3	Collection hose for transporting grinding dust.
4	Valve
5	Pre-separator that takes care of coarse grinding residue.
6	The filter cyclone takes care of fine grinding dust.
7	The air cannon/filter cleaner produces pulses of compressed air to clean the filter cyclone’s filter.
8	Absolute filter which cleans the remaining air of particles.
9	Suction fan.
10	Exhaust after suction fan.

Operation
Suction system

The suction fan is connected via a belt coupling to the diesel engine, and is operated with compressed air. Under the ALARM page in the display, check that “Air pressure VAC main switch” is inactive (green symbol). To activate vacuum cleaning, set the knob in the ON position.



If the suction system is to be effective, it is necessary for the cyclones to be emptied at regular intervals. The suction system is designed with two parallel routes in order that they can be emptied independently of each other, which means that you are never without suction capacity. This takes place automatically as long as the suction system has been activated.

In order to empty one side manually, press either LEFT or RIGHT by EMPTY VAC under the SERVICE page. It is not possible to empty both sides simultaneously.

In order to replace vacuum cleaner bag: Press LEFT or RIGHT under “EMPTY VAC” in the SERVICE menu. Wait until the indicator is green (can take up to 30 seconds). Replace bag.
When suction is to be activated again, press the same button again.

The emptying interval can be regulated by the SOFT GRINDING button indicating red or green in the SERVICE menu, where green indication in the event of HEAVY GRINDING means that emptying takes place at short intervals.

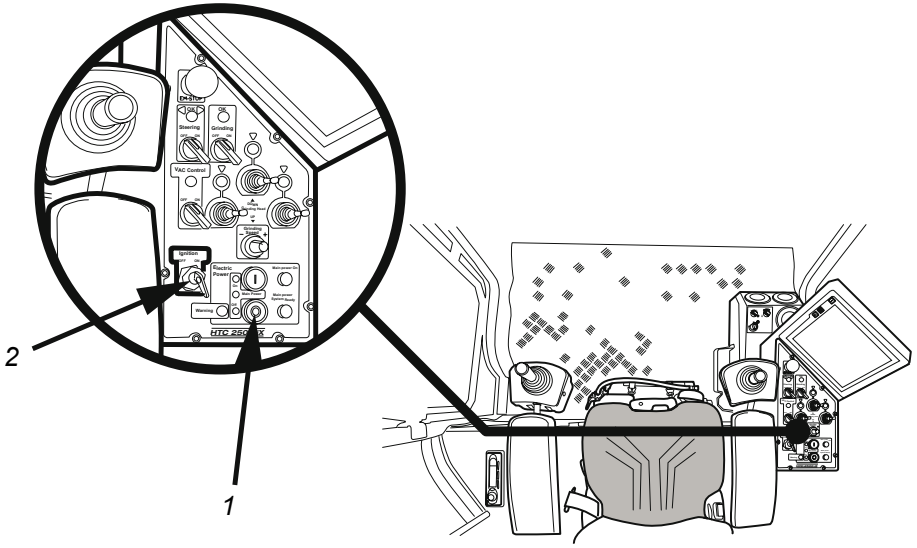
Pay attention to the level to which the Longopac bags below the cyclones are filled, so that they are replaced at the right time.

Operation
Stopping the engine

NOTICE: Stopping the engine immediately after it has been working under load can result in overheating and accelerated wear of the engine components. If the engine has been working at high loads it is important that the engine is run at low idle for at least three minutes to reduce and stabilise internal engine temperature before it is stopped. Avoiding hot engine shutdowns will maximise turbocharger shaft and bearing life.

NOTICE: Emergency shutoff controls are for EMERGENCY use ONLY. DO NOT use emergency shutoff devices or controls for normal stopping procedure.

1. Press the Main Power button OFF
2. Turn the key to the OFF position.



3. The engine will run at idle and stops automatically after two minutes in order to stabilise internal engine temperature and maximise turbocharger life.

4. Make sure that diesel engine is complete stopped.

5. Turn the Main Power switch to OFF and remove the key.

⚠ **WARNING:** Always let the engine cool before inspecting the coolant level. Failure to do so can result in personal injury.

NOTICE: Only use antifreeze/coolant mixtures recommended in the coolant specifications that are in the Operation and Maintenance Manual. Failure to do so can cause engine damage.

- Check crankcase oil level. Maintain the oil level between the “ADD” mark and the “FULL” mark on the oil level dipstick. In order to allow the oil to return to the oil pan, do not operate the engine for at least 10 minutes prior to this check.

- If necessary, perform minor adjustments. Repair any leaks and tighten any loose bolts.

- Note the required service intervals for the machine’s components. Perform the engine maintenance that is specified in the Operation and Maintenance Manual, “Maintenance Interval Schedule”. Perform all required periodic maintenance on all driven equipment.

- Fill the fuel tank in order to help prevent accumulation of moisture in the fuel. The fuel tank may only be filled with diesel class MK1. Do not overfill the fuel tank.

- Allow the engine to cool. Check the coolant level.

- If freezing temperatures are expected, check the coolant for the correct antifreeze protection. The cooling system must be protected against freezing to the lowest expected outside temperature. If necessary, add the correct coolant/water mixture.

Care and maintenance

Cleaning the machine

The grinding heads and their mechanical mountings can be washed and cleaned by thoroughly flushing them with water. The cab can be cleaned with water, but with the restriction that water must not penetrate via the moulding around the entrance door to the cab. When wiping off windows, particular attention must be paid when cleaning the side windows, as these are made of plastic and become scratched more easily than glass. Use a damp, lint-free, soft, clean cloth to achieve the best results.

Bearing in mind the risk of electric flashover, machine covers and the dust separation system must only be cleaned with a dry cloth or brush.

Refuelling the diesel engine

When filling up with diesel, the machine must be earthed (potential equalised) before refuelling. This is done to counteract sparking in conjunction with handling of the fuel.

Felkoder i kontrollpanel

Frekvensomriktare: Felkod 0 - 14

Felkod:	Visas i display:	Förklaring:
0	No fault	
1		Reserved
2	[Control EEprom] (EEF1)	Internal memory fault, control card.
3	[Incorrect config] (CFF)	Option card changed or removed. Control card replaced by a control card configured on a drive with a different rating. The current configuration is inconsistent.
4	[Invalid config] (CFI)	Invalid configuration. The configuration loaded in the drive via the bus or communication network is inconsistent.
5	[Modbus com.] (SLF1)	Interruption in communication on the Modbus bus.
6	[internal com. link] (ILF)	Communication fault between option card and drive.
7	[Com. network] (CnF)	Communication fault on communication card.
8	[External flt-LI/Bit] (EPF1)	Fault triggered by an external device, depending on user.
9	[Overcurrent] (OCF)	Parameters in the [SETTINGS] (SEt-) and [1.4 MOTOR CONTROL] (drC-) menus are not correct. Inertia or load too high. Mechanical locking.
10	[Precharge] (CrF1)	Pre-charge relay control fault or charging resistor damaged.
11	[Speed fdback loss] (SPF)	Encoder feedback signal missing.
12	[Load slipping] (AnF)	The encoder speed feedback does not match the reference.
13	[AI2 4-20 mA loss] (LFF2)	Loss of the 4-20 mA reference on analog input AI2.
14	[PTC1 probe] (PtF1)	PTC1 probes open or short-circuited.

Felkoder i kontrollpanel

Frekvensomriktare: Felkod 15 - 28

Felkod:	Visas i display:	Förklaring:
15	[PTC1 overheat] (OtF1)	Overheating of the PTC1 probes detected.
16	[Drive overheat] (OHF)	Drive temperature too high.
17	[Motor overload] (OLF)	Triggered by excessive motor current.
18	[Overbraking] (ObF)	Braking too sudden or driving load.
19	[Mains overvoltage] (OSF)	Line voltage too high. Disturbed line supply.
20	[1 motor phase loss] (OPF1)	Loss of one phase at drive output.
21	[Input phase loss] (PHF)	Drive incorrectly supplied or a fuse blown. Loss of one phase. 3-phase ATV71 used on a single-phase line supply. Unbalanced load. This protection only operates with the drive on load.
22	[Undervoltage] (USF)	Line supply too low. Transient voltage dip. Damaged precharge resistor.
23	[Motor short-circuit] (SCF1)	Short-circuit or grounding at the drive output. Significant earth leakage current at the drive output if several motors are connected in parallel.
24	[Overspeed] (SOF)	Instability or driving load too high.
25	[Auto-tuning] (tnF)	Special motor or motor whose power is not suitable for the drive. Motor not connected to the drive.
26	[Rating error] (InF1)	The power card is not the one stored.
27	[Incompatible PB] (InF2)	The power card is incompatible with the control card.
28	[Internal serial link] (InF3)	Communication fault between the internal cards.

Felkoder i kontrollpanel
Frekvensomriktare: Felkod 29 - 42

Felkod:	Visas i display:	Förklaring:
29	[Internal MFG area] (InF4)	Internal data inconsistent.
30	[Power EEprom] (EEF2)	Internal memory fault, power card.
31	[Impedant sh. circuit] (SCF2)	Impedant short-circuit.
32	[Ground short circuit] (SCF3)	Ground short-circuit.
33	[3 output phase loss] (OPF2)	Motor not connected or motor power too low. Output contactor open. Instantaneous instability in the motor current*);
34	[CANopen. com.] (COF)	Interruption in communication on the CANopen bus.
35	[Brake control] (bLF)	Brake release current not achieved. Brake engage frequency threshold [Brake engage freq] (bEn) only regulated when brake logic control is assigned.
36		Reserved
37	[Internal-hard init.] (InF7)	Initialisation of the drive is incomplete.
38	[External fault com.] (EPF2)	Fault triggered by a communication network.
39	[Application fault] (APF)	Controller Inside card fault.
40	[Internal-ctrl supply] (InF8)	The control supply is not correct.
41	[Brake feedback] (brF)	The brake feedback contact does not match the brake logic control.
42	[PowerSuite com.] (SLF2)	Fault communicating with PowerSuite.

Felkoder i kontrollpanel
Frekvensomriktare: Felkod 43 - 56

Felkod:	Visas i display:	Förklaring:
43	[Encoder coupling] (ECF)	Break in the mechanical coupling of the encoder.
44	[Torque/current lim] (SSF)	Switch to torque limitation.
45	[HMI com.] (SLF3)	Fault communicating with the graphic display terminal.
46	[Power removal] (PrF)	Fault with the drive's Power removal safety function.
47	[PTC 2 probe] (PtF2)	PTC2 probes open or shout-circuited.
48	[PTC2 overheat] (OtF2)	Overheating of the PTC2 probes detected.
49	[LI6=PTC probe] (PtFL)	PTC probes on input LI6 open or short-circuited.
50	[LI6=PTC overheat] (OtFL)	Overheating of PTC probes detected on input LI6.
51	[Internal- I measure] (InF9)	The current measurements are not correct.
52	[Internal-mains circuit] (InFA)	The input stage is not operating correctly.
53	[Internal-th. sensor] (InFb)	The drive temperature sensor is not operating correctly.
54	[IGBT overheat] (tJF)	Drive overheated.
55	[IGBT short circuit] (SCF4)	Power component fault.
56	[Motor short circuit] (SCF5)	Short-circuit at the drive output.

Felkoder i kontrollpanel

Frekvensomriktare: Felkod 57 - 70

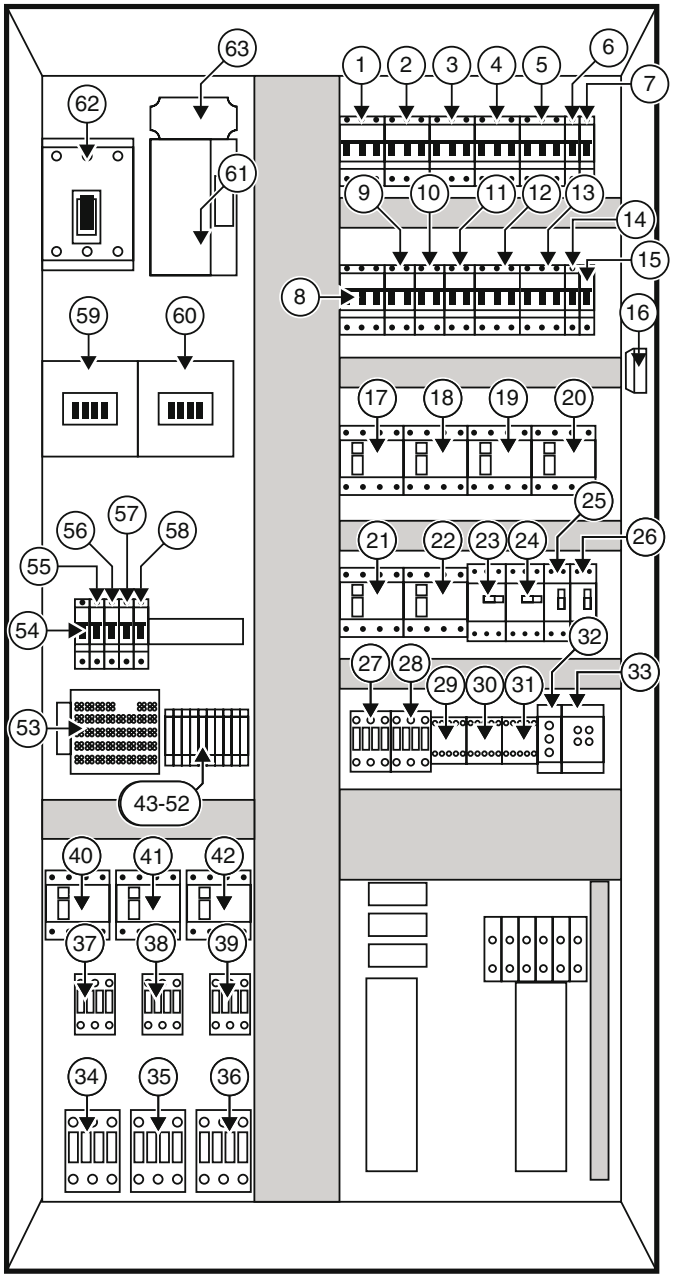
Felkod:	Visas i display:	Förklaring:
57	[Torque time-out] (SrF)	Torque control function time-out.
58	[Out. contact. stuck] (FCF1)	The output contactor remains closed although the opening conditions have been met.
59	[Out. contact. open.] (FCF2)	The output contactor remains open although the closing conditions have been met.
60	[Internal-time meas.] (InFC)	Fault on the electronic time measurement component.
61	[AI2 input] (AI2F)	Non-conforming signal on analog input AI2.
62	[Encoder] (EnF)	Encoder feedback fault.
63	[Thyr. soft charge] (CrF2)	DC bus charging fault (thyristors).
64	[input contactor] (LCF)	The drive is not turned on even though [Mains V. time out] (LCt) has elapsed.
65	[DB unit sh. circuit] (bUF)	Short-circuit output from braking unit.
66		Reserved
67	[IGBT desaturation] (HdF)	Short-circuit or grounding at the drive output.
68	[Internal-option] (InF6)	The option installed in the drive is not recognised.
69	[internal- CPU] (InFE)	Internal microprocessor fault.
70	[DBR overload] (bOF)	The braking resistor is under excessive stress.

Felkoder i kontrollpanel

Frekvensomriktare: Felkod 71 - 73

Felkod:	Visas i display:	Förklaring:
71	[AI3 4-20 mA loss] (LFF3)	Loss of the 4-20 mA reference on analog input AI3.
72	[AI4 4-20 mA loss] (LFF4)	Loss OF the 4-20 mA reference on analog input AI4.
73	[Cards pairing] (HCF)	The [CARDS PAIRING] (PPI-) FUNCTION has been configured AND a drive card has been changed.

Control cabinet - AS1



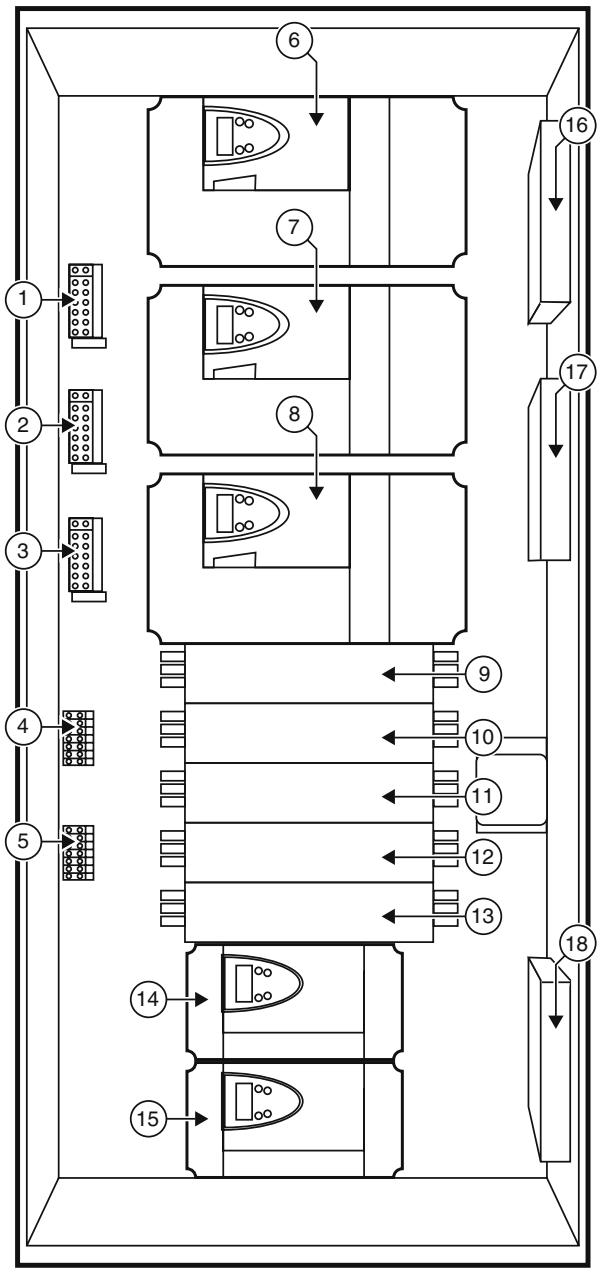
No.	Inst. no.:	Function:
1	F7	Fuse – Frequency converter 4
2	F8	Fuse – Frequency converter 5
3	F9	Fuse - 24VDC unit AS4
4	F2	Electrical socket 1
5	F3	Electrical socket 2
6	F15	Fuse – Terminal box 67 24 VDC FIN
7	F16	Fuse – Terminal box 69 24 VDC FIN
8	F1	Fuse – Control transformer 1
9	F13	Fuse – Control transformer 2
10	F12	Fuse – Transformer 2 primary
11	F14	Fuse – Transformer 2 secondary
12	F10	Fuse – Air compressor
13	F11	Fuse – Mist pump
14	F17	Fuse - 24VDC Relays
15	F18	Fuse - 24VDC Relays
16	B3	Operating time counter
17	Q8	Residual current device – Frequency converter 4
18	Q9	Residual current device – Frequency converter 5
19	Q3	Electrical socket 1
20	Q4	Electrical socket 2
21	Q13	Residual current device - 24VDC unit AS4
22	Q10	Residual current device – Compressor, Water pump
23	Q11	Motor protection, Compressor
24	Q12	Motor protection, Water pump

Control cabinet - AS1

No.	Inst. no.:	Function:
25	Q14	Residual current device – Transformer 1 secondary
26	Q15	Residual current device – Transformer 2 secondary
27	K6	Contactor – Frequency converter 4
28	K7	Contactor – Frequency converter 5
29	K8	Contactor - Compressor
30	K9	Contactor – Water pump
31	K10	Contactor – Brakes, drive motors
32	B2	Voltage relay
33	B1	Frequency relay
34	K3	Contactor – Frequency converter 1
35	K4	Contactor – Frequency converter 2
36	K5	Contactor – Frequency converter 3
37	F4	Fuse – Frequency converter 1
38	F5	Fuse – Frequency converter 2
39	F6	Fuse – Frequency converter 3
40	Q5	Residual current device – Frequency converter 1
41	Q6	Residual current device – Frequency converter 2
42	Q7	Residual current device – Frequency converter 3
43	K11	Control RELAY K3
44	K12	Control RELAY K4
45	K13	Control RELAY K5
46	K14	Control RELAY K6

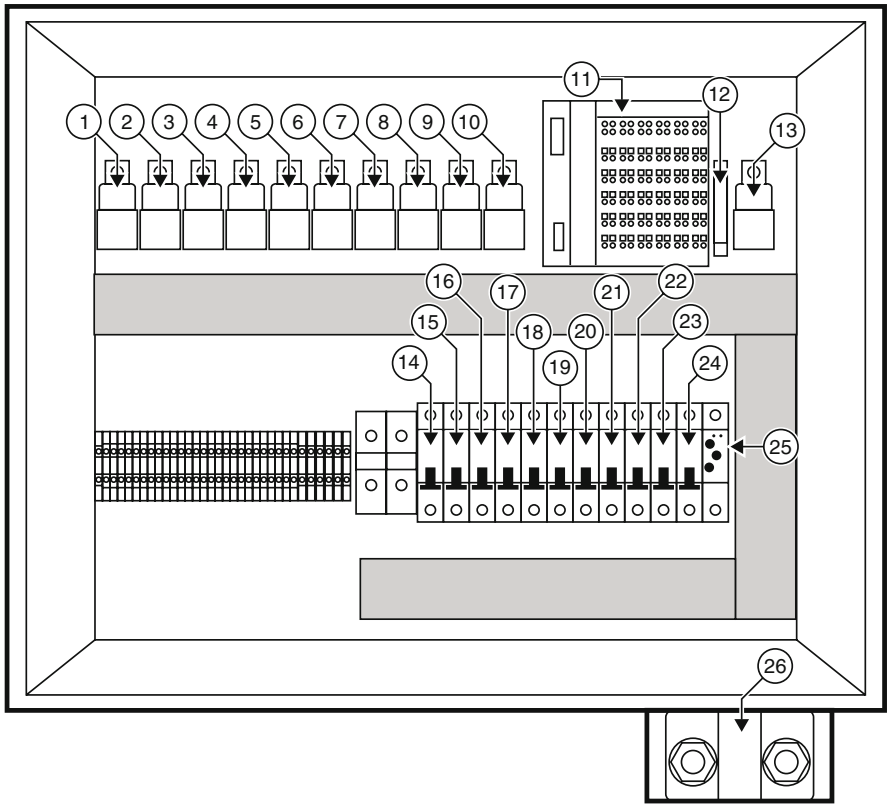
No.	Inst. no.:	Function:
47	K15	Control RELAY K7
48	K16	Control RELAY K40, AS4
49	K17	Control RELAY
50	K18	Control RELAY
51	K19	Control RELAY K2
52	K20	Control RELAY
53	PLC	CanOpen module
54	F19	Fuse – Fan 1 Drive box
55	F20	Fuse – Fan 2 Drive box
56	F21	Fuse – Fan 3 Drive box
57	F22	Fuse – Fan 4 Drive box
58	F23	Fuse – Fan 5 Drive box
59	K1	Main contactor
60	K2	Contactor – electrical socket
61	Q1	Circuit breaker
62	T2	Transformer 2
63	T1	Transformer 1

Control cabinet - AS2



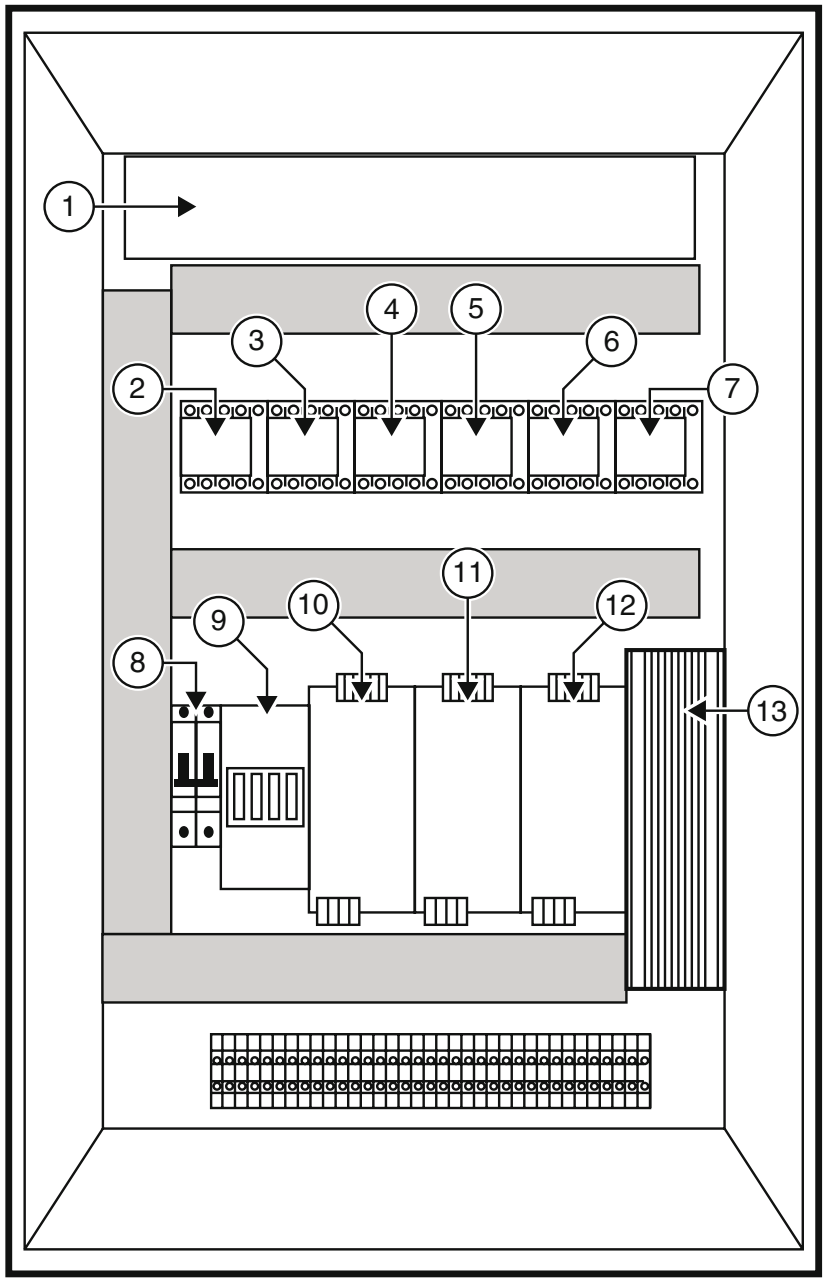
No.	Inst. no.:	Function:
1	L1	Inductance 1
2	L2	Inductance 2
3	L3	Inductance 3
4	L4	Inductance 4
5	L5	Inductance 5
6	U1	Frequency converter 1
7	U2	Frequency converter 2
8	U3	Frequency converter 3
9	U6	EMC Filter 1
10	U7	EMC Filter 2
11	U8	EMC Filter 3
12	U9	EMC Filter 4
13	U10	EMC Filter 5
14	U4	Frequency converter 4
15	U5	Frequency converter 5
16	E1	Cooling element 1
17	E2	Cooling element 2
18	E3	Cooling element 3

Control cabinet - AS3



No.	Inst. no.:	Function:
1	K12	Relay, fuel pump
2	K13	Relay, fuel delay
3	K14	Relay, starter motor
4	K15	Relay, ignition
5	K16	Relay, headlight, roof
6	K17	Relay, fan, cab
7	K18	Relay, condenser, AC system
8	K19	Relay, fresh air fan
9	K20	Relay, Cab lighting
10	K21	Relay, radio mode PC, Radio, LCD, cam-eras
11	PLC	CanOpen module
12	K22	Relay, RPM diesel engine
13	K23	12/24 UNIT AS4
14	F30	Fuse, main fuse for 12V system
15	F31	Fuse, headlight, roof
16	F32	Fuse for control relay
17	F33	Fuse, fan cab, condenser AC
18	F34	Fuse, fresh air fan
19	F35	Fuse, cab lighting
20	F36	Fuel pump, fuel delay, starter motor, ignition
21	F37	Fuse, radio mode PC, radio, LCD, cam-eras
22	F38	Fuse, emergency stop switch
23	F39	Fuse, PC, Stereo
24	F40	Fuse, 12/24 VDC unit AS4
25	K24	Delay relay, diesel engine
26	K25	Emergency stop switch

Control cabinet - AS4



No.	Inst. no.:	Function:
1	U11	Filter
2	K41	Contactor – actuator 1 Down
3	K42	Contactor – actuator 1 Up
4	K43	Contactor – actuator 2 Down
5	K44	Contactor – actuator 2 Up
6	K45	Contactor – actuator 3 Down
7	K47	Contactor – actuator 3 Up
8	F41	Fuse - 24VDC CanOpen
9	K40	Contactor - Cooling AS2
10	U12	DC unit Relay, actuator
11	U13	DC unit Relay, actuator
12	U14	DC unit Relay, actuator
13	U15	DC/DC converter, CanOpen

Appendix 1 – Additions to manual for HTC 2500 iX

Transportation of the machine

A freight container is recommended for transporting the machine. When anchoring the machine, the following methods are recommended:

- Securing strap or chain in the towing eyelets at the front, under the mountings for the grinding heads, and under the loading platform at the rear.
- Chocks in front of & behind the pairs of wheels.
- Securing strap around the wheels with mounting points in the floor.
- The ramp for the container may not exceed an incline of 10°.
- Lifting points for the machine are located directly in front of the pairs of wheels.
- When lifting with a crane, stays must be positioned under the lifting points.

Wheel replacement

- When replacing wheels, position the jack at the lifting point by the wheel that is to be replaced.

Mist cooler system

- You are recommended to use decalcified water for the Mist cooler system.
- When storing the machine, drain the water tank for the Mist cooler system.

Maintenance instructions

Fill with diesel & water.

- Ensure that the machine is turned off.

The engine must not be in operation and the electrical system must be disconnected.

- Remove the cover and top up the tank.
- Do not use category 2 & 3 diesel. This would reduce the engine's service life and result in the particle filter having to be cleaned at more regular intervals.

Service and maintenance – General overview

- Check the absolute filter for the vacuum cleaning system. If it is dusty, check the sock filters for leaks. See page 21, point 4.
- Check the play of the clutch discs weekly. Access from beneath the mesh grille. See page 23, between points 3 & 5.
- Check the oil level for the diesel engine. See page 21, point 13.
- Empty the compressed air system of water. See page 21, point 8.
- Check the mist system's filter before use. See page 21, point 10.
- Check the intake filter – clean if necessary, replace if required. See page 23, point 2.
- Check the oil level in the mist lubricator for compressed air. See page 23, point 5.
- Check belts for generator and vacuum cleaner. Page 23, points 1 & 4.
- Check belts for AC & fans. See figure 1, point 7.
- Check the level in the cooling system – the engine must not be running or hot. See figure 1, point 2.
- Check the level in the water separator for the fuel system – must not be more than 50%. See figure 1, point 3.
- Residual current devices are activated at least every six months. You are recommended to activate the residual current device before starting an assignment.
- Miniature circuit breakers must be activated at least once a year. You are recommended to activate the miniature circuit breakers before starting an assignment.

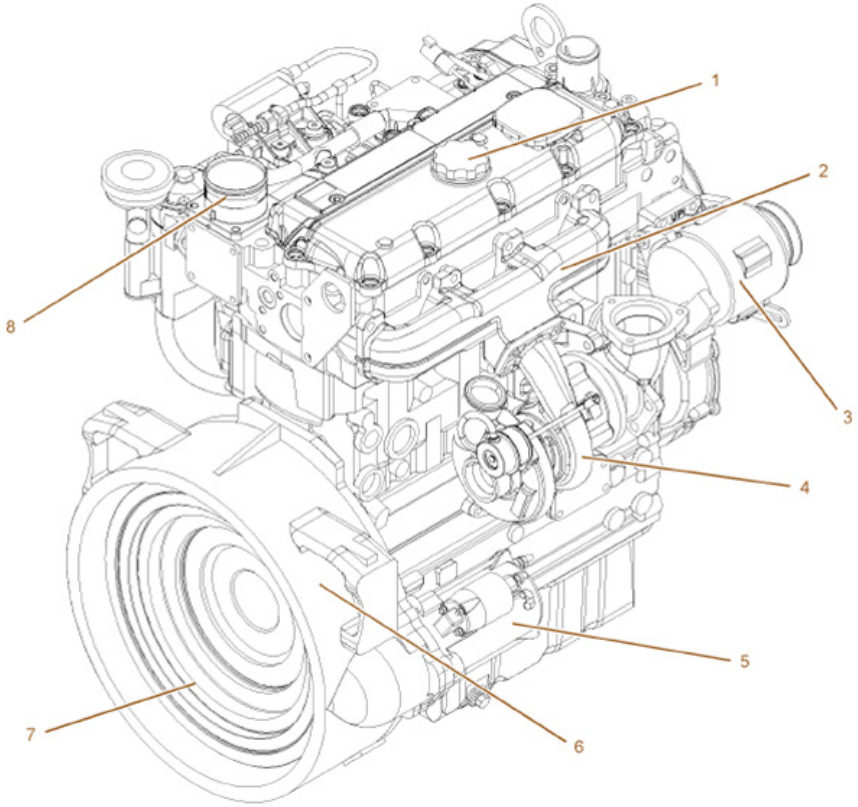


Image 1

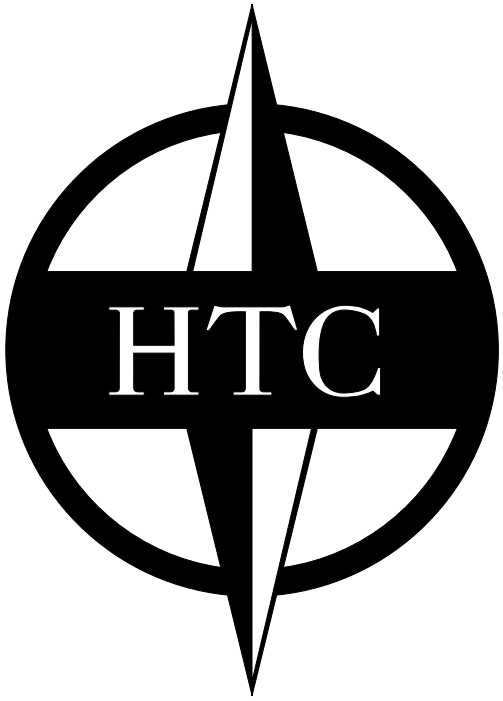
Appendix 2 – Maintenance intervals for HTC 2500 iX

			A Daily	50h	B 500h	C 1,000h	D 2,000h	E 2 years	F 3,000h	G	H 4,000h		
1	Fan drive belts – Check / Adjustment / Replacement			X		X	X	X	X	X	X		X
2	Coolant level – check	X		X	X	X	X	X	X		X		
3	Driving functions – check			X	X	X	X	X	X	X	X		
4	Engine air filter						X	X	X	X	X		
5	Engine oil – check	X	X	X	X	X	X	X	X				
6	Fuel filter – check / replacement					X	X	X	X	X	X	X	
7	General inspection			X	X	X	X	X	X	X	X		
8	Battery – charging / acid level – check				X	X	X		X	X			
9	Earth cables, check					X	X	X		X	X		
10	Oil filter – replacement					X	X	X		X	X		
11	Hoses & hose clamps – check / replacement					X	X	X		X	X		
12	Cooler / intercooler / condenser – check / cleaning				X	X	X		X	X			
13	Engine valve play – check / adjustment						X	X		X	X		
14	Generator - check					X			X				
15	Engine mounts – check				X	X	X	X		X	X		
16	Starter motor – check									X			
17	Turbocharger - check										X		
18	Water pump – check									X			
19	Refrigerant – change								X				
20	Fuel injection – check / replacement								X				
21	Intercooler – cleaning / check									X			
22	Particle filter – turn				X		X			X			
23	Sock filter, absolute filter – check / cleaning / replace if necessary **			X									
24	Activate residual current device *						X						
25	Activate miniature circuit breaker*						X						
26	Side duct fan Grease nipple – check / top up if necessary				X	X	X	X	X	X			

A	Daily	If necessary
B	At 50h	Battery – replace if necessary
C	At 500h or 1 year	Engine – Clean if necessary
D	At 1,000h	Engine air filter – check / replace if it is dusty
E	At 2,000h	Test the engine oil – change if necessary
F	At 2 years	Fuel injection – check / replace if necessary
G	At 3,000h	Fuel system – Build up pressure in the fuel system (20) if necessary
H	At 4,000h	General inspection of the machine

* Activate residual current devices / miniature circuit breakers before new assignments. Otherwise every six months for residual current devices / annually for miniature circuit breakers

** Check other filters before new assignments. Clean / replace if necessary.



HTC Sweden AB
Box 69
SE-614 22 Söderköping - Sweden
Tel: +46 (0) 121-294 00
Fax: +46 (0) 121-152 12
www.htc-sweden.com

HTC 2500 IX

Education Material

November 2007

Concept Description of HTC 2500 IX

Short startup time

Everything integrated

Better working environment

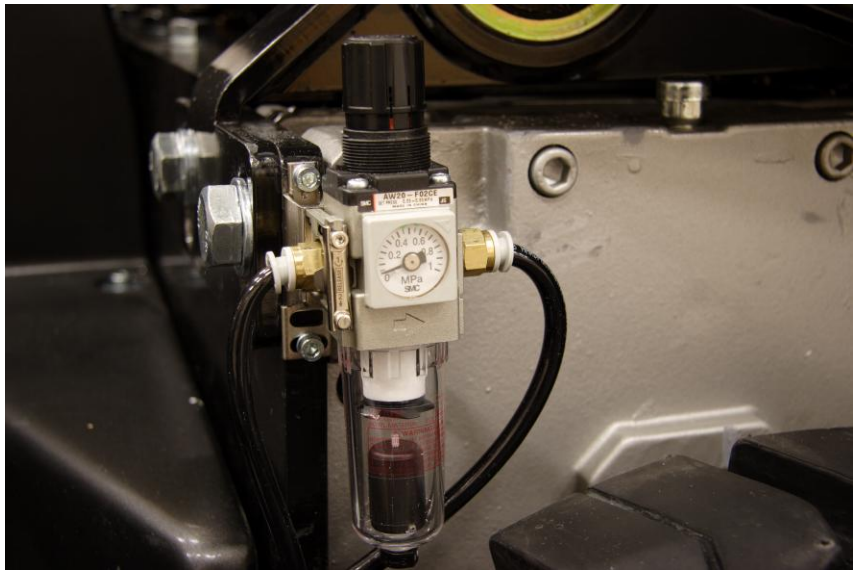
High Capacity

Fun facts of HTC 2500IX

- The machine contains more wires than a normal house
- The output is 105 kW, that is equal to 7 normal houses
- The machine has a virtual waist that is computer controlled
- The control system has more than 2000 lines of code
- Magnetic field for the operator is equal to a normal office

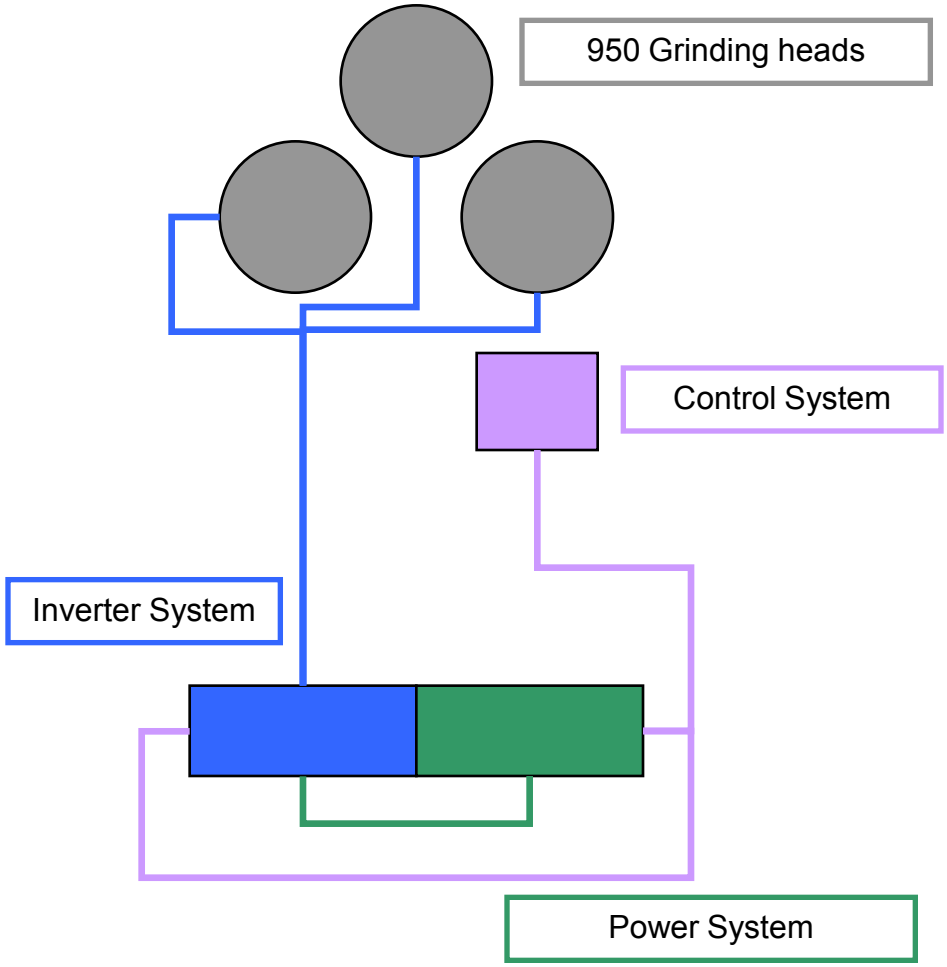
Systems in the machine

- Grinding system
- Lift system
- Air system
- Power system
- VAC system
- Driving system
- Control System
- Water system
- Engine system



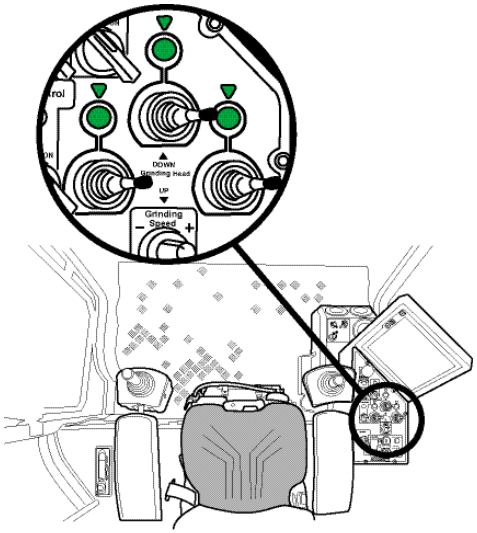
Grinding system

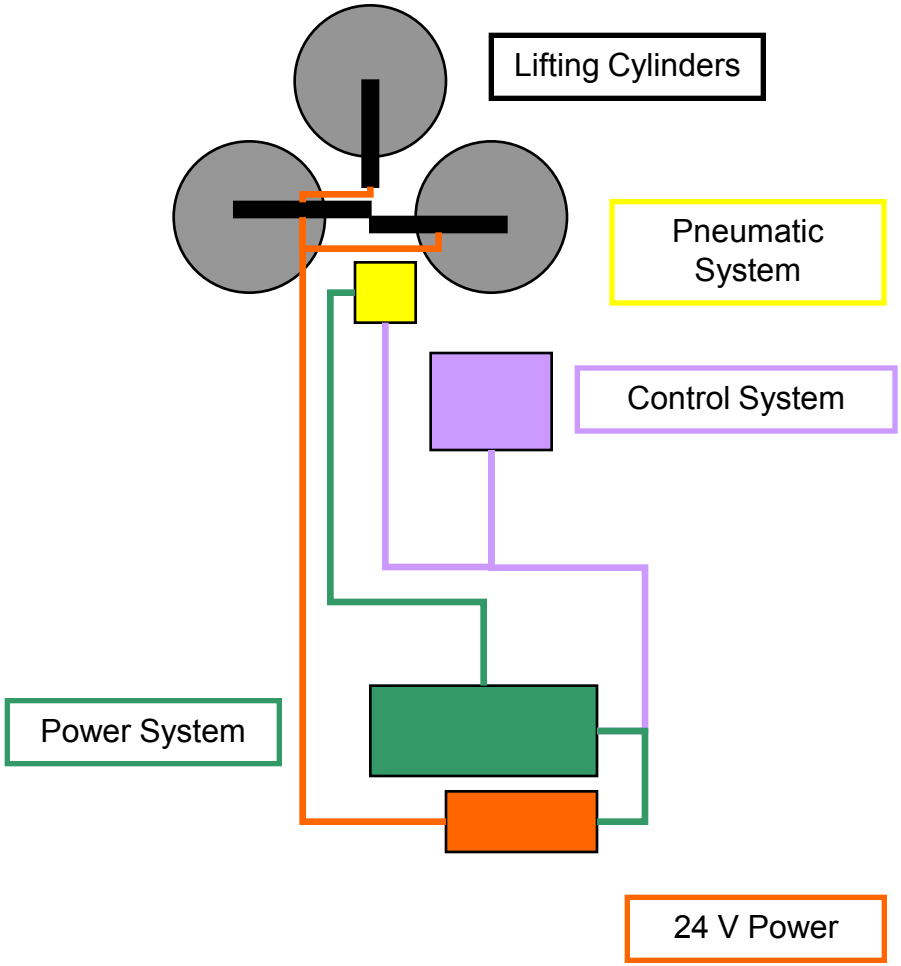
- The grinding system i basically 3 HTC 950 units connected together
- There are one inverter for each grinding head
- The inverters are controlled via the control system in the cabin
- Each head can be controlled separately (head has to be lifted and locked)
- Fuses are located in the (green) power box



Lifting System

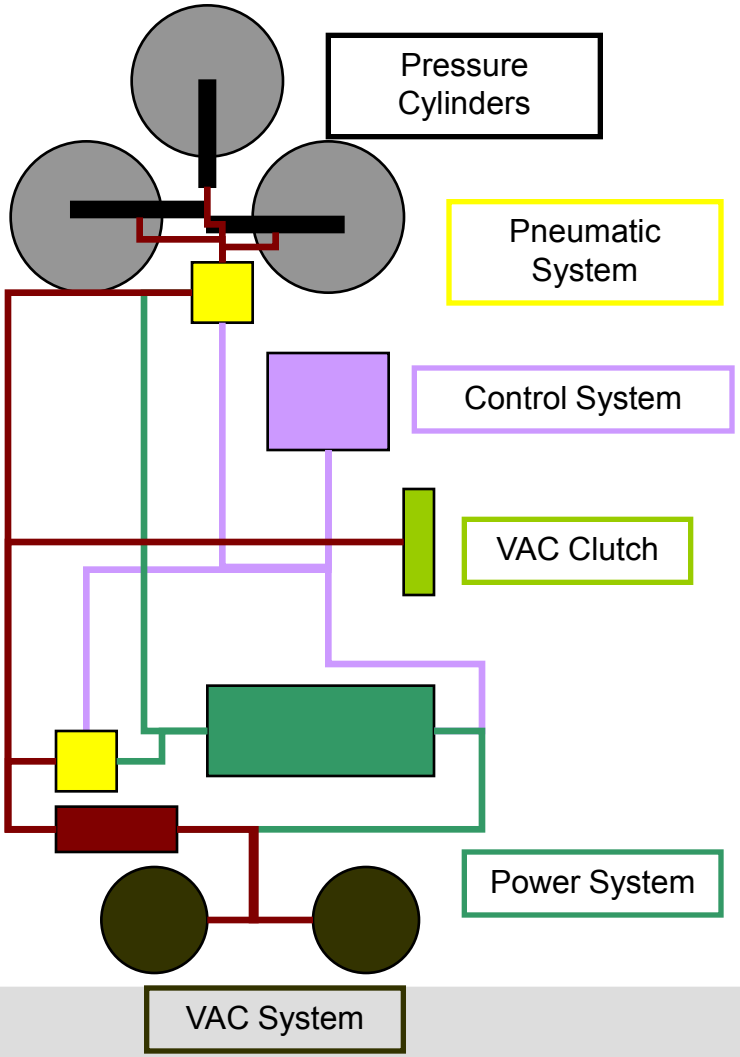
- The lift system is electrical (24V) and controlled from the cabin
- Each cylinder is controlled individually from the cabin





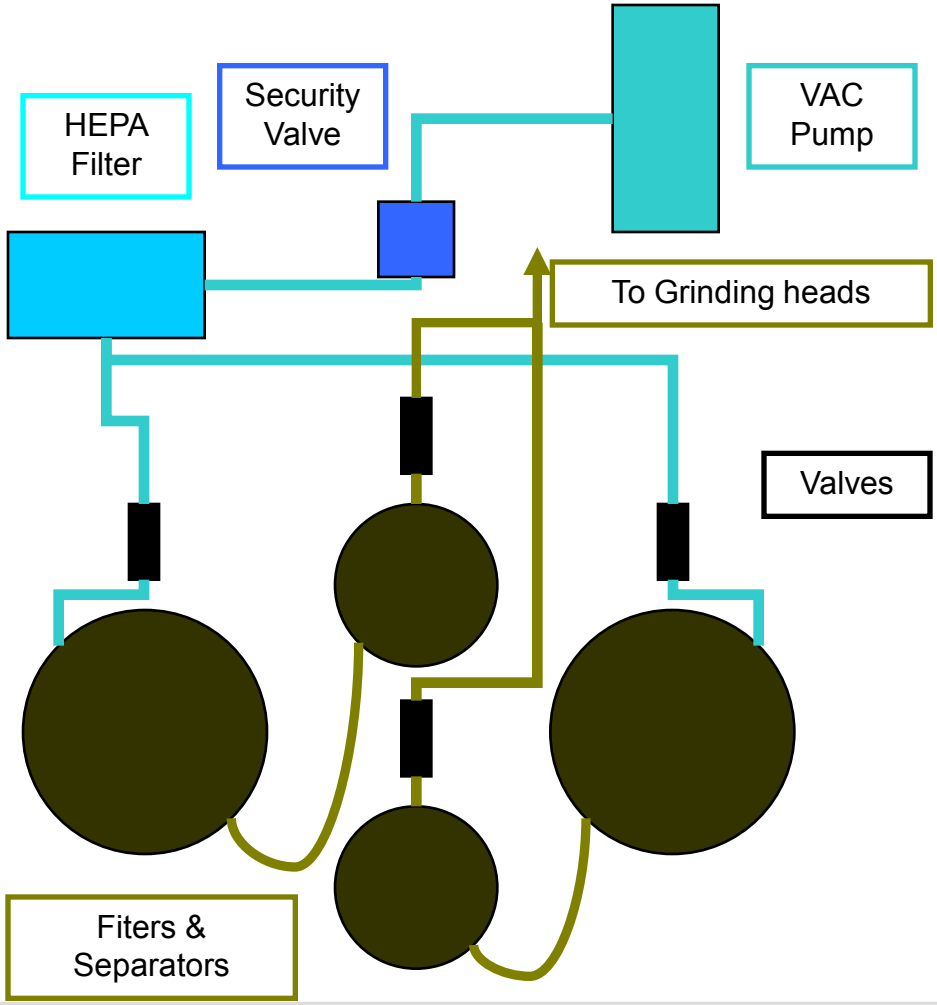
Air System

- Air system is controlled from the cabin
- Air is used to start the VAC through the pneumatic clutch
- Air is used to unlock the heads when lowering them
- Air is also used to clean the filters in the VACs and to shift between the VAC units
- Air is also used to increase the grinding pressure on the heads – the pressure is set from outside the cabin – just in front of the door



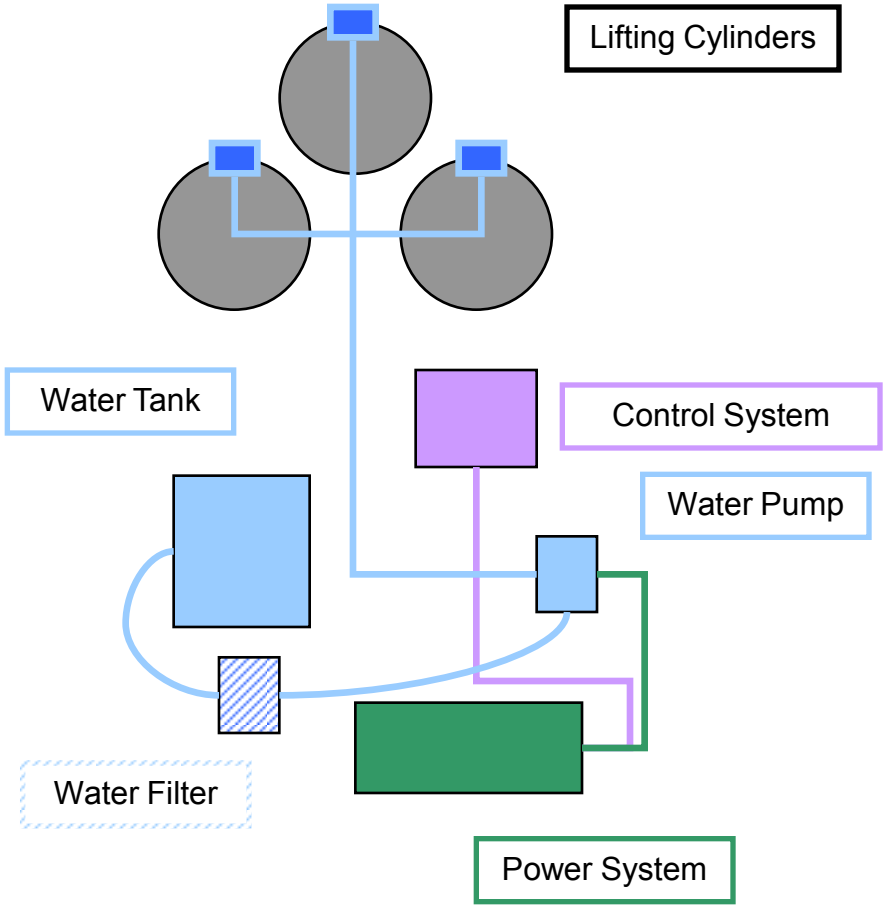
VAC System

- The VAC system contains of 1 110DAP with 2 preseparators
- Clean air is described as blue lines while dirty air is dark olive green



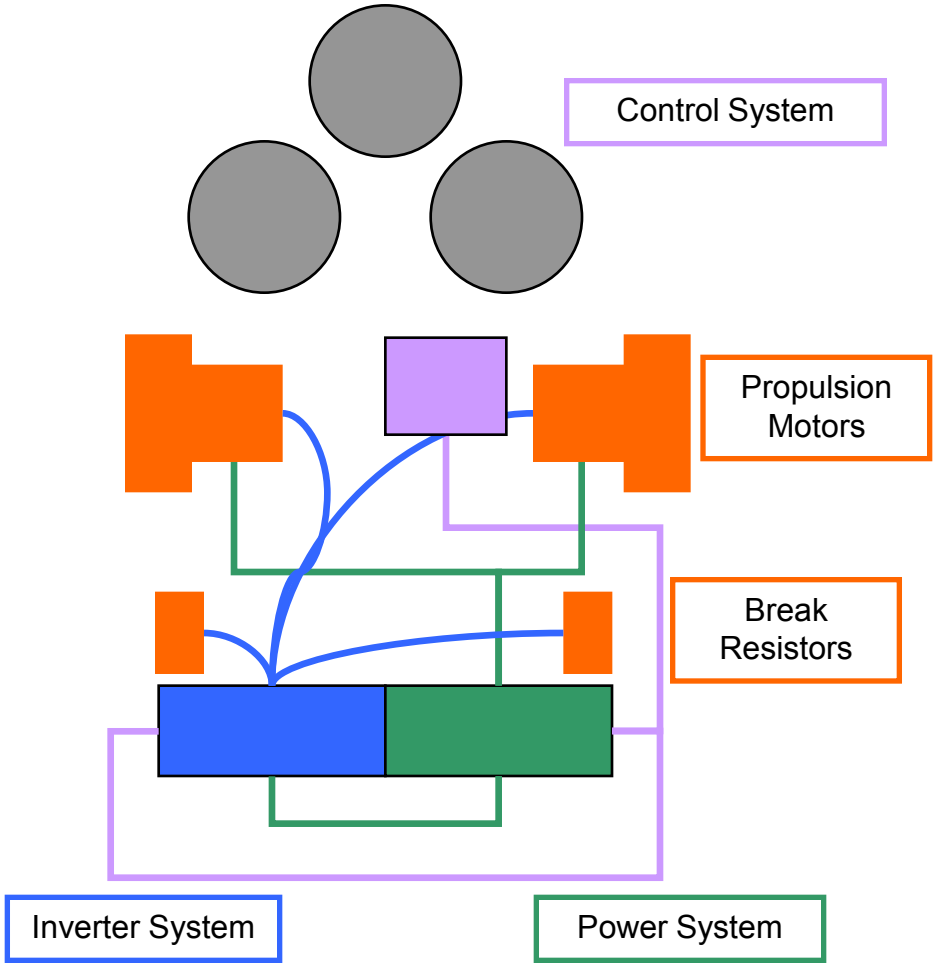
Water System

- The HTC 2500IX is equipped with the patented MIST system to improve the efficiency
- The system is controlled from the cabin
- The water level can be monitored from the cabin display



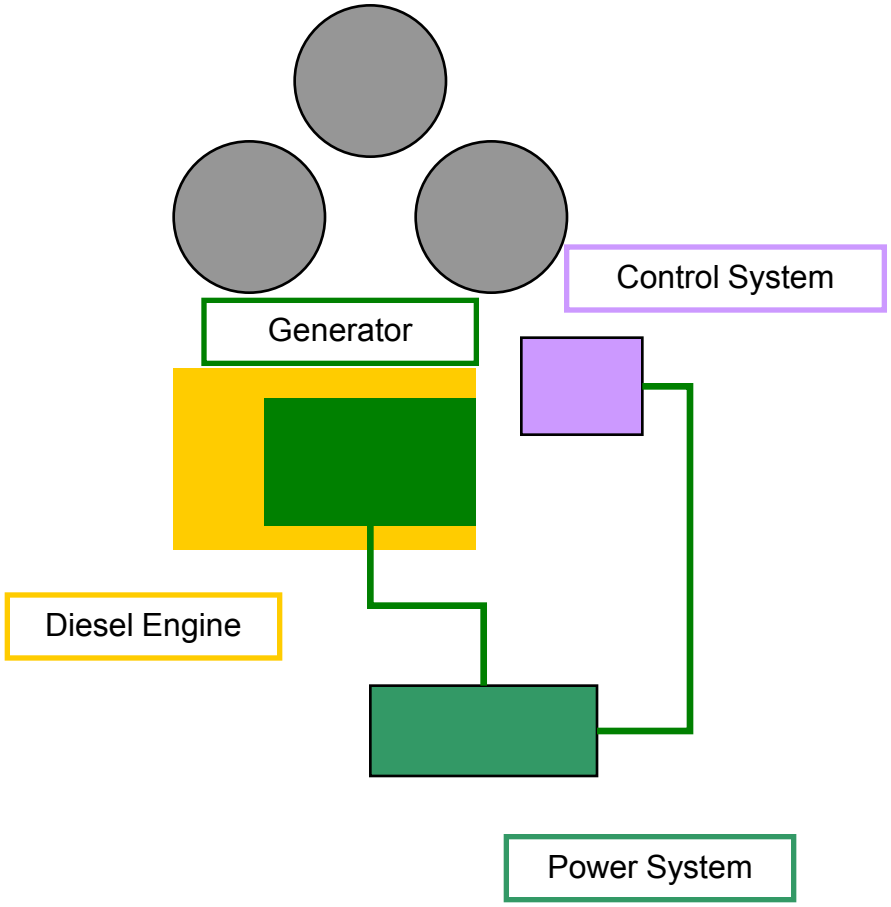
Driving system

- Propulsion is made by 2 motors and are controlled by 2 inverters
- Break resistors are connected to the inverters to enable the machine to drive in slopes (max 10 degrees in 2 minutes)
- The propulsion motors are equipped with thermal switch and parking brakes
- Parking brakes are automatic and signal from thermal switch is shown at the panel



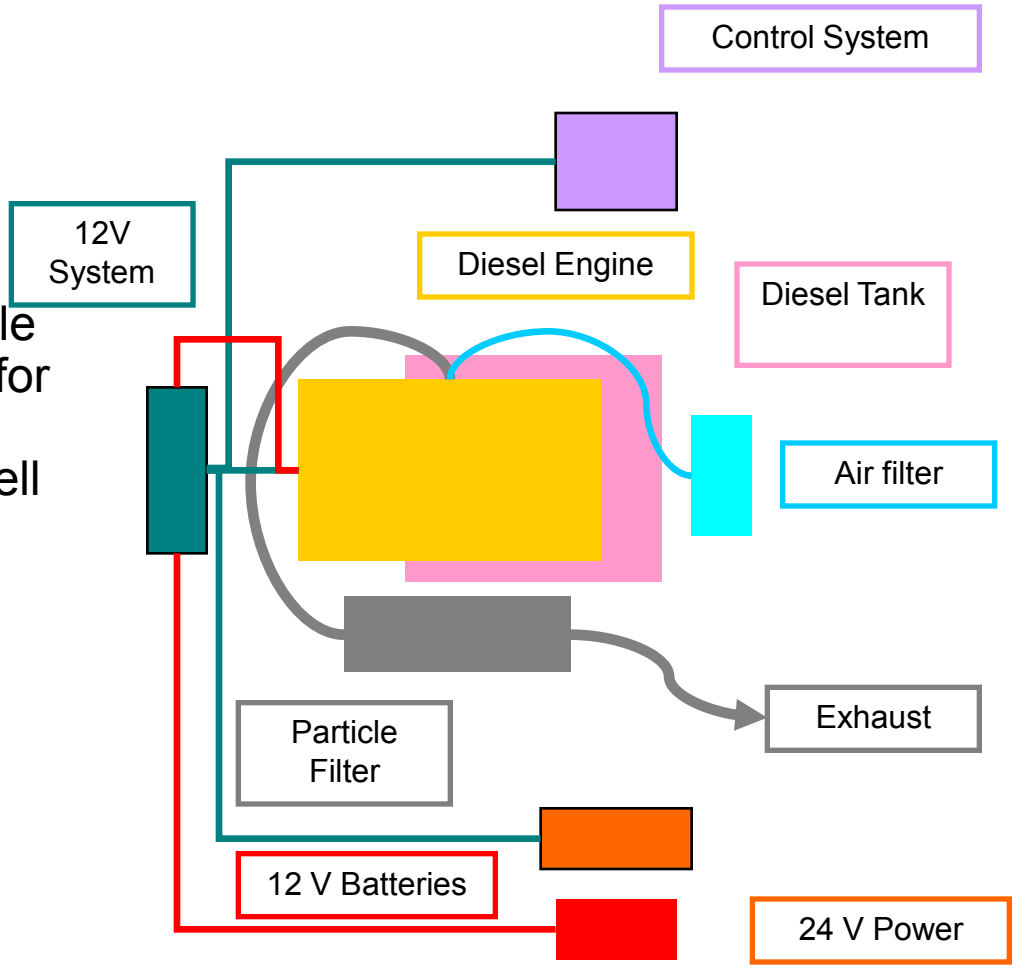
Power system

- Power is generated by the generator located above the diesel engine
- Main power switch is located in the cabin
- Main power is protected by frequency and voltage relay's
- The system is also protected by Ground Circuit Brakers



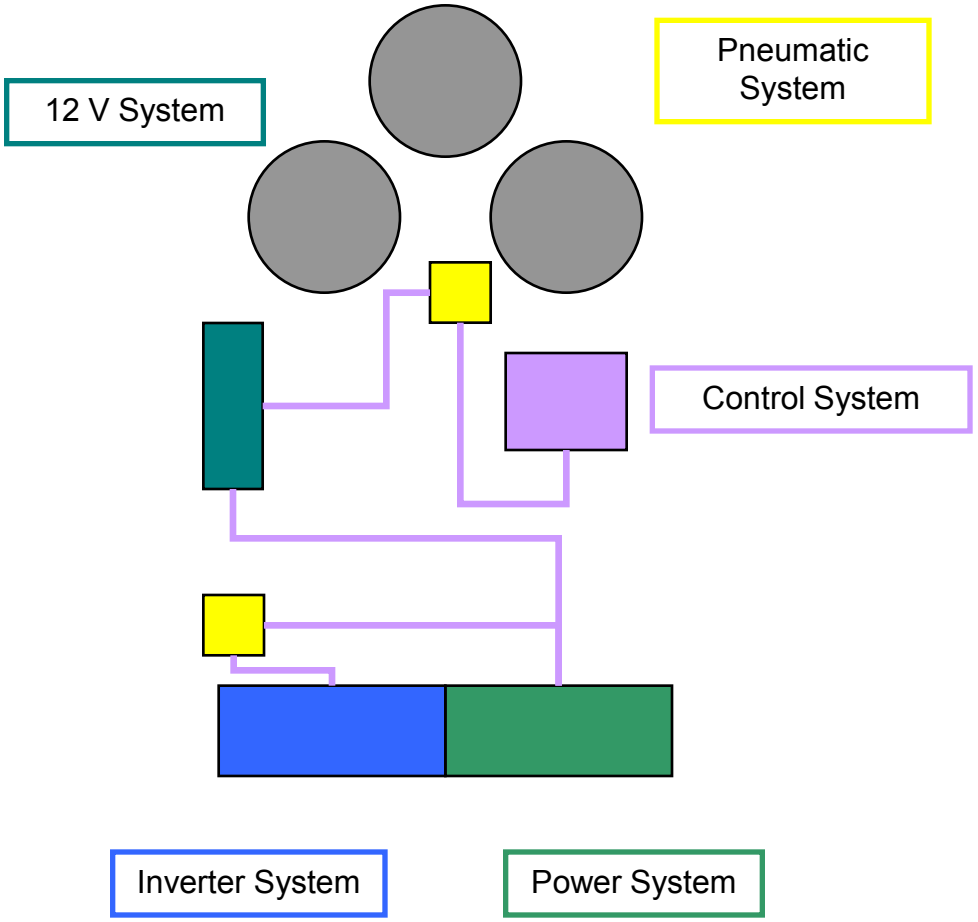
Engine system

- Diesel engine has a special air filter for dirty environments
- The engine is equipped with a Dinex particle filter that is turnable and cleanable and can be used for years, this also enables the machine to operate indoors in well ventilated areas
- By the batteries a main switch is located, if this is missing nothing will start
- The 12 V box contains all fuses and relays for the engine
- The 12 V system also operates lights and AC, radio etc



Control System

- The machine is controlled from a computer located behind the touch screen in the cabin
- The computer communicates with all other electronics through CAN open bus network



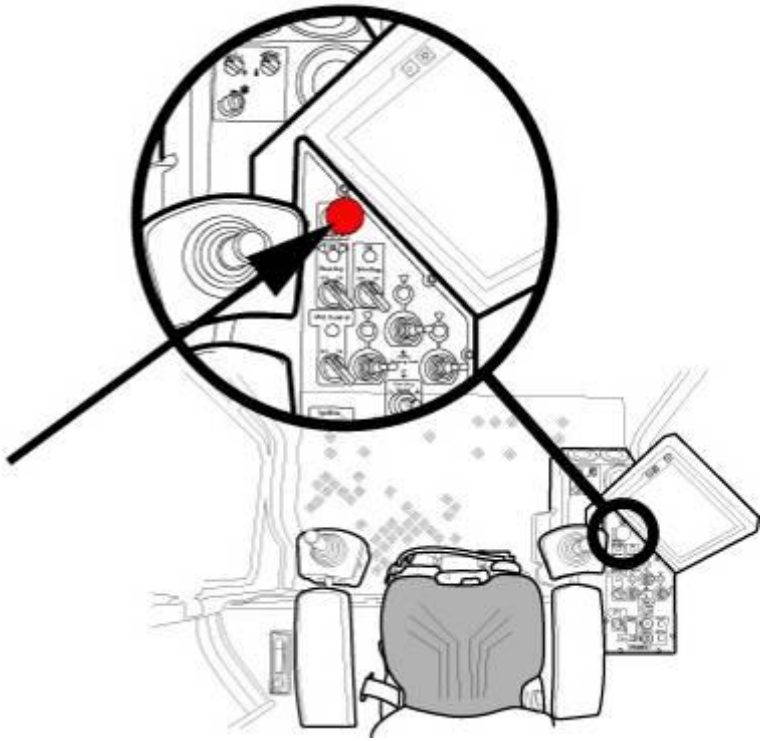
HTC 2500IX

SAFETY INSTRUCTIONS

November 2007

Safety Instructions

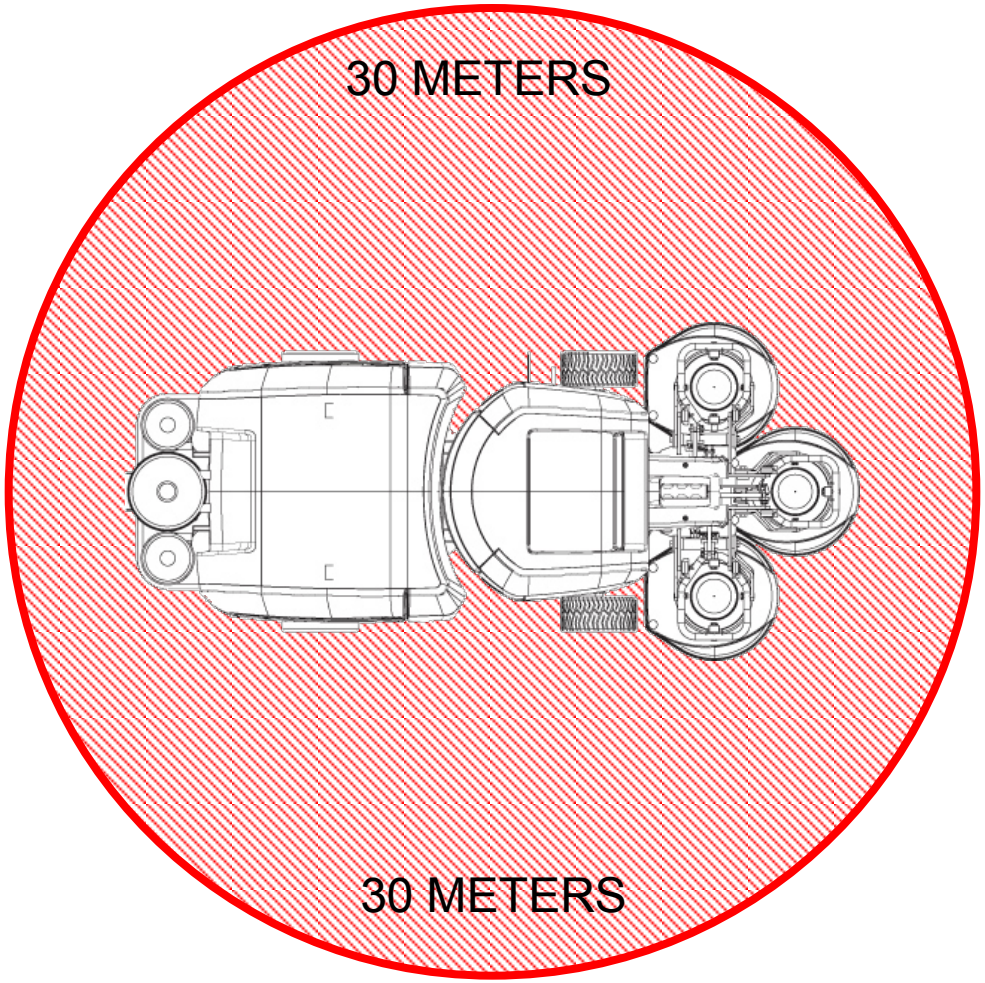
- The machine is equipped with a fire extinguisher in the cabin below the seat
- The emergency break will break all electricity in the machine to all systems
- DO NOT USE THE EMERGENCY BRAKE UNLESS IT'S NECESSARY AS IT CAN DAMAGE THE DIESEL ENGINE AND GENERATOR!!!!
- If you need to escape from the cabin and the door is trapped you have a hammer to break the front window



SAFETY - IMPORTANT

Safety Instructions

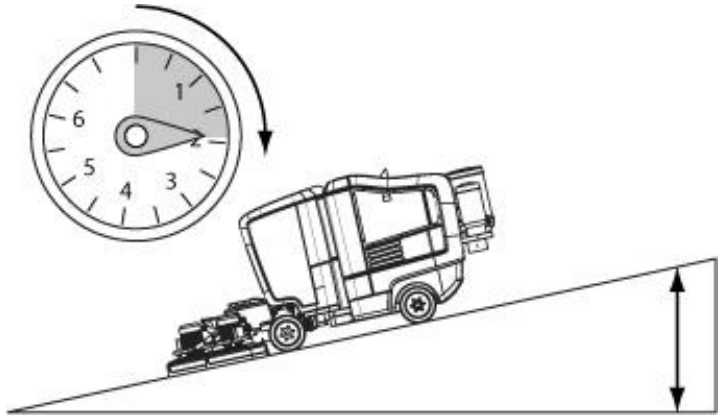
- The machine has a safety area around it of 30 meters radius or in a safe area surrounded walls
- The driver have limited control of the surrounding and no one is allowed to operate behind the machine or in it’s dead angle



SAFETY - IMPORTANT

Safety Instructions

- As the machine has no mechanical brakes (it's not a car) it's vital that you do not drive the machines in slopes more than 120 seconds and more than 5.7 meters in height downhill – equal to 10 degrees
- Uphill the machine manages a 10 degrees slope no time limitations, check Amp meters on the control panel when going uphill
- You should never drive the machine as shown on the lower picture to the right



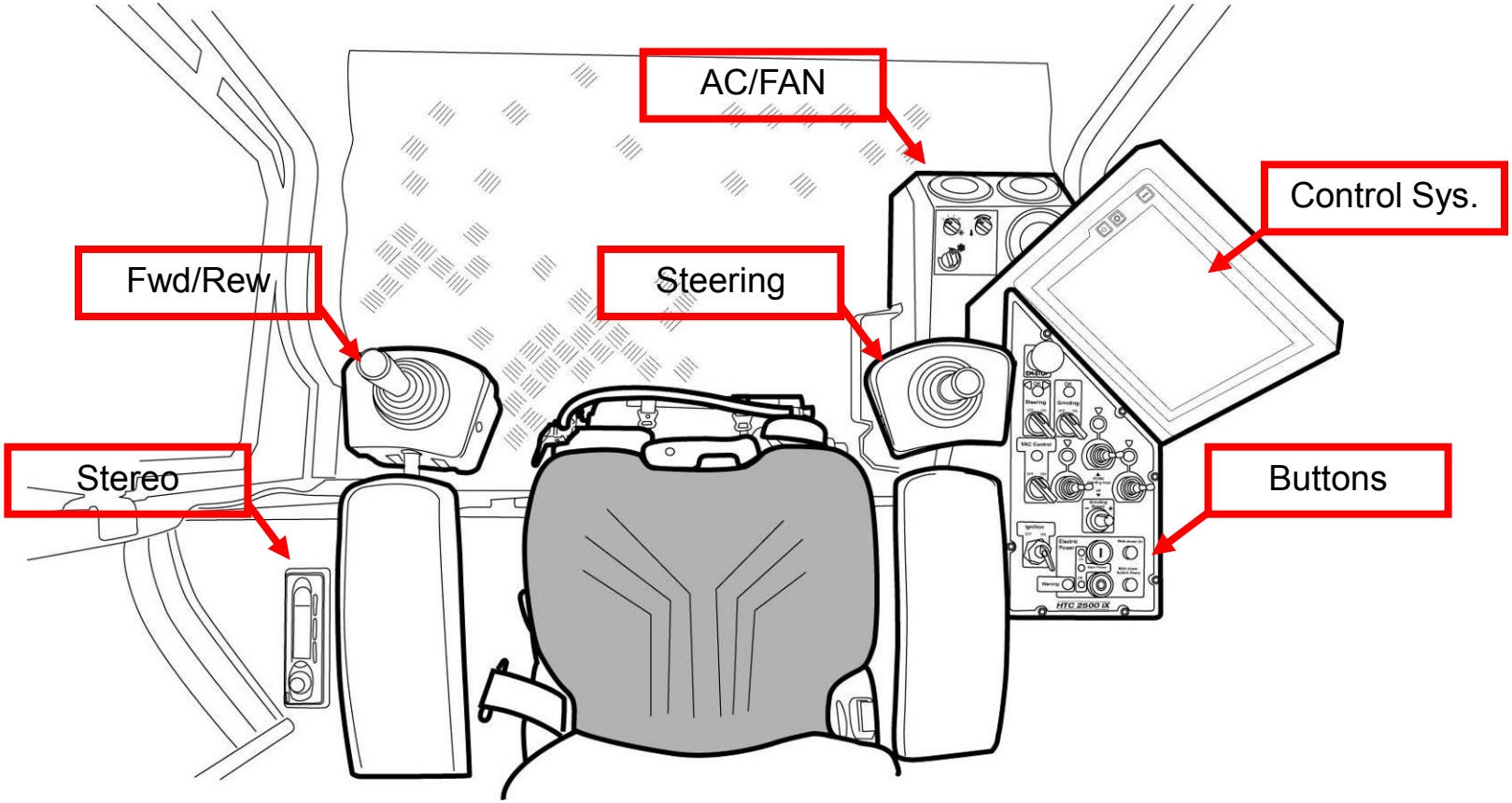
SAFETY - IMPORTANT

HTC 2500IX

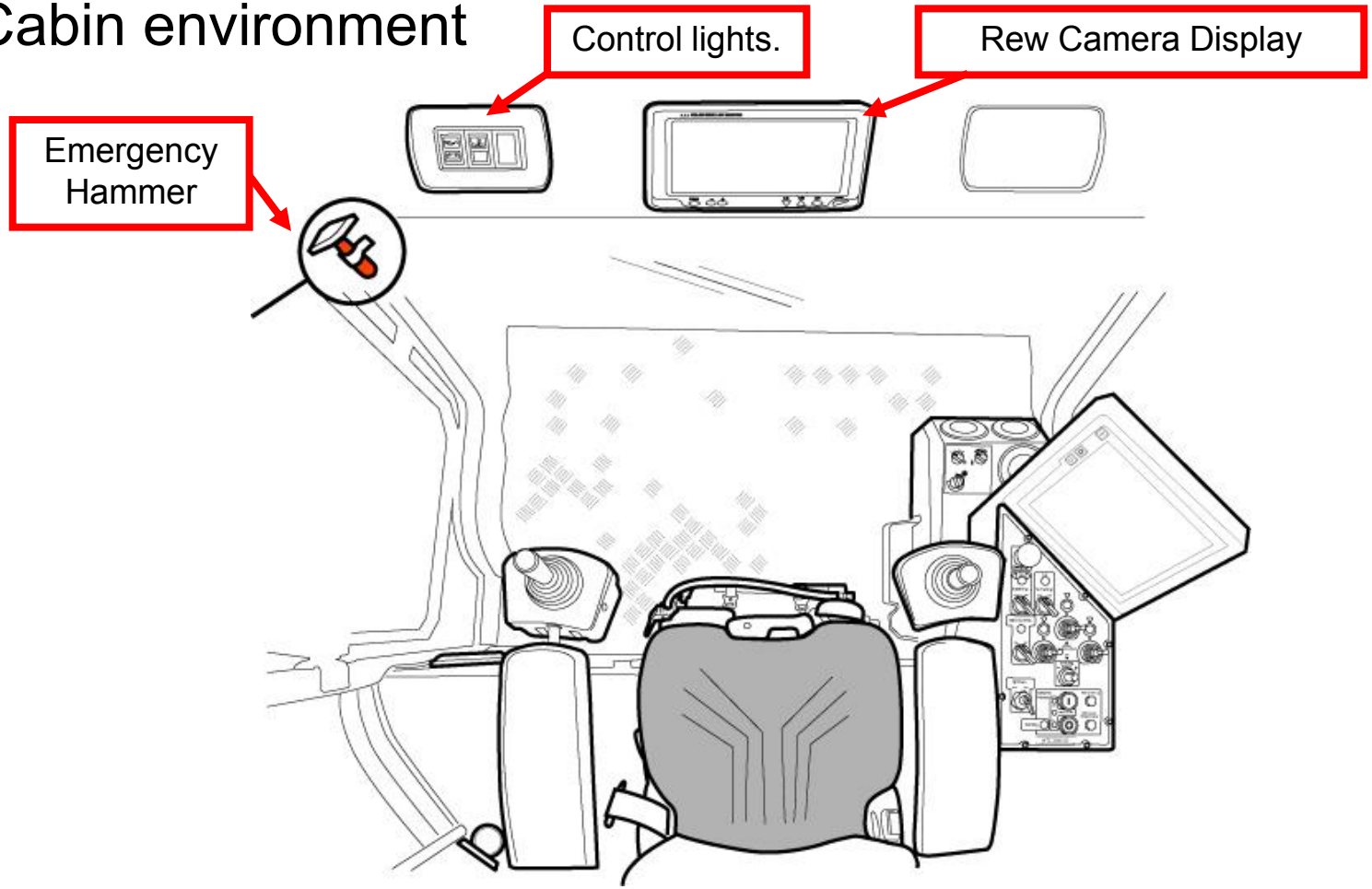
CONTROLS

November 2007

Cabin environment

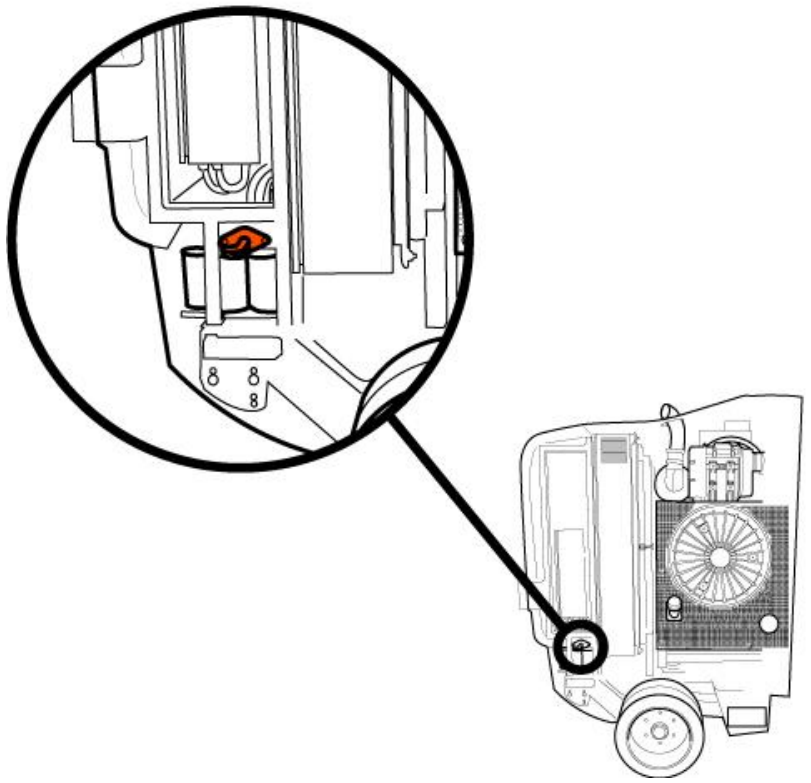


Cabin environment

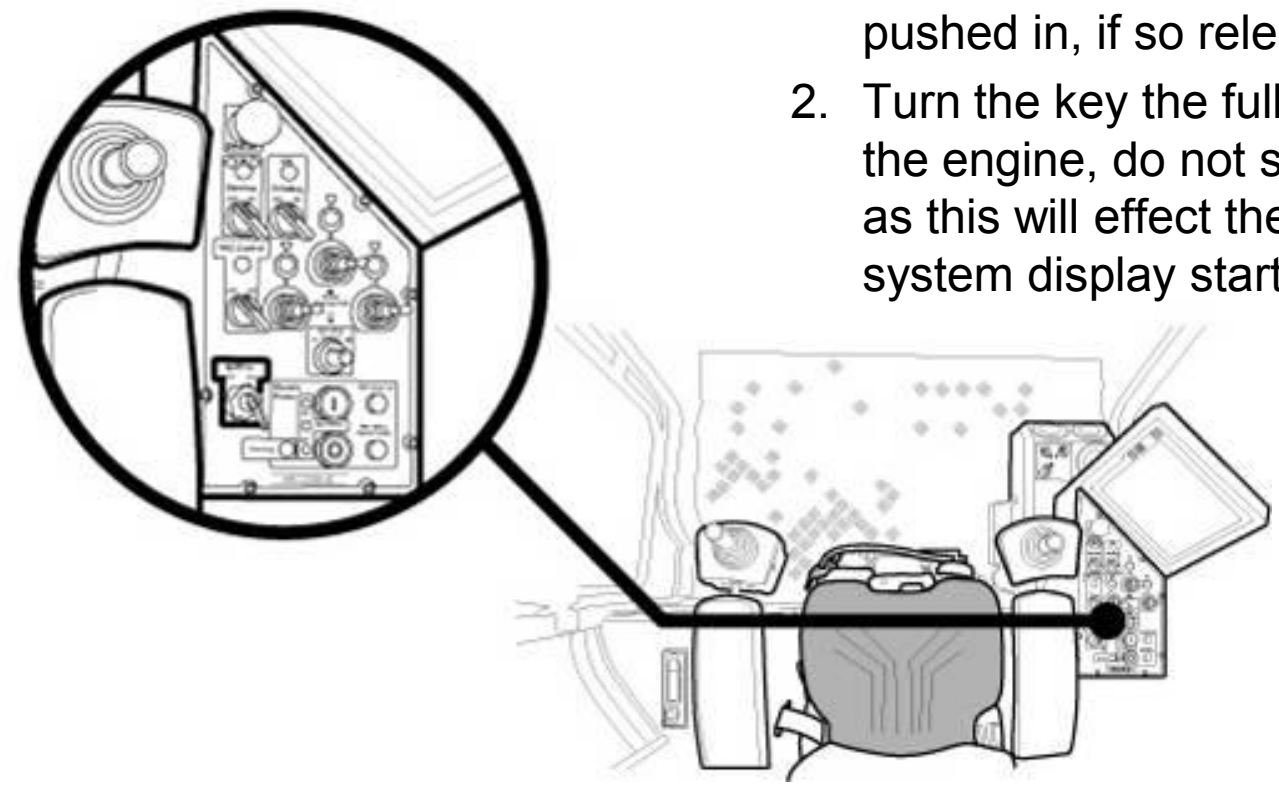


Starting the machine

1. Ensure that the main switch is turned on
2. The switch is located at the back behind the right cover at the bottom just beside the batteries

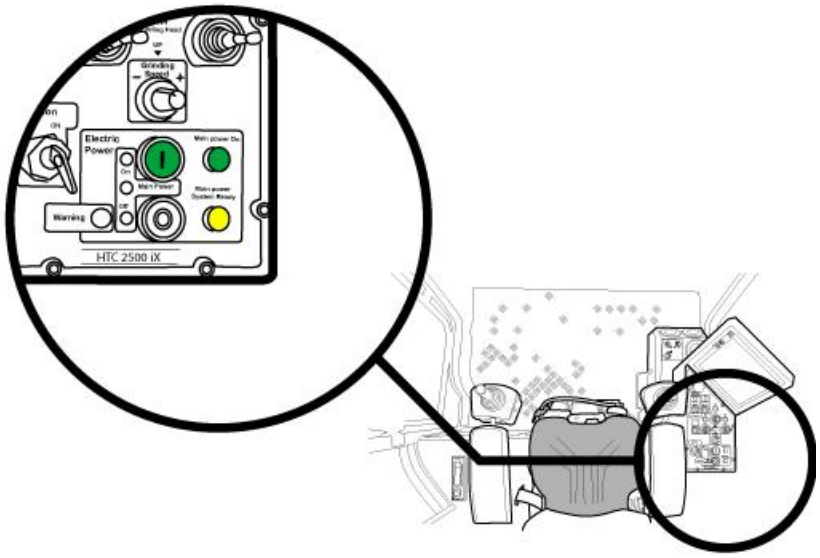


Starting the machine



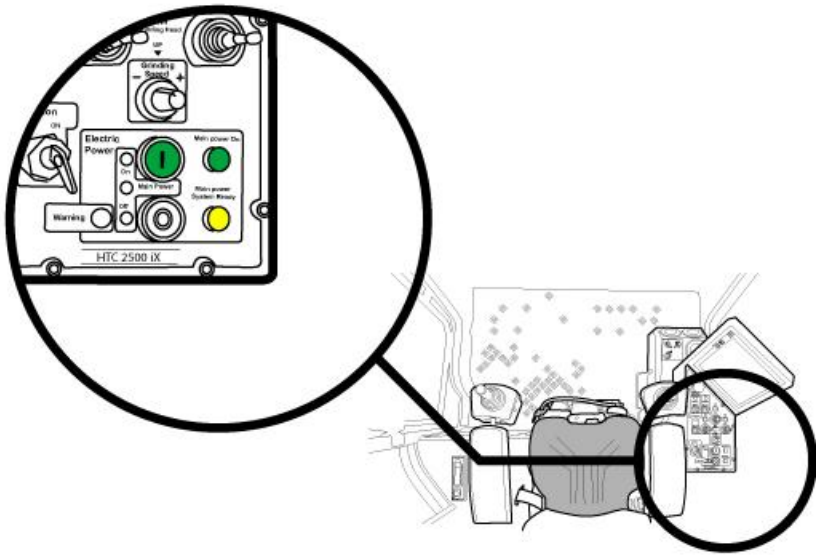
1. Ensure that the EM-Stop is not pushed in, if so release it
2. Turn the key the full length to start the engine, do not stop half way as this will effect the control system display startup

Starting the machine



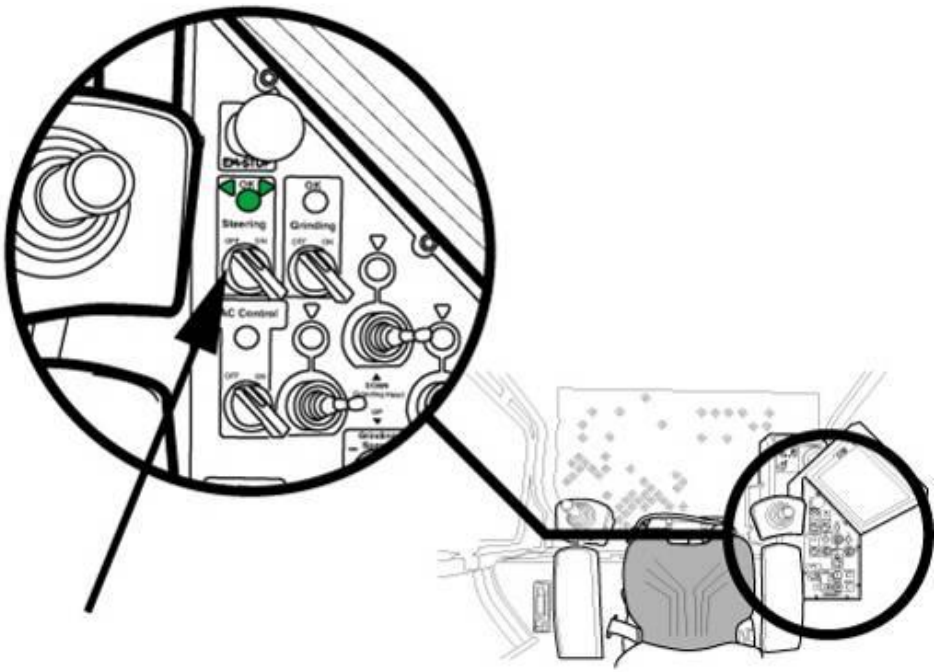
1. Wait until the control display has started
2. When this is done the diesel engine will increase it's speed
3. When this is done the yellow light goes on
4. Check that all switches and joysticks are in zero position
5. Press the green button to activate the generator
6. This will turn the green light on
7. The machine is now running with all system ready

Starting the machine



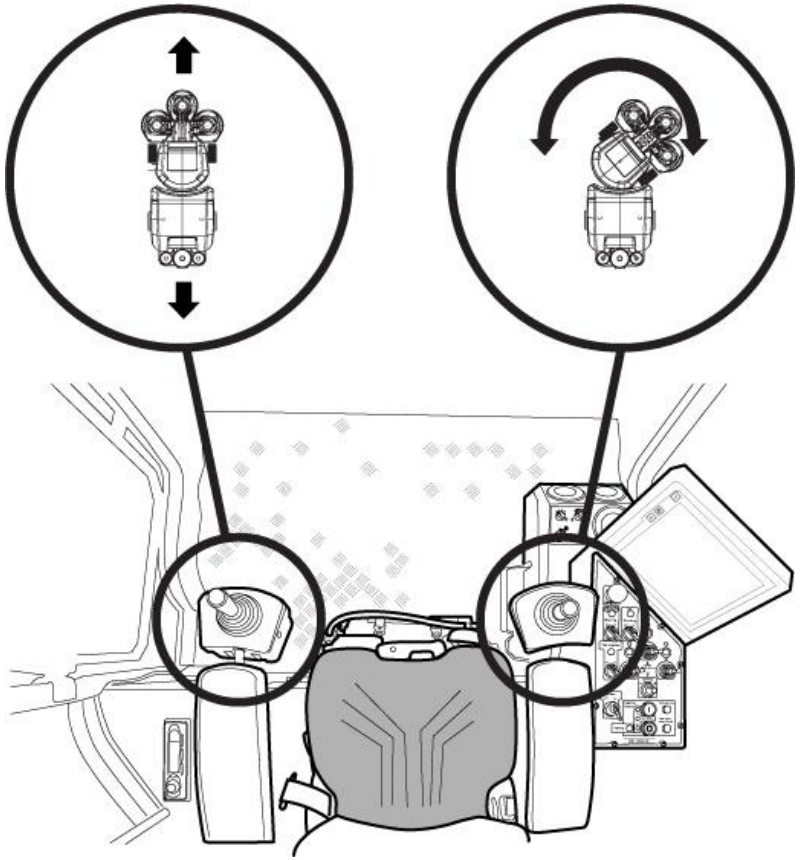
1. Wait until the control display has started
2. When this is done the diesel engine will increase it's speed
3. When this is done the yellow light goes on
4. Check that all switches and joysticks are in zero position
5. Press the green button to activate the generator
6. This will turn the green light on
7. The machine is now running with all system ready

Handling the machine - driving



1. Check the joysticks – they got to be in their default center position if not the machine will start moving when you take the next step
2. You got to be seated to be able to drive the machine, if you stand up the machine will stop
3. To enable the steering you got to turn the steering switch on as shown on the picture
4. A green light turns on when the steering is enabled

Handling the machine - driving

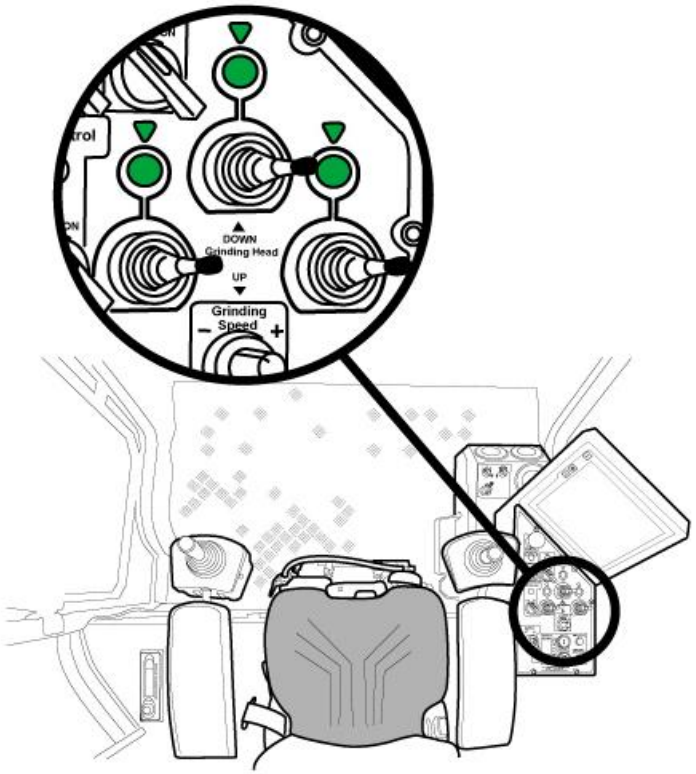


1. The left joysticks controls the propulsion as shown at the picture
2. The right joystick controls the steering
3. When driving uphill, check the Operations Menu at the display for overload signs, if so decrease the speed

Reversing the machine

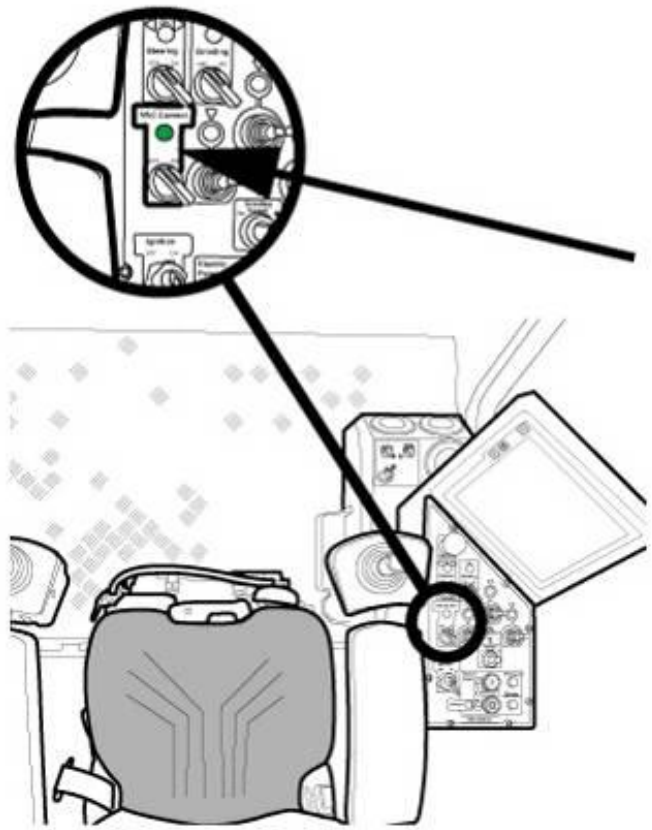
As described earlier the machine have a computer that controls the waist. The machine maintain the angle set by the right joystick when reversing.

Handling the machine - grinding



1. Make sure the tools are fastened to the grinding heads
2. Lower the heads by pulling the joysticks into forward position, the joystick should be positioned in forward position to enable the heads to float and this also enables you to start grinding.
3. When the heads are in floating position the green light will be turned on

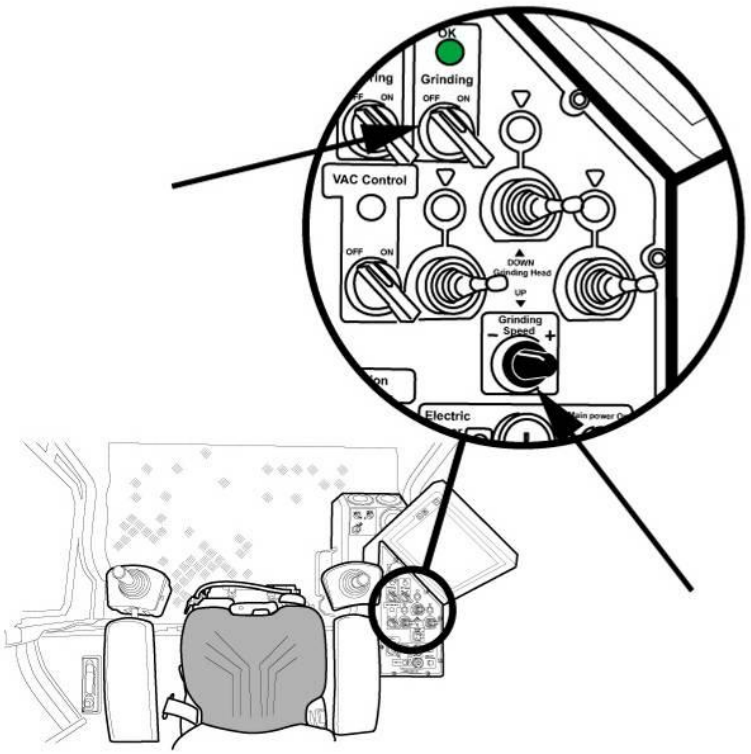
Handling the machine - grinding



1. Start the Vac before you start grinding
2. When the switch is turned the clutch on the VAC is enabled
3. When the green light is turned on the VAC is ok

If any problems occurs you will get an alarm if you have a leakage

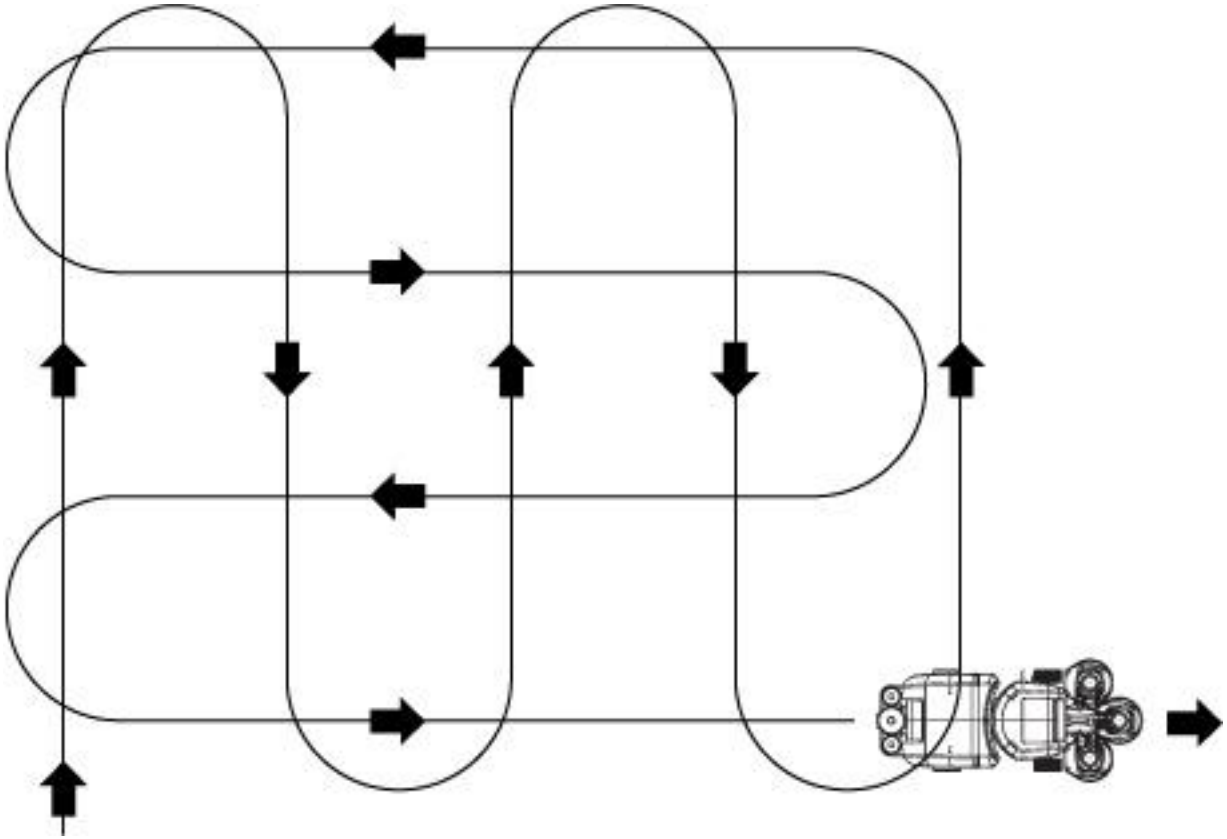
Handling the machine - grinding



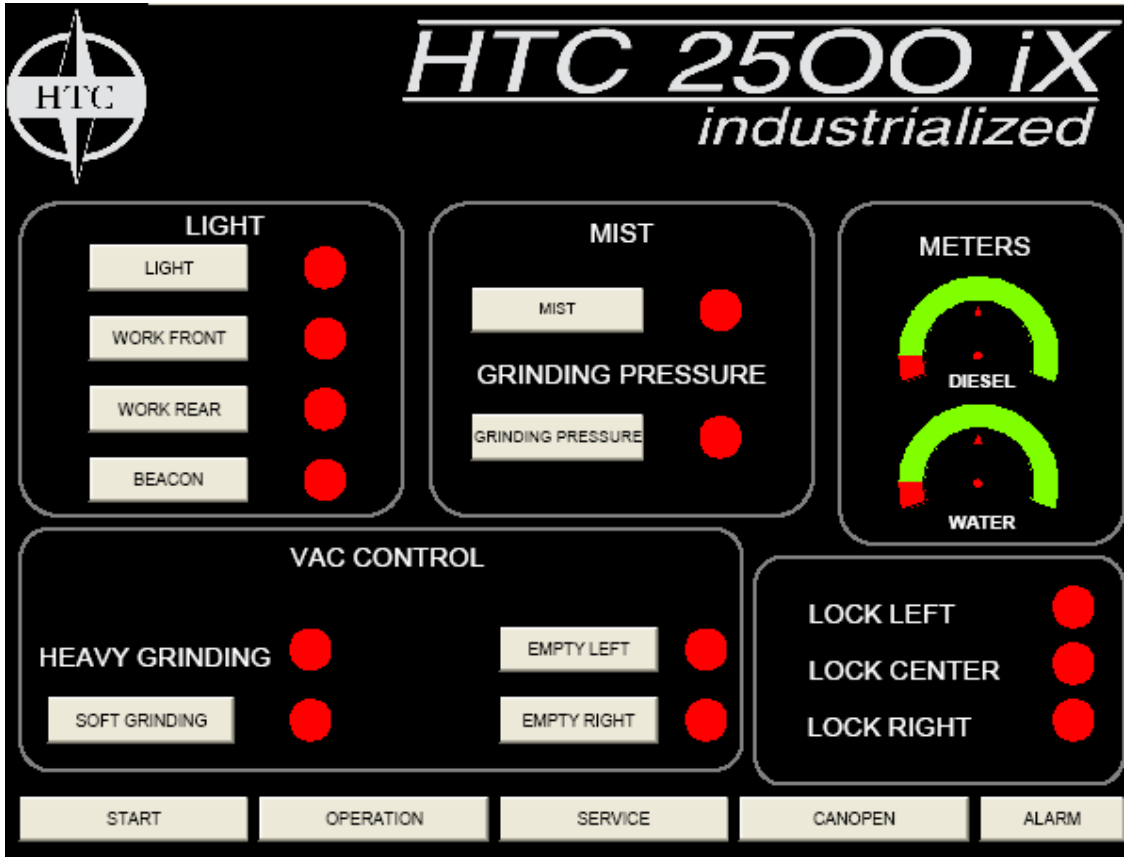
1. Before the grinding switch can be turned on the following steps has to done:
    1. Steering has to be enabled
    2. The grinding heads needs to be in floating position
2. Select the speed on the potentiometer, we recommend to start in the mid range
3. Turn the switch on and you will start grinding.
4. Check the display Operation Meny for overload signs, if so decrease the speed until they are turned off

Planning your work

- As the machine is bigger than a normal grinder it has to be driven in another pattern
- The pattern is individual and must be adapted to the area that you work on
- Suggested pattern to the right
- Don’t forget to examine the area for objects that can damage the machine



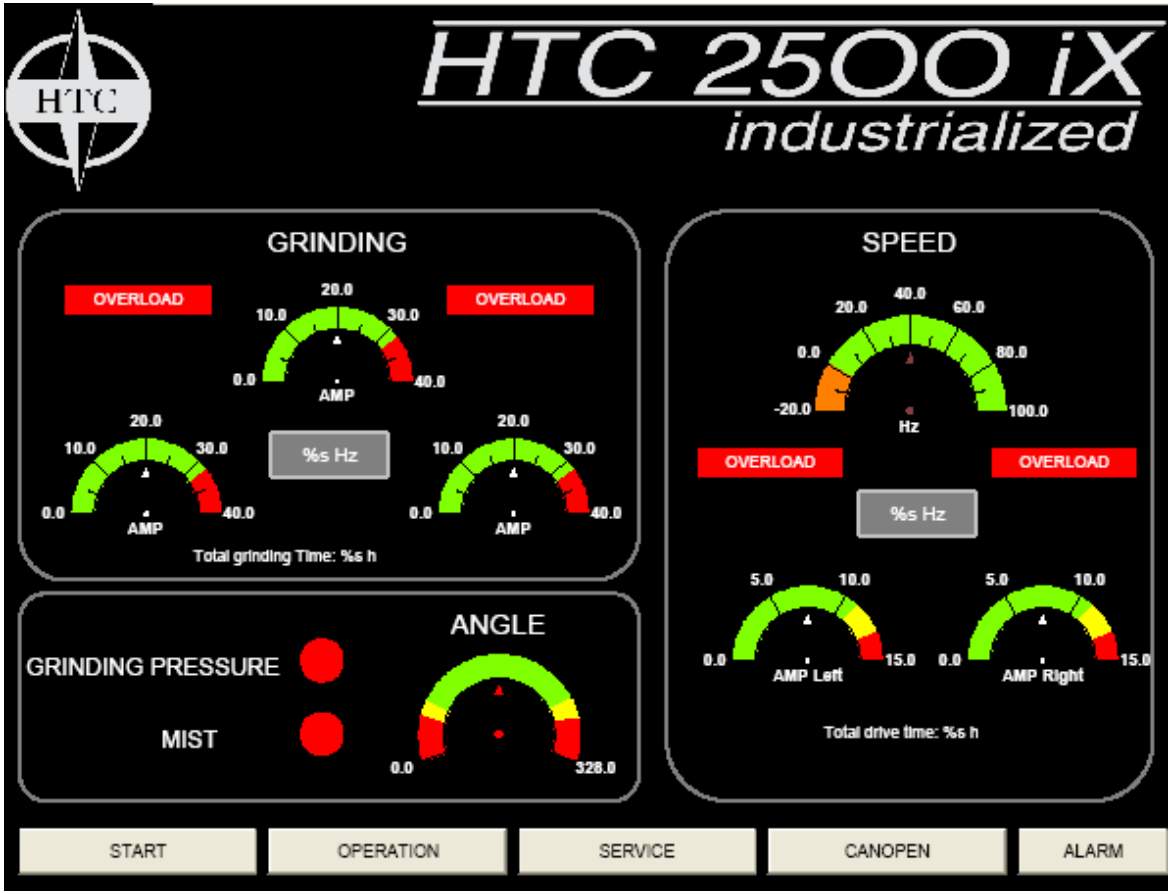
Handling the machine – Control system – Service Menu



- Mist and grinding pressure can be turned on before you start grinding, if so the light will turn yellow (stand by mode) and they will start working as soon as grinding is enabled
- The lock lights show if the heads are in safe position for tool change. They should be green before you change the tools

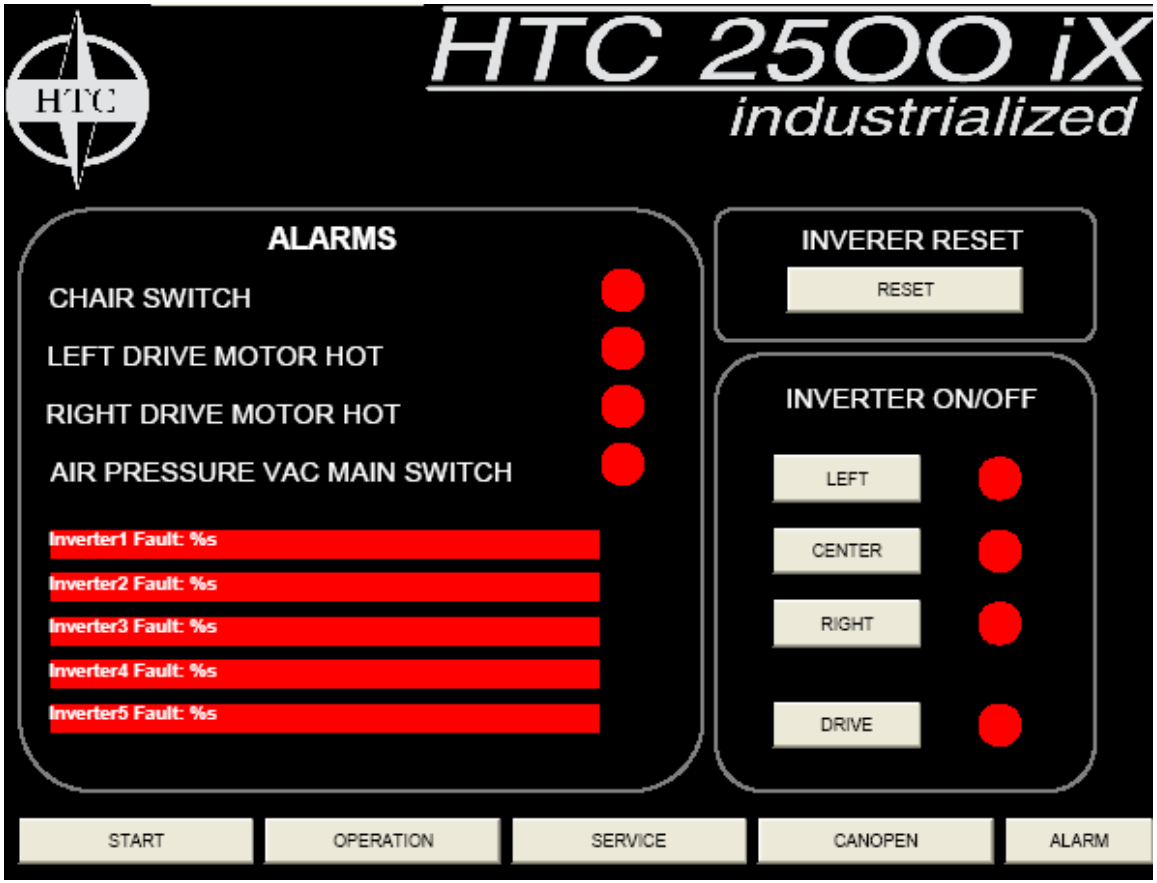
Not all machines are equipped with beacon, front and rear work lights.

Handling the machine – Control system – Operations Menu



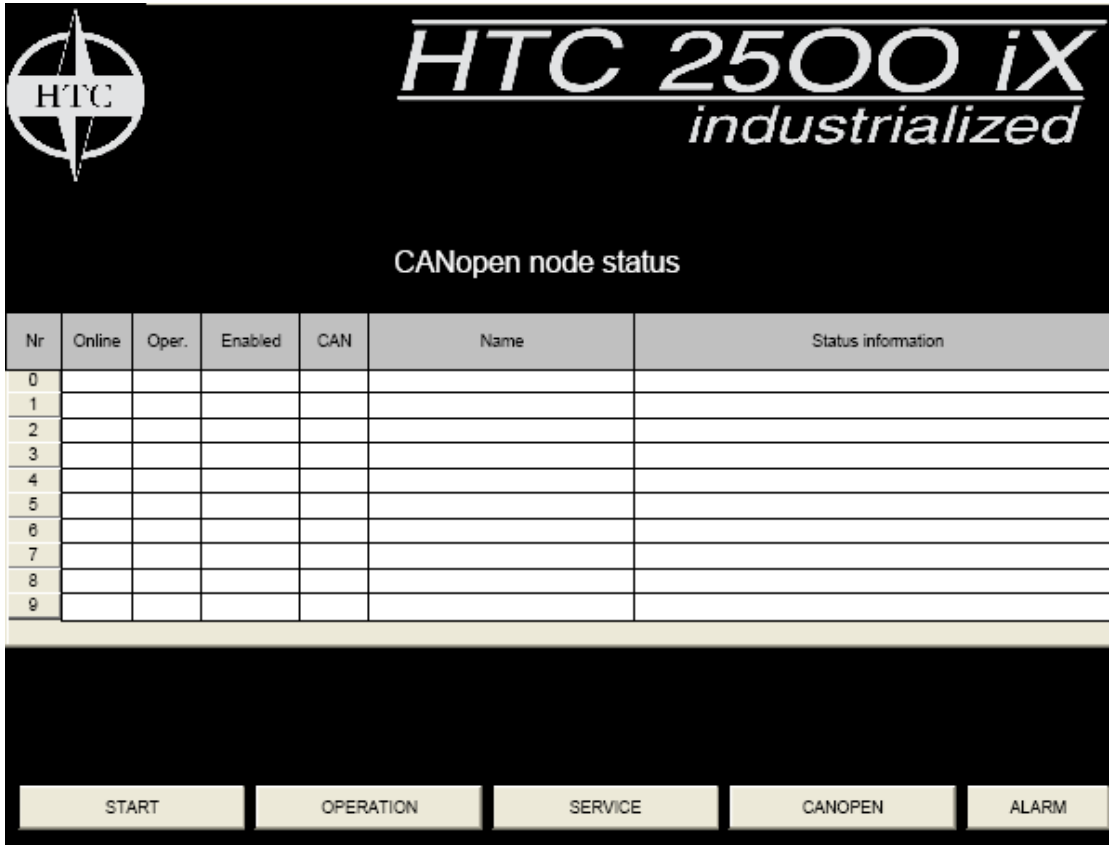
- On the area for grinding you will see both frequency and power consumption. On this picture you also see the overload lights turned on.
- The machine working time shows both for the grinding and transportation

Handling the machine – Control system – Alarm Menu



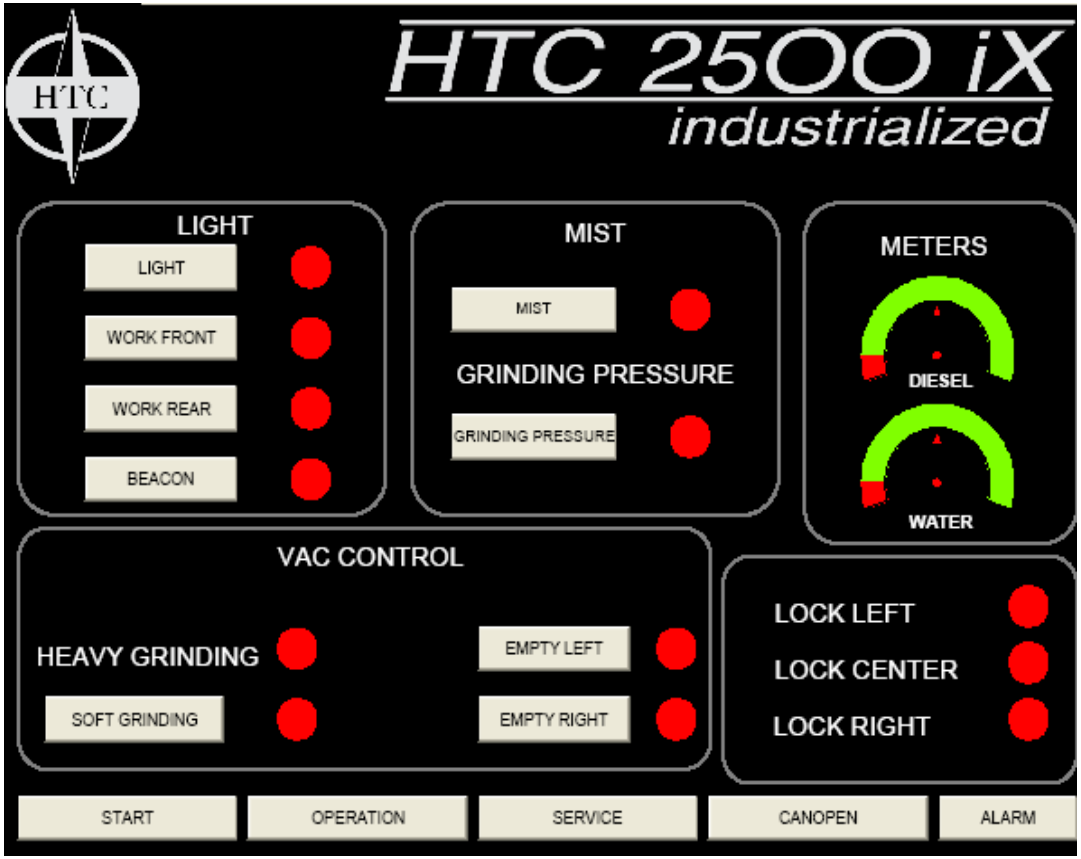
- This page shows alarms and error codes
- You can also reset the inverter after overload
- The inverter on/off section enables you to turn of each inverter, the propulsion inverters are paired together

Handling the machine – Control system – CANopen Menu



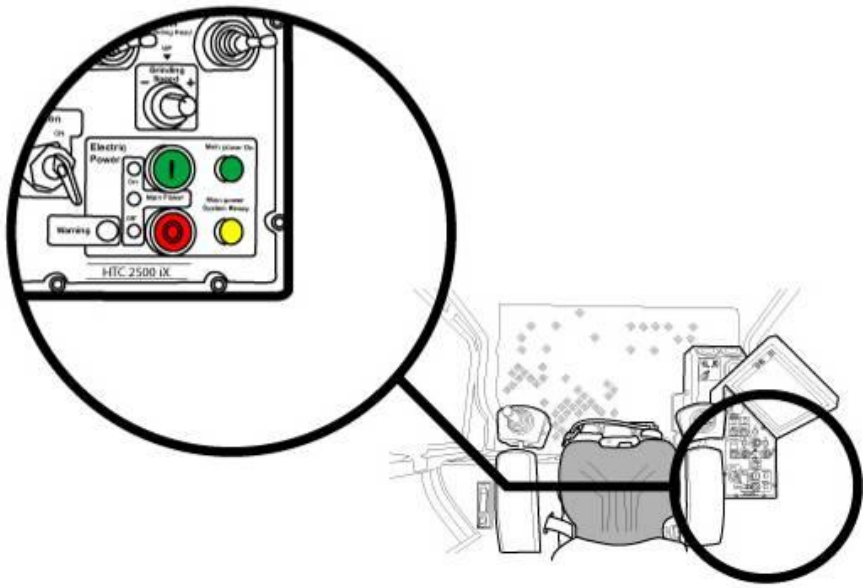
- This page shows the state of each CANopen unit
- This page is only for support issues with HTC staff

Handling the machine – Emptying the VAC



- The VAC has two different programs depending on the floor you grind, one for heavy with faster emptying cycle
- If you want to empty the VAC manually you can press the buttons Empty left / Empty right on the panel, the light will be yellow for cleaning, when it turns green the bag can be changed, to start the VAC again press the same button and it will go back to the ordinary sequence

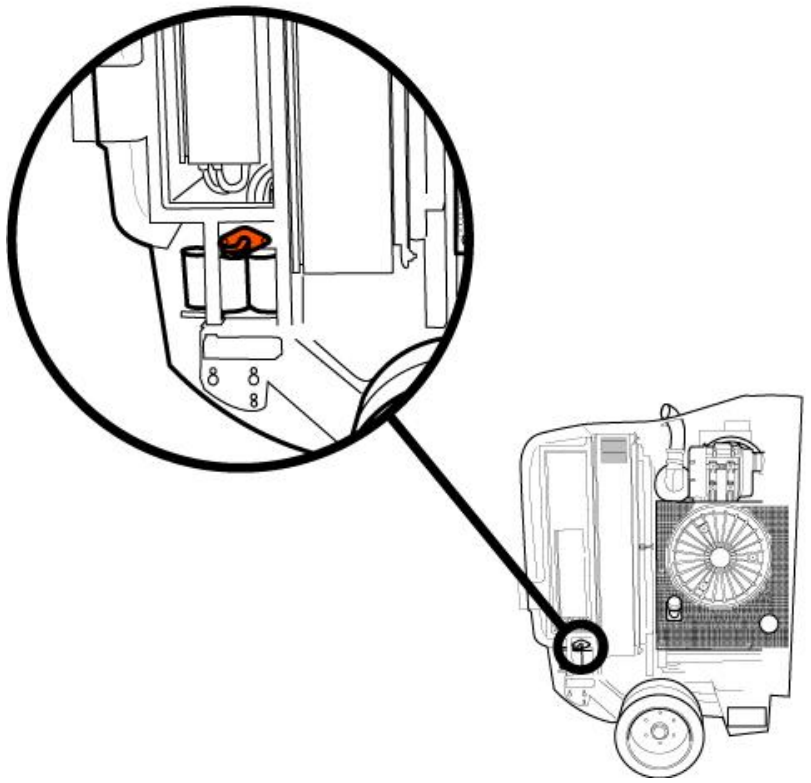
Stopping the machine



1. Stop the propulsion by setting the joysticks into middle position
2. Turn of the grinding heads
3. Lift the heads from the ground
4. You can now drive the machine to a location where you want to park it.
5. Turn off steering
6. Press main power off at the control panel (red button)
7. Turn the engine key off – the motor will now run 2 minutes to cool the motor down before it stops

Stopping the machine

1. When the machine has stopped turn the main switch off to prevent the battery from getting discharged
2. This also prevents the motor from starting and it also prevents unauthorized use
3. If the machine is stored below 0 degrees check the water level in the water tank



HTC 2500IX

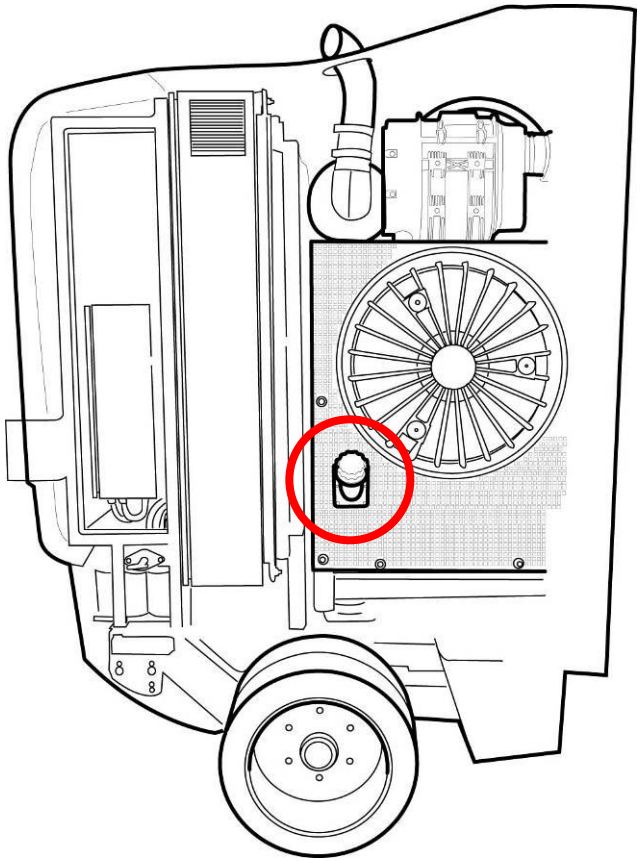
SERVICE INSTRUCTIONS

November 2007

Service & Maintenance – Filling Diesel & Water

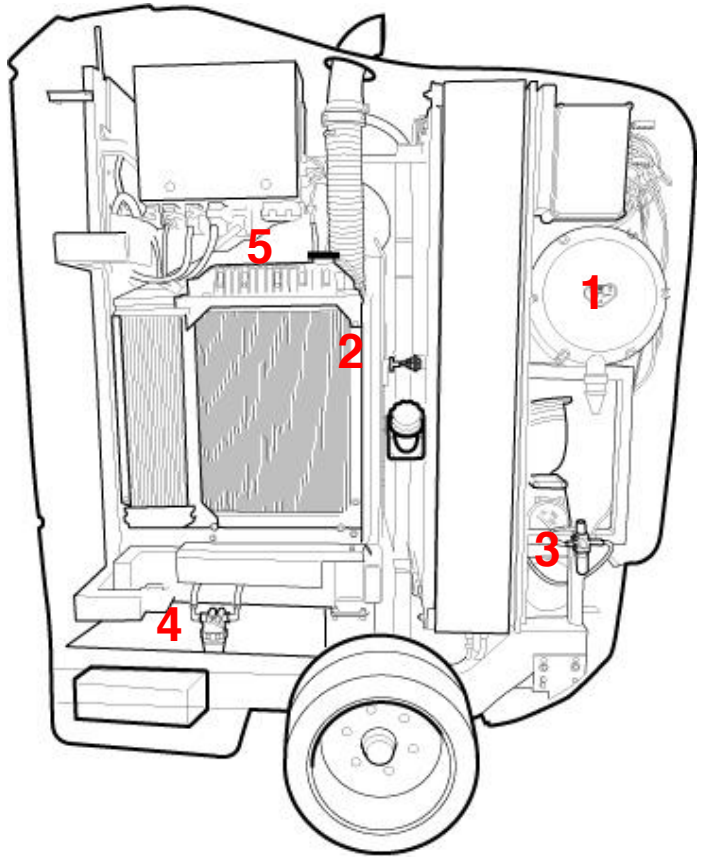
1. Make sure the machine is turned off
2. Unscrew the cap and fill up
3. The level can be monitored inside the machine on the panel if ignition is on but the machine is turned off

If Diesel of Category 2 & 3 is used the lifetime on the motor will be decreased and cleaning of the particle filter needs to be done regularly



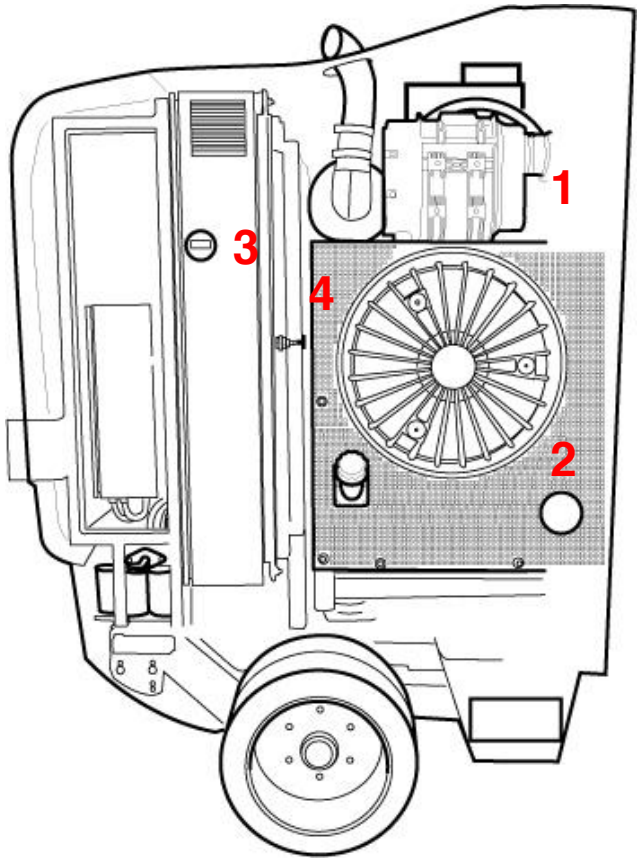
Service & Maintenance – Daily Control Schedule

1. Check the HEPA filter for the VAC system. If dust inside replace filter and check the other filters for leakage
2. Check oil level in diesel engine
3. Empty water in air system
4. Check filter for mist system if you will use it
5. Check cooling fluid in diesel engine



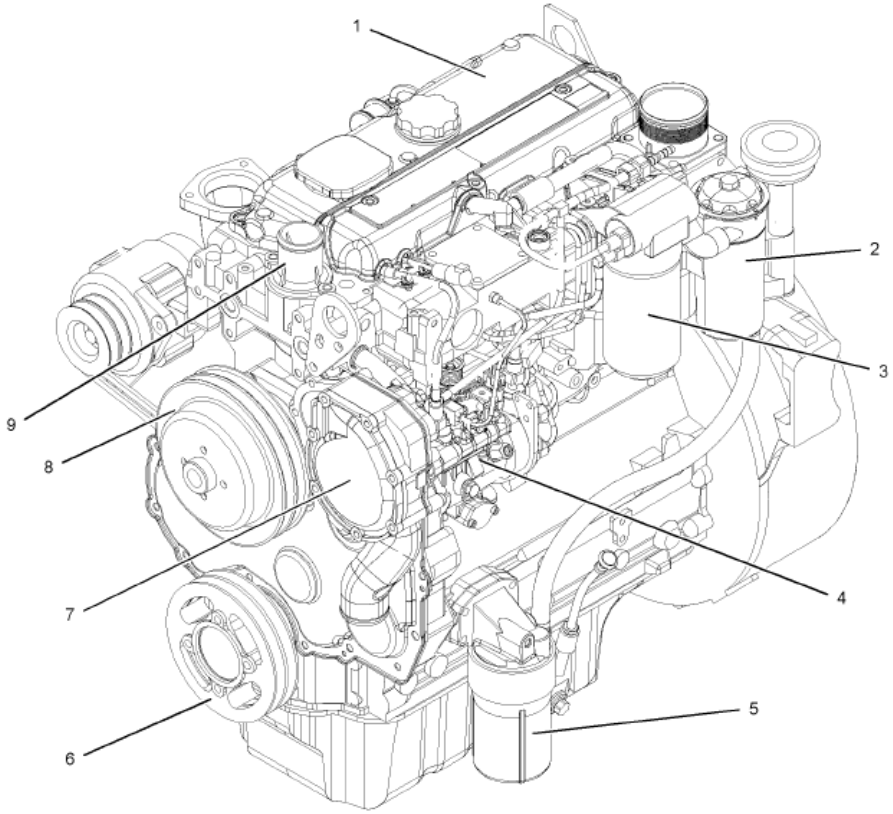
Service & Maintenance – Daily Control Schedule

1. Check the air filter for diesel and air system – clean if necessary and change if needed
2. Check oil level for VAC clutch valve
3. Check diesel run time watch for service maintenance
4. Check belts for generator and vacuum



Service & Maintenance – Daily Control Schedule

1. Check belt for motor generator and Air Condition and fans
2. Check cooling system level – the motor must not be hot or running
3. Check water level in water separator for fuel system – must not be more than 50%



Service & Maintenance – Diesel engine

EVERY 500 hours

- Test and refill cooling fluid in motor
- Air filter exchange
- Control ground cable on motor, clean if necessary
- Change oil and oil filter
- Change water separator for fuel system
- Change fuel filters
- Check hoses and clamps
- Clean cooler

EVERY 1000 hours

1. Control tappet clearance, adjust

EVERY 2000 hours

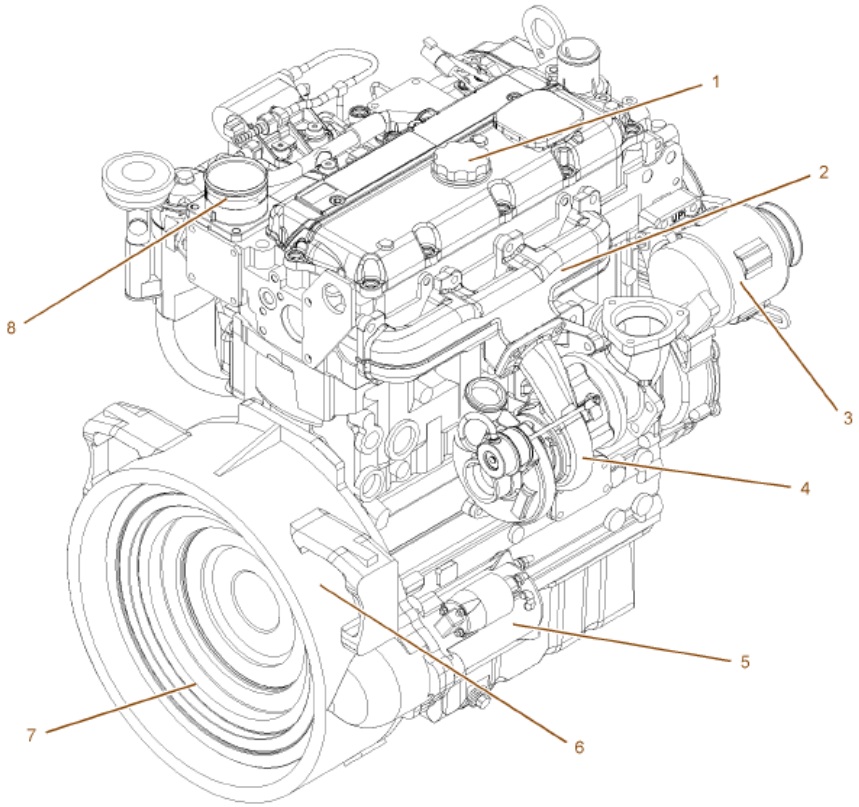
1. Control after cooler package
2. Generator control
3. Control motor bracket
4. Control start motor
5. Control turbo
6. Control water pump

EVERY 2nd year

1. Change cooling fluid
2. Cleaning & testing after cooler (4000 hrs)

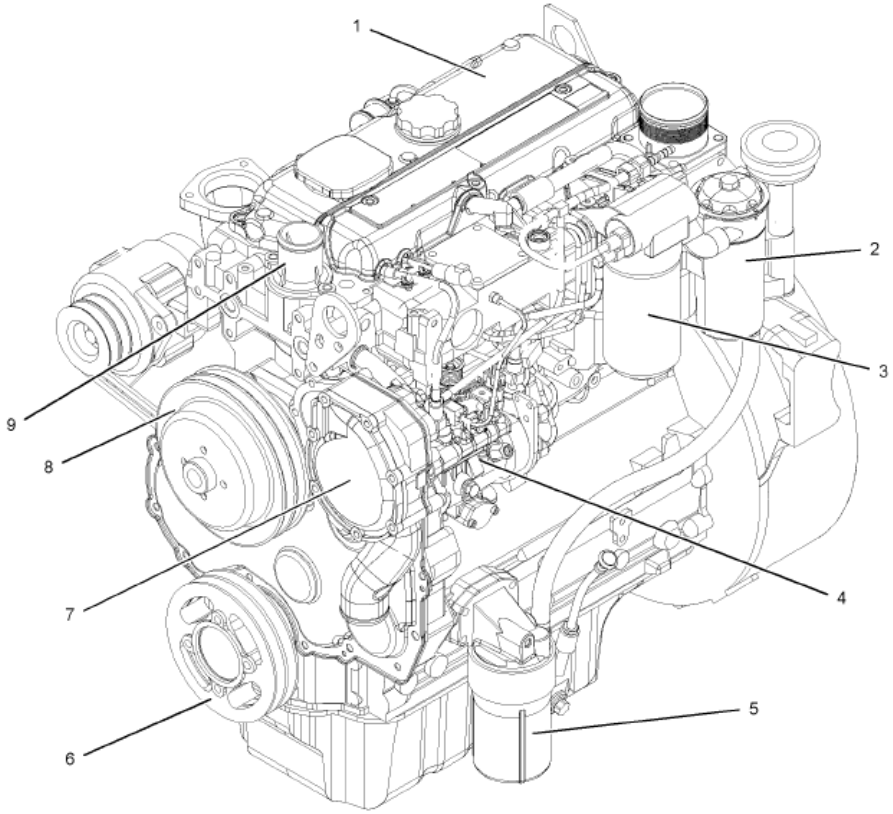
Service & Maintenance – Motor schematics

1. Engine Oil
2. Exhaust pipe
3. Generator
4. Turbo
5. Start motor
6. Turn wheel housing
7. Turn wheel (connected to belt for generator set)
8. Air intake



Service & Maintenance – Motor schematics

1. Valve cover
2. Crank case ventilator
3. Fuel filter
4. Fuel injection pump
5. Motor oil filter
6. Crank axel disc
7. Water pump
8. Fan wheel
9. Housing for water temp regulator



HTC 2500IX

TROUBLESHOOTING

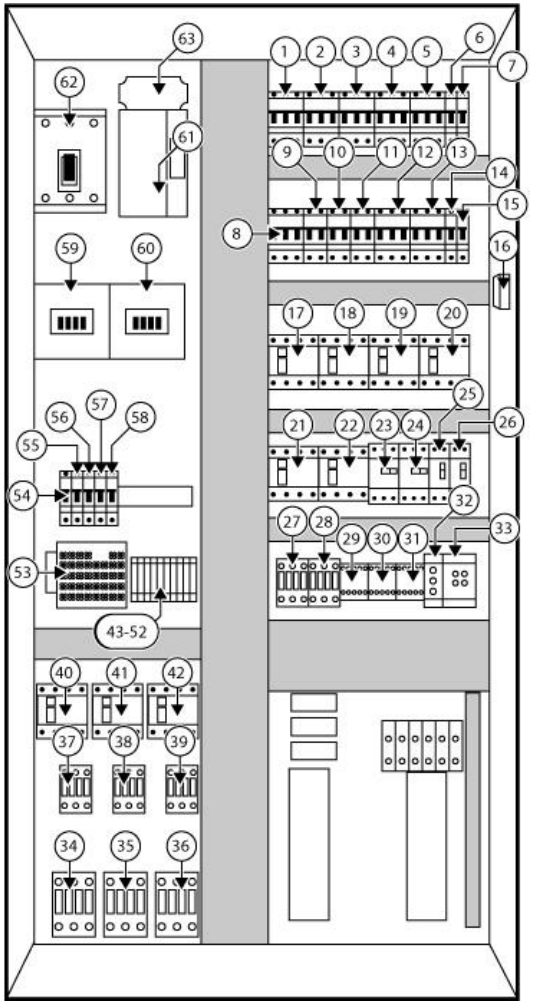
November 2007

Troubleshooting – Power syst.

Do not enter the electrical boxes when the machine is running!

Fuses number 1 to 15 should always be on.

Ground circuit brakers are number 17-22 and 25, 26 and 40-42 and should also always be on

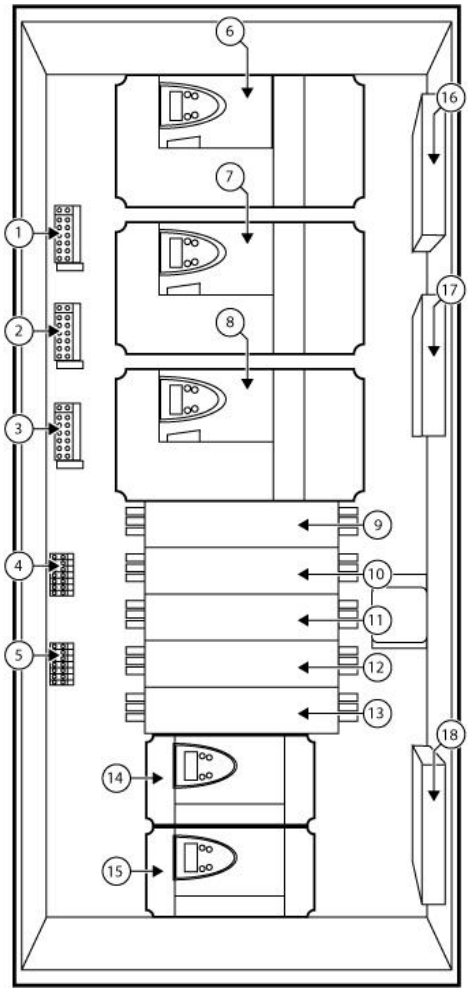


Troubleshooting – Inverter syst.

Do not enter the electrical boxes when the machine is running!

The inverters are placed in the following order from the bottom:

15. Right drive engine
14. Left drive engine
8. Right gridning head
7. Center grinding head
6. Left grinding head

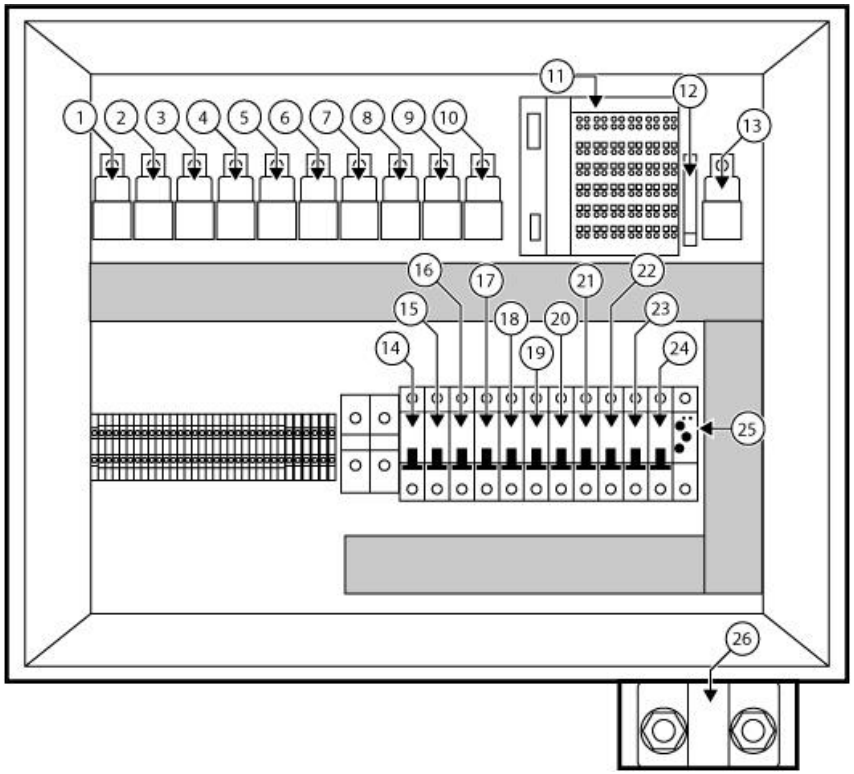


Troubleshooting – 12 V syst.

Do not enter the electrical boxes when the machine is running!

Contains relays and fuses.

14. Main fuse
15. Light fuse
16. Fuse maneuver
17. Fan A/C
18. Fresh air fan
19. Light inside cabin
20. Fuse diesel engine
21. Fuse back video & control system
22. Fuse EM-Circuit 12V
23. Stereo & Control system
24. Fuse for 24V box 12-24V



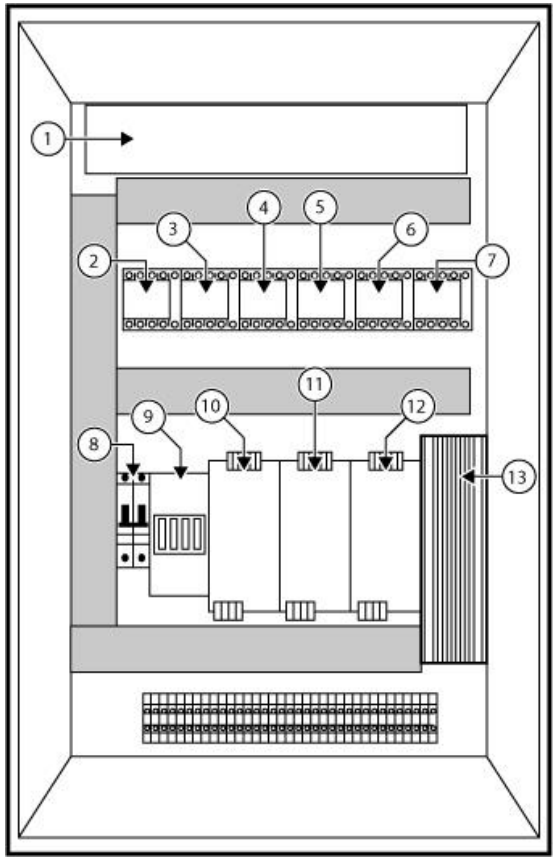
26 - EMERGENCY BRAKER 12V

Troubleshooting – Inverter syst.

Do not enter the electrical boxes when the machine is running!

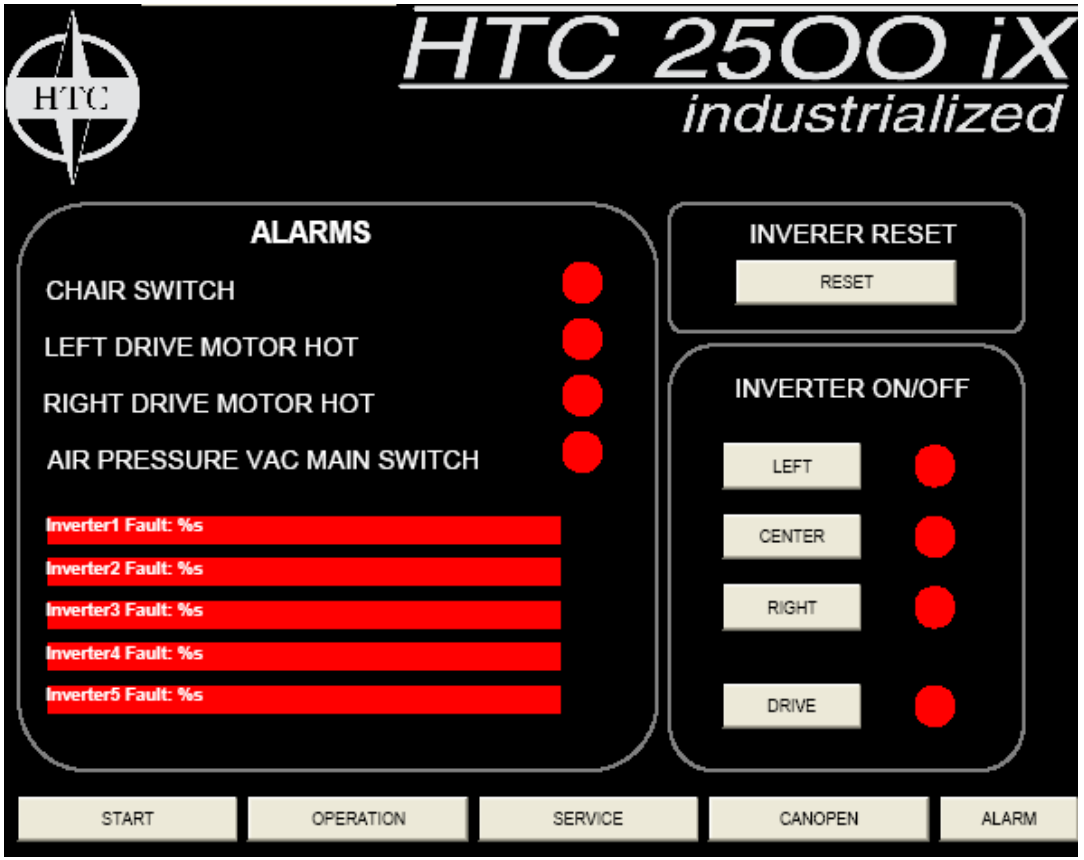
This box contains units for controling lifting system and 24V supply and cooling supply for Inverter system

8. Fuse for CANopen units



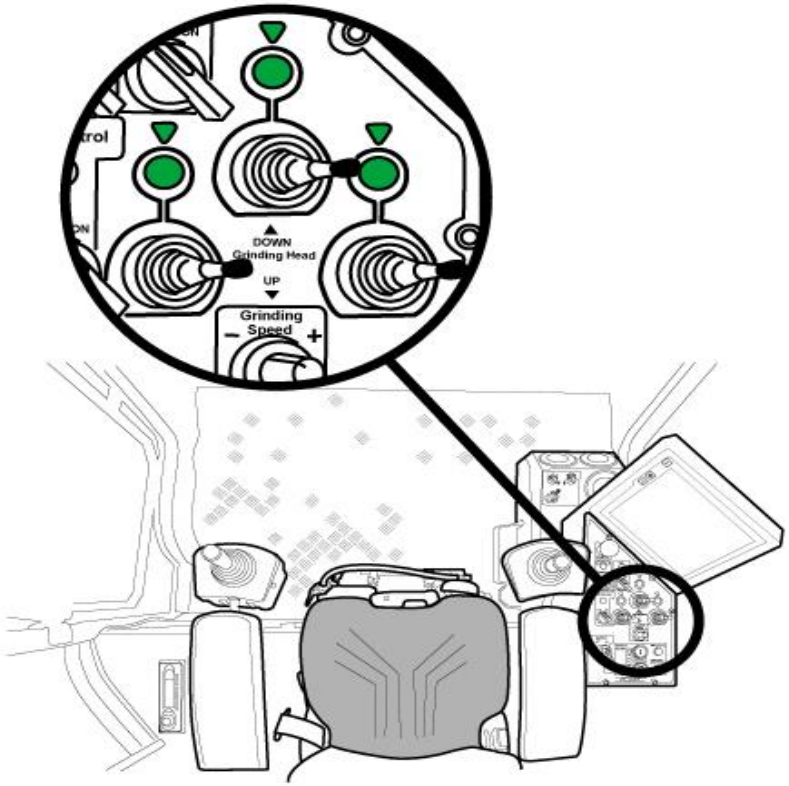
Using the machines with 1 or 2 heads

- In case of mechanical breakdown you can disable 1 or 2 grinding heads and continue working with the machine. To do this enter the alarm menu
- Disable the left, center or right inverter. When this is done the grinding heads can not be lowered, just raised



Using the machine with 1 or 2 heads

- Raise the head you have disabled until the green light turns on showing that the head is locked in the upright position and safe
- When this is done the head is by-passed and the machine can be used with the remaining heads
- Do this for all heads if you want to run the mist system without grinding



November 2007

E.W & KT

Updated 2007-11-20

HTC Sweden AB

SEBU7833-03
September 2008

Operation and Maintenance Manual

1103 and 1104 Industrial Engines

DC (Engine)
DD (Engine)
DJ (Engine)
DK (Engine)
RE (Engine)
RG (Engine)
RJ (Engine)
RR (Engine)
RS (Engine)
RT (Engine)
DF (Engine)
DG (Engine)

Important Safety Information

Most accidents that involve product operation, maintenance and repair are caused by failure to observe basic safety rules or precautions. An accident can often be avoided by recognizing potentially hazardous situations before an accident occurs. A person must be alert to potential hazards. This person should also have the necessary training, skills and tools to perform these functions properly.

Improper operation, lubrication, maintenance or repair of this product can be dangerous and could result in injury or death.

Do not operate or perform any lubrication, maintenance or repair on this product, until you have read and understood the operation, lubrication, maintenance and repair information.

Safety precautions and warnings are provided in this manual and on the product. If these hazard warnings are not heeded, bodily injury or death could occur to you or to other persons.

The hazards are identified by the “Safety Alert Symbol” and followed by a “Signal Word” such as “DANGER”, “WARNING” or “CAUTION”. The Safety Alert “WARNING” label is shown below.

⚠ WARNING

The meaning of this safety alert symbol is as follows:

Attention! Become Alert! Your Safety is Involved.

The message that appears under the warning explains the hazard and can be either written or pictorially presented.

Operations that may cause product damage are identified by “NOTICE” labels on the product and in this publication.

Perkins cannot anticipate every possible circumstance that might involve a potential hazard. The warnings in this publication and on the product are, therefore, not all inclusive. If a tool, procedure, work method or operating technique that is not specifically recommended by Perkins is used, you must satisfy yourself that it is safe for you and for others. You should also ensure that the product will not be damaged or be made unsafe by the operation, lubrication, maintenance or repair procedures that you choose.

The information, specifications, and illustrations in this publication are on the basis of information that was available at the time that the publication was written. The specifications, torques, pressures, measurements, adjustments, illustrations, and other items can change at any time. These changes can affect the service that is given to the product. Obtain the complete and most current information before you start any job. Perkins dealers or Perkins distributors have the most current information available.

⚠ WARNING

When replacement parts are required for this product Perkins recommends using Perkins replacement parts.

Failure to heed this warning can lead to premature failures, product damage, personal injury or death.

Table of Contents

Foreword 4

Safety Section

Safety Messages 5

General Hazard Information 6

Burn Prevention 7

Fire Prevention and Explosion Prevention 8

Crushing Prevention and Cutting Prevention 10

Mounting and Dismounting 10

Before Starting Engine 10

Engine Starting 11

Engine Stopping 11

Electrical System 11

Product Information Section

Model Views 13

Product Identification Information 19

Operation Section

Lifting and Storage 24

Gauges and Indicators 27

Engine Starting 28

Engine Operation 31

Engine Stopping 32

Cold Weather Operation 33

Maintenance Section

Refill Capacities 37

Maintenance Interval Schedule 51

Warranty Section

Warranty Information 79

Index Section

Index 80

Foreword

Literature Information

This manual contains safety, operation instructions, lubrication and maintenance information. This manual should be stored in or near the engine area in a literature holder or literature storage area. Read, study and keep it with the literature and engine information.

English is the primary language for all Perkins publications. The English used facilitates translation and consistency.

Some photographs or illustrations in this manual show details or attachments that may be different from your engine. Guards and covers may have been removed for illustrative purposes. Continuing improvement and advancement of product design may have caused changes to your engine which are not included in this manual. Whenever a question arises regarding your engine, or this manual, please consult with your Perkins dealer or your Perkins distributor for the latest available information.

Safety

This safety section lists basic safety precautions. In addition, this section identifies hazardous, warning situations. Read and understand the basic precautions listed in the safety section before operating or performing lubrication, maintenance and repair on this product.

Operation

Operating techniques outlined in this manual are basic. They assist with developing the skills and techniques required to operate the engine more efficiently and economically. Skill and techniques develop as the operator gains knowledge of the engine and its capabilities.

The operation section is a reference for operators. Photographs and illustrations guide the operator through procedures of inspecting, starting, operating and stopping the engine. This section also includes a discussion of electronic diagnostic information.

Maintenance

The maintenance section is a guide to engine care. The illustrated, step-by-step instructions are grouped by service hours and/or calendar time maintenance intervals. Items in the maintenance schedule are referenced to detailed instructions that follow.

Recommended service should be performed at the appropriate intervals as indicated in the Maintenance Interval Schedule. The actual operating environment of the engine also governs the Maintenance Interval Schedule. Therefore, under extremely severe, dusty, wet or freezing cold operating conditions, more frequent lubrication and maintenance than is specified in the Maintenance Interval Schedule may be necessary.

The maintenance schedule items are organized for a preventive maintenance management program. If the preventive maintenance program is followed, a periodic tune-up is not required. The implementation of a preventive maintenance management program should minimize operating costs through cost avoidances resulting from reductions in unscheduled downtime and failures.

Maintenance Intervals

Perform maintenance on items at multiples of the original requirement. We recommend that the maintenance schedules be reproduced and displayed near the engine as a convenient reminder. We also recommend that a maintenance record be maintained as part of the engine’s permanent record.

Your authorized Perkins dealer or your Perkins distributor can assist you in adjusting your maintenance schedule to meet the needs of your operating environment.

Overhaul

Major engine overhaul details are not covered in the Operation and Maintenance Manual except for the interval and the maintenance items in that interval. Major repairs should only be carried out by Perkins authorized personnel. Your Perkins dealer or your Perkins distributor offers a variety of options regarding overhaul programs. If you experience a major engine failure, there are also numerous after failure overhaul options available. Consult with your Perkins dealer or your Perkins distributor for information regarding these options.

California Proposition 65 Warning

Diesel engine exhaust and some of its constituents are known to the State of California to cause cancer, birth defects, and other reproductive harm. Battery posts, terminals and related accessories contain lead and lead compounds. **Wash hands after handling**.

Safety Section

i03299360

Safety Messages

There may be several specific warning signs on an engine. The exact location of the hazards and the description of the hazards are reviewed in this section. Please become familiar with all warning signs.

Ensure that all of the warning signs are legible. Clean the warning signs or replace the warning signs if the words cannot be read or if the pictures are not visible. When the warning signs are cleaned, use a cloth, water, and soap. Do not use solvent, gasoline, or other harsh chemicals to clean the warning signs. Solvents, gasoline, or harsh chemicals could loosen the adhesive that secures the warning signs. The warning signs that are loosened could drop off of the engine.

Replace any damaged warning signs or missing warning signs. If a warning sign is attached to a part of the engine that is replaced, install a new warning sign on the replacement part. Perkins dealers or Perkins distributors can provide new warning signs.

Do not work on the engine and do not operate the engine unless the instructions and warnings in the Operation and Maintenance Manual are understood. Correct care is your responsibility. Failure to follow the instructions or failure to heed the warnings could result in injury or in death.

(1) Universal Warning

⚠ WARNING

Do not operate or work on this equipment unless you have read and understand the instructions and warnings in the Operation and Maintenance Manuals. Failure to follow the instructions or heed the warnings could result in serious injury or death.

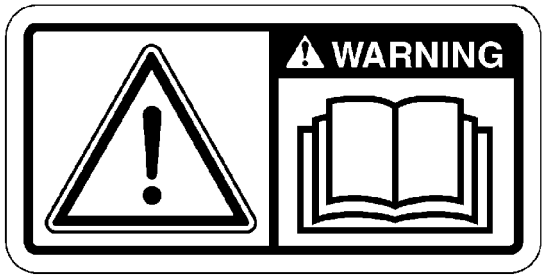


Illustration 1 g01154807

Typical example

The Universal Warning label (1) may be located on the valve mechanism cover or the inlet manifold. Refer to illustration 2.

Note: The location of this label will depend on the application of the engine.

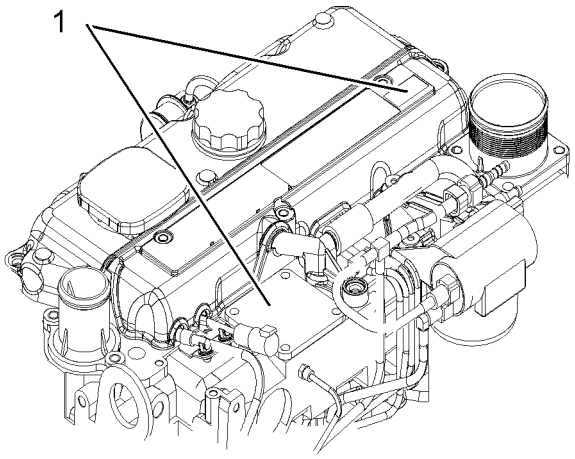


Illustration 2 g01682734

Typical example

(2) Ether

⚠ WARNING

Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

Illustration 3 g01682820

The ether warning label (2) is located on the cover of the inlet manifold. Refer to illustration 4.

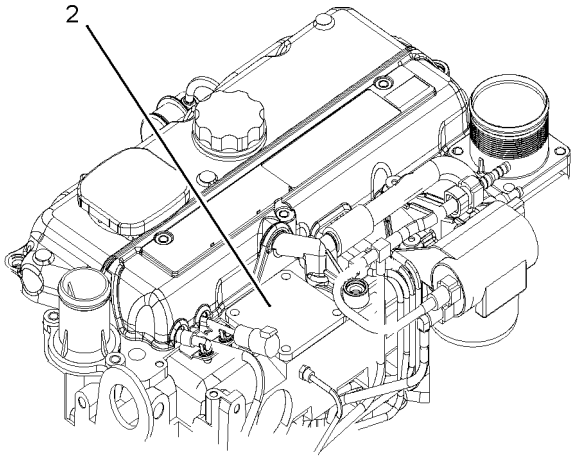


Illustration 4 g01682833

Typical example

i02328435

General Hazard Information

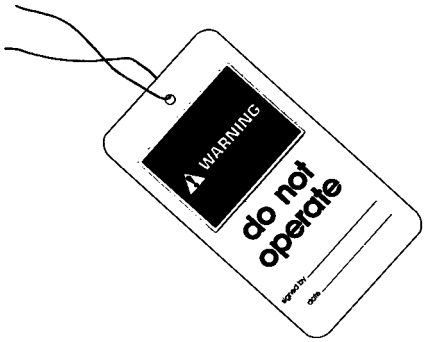


Illustration 5 g00104545

Attach a “Do Not Operate” warning tag or a similar warning tag to the start switch or to the controls before you service the equipment or before you repair the equipment.

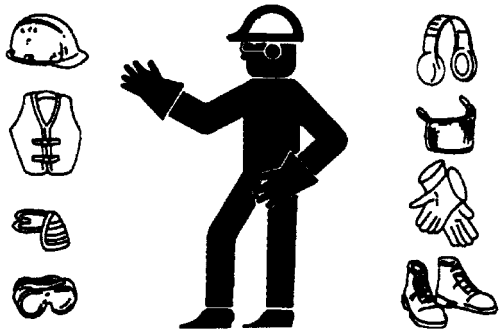


Illustration 6 g00702020

Wear a hard hat, protective glasses, and other protective equipment, as required.

Do not wear loose clothing or jewelry that can snag on controls or on other parts of the engine.

Make sure that all protective guards and all covers are secured in place on the engine.

Keep the engine free from foreign material. Remove debris, oil, tools, and other items from the deck, from walkways, and from steps.

Never put maintenance fluids into glass containers. Drain all liquids into a suitable container.

Obey all local regulations for the disposal of liquids.

Use all cleaning solutions with care.

Report all necessary repairs.

Do not allow unauthorized personnel on the equipment.

Ensure that the power supply is disconnected before you work on the bus bar or the glow plugs.

Perform maintenance on the engine with the equipment in the servicing position. Refer to the OEM information for the procedure for placing the equipment in the servicing position.

Pressure Air and Water

Pressurized air and/or water can cause debris and/or hot water to be blown out. This could result in personal injury.

The direct application of pressurized air or pressurized water to the body could result in personal injury.

When pressurized air and/or water is used for cleaning, wear protective clothing, protective shoes, and eye protection. Eye protection includes goggles or a protective face shield.

The maximum air pressure for cleaning purposes must be below 205 kPa (30 psi). The maximum water pressure for cleaning purposes must be below 275 kPa (40 psi).

Fluid Penetration

Pressure can be trapped in the hydraulic circuit long after the engine has been stopped. The pressure can cause hydraulic fluid or items such as pipe plugs to escape rapidly if the pressure is not relieved correctly.

Do not remove any hydraulic components or parts until pressure has been relieved or personal injury may occur. Do not disassemble any hydraulic components or parts until pressure has been relieved or personal injury may occur. Refer to the OEM information for any procedures that are required to relieve the hydraulic pressure.

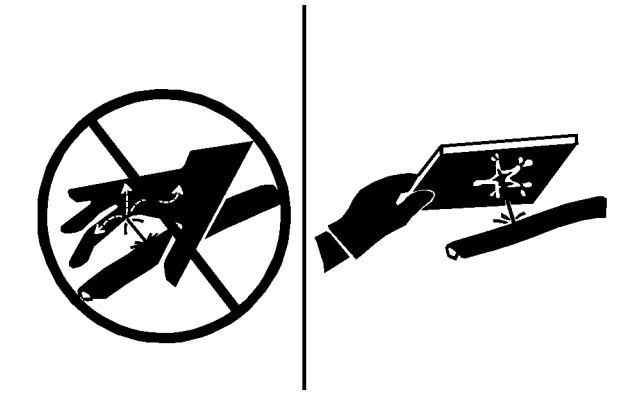


Illustration 7 g00687600

Always use a board or cardboard when you check for a leak. Leaking fluid that is under pressure can penetrate body tissue. Fluid penetration can cause serious injury and possible death. A pin hole leak can cause severe injury. If fluid is injected into your skin, you must get treatment immediately. Seek treatment from a doctor that is familiar with this type of injury.

Containing Fluid Spillage

Care must be taken in order to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the engine. Make provision to collect the fluid with a suitable container before any compartment is opened or before any component is disassembled.

- Only use the tools that are suitable for collecting fluids and equipment that is suitable for collecting fluids.
- Only use the tools that are suitable for containing fluids and equipment that is suitable for containing fluids.

Obey all local regulations for the disposal of liquids.

i02143195

Burn Prevention

Do not touch any part of an operating engine. Allow the engine to cool before any maintenance is performed on the engine. Relieve all pressure in the air system, in the hydraulic system, in the lubrication system, in the fuel system, or in the cooling system before any lines, fittings or related items are disconnected.

Coolant

When the engine is at operating temperature, the engine coolant is hot. The coolant is also under pressure. The radiator and all lines to the heaters or to the engine contain hot coolant.

Any contact with hot coolant or with steam can cause severe burns. Allow cooling system components to cool before the cooling system is drained.

Check the coolant level after the engine has stopped and the engine has been allowed to cool.

Ensure that the filler cap is cool before removing the filler cap. The filler cap must be cool enough to touch with a bare hand. Remove the filler cap slowly in order to relieve pressure.

Cooling system conditioner contains alkali. Alkali can cause personal injury. Do not allow alkali to contact the skin, the eyes, or the mouth.

Oils

Hot oil and hot lubricating components can cause personal injury. Do not allow hot oil to contact the skin. Also, do not allow hot components to contact the skin.

Batteries

Electrolyte is an acid. Electrolyte can cause personal injury. Do not allow electrolyte to contact the skin or the eyes. Always wear protective glasses for servicing batteries. Wash hands after touching the batteries and connectors. Use of gloves is recommended.

i02813488

Fire Prevention and Explosion Prevention

Illustration 8 g00704000

All fuels, most lubricants, and some coolant mixtures are flammable.

Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause a fire. Fire may cause personal injury and property damage.

A flash fire may result if the covers for the engine crankcase are removed within fifteen minutes after an emergency shutdown.

Determine whether the engine will be operated in an environment that allows combustible gases to be drawn into the air inlet system. These gases could cause the engine to overspeed. Personal injury, property damage, or engine damage could result.

If the application involves the presence of combustible gases, consult your Perkins dealer and/or your Perkins distributor for additional information about suitable protection devices.

Remove all flammable combustible materials or conductive materials such as fuel, oil, and debris from the engine. Do not allow any flammable combustible materials or conductive materials to accumulate on the engine.

Store fuels and lubricants in correctly marked containers away from unauthorized persons. Store oily rags and any flammable materials in protective containers. Do not smoke in areas that are used for storing flammable materials.

Do not expose the engine to any flame.

Exhaust shields (if equipped) protect hot exhaust components from oil or fuel spray in case of a line, a tube, or a seal failure. Exhaust shields must be installed correctly.

Do not weld on lines or tanks that contain flammable fluids. Do not flame cut lines or tanks that contain flammable fluid. Clean any such lines or tanks thoroughly with a nonflammable solvent prior to welding or flame cutting.

Wiring must be kept in good condition. All electrical wires must be correctly routed and securely attached. Check all electrical wires daily. Repair any wires that are loose or frayed before you operate the engine. Clean all electrical connections and tighten all electrical connections.

Eliminate all wiring that is unattached or unnecessary. Do not use any wires or cables that are smaller than the recommended gauge. Do not bypass any fuses and/or circuit breakers.

Arcing or sparking could cause a fire. Secure connections, recommended wiring, and correctly maintained battery cables will help to prevent arcing or sparking.

Inspect all lines and hoses for wear or for deterioration. The hoses must be correctly routed. The lines and hoses must have adequate support and secure clamps. Tighten all connections to the recommended torque. Leaks can cause fires.

Oil filters and fuel filters must be correctly installed. The filter housings must be tightened to the correct torque.

Illustration 9 g00704059

Use caution when you are refueling an engine. Do not smoke while you are refueling an engine. Do not refuel an engine near open flames or sparks. Always stop the engine before refueling.

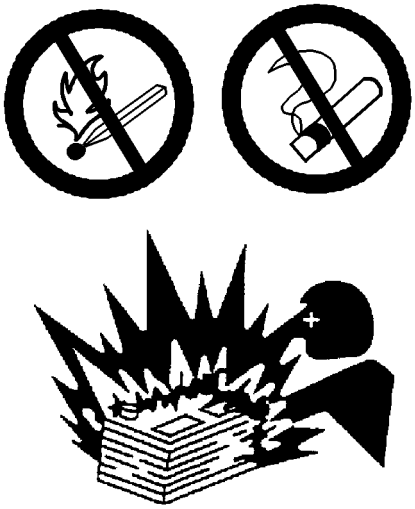


Illustration 10 g00704135

Gases from a battery can explode. Keep any open flames or sparks away from the top of a battery. Do not smoke in battery charging areas.

Never check the battery charge by placing a metal object across the terminal posts. Use a voltmeter or a hydrometer.

Incorrect jumper cable connections can cause an explosion that can result in injury. Refer to the Operation Section of this manual for specific instructions.

Do not charge a frozen battery. This may cause an explosion.

The batteries must be kept clean. The covers (if equipped) must be kept on the cells. Use the recommended cables, connections, and battery box covers when the engine is operated.

Fire Extinguisher

Make sure that a fire extinguisher is available. Be familiar with the operation of the fire extinguisher. Inspect the fire extinguisher and service the fire extinguisher regularly. Obey the recommendations on the instruction plate.

Lines, Tubes and Hoses

Do not bend high pressure lines. Do not strike high pressure lines. Do not install any lines that are bent or damaged. Do not clip any other items to the high pressure lines.

Repair any lines that are loose or damaged. Leaks can cause fires. Consult your Perkins dealer or your Perkins distributor for repair or for replacement parts.

Check lines, tubes and hoses carefully. Do not use your bare hand to check for leaks. Use a board or cardboard to check for leaks. Tighten all connections to the recommended torque.

Replace the parts if any of the following conditions are present:

- End fittings are damaged or leaking.
- Outer coverings are chafed or cut.
- Wires are exposed.
- Outer coverings are ballooning.
- Flexible part of the hoses are kinked.
- Outer covers have embedded armoring.
- End fittings are displaced.

Make sure that all clamps, guards, and heat shields are installed correctly. During engine operation, this will help to prevent vibration, rubbing against other parts, and excessive heat.

i02143194

Crushing Prevention and Cutting Prevention

Support the component correctly when work beneath the component is performed.

Unless other maintenance instructions are provided, never attempt adjustments while the engine is running.

Stay clear of all rotating parts and of all moving parts. Leave the guards in place until maintenance is performed. After the maintenance is performed, reinstall the guards.

Keep objects away from moving fan blades. The fan blades will throw objects or cut objects.

When objects are struck, wear protective glasses in order to avoid injury to the eyes.

Chips or other debris may fly off objects when objects are struck. Before objects are struck, ensure that no one will be injured by flying debris.

i01372247

Mounting and Dismounting

Inspect the steps, the handholds, and the work area before mounting the engine. Keep these items clean and keep these items in good repair.

Mount the engine and dismount the engine only at locations that have steps and/or handholds. Do not climb on the engine, and do not jump off the engine.

Face the engine in order to mount the engine or dismount the engine. Maintain a three-point contact with the steps and handholds. Use two feet and one hand or use one foot and two hands. Do not use any controls as handholds.

Do not stand on components which cannot support your weight. Use an adequate ladder or use a work platform. Secure the climbing equipment so that the equipment will not move.

Do not carry tools or supplies when you mount the engine or when you dismount the engine. Use a hand line to raise and lower tools or supplies.

i02813489

Before Starting Engine

Before the initial start-up of an engine that is new, serviced or repaired, make provision to shut the engine off, in order to stop an overspeed. This may be accomplished by shutting off the air and/or fuel supply to the engine.

Overspeed shutdown should occur automatically for engines that are controlled electronically. If automatic shutdown does not occur, press the emergency stop button in order to cut the fuel and/or air to the engine.

Inspect the engine for potential hazards.

Before starting the engine, ensure that no one is on, underneath, or close to the engine. Ensure that the area is free of personnel.

If equipped, ensure that the lighting system for the engine is suitable for the conditions. Ensure that all lights work correctly, if equipped.

All protective guards and all protective covers must be installed if the engine must be started in order to perform service procedures. To help prevent an accident that is caused by parts in rotation, work around the parts carefully.

Do not bypass the automatic shutoff circuits. Do not disable the automatic shutoff circuits. The circuits are provided in order to help prevent personal injury. The circuits are also provided in order to help prevent engine damage.

See the Service Manual for repairs and for adjustments.

i02207232

Engine Starting

⚠ WARNING

Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

If a warning tag is attached to the engine start switch or to the controls, DO NOT start the engine or move the controls. Consult with the person that attached the warning tag before the engine is started.

All protective guards and all protective covers must be installed if the engine must be started in order to perform service procedures. To help prevent an accident that is caused by parts in rotation, work around the parts carefully.

Start the engine from the operator's compartment or from the engine start switch.

Always start the engine according to the procedure that is described in the Operation and Maintenance Manual, "Engine Starting" topic in the Operation Section. Knowing the correct procedure will help to prevent major damage to the engine components. Knowing the procedure will also help to prevent personal injury.

To ensure that the jacket water heater (if equipped) and/or the lube oil heater (if equipped) is working correctly, check the water temperature gauge and the oil temperature gauge during the heater operation.

Engine exhaust contains products of combustion which can be harmful to your health. Always start the engine and operate the engine in a well ventilated area. If the engine is started in an enclosed area, vent the engine exhaust to the outside.

Note: The engine is equipped with an automatic device for cold starting for normal conditions of operation. If the engine will be operated in very cold conditions, then an extra cold starting aid may be required. Normally, the engine will be equipped with the correct type of starting aid for your region of operation.

The engines are equipped with a glow plug starting aid in each individual cylinder that heats the intake air in order to improve starting.

i01928905

Engine Stopping

Stop the engine according to the procedure in the Operation and Maintenance Manual, "Engine Stopping (Operation Section)" in order to avoid overheating of the engine and accelerated wear of the engine components.

Use the Emergency Stop Button (if equipped) ONLY in an emergency situation. Do not use the Emergency Stop Button for normal engine stopping. After an emergency stop, DO NOT start the engine until the problem that caused the emergency stop has been corrected.

Stop the engine if an overspeed condition occurs during the initial start-up of a new engine or an engine that has been overhauled. This may be accomplished by shutting off the fuel supply to the engine and/or shutting off the air supply to the engine.

i02176668

Electrical System

Never disconnect any charging unit circuit or battery circuit cable from the battery when the charging unit is operating. A spark can cause the combustible gases that are produced by some batteries to ignite.

To help prevent sparks from igniting combustible gases that are produced by some batteries, the negative "−" jump start cable should be connected last from the external power source to the negative "−" terminal of the starting motor. If the starting motor is not equipped with a negative "−" terminal, connect the jump start cable to the engine block.

Check the electrical wires daily for wires that are loose or frayed. Tighten all loose electrical wires before the engine is started. Repair all frayed electrical wires before the engine is started. See the Operation and Maintenance Manual for specific starting instructions.

Grounding Practices

Correct grounding for the engine electrical system is necessary for optimum engine performance and reliability. Incorrect grounding will result in uncontrolled electrical circuit paths and in unreliable electrical circuit paths.

Uncontrolled electrical circuit paths can result in damage to main bearings, to crankshaft bearing journal surfaces, and to aluminum components.

Engines that are installed without engine-to-frame ground straps can be damaged by electrical discharge.

To ensure that the engine and the engine electrical systems function correctly, an engine-to-frame ground strap with a direct path to the battery must be used. This path may be provided by way of a direct engine ground to the frame.

All grounds should be tight and free of corrosion. The engine alternator must be grounded to the negative “-” battery terminal with a wire that is adequate to handle the full charging current of the alternator.

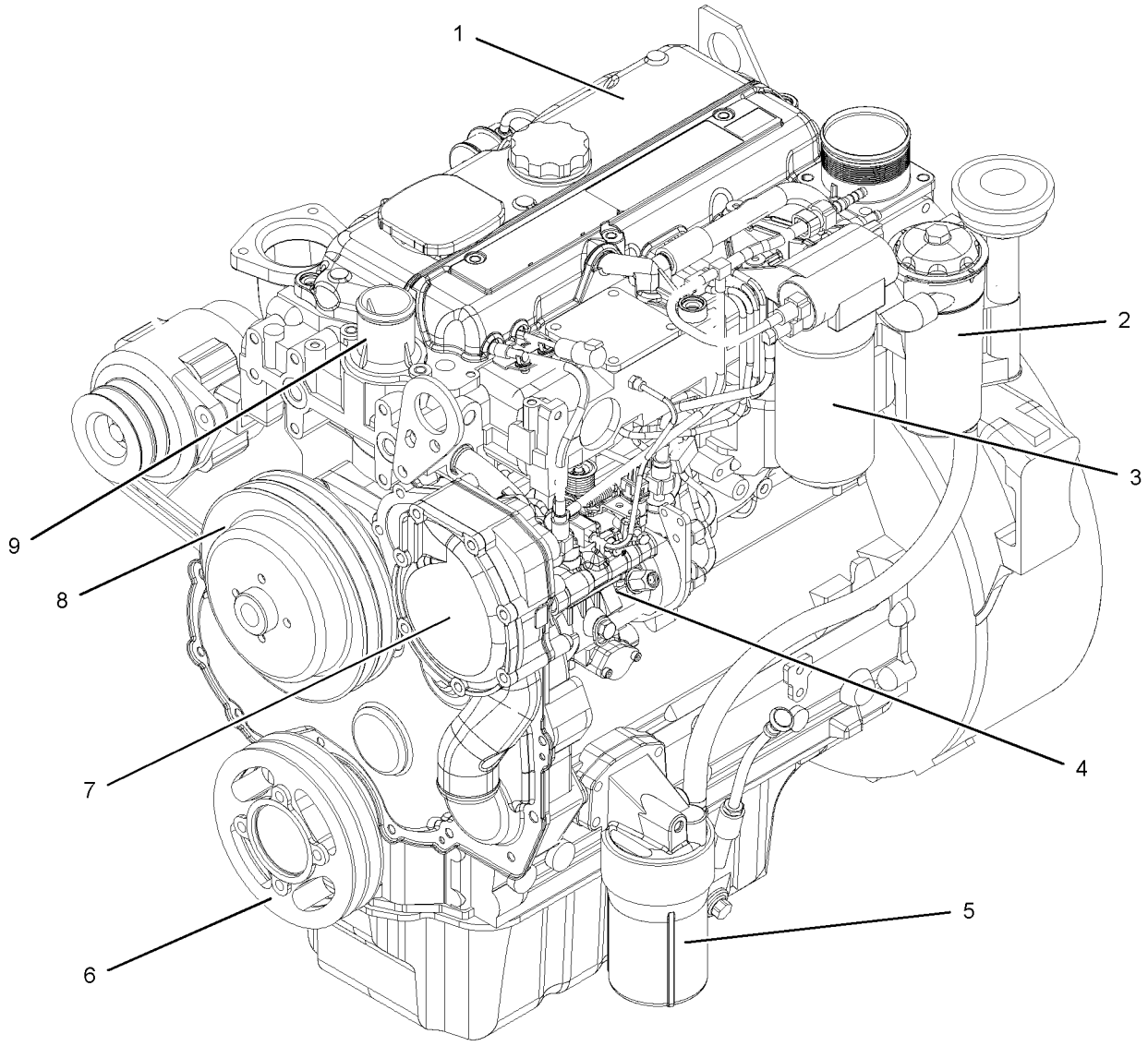
Product Information Section

Model Views

i01928892

Model View Illustrations

1104 Engine Model Views



g01012280

Illustration 11

(1) Valve mechanism cover
(2) Crankcase breather
(3) Fuel filter
(4) Fuel injection pump
(5) Engine oil filter
(6) Crankshaft pulley
(7) Water pump
(8) Fan pulley
(9) Water temperature regulator housing

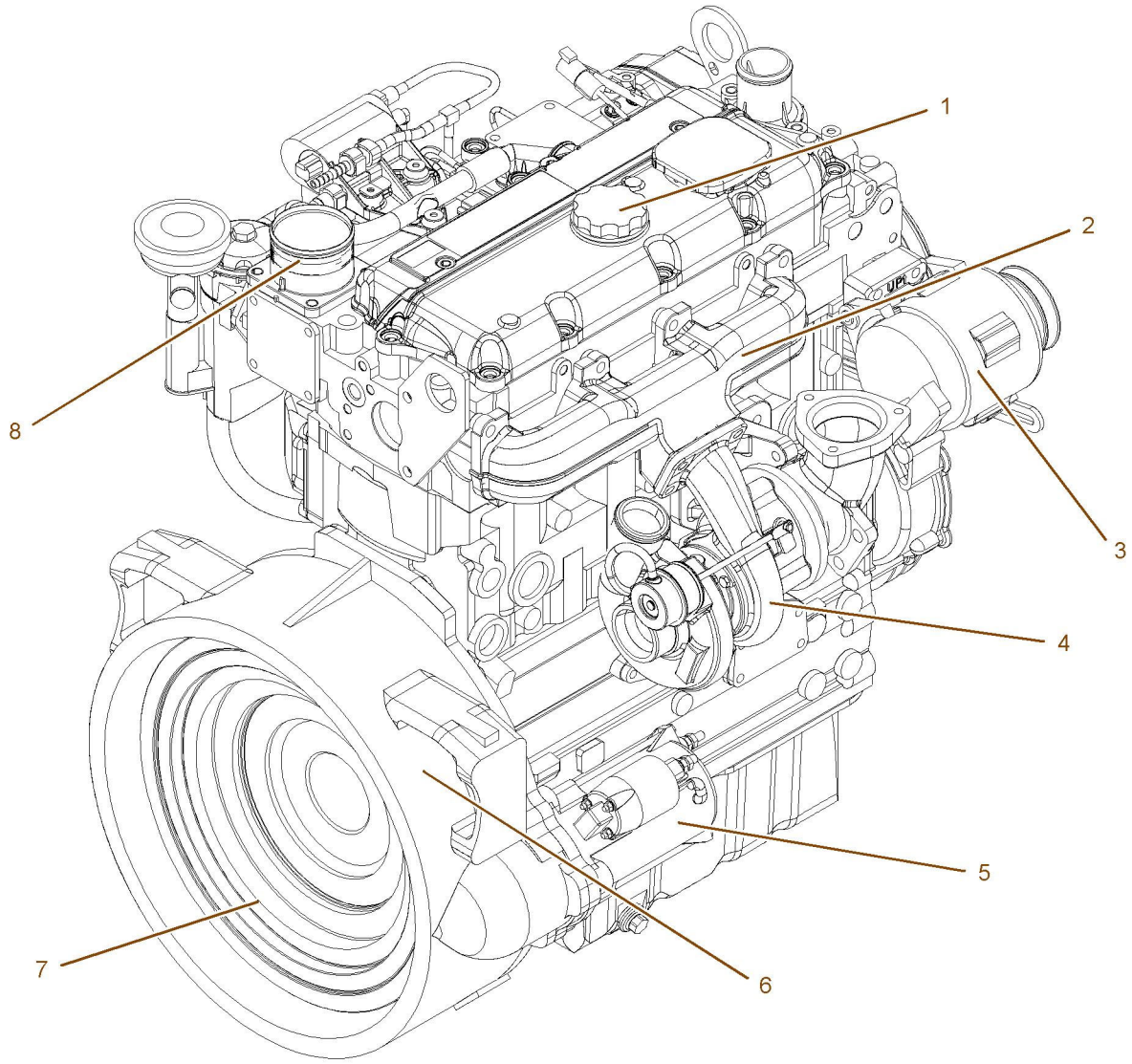
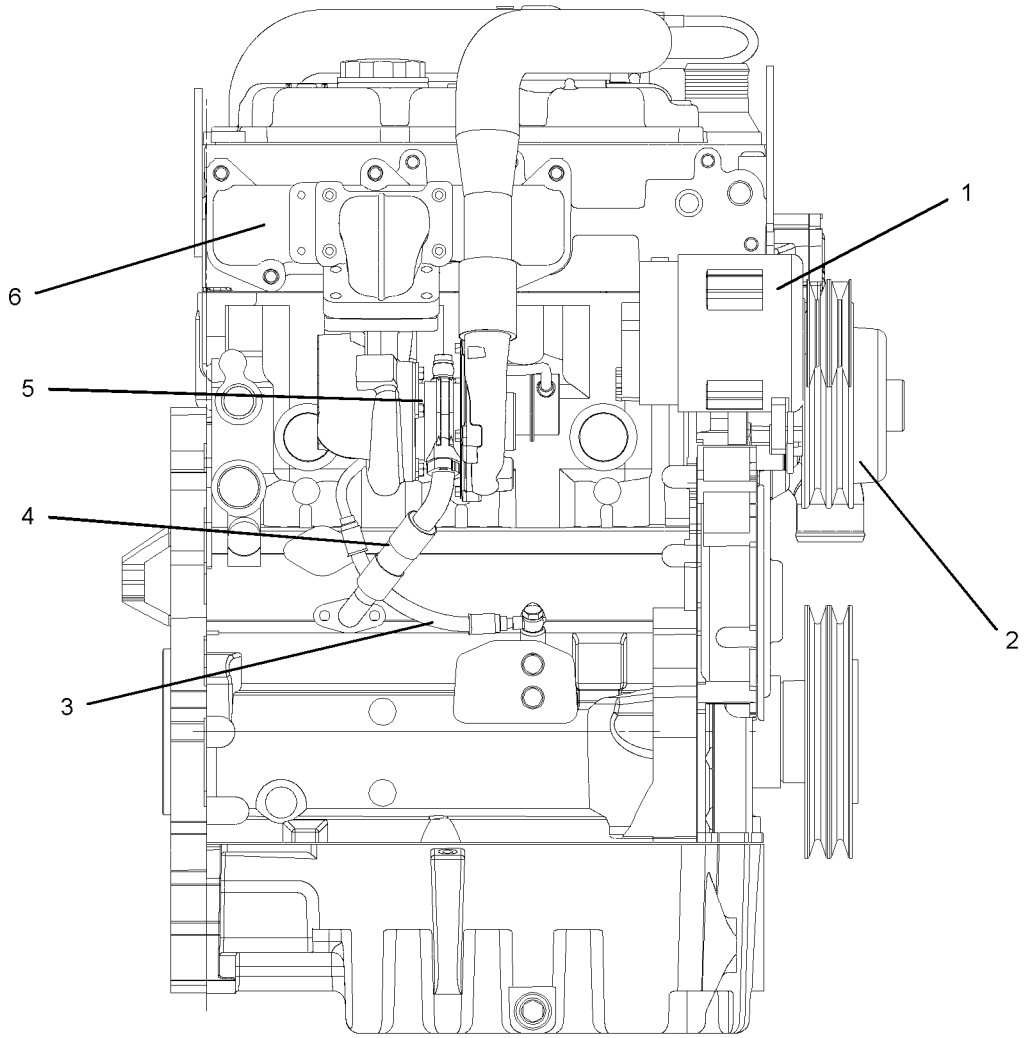


Illustration 12 g01012281

(1) Oil filler cap
(2) Exhaust manifold
(3) Alternator
(4) Turbocharger
(5) Starter motor
(6) Flywheel housing
(7) Flywheel
(8) Air intake

1103 Engine Model Views



g01011348

Illustration 13

(1) Alternator
(2) Fan pulley
(3) Turbocharger oil supply
(4) Turbocharger oil drain
(5) Turbocharger
(6) exhaust manifold

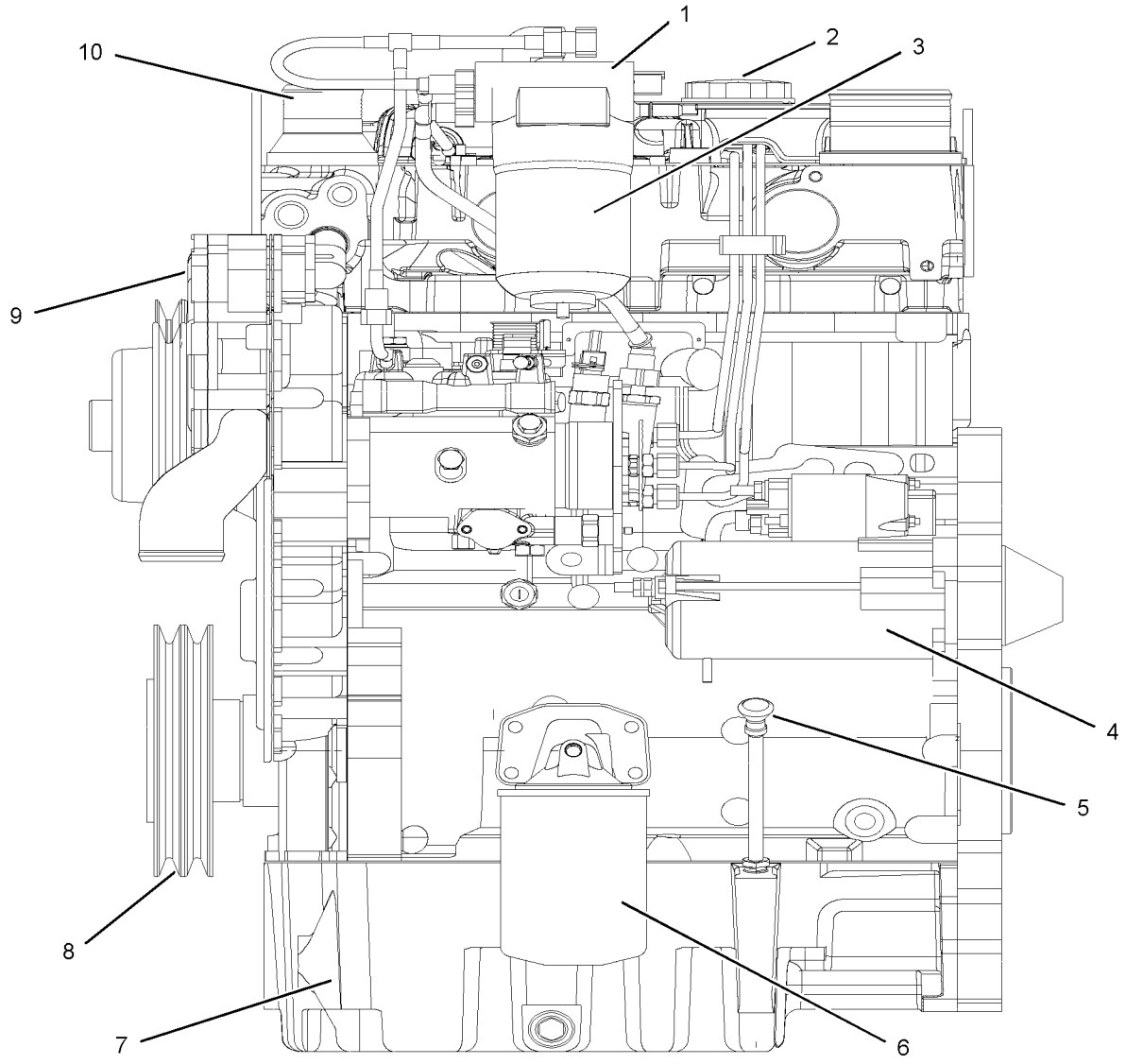


Illustration 14 g01011349

(1) Fuel transfer pump
(2) Oil filler cap
(3) Fuel filter
(4) Starter motor
(5) Dipstick
(6) Oil filter
(7) Oil pan
(8) Crankshaft pulley
(9) Water pump
(10) Water temperature regulator housing

i02196981

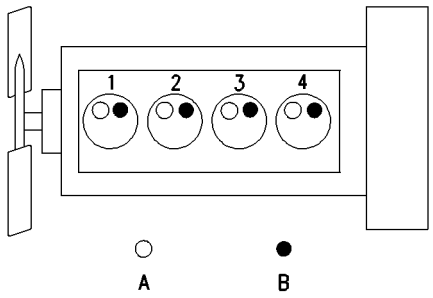
Engine Description

Perkins Engines are designed for the following applications: machine, genset, and industrial mobile equipment. The engines are available in the following types of aspiration:

- Turbocharged aftercooled
- Turbocharged
- Naturally aspirated

Engine Specifications

Note: The front end of the engine is opposite the flywheel end of the engine. The left and the right sides of the engine are determined from the flywheel end. The number 1 cylinder is the front cylinder.



g00984281

Illustration 15

A typical example of the layout of the valves

(A) Inlet valves
(B) Exhaust valves

Table 1

1104 Industrial Engine Specifications	
Number of Cylinders	4 In-Line
Bore	105 mm (4.134 inch)
Stroke	127 mm (5.0 inch)
Aspiration	Turbocharged aftercooled Turbocharged Naturally aspirated
Compression Ratio	NA 19.25:1 NA T 18.23:1 T, TA
Displacement	4.4 L (268 in ^{3})
Firing Order	1 3 4 2
Rotation (flywheel end)	Counterclockwise
Valve Lash Setting (Inlet)	0.20 mm (0.008 inch)
Valve Lash Setting (Exhaust)	0.45 mm (0.018 inch)

Table 2

1103 Industrial Engine Specifications	
Number of Cylinders	3 In-Line
Bore	105 mm (4.134 inch)
Stroke	127 mm (5.0 inch)
Aspiration	Turbocharged Naturally aspirated
Compression Ratio	NA 19.25:1 T 18.25:1
Displacement	3.3 L (201 in^3)
Firing Order	1 2 3
Rotation (flywheel end)	Counterclockwise
Valve Lash Setting (Inlet)	0.20 mm (0.008 inch)
Valve Lash Setting (Exhaust)	0.45 mm (0.018 inch)

Table 3

1104 Genset Specifications	
Number of Cylinders	4 In-Line
Bore	105 mm (4.134 inch)
Stroke	127 mm (5.0 inch)
Aspiration	Turbocharged aftercooled Turbocharged Naturally aspirated
Compression Ratios	NA 19.25:1 T 17.25:1, T 18.23:1, TA 18.23:1
Displacement	4.4 L (268 in ^{3})
Firing Order	1 3 4 2
Rotation (flywheel end)	Counterclockwise
Valve Lash Setting (Inlet)	0.20 mm (0.008 inch)
Valve Lash Setting (Exhaust)	0.45 mm (0.018 inch)

Table 4

1103 Genset Specifications	
Number of Cylinders	3 In-Line
Bore	105 mm (4.134 inch)
Stroke	127 mm (5.0 inch)
Aspiration	Turbocharged Naturally aspirated
Compression Ratio	NA 19.25:1 T 17.25:1
Displacement	3.3 L (201 in^3)
Firing Order	1 2 3
Rotation (flywheel end)	Counterclockwise
Valve Lash Setting (Inlet)	0.20 mm (0.008 inch)
Valve Lash Setting (Exhaust)	0.45 mm (0.018 inch)

Engine Cooling and Lubrication

The cooling system consists of the following components:

- Gear-driven centrifugal water pump
- Water temperature regulator which regulates the engine coolant temperature
- Gear-driven oil pump (gear type)
- Oil cooler

The engine lubricating oil is supplied by a gear type pump. The engine lubricating oil is cooled and the engine lubricating oil is filtered. Bypass valves provide unrestricted flow of lubrication oil to the engine parts when oil viscosity is high. Bypass valves can also provide unrestricted flow of lubrication oil to the engine parts if the oil cooler should become plugged or if the oil filter element should become plugged.

Engine efficiency, efficiency of emission controls, and engine performance depend on adherence to proper operation and maintenance recommendations. Engine performance and efficiency also depend on the use of recommended fuels, lubrication oils, and coolants. Refer to the Operation and Maintenance Manual, “Maintenance Interval Schedule” for more information on maintenance items.

Engine Service Life

Engine efficiency and maximum utilization of engine performance depend on the adherence to proper operation and maintenance recommendations. In addition, use recommended fuels, coolants and lubricants. Use the Operation and Maintenance Manual as a guide for required engine maintenance.

Expected engine life is generally predicted by the average power that is demanded. The average power that is demanded is based on fuel consumption of the engine over a period of time. Reduced hours of operation at full throttle and/or operating at reduced throttle settings result in a lower average power demand. Reduced hours of operation will increase the length of operating time before an engine overhaul is required.

Product Identification Information

i02280116

Engine Identification

Perkins engines are identified by a serial number. This number is shown on a serial number plate that is mounted on the left hand side of the engine block.

An example of an engine number is RE12345U090001H.

RE _____Type of engine

RE12345_____Engine List Number

U _____Built in the United Kingdom

090001 _____Engine Serial Number

H _____Year of Manufacture

Perkins dealers need these numbers in order to determine the components that were included with the engine. This permits accurate identification of replacement part numbers.

i01940474

Serial Number Plate

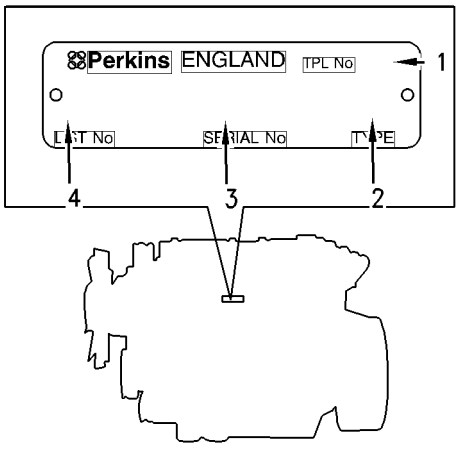


Illustration 16 g00994966

Typical serial number plate

(1) Temporary Parts List number
(2) Type
(3) Serial number
(4) List number

The Serial Number Plate is located on the left side of the cylinder block behind the high pressure pipes of the Fuel injection pump.

The following information is stamped on the Serial Number Plate: Engine serial number, Model, and Arrangement number.

i02164876

Reference Numbers

Information for the following items may be needed to order parts. Locate the information for your engine. Record the information in the appropriate space. Make a copy of this list for a record. Keep the information for future reference.

Record for Reference

Engine Model _____

Engine Serial number _____

Engine Low Idle rpm _____

Engine Full Load rpm _____

Primary Fuel Filter _____

Water Separator Element _____

Secondary Fuel Filter Element _____

Lubrication Oil Filter Element _____

Auxiliary Oil Filter Element _____

Total Lubrication System Capacity _____

Total Cooling System Capacity _____

Air Cleaner Element _____

Fan Drive Belt _____

Alternator Belt _____

i02758852

Emissions Certification Film

Label for compliant engines

Typical examples of emissions labels

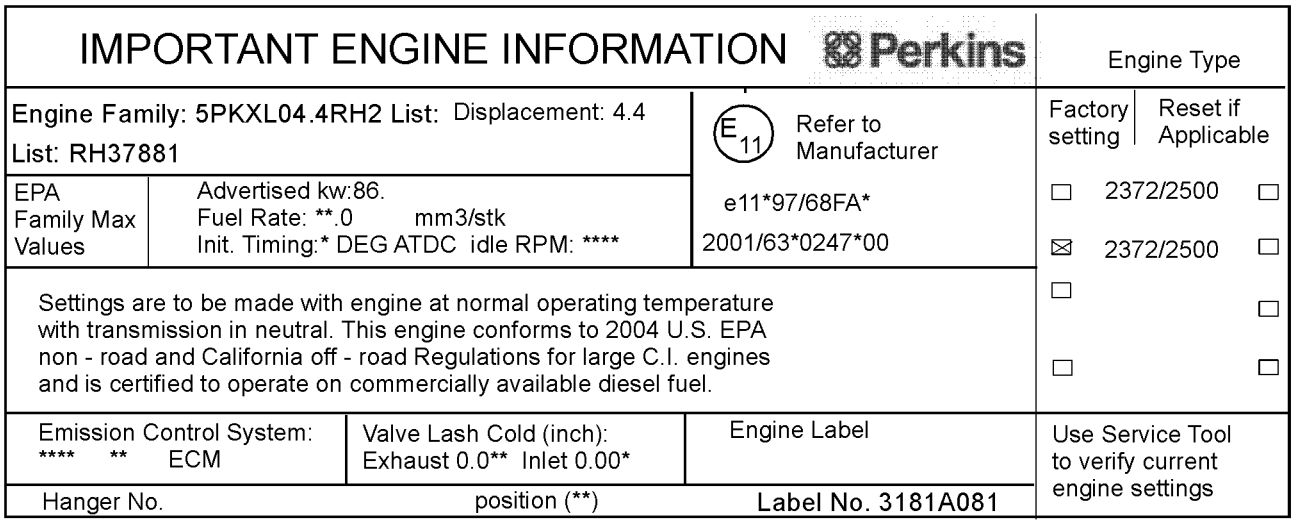


Illustration 17 g01173630

This typical example of a label is installed on engines that have electronic fuel injection systems and installed on engines that have electronic fuel injection pumps.

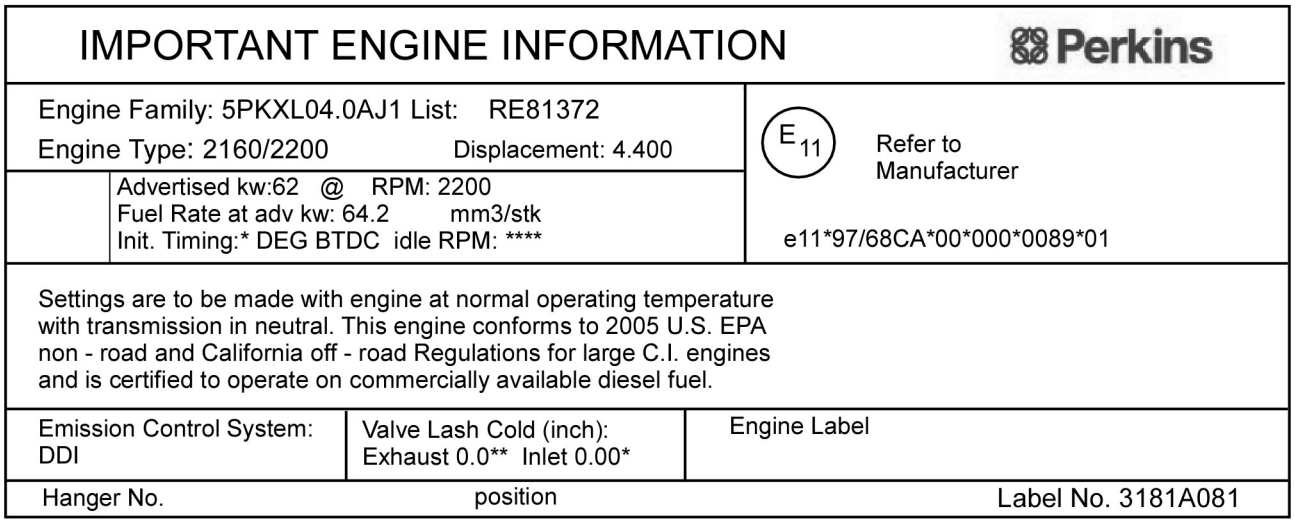


Illustration 18 g01156733

This typical example of a label is installed on engines that have mechanical fuel injection pumps.

Label for engines that comply with MSHA emissions

Perkins	LABEL NUMBER 3181
MSHA APPR NO.	
ENGINE MODEL	
CURVE NO.	
RATED HP RATED kW	AT rpm
HIGH IDLE	rpm
MAX ALT.	m
VENT RATE	cfm

g01381316

Illustration 19

Typical example

The label that is shown in illustration 19 is for engines that operate in underground coal mines in North America. The label is installed on engines that comply with the Mine Safety and Health Administration (MSHA) emissions. Approved diesel engines shall be identified by an approved mark that is legible and permanent. The approved mark is scribed with the approved MSHA number. The label should be securely attached to the diesel engine.

Label for engines that do not comply with emissions

EMISSIONS CONTROL INFORMATION Perkins

ENGINE FAMILY: ******
ENGINE DISPLACEMENT: *****
MODEL YEAR: 2005

This non - road engine may be used as a REPLACEMENT engine within the EU, as per the provisions of Directive 97/68/EC

INFORMATION APPLICABLE TO USA ONLY

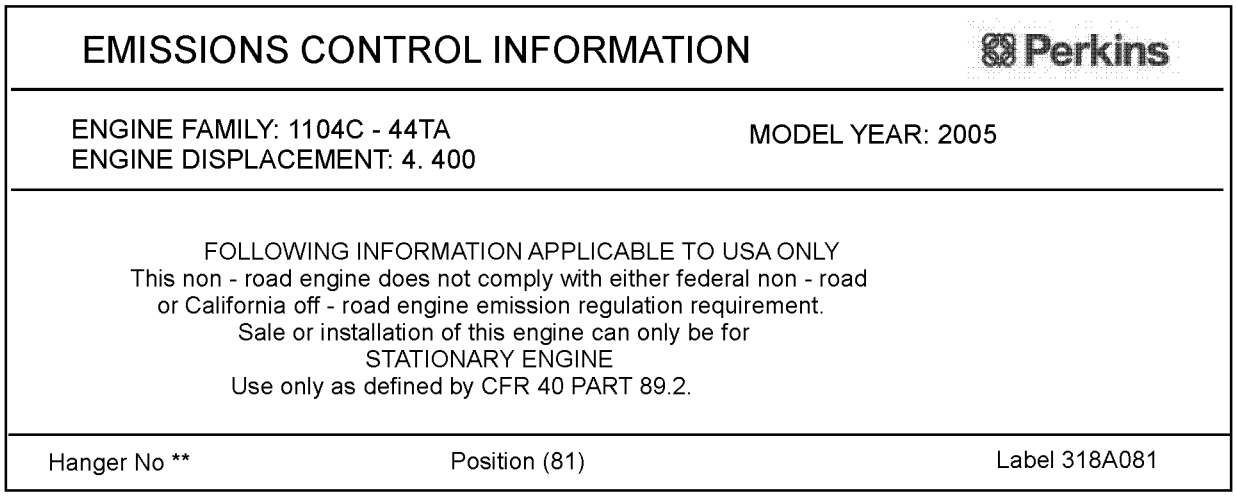
This non - road engine does not comply with either federal non - road or California off - road engine emission regulation requirements. Sale or installation of this engine is a violation of federal and Californian law subject to civil penalty for any purpose other than as an EXPORT - ONLY or REPLACEMENT engine.
Export - only engine is indicated by an additional attached tag.

Hanger No** Position **** Label No. 3181A081

g01156734

Illustration 20

This typical example of a label is installed on engines that do not comply with emissions.



g01157127

Illustration 21

This typical example of a label is installed on engines that are stationary engines.

Operation Section

Lifting and Storage

i02164186

Engine Lifting

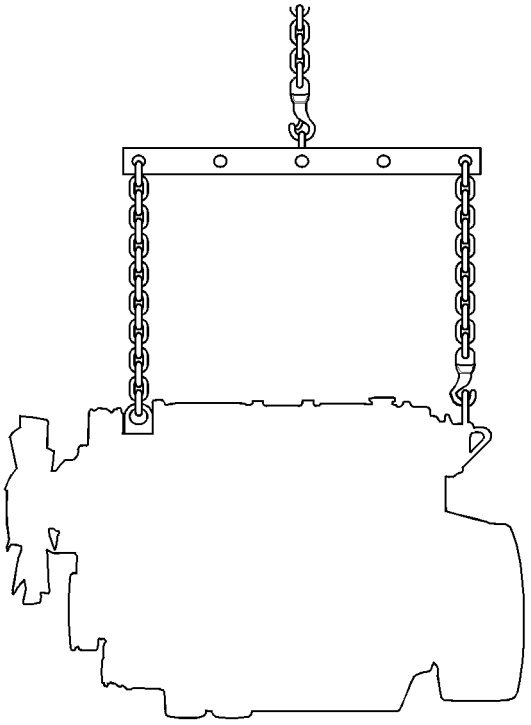


Illustration 22 g01097527

NOTICE
Never bend the eyebolts and the brackets. Only load the eyebolts and the brackets under tension. Remember that the capacity of an eyebolt is less as the angle between the supporting members and the object becomes less than 90 degrees.

When it is necessary to remove a component at an angle, only use a link bracket that is properly rated for the weight.

Use a hoist to remove heavy components. Use an adjustable lifting beam to lift the engine. All supporting members (chains and cables) should be parallel to each other. The chains and cables should be perpendicular to the top of the object that is being lifted.

Some removals require lifting the fixtures in order to obtain correct balance and safety.

To remove the engine ONLY, use the lifting eyes that are on the engine.

Lifting eyes are designed and installed for specific engine arrangements. Alterations to the lifting eyes and/or the engine make the lifting eyes and the lifting fixtures obsolete. If alterations are made, ensure that correct lifting devices are provided. Consult your Perkins dealer or your Perkins distributor for information regarding fixtures for correct engine lifting.

i01930351

Engine Storage

If the engine will not be started for several weeks, the lubricating oil will drain from the cylinder walls and from the piston rings. Rust can form on the cylinder walls. Rust on the cylinder walls will cause increased engine wear and a reduction in engine service life.

Lubrication System

To help prevent excessive engine wear, use the following guidelines:

Complete all of the lubrication recommendations that are listed in this Operation and Maintenance Manual, “Maintenance Interval Schedule” (Maintenance Section).

If an engine is out of operation and if use of the engine is not planned, special precautions should be made. If the engine will be stored for more than one month, a complete protection procedure is recommended.

Use the following guidelines :

- Completely clean the outside of the engine.
- Drain the fuel system completely and refill the system with preservative fuel.1772204 POWERPART Lay-Up 1 can be mixed with the normal fuel in order to change the fuel into preservative fuel.
- If preservative fuel is not available, the fuel system can be filled with normal fuel. This fuel must be discarded at the end of the storage period together with the fuel filter elements.
- Operate the engine until the engine reaches normal operating temperature. Stop any leaks from fuel, lubricating oil or air systems. Stop the engine and drain the lubricating oil from the oil pan.

- Renew the canister(s) of the lubricating oil filter.
- Fill the oil pan to the Full Mark on the dipstick with new, clean lubricating oil. Add 1762811 POWERPART Lay-Up 2 to the oil in order to protect the engine against corrosion. If 1762811 POWERPART Lay-Up 2 is not available, use a preservative of the correct specification instead of the lubricating oil. If a preservative is used, this must be drained completely at the end of the storage period and the oil pan must be refilled to the correct level with normal lubricating oil.

Cooling System

To help prevent excessive engine wear, use the following guidelines:

NOTICE
Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.

If freezing temperatures are expected, check the cooling system for adequate protection against freezing. See this Operation and Maintenance Manual, “General Coolant Information” (Maintenance Section).

NOTICE
To prevent frost damage, ensure that all the coolant is removed from the engine. This is important if the system is drained after it has been flushed with water, or if an antifreeze solution too weak to protect the system from frost has been used.

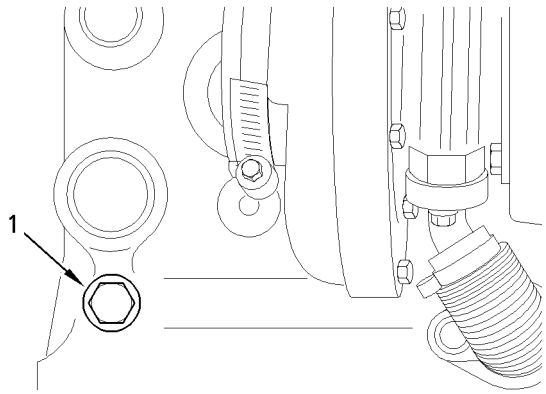


Illustration 23 g01003928

1. Ensure that the vehicle is on level ground.
2. Remove the filler cap of the cooling system.
3. Remove the drain plug (1) from the side of the cylinder block in order to drain the engine. Ensure that the drain hole is not restricted.
4. Open the tap or remove the drain plug at the bottom of the radiator in order to drain the radiator. If the radiator does not have a tap or a drain plug, disconnect the hose at the bottom of the radiator.
5. Flush the cooling system with clean water.
6. Fit the drain plugs and the filler cap. Close the tap or connect the radiator hose.
7. Fill the cooling system with an approved antifreeze mixture because this gives protection against corrosion. The maximum flow rate is 1 L (0.2200 Imp gal) per minute in order to fill the system.

Note: Certain corrosion inhibitors could cause damage to some engine components. Contact the Service Department of Perkins for advice.

8. Operate the engine for a short period in order to circulate the lubricating oil and the coolant in the engine.
9. Disconnect the battery. Put the battery into safe storage in a fully charged condition. Before the battery is put into storage, protect the terminals against corrosion.1734115 POWERPART Lay-Up 3 can be used on the terminals.
10. Clean the crankcase breather if one is installed. Seal the end of the pipe.
11. Remove the fuel injector nozzles and spray 1762811 POWERPART Lay-Up 2 for one or two seconds into each cylinder bore with the piston at BDC.
12. Slowly rotate the crankshaft for one complete revolution and then replace the fuel injector nozzles.

Induction System

- Remove the air filter assembly. If necessary, remove the pipes that are installed between the air filter assembly and the turbocharger. Spray 1762811 POWERPART Lay-Up 2 into the turbocharger. The duration of the spray is printed on the container. Seal the turbocharger with waterproof tape.

Exhaust System

- Remove the exhaust pipe. Spray 1762811 POWERPART Lay-Up 2 into the turbocharger. The duration of the spray is printed on the container. Seal the turbocharger with waterproof tape.

General Items

- If the lubricating oil filler is installed on the rocker cover, remove the filler cap. If the lubricating oil filler cap is not installed on the rocker cover, remove the rocker cover. Spray 1762811 POWERPART Lay-Up 2 around the rocker shaft assembly. Replace the filler cap or the rocker cover.
- Seal the vent of the fuel tank or the fuel filler cap with waterproof tape.
- Remove the alternator drive belts and put the drive belts into storage.
- In order to prevent corrosion, spray the engine with 1734115 POWERPART Lay-Up 3. Do not spray the area inside the alternator.

When the engine protection has been completed in accordance with these instructions, this ensures that no corrosion will occur. Perkins are not responsible for damage which may occur when an engine is in storage after a period in service.

Your Perkins dealer or your Perkins distributor can assist in preparing the engine for extended storage periods.

Gauges and Indicators

i02164190

Gauges and Indicators

Your engine may not have the same gauges or all of the gauges that are described. For more information about the gauge package, see the OEM information.

Gauges provide indications of engine performance. Ensure that the gauges are in good working order. Determine the normal operating range by observing the gauges over a period of time.

Noticeable changes in gauge readings indicate potential gauge or engine problems. Problems may also be indicated by gauge readings that change even if the readings are within specifications. Determine and correct the cause of any significant change in the readings. Consult your Perkins dealer or your Perkins distributor for assistance.

NOTICE
If no oil pressure is indicated, STOP the engine. If maximum coolant temperature is exceeded, STOP the engine. Engine damage can result.

Engine Oil Pressure – The oil pressure should be greatest after a cold engine is started. The typical engine oil pressure with SAE10W30 is 207 to 413 kPa (30 to 60 psi) at rated rpm.

A lower oil pressure is normal at low idle. If the load is stable and the gauge reading changes, perform the following procedure:

1. Remove the load.
2. Reduce engine speed to low idle.
3. Check and maintain the oil level.

Jacket Water Coolant Temperature – Typical temperature range is 71 to 96°C (160 to 205°F). The maximum allowable temperature with the pressurized cooling system at 48 kPa (7 psi) is 110°C (230°F). Higher temperatures may occur under certain conditions. The water temperature reading may vary according to load. The reading should never exceed the boiling point for the pressurized system that is being used.

If the engine is operating above the normal range and steam becomes apparent, perform the following procedure:

1. Reduce the load and the engine rpm.
2. Inspect the cooling system for leaks.
3. Determine if the engine must be shut down immediately or if the engine can be cooled by reducing the load.

Tachometer – This gauge indicates engine speed (rpm). When the throttle control lever is moved to the full throttle position without load, the engine is running at high idle. The engine is running at the full load rpm when the throttle control lever is at the full throttle position with maximum rated load.

NOTICE
To help prevent engine damage, never exceed the high idle rpm. Overspeeding can result in serious damage to the engine. The engine can be operated at high idle without damage, but should never be allowed to exceed high idle rpm.

Ammeter – This gauge indicates the amount of charge or discharge in the battery charging circuit. Operation of the indicator should be to the right side of “0” (zero).

Fuel Level – This gauge indicates the fuel level in the fuel tank. The fuel level gauge operates when the “START/STOP” switch is in the “ON” position.

Service Hour Meter – The gauge indicates operating time of the engine.

Engine Starting

i02194223

Before Starting Engine

Before the engine is started, perform the required daily maintenance and any other periodic maintenance that is due. Refer to the Operation and Maintenance Manual, “Maintenance Interval Schedule” for more information.

- For the maximum service life of the engine, make a thorough inspection within the engine compartment before the engine is started. Look for the following items: oil leaks, coolant leaks, loose bolts, and excessive dirt and/or grease. Remove any excess dirt and/or grease buildup. Repair any faults that were identified during the inspection.
- Inspect the cooling system hoses for cracks and for loose clamps.
- Inspect the alternator and accessory drive belts for cracks, breaks, and other damage.
- Inspect the wiring for loose connections and for worn wires or frayed wires.
- Check the fuel supply. Drain water from the water separator (if equipped). Open the fuel supply valve (if equipped).

NOTICE
All valves in the fuel return line must be open before and during engine operation to help prevent high fuel pressure. High fuel pressure may cause filter housing failure or other damage.

If the engine has not been started for several weeks, fuel may have drained from the fuel system. Air may have entered the filter housing. Also, when fuel filters have been changed, some air pockets will be trapped in the engine. In these instances, prime the fuel system. Refer to the Operation and Maintenance Manual, “Fuel System - Prime” for more information on priming the fuel system.

⚠ WARNING

Engine exhaust contains products of combustion which may be harmful to your health. Always start and operate the engine in a well ventilated area and, if in an enclosed area, vent the exhaust to the outside.

- Do not start the engine or move any of the controls if there is a “DO NOT OPERATE” warning tag or similar warning tag attached to the start switch or to the controls.
- Ensure that the areas around the rotating parts are clear.
- All of the guards must be put in place. Check for damaged guards or for missing guards. Repair any damaged guards. Replace damaged guards and/or missing guards.
- Disconnect any battery chargers that are not protected against the high current drain that is created when the electric starting motor is engaged. Check electrical cables and check the battery for poor connections and for corrosion.
- Reset all of the shutoffs or alarm components (if equipped).
- Check the engine lubrication oil level. Maintain the oil level between the “ADD” mark and the “FULL” mark on the engine oil level gauge.
- Check the coolant level. Observe the coolant level in the header tank (if equipped). Maintain the coolant level to the “FULL” mark on the header tank.
- If the engine is not equipped with a header tank maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe. If the engine is equipped with a sight glass, maintain the coolant level in the sight glass.
- Observe the air cleaner service indicator (if equipped). Service the air cleaner when the yellow diaphragm enters the red zone, or when the red piston locks in the visible position.
- Ensure that any equipment that is driven by the engine has been disengaged from the engine. Minimize electrical loads or remove any electrical loads.

i02198348

Starting the Engine

WARNING

Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

Refer to the OMM for your type of controls. Use the following procedure to start the engine.

1. If equipped, move the throttle lever to the full throttle position before you start the engine.

NOTICE
Do not crank the engine for more than 30 seconds. Allow the electric starting motor to cool for two minutes before cranking the engine again.

2. Turn the engine start switch to the START position. Hold the engine start switch in the START position and crank the engine.
3. When the engine starts, release the engine start switch.
4. If equipped, slowly move the throttle lever to the low idle position and allow the engine to idle. Refer to the Operation and Maintenance Manual, “After Starting Engine” topic.
5. If the engine does not start, release the engine start switch and allow the electric starting motor to cool. Then, repeat steps 2 through step 4.
6. Turn the engine start switch to the OFF position in order to stop the engine.

i02198092

Cold Weather Starting

WARNING

Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

Startability will be improved at temperatures below −18 °C (0 °F) from the use of a jacket water heater or extra battery capacity.

When Group 2 diesel fuel is used, the following items provide a means of minimizing starting problems and fuel problems in cold weather: engine oil pan heaters, jacket water heaters, fuel heaters, and fuel line insulation.

Use the procedure that follows for cold weather starting.

1. If equipped, move the throttle lever to the full throttle position before you start the engine.
2. If equipped, turn the engine start switch to the HEAT position. Hold the engine start switch in the HEAT position for 6 seconds until the glow plug indicator light illuminates. This will activate the glow plugs and aid in the starting of the engine.

NOTICE
Do not crank the engine for more than 30 seconds. Allow the electric starting motor to cool for two minutes before cranking the engine again.

3. While the glow plug indicator light is illuminated, turn the engine start switch to the START position and crank the engine.

Note: If the glow plug indicator light illuminates rapidly for 2 to 3 seconds, or if the glow plug indicator light fails to illuminate, a malfunction exists in the cold start system. Do not use ether or other starting fluids to start the engine.

4. When the engine starts, release the engine start switch key.
5. If the engine does not start, release the engine start switch and allow the starter motor to cool. Then, repeat steps 2 through step 4.
6. If the engine is equipped with a throttle allow the engine to idle for three to five minutes, or allow the engine to idle until the water temperature indicator begins to rise. The engine should run at low idle smoothly until speed is gradually increased to high idle. Allow the white smoke to disperse before proceeding with normal operation.
7. Operate the engine at low load until all systems reach operating temperature. Check the gauges during the warm-up period.
8. Turn the engine start switch to the OFF position in order to stop the engine.

i02177935

Starting with Jump Start Cables

⚠ WARNING

Improper jump start cable connections can cause an explosion resulting in personal injury.

Prevent sparks near the batteries. Sparks could cause vapors to explode. Do not allow jump start cable ends to contact each other or the engine.

Note: If it is possible, first diagnose the reason for the starting failure. Make any necessary repairs. If the engine will not start only due to the condition of the battery, either charge the battery, or start the engine with jump start cables. The condition of the battery can be rechecked after the engine has been switched OFF.

NOTICE

Using a battery source with the same voltage as the electric starting motor. Use ONLY equal voltage for jump starting. The use of higher voltage will damage the electrical system.

Do not reverse the battery cables. The alternator can be damaged. Attach ground cable last and remove first.

When using an external electrical source to start the engine, turn the generator set control switch to the “OFF” position. Turn all electrical accessories OFF before attaching the jump start cables.

Ensure that the main power switch is in the OFF position before attaching the jump start cables to the engine being started.

1. Turn the start switch to the OFF position. Turn off all the engine’s accessories.
2. Connect one positive end of the jump start cable to the positive cable terminal of the discharged battery. Connect the other positive end of the jump start cable to the positive cable terminal of the electrical source.
3. Connect one negative end of the jump start cable to the negative cable terminal of the electrical source. Connect the other negative end of the jump start cable to the engine block or to the chassis ground. This procedure helps to prevent potential sparks from igniting the combustible gases that are produced by some batteries.
4. Start the engine.
5. Immediately after the stalled engine is started, disconnect the jump start cables in reverse order.

After jump starting, the alternator may not be able to fully recharge batteries that are severely discharged. The batteries must be replaced or charged to the correct voltage with a battery charger after the engine is stopped. Many batteries which are considered unusable are still rechargeable. Refer to Operation and Maintenance Manual, “Battery - Replace” and Testing and Adjusting Manual, “Battery - Test”.

i01903609

After Starting Engine

Note: In temperatures from 0 to 60°C (32 to 140°F), the warm-up time is approximately three minutes. In temperatures below 0°C (32°F), additional warm-up time may be required.

When the engine idles during warm-up, observe the following conditions:

- Check for any fluid or for any air leaks at idle rpm and at one-half full rpm (no load on the engine) before operating the engine under load. This is not possible in some applications.
- Operate the engine at low idle until all systems achieve operating temperatures. Check all gauges during the warm-up period.

Note: Gauge readings should be observed and the data should be recorded frequently while the engine is operating. Comparing the data over time will help to determine normal readings for each gauge. Comparing data over time will also help detect abnormal operating developments. Significant changes in the readings should be investigated.

Engine Operation

i02176671

Engine Operation

Correct operation and maintenance are key factors in obtaining the maximum life and economy of the engine. If the directions in the Operation and Maintenance Manual are followed, costs can be minimized and engine service life can be maximized.

The engine can be operated at the rated rpm after the engine reaches operating temperature. The engine will reach normal operating temperature sooner during a low engine speed (rpm) and during a low power demand. This procedure is more effective than idling the engine at no load. The engine should reach operating temperature in a few minutes.

Gauge readings should be observed and the data should be recorded frequently while the engine is operating. Comparing the data over time will help to determine normal readings for each gauge. Comparing data over time will also help detect abnormal operating developments. Significant changes in the readings should be investigated.

i01929404

Engine Warm-up

1. Run the engine at low idle for three to five minutes, or run the engine at low idle until the jacket water temperature starts to rise.

   More time may be necessary when the temperature is below −18°C (0°F).

2. Check all of the gauges during the warm-up period.

3. Perform a walk-around inspection. Check the engine for fluid leaks and air leaks.

4. Increase the rpm to the rated rpm. Check for fluid leaks and air leaks. The engine may be operated at full rated rpm and at full load when the temperature of the water jacket reaches 60°C (140°F).

i02330149

Fuel Conservation Practices

The efficiency of the engine can affect the fuel economy. Perkins design and technology in manufacturing provides maximum fuel efficiency in all applications. Follow the recommended procedures in order to attain optimum performance for the life of the engine.

- Avoid spilling fuel.

Fuel expands when the fuel is warmed up. The fuel may overflow from the fuel tank. Inspect fuel lines for leaks. Repair the fuel lines, as needed.

- Be aware of the properties of the different fuels. Use only the recommended fuels.

- Avoid unnecessary idling.

Shut off the engine rather than idle for long periods of time.

- Observe the air cleaner service indicator frequently. Keep the air cleaner elements clean.

- Maintain the electrical systems.

One damaged battery cell will overwork the alternator. This will consume excess power and excess fuel.

- Ensure that the drive belts are correctly adjusted. The drive belts should be in good condition.

- Ensure that all of the connections of the hoses are tight. The connections should not leak.

- Ensure that the driven equipment is in good working order.

- Cold engines consume excess fuel. Utilize heat from the jacket water system and the exhaust system, when possible. Keep cooling system components clean and keep cooling system components in good repair. Never operate the engine without water temperature regulators. All of these items will help maintain operating temperatures.

Engine Stopping

i01929389

Stopping the Engine

NOTICE
Stopping the engine immediately after it has been working under load can result in overheating and accelerated wear of the engine components.

If the engine has been operating at high rpm and/or high loads, run at low idle for at least three minutes to reduce and stabilize internal engine temperature before stopping the engine.

Avoiding hot engine shutdowns will maximize turbocharger shaft and bearing life.

Prior to stopping an engine that is being operated at low loads, operate the engine at low idle for 30 seconds before stopping. If the engine has been operating at highway speeds and/or at high loads, operate the engine at low idle for at least three minutes. This procedure will cause the internal engine temperature to be reduced and stabilized.

Ensure that the engine stopping procedure is understood. Stop the engine according to the shutoff system on the engine or refer to the instructions that are provided by the OEM.

- To stop the engine, turn the ignition key switch to the OFF position.

i01903586

Emergency Stopping

NOTICE
Emergency shutoff controls are for EMERGENCY use ONLY. DO NOT use emergency shutoff devices or controls for normal stopping procedure.

The OEM may have equipped the application with an emergency stop button. For more information about the emergency stop button, refer to the OEM information.

Ensure that any components for the external system that support the engine operation are secured after the engine is stopped.

i01903608

After Stopping Engine

Note: Before you check the engine oil, do not operate the engine for at least 10 minutes in order to allow the engine oil to return to the oil pan.

- Check the crankcase oil level. Maintain the oil level between the “ADD” mark and the “FULL” mark on the oil level dipstick.
- If necessary, perform minor adjustments. Repair any leaks and tighten any loose bolts.
- Note the required service interval. Perform the maintenance that is in the Operation and Maintenance Manual, “Maintenance Interval Schedule”.
- Fill the fuel tank in order to help prevent accumulation of moisture in the fuel. Do not overfill the fuel tank.

NOTICE
Only use antifreeze/coolant mixtures recommended in the Coolant Specifications that are in the Operation and Maintenance Manual. Failure to do so can cause engine damage.

- Allow the engine to cool. Check the coolant level.
- If freezing temperatures are expected, check the coolant for the correct antifreeze protection. The cooling system must be protected against freezing to the lowest expected outside temperature. Add the correct coolant/water mixture, if necessary.
- Perform all required periodic maintenance on all driven equipment. This maintenance is outlined in the instructions from the OEM.

Cold Weather Operation

i02717265

Cold Weather Operation

Perkins Diesel Engines can operate effectively in cold weather. During cold weather, the starting and the operation of the diesel engine is dependent on the following items:

- The type of fuel that is used
- The viscosity of the engine oil
- The operation of the glow plugs
- Optional Cold starting aid
- Battery condition

This section will cover the following information:

- Potential problems that are caused by cold weather operation
- Suggest steps which can be taken in order to minimize starting problems and operating problems when the ambient air temperature is between 0° to−40 °C (32° to 40 °F).

The operation and maintenance of an engine in freezing temperatures is complex . This is because of the following conditions:

- Weather conditions
- Engine applications

Recommendations from your Perkins dealer or your Perkins distributor are based on past proven practices. The information that is contained in this section provides guidelines for cold weather operation.

Hints for Cold Weather Operation

- If the engine will start, operate the engine until a minimum operating temperature of 81 °C (177.8 °F) is achieved. Achieving operating temperature will help prevent the intake valves and exhaust valves from sticking.
- The cooling system and the lubrication system for the engine do not lose heat immediately upon shutdown. This means that an engine can be shut down for a period of time and the engine can still have the ability to start readily.
- Install the correct specification of engine lubricant before the beginning of cold weather.
- Check all rubber parts (hoses, fan drive belts, etc) weekly.
- Check all electrical wiring and connections for any fraying or damaged insulation.
- Keep all batteries fully charged and warm.
- Fill the fuel tank at the end of each shift.
- Check the air cleaners and the air intake daily. Check the air intake more often when you operate in snow.
- Ensure that the glow plugs are in working order. Refer to Testing and Adjusting Manual, “Glow Plug - Test”.

WARNING

Personal injury or property damage can result from alcohol or starting fluids.

Alcohol or starting fluids are highly flammable and toxic and if improperly stored could result in injury or property damage.

WARNING

Do not use aerosol types of starting aids such as ether. Such use could result in an explosion and personal injury.

- For jump starting with cables in cold weather, refer to the Operation and Maintenance Manual, “Starting with Jump Start Cables.” for instructions.

Viscosity of the Engine Lubrication Oil

Correct engine oil viscosity is essential. Oil viscosity affects the amount of torque that is needed to crank the engine. Refer to this Operation and Maintenance Manual, “Fluid Recommendations” for the recommended viscosity of oil.

Recommendations for the Coolant

Provide cooling system protection for the lowest expected outside temperature. Refer to this Operation and Maintenance Manual, “Fluid Recommendations” for the recommended coolant mixture.

In cold weather, check the coolant often for the correct glycol concentration in order to ensure adequate freeze protection.

Engine Block Heaters

Engine block heaters (if equipped) heat the engine jacket water that surrounds the combustion chambers. This provides the following functions:

- Startability is improved.
- Warm up time is reduced.

An electric block heater can be activated once the engine is stopped. An effective block heater is typically a 1250/1500 W unit. Consult your Perkins dealer or your Perkins distributor for more information.

Idling the Engine

When idling after the engine is started in cold weather, increase the engine rpm from 1000 to 1200 rpm. This will warm up the engine more quickly. Maintaining an elevated low idle speed for extended periods will be easier with the installation of a hand throttle. The engine should not be “raced” in order to speed up the warm up process.

While the engine is idling, the application of a light load (parasitic load) will assist in achieving the minimum operating temperature. The minimum operating temperature is 82 °C (179.6 °F).

Recommendations for Coolant Warm Up

Warm up an engine that has cooled below normal operating temperatures due to inactivity. This should be performed before the engine is returned to full operation. During operation in very cold temperature conditions, damage to engine valve mechanisms can result from engine operation for short intervals. This can happen if the engine is started and the engine is stopped many times without being operated in order to warm up completely.

When the engine is operated below normal operating temperatures, fuel and oil are not completely burned in the combustion chamber. This fuel and oil causes soft carbon deposits to form on the valve stems. Generally, the deposits do not cause problems and the deposits are burned off during operation at normal engine operating temperatures.

When the engine is started and the engine is stopped many times without being operated in order to warm up completely, the carbon deposits become thicker. This can cause the following problems:

- Free operation of the valves is prevented.
- Valves become stuck.
- Pushrods may become bent.
- Other damage to valve train components can result.

For this reason, when the engine is started, the engine must be operated until the coolant temperature is 71 °C (160 °F) minimum. Carbon deposits on the valve stems will be kept at a minimum and the free operation of the valves and the valve components will be maintained.

In addition, the engine must be thoroughly warmed in order to keep other engine parts in better condition and the service life of the engine will be generally extended. Lubrication will be improved. There will be less acid and less sludge in the oil. This will provide longer service life for the engine bearings, the piston rings, and other parts. However, limit unnecessary idle time to ten minutes in order to reduce wear and unnecessary fuel consumption.

The Water Temperature Regulator and Insulated Heater Lines

The engine is equipped with a water temperature regulator. When the engine coolant is below the correct operating temperature jacket water circulates through the engine cylinder block and into the engine cylinder head. The coolant then returns to the cylinder block via an internal passage that bypasses the valve of the coolant temperature regulator. This ensures that coolant flows around the engine under cold operating conditions. The water temperature regulator begins to open when the engine jacket water has reached the correct minimum operating temperature. As the jacket water coolant temperature rises above the minimum operating temperature the water temperature regulator opens further allowing more coolant through the radiator to dissipate excess heat.

The progressive opening of the water temperature regulator operates the progressive closing of the bypass passage between the cylinder block and head. This ensures maximum coolant flow to the radiator in order to achieve maximum heat dissipation.

Note: Perkins discourages the use of all air flow restriction devices such as radiator shutters. Restriction of the air flow can result in the following: high exhaust temperatures, power loss, excessive fan usage, and reduction in fuel economy.

A cab heater is beneficial in very cold weather. The feed from the engine and the return lines from the cab should be insulated in order to reduce heat loss to the outside air.

Insulating the Air Inlet and Engine Compartment

When temperatures below −18 °C (−0 °F) will be frequently encountered, an air cleaner inlet that is located in the engine compartment may be specified. An air cleaner that is located in the engine compartment may also minimize the entry of snow into the air cleaner. Also, heat that is rejected by the engine helps to warm the intake air.

Additional heat can be retained around the engine by insulating the engine compartment.

i02322217

Fuel and the Effect from Cold Weather

Note: Only use grades of fuel that are recommended by Perkins. Refer to this Operation and Maintenance Manual, “Fluid Recommendations”.

The following fuels can be used in this series of engine.

- Group 1
- Group 2
- Group 3
- Special Fuels

Perkins prefer only Group 1 and Group 2 fuels for use in this series of engines.

Group 1 fuels are the preferred Group of Fuels for general use by Perkins. Group 1 fuels maximize engine life and engine performance. Group 1 fuels are usually less available than Group 2 fuels. Frequently, Group 1 fuels are not available in colder climates during the winter.

Note: Group 2 fuels must have a maximum wear scar of 650 micrometers (HFRR to ISO 12156-1).

Group 2 fuels are considered acceptable for issues of warranty. This group of fuels may reduce the life of the engine, the engine’s maximum power, and the engine’s fuel efficiency.

When Group 2 diesel fuels are used the following components provide a means of minimizing problems in cold weather:

- Glow plugs (if equipped)
- Engine coolant heaters, which may be an OEM option
- Fuel heaters, which may be an OEM option
- Fuel line insulation, which may be an OEM option

There are three major differences between Group 1 fuels and Group 2 fuels. Group 1 fuels have the following different characteristics to Group 2 fuels.

- A lower cloud point
- A lower pour point
- A higher energy per unit volume of fuel

Note: Group 3 fuels reduce the life of the engine. The use of Group 3 fuels is not covered by the Perkins warranty.

Group 3 fuels include Low Temperature Fuels and Aviation Kerosene Fuels.

Special fuels include Biofuel.

The cloud point is a temperature that allows wax crystals to form in the fuel. These crystals can cause the fuel filters to plug.

The pour point is the temperature when diesel fuel will thicken. The diesel fuel becomes more resistant to flow through fuel lines, fuel filters,and fuel pumps.

Be aware of these facts when diesel fuel is purchased. Consider the average ambient air temperature for the engine’s application. Engines that are fueled in one climate may not operate well if the engines are moved to another climate. Problems can result due to changes in temperature.

Before troubleshooting for low power or for poor performance in the winter, check the fuel for waxing.

Low temperature fuels may be available for engine operation at temperatures below 0 °C (32 °F). These fuels limit the formation of wax in the fuel at low temperatures.

For more information on cold weather operation, refer to the Operation and Maintenance Manual, “Cold Weather Operation and Fuel Related Components in Cold Weather”.

i01903588

Fuel Related Components in Cold Weather

Fuel Tanks

Condensation can form in partially filled fuel tanks. Top off the fuel tanks after you operate the engine.

Fuel tanks should contain some provision for draining water and sediment from the bottom of the tanks. Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe.

Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

Drain the water and sediment from any fuel storage tank at the following intervals: weekly, oil changes, and refueling of the fuel tank. This will help prevent water and/or sediment from being pumped from the fuel storage tank and into the engine fuel tank.

Fuel Filters

It is possible that a primary fuel filter is installed between the fuel tank and the engine fuel inlet. After you change the fuel filter, always prime the fuel system in order to remove air bubbles from the fuel system. Refer to the Operation and Maintenance Manual in the Maintenance Section for more information on priming the fuel system.

The micron rating and the location of a primary fuel filter is important in cold weather operation. The primary fuel filter and the fuel supply line are the most common components that are affected by cold fuel.

Fuel Heaters

Note: The OEM may equip the application with fuel heaters. If this is the case, disconnect an electric type of fuel heater in warm weather in order to prevent overheating of the fuel. If the type of fuel heater is a heat exchanger, the OEM should have included a bypass for warm weather. Ensure that the bypass is operational during warm weather in order to prevent overheating of the fuel.

For more information about fuel heaters (if equipped), refer to the OEM information.

Maintenance Section

Refill Capacities

i02198350

Refill Capacities

Lubrication System

The refill capacities for the engine crankcase reflect the approximate capacity of the crankcase or sump plus standard oil filters. Auxiliary oil filter systems will require additional oil. Refer to the OEM specifications for the capacity of the auxiliary oil filter. Refer to the Operation and Maintenance Manual, “Maintenance Section” for more information on Lubricant Specifications.

1104 Engine

Table 5

1104 Engine		
Compartment or System	**Liters**	**Quarts**
Standard Oil Sump for the Engine Crankcase (1)	6.5	7

(1) These values are the approximate capacities for the crankcase oil sump which include the standard factory installed oil filters. Engines with auxiliary oil filters will require additional oil. Refer to the OEM specifications for the capacity of the auxiliary oil filter.

1103 Engine

Table 6

1103 Engine		
Compartment or System	**Liters**	**Quarts**
Standard Oil Sump for the Engine Crankcase (1)	6.5	7

(1) These values are the approximate capacities for the crankcase oil sump which include the standard factory installed oil filters. Engines with auxiliary oil filters will require additional oil. Refer to the OEM specifications for the capacity of the auxiliary oil filter.

Cooling System

To maintain the cooling system, the Total Cooling System capacity must be known. The approximate capacity for the engine cooling system is listed below. External System capacities will vary among applications. Refer to the OEM specifications for the External System capacity. This capacity information will be needed in order to determine the amount of coolant/antifreeze that is required for the Total Cooling System.

1104 Engine

Table 7

1104 Naturally Aspirated Engine		
Compartment or System	**Liters**	**Quarts**
Engine Only	10.4	11
External cooling system capacity (OEM recommendation) (1)		
Total Cooling System (2)		

(1) The external cooling system includes a radiator or an expansion tank with the following components: heat exchanger, aftercooler, and piping. Refer to the OEM specifications. Enter the value for the external system capacity in this row.

(2) The Total Cooling System includes the capacity for the engine cooling system plus the capacity for the external cooling system. Enter the total in this row.

Table 8

1104 Turbocharged Engine		
Compartment or System	**Liters**	**Quarts**
Engine Only	11.4	12
External cooling System capacity (OEM recommendation) (1)		
Total Cooling System (2)		

(1) The external cooling system includes a radiator or an expansion tank with the following components: heat exchanger, aftercooler, and piping. Refer to the OEM specifications. Enter the value for the external cooling system capacity in this row.

(2) The Total Cooling System includes the capacity for the engine cooling system plus the capacity for the external cooling system. Enter the total in this row.

1103 Engine

Table 9

1103 Naturally Aspirated Engine without an oil cooler		
Compartment or System	**Liters**	**Quarts**
Engine Only	4.21	4
External cooling system capacity (OEM recommendation) (1)		
Total Cooling System (2)		

(1) The external cooling system includes a radiator or an expansion tank with the following components: heat exchanger, aftercooler, and piping. Refer to the OEM specifications. Enter the value for the external system capacity in this row.

(2) The Total Cooling System includes the capacity for the engine cooling system plus the capacity for the external cooling system. Enter the total in this row.

Table 10

1103 Naturally Aspirated Engines and Turbocharged Engines with an oil cooler		
Compartment or System	**Liters**	**Quarts**
Engine Only	4.43	4.02
External cooling system capacity (OEM recommendation) (1)		
Total Cooling System (2)		

(1) The external cooling system includes a radiator or an expansion tank with the following components: heat exchanger, aftercooler, and piping. Refer to the OEM specifications. Enter the value for the external system capacity in this row.

(2) The Total Cooling System includes the capacity for the engine cooling system plus the capacity for the external cooling system. Enter the total in this row.

i02280119

Fluid Recommendations

General Lubricant Information

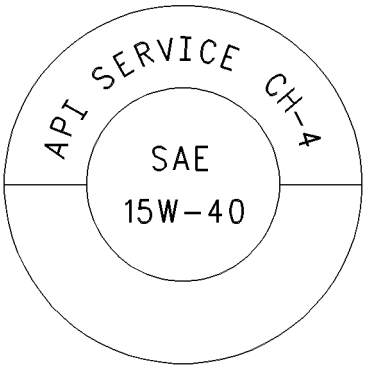
Because of government regulations regarding the certification of exhaust emissions from the engine, the lubricant recommendations must be followed.

Engine Manufacturers Association (EMA) Oils

The “Engine Manufacturers Association Recommended Guideline on Diesel Engine Oil” is recognized by Perkins. For detailed information about this guideline, see the latest edition of EMA publication, “EMA DHD -1”.

API Oils

The Engine Oil Licensing and Certification System by the American Petroleum Institute (API) is recognized by Perkins. For detailed information about this system, see the latest edition of the “API publication No. 1509”. Engine oils that bear the API symbol are authorized by API.



g00546535

Illustration 24

Typical API symbol

Diesel engine oils CC, CD, CD-2, and CE have not been API authorized classifications since 1 January 1996. Table 11 summarizes the status of the classifications.

Table 11

API Classifications	
Current	**Obsolete**
CF-4, CG-4, CH-4	CE
CF	CC, CD
CF-2(1)	CD-2(1)

(1) The classifications CD-2 and American Petroleum Institute CF-2 are for two-cycle diesel engines. Perkins does not sell engines that utilize CD-2 and API CF-2 oils.

Terminology

Certain abbreviations follow the nomenclature of “SAE J754”. Some classifications follow “SAE J183” abbreviations, and some classifications follow the “EMA Recommended Guideline on Diesel Engine Oil”. In addition to Perkins definitions, there are other definitions that will be of assistance in purchasing lubricants. Recommended oil viscosities can be found in this publication, “Fluid Recommendations/Engine Oil” topic (Maintenance Section).

Engine Oil

Commercial Oils

The performance of commercial diesel engine oils is based on American Petroleum Institute (API) classifications. These API classifications are developed in order to provide commercial lubricants for a broad range of diesel engines that operate at various conditions.

Only use commercial oils that meet the following classifications:

- EMA DHD-1 multigrade oil (preferred oil)
- API CH-4 multigrade oil (preferred oil)
- ACEAE3

In order to make the correct choice of a commercial oil, refer to the following explanations:

EMA DHD-1 – The Engine Manufacturers Association (EMA) has developed lubricant recommendations as an alternative to the API oil classification system. DHD-1 is a Recommended Guideline that defines a level of oil performance for these types of diesel engines: high speed, four stroke cycle, heavy-duty, and light duty. DHD-1 oils may be used in Perkins engines when the following oils are recommended: API CH-4, API CG-4, and API CF-4. DHD-1 oils are intended to provide superior performance in comparison to API CG-4 and API CF-4.

DHD-1 oils will meet the needs of high performance Perkins diesel engines that are operating in many applications. The tests and the test limits that are used to define DHD-1 are similar to the new API CH-4 classification. Therefore, these oils will also meet the requirements for diesel engines that require low emissions. DHD-1 oils are designed to control the harmful effects of soot with improved wear resistance and improved resistance to plugging of the oil filter. These oils will also provide superior piston deposit control for engines with either two-piece steel pistons or aluminum pistons.

All DHD-1 oils must complete a full test program with the base stock and with the viscosity grade of the finished commercial oil. The use of “API Base Oil Interchange Guidelines” are not appropriate for DHD-1 oils. This feature reduces the variation in performance that can occur when base stocks are changed in commercial oil formulations.

DHD-1 oils are recommended for use in extended oil change interval programs that optimize the life of the oil. These oil change interval programs are based on oil analysis. DHD-1 oils are recommended for conditions that demand a premium oil. Your Perkins dealer or your Perkins distributor has the specific guidelines for optimizing oil change intervals.

API CH-4 – API CH-4 oils were developed in order to meet the requirements of the new high performance diesel engines. Also, the oil was designed to meet the requirements of the low emissions diesel engines. API CH-4 oils are also acceptable for use in older diesel engines and in diesel engines that use high sulfur diesel fuel. API CH-4 oils may be used in Perkins engines that use API CG-4 and API CF-4 oils. API CH-4 oils will generally exceed the performance of API CG-4 oils in the following criteria: deposits on pistons, control of oil consumption, wear of piston rings, valve train wear, viscosity control, and corrosion.

Three new engine tests were developed for the API CH-4 oil. The first test specifically evaluates deposits on pistons for engines with the two-piece steel piston. This test (piston deposit) also measures the control of oil consumption. A second test is conducted with moderate oil soot. The second test measures the following criteria: wear of piston rings, wear of cylinder liners, and resistance to corrosion. A third new test measures the following characteristics with high levels of soot in the oil: wear of the valve train, resistance of the oil in plugging the oil filter, and control of sludge.

In addition to the new tests, API CH-4 oils have tougher limits for viscosity control in applications that generate high soot. The oils also have improved oxidation resistance. API CH-4 oils must pass an additional test (piston deposit) for engines that use aluminum pistons (single piece). Oil performance is also established for engines that operate in areas with high sulfur diesel fuel.

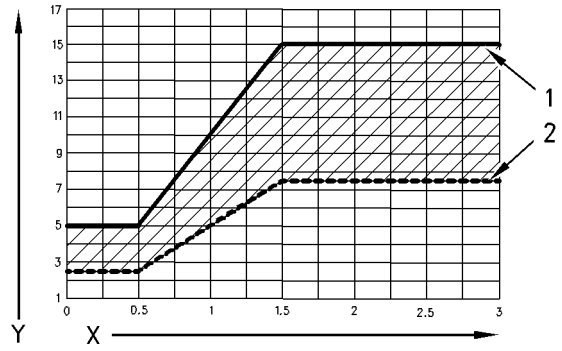
All of these improvements allow the API CH-4 oil to achieve optimum oil change intervals. API CH-4 oils are recommended for use in extended oil change intervals. API CH-4 oils are recommended for conditions that demand a premium oil. Your Perkins dealer or your Perkins distributor has specific guidelines for optimizing oil change intervals.

Some commercial oils that meet the API classifications may require reduced oil change intervals. To determine the oil change interval, closely monitor the condition of the oil and perform a wear metal analysis.

NOTICE
Failure to follow these oil recommendations can cause shortened engine service life due to deposits and/or excessive wear.

Total Base Number (TBN) and Fuel Sulfur Levels for Direct Injection (DI) Diesel Engines

The Total Base Number (TBN) for an oil depends on the fuel sulfur level. For direct injection engines that use distillate fuel, the minimum TBN of the new oil must be 10 times the fuel sulfur level. The TBN is defined by “ASTM D2896”. The minimum TBN of the oil is 5 regardless of fuel sulfur level. Illustration 25 demonstrates the TBN.



g00799818

Illustration 25

(Y) TBN by “ASTM D2896”
(X) Percentage of fuel sulfur by weight
(1) TBN of new oil
(2) Change the oil when the TBN deteriorates to 50 percent of the original TBN.

Use the following guidelines for fuel sulfur levels that exceed 1.5 percent:

- Choose an oil with the highest TBN that meets one of these classifications: EMA DHD-1 and API CH-4.
- Reduce the oil change interval. Base the oil change interval on the oil analysis. Ensure that the oil analysis includes the condition of the oil and a wear metal analysis.

Excessive piston deposits can be produced by an oil with a high TBN. These deposits can lead to a loss of control of the oil consumption and to the polishing of the cylinder bore.

NOTICE
Operating Direct Injection (DI) diesel engines with fuel sulphur levels over 0.5 percent will require shortened oil change intervals in order to help maintain adequate wear protection.

Table 12

Percentage of Sulfur in the fuel	**Oil change interval**
Lower than 0.5	Normal
0.5 to 1.0	0.75 of normal
Greater than 1.0	0.50 of normal

Lubricant Viscosity Recommendations for Direct Injection (DI) Diesel Engines

The correct SAE viscosity grade of oil is determined by the minimum ambient temperature during cold engine start-up, and the maximum ambient temperature during engine operation.

Refer to Table 13 (minimum temperature) in order to determine the required oil viscosity for starting a cold engine.

Refer to Table 13 (maximum temperature) in order to select the oil viscosity for engine operation at the highest ambient temperature that is anticipated.

Generally, use the highest oil viscosity that is available to meet the requirement for the temperature at start-up.

Table 13

Engine Oil Viscosity		
EMA LRG-1 API CH-4 Viscosity Grade	**Ambient Temperature**	
	Minimum	**Maximum**
SAE 0W20	−40 °C (−40 °F)	10 °C (50 °F)
SAE 0W30	−40 °C (−40 °F)	30 °C (86 °F)
SAE 0W40	−40 °C (−40 °F)	40 °C (104 °F)
SAE 5W30	−30 °C (−22 °F)	30 °C (86 °F)
SAE 5W40	−30 °C (−22 °F)	40 °C (104 °F)
SAE 10W30	−20 °C (−4 °F)	40 °C (104 °F)
SAE 15W40	−10 °C (14 °F)	50 °C (122 °F)

Synthetic Base Stock Oil

Synthetic base oils are acceptable for use in these engines if these oils meet the performance requirements that are specified for the engine.

Synthetic base oils generally perform better than conventional oils in the following two areas:

- Synthetic base oils have improved flow at low temperatures especially in arctic conditions.
- Synthetic base oils have improved oxidation stability especially at high operating temperatures.

Some synthetic base oils have performance characteristics that enhance the service life of the oil. Perkins does not recommend the automatic extending of the oil change intervals for any type of oil.

Re-refined base stock oil

Re-refined base stock oil are acceptable for use in Perkins engines if these oils meet the performance requirements that are specified by Perkins.Re-refined base stock oil can be used exclusively in finished oil or in a combination with new base stock oil . The US military specifications and the specifications of other heavy equipment manufacturers also allow the use of re-refined base stock oil that meet the same criteria.

The process that is used to make re-refined base stock oil should adequately remove all wear metals that are in the used oil and all the additives that are in the used oil. The process that is used to make re-refined base stock oil generally involves the process of vacuum distillation and hydrotreating the used oil. Filtering is adequate for the production of high quality, re-refined base stock oil.

Lubricants for Cold Weather

When an engine is started and an engine is operated in ambient temperatures below −20 °C (−4 °F), use multigrade oils that are capable of flowing in low temperatures.

These oils have lubricant viscosity grades of SAE 0W or SAE 5W.

When an engine is started and operated in ambient temperatures below −30 °C (−22 °F), use a synthetic base stock multigrade oil with an 0W viscosity grade or with a 5W viscosity grade. Use an oil with a pour point that is lower than −50 °C (−58 °F).

The number of acceptable lubricants is limited in cold weather conditions. Perkins recommends the following lubricants for use in cold weather conditions:

First Choice – Use oil with an EMA DHD-1 Recommended Guideline. Use a CH-4 oil that has an API license. The oil should be either SAE 0W20, SAE 0W30, SAE 0W40, SAE 5W30, or SAE 5W40 lubricant viscosity grade.

Second Choice – Use an oil that has a CH-4 additive package. Although the oil has not been tested for the requirements of the API license, the oil must be either SAE 0W20, SAE 0W30, SAE 0W40, SAE 5W30, or SAE 5W40.

NOTICE
Shortened engine service life could result if second choice oils are used.

Aftermarket Oil Additives

Perkins does not recommend the use of aftermarket additives in oil. It is not necessary to use aftermarket additives in order to achieve the engine's maximum service life or rated performance. Fully formulated, finished oils consist of base oils and of commercial additive packages. These additive packages are blended into the base oils at precise percentages in order to help provide finished oils with performance characteristics that meet industry standards.

There are no industry standard tests that evaluate the performance or the compatibility of aftermarket additives in finished oil. Aftermarket additives may not be compatible with the finished oil's additive package, which could lower the performance of the finished oil. The aftermarket additive could fail to mix with the finished oil. This could produce sludge in the crankcase. Perkins discourages the use of aftermarket additives in finished oils.

To achieve the best performance from a Perkins engine, conform to the following guidelines:

- Select the correct oil, or a commercial oil that meets the "EMA Recommended Guideline on Diesel Engine Oil" or the recommended API classification.
- See the appropriate "Lubricant Viscosities" table in order to find the correct oil viscosity grade for your engine.
- At the specified interval, service the engine. Use new oil and install a new oil filter.
- Perform maintenance at the intervals that are specified in the Operation and Maintenance Manual, "Maintenance Interval Schedule".

S·O·S Oil analysis

Some engines may be equipped with an oil sampling valve. If S·O·S oil analysis is required the oil sampling valve is used to obtain samples of the engine oil. The S·O·S oil analysis will complement the preventive maintenance program.

The S·O·S oil analysis is a diagnostic tool that is used to determine oil performance and component wear rates. Contamination can be identified and measured through the use of the S·O·S oil analysis. The S·O·S oil analysis includes the following tests:

- The Wear Rate Analysis monitors the wear of the engine's metals. The amount of wear metal and type of wear metal that is in the oil is analyzed. The increase in the rate of engine wear metal in the oil is as important as the quantity of engine wear metal in the oil.
- Tests are conducted in order to detect contamination of the oil by water, glycol or fuel.
- The Oil Condition Analysis determines the loss of the oil's lubricating properties. An infrared analysis is used to compare the properties of new oil to the properties of the used oil sample. This analysis allows technicians to determine the amount of deterioration of the oil during use. This analysis also allows technicians to verify the performance of the oil according to the specification during the entire oil change interval.

Fuel Specifications

Fuel Recommendations

To get the correct power and performance from the engine, use a fuel of the correct quality. The recommended fuel specification for Perkins engines is shown below:

- Cetane number_____45 minimum
- Viscosity_____2,0 to 4.5 cSt at 40 °C (104 °F)
- Density_____0.835 to 0.855 Kg/liter
- Sulfur_____0.2% of mass, maximum
- Distillation_____85% at 350 °C (662 °F)
- Lubricity_____460 micrometers maximum wear scar on "ISO 12156 - 1"

Cetane number

This indicates the properties of ignition of the fuel. Fuel with a low cetane number can be the root cause of problems during cold start. This will affect combustion.

Viscosity

This is the resistance to flow of a fluid. If this resistance is outside the limits, the engine and the engine starting performance in particular can be affected.

Sulfur

High sulfur content of the fuel is not normally found in Europe, North America or Australasia. This can cause engine wear. When only high sulfur fuels are available, it will be necessary that high alkaline lubricating oil is used in the engine or that the lubricating oil change interval is reduced.

Distillation

This is an indication of the mixture of different hydrocarbons in the fuel. A high ratio of light weight hydrocarbons can affect the characteristics of combustion.

Lubricity

This is the capability of the fuel to prevent pump wear.

Diesel engines have the ability to burn a wide variety of fuels. These fuels are divided into four general groups:

- Group 1 (preferred fuels)
- Group 2 (permissible fuels)
- Group 3 (aviation kerosene fuels)
- Other fuels

Group 1 (preferred fuels): Specification

"DERV to EN590"

Note: Only use Arctic fuels when the temperature is below 0 °C (32 °F). Do not use Arctic fuels when the ambient temperature is above 0 °C (32 °F). To ensure that the time period between cranking the engine and first fire is kept to a minimum, only use fuel of the correct viscosity and at the correct temperature.

Gas oil to "BS2869 Class A2"

"ASTM D975 - 91 Class 2D" This can only be used if the fuel has the correct specification of lubricity.

"JIS K2204 (1992) Grades 1,2,3 and Special Grade 3" This can only be used if the fuel has the correct specification of lubricity.

Note: If low sulfur or low sulfur aromatic fuels are used, then fuel additives can be used to increase lubricity.

Group 2 (permissible fuels): Specification

These fuel specifications are considered acceptable for issues of warranty. However,these fuels may reduce the life of the engine, the engine's maximum power and the engine's fuel efficiency.

“ASTM D975 - 91 Class 1D”

“JP7, Mil T38219”

“NATO F63”

NOTICE
These fuels should have a wear scar value of 650 micrometers maximum *HFRR to ISO 12156 - 1.*

Group 3 (aviation kerosene fuels): Specification

These fuels need additives to achieve lubricity of 650 micrometers wear scar and the reliability of the fuel injection pump will be reduced. The fuel injection pump is not covered by a warranty, even when the additives are included.

“JP5 MIL T5624 (Avcat FSII, NATO F44”

“JP8 T83133 (Avtur FSII, NATO F34”

“Jet A”

“Jet A1, NATO F35, XF63”

Low temperature fuels

Special fuels for use in cold weather may be available for engine operation at temperatures below 0 °C (32 °F). These fuels limit the formation of wax in the fuel oil at low temperatures. If wax forms in the fuel oil, this could stop the flow of fuel oil through the filter.

Note: These fuels that lack lubricity may cause the following problems:

- Low engine power
- Difficult starting in hot conditions or in cold conditions
- White smoke
- Deterioration of emissions and misfire at certain operating conditions

Biofuel: Specification

Biofuel: A 5% mix of RME to EN14214 in conventional fuel is permitted.

NOTICE
Water emulsion fuels: These fuels are not permitted

Refer to the following fuel specifications for North America.

The preferred fuels provide maximum engine service life and performance. The preferred fuels are distillate fuels. These fuels are commonly called diesel fuel or gas oil.

The permissible fuels are crude oils or blended fuels. Use of these fuels can result in higher maintenance costs and in reduced engine service life.

Diesel fuels that meet the specifications in Table 14 will help to provide maximum engine service life and performance. In North America, diesel fuel that is identified as No. 2-D in “ASTM D975” generally meets the specifications. Table 14 is for diesel fuels that are distilled from crude oil. Diesel fuels from other sources could exhibit detrimental properties that are not defined or controlled by this specification.

Table 14

Perkins Specifications for Distillate Diesel Fuel		
Specifications	**Requirements**	**ASTM Test**
Aromatics	35% maximum	“D1319”
Ash	0.02% maximum (weight)	“D482”
Carbon Residue on 10% Bottoms	0.35% maximum (weight)	“D524”
Cetane Number	40 minimum (DI engines)	“D613”
Cloud Point	The cloud point must not exceed the lowest expected ambient temperature.	-

(continued)

(Table 14, contd)

Copper Strip Corrosion	No. 3 maximum	“D130”
Distillation	10% at 282 °C (540 °F) maximum	“D86”
	90% at 360 °C (680 °F) maximum	
Flash Point	legal limit	“D93”
API Gravity	30 minimum	“D287”
	45 maximum	
Pour Point	6 °C (10 °F) minimum below ambient temperature	“D97”
Sulfur (1)	0.2% maximum	“D3605” or “D1552”
Kinematic Viscosity (2)	2.0 cSt minimum and 4.5 cSt maximum at 40 °C (104 °F)	“D445”
Water and Sediment	0.1% maximum	“D1796”
Water	0.1% maximum	“D1744”
Sediment	0.05% maximum (weight)	“D473”
Gum and Resins (3)	10 mg per 100 mL maximum	“D381”
Lubricity (4)	0.38 mm (0.015 inch) maximum at 25 °C (77 °F)	“D6079”

(1) Perkins fuel systems and engine components can operate on high sulfur fuels. Fuel sulfur levels affect exhaust emissions. High sulfur fuels also increase the potential for corrosion of internal components. Fuel sulfur levels above 0.5 percent may significantly shorten the oil change interval. For additional information, see this publication, “Fluid Recommendations/Engine Oil” topic (Maintenance Section).

(2) The values of the fuel viscosity are the values as the fuel is delivered to the fuel injection pumps. If a fuel with a low viscosity is used, cooling of the fuel may be required to maintain a 1.4 cSt viscosity at the fuel injection pump. Fuels with a high viscosity might require fuel heaters in order to bring down the viscosity to a 20 cSt viscosity.

(3) Follow the test conditions and procedures for gasoline (motor).

(4) The lubricity of a fuel is a concern with low sulfur fuel. To determine the lubricity of the fuel, use either the “ASTM D6078 Scuffing Load Wear Test (SBOCLE)” or the “ASTM D6079 High Frequency Reciprocating Rig (HFRR)” test. If the lubricity of a fuel does not meet the minimum requirements, consult your fuel supplier. Do not treat the fuel without consulting the fuel supplier. Some additives are not compatible. These additives can cause problems in the fuel system.

NOTICE

Operating with fuels that do not meet the Perkins recommendations can cause the following effects: Starting difficulty, poor combustion, deposits in the fuel injectors, reduced service life of the fuel system, deposits in the combustion chamber, and reduced service life of the engine.

NOTICE

Heavy Fuel Oil (HFO), Residual fuel, or Blended fuel must NOT be used in Perkins diesel engines. Severe component wear and component failures will result if HFO type fuels are used in engines that are configured to use distillate fuel.

In extreme cold ambient conditions, you may use the distillate fuels that are specified in Table 15. However, the fuel that is selected must meet the requirements that are specified in Table 14. These fuels are intended to be used in operating temperatures that are down to −54 °C (−65 °F).

Table 15

Distillate Fuels (1)	
Specification	**Grade**
“MIL-T-5624R”	JP-5
“ASTM D1655”	Jet-A-1
“MIL-T-83133D”	JP-8

(1) The fuels that are listed in this Table may not meet the requirements that are specified in the “Perkins Specifications for Distillate Diesel Fuel” Table. Consult the supplier for the recommended additives in order to maintain the correct fuel lubricity.

These fuels are lighter than the No. 2 grades of fuel. The cetane number of the fuels in Table 15 must be at least 40. If the viscosity is below 1.4 cSt at 38 °C (100 °F), use the fuel only in temperatures below 0 °C (32 °F). Do not use any fuels with a viscosity of less than 1.2 cSt at 38 °C (100 °F). Fuel cooling may be required in order to maintain the minimum viscosity of 1.4 cSt at the fuel injection pump.

There are many other diesel fuel specifications that are published by governments and by technological societies. Usually, those specifications do not review all the requirements that are addressed in this specification. To ensure optimum engine performance, a complete fuel analysis should be obtained before engine operation. The fuel analysis should include all of the properties that are listed in Table 14.

Cooling System Specifications

General Coolant Information

NOTICE
Never add coolant to an overheated engine. Engine damage could result. Allow the engine to cool first.

NOTICE
If the engine is to be stored in, or shipped to an area with below freezing temperatures, the cooling system must be either protected to the lowest outside temperature or drained completely to prevent damage.

NOTICE
Frequently check the specific gravity of the coolant for proper freeze protection or for anti-boil protection.

Clean the cooling system for the following reasons:

- Contamination of the cooling system
- Overheating of the engine
- Foaming of the coolant

NOTICE
Never operate an engine without water temperature regulators in the cooling system. Water temperature regulators help to maintain the engine coolant at the proper operating temperature. Cooling system problems can develop without water temperature regulators.

Many engine failures are related to the cooling system. The following problems are related to cooling system failures: Overheating, leakage of the water pump, and plugged radiators or heat exchangers.

These failures can be avoided with correct cooling system maintenance. Cooling system maintenance is as important as maintenance of the fuel system and the lubrication system. Quality of the coolant is as important as the quality of the fuel and the lubricating oil.

Coolant is normally composed of three elements: Water, additives, and glycol.

Water

Water is used in the cooling system in order to transfer heat.

Distilled water or deionized water is recommended for use in engine cooling systems.

DO NOT use the following types of water in cooling systems: Hard water, softened water that has been conditioned with salt, and sea water.

If distilled water or deionized water is not available, use water with the properties that are listed in Table 16.

Table 16

Perkins Minimum Acceptable Water Requirements	
Property	**Maximum Limit**
Chloride (Cl)	40 mg/L
Sulfate (SO_4)	100 mg/L
Total Hardness	170 mg/L
Total Solids	340 mg/L
Acidity	pH of 5.5 to 9.0

For a water analysis, consult one of the following sources:

- Local water utility company
- Agricultural agent
- Independent laboratory

Additives

Additives help to protect the metal surfaces of the cooling system. A lack of coolant additives or insufficient amounts of additives enable the following conditions to occur:

- Corrosion
- Formation of mineral deposits
- Rust
- Scale
- Foaming of the coolant

Many additives are depleted during engine operation. These additives must be replaced periodically.

Additives must be added at the correct concentration. Overconcentration of additives can cause the inhibitors to drop out-of-solution. The deposits can enable the following problems to occur:

- Formation of gel compounds
- Reduction of heat transfer
- Leakage of the water pump seal
- Plugging of radiators, coolers, and small passages

Glycol

Glycol in the coolant helps to provide protection against the following conditions:

- Boiling
- Freezing
- Cavitation of the water pump

For optimum performance, Perkins recommends a 1:1 mixture of a water/glycol solution.

Note: Use a mixture that will provide protection against the lowest ambient temperature.

Note: 100 percent pure glycol will freeze at a temperature of −23 °C (−9 °F).

Most conventional coolant/antifreezes use ethylene glycol. Propylene glycol may also be used. In a 1:1 mixture with water, ethylene and propylene glycol provide similar protection against freezing and boiling. See Tables 17 and 18.

Table 17

Ethylene Glycol		
Concentration	**Freeze Protection**	**Boil Protection**
50 Percent	−36 °C (−33 °F)	106 °C (223 °F)
60 Percent	−51 °C (−60 °F)	111 °C (232 °F)

NOTICE
Do not use propylene glycol in concentrations that exceed 50 percent glycol because of propylene glycol's reduced heat transfer capability. Use ethylene glycol in conditions that require additional protection against boiling or freezing.

Table 18

Propylene Glycol		
Concentration	**Freeze Protection**	**Anti-Boil Protection**
50 Percent	−29 °C (−20 °F)	106 °C (223 °F)

To check the concentration of glycol in the coolant, measure the specific gravity of the coolant.

Coolant Recommendations

The following two coolants are used in Perkins diesel engines:

Preferred – Perkins Extended Life Coolant (ELC)

Acceptable – A commercial heavy-duty coolant/antifreeze that meets "ASTM D4985" specifications

NOTICE
Do not use a commercial coolant/antifreeze that only meets the ASTM D3306 specification. This type of coolant/antifreeze is made for light automotive applications.

Perkins recommends a 1:1 mixture of water and glycol. This mixture of water and glycol will provide optimum heavy-duty performance as a coolant/antifreeze. This ratio may be increased to 1:2 water to glycol if extra freezing protection is required.

Note: A commercial heavy-duty coolant/antifreeze that meets "ASTM D4985" specifications MAY require a treatment with an SCA at the initial fill. Read the label or the instructions that are provided by the OEM of the product.

In stationary engine applications and marine engine applications that do not require anti-boil protection or freeze protection, a mixture of SCA and water is acceptable. Perkins recommends a six percent to eight percent concentration of SCA in those cooling systems. Distilled water or deionized water is preferred. Water which has the recommended properties may be used.

Engines that are operating in an ambient temperature above 43 °C (109.4 °F) must use SCA and water. Engines that operate in an ambient temperature above 43 °C (109.4 °F) and below 0 °C (32 °F) due to seasonal variations consult your Perkins dealer or your Perkins distributor for the correct level of protection.

Table 19

Coolant Service Life	
Coolant Type	**Service Life**
Perkins ELC	12,000 Service Hours or Six Years
Commercial Heavy-Duty Coolant/Antifreeze that meets "ASTM D4985"	3000 Service Hours or Two Years
Perkins POWERPART SCA	3000 Service Hours or Two Years
Commercial SCA and Water	3000 Service Hours or Two Years

Extended Life Coolant (ELC)

Perkins provides Extended Life Coolant (ELC) for use in the following applications:

- Heavy-duty spark ignited gas engines

- Heavy-duty diesel engines
- Automotive applications

The anti-corrosion package for ELC is different from the anti-corrosion package for other coolants. ELC is an ethylene glycol base coolant. However, ELC contains organic corrosion inhibitors and antifoam agents with low amounts of nitrite. Perkins ELC has been formulated with the correct amount of these additives in order to provide superior corrosion protection for all metals in engine cooling systems.

ELC extends the service life of the coolant to 12000 service hours or six years. ELC does not require a frequent addition of a Supplemental Coolant Additive (SCA). An Extender is the only additional maintenance that is needed at 6000 service hours or one half of the ELC service life.

ELC is available in a 1:1 premixed cooling solution with distilled water. The Premixed ELC provides freeze protection to −36 °C (−33 °F). The Premixed ELC is recommended for the initial fill of the cooling system. The Premixed ELC is also recommended for topping off the cooling system.

ELC Concentrate is also available. ELC Concentrate can be used to lower the freezing point to −51 °C (−60 °F) for arctic conditions.

Containers of several sizes are available. Consult your Perkins dealer or your Perkins distributor for the part numbers.

ELC Cooling System Maintenance

Correct additions to the Extended Life Coolant

NOTICE
Use only Perkins products for pre-mixed or concentrated coolants.

Use only Perkins Extender with Extended Life Coolant.

Mixing Extended Life Coolant with other products reduces the Extended Life Coolant service life. Failure to follow the recommendations can reduce cooling system components life unless appropriate corrective action is performed.

In order to maintain the correct balance between the antifreeze and the additives, you must maintain the recommended concentration of Extended Life Coolant (ELC). Lowering the proportion of antifreeze lowers the proportion of additive. This will lower the ability of the coolant to protect the system from pitting, from cavitation, from erosion, and from deposits.

NOTICE
Do not use a conventional coolant to top-off a cooling system that is filled with Extended Life Coolant (ELC).

Do not use standard supplemental coolant additive (SCA). Only use ELC Extender in cooling systems that are filled with ELC.

Perkins ELC Extender

ELC Extender is added to the cooling system halfway through the ELC service life. Treat the cooling system with ELC Extender at 6000 hours or three years. Use Table 20 in order to determine the correct amount of ELC Extender that is required.

Containers of several sizes are available. Consult your Perkins dealer or your Perkins distributor for the part numbers.

Use the formula in Table 20 to determine the correct amount of ELC Extender for your cooling system. Refer to Operation and Maintenance Manual, “Refill Capacities” in order to determine the capacity of the cooling system.

Table 20

Formula For Adding ELC Extender To ELC
V × 0.02 = X
V is the total capacity of the cooling system.
X is the amount of ELC Extender that is required.

Table 21 is an example for using the formula that is in Table 20.

Table 21

Example Of The Equation For Adding ELC Extender To ELC		
Total Volume of the Cooling System (V)	**Multiplication Factor**	**Amount of ELC Extender that is Required (X)**
9 L (2.4 US gal)	× 0.02	0.18 L (0.05 US gal) or (6 fl oz)

NOTICE
When using Perkins ELC, do not use standard SCA’s or SCA filters.

ELC Cooling System Cleaning

Note: If the cooling system is already using ELC, cleaning agents are not required to be used at the specified coolant change interval. Cleaning agents are only required if the system has been contaminated by the addition of some other type of coolant or by cooling system damage.

Clean water is the only cleaning agent that is required when ELC is drained from the cooling system.

After the cooling system is drained and after the cooling system is refilled, operate the engine while the cooling system filler cap is removed. Operate the engine until the coolant level reaches the normal operating temperature and until the coolant level stabilizes. As needed, add the coolant mixture in order to fill the system to the specified level.

Changing to Perkins ELC

To change from heavy-duty coolant/antifreeze to the Perkins ELC, perform the following steps:

NOTICE
Care must be taken to ensure that all fluids are contained during performance of inspection, maintenance, testing, adjusting and the repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

1. Drain the coolant into a suitable container.
2. Dispose of the coolant according to local regulations.
3. Flush the system with clean water in order to remove any debris.
4. Use Perkins cleaner to clean the system. Follow the instruction on the label.
5. Drain the cleaner into a suitable container. Flush the cooling system with clean water.
6. Fill the cooling system with clean water and operate the engine until the engine is warmed to 49° to 66°C (120° to 150°F).

NOTICE
Incorrect or incomplete flushing of the cooling system can result in damage to copper and other metal components.

To avoid damage to the cooling system, make sure to completely flush the cooling system with clear water. Continue to flush the system until all the signs of the cleaning agent are gone.

7. Drain the cooling system into a suitable container and flush the cooling system with clean water.

Note: The cooling system cleaner must be thoroughly flushed from the cooling system. Cooling system cleaner that is left in the system will contaminate the coolant. The cleaner may also corrode the cooling system.

8. Repeat Steps 6 and 7 until the system is completely clean.
9. Fill the cooling system with the Perkins Premixed ELC.

ELC Cooling System Contamination

NOTICE
Mixing ELC with other products reduces the effectiveness of the ELC and shortens the ELC service life. Use only Perkins Products for premixed or concentrate coolants. Use only Perkins ELC extender with Perkins ELC. Failure to follow these recommendations can result in shortened cooling system component life.

ELC cooling systems can withstand contamination to a maximum of ten percent of conventional heavy-duty coolant/antifreeze or SCA. If the contamination exceeds ten percent of the total system capacity, perform ONE of the following procedures:

- Drain the cooling system into a suitable container. Dispose of the coolant according to local regulations. Flush the system with clean water. Fill the system with the Perkins ELC.
- Drain a portion of the cooling system into a suitable container according to local regulations. Then, fill the cooling system with premixed ELC. This should lower the contamination to less than 10 percent.
- Maintain the system as a conventional Heavy-Duty Coolant. Treat the system with an SCA. Change the coolant at the interval that is recommended for the conventional Heavy-Duty Coolant.

Commercial Heavy-Duty Coolant/ Antifreeze and SCA

NOTICE
Commercial Heavy-Duty Coolant which contains Amine as part of the corrision protection system must not be used.

NOTICE
Never operate an engine without water temperature regulators in the cooling system. Water temperature regulators help to maintain the engine coolant at the correct operating temperature. Cooling system problems can develop without water temperature regulators.

Check the coolant/antifreeze (glycol concentration) in order to ensure adequate protection against boiling or freezing. Perkins recommends the use of a refractometer for checking the glycol concentration.

Perkins engine cooling systems should be tested at 500 hour intervals for the concentration of Supplemental Coolant Additive (SCA).

Additions of SCA are based on the results of the test. An SCA that is liquid may be needed at 500 hour intervals.

Refer to Table 22 for part numbers and for quantities of SCA.

Table 22

Perkins Liquid SCA	
Part Number	**Quantity**
21825735	

Adding the SCA to Heavy-Duty Coolant at the Initial Fill

Commercial heavy-duty coolant/antifreeze that meets “ASTM D4985” specifications MAY require an addition of SCA at the initial fill. Read the label or the instructions that are provided by the OEM of the product.

Use the equation that is in Table 23 to determine the amount of Perkins SCA that is required when the cooling system is initially filled.

Table 23

Equation For Adding The SCA To The Heavy-Duty Coolant At The Initial Fill
V × 0.045 = X
V is the total volume of the cooling system.
X is the amount of SCA that is required.

Table 24 is an example for using the equation that is in Table 23.

Table 24

Example Of The Equation For Adding The SCA To The Heavy-Duty Coolant At The Initial Fill		
Total Volume of the Cooling System (V)	**Multiplication Factor**	**Amount of SCA that is Required (X)**
15 L (4 US gal)	× 0.045	0.7 L (24 oz)

Adding The SCA to The Heavy-Duty Coolant For Maintenance

Heavy-duty coolant/antifreeze of all types REQUIRE periodic additions of an SCA.

Test the coolant/antifreeze periodically for the concentration of SCA. For the interval, refer to the Operation and Maintenance Manual, “Maintenance Interval Schedule” (Maintenance Section). Test the concentration of SCA.

Additions of SCA are based on the results of the test. The size of the cooling system determines the amount of SCA that is needed.

Use the equation that is in Table 25 to determine the amount of Perkins SCA that is required, if necessary:

Table 25

Equation For Adding The SCA To The Heavy-Duty Coolant For Maintenance
V × 0.014 = X
V is the total volume of the cooling system.
X is the amount of SCA that is required.

Table 26 is an example for using the equation that is in Table 25.

Table 26

Example Of The Equation For Adding The SCA To The Heavy-Duty Coolant For Maintenance		
Total Volume of the Cooling System (V)	**Multiplication Factor**	**Amount of SCA that is Required (X)**
15 L (4 US gal)	× 0.014	0.2 L (7 oz)

Cleaning the System of Heavy-Duty Coolant/Antifreeze

Perkins cooling system cleaners are designed to clean the cooling system of harmful scale and corrosion. Perkins cooling system cleaners dissolve mineral scale, corrosion products, light oil contamination and sludge.

- Clean the cooling system after used coolant is drained or before the cooling system is filled with new coolant.
- Clean the cooling system whenever the coolant is contaminated or whenever the coolant is foaming.

i03302982

Maintenance Interval Schedule

When Required

Battery - Replace 54
Battery or Battery Cable - Disconnect 55
Engine - Clean 60
Engine Air Cleaner Element (Dual Element) - Clean/Replace 61
Engine Air Cleaner Element (Single Element) - Inspect/Replace 63
Engine Oil Sample - Obtain 64
Fuel Injector - Test/Change 68
Fuel System - Prime 69
Severe Service Application - Check 75

Daily

Alternator and Fan Belts - Inspect/Adjust/ Replace 53
Cooling System Coolant Level - Check 59
Driven Equipment - Check 60
Engine Air Cleaner Service Indicator - Inspect 63
Engine Oil Level - Check 64
Fuel System Primary Filter/Water Separator - Drain 70
Walk-Around Inspection 77

Every 50 Service Hours or Weekly

Fuel Tank Water and Sediment - Drain 73

Every 500 Service Hours or 1 Year

Battery Electrolyte Level - Check 54
Engine Air Cleaner Element (Dual Element) - Clean/Replace 61
Engine Air Cleaner Element (Single Element) - Inspect/Replace 63
Engine Ground - Inspect/Clean 64
Engine Oil and Filter - Change 65
Fuel System Primary Filter (Water Separator) Element - Replace 70
Fuel System Secondary Filter - Replace 71
Hoses and Clamps - Inspect/Replace 74
Radiator - Clean 75

Every 1000 Service Hours

Engine Valve Lash - Inspect/Adjust 67

Every 2000 Service Hours

Aftercooler Core - Inspect 52
Alternator - Inspect 53
Engine Mounts - Inspect 64
Starting Motor - Inspect 76
Turbocharger - Inspect 76
Water Pump - Inspect 78

Every 2 Years

Cooling System Coolant - Change 58

Every 3000 Service Hours

Fuel Injector - Test/Change 68

Every 3000 Service Hours or 2 Years

Cooling System Coolant (Commercial Heavy-Duty) - Change 55

Every 4000 Service Hours

Aftercooler Core - Clean/Test 52

Every 6000 Service Hours or 3 Years

Cooling System Coolant Extender (ELC) - Add 59

Every 12 000 Service Hours or 6 Years

Cooling System Coolant (ELC) - Change 57

i02322260

Aftercooler Core - Clean/Test

1. Remove the core. Refer to the OEM information for the correct procedure.

2. Turn the aftercooler core upside-down in order to remove debris.

⚠ WARNING

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

3. Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction of the fan's air flow. Hold the nozzle approximately 6 mm (.25 inch) away from the fins. Slowly move the air nozzle in a direction that is parallel with the tubes. This will remove debris that is between the tubes.

4. Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

NOTICE
Do not use a high concentration of caustic cleaner to clean the core. A high concentration of caustic cleaner can attack the internal metals of the core and cause leakage. Only use the recommended concentration of cleaner.

5. Back flush the core with a suitable cleaner.

6. Steam clean the core in order to remove any residue. Flush the fins of the aftercooler core. Remove any other trapped debris.

7. Wash the core with hot, soapy water. Rinse the core thoroughly with clean water.

⚠ WARNING

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

8. Dry the core with compressed air. Direct the air in the reverse direction of the normal flow.

9. Inspect the core in order to ensure cleanliness. Pressure test the core. If necessary, repair the core.

10. Install the core. Refer to the OEM information for the correct procedure.

11. After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

i02322295

Aftercooler Core - Inspect

Note: Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the aftercooler for these items: damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the aftercooler, if necessary.

For air-to-air aftercoolers, use the same methods that are used for cleaning radiators.

⚠ WARNING

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

After cleaning, start the engine and accelerate the engine to high idle rpm. This will help in the removal of debris and drying of the core. Stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a “comb”.

Note: If parts of the aftercooler system are repaired or replaced, a leak test is highly recommended.

Inspect these items for good condition: Welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

i02322311

Alternator - Inspect

Perkins recommends a scheduled inspection of the alternator. Inspect the alternator for loose connections and correct battery charging. Check the ammeter (if equipped) during engine operation in order to ensure correct battery performance and/or correct performance of the electrical system. Make repairs, as required.

Check the alternator and the battery charger for correct operation. If the batteries are correctly charged, the ammeter reading should be very near zero. All batteries should be kept charged. The batteries should be kept warm because temperature affects the cranking power. If the battery is too cold, the battery will not crank the engine. When the engine is not run for long periods of time or if the engine is run for short periods, the batteries may not fully charge. A battery with a low charge will freeze more easily than a battery with a full charge.

i01929797

Alternator and Fan Belts - Inspect/Adjust/Replace

Inspection

To maximize the engine performance, inspect the belts for wear and for cracking. Replace belts that are worn or damaged.

For applications that require multiple drive belts, replace the belts in matched sets. Replacing only one belt of a matched set will cause the new belt to carry more load because the older belt is stretched. The additional load on the new belt could cause the new belt to break.

If the belts are too loose, vibration causes unnecessary wear on the belts and pulleys. Loose belts may slip enough to cause overheating.

To accurately check the belt tension, a suitable gauge should be used.

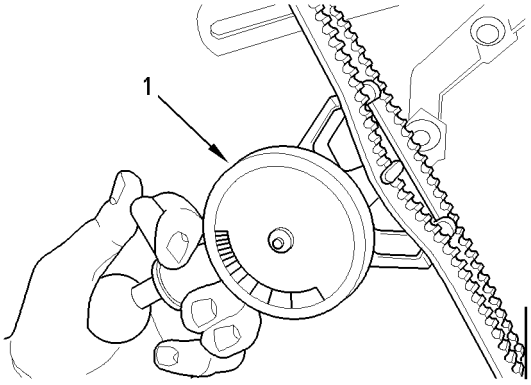


Illustration 26 g01003936

Typical example

(1) Burroughs Gauge

Fit the gauge (1) at the center of the longest free length and check the tension. The correct tension is 535 N (120 lb). If the tension of the belt is below 250 N (56 lb) adjust the belt to 535 N (120 lb).

If twin belts are installed, check and adjust the tension on both belts.

Adjustment

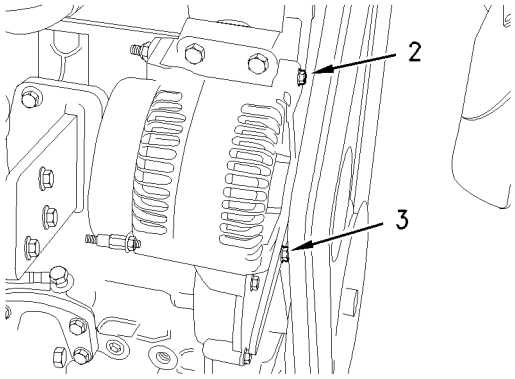


Illustration 27 g01003939

1. Loosen The alternator pivot bolt (2) and the bolt (3).

2. Move the alternator in order to increase or decrease the belt tension. Tighten the alternator pivot bolt and the link bolt to 22 N·m (16 lb ft).(1).

Replacement

Refer to the Disassembly and Assembly Manual for the installation procedure and the removal procedure for the belt.

i02322315

Battery - Replace

⚠ WARNING

Batteries give off combustible gases which can explode. A spark can cause the combustible gases to ignite. This can result in severe personal injury or death.

Ensure proper ventilation for batteries that are in an enclosure. Follow the proper procedures in order to help prevent electrical arcs and/or sparks near batteries. Do not smoke when batteries are serviced.

⚠ WARNING

The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.

Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.

1. Switch the engine to the OFF position. Remove all electrical loads.
2. Turn off any battery chargers. Disconnect any battery chargers.
3. The NEGATIVE “-” cable connects the NEGATIVE “-” battery terminal to the NEGATIVE “-” terminal on the starting motor. Disconnect the cable from the NEGATIVE “-” battery terminal.
4. The POSITIVE “+” cable connects the POSITIVE “+” battery terminal to the POSITIVE “+” terminal on the starting motor. Disconnect the cable from the POSITIVE “+” battery terminal.

Note: Always recycle a battery. Never discard a battery. Dispose of used batteries to an appropriate recycling facility.

5. Remove the used battery.
6. Install the new battery.

Note: Before the cables are connected, ensure that the engine start switch is OFF.

7. Connect the cable from the starting motor to the POSITIVE “+” battery terminal.
8. Connect the NEGATIVE “-” cable to the NEGATIVE “-” battery terminal.

i02747977

Battery Electrolyte Level - Check

When the engine is not run for long periods of time or when the engine is run for short periods, the batteries may not fully recharge. Ensure a full charge in order to help prevent the battery from freezing. If batteries are correctly charged, the ammeter reading should be very near zero, when the engine is in operation.

⚠ WARNING

All lead-acid batteries contain sulfuric acid which can burn the skin and clothing. Always wear a face shield and protective clothing when working on or near batteries.

1. Remove the filler caps. Maintain the electrolyte level to the “FULL” mark on the battery.

   If the addition of water is necessary, use distilled water. If distilled water is not available use clean water that is low in minerals. Do not use artificially softened water.
2. Check the condition of the electrolyte with a suitable battery tester.
3. Install the caps.
4. Keep the batteries clean.

   Clean the battery case with one of the following cleaning solutions:

   - Use a solution of 0.1 kg (0.2 lb) baking soda and 1 L (1 qt) of clean water.
   - Use a solution of ammonium hydroxide.

   Thoroughly rinse the battery case with clean water.

i02323088

Battery or Battery Cable - Disconnect

⚠ WARNING

The battery cables or the batteries should not be removed with the battery cover in place. The battery cover should be removed before any servicing is attempted.

Removing the battery cables or the batteries with the cover in place may cause a battery explosion resulting in personal injury.

1. Turn the start switch to the OFF position. Turn the ignition switch (if equipped) to the OFF position and remove the key and all electrical loads.
2. Disconnect the negative battery terminal. Ensure that the cable cannot contact the terminal. When four 12 volt batteries are involved, two negative connection must be disconnected.
3. Remove the positive connection.
4. Clean all disconnected connection and battery terminals.
5. Use a fine grade of sandpaper to clean the terminals and the cable clamps. Clean the items until the surfaces are bright or shiny. DO NOT remove material excessively. Excessive removal of material can cause the clamps to not fit correctly. Coat the clamps and the terminals with a suitable silicone lubricant or petroleum jelly.
6. Tape the cable connections in order to help prevent accidental starting.
7. Proceed with necessary system repairs.
8. In order to connect the battery, connect the positive connection before the negative connector.

i02203590

Cooling System Coolant (Commercial Heavy-Duty) - Change

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to Local regulations and mandates.

NOTICE
Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

Note: When the cooling system is cleaned, only clean water is needed.

Note: Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

Drain

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

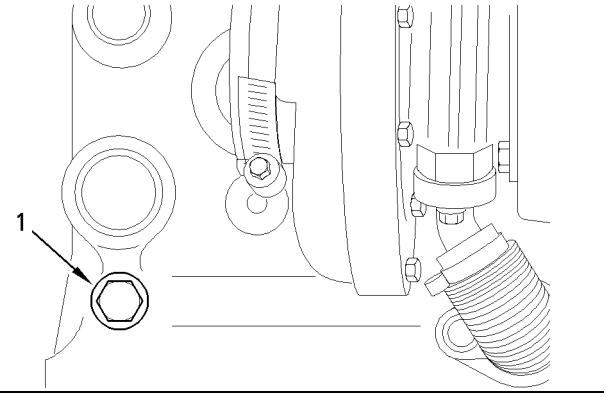


Illustration 28 g01003928

2. Open the drain cock or remove the drain plug (1) on the engine. Open the drain cock or remove the drain plug on the radiator.

   Allow the coolant to drain.

NOTICE
Dispose of used engine coolant or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Perkins to reclaim the coolant.

For information regarding the disposal and the recycling of used coolant, consult your Perkins dealer or your Perkins distributor.

Flush

1. Flush the cooling system with clean water in order to remove any debris.

2. Close the drain cock or install the drain plug in the engine. Close the drain cock or install the drain plug on the radiator.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

3. Fill the cooling system with clean water. Install the cooling system filler cap.

4. Start and run the engine at low idle until the temperature reaches 49 to 66 °C (120 to 150 °F).

5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain cock or remove the drain plug on the engine. Open the drain cock or remove the drain plug on the radiator. Allow the water to drain. Flush the cooling system with clean water.

Fill

1. Close the drain cock or install the drain plug on the engine. Close the drain cock or install the drain plug on the radiator.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

2. Fill the cooling system with Commercial Heavy-Duty Coolant. Add Supplemental Coolant Additive to the coolant. For the correct amount, refer to the Operation and Maintenance Manual, “Fluid Recommendations” topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.

3. Start and run the engine at low idle. Increase the engine rpm to high idle. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.

4. Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level in the expansion bottle (if equipped) at the correct level.

5. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, use a suitable pressurizing pump in order to pressure test the cooling system filler cap. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.

6. Start the engine. Inspect the cooling system for leaks and for correct operating temperature.

i02203595

Cooling System Coolant (ELC) - Change

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to Local regulations and mandates.

NOTICE
Keep all parts clean from contaminants.

Contaminants may cause rapid wear and shortened component life.

Clean the cooling system and flush the cooling system before the recommended maintenance interval if the following conditions exist:

- The engine overheats frequently.
- Foaming is observed.
- The oil has entered the cooling system and the coolant is contaminated.
- The fuel has entered the cooling system and the coolant is contaminated.

Note: When the cooling system is cleaned, only clean water is needed when the ELC is drained and replaced.

Note: Inspect the water pump and the water temperature regulator after the cooling system has been drained. This is a good opportunity to replace the water pump, the water temperature regulator and the hoses, if necessary.

Drain

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

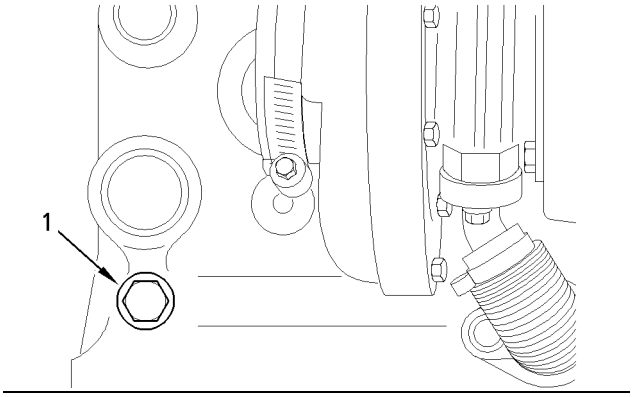


Illustration 29 g01003928
Typical example

2. Open the drain cock or remove the drain plug (1) on the engine. Open the drain cock or remove the drain plug on the radiator.

   Allow the coolant to drain.

NOTICE
Dispose of used engine coolant or recycle. Various methods have been proposed to reclaim used coolant for reuse in engine cooling systems. The full distillation procedure is the only method acceptable by Perkins to reclaim the coolant.

For information regarding the disposal and the recycling of used coolant, consult your Perkins dealer or your Perkins distributor.

Flush

1. Flush the cooling system with clean water in order to remove any debris.
2. Close the drain cock or install the drain plug in the engine. Close the drain cock or install the drain plug on the radiator.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

3. Fill the cooling system with clean water. Install the cooling system filler cap.
4. Start and run the engine at low idle until the temperature reaches 49 to 66 °C (120 to 150 °F).

5. Stop the engine and allow the engine to cool. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap. Open the drain cock or remove the drain plug on the engine. Open the drain cock or remove the drain plug on the radiator. Allow the water to drain. Flush the cooling system with clean water.

Fill

1. Close the drain cock or install the drain plug on the engine. Close the drain cock or install the drain plug on the radiator.

NOTICE
Do not fill the cooling system faster than 5 L (1.3 US gal) per minute to avoid air locks.

Cooling system air locks may result in engine damage.

2. Fill the cooling system with Extended Life Coolant (ELC). Refer to the Operation and Maintenance Manual, “Fluid Recommendations” topic (Maintenance Section) for more information on cooling system specifications. Do not install the cooling system filler cap.

3. Start and run the engine at low idle. Increase the engine rpm to high idle. Run the engine at high idle for one minute in order to purge the air from the cavities of the engine block. Stop the engine.

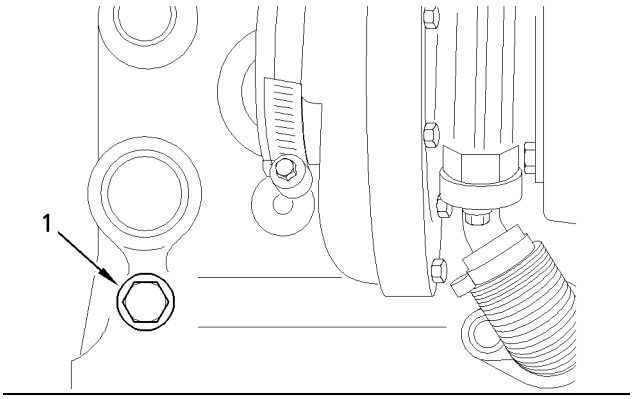
4. Check the coolant level. Maintain the coolant level within 13 mm (0.5 inch) below the bottom of the pipe for filling. Maintain the coolant level in the expansion bottle (if equipped) at the correct level.

5. Clean the cooling system filler cap. Inspect the gasket that is on the cooling system filler cap. If the gasket that is on the cooling system filler cap is damaged, discard the old cooling system filler cap and install a new cooling system filler cap. If the gasket that is on the cooling system filler cap is not damaged, use a suitable pressurizing pump in order to pressure test the cooling system filler cap. The correct pressure for the cooling system filler cap is stamped on the face of the cooling system filler cap. If the cooling system filler cap does not retain the correct pressure, install a new cooling system filler cap.

6. Start the engine. Inspect the cooling system for leaks and for correct operating temperature.

i01929799

Cooling System Coolant - Change



g01003928

Illustration 30

Drain plug

NOTICE
Do not drain the coolant while the engine is still hot and the system is under pressure because dangerous hot coolant can be discharged.

Note: The radiator may not have been provided by Perkins. The following is a general procedure for changing the coolant. Refer to the OEM information for the correct procedure.

1. Ensure that the vehicle is on level ground.

2. Remove the filler cap of the cooling system.

3. Remove the drain plug (1) from the side of the cylinder block in order to drain the engine. Ensure that the drain hole is not restricted.

4. Open the radiator drain tap or remove the drain plug at the bottom of the radiator in order to drain the radiator. If the radiator does not have a radiator drain tap or a drain plug, disconnect the hose at the bottom of the radiator.

5. Flush the coolant system with clean water.

6. Install the drain plugs and close the radiator drain tap. Install the radiator hose if the radiator hose was previously removed.

7. Fill the system with an approved antifreeze mixture. The maximum flow rate is 1 L (0.2200 Imp gal) per minute in order to fill the system. Install the filler cap.

8. Run the engine and check for coolant leaks.

i02335364

Cooling System Coolant Extender (ELC) - Add

The Perkins Extended Life Coolant (ELC) does not need the frequent addition of Supplemental Coolant Additives (SCA) that are associated with conventional coolants. The Extender only needs to be added once.

Check the cooling system only when the engine is stopped and cool.

1. Loosen the cooling system filler cap slowly in order to relieve pressure. Remove the cooling system filler cap.
2. It may be necessary to drain enough coolant from the cooling system in order to add the Extender.
3. Add Extender according to the requirements for your engine's cooling system capacity. Refer to this Operation and Maintenance Manual, "Refill Capacities" in the Maintenance Section for the capacity of the cooling system for your engine. Refer to this Operation and Maintenance Manual, "Fluid Recommendations" information for the Perkins ELC Extender.
4. Clean the cooling system filler cap and inspect the gasket. If the gasket is damaged, discard the old filler cap and install a new filler cap. If the gasket is not damaged, use a suitable pressurizing pump in order to pressure test the filler cap. The correct pressure is stamped on the face of the filler cap. If the filler cap does not retain the correct pressure, install a new filler cap.

i02335378

Cooling System Coolant Level - Check

Engines With a Coolant Recovery Tank

Note: The cooling system may not have been provided by Perkins. The procedure that follows is for typical cooling systems. Refer to the OEM information for the correct procedures.

Check the coolant level when the engine is stopped and cool.

1. Observe the coolant level in the coolant recovery tank. Maintain the coolant level to "COLD FULL" mark on the coolant recovery tank.

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

2. Loosen filler cap slowly in order to relieve any pressure. Remove the filler cap.
3. Pour the correct coolant mixture into the tank. Refer to the Operation and Maintenance Manual, "Refill Capacities and Recommendations" for information on the correct mixture and type of coolant. Refer to the Operation and Maintenance Manual, "Refill Capacities and Recommendations" for the cooling system capacity. Do not fill the coolant recovery tank above "COLD FULL" mark.

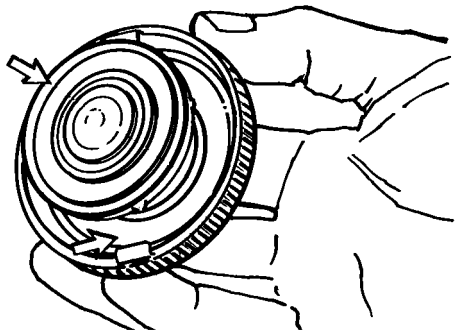


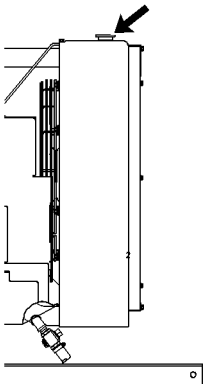
Illustration 31 g00103639

4. Clean filler cap and the receptacle. Reinstall the filler cap and inspect the cooling system for leaks.

Note: The coolant will expand as the coolant heats up during normal engine operation. The additional volume will be forced into the coolant recovery tank during engine operation. When the engine is stopped and cool, the coolant will return to the engine.

Engines Without a Coolant Recovery Tank

Check the coolant level when the engine is stopped and cool.



g00285520

Illustration 32

Cooling system filler cap

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Remove the cooling system filler cap slowly in order to relieve pressure.
2. Maintain the coolant level within 13 mm (0.5 inch) of the bottom of the filler pipe. If the engine is equipped with a sight glass, maintain the coolant level to the correct level in the sight glass.
3. Clean the cooling system filler cap and inspect the gasket. If the gasket is damaged, discard the old filler cap and install a new filler cap. If the gasket is not damaged, use a suitable pressurizing pump in order to pressure test the filler cap. The correct pressure is stamped on the face of the filler cap. If the filler cap does not retain the correct pressure, install a new filler cap.
4. Inspect the cooling system for leaks.

i00174798

Driven Equipment - Check

Refer to the OEM specifications for more information on the following maintenance recommendations for the driven equipment:

- Inspection
- Adjustment
- Lubrication
- Other maintenance recommendations

Perform any maintenance for the driven equipment which is recommended by the OEM.

i01930350

Engine - Clean

⚠ WARNING

Personal injury or death can result from high voltage.

Moisture can create paths of electrical conductivity.

Make sure that the electrical system is OFF. Lock out the starting controls and tag the controls “DO NOT OPERATE”.

NOTICE

Accumulated grease and oil on an engine is a fire hazard. Keep the engine clean. Remove debris and fluid spills whenever a significant quantity accumulates on the engine.

NOTICE

Failure to protect some engine components from washing may make your engine warranty invalid. Allow the engine to cool for one hour before washing the engine.

Periodic cleaning of the engine is recommended. Steam cleaning the engine will remove accumulated oil and grease. A clean engine provides the following benefits:

- Easy detection of fluid leaks
- Maximum heat transfer characteristics
- Ease of maintenance

Note: Caution must be used in order to prevent electrical components from being damaged by excessive water when the engine is cleaned. Pressure washers and steam cleaners should not be directed at any electrical connectors or the junction of cables into the rear of the connectors. Avoid electrical components such as the alternator and the starter. Protect the fuel injection pump from fluids in order to wash the engine.

i01915869

Engine Air Cleaner Element (Dual Element) - Clean/Replace

NOTICE
Never run the engine without an air cleaner element installed. Never run the engine with a damaged air cleaner element. Do not use air cleaner elements with damaged pleats, gaskets or seals. Dirt entering the engine causes premature wear and damage to engine components. Air cleaner elements help to prevent airborne debris from entering the air inlet.

NOTICE
Never service the air cleaner element with the engine running since this will allow dirt to enter the engine.

Servicing the Air Cleaner Elements

Note: The air filter system may not have been provided by Perkins. The procedure that follows is for a typical air filter system. Refer to the OEM information for the correct procedure.

If the air cleaner element becomes plugged, the air can split the material of the air cleaner element. Unfiltered air will drastically accelerate internal engine wear. Refer to the OEM information for the correct air cleaner elements for your application.

- Check the precleaner (if equipped) and the dust bowl daily for accumulation of dirt and debris. Remove any dirt and debris, as needed.
- Operating conditions (dust, dirt and debris) may require more frequent service of the air cleaner element.
- The air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

Replace the dirty air cleaner elements with clean air cleaner elements. Before installation, the air cleaner elements should be thoroughly checked for tears and/or holes in the filter material. Inspect the gasket or the seal of the air cleaner element for damage. Maintain a supply of suitable air cleaner elements for replacement purposes.

Dual Element Air Cleaners

The dual element air cleaner contains a primary air cleaner element and a secondary air cleaner element. The primary air cleaner element can be used up to six times if the element is properly cleaned and properly inspected. The primary air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

The secondary air cleaner element is not serviceable or washable. Refer to the OEM information for instructions in order to replace the secondary air cleaner element. When the engine is operating in environments that are dusty or dirty, air cleaner elements may require more frequent replacement.

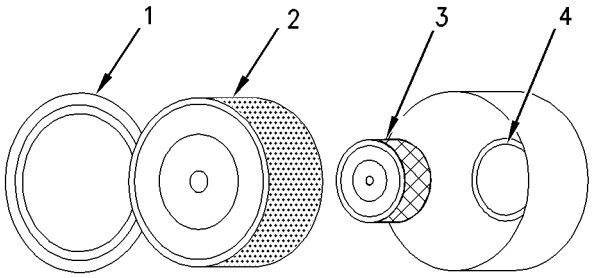


Illustration 33 g00736431

(1) Cover
(2) Primary air cleaner element
(3) Secondary air cleaner element
(4) Air inlet

1. Remove the cover. Remove the primary air cleaner element.
2. The secondary air cleaner element should be removed and discarded for every three cleanings of the primary air cleaner element.

Note: Refer to “Cleaning the Primary Air Cleaner Elements”.

3. Cover the air inlet with tape in order to keep dirt out.
4. Clean the inside of the air cleaner cover and body with a clean, dry cloth.
5. Remove the tape for the air inlet. Install the secondary air cleaner element. Install a primary air cleaner element that is new or cleaned.
6. Install the air cleaner cover.
7. Reset the air cleaner service indicator.

Cleaning the Primary Air Cleaner Elements

NOTICE
Observe the following guidelines if you attempt to clean the filter element:

Do not tap or strike the filter element in order to remove dust.

Do not wash the filter element.

Use low pressure compressed air in order to remove the dust from the filter element. Air pressure must not exceed 207 kPa (30 psi). Direct the air flow up the pleats and down the pleats from the inside of the filter element. Take extreme care in order to avoid damage to the pleats.

Do not use air filters with damaged pleats, gaskets, or seals. Dirt entering the engine will cause damage to engine components.

Refer to the OEM information in order to determine the number of times that the primary filter element can be cleaned. When the primary air cleaner element is cleaned, check for rips or tears in the filter material. The primary air cleaner element should be replaced at least one time per year. This replacement should be performed regardless of the number of cleanings.

NOTICE
Do not clean the air cleaner elements by bumping or tapping. This could damage the seals. Do not use elements with damaged pleats, gaskets or seals. Damaged elements will allow dirt to pass through. Engine damage could result.

Visually inspect the primary air cleaner elements before cleaning. Inspect the air cleaner elements for damage to the seal, the gaskets, and the outer cover. Discard any damaged air cleaner elements.

There are two common methods that are used to clean primary air cleaner elements:

- Pressurized air
- Vacuum cleaning

Pressurized Air

Pressurized air can be used to clean primary air cleaner elements that have not been cleaned more than two times. Pressurized air will not remove deposits of carbon and oil. Use filtered, dry air with a maximum pressure of 207 kPa (30 psi).

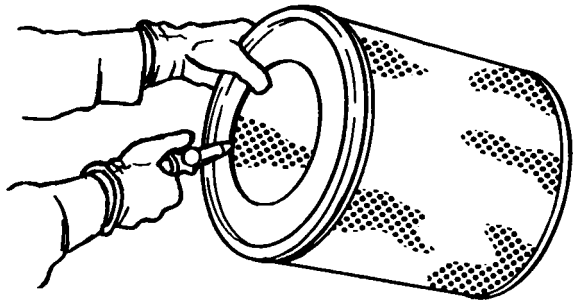


Illustration 34 g00281692

Note: When the primary air cleaner elements are cleaned, always begin with the clean side (inside) in order to force dirt particles toward the dirty side (outside).

Aim the hose so that the air flows inside the element along the length of the filter in order to help prevent damage to the paper pleats. Do not aim the stream of air directly at the primary air cleaner element. Dirt could be forced further into the pleats.

Note: Refer to “Inspecting the Primary Air Cleaner Elements”.

Vacuum Cleaning

Vacuum cleaning is a good method for cleaning primary air cleaner elements which require daily cleaning because of a dry, dusty environment. Cleaning with pressurized air is recommended prior to vacuum cleaning. Vacuum cleaning will not remove deposits of carbon and oil.

Note: Refer to “Inspecting the Primary Air Cleaner Elements”.

Inspecting the Primary Air Cleaner Elements

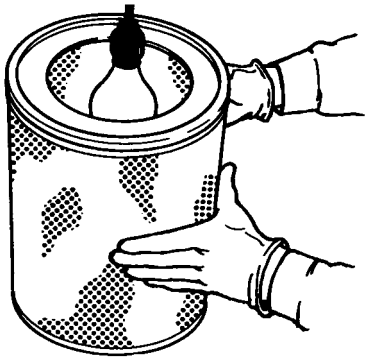


Illustration 35 g00281693

Inspect the clean, dry primary air cleaner element. Use a 60 watt blue light in a dark room or in a similar facility. Place the blue light in the primary air cleaner element. Rotate the primary air cleaner element. Inspect the primary air cleaner element for tears and/or holes. Inspect the primary air cleaner element for light that may show through the filter material. If it is necessary in order to confirm the result, compare the primary air cleaner element to a new primary air cleaner element that has the same part number.

Do not use a primary air cleaner element that has any tears and/or holes in the filter material. Do not use a primary air cleaner element with damaged pleats, gaskets or seals. Discard damaged primary air cleaner elements.

i02152042

Engine Air Cleaner Element (Single Element) - Inspect/Replace

Refer to Operation and Maintenance Manual, “Engine Air Cleaner Service Indicator-Inspect”.

NOTICE
Never run the engine without an air cleaner element installed. Never run the engine with a damaged air cleaner element. Do not use air cleaner elements with damaged pleats, gaskets or seals. Dirt entering the engine causes premature wear and damage to engine components. Air cleaner elements help to prevent air-borne debris from entering the air inlet.

NOTICE
Never service the air cleaner element with the engine running since this will allow dirt to enter the engine.

A wide variety of air cleaners may be installed for use with this engine. Consult the OEM information for the correct procedure to replace the air cleaner.

i01909507

Engine Air Cleaner Service Indicator - Inspect

Some engines may be equipped with a different service indicator.

Some engines are equipped with a differential gauge for inlet air pressure. The differential gauge for inlet air pressure displays the difference in the pressure that is measured before the air cleaner element and the pressure that is measured after the air cleaner element. As the air cleaner element becomes dirty, the pressure differential rises. If your engine is equipped with a different type of service indicator, follow the OEM recommendations in order to service the air cleaner service indicator.

The service indicator may be mounted on the air cleaner element or in a remote location.

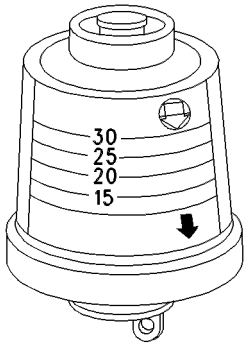


Illustration 36 g00103777
Typical service indicator

Observe the service indicator. The air cleaner element should be cleaned or the air cleaner element should be replaced when one of the following conditions occur:

- The yellow diaphragm enters the red zone.
- The red piston locks in the visible position.

Test the Service Indicator

Service indicators are important instruments.

- Check for ease of resetting. The service indicator should reset in less than three pushes.
- Check the movement of the yellow core when the engine is accelerated to the engine rated speed. The yellow core should latch approximately at the greatest vacuum that is attained.

If the service indicator does not reset easily, or if the yellow core does not latch at the greatest vacuum, the service indicator should be replaced. If the new service indicator will not reset, the hole for the service indicator may be restricted.

The service indicator may need to be replaced frequently in environments that are severely dusty.

i01941505

Engine Ground - Inspect/Clean

Inspect the wiring harness for good connections.

Perkins use the starter motor in order to ground the engine. Check the connection on the starter motor at every oil change. Ground wires and straps should be combined at engine grounds. All grounds should be tight and free of corrosion.

- Clean the grounding stud on the starter motor and the terminals with a clean cloth.
- If the connections are corroded, clean the connections with a solution of baking soda and water.
- Keep the grounding stud and the strap clean and coated with suitable grease or petroleum jelly.

i02323089

Engine Mounts - Inspect

Note: The engine mounts may not have been supplied by Perkins. Refer to the OEM information for further information on the engine mounts and the correct bolt torque.

Inspect the engine mounts for deterioration and for correct bolt torque. Engine vibration can be caused by the following conditions:

- Incorrect mounting of the engine
- Deterioration of the engine mounts
- Loose engine mounts

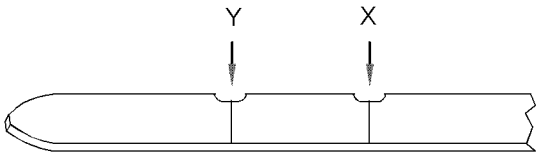
Any engine mount that shows deterioration should be replaced. Refer to the OEM information for the recommended torques.

i02335785

Engine Oil Level - Check

⚠ WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.



g01165836

Illustration 37

(Y) “Min” mark. (X) “Max” mark.

NOTICE
Perform this maintenance with the engine stopped.

Note: Ensure that the engine is either level or that the engine is in the normal operating position in order to obtain a true level indication.

Note: After the engine has been switched OFF, wait for ten minutes in order to allow the engine oil to drain to the oil pan before checking the oil level.

1. Maintain the oil level between the “ADD” mark (Y) and the “FULL” mark (X) on the engine oil dipstick. Do not fill the crankcase above the “FULL” mark (X).

NOTICE
Operating your engine when the oil level is above the “FULL” mark could cause your crankshaft to dip into the oil. The air bubbles created from the crankshaft dipping into the oil reduces the oil’s lubricating characteristics and could result in the loss of power.

2. Remove the oil filler cap and add oil, if necessary. Clean the oil filler cap. Install the oil filler cap.

i02202699

Engine Oil Sample - Obtain

The condition of the engine lubricating oil may be checked at regular intervals as part of a preventive maintenance program. Perkins include an oil sampling valve as an option. The oil sampling valve (if equipped) is included in order to regularly sample the engine lubricating oil. The oil sampling valve is positioned on the oil filter head or the oil sampling valve is positioned on the cylinder block.

Perkins recommends using a sampling valve in order to obtain oil samples. The quality and the consistency of the samples are better when a sampling valve is used. The location of the sampling valve allows oil that is flowing under pressure to be obtained during normal engine operation.

Obtain the Sample and the Analysis

WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

In order to help obtain the most accurate analysis, record the following information before an oil sample is taken:

- The date of the sample
- Engine model
- Engine number
- Service hours on the engine
- The number of hours that have accumulated since the last oil change
- The amount of oil that has been added since the last oil change

Ensure that the container for the sample is clean and dry. Also ensure that the container for the sample is clearly labelled.

To ensure that the sample is representative of the oil in the crankcase, obtain a warm, well mixed oil sample.

To avoid contamination of the oil samples, the tools and the supplies that are used for obtaining oil samples must be clean.

The sample can be checked for the following: the quality of the oil, the existence of any coolant in the oil, the existence of any ferrous metal particles in the oil, and the existence of any nonferrous metal particles in the oil.

i01929323

Engine Oil and Filter - Change

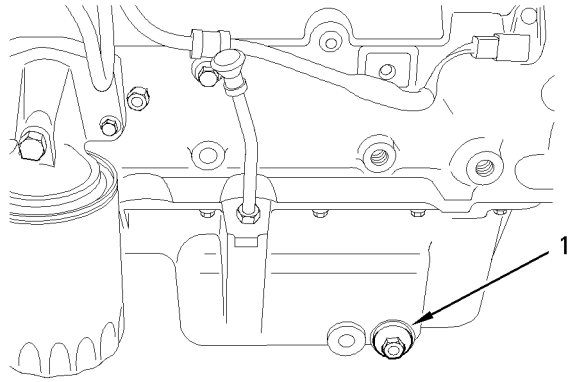
WARNING

Hot oil and hot components can cause personal injury. Do not allow hot oil or hot components to contact the skin.

Do not drain the oil when the engine is cold. As the oil cools, suspended waste particles settle on the bottom of the oil pan. The waste particles are not removed with the draining cold oil. Drain the crankcase with the engine stopped. Drain the crankcase with the oil warm. This draining method allows the waste particles that are suspended in the oil to be drained properly.

Failure to follow this recommended procedure will cause the waste particles to be recirculated through the engine lubrication system with the new oil.

Drain the Engine Oil



g01003623

Illustration 38

Oil drain plug

After the engine has been run at the normal operating temperature, stop the engine. Use one of the following methods to drain the engine crankcase oil:

- If the engine is equipped with a drain valve, turn the drain valve knob counterclockwise in order to drain the oil. After the oil has drained, turn the drain valve knob clockwise in order to close the drain valve.
- If the engine is not equipped with a drain valve, remove the oil drain plug (1) in order to allow the oil to drain. If the engine is equipped with a shallow sump, remove the bottom oil drain plugs from both ends of the oil pan.

After the oil has drained, the oil drain plugs should be cleaned and installed. If necessary, renew the O ring seal on the drain plug.

Some types of oil pans have oil drain plugs that are on both sides of the oil pan, because of the shape of the pan. This type of oil pan requires the engine oil to be drained from both plugs.

Replace the Spin-on Oil Filter

NOTICE
Perkins oil filters are manufactured to Perkins specifications. Use of an oil filter that is not recommended by Perkins could result in severe damage to the engine bearings, crankshaft, etc., as a result of the larger waste particles from unfiltered oil entering the engine lubricating system. Only use oil filters recommended by Perkins.

1. Remove the oil filter with a suitable tool.

Note: The following actions can be carried out as part of the preventive maintenance program.

2. Cut the oil filter open with a suitable tool. Break apart the pleats and inspect the oil filter for metal debris. An excessive amount of metal debris in the oil filter may indicate early wear or a pending failure.

Use a magnet to differentiate between the ferrous metals and the nonferrous metals that are found in the oil filter element. Ferrous metals may indicate wear on the steel and cast iron parts of the engine.

Nonferrous metals may indicate wear on the aluminum parts, brass parts or bronze parts of the engine. Parts that may be affected include the following items: main bearings, rod bearings, turbocharger bearings, and cylinder heads.

Due to normal wear and friction, it is not uncommon to find small amounts of debris in the oil filter.

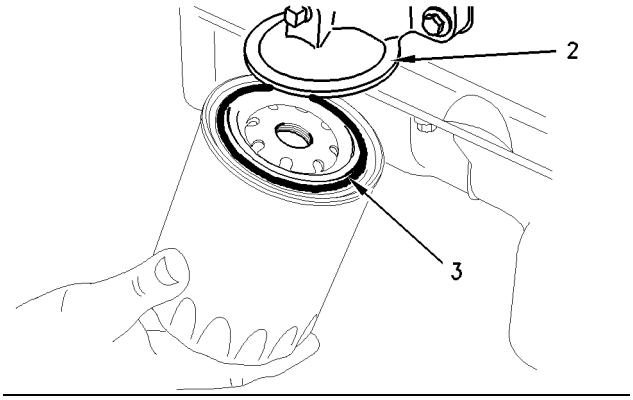


Illustration 39 g01003628

(2) Filter head
(3) O ring seal

3. Clean the sealing surface of the oil filter head (2). Ensure that the union (not shown) in the oil filter head is secure.

4. Apply clean engine oil to the O ring seal (3) on the oil filter.

NOTICE
Do not fill the oil filters with oil before installing them. This oil would not be filtered and could be contaminated. Contaminated oil can cause accelerated wear to engine components.

5. Install the oil filter. Tighten the oil filter by hand according to the instructions that are shown on the oil filter. Do not overtighten the oil filter.

Replace the Element for the Oil Filter

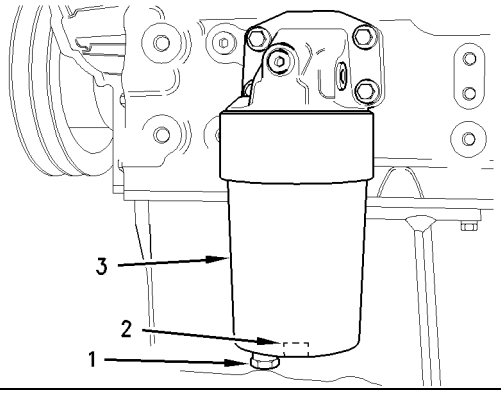


Illustration 40 g01003662

(1) Drain plug
(2) Square hole
(3) Filter bowl

1. Place a suitable container under the oil filter. Remove the drain plug (1) and the seal, from the oil filter.

2. Locate a suitable wrench into the square hole (2) in order to remove the filter bowl (3).

3. Remove the filter bowl (3) and remove the element from the filter bowl. Clean the filter bowl.

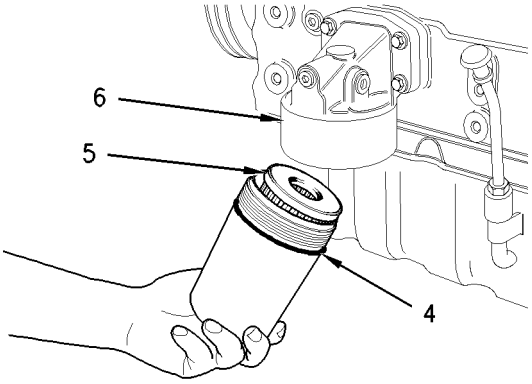


Illustration 41 g01003675

(4) O ring seal
(5) Element
(6) Filter head

4. Install a new O ring (4) onto the filter bowl and lubricate the O ring with clean engine oil. Install the filter element (5) into the filter bowl.

5. Install the filter bowl into the oil filter head (6). Tighten the filter bowl to the following torque 25 N·m (18 lb ft).

6. Install a new seal onto the drain plug (1) and install the drain plug into the oil filter. Tighten the drain plug to the following torque 12 N·m (8 lb ft).

Note: Some engines may have a horizontally mounted oil filter. This oil filter has a drain plug that is located in the oil filter head.

Fill the Engine Crankcase

1. Remove the oil filler cap. Refer to the Operation and Maintenance Manual for more information on lubricant specifications. Fill the crankcase with the proper amount of oil. Refer to the Operation and Maintenance Manual for more information on refill capacities.

NOTICE
If equipped with an auxiliary oil filter system or a remote oil filter system, follow the OEM or filter manufacturer's recommendations. Under filling or overfilling the crankcase with oil can cause engine damage.

NOTICE
To prevent crankshaft bearing damage, crank the engine with the fuel OFF. This will fill the oil filters before starting the engine. Do not crank the engine for more than 30 seconds.

2. Start the engine and run the engine at "LOW IDLE" for two minutes. Perform this procedure in order to ensure that the lubrication system has oil and that the oil filters are filled. Inspect the oil filter for oil leaks.

3. Stop the engine and allow the oil to drain back to the sump for a minimum of ten minutes.

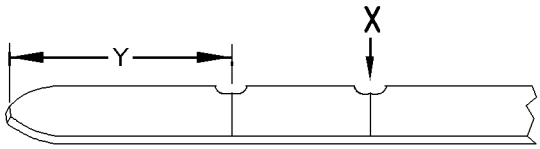


Illustration 42 g00998024

(Y) "ADD" mark. (X) "FULL" mark.

4. Remove the oil level gauge in order to check the oil level. Maintain the oil level between the "ADD" and "FULL" marks on the engine oil dipstick.

i02171102

Engine Valve Lash - Inspect/Adjust

This maintenance is recommended by Perkins as part of a lubrication and preventive maintenance schedule in order to help provide maximum engine life.

NOTICE
Only qualified service personel should perform this maintenance. Refer to the Service Manual or your authorized Perkins dealer or your Perkins distributor for the complete valve lash adjustment procedure.

Operation of Perkins engines with incorrect valve lash can reduce engine efficiency, and also reduce engine component life.

⚠ WARNING

Ensure that the engine can not be started while this maintenance is being performed. To help prevent possible injury, do not use the starting motor to turn the flywheel.

Hot engine components can cause burns. Allow additional time for the engine to cool before measuring/adjusting valve lash clearance.

Ensure that the engine is stopped before measuring the valve lash. The engine valve lash can be inspected and adjusted when the temperature of the engine is hot or cold.

Refer to Systems Operation/Testing and Adjusting, “Engine Valve Lash - Inspect/Adjust” for more information.

i02198352

Fuel Injector - Test/Change

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire.

NOTICE
Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

NOTICE
If a fuel injector is suspected of operating outside of normal parameters it should be removed by a qualified technician. The suspect fuel injector should be taken to an authorised agent for inspection.

The fuel injector (1) in illustration 43 has no fuel return. The fuel injector (2) has a fuel return.

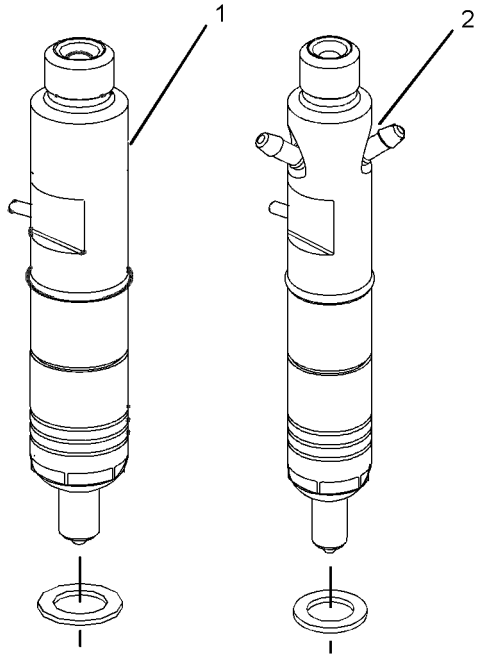


Illustration 43 g01110422
Typical fuel Injectors

The fuel injector (1) will need to be removed and the injector will need to be checked for performance.

The fuel injectors should not be cleaned as cleaning with incorrect tools can damage the nozzle. The fuel injectors should be renewed only if a fault with the fuel injectors occurs. Some of the problems that may indicate that new fuel injectors are needed are listed below:

- The engine will not start or the engine is difficult to start.
- Not enough power
- The engine misfires or the engine runs erratically.
- High fuel consumption
- Black exhaust smoke
- The engine knocks or there is vibration in the engine.
- Excessive engine temperature

Removal and Installation of the Fuel Injectors

⚠ WARNING

Work carefully around an engine that is running. Engine parts that are hot, or parts that are moving, can cause personal injury.

⚠ WARNING

Make sure that you wear eye protection at all times during testing. When fuel injection nozzles are tested, test fluids travel through the orifices of the nozzle tip with high pressure. Under this amount of pressure, the test fluid can pierce the skin and cause serious injury to the operator. Always keep the tip of the fuel injection nozzle pointed away from the operator and into the fuel collector and extension.

NOTICE
If your skin comes into contact with high pressure fuel, obtain medical assistence immediately.

Operate the engine at a fast idle speed in order to identify the faulty fuel injector. Individually loosen and tighten the union nut for the high pressure pipe to each fuel injector. Do not loosen the union nut more than half a turn. There will be little effect on the engine speed when the union nut to the faulty fuel injection nozzle is loosened. Refer to the Disassembly and Assembly Manual for more information. Consult your authorized Perkins dealer or your Perkins distributor for assistance.

i02890360

Fuel System - Prime

If air enters the fuel system, the air must be purged from the fuel system before the engine can be started. Air can enter the fuel system when the following events occur:

- The fuel tank is empty or the fuel tank has been partially drained.
- The low pressure fuel lines are disconnected.
- A leak exists in the low pressure fuel system.
- The fuel filter is replaced.
- A new injection pump is installed.

Use the following procedure in order to remove air from the fuel system:

1. Ensure that all low pressure fuel connections and high pressure fuel lines are installed correctly.
2. Turn the ignition key to the RUN position. Leave the ignition key in the RUN position for three minutes. If a manual purging screw is installed, the purging screw should be slackened during priming the fuel system.

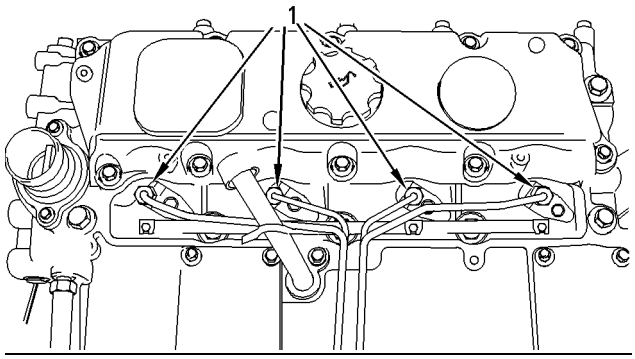


Illustration 44 g01003929
Typical example

3. Crank the engine with the throttle lever in the CLOSED position until the engine starts.

Note: If necessary, loosen the union nuts (1) on the fuel injection lines at the connection with the fuel injector until fuel is evident. Stop cranking the engine. Tighten the union nuts (1) to a torque of 30 N·m (22 lb ft).

4. Start the engine and run the engine at idle for one minute.

NOTICE
Do not crank the engine continuously for more than 30 seconds. Allow the starting motor to cool for two minutes before cranking the engine again.

5. Cycle the throttle lever from the low idle position to the high idle position three times. The cycle time for the throttle lever is one second to six seconds for one complete cycle.

Note: In order to purge air from the fuel injection pump on Perkins engines with a fixed throttle, the engine should be run at full load for thirty seconds. The load should then be decreased until the engine is at high idle. This should be repeated three times. This will assist in removing trapped air from the fuel injection pump.

6. Check for leaks in the fuel system.

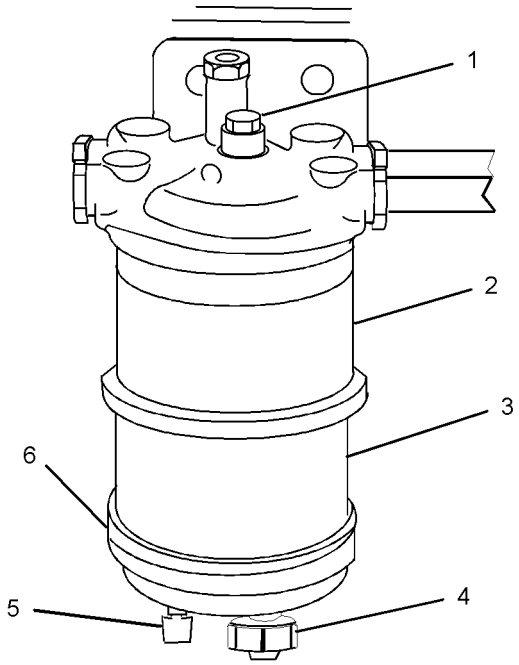
i02206563

Fuel System Primary Filter (Water Separator) Element - Replace

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

NOTICE
Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.



g01118416

Illustration 45

(1) Screw
(2) Element
(3) Glass bowl
(4) Sensor connection
(5) Drain
(6) Bottom cover

1. Turn the fuel supply valve (if equipped) to the OFF position.
2. Place a suitable container under the water separator. Clean the outside of the water separator.
3. Open the drain (5). Allow the fluid to drain into the container.
4. Tighten the drain (5) by hand pressure only.
5. Hold the element (2) and remove the screw (1). Remove the element and the glass bowl (3) from the base. Discard the old element.
6. Clean the glass bowl (4). Clean the bottom cover (6).
7. Install the new O ring seal. Install the bottom cover onto the new element. Install the assembly onto the base.
8. Install the screw (1) and tighten the screw to a torque of 8 N·m (6 lb ft).
9. Remove the container and dispose of the fuel safely.
10. Open the fuel supply valve.
11. Prime the fuel system. Refer to the Operation and Maintenance Manual, “Fuel System - Prime” for more information.

i02211066

Fuel System Primary Filter/Water Separator - Drain

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

NOTICE
The water separator is not a filter. The water separator separates water from the fuel. The engine should never be allowed to run with the water separator more than half full. Engine damage may result.

NOTICE
The water separator is under suction during normal engine operation. Ensure that the drain valve is tightened securely to help prevent air from entering the fuel system.

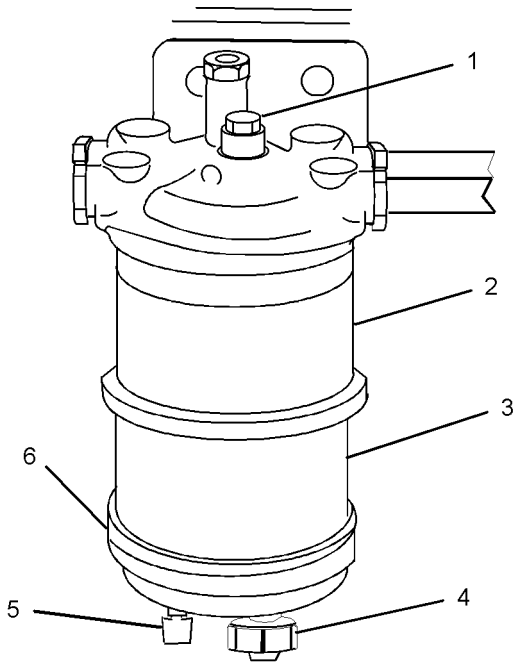


Illustration 46 g01118416

(1) Screw
(2) Element
(3) Glass bowl
(4) Sensor connection
(5) Drain
(6) Bottom cover

1. Place a suitable container below the water separator.
2. Open the drain (5). Allow the fluid to drain into the container.
3. When clean fuel drains from the water separator close the drain (5). Tighten the drain by hand pressure only. Dispose of the drained fluid correctly.

i02469473

Fuel System Secondary Filter - Replace

⚠ WARNING

Fuel leaked or spilled onto hot surfaces or electrical components can cause a fire. To help prevent possible injury, turn the start switch off when changing fuel filters or water separator elements. Clean up fuel spills immediately.

NOTICE
Do not allow dirt to enter the fuel system. Thoroughly clean the area around a fuel system component that will be disconnected. Fit a suitable cover over disconnected fuel system component.

Element filter

Turn the valves for the fuel lines (if equipped) to the OFF position before performing this maintenance. Place a tray under the fuel filter in order to catch any fuel that might spill. Clean up any spilled fuel immediately.

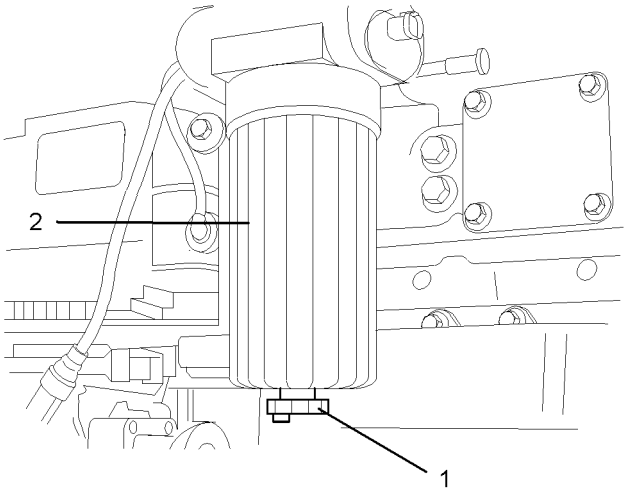


Illustration 47 g01010637

(1) Drain
(2) Filter bowl

1. Close the valves for the fuel lines (if equipped).
2. Clean the outside of the fuel filter assembly. Open the fuel drain (1) and drain the fuel into a suitable container.

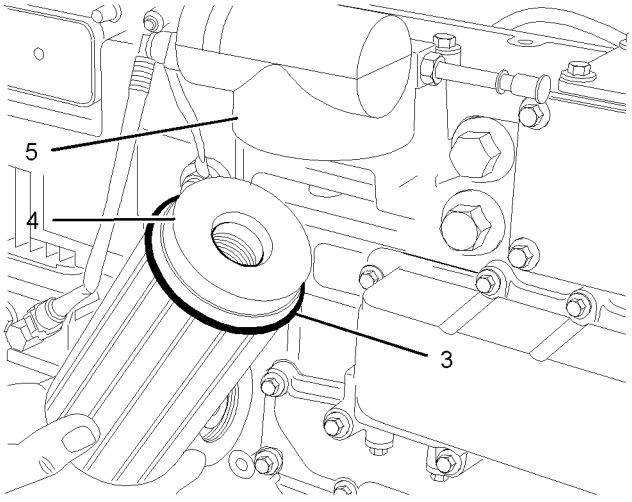


Illustration 48 g01010595

(3) O ring seal
(4) Element
(5) Filter head

3. Remove the filter bowl (2) from the filter head (5). Press on the element (4). Rotate the element counterclockwise in order to release the element for the filter bowl and remove the element from the bowl. Discard the used element.

4. Remove the O ring (3) from the filter bowl and clean the filter bowl. Check that the threads of the filter bowl are not damaged.

5. Install a new O ring seal (3) to the filter bowl (2).

6. Locate a new filter element (4) into the filter bowl. Press on the element and rotate the element clockwise in order to lock the element into the filter bowl.

7. Install the filter bowl (4) into the top of the filter head (5).

8. Tighten the filter bowl by hand until the filter bowl contacts the filter head. Rotate the filter bowl through 90 degrees.

Note: Do not use a tool to tighten the filter bowl.

9. Open the valves for the fuel lines (if equipped).

Spin-on filter

Turn the valves for the fuel lines (if equipped) to the OFF position before performing this maintenance. Place a tray under the fuel filter in order to catch any fuel that might spill. Clean up any spilled fuel immediately.

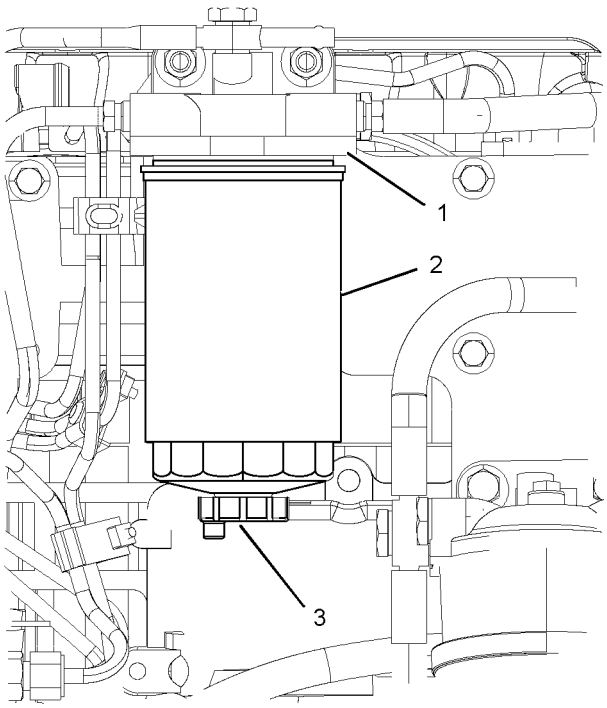


Illustration 49 g01121396

(1) Filter Head
(2) Spin-on filter
(3) Drain

1. Clean the outside of the fuel filter assembly. Open the fuel drain (3) and drain the fuel into a suitable container.

2. Use a suitable tool in order to remove the spin-on filter (2) from the filter head (1).

3. Ensure that the fuel drain (3) on the new spin-on filter is closed.

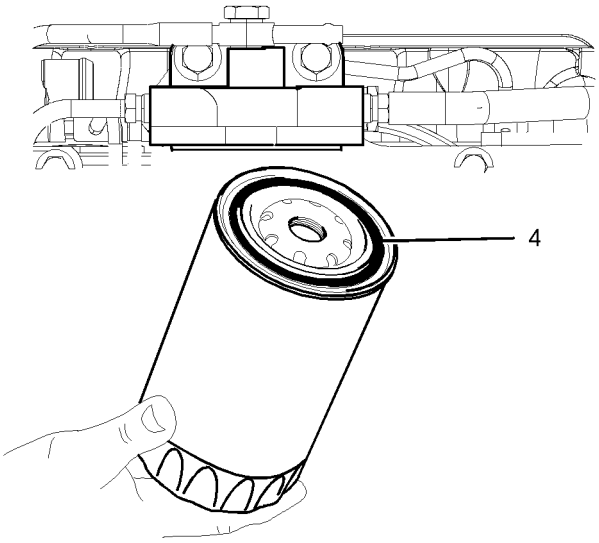


Illustration 50 g01121723

4. Lubricate the sealing ring (4) with clean fuel oil.

5. Install the spin-on filter (2) into the top of the filter head (1).

6. Tighten the spin-on filter by hand until the sealing ring contacts the filter head. Rotate the spin-on filter through 90 degrees.

7. Prime the fuel system. Refer to Operation and Maintenance Manual, “Fuel System - Prime”.

i02335436

Fuel Tank Water and Sediment - Drain

NOTICE
Care must be taken to ensure that fluids are contained during performance of inspection, maintenance, testing, adjusting, and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Dispose of all fluids according to local regulations and mandates.

Fuel Tank

Fuel quality is critical to the performance and to the service life of the engine. Water in the fuel can cause excessive wear to the fuel system.

Water can be introduced into the fuel tank when the fuel tank is being filled.

Condensation occurs during the heating and cooling of fuel. The condensation occurs as the fuel passes through the fuel system and the fuel returns to the fuel tank. This causes water to accumulate in fuel tanks. Draining the fuel tank regularly and obtaining fuel from reliable sources can help to eliminate water in the fuel.

Drain the Water and the Sediment

Fuel tanks should contain some provision for draining water and draining sediment from the bottom of the fuel tanks.

Open the drain valve on the bottom of the fuel tank in order to drain the water and the sediment. Close the drain valve.

Check the fuel daily. Allow five minutes after the fuel tank has been filled before draining water and sediment from the fuel tank.

Fill the fuel tank after operating the engine in order to drive out moist air. This will help prevent condensation. Do not fill the tank to the top. The fuel expands as the fuel gets warm. The tank may overflow.

Some fuel tanks use supply pipes that allow water and sediment to settle below the end of the fuel supply pipe. Some fuel tanks use supply lines that take fuel directly from the bottom of the tank. If the engine is equipped with this system, regular maintenance of the fuel system filter is important.

Fuel Storage Tanks

Drain the water and the sediment from the fuel storage tank at the following intervals:

- Weekly
- Service intervals
- Refill of the tank

This will help prevent water or sediment from being pumped from the storage tank into the engine fuel tank.

If a bulk storage tank has been refilled or moved recently, allow adequate time for the sediment to settle before filling the engine fuel tank. Internal baffles in the bulk storage tank will also help trap sediment. Filtering fuel that is pumped from the storage tank helps to ensure the quality of the fuel. When possible, water separators should be used.

i02813964

Hoses and Clamps - Inspect/Replace

Inspect all hoses for leaks that are caused by the following conditions:

- Cracking
- Softness
- Loose clamps

Replace hoses that are cracked or soft. Tighten any loose clamps.

NOTICE
Do not bend or strike high pressure lines. Do not install bent or damaged lines, tubes or hoses. Repair any loose or damaged fuel and oil lines, tubes and hoses. Leaks can cause fires. Inspect all lines, tubes and hoses carefully. Tighten all connections to the recommended torque. Do not clip any other item to the high pressure lines.

Check for the following conditions:

- End fittings that are damaged or leaking
- Outer covering that is chafed or cut
- Exposed wire that is used for reinforcement
- Outer covering that is ballooning locally
- Flexible part of the hose that is kinked or crushed
- Armoring that is embedded in the outer covering

A constant torque hose clamp can be used in place of any standard hose clamp. Ensure that the constant torque hose clamp is the same size as the standard clamp.

Due to extreme temperature changes, the hose will harden. Hardening of the hoses will cause hose clamps to loosen. This can result in leaks. A constant torque hose clamp will help to prevent loose hose clamps.

Each installation application can be different. The differences depend on the following factors:

- Type of hose
- Type of fitting material
- Anticipated expansion and contraction of the hose
- Anticipated expansion and contraction of the fittings

Replace the Hoses and the Clamps

Refer to the OEM information for further information on removing and replacing fuel hoses (if equipped).

The coolant system and the hoses for the coolant system are not usually supplied by Perkins. The following text describes a typical method of replacing coolant hoses. Refer to the OEM information for further information on the coolant system and the hoses for the coolant system.

⚠ WARNING

Pressurized System: Hot coolant can cause serious burns. To open the cooling system filler cap, stop the engine and wait until the cooling system components are cool. Loosen the cooling system pressure cap slowly in order to relieve the pressure.

1. Stop the engine. Allow the engine to cool.
2. Loosen the cooling system filler cap slowly in order to relieve any pressure. Remove the cooling system filler cap.

Note: Drain the coolant into a suitable, clean container. The coolant can be reused.

3. Drain the coolant from the cooling system to a level that is below the hose that is being replaced.
4. Remove the hose clamps.
5. Disconnect the old hose.
6. Replace the old hose with a new hose.
7. Install the hose clamps with a torque wrench.

Note: For the correct coolant, see this Operation and Maintenance Manual, “Fluid Recommendations”.

8. Refill the cooling system. Refer to the OEM information for further information on refilling the cooling system.
9. Clean the cooling system filler cap. Inspect the cooling system filler cap’s seals. Replace the cooling system filler cap if the seals are damaged. Install the cooling system filler cap.
10. Start the engine. Inspect the cooling system for leaks.

i02335774

Radiator - Clean

The radiator is not usually supplied by Perkins. The following text describes a typical cleaning procedure for the radiator. Refer to the OEM information for further information on cleaning the radiator.

Note: Adjust the frequency of cleaning according to the effects of the operating environment.

Inspect the radiator for these items: Damaged fins, corrosion, dirt, grease, insects, leaves, oil, and other debris. Clean the radiator, if necessary.

⚠ WARNING

Personal injury can result from air pressure.

Personal injury can result without following proper procedure. When using pressure air, wear a protective face shield and protective clothing.

Maximum air pressure at the nozzle must be less than 205 kPa (30 psi) for cleaning purposes.

Pressurized air is the preferred method for removing loose debris. Direct the air in the opposite direction to the fan's air flow. Hold the nozzle approximately 6 mm (0.25 inch) away from the radiator fins. Slowly move the air nozzle in a direction that is parallel with the radiator tube assembly. This will remove debris that is between the tubes.

Pressurized water may also be used for cleaning. The maximum water pressure for cleaning purposes must be less than 275 kPa (40 psi). Use pressurized water in order to soften mud. Clean the core from both sides.

Use a degreaser and steam for removal of oil and grease. Clean both sides of the core. Wash the core with detergent and hot water. Thoroughly rinse the core with clean water.

If the radiator is blocked internally, refer to the OEM Manual for information regarding flushing the cooling system.

After cleaning the radiator, start the engine. Allow the engine to operate at low idle speed for three to five minutes. Accelerate the engine to high idle. This will help in the removal of debris and the drying of the core. Slowly reduce the engine speed to low idle and then stop the engine. Use a light bulb behind the core in order to inspect the core for cleanliness. Repeat the cleaning, if necessary.

Inspect the fins for damage. Bent fins may be opened with a "comb". Inspect these items for good condition: Welds, mounting brackets, air lines, connections, clamps, and seals. Make repairs, if necessary.

i02335775

Severe Service Application - Check

Severe service is the application of an engine that exceeds the current published standards for that engine. Perkins maintains standards for the following engine parameters:

- Performance such as power range, speed range, and fuel consumption
- Fuel quality
- Operational Altitude
- Maintenance intervals
- Oil selection and maintenance
- Coolant type and maintenance
- Environmental qualities
- Installation
- The temperature of the fluid in the engine

Refer to the standards for the engine or consult your Perkins dealer or your Perkins distributor in order to determine if the engine is operating within the defined parameters.

Severe service operation can accelerate component wear. Engines that operate under severe conditions may need more frequent maintenance intervals in order to ensure maximum reliability and retention of full service life.

Due to individual applications, it is not possible to identify all of the factors which can contribute to severe service operation. Consult your Perkins dealer or your Perkins distributor for the unique maintenance that is necessary for the engine.

The operating environment, incorrect operating procedures and incorrect maintenance procedures can be factors which contribute to a severe service application.

Environmental Factors

Ambient temperatures – The engine may be exposed to extended operation in extremely cold environments or hot environments. Valve components can be damaged by carbon buildup if the engine is frequently started and stopped in very cold temperatures. Extremely hot intake air reduces engine performance.

Quality of the air – The engine may be exposed to extended operation in an environment that is dirty or dusty, unless the equipment is cleaned regularly. Mud, dirt and dust can encase components. Maintenance can be very difficult. The buildup can contain corrosive chemicals.

Buildup – Compounds, elements, corrosive chemicals and salt can damage some components.

Altitude – Problems can arise when the engine is operated at altitudes that are higher than the intended settings for that application. Necessary adjustments should be made.

Incorrect Operating Procedures

- Extended operation at low idle
- Frequent hot shutdowns
- Operating at excessive loads
- Operating at excessive speeds
- Operating outside the intended application

Incorrect Maintenance Procedures

- Extending the maintenance intervals
- Failure to use recommended fuel, lubricants and coolant/antifreeze

i02177969

Starting Motor - Inspect

Perkins recommends a scheduled inspection of the starting motor. If the starting motor fails, the engine may not start in an emergency situation.

Check the starting motor for correct operation. Check the electrical connections and clean the electrical connections. Refer to the Systems Operation, Testing and Adjusting Manual, “Electric Starting System - Test” for more information on the checking procedure and for specifications or consult your Perkins dealer or your Perkins distributor for assistance.

i02184788

Turbocharger - Inspect (If Equipped)

A regular visual inspection of the turbocharger is recommended. Any fumes from the crankcase are filtered through the air inlet system. Therefore, by-products from oil and from combustion can collect in the turbocharger compressor housing. Over time, this buildup can contribute to loss of engine power, increased black smoke and overall loss of engine efficiency.

If the turbocharger fails during engine operation, damage to the turbocharger compressor wheel and/or to the engine may occur. Damage to the turbocharger compressor wheel can cause additional damage to the pistons, the valves, and the cylinder head.

NOTICE
Turbocharger bearing failures can cause large quantities of oil to enter the air intake and exhaust systems. Loss of engine lubricant can result in serious engine damage.

Minor leakage of oil into a turbocharger under extended low idle operation should not cause problems as long as a turbocharger bearing failure has not occured.

When a turbocharger bearing failure is accompanied by a significant engine performance loss (exhaust smoke or engine rpm up at no load), do not continue engine operation until the turbocharger is renewed.

A visual inspection of the turbocharger can minimize unscheduled downtime. A visual inspection of the turbocharger can also reduce the chance for potential damage to other engine parts.

Removal and Installation

Note: The turbochargers that are supplied are nonserviceable.

For options regarding the removal, installation, and replacement, consult your Perkins dealer or your Perkins distributor. Refer to the Disassembly and Assembly Manual, “Turbocharger - Remove and Turbocharger - Install” for further information.

Inspecting

NOTICE
The compressor housing for the turbocharger must not be removed from the turbocharger for cleaning.

The actuator linkage is connected to the compressor housing. If the actuator linkage is moved or disturbed the engine may not comply with emmissions legislation.

1. Remove the pipe from the turbocharger exhaust outlet and remove the air intake pipe to the turbocharger. Visually inspect the piping for the presence of oil. Clean the interior of the pipes in order to prevent dirt from entering during reassembly.

2. Check for the presence of oil. If oil is leaking from the back side of the compressor wheel, there is a possibility of a failed turbocharger oil seal.

   The presence of oil may be the result of extended engine operation at low idle. The presence of oil may also be the result of a restriction of the line for the intake air (clogged air filters), which causes the turbocharger to slobber.

3. Inspect the bore of the housing of the turbine outlet for corrosion.

4. Fasten the air intake pipe and the exhaust outlet pipe to the turbocharger housing.

i02177973

Walk-Around Inspection

Inspect the Engine for Leaks and for Loose Connections

A walk-around inspection should only take a few minutes. When the time is taken to perform these checks, costly repairs and accidents can be avoided.

For maximum engine service life, make a thorough inspection of the engine compartment before starting the engine. Look for items such as oil leaks or coolant leaks, loose bolts, worn belts, loose connections and trash buildup. Make repairs, as needed:

- The guards must be in the correct place. Repair damaged guards or replace missing guards.

- Wipe all caps and plugs before the engine is serviced in order to reduce the chance of system contamination.

NOTICE
For any type of leak (coolant, lube, or fuel) clean up the fluid. If leaking is observed, find the source and correct the leak. If leaking is suspected, check the fluid levels more often than recommended until the leak is found or fixed, or until the suspicion of a leak is proved to be unwarranted.

NOTICE
Accumulated grease and/or oil on an engine is a fire hazard. Remove the accumulated grease and oil. Refer to this Operation and Maintenance Manual, “Engine - Clean” for more information.

- Ensure that the cooling system hoses are correctly clamped and that the cooling system hoses are tight. Check for leaks. Check the condition of all pipes.

- Inspect the water pump for coolant leaks.

Note: The water pump seal is lubricated by the coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and the parts contract.

Excessive coolant leakage may indicate the need to replace the water pump seal. For the removal of the water pump and the installation of water pump and/or seal, refer to the Disassembly and Assembly Manual, “Water Pump - Remove and Install” for more information or consult your Perkins dealer or your Perkins distributor.

- Inspect the lubrication system for leaks at the front crankshaft seal, the rear crankshaft seal, the oil pan, the oil filters and the rocker cover.

- Inspect the fuel system for leaks. Look for loose fuel line clamps and/or tie-wraps.

- Inspect the piping for the air intake system and the elbows for cracks and for loose clamps. Ensure that hoses and tubes are not contacting other hoses, tubes, wiring harnesses, etc.

- Inspect the alternator belts and any accessory drive belts for cracks, breaks or other damage.

Belts for multiple groove pulleys must be replaced as matched sets. If only one belt is replaced, the belt will carry more load than the belts that are not replaced. The older belts are stretched. The additional load on the new belt could cause the belt to break.

- Drain the water and the sediment from the fuel tank on a daily basis in order to ensure that only clean fuel enters the fuel system.
- Inspect the wiring and the wiring harnesses for loose connections and for worn wires or frayed wires.
- Inspect the ground strap for a good connection and for good condition.
- Disconnect any battery chargers that are not protected against the current drain of the starting motor. Check the condition and the electrolyte level of the batteries, unless the engine is equipped with a maintenance free battery.
- Check the condition of the gauges. Replace any gauges that are cracked. Replace any gauge that can not be calibrated.

i01907756

Water Pump - Inspect

A failed water pump may cause severe engine overheating problems that could result in the following conditions:

- Cracks in the cylinder head
- A piston seizure
- Other potential damage to the engine

Note: The water pump seal is lubricated by the coolant in the cooling system. It is normal for a small amount of leakage to occur as the engine cools down and parts contract.

Visually inspect the water pump for leaks. Renew the water pump seal or the water pump if there is an excessive leakage of coolant. Refer to the Disassembly and Assembly Manual, “Water Pump - Remove and Install” for the disassembly and assembly procedure.

Warranty Section

Warranty Information

i01903596

Emissions Warranty Information

This engine may be certified to comply with exhaust emission standards and gaseous emission standards that are prescribed by the law at the time of manufacture, and this engine may be covered by an Emissions Warranty. Consult your authorized Perkins dealer or your authorized Perkins distributor in order to determine if your engine is emissions certified and if your engine is subject to an Emissions Warranty.

Index

A

After Starting Engine 30
After Stopping Engine..... 32
Aftercooler Core - Clean/Test 52
Aftercooler Core - Inspect..... 52
Alternator - Inspect 53
Alternator and Fan Belts - Inspect/Adjust/ Replace..... 53
  Adjustment..... 53
  Inspection..... 53
  Replacement..... 54

B

Battery - Replace..... 54
Battery Electrolyte Level - Check 54
Battery or Battery Cable - Disconnect 55
Before Starting Engine 10, 28
Burn Prevention..... 7
  Batteries..... 8
  Coolant..... 8
  Oils..... 8

C

Cold Weather Operation..... 33
  Hints for Cold Weather Operation..... 33
  Idling the Engine 34
  Recommendations for Coolant Warm Up 34
  Recommendations for the Coolant 33
  Viscosity of the Engine Lubrication Oil..... 33
Cold Weather Starting 29
Cooling System Coolant - Change 58
Cooling System Coolant (Commercial Heavy-Duty) - Change 55
  Drain 55
  Fill 56
  Flush 56
Cooling System Coolant (ELC) - Change..... 57
  Drain 57
  Fill 58
  Flush 57
Cooling System Coolant Extender (ELC) - Add..... 59
Cooling System Coolant Level - Check..... 59
  Engines With a Coolant Recovery Tank..... 59
  Engines Without a Coolant Recovery Tank..... 59
Crushing Prevention and Cutting Prevention 10

D

Driven Equipment - Check..... 60

E

Electrical System..... 11
  Grounding Practices 12
Emergency Stopping 32
Emissions Certification Film 20
  Label for compliant engines..... 20
  Label for engines that comply with MSHA emissions 22
  Label for engines that do not comply with emissions 22
Emissions Warranty Information..... 79
Engine - Clean..... 60
Engine Air Cleaner Element (Dual Element) - Clean/Replace 61
  Cleaning the Primary Air Cleaner Elements 62
  Servicing the Air Cleaner Elements 61
Engine Air Cleaner Element (Single Element) - Inspect/Replace..... 63
Engine Air Cleaner Service Indicator - Inspect..... 63
  Test the Service Indicator..... 63
Engine Description 16
  Engine Cooling and Lubrication..... 18
  Engine Service Life..... 18
  Engine Specifications..... 16
Engine Ground - Inspect/Clean 64
Engine Identification 19
Engine Lifting..... 24
Engine Mounts - Inspect..... 64
Engine Oil and Filter - Change 65
  Drain the Engine Oil..... 65
  Fill the Engine Crankcase..... 67
  Replace the Element for the Oil Filter..... 66
  Replace the Spin-on Oil Filter 66
Engine Oil Level - Check..... 64
Engine Oil Sample - Obtain..... 64
  Obtain the Sample and the Analysis..... 65
Engine Operation..... 31
Engine Starting..... 11, 28
Engine Stopping 11, 32
Engine Storage..... 24
  Cooling System..... 25
  Exhaust System..... 25
  General Items 26
  Induction System 25
  Lubrication System 24
Engine Valve Lash - Inspect/Adjust..... 67
Engine Warm-up..... 31

F

Fire Prevention and Explosion Prevention 8
  Fire Extinguisher..... 9
  Lines, Tubes and Hoses 9

Fluid Recommendations 38
Cooling System Specifications 45
ELC Cooling System Maintenance 47
Engine Oil 39
Fuel Specifications 42
General Lubricant Information 38
Foreword 4
California Proposition 65 Warning 4
Literature Information 4
Maintenance 4
Maintenance Intervals 4
Operation 4
Overhaul 4
Safety 4
Fuel and the Effect from Cold Weather 35
Fuel Conservation Practices 31
Fuel Injector - Test/Change 68
Removal and Installation of the Fuel Injectors 69
Fuel Related Components in Cold Weather 36
Fuel Filters 36
Fuel Heaters 36
Fuel Tanks 36
Fuel System - Prime 69
Fuel System Primary Filter (Water Separator) Element - Replace 70
Fuel System Primary Filter/Water Separator - Drain 70
Fuel System Secondary Filter - Replace 71
Element filter 71
Spin-on filter 72
Fuel Tank Water and Sediment - Drain 73
Drain the Water and the Sediment 73
Fuel Storage Tanks 73
Fuel Tank 73

G

Gauges and Indicators 27
General Hazard Information 6
Containing Fluid Spillage 7
Fluid Penetration 7
Pressure Air and Water 7

H

Hoses and Clamps - Inspect/Replace 74
Replace the Hoses and the Clamps 74

I

Important Safety Information 2

L

Lifting and Storage 24

M

Maintenance Interval Schedule 51
Maintenance Section 37
Model View Illustrations 13
1103 Engine Model Views 15
1104 Engine Model Views 13
Model Views 13
Mounting and Dismounting 10

O

Operation Section 24

P

Product Identification Information 19
Product Information Section 13

R

Radiator - Clean 75
Reference Numbers 19
Record for Reference 19
Refill Capacities 37
Cooling System 37
Lubrication System 37

S

Safety Messages 5
(1) Universal Warning 5
(2) Ether 5
Safety Section 5
Serial Number Plate 19
Severe Service Application - Check 75
Environmental Factors 76
Incorrect Maintenance Procedures 76
Incorrect Operating Procedures 76
Starting Motor - Inspect 76
Starting the Engine 29
Starting with Jump Start Cables 30
Stopping the Engine 32

T

Table of Contents 3
Turbocharger - Inspect (If Equipped) 76
Inspecting 77
Removal and Installation 76

W

Walk-Around Inspection 77
Inspect the Engine for Leaks and for Loose Connections 77
Warranty Information 79
Warranty Section 79
Water Pump - Inspect 78

Product and Dealer Information

Note: For product identification plate locations, see the section “Product Identification Information” in the Operation and Maintenance Manual.

Delivery Date: _____

Product Information

Model: _____

Product Identification Number: _____

Engine Serial Number: _____

Transmission Serial Number: _____

Generator Serial Number: _____

Attachment Serial Numbers: _____

Attachment Information: _____

Customer Equipment Number: _____

Dealer Equipment Number: _____

Dealer Information

Name: _____ Branch: _____

Address: _____

_____

_____

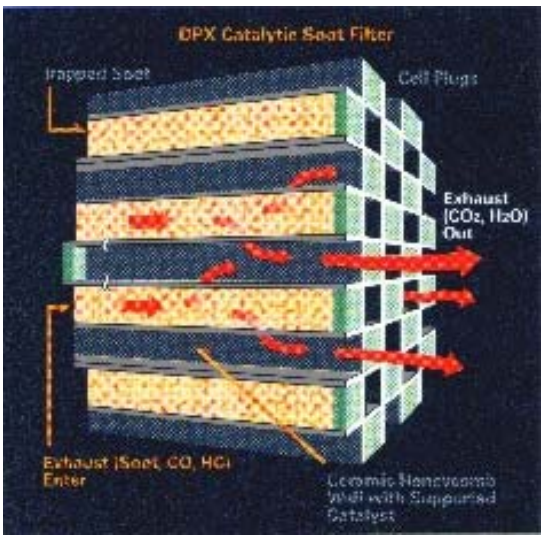
	Dealer Contact	Phone Number	Hours
Sales:	_____	_____	_____
Parts:	_____	_____	_____
Service:	_____	_____	_____

Copyright © 2008 Perkins Engines Company Limited
All Rights Reserved

Printed in U.K.

Proposal for the supply of DPX™ Catalysed Soot Filters for .....

Quotation No.: .....



Customer:

Date:

.....

Manufacturer
Engelhard Technologies Ltd.
Crucible Close
Coleford, GL 16 8RD

Application Engineering & Distribution
Krone GmbH
Herbert-Ludwig-Str.14
D-28832 Achim
Tel.:+(49)04202-9769-20
Fax:+49(0)4202-9769-11
e-mail: info@krone-filter.de

Scope of Supply

This proposal applies to the supply of the DPX™ Catalysed Soot Filter for use on …… (Euro ……) Engines powered by Diesel Fuel with **a maximum content of 350 ppm Sulphur level**. The target is to reach EURO 3 standards in terms of Particulate Matter (PM), CO & HC.

2 Product Description

For all Euro 2 class engines the DPX™ Catalysed Soot Filter System will comprise of a single ceramic "Wall Flow" Particulate Filter that is coated with a combination of a highly active base metal washcoat and a specially formulated "Precious Metal" coating. Referred to as DPX1.
For all Euro 0/1 class engines the DPX™ Catalysed Soot Filter System will comprise of a "Flow Through" ceramic Pre-Filter substrate that is coated with a highly active base metal washcoat, sited upstream of the Wall Flow Particulate Filter as described above. Referred to as DPX2

The "Wall Flow" Particulate Filter, and "Flow Through" Pre-Filter (where applicable) will be contained within a stainless steel outer casing. This patented system is designed to dramatically **reduce** the levels of **Carbon Monoxides (CO), Hydrocarbons (HC), and Particulate Matter (PM)** present within the exhaust output of a diesel engine by use of an oxidation process.

The DPX™ Catalysed Soot Filter has excellent sound attenuation characteristics for the removal of both high and low frequencies, and hence requires no further silencing. Therefore the existing silencer should be removed and replaced directly with the Catalysed Soot Filter System.

3 Operation

This system has been specifically designed to operate where the "Duty Cycle" of the diesel engine is operating at low temperatures (below 300°C)

To enable the System to function most effectively, it should be used in conjunction with the "Ultra Low Sulphur" Diesel Fuel (S=0.005%, NFE 590). The system can also be used on engines running with Standard Diesel Fuels having a sulphur content not exceeding 350 ppm (NF EN 590), with an increase in sulphate emissions only if the exhaust gas temperature exceeds 350°C.

The catalyst coating on the Filter element effectively lowers the ,,Light Off" temperature at which soot particles will combust. Therefore it promotes continuous and automatic regeneration of the soot particles that have been collected within the filter element.

The DPX™ Catalysed Soot Filter System does not require the use of fuel additives, burners or additional power sources and has no moving parts.

As the combustion process is dependent upon temperature, we recommend that wherever possible the vehicle should not be left idling for long periods of time.
If no temperature profile of the vehicle is given, Greentop – CTK rents out a data logging device to determine the actual exhaust temperature at vehicle duty cycle over a period of 2 – 5 days. The data logger is easy to install and guarantees that the right filter is laid out for the application.
The rental cost of the logger is DM 300,00 and will be refunded in case the filter is ordered.

4 Installation

Engelhard's DPX™ Catalytic Soot Filter is designed to be a direct replacement for your existing silencer. Installation is quick and easy.

The product is supplied complete with temperature and backpressure ports.

It is the responsibility of the operator to measure and record the backpressure of the system at the time of installation, and follow the cleaning procedure of the filter (as described below). Failure to do so may void the warranty.

Before testing the back pressure, the engine should be run for a period of time at half throttle to ensure normal operating temperatures of the vehicle are reached.

Backpressure test should be carried out with a standard manometer at high idle (fuel cut-off) with no load, i.e. neutral gear. The backpressure should not be higher than 150 millibar. If required a backpressure Kit can be purchased through Engelhard. The kit comes complete with a backpressure gauge capable of reading up to 250 millibars, and a snubber valve to eliminate engine pulsation.

After installation, there should be no visible smoke. If smoke is noticed, the operator should contact the supplier immediately.

5 Cleaning and Maintenance

The cleaning procedure for DPX™ units must be followed to ensure proper operation and durability. Failure to follow this procedure may void the warranty.

The DPX™ unit must be cleaned annually, every 1000 hours, according to the following procedure.

Note: The System backpressure is expected not to exceed a maximum of 200 millibar at this stage.

A. Before removing the DPX Centerbody for cleaning, mark the exhaust side (outlet) of the unit.
B. Remove the DPX Centerbody and with compressed dry air first clean the inlet face of the unit. Then blow air from the outlet side of the unit until minimum soot is detected.
   DO NOT APPLY COMPRESSED AIR NOZZLE DIRECTLY ON THE FACE OF THE FILTER.
C. Replace the DPX Centerbody on the vehicle in the opposite Flow direction from which it was removed.
   Only in Switzerland you have to use the filter always in the same flow direction.

We do not recommend cleaning DPX units with steam and / or other detergents. Use of these products may damage and / or deactivate the DPX unit.

MASK, GLOVES AND SAFETY GLASSED SHOULD BE WORN DURING CLEANING PROCEDURE.

Before normal operations are resumed, a backpressure and opacity reading should be recorded along with the Part Number/Serial Number of the Filter, and the mileage and date the maintenance took place.

Following cleaning some smoke may be emitted initially, but this will rapidly disperse.

Having removed the soot and ash particles from the filter, the operator should dispose of the contents as recommended by local regulatory legislation

Should any spare parts be required please contact Engelhard quoting the serial number of the DPX™ Catalysed Soot Filter System.

Details of Part Numbers and Prices can be found in Pricing & Delivery Section 6 below.

6 Pricing & Delivery

Prices given below are based upon the following Filter Sizing:

Catalysed Wall Flow Filter : ∅ ….” x ……”
Calculated Exhaust Back Pressure (as fresh) : < …..mbar (…..” w.c.)
Dimensions : see page 8

Terms:
Prices given are in EURO, FOB Achim, excluding freight, taxes, duties, insurance or any other additional cost.
Individual payment terms after agreement.
Pricing quoted is valid 90 days from proposal date.

Engine	**Order Quantity**	**DPX™ Product No**	**Price/Unit**	**Prototype Delivery**
	1 off	**DPX ……..**	**EURO ……**	**……. weeks**

OPTIONS & SPARE PARTS LIST

Component Part No	Description	Price each
C00415021	Blanking Plug 1/8" NPT SS	EURO
C00415009	Blanking Plug 1/4" NPT SS	EURO
S00402591	Back Pressure Kit	EURO

7 Product References

Engelhard is the world wide leading company for automotive catalysts. In the field of industrial exhaust abatement Engelhard's PTX™ Catalyst made it's name in the industry with more than 500.000 catalysts sold. Gaining from this experience the innovative and patented coating technology of the DPX Catalysed Soot Filter is State of the Art for particulate traps at the moment and is permanently improved.

The DPX filter is certified in France, Scandinavia and England, where bus and truck operators enjoy a tax reduction when retrofitting the filter.

Recently the DPX filter passed a TÜV test (Report No. S-134.99.008.00) with a remaining amount of Particulate Matter of 0.01 g/kWh (according to 96/1/EG/EC). This concentration is below the planned EURO 5 limit which will be valid in 2008.

Comprehensive results with the filters in underground mining applications are also available.

References for DPX™ Catalysed Soot Filters (Selection):

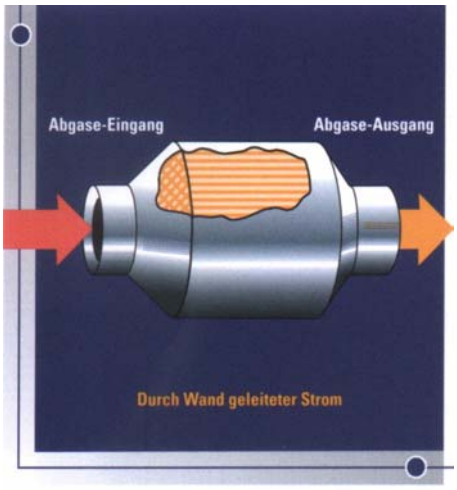
Customer:	RATP Paris, France
Program:	City Buses, First Prototype installed September 98
Fuel:	Ultra Low Sulphur Diesel (50 ppm)
Average Speeds:	Urban, 12 mph (19 kph)
Approximate Mileage:	Each Vehicle averages approximately 33.000 km Per Annum
PM Conversions:	In excess of 90%
Comments:	Products approved under AQA Cycle at UTAC Paris

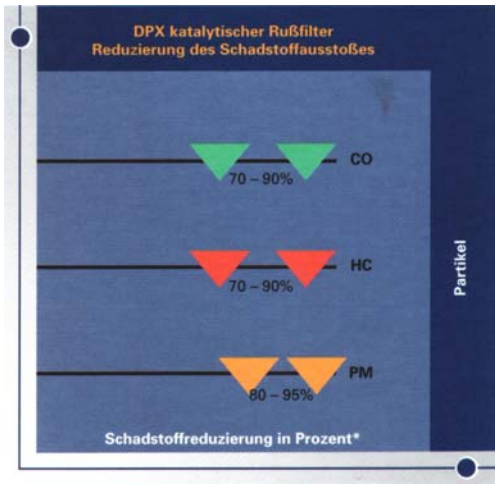
Customer:	Mount IZA Mining, Australia
Application:	Underground Mining Equipment
Fuel:	Standard Diesel (500 ppm Sulphur)
Total Units:	In excess of 300
Cumulative Totals:	10 years with trap life. >15.000 hours under high load operation
PM Conversions:	In excess of 80% at operating temperature 350°C
Comments:	Certified by Australian Mines

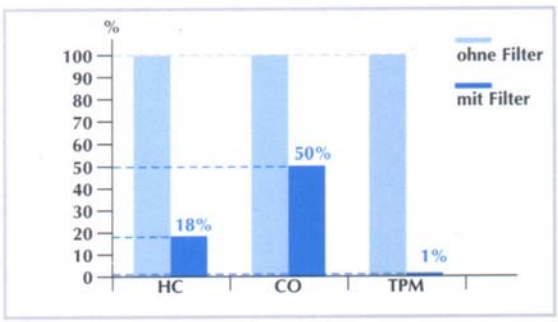
Customer:	Kali & Salz GmbH, Germany
Application:	Underground Mining Equipment
Fuel:	Standard Diesel (350 ppm Sulphur)
Total Prototype Units:	6 Vehicles (60 – 240 kW)
Cumulative Totals:	Approximately 1000 hours

PM Conversions:	> 90%
Exhaust Temperature	200 - 400° C

8 Emission-Reduction

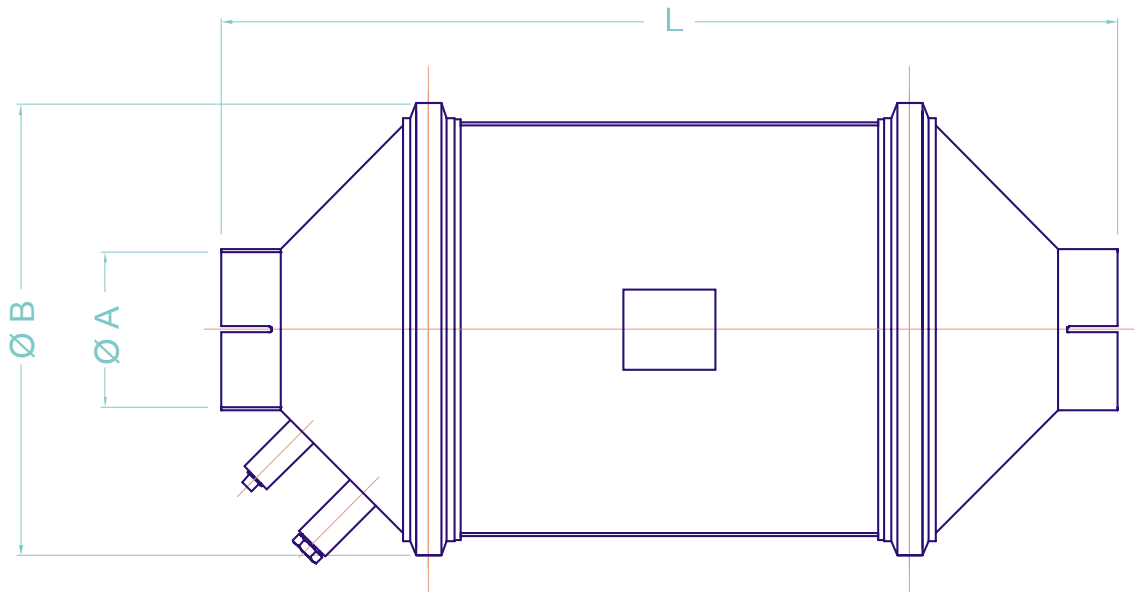






Emission Reduction in the US Transient Cycle

9 Dimensions



DPX Model	Monolith-Dim.	Ø A	Ø B	L
DPX 9056	Ø 5.66“ x 6.0“	76.2 mm	162 mm	356 mm
DPX 8939	Ø 7.5“ x 8.0“	76.2 mm	223 mm	440 mm
DPX 8944	Ø 7.5“ x 12.0“	76.2 mm	223 mm	540 mm
DPX 8945	Ø 9.0“ x 12.0“	76.2 mm	274 mm	640 mm
DPX 8940	Ø 10.5“ x 12.0“	101.6 mm	312 mm	640 mm
DPX 8941	Ø 11.25“ x 12.0“	101.6 mm	325 mm	650 mm
DPX 8942	Ø 11.25“ x 14.0“	101.6 mm	325 mm	700 mm
DPX 8943	Ø 12.0“ x 14.0“	101.0 mm	325 mm	761 mm
DPX 9169	Ø 15.0“ x 15.0“	180.0 mm	425 mm	775 mm
DPX SF2015	Ø 20.0“ x 15.0“	TBA	TBA	TBA

FG Wilson WARRANTY Statement

This is a warranty which applies to Electric Power Generation Products sold by FG Wilson (herein after referred to as "the Company"). The products are warranted against defects in material and workmanship for a period of 12 months* (24 months for standby application limited to 500 hrs per annum) from the date of delivery to first user.

The Company's Responsibilities

If a defect in material or workmanship arises during the warranty period the Company will during normal working hours and through a place of business of a FG Wilson Dealer or other source approved by FG Wilson:

- Replace or at the Company's discretion repair the defective parts.
- Provide for reasonable and customary labour costs to correct the defect.
- Provide for the cost of service supplies such as coolant oil and filters which are made unserviceable by the defect.
- Provide travel labour, up to four hours and 250 miles round trip, if the engine is inoperative due to a defect and, in the opinion of the Company, it cannot reasonably be transported to an appropriate service location.

The User's Responsibilities

The User is responsible for:

- Installing, operating and maintaining the generator set in accordance with the manufacturer's instructions.
- Returning the Warranty Registration Form within one month of delivery.
- Ensuring initial startup is performed by an authorised representative of the company or it dealers. In exceptional circumstances, said startup will be waived but only if a Pre-Delivery Inspection has been completed. In such circumstances, warranty will be adjudged to have commenced one month and terminated 13 months after the date of shipment by the Company.
- Making the equipment available for repair as soon as the defect has become apparent.
- Accepting the Company's sole judgement as to whether the faulty part is defective in material or workmanship.
- Labour costs, except as stated under "The Company's Responsibilities," including costs beyond those required to disconnect the product from and reconnect the product to it's attached equipment, mountings and support systems.
- The costs and risks for transport/shipping and other charges associated with the replacement of the repair parts.
- Any costs in excess of the purchase price of the product.
- Other miscellaneous costs including but not limited to courier, travel, mileage, lodging, taxes, telephone calls, overtime, etc., except as stated under "The Company's Responsibilities."
- Completing any outstanding payments for the purchase of equipment, parts or services relating to the equipment under warranty.

Limitations

This warranty does not cover:

- Defects due to the user's improper installation, maintenance or use as adjudged by the Company
- Alterations or repairs not authorised by the Company in writing.
- Any operation in excess of the Company's rating or outside the stated site conditions.
- Normal wear and tear.
- Damage to parts, fixtures, housings, attachments and accessory items that are not part of the. Electric Power Generation Product.
- Any product specific hours limitations.

* Lister power generating set models have an additional running hour limitation as follows: – 5000 hrs at 1500/1800 rpm, 2000 hours at 3000 rpm and 1000 hours at 3600 rpm. Either the 12 months limitations or the running hour limitation is applicable, depending on which occurs first.

This warranty is expressly in lieu of all other warranties, express or implied, including, but not limited to, any warranty of merchantability or fitness for a particular purpose. All warranties which exceed the aforementioned obligations are hereby disclaimed by the Company and excluded from this warranty. The Company shall, under no circumstances, be held liable for any special direct, indirect, incidental or consequential damages. All claims made under this warranty should be made by contacting your local dealer or the Company who will outline the administration and scope.

www.FGWilson.com

P110-2

Image for illustration purposes only.

Output Ratings

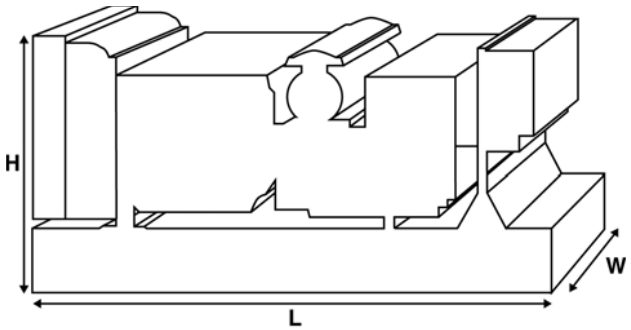
Generating Set Model	Prime*	Standby*
380-415V,50Hz	100.0 kVA / 80.0 kW	110.0 kVA / 88.0 kW
480V, 60 Hz	113.0 kVA / 90.4 kW	125.0 kVA / 100.0 kW

Ratings at 0.8 power factor.

Prime Rating
These ratings are applicable for supplying continuous electrical power (at variable load) in lieu of commercially purchased power. There is no limitation to the annual hours of operation and this model can supply 10% overload power for 1 hour in 12 hours.

Standby Rating
These ratings are applicable for supplying continuous electrical power (at variable load) in the event of a utility power failure. No overload is permitted on these ratings. The alternator on this model is peak continuous rated (as defined in ISO 8528-3).

Standard Reference Conditions
Note: Standard reference conditions 25°C (77°F) Air Inlet Temp, 100m (328 ft) A.S.L. 30% relative humidity.
Fuel consumption data at full load with diesel fuel with specific gravity of 0.85 and conforming to BS2869: 1998, Class A2.



Ratings and Performance Data

Engine Make & Model:		Perkins 1104C-44TAG2	
Alternator manufactured for FG Wilson by:		Leroy Somer	
Alternator Model:		LL3014B	
Control Panel:		DCP-10	
Base Frame:		Fbc2 - (08Hr)	
Circuit Breaker Type:		3 Pole MCCB	
Frequency:		**50 Hz**	**60 Hz**
Engine Speed: RPM		1500	1800
Fuel Tank Capacity: litres (US gal)		250 (66.0)	
Fuel Consumption: l/hr (US gal/hr)			
(100% Load)	**- Prime**	21.9 (5.8)	26.3 (6.9)
	- Standby	24.1 (6.4)	29.3 (7.7)

Available Options

FG Wilson offer a range of optional features to tailor our generating sets to meet your power needs. Options include:

- Upgrade to CE Certification◆
- A wide range of Sound Attenuated Enclosures
- A variety of generating set control and synchronising panels
- Additional alarms and shutdowns
- A selection of exhaust silencer noise levels

For further information on all of the standard and optional features accompanying this product please contact your local Dealer or visit: www.FGWilson.com

◆Not available from our Chinese facility – Tianjin.

Dimensions and Weights

Length (L) mm (in)	**Width** (W) mm (in)	**Height** (H) mm (in)	**Dry** kg (lb)	**Wet** kg (lb)
2089 (82.2)	1120 (44.1)	1367 (53.8)	1182 (2607)	1200 (2646)

Dry = With Lube Oil Wet = With Lube Oil and Coolant

Ratings in accordance with ISO 8528, ISO 3046, IEC 60034, BS5000 and NEMA MG-1/22.
Generating set pictured may include optional accessories.

FG Wilson has manufacturing facilities in the following locations:
Northern Ireland • Brazil • China • India • USA
With headquarters in Northern Ireland, FG Wilson operates through a Global Dealer Network.
To contact your local Sales Office please visit the FG Wilson website at www.FGWilson.com

Engine Technical Data	
No. of Cylinders / Alignment:	4 / In Line
Cycle:	4 Stroke
Bore / Stroke: mm (in)	105.0 (4.1)/127.0 (5.0)
Induction:	Turbocharged Air To Air Charge Cooled
Cooling Method:	Water
Governing Type:	Electronic
Governing Class:	ISO 8528 G2
Compression Ratio:	18.3:1
Displacement: l (cu. in)	4.4 (268.5)
Moment of Inertia: kg m² (lb/in²)	1.51 (5160)
Engine Electrical System:	
- Voltage / Ground	12/Negative
- Battery Charger Amps	65
Weight: kg (lb) **- Dry**	500 (1102)
- Wet	520 (1146)

Performance	50 Hz	60 Hz
Engine Speed: rpm	1500	1800
Gross Engine Power: kW (hp)		
- Prime	93.6 (126.0)	106.8 (143.0)
- Standby	103.0 (138.0)	117.5 (158.0)
BMEP: kPa (psi)		
- Prime	1702.0 (246.9)	1619.0 (234.8)
- Standby	1873.0 (271.7)	1781.0 (258.3)

Fuel System	
Fuel Filter Type:	Replaceable Element
Recommended Fuel:	Class A2 Diesel

Fuel Consumption: l/hr (US gal/hr)

Prime	110% Load	100% Load	75% Load	50% Load
50 Hz	24.1 (6.4)	21.9 (5.8)	16.6 (4.4)	11.7 (3.1)
60 Hz	29.3 (7.7)	26.3 (6.9)	19.9 (5.3)	14.2 (3.8)

Standby	110% Load	100% Load	75% Load	50% Load
50 Hz		24.1 (6.4)	18.2 (4.8)	12.6 (3.3)
60 Hz		29.3 (7.7)	21.9 (5.8)	15.4 (4.1)

(Based on diesel fuel with a specific gravity of 0.84 and conforming to BS2869, Class A2)

Air Systems		50 Hz	60 Hz
Air Filter Type:		Replaceable Element	
Combustion Air Flow: m³/min (cfm)			
	- Prime	6.0 (212)	7.8 (274)
	- Standby	6.3 (221)	7.8 (275)
Max. Combustion Air Intate Restriction: kPa (in H_2O)		8.0 (32.1)	8.0 (32.1)

Cooling System		50 Hz	60 Hz
Cooling System Capacity: l (US gal)		17.5 (4.6)	17.5 (4.6)
Water Pump Type:		Centrifugal	
Heat Rejected to Water & Lube Oil:			
kW (Btu/min)	**- Prime**	46.1 (2622)	57.7 (3281)
	- Standby	50.7 (2883)	64.0 (3640)
Heat Radiation to Room: Heat radiated from engine and alternator			
kW (Btu/min)	**- Prime**	14.6 (830)	17.9 (1018)
	- Standby	16.5 (938)	20.4 (1160)
Radiator Fan Load: kW (hp)		2.8 (3.8)	4.8 (6.4)
Radiator Cooling Airflow: m³/min (cfm)		187.8 (6632)	244.2 (8624)
External Restriction to Cooling Airflow: Pa (in H_2O)		125 (0.5)	125 (0.5)

Designed to operate in ambient conditions up to 50°C (122°F).
Contact your local FG Wilson Dealer for power ratings at specific site conditions.

Lubrication System	
Oil Filter Type:	Spin-On, Full Flow
Total Oil Capacity: l (US gal)	8.0 (2.1)
Oil Pan: l (US gal)	7.0 (1.8)
Oil Type:	API CC/SE
Oil Cooling Method:	Water

Exhaust System		50 Hz	60 Hz
Silencer Type:		Industrial	
Silencer Model & Quantity:		SD50 (1)	
Pressure Drop Across Silencer System: kPa (in Hg)		2.10 (0.620)	3.56 (1.051)
Silencer Noise Reduction Level: dB		22	17
Maximum Allowable Back Pressure: kPa (in Hg)		18.0 (5.3)	15.0 (4.4)
Exhaust Gas Flow: m³/min (cfm)			
	- Prime	15.2 (537)	18.4 (650)
	- Standby	16.3 (576)	20.4 (720)
Exhaust Gas Temperature: °C (°F)			
	- Prime	514 (957)	517 (963)
	- Standby	543 (1009)	574 (1065)

Alternator Physical Data	
Manufactured for FG Wilson by:	Leroy Somer
Model:	LL3014B
No. of Bearings:	1
Insulation Class:	H
Winding Pitch Code:	2/3 - 6
Wires:	12
Ingress Protection Rating:	IP23
Excitation System:	SHUNT
AVR Model:	R250

Alternator Operating Data	
Overspeed: rpm	2250
Voltage Regulation: (Steady state)	+/- 0.5
Wave Form NEMA = TIF:	50
Wave Form IEC = THF:	2.0%
Total Harmonic content LL/LN:	4.0%
Radio Interference:	Suppression is in line with European Standard EN61000-6
Radiant Heat: kW (Btu/min)	
- 50 Hz	9.0 (512)
- 60 Hz	11.0 (626)

Alternator Performance Data:	50 Hz				60 Hz				
Data Item	415/240V	400/230V 230/115V 200/115V	380/220V 220/110V	220/127V	480/277V 240/139V	380/220V 220/110V	240/120V 208/120V	230/115V	440/254V 220/127V
Motor Starting Capability* kVA	187	176	160	208	206	136	160	149	177
Short Circuit Capacity %**	300	300	300	300	300	300	300	300	300
Reactances: Per Unit									
Xd	3.200	3.440	3.810	2.840	3.240	5.080	4.310	4.660	3.850
X'd	0.120	0.130	0.150	0.110	0.130	0.200	0.170	0.180	0.150
X"d	0.074	0.080	0.089	0.066	0.075	0.118	0.100	0.108	0.090

Reactances shown are applicable to prime ratings.
*Based on 30% voltage dip at 0.6 power factor.
**With optional permanent magnet generator.

Voltage Technical Data 50 Hz				
Voltage	**Prime:**		**Standby:**	
	kVA	**kW**	**kVA**	**kW**
415/240V	100.0	80.0	110.0	88.0
400/230V	100.0	80.0	110.0	88.0
380/220V	100.0	80.0	110.0	88.0
230/115V ◆	100.0	80.0	110.0	88.0
220/127V	100.0	80.0	110.0	88.0
220/110V ◆	100.0	80.0	110.0	88.0
200/115V ◆	100.0	80.0	110.0	88.0

Voltage Technical Data 60 Hz				
Voltage	**Prime:**		**Standby:**	
	kVA	**kW**	**kVA**	**kW**
480/277V	113.0	90.4	125.0	100.0
220/127V	113.0	90.4	125.0	100.0
380/220V	111.0	88.8	122.0	97.6
240/120V	113.0	90.4	125.0	100.0
230/115V	113.0	90.4	125.0	100.0
440/254V	113.0	90.4	125.0	100.0
220/110V ◆	111.0	88.8	122.0	97.6
208/120V ◆	113.0	90.4	125.0	100.0
240/139V ◆	113.0	90.4	125.0	100.0

◆Not available from our Chinese facility – Tianjin.

General Information

Documentation

A full set of operation and maintenance manuals and circuit wiring diagrams.

Generating Set Standards

The equipment meets the following standards: BS5000, ISO 8528, ISO 3046, IEC 60034, NEMA MG-1.22.

FG Wilson is a fully accredited ISO 9001 company.

EU Stage II Emissions Compliant.

Warranty

All prime equipment carries a one year manufacturer's warranty. Standby equipment, limited to 500 running hours per year, has a two year manufacturer's warranty. For details on warranty cover please contact your local Dealer, or visit our website: FGWilson.com.

Dealer contact details:

FG Wilson has manufacturing facilities in the following locations:

Northern Ireland • Brazil • China • India • USA

With headquarters in Northern Ireland, FG Wilson operates through a Global Dealer Network.

To contact your local Sales Office please visit the FG Wilson website at www.FGWilson.com

In line with our policy of continuous product development, we reserve the right to change specification without notice

GENERATOR SET
OPERATOR AND MAINTENANCE
INSTRUCTION MANUAL

This manual has been designed as a guide to operators to aid in starting, stopping and otherwise operating the generator set.

Issue Number: 06/12

Part Number: 356-5901

Language: English

Revision V4

ORIGINAL INSTRUCTIONS

CONTENTS

1. INTRODUCTION 6

2. SAFETY 7

2.1 General 7
2.1.1 Emergency Stop Button 7
2.2 Personal Protective Equipment 7
2.3 General Hazard Information 8
2.3.1 Pressurized Air and Water 8
2.3.2 Containing Fluid Spillage 8
2.3.3 Lines, Tubes and Hoses 8
2.3.4 Disposal of Waste 9
2.4 Fire and Explosion 9
2.4.1 Fire Extinguisher 9
2.5 Exhaust Gases 10
2.6 Mechanical 10
2.7 Chemical 10
2.7.1 Coolant 10
2.7.2 Oils 10
2.7.3 Batteries 10
2.8 Noise 11
2.9 Electrical 11
2.10 First Aid For Electric Shock 11
2.11 HAZARD LABEL LEGEND - (6.8 – 275 kVA range) 13
HAZARD LABEL LEGEND - (350 – 2500 kVA range) 14

3. GENERAL DESCRIPTION 15

3.1 Typical Rating Plate 15

4. INSTALLATION, HANDLING AND STORAGE 18

4.1 General 18
4.2 Outdoor Installation 19
4.2.1 Positioning of Walk-in Containers 20
4.2.2 Concrete Plinth 20
4.3.1 Approved Lifting Methods for ISO Walk-in Containers 23
4.3.2 Approved Lifting Methods for Non-ISO Walk-in Containers 23
4.4 Foundations and Vibration Isolation 24
4.4.1 Foundation 24
4.4.2 Vibration Isolation 24
4.5 Storage 25
4.5.1 Engine Storage 25
4.5.2 Alternator Storage 25
4.5.3 Battery Storage 25

5. CONTROL SYSTEM DESCRIPTION AND TROUBLE SHOOTING 26

5.1 Control System Description 26
5.2 1002T and LCP1002 (Quickstart) 26
5.2.1 Control Panel Instrumentation 26
5.2.2 General Information1002T / LCP1002 Control Systems 28
5.2.3 Pre-Start Checks 28
5.2.4 Normal Startup / Shutdown – Key Start Panel (1002T / LCP1002) 29
5.2.5 Control System Fault Finding / Trouble Shooting Guide 1002T / LCP1002 30
5.3 PowerWizard 1.0 & 2.0 (Quickstart) 31
5.3.1 General Information 31
5.3.2 PowerWizard Control Module Description 31
w Pre-Start Checks (applicable to all control systems) 32
5.3.4 Basic Operation 33
5.3.5 Fault / Alarm Reset Process 34
5.3.6 User Interface Overview 34
5.3.7 Alarm Log and Resetting 36
5.3.8 Security 37
5.3.9 Real Time Clock Programming (PowerWizard 2.0) 37
5.3.10 Fuel Priming – Engines with Electric Fuel Lift Pump 38
5.3.11 Additional Features Available 38
5.3.12 Trouble Shooting Guide for PowerWizard 38
5.4 PowerWizard 1.1, 1.1+ & 2.1 (Quickstart) 39
5.4.1 General Information 39
5.4.2 PowerWizard Control Module Description 39
5.4.3 Pre-Start Checks (applicable to all control systems) 40
5.4.4 Basic Operation 42
5.4.5 Fault / Alarm Reset Process 43
5.4.6 User Interface Overview 43
5.4.7 Alarm Log and Resetting 45
5.4.8 Security 46
5.4.9 Real Time Clock Programming (PowerWizard 2.1) 47
5.4.10 Fuel Transfer (PowerWizard 2.1) 47
5.4.11 Additional Features Available 47
5.4.12 Trouble Shooting Guide for PowerWizard 48
5.5 DCP-10 & DCP-20 49
5.5.1 General Information 49
5.5.2 DCP Control Module Description 49
5.5.3 Pre-Start Checks (applicable to all control systems) 50
5.5.4 Basic Operation 51
5.5.5 Fault / Alarm Reset Process - DCP-10 52
5.5.6 Fault / Alarm Reset Process - DCP-20 52
5.5.7 User Interface Overview 52

5.6 Control System Options and Upgrades 55
5.6.1 Battery Trickle / Switch-Mode Chargers 55
5.6.2 Heaters 55
5.6.3 Electric Fuel Transfer Pumps 55
5.6.4 Meters / Gauges 56
5.6.5 Speed / Voltage Control 56
5.6.6 Alarm Signalling 56
5.6.7 Automatic Preheat Control 56
5.6.8 Remote Annunciator Panels 56

6. OPERATION 57

6.1 Priming Procedure for 1100 Series 57
6.1.1 Products fitted with the small Perkins pre-filter / water separator 57
6.1.2 Products fitted with the Racor Pre-Filter / Water Separator (Option) 58
6.1.3 Troubleshooting 59
6.1.4 Starting with Jump Start Cables 59

7. LOAD TRANSFER PANELS 61

7.1 Engine Interface Module Description (where fitted) 62
7.2 Output Circuit Breaker Description 62

8. ELECTRONIC ENGINE FAULT DETECTION FLASH CODES 63

9. MAINTENANCE 64

9.1 Battery Removal and Fitting 64
9.2 Preventative Maintenance 65
9.3 Alternator Preventative Maintenance 65
9.4 Engine Preventative Maintenance 65
9.5 Decommissioning, Dismantling and Disposal 65

1. INTRODUCTION

Thank you for choosing our company to supply your electrical power needs. In line with our policy of continuous product improvement, we reserve the right to change the information contained within this manual without notice.

This Operator Instruction Manual has been designed to help you operate and maintain your electrical generator set correctly. We recommend that the operator should take the time to read this manual. Certain tasks may require work to be completed by specifically trained technicians, an operator should only attempt a task detailed for an operator to complete.

This generator set is one of a family of heavy duty industrial generator sets designed to be ready to run when it arrives. Years of diesel generator set experience has gone into the set to produce a quality source of electrical power that is efficient and reliable.

Always ensure that maintenance, adjustments and repairs are done by personnel who are authorised to do the work and have been properly trained. Maintenance and repairs should also be carried out at regular intervals using genuine parts, this will prolong the life of the generator set. The manufacturer is not liable for any defects or claims due to the user's improper installation, maintenance or use, or for any products which have been modified in any way from the state in which they were sold. All generator sets should only be operated by those required to do so and therefore be safely kept away from non authorised use.

Some photographs or illustrations in this manual show details or attachments that may be different from your generator set. These images are for illustrative purposes only. If you have any questions regarding your generator set, please contact your local Dealer for the latest available information.

Every generator set is uniquely defined by a model number and serial number indicated on a rating plate generally affixed to the alternator housing (See Section 3.1). This information is required when ordering spare parts or when service or warranty work is required.

2. SAFETY

2.1 General

The generator set is designed to be safe when used in the correct manner. Responsibility for safety, however, rests with the personnel who use the set. Before performing any procedure or operating technique, it is the user's responsibility to ensure that it is safe to do so.

Warning:

⚠ **Read and understand all safety precautions and warnings before operating the generator set.**

⚠ **Failure to follow the instructions, procedures and safety precautions in this manual may increase the possibility of accidents and injuries.**

⚠ **Never start the generator set unless it is safe to do so.**

⚠ **Do not attempt to operate the generator set with a known unsafe condition.**

⚠ **If the generator set is unsafe, fit danger notices and disconnect the battery negative (–) lead so that it cannot be started until the condition is corrected.**

⚠ **Ensure the generator set is protected from any unauthorised use, use signs were appropriate.**

⚠ **Disconnect the battery negative (–) lead prior to attempting installation, repairs or cleaning on the generator set.**

⚠ **Install and operate this generator set only in full compliance with relevant National, Local, or Federal Codes, Standards or other requirements.**

2.1.1 Emergency Stop Button

The emergency stop button is in the OUT position for normal engine operation. Push the emergency stop button. The engine will not start when the button is locked. Turn the button clockwise in order to reset.

Warning

⚠ **Familiarise yourself with the location of the Emergency Stop Button. Emergency shutoff controls are for EMERGENCY use ONLY.**

⚠ **DO NOT use emergency shutoff devices or controls for normal stopping procedure.**

⚠ **Do not start the engine until the problem necessitating the emergency stop has been located and corrected.**

2.2 Personal Protective Equipment

Figure 2a – Typical PPE to be worn by an Operator

- Appropriate PPE should always be worn whilst working in and around the generator set. Wear a hard hat, protective glasses, gloves and other protective equipment, as required by generator set location.
- When work is performed around an engine that is operating, wear protective devices for ears in order to help prevent damage to hearing.
- Do not wear loose clothing or jewellery that can snag on controls or on other parts of the engine.

- Ensure that all protective guards and all covers are secured in place on the engine.
- Never put maintenance fluids into glass containers. Glass containers can break.
- Use all cleaning solutions with care.
- Report all necessary repairs.

Unless other instructions are provided, perform the maintenance under the following conditions:

- The engine is stopped. Ensure that the engine cannot be started.
- Disconnect the batteries when maintenance is performed or when the electrical system is serviced. Disconnect the battery ground leads. Tape the leads in order to help prevent sparks.
- Do not attempt any repairs that are not understood. Use the proper tools. Replace any equipment that is damaged or repair the equipment.

2.3 General Hazard Information

2.3.1 Pressurized Air and Water

Pressurized air and/or water (not recommended) can cause debris and/or hot water to be blown out which could result in personal injury.

When pressurized air is used, wear protective clothing, protective shoes and eye protection. Eye protection includes goggles or a protective face shield.

The maximum air pressure for cleaning purposes must be reduced to 205 kPa (30 psi) when the air nozzle is deadheaded and used with effective chip guarding (if applicable) and personal protective equipment. The maximum water pressure for cleaning purposes must be below 275 kPa (40 psi). Always wear eye protection for cleaning the cooling system.

Do not touch any part of an operating engine. Allow the engine to cool before any maintenance is performed on the engine. Relieve all pressure in the air system, in the hydraulic system, in the lubrication system, in the fuel system, or in the cooling system before any lines, fittings or related items are disconnected.

2.3.2 Containing Fluid Spillage

Care must be taken to ensure that fluids are contained during inspection, maintenance, testing, adjusting and repair of the product. Be prepared to collect the fluid with suitable containers before opening any compartment or disassembling any component containing fluids.

Note:

- Dispose of all fluids according to local regulations and mandates.

2.3.3 Lines, Tubes and Hoses

Do not bend or strike lines. Do not install lines, tubes, or hoses that are damaged.

Inspect all lines, tubes, and hoses carefully. Do not use bare hands to check for leaks. Organise with your local Dealer repair of any fuel lines, oil lines, tubes, or hoses that are loose or damaged

Check for the following conditions:

- End fittings that are damaged or leaking
- Outer covering that is chafed or cut
- Wire that is exposed in reinforced hose
- Outer covering that is ballooning
- Flexible part of the hose that is kinked or crushed
- Armoring that is embedded in the outer covering

Ensure that all of the clamps, the guards and the heat shields are installed correctly. Correct installation of these components will help to prevent these effects: vibration, rubbing against other parts and excessive heat during operation.

2.3.4 Disposal of Waste

Improper disposal of waste can threaten the environment. Potentially harmful fluids should be disposed of according to local regulations. Always use leakproof containers when you drain fluids. Do not pour waste onto the ground, down a drain, or into any source of water.

2.4 Fire and Explosion

All fuels, most lubricants, and some coolant mixtures are flammable. Flammable fluids that are leaking or spilled onto hot surfaces or onto electrical components can cause a fire. Fire may cause personal injury and property damage.

Determine whether the engine will be operated in an environment that allows combustible gases to be drawn into the air inlet system. These gases could cause the engine to overspeed. Personal injury, property damage, or engine damage could result. If the application involves the presence of combustible gases, consult your local Dealer for additional information about suitable protection devices.

Do not allow any flammable materials to accumulate on the engine. Store fuels and lubricants in properly marked containers away from unauthorized persons. Store oily rags and any flammable materials in protective containers. Do not smoke in areas that are used for storing flammable materials.

Wiring must be kept in good condition, all electrical wires must be properly routed and securely attached. Check all electrical wires daily, seek appropraite maintenance from your local Dealer for any wires that are loose or frayed, before you operate the engine.

Arcing or sparking could cause a fire. Secure connections, recommended wiring and properly maintained battery cables will help to prevent arcing or sparking.

Never check the battery charge by placing a metal object across the terminal posts. Use a voltmeter or a hydrometer.

The batteries must be kept clean, the covers (if equipped) must be kept on the cells. Use the recommended cables, connections, and battery box covers (where fitted) when the generator set is operated.

Warning

- ⚠ **Do not charge a frozen battery, this may cause an explosion.**
- ⚠ **Ensure the generator set room is properly ventilated.**
- ⚠ **Keep the room, the floor and the generator set clean. When spills of fuel, oil, battery electrolyte or coolant occur, they should be cleaned up immediately.**
- ⚠ **Never store flammable liquids near the engine.**
- ⚠ **Store oily rags in covered metal containers.**
- ⚠ **Do not smoke or allow sparks, flames or other sources of ignition around fuel or batteries. Fuel vapours are explosive. Hydrogen gas generated by charging batteries is also explosive.**
- ⚠ **Avoid refilling the fuel tank while the engine is running.**
- ⚠ **Do not attempt to operate the generator set with any known leaks in the fuel system.**
- ⚠ **Do not use aerosol types of starting aids such as ether. Using these types of items could result in an explosion and personal injury.**

2.4.1 Fire Extinguisher

Fuels and fumes associated with generator sets can be flammable and potentially explosive. Proper care in handling these materials can dramatically limit the risk of fire or explosion. However, safety dictates that fully charged BC and ABC fire extinguishers are kept on hand. Personnel must be familiar with the operation of the fire extinguisher. Inspect the fire extinguisher and service the fire extinguisher regularly. Obey the recommendations on the instruction plate.

2.5 Exhaust Gases

Always start and operate the engine in a well-ventilated area. If the engine is in an enclosed area, vent the engine exhaust to the outside.

Warning

⚠ **Engine exhaust contains products of combustion which may be harmful to your health.**

2.6 Mechanical

The generator set is designed with guards for protection from moving parts. Care must still be taken to protect personnel and equipment from other mechanical hazards when working around the generator set.

Warning:

⚠ **Do not attempt to operate the generator set with safety guards removed. While the generator set is running do not attempt to reach under or around the guards for any reason.**

⚠ **Keep hands, arms, long hair, loose clothing and jewellery away from pulleys, belts and other moving parts.**

- Some moving parts can not be seen clearly when the set is running.

⚠ **Keep access doors on enclosures, if equipped, closed and locked when not required to be open.**

⚠ **Avoid contact with hot oil, hot coolant, hot exhaust gases, hot surfaces, sharp edges and corners.**

⚠ **Wear protective clothing including gloves and hat when working around the generator set.**

2.7 Chemical

Fuels, oils, coolants, lubricants and battery electrolyte used in this generator set are typical of the industry. However, they can be hazardous to personnel if not treated properly. The disposal of fuels, oils, coolants, lubricants, battery electrolyte and batteries should be carried out in accordance with local government laws and regulations.

2.7.1 Coolant

When the engine is at operating temperature, the engine coolant is hot. The coolant is also under pressure. The radiator and all hoses to the heaters or to the engine contain hot coolant. Any contact with hot coolant or with steam can cause severe burns. Allow cooling system components to cool before the cooling system is drained. Cooling system conditioner contains alkali. Alkali can cause personal injury. Do not allow alkali to contact the skin, the eyes, or the mouth.

2.7.2 Oils

Hot oil and hot lubricating components can cause personal injury. Do not allow hot oil to contact the skin. Also, do not allow hot components to contact the skin.

2.7.3 Batteries

Electrolyte is an acid. Electrolyte can cause personal injury. Do not allow electrolyte to contact the skin or the eyes. Always wear protective glasses for servicing batteries. Wash hands after touching the batteries and connectors. Use of gloves is recommended.

Warning:

⚠ **Do not swallow or have skin contact with fuel, oil, coolant, lubricants or battery electrolyte. If swallowed, seek medical treatment immediately. Do not induce vomiting if fuel is swallowed. For skin contact, wash with soap and water.**

⚠ **Do not wear clothing that has been contaminated by fuel or lube oil.**

2.8 Noise

Sound levels will vary depending on the configuration of the generator set and the final installation of the generator set.

Refer to the following for factors that influence the level of exposure:

- The characteristics of the area around the generator set
- Other sources of noise
- The number of machines and other adjacent processes
- The length of time of exposure to the noise

This information will enable the user of the machine to evaluate the hazard and the risk.

Warning:

⚠ **Prolonged exposure to noise levels above 80 dBA is hazardous to hearing.**

⚠ **Ear protection must be worn when operating or working around an operating generator set.**

2.9 Electrical

Safe and efficient operation of electrical equipment can be achieved only if the equipment is correctly operated and maintained.

Warning:

⚠ **Ensure the generator set, including a mobile set, is effectively grounded/earthed prior to operation.**

⚠ **Do not touch 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.**

⚠ **Use only Class BC or Class ABC extinguishers on electrical fires.**

⚠ **For generator sets with external socket outlets only – Residual Current Device (RCD) protection on socket outlets, where fitted, is designed to operate within a TN earthing system. Ensure local wiring regulations are met prior to generator set operation and that all equipment connected via the generator set sockets, including plugs and electrical cables, are of the correct specification and are known to be in a safe and undamaged condition.**

2.10 First Aid For Electric Shock

Warning:

⚠ **Do not touch the victim's skin with bare hands until the source of electricity has been turned off.**

⚠ **Switch off the power, if possible.**

⚠ **Otherwise pull the plug or pull the cable away from the victim.**

⚠ **If this is not possible, stand on dry insulating material and pull the victim clear of the conductor, preferably using insulated material such as dry wood.**

⚠ **If victim is breathing, turn the victim into the recovery position.**

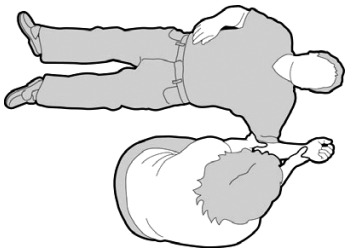
⚠ **If victim is unconscious, perform resuscitation as required:**

OPEN THE AIRWAY:

1. Tilt the victim's head back and lift the chin upwards.
2. Remove objects from the mouth or throat (including false teeth, tobacco or chewing gum).

BREATHING:

1. Check that the victim is breathing by looking, listening and feeling for the breath.



CIRCULATION:

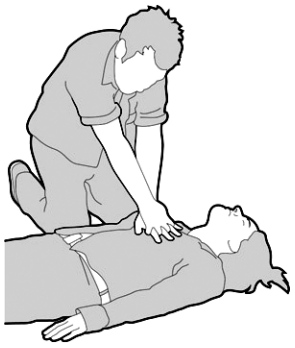
1. Check for pulse in the victim's neck or wrist.

IF NO BREATHING BUT PULSE IS PRESENT:

1. Pinch the victim's nose firmly.
2. Take a deep breath and seal your lips around the victim's lips.
3. Blow slowly into the mouth watching for the chest to rise. Let the chest fall completely. Give breaths at a rate of 10 per minute.
4. If the victim must be left to get help, give 10 breaths first and then return quickly and continue.
5. Check for pulse after every 10 breaths.
6. When breathing restarts, place the victim into the recovery position described later in this section.

IF NO BREATHING AND NO PULSE:

1. Call or telephone for medical help.
2. Give two breaths and start chest compression as follows:
3. Place heel of hand 2 fingers breadth above ribcage/breastbone junction.
4. Place other hand on top and interlock fingers.
5. Keeping arms straight, press down 4–5 cm (1.5–2 inch) 30 times at a rate of 100 per minute. There should be equal timing between chest compression and release.
6. Repeat cycle (2 breaths, 30 compressions) until medical help takes over.
7. If condition improves, confirm pulse and continue with breaths. Check for pulse after every 10 breaths.
8. When breathing restarts, place the victim into the recovery position.

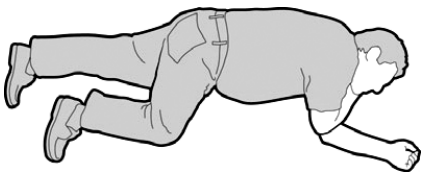


WARNING

⚠ **Do not apply pressure over the ribs, lower tip of the victim's breastbone or the abdomen.**

RECOVERY POSITION:

1. Turn the victim onto the side.
2. Keep the head tilted with the jaw forward to maintain the open airway.
3. Make sure the victim cannot roll forwards or backwards.
4. Check for breathing and pulse regularly. If either stops, proceed as above.



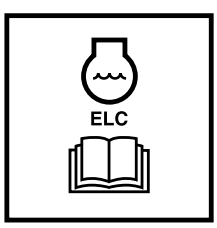
Warning:

⚠ **Do not give liquids until victim is conscious.**

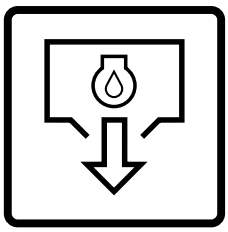
2.11 HAZARD LABEL LEGEND - (6.8 – 275 kVA range)

Ensure that all of the safety messages are legible. Clean the safety messages or replace them if the words cannot be read or if the illustrations are not visible. Use a cloth, water and soap to clean the safety messages. Do not use solvents, gasoline, or other harsh chemicals as these could loosen the adhesive that secures the safety messages. Safety messages that are loosened could drop off the engine.

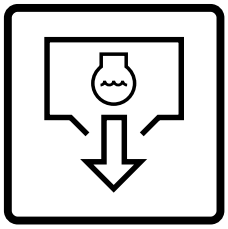
Replace any safety message that is damaged or missing. If a safety message is attached to a part of the engine that is replaced, install a new safety message on the replacement part. Your local Dealer can provide new safety messages.



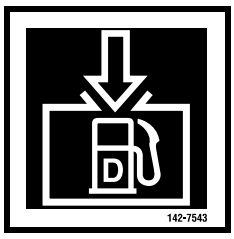
Extended Life Coolant



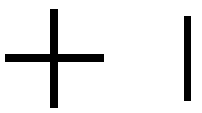
Oil Drain



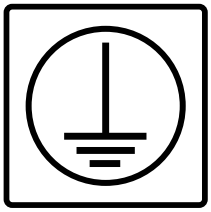
Coolant Drain



Diesel Fuel Fill

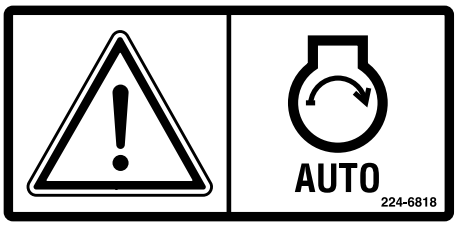


Positive & Neutral Electric Terminals

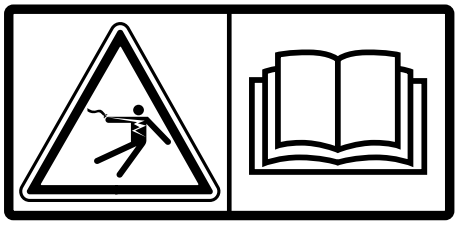


Earth

Hot Fluid Under Pressure

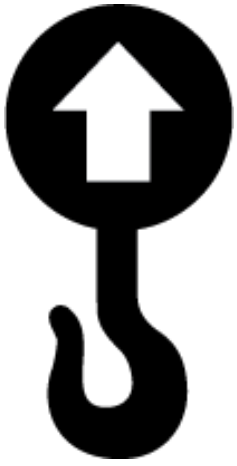


Warning Auto Start



Electric Shock

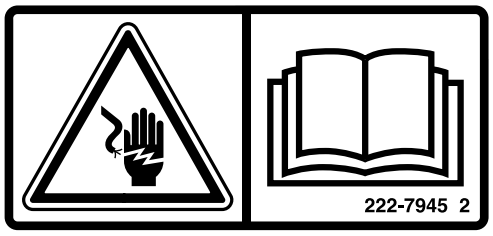
Warning - Read the manual



Lift Symbol

Do Not Touch Hot Surface

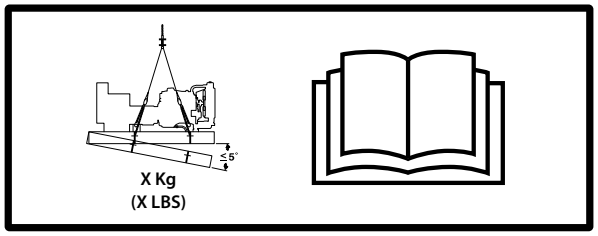
Warning Crush Falling Object



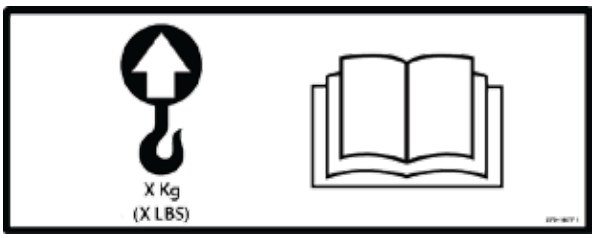
Shock Warning

Centre of Gravity

Do NOT Powerwash

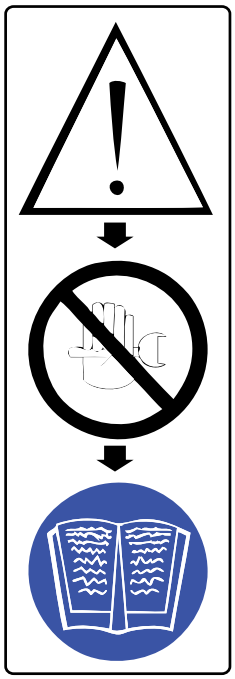


Lifting X Ton 4 Point



Lifting X Ton 1 Point

HAZARD LABEL LEGEND - (350 – 2500 kVA range)



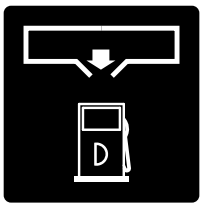
Do Not Tamper With Unless You Have Read The Instruction Manual

Use Fan Guards

Electric Shock Hazard

Hot Exhaust Gas

Low Overhead Objects



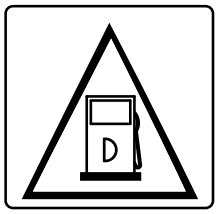
Diesel Fuel Line Supply

Rated Speed

No Naked Flames

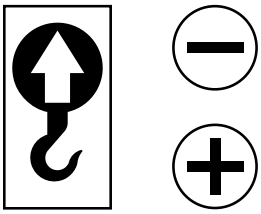
Wear Ear Protection

Emergency / Panic Exit

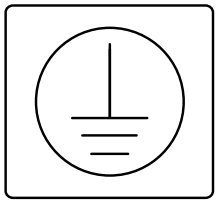


Diesel Fuel Warning

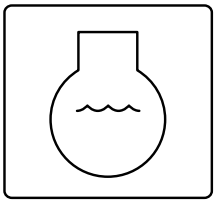
Hot Surfaces



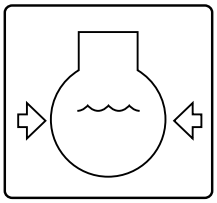
Lift Electric Terminals



Protective Earth (Ground)



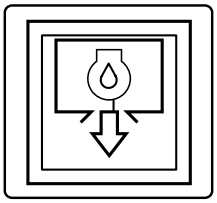
Engine Coolant



Engine Coolant Pressure

No Lifting From This Point

Do Not Powerwash



Oil Drain

3. GENERAL DESCRIPTION

This generator set has been designed as a complete package to provide superior performance and reliability.

Each generator set is provided with a Rating Plate generally affixed to the alternator housing / panel enclosure. This label contains the information needed to identify the generator set and its operating characteristics. This information includes, but is not limited to, the model and serial numbers, output characteristics such as voltage, phase and frequency, output rating in kVA and kW and rating type (basis of the rating). The model and serial numbers uniquely identify the generator set.

The diesel engine powering the generator set has been chosen for its reliability and the fact that it has been specifically designed for powering generator sets. The engine is of the heavy duty industrial type with 4 stroke compression ignition and is fitted with all accessories to provide a reliable power supply.

The engine electrical system is either 12 or 24 volts DC depending on the size of the set.

The engine cooling system comprises of a radiator, a high capacity pusher fan and a thermostat. The main AC alternator has its own internal fan to cool the alternator components.

The output electrical power is produced by an alternator fine tuned to the output of this generator set.

The engine and alternator are coupled together and mounted on a heavy duty steel base frame. The base frame incorporates an integrated or polyethylene fuel tank except for the largest sets (approximately 1,000 kVA and above).

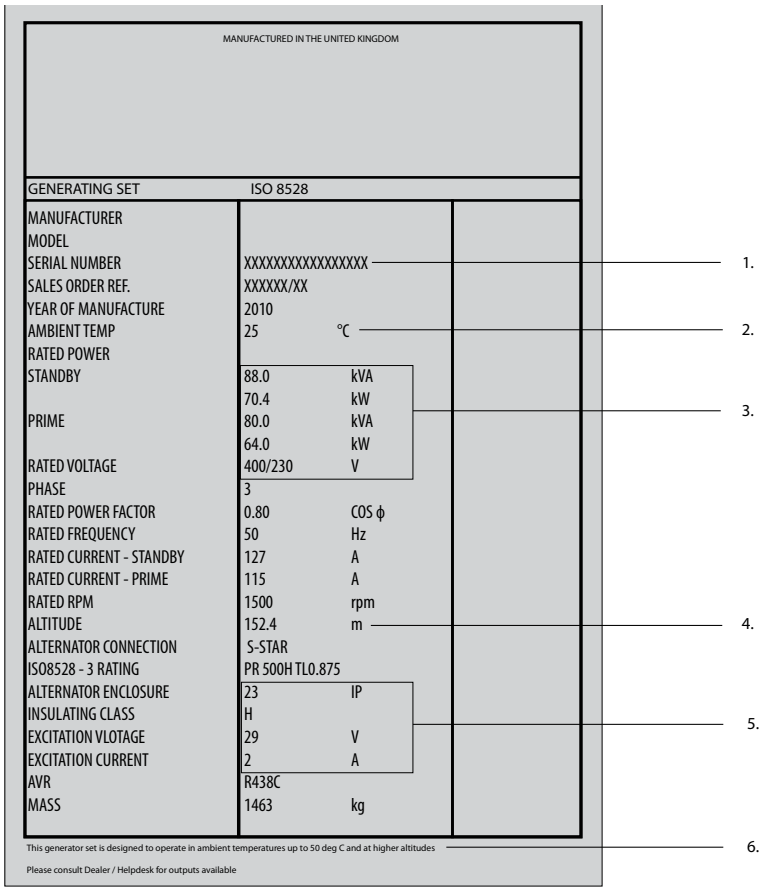
The generator set is fitted with vibration isolators which are designed to reduce engine vibration being transmitted to the foundation on which the generator set is mounted. These isolators are fitted between the engine/alternator feet and the base frame. Alternatively, on 4008, 4012 and 4016 powered models the engine/alternator is rigidly mounted on the base frame and the vibration isolators are supplied loose to be fitted between the base frame and the foundation.

An exhaust silencer is provided loose for installation with the generator sets. The silencer and exhaust system reduce the noise emission from the engine and can direct exhaust gases to safe outlets.

One of several types of control systems and panels is fitted to control the operation and output of the generator set and to protect the set from possible malfunctions. Section 5 of this manual provides detailed information on these systems and will aid in identification of the control system fitted on the generator set.

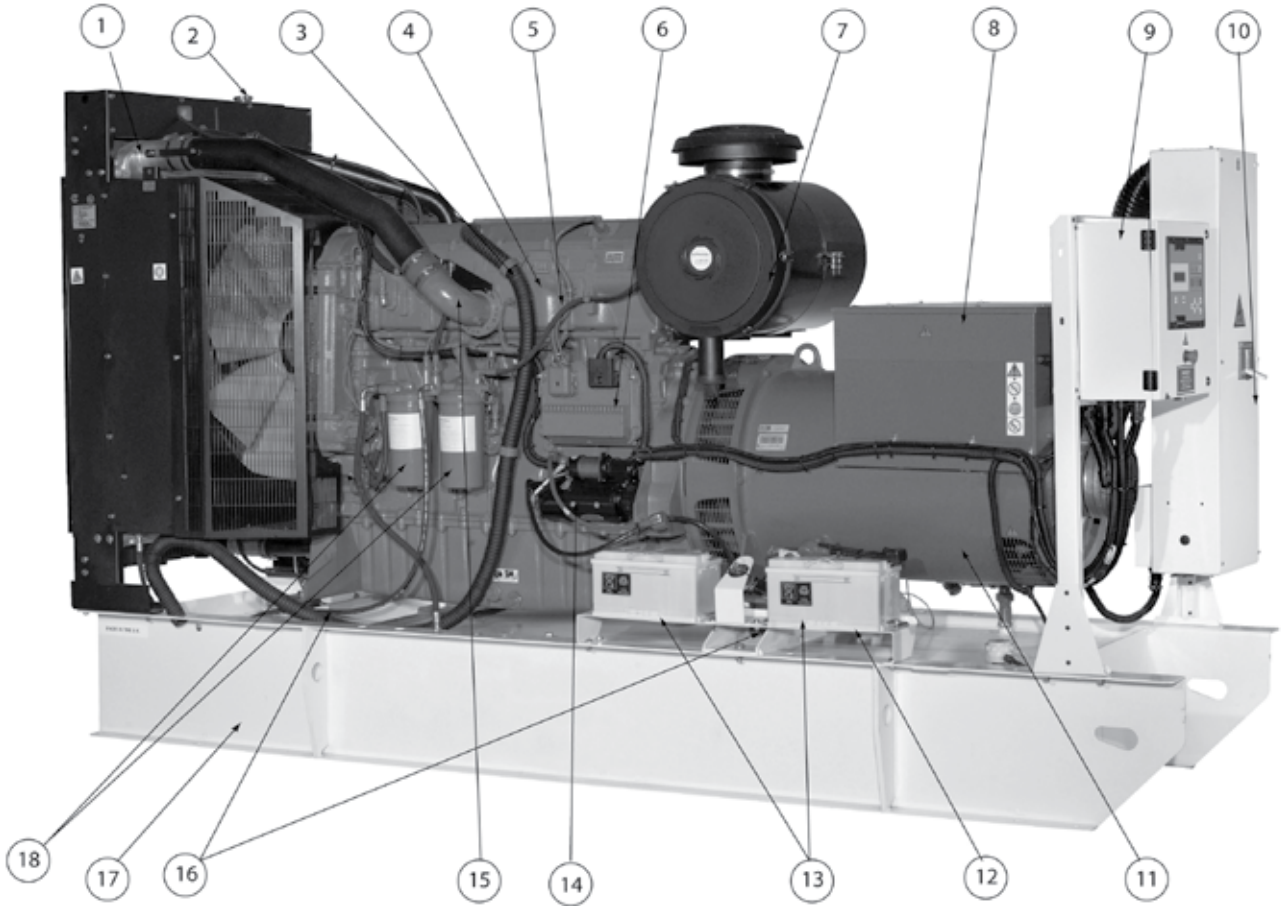
To protect the alternator, a suitably rated circuit breaker selected for the generator set model and output rating is supplied mounted in a steel enclosure.

3.1 Typical Rating Plate



1 - Unique Generator set Number
2 - Rated Ambient Temperature
3 - Voltage Output of Generator set
4 - Rated Altitude above Sea Level
5 - Relates to AC Alternator
6 - Ambient Temperature Information

Figure 3a – Description of Typical Rating Plate



1 - Radiator
2 - Radiator fill
3 - ENGINE BREATHER
4 - BATTERY CHARGING ALTERNATOR (OPPOSEITE SIDE)
5 - DIESEL ENGINE
6 - ECM
7 - AIR FILTER (INSIDE HOUSING
8 - MAIN AC ALTERNATOR TERMINAL BOX
9 - CONTROL PANEL
10 - CIRCUIT BREAKER
11 - MAIN AC ALTERNATOR
12 - BATTERY RACK
13 - BATTERIES
14 - STARTER MOTOR
15 - TURBO CHARGER (OPPOSITE SIDE) IF EQUIPTED
16 - VIBRATION ISOLATORS
17 - BASE FRAME / FUEL TANK
18 - FUEL FILTERS

⚠ **Generator sets contain moving parts and hot surfaces. Wear the appropraite PPE as required.**

Figure 3b – Typical Generator set Description (this may differ from the Generator set you have received)

3.3 Generator set Description (26 – 200 kVA Range)

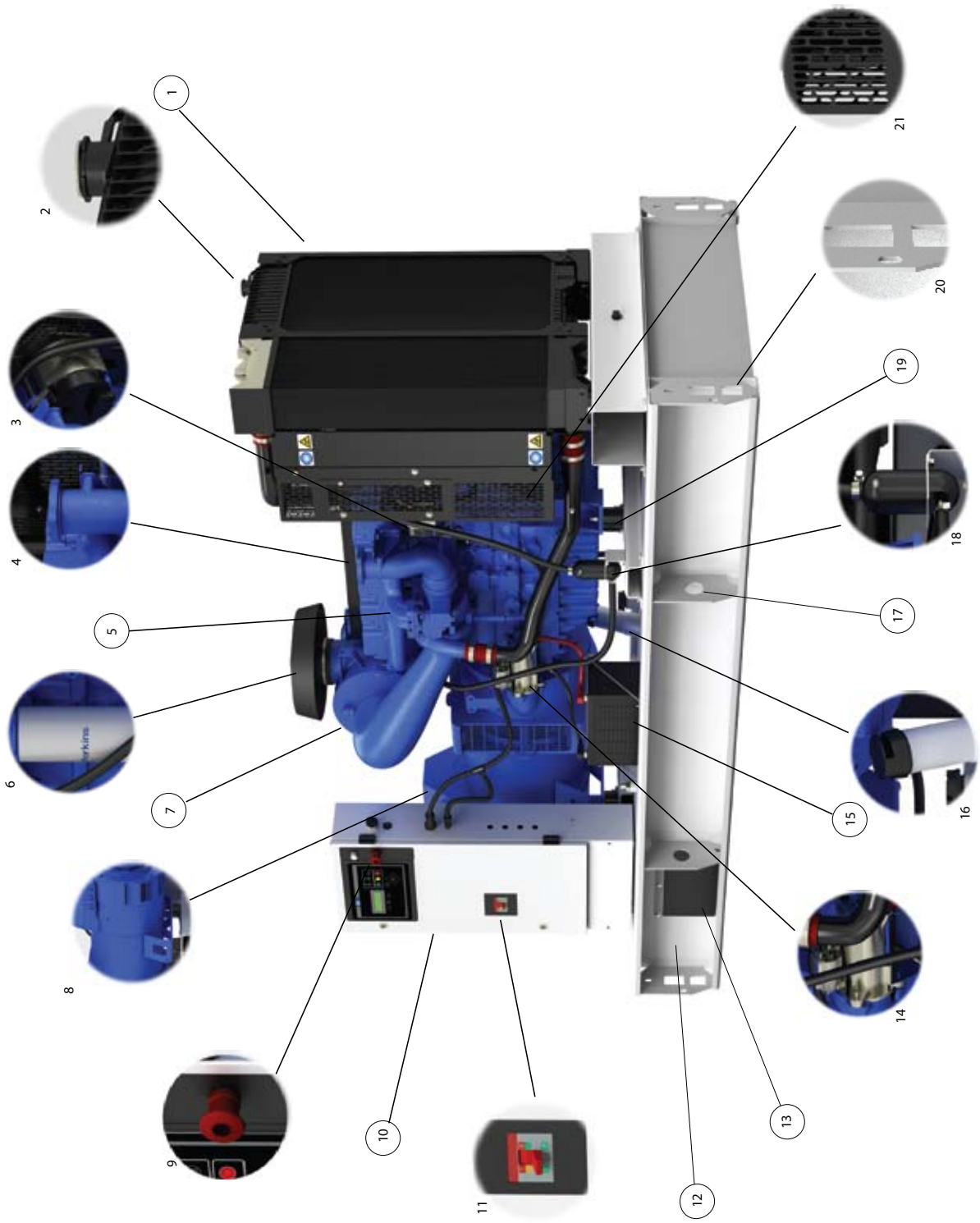


Figure 3c – Typical Generator set Description (this may differ from the Generator set you have received)

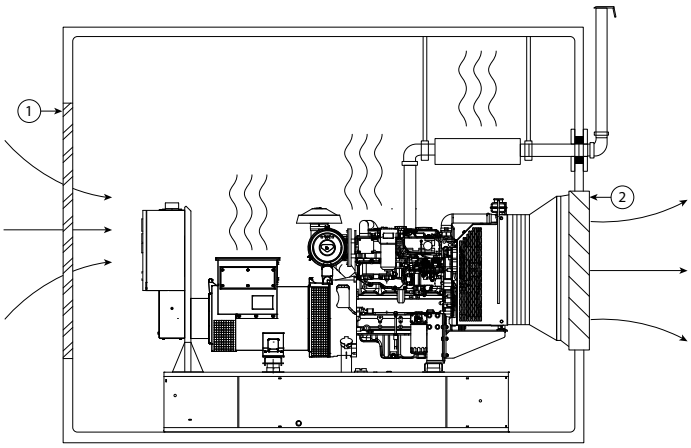
4. INSTALLATION, HANDLING AND STORAGE

4.1 General

This section discusses factors important in the effective and safe installation of the generator set.

Selecting a location for the generator set can be the most important part of any installation procedure. The following factors are important in determining the location:

- Adequate ventilation.



1 - Air Inlet Opening
2 - Air Exit Opening

Figure 4a – Typical installation showing generator set ventilation

- Protection from the elements such as rain, snow, sleet, wind driven precipitation, flood water, direct sunlight, freezing temperatures or excessive heat.
- Protection from exposure to airborne contaminants such as abrasive or conductive dust, lint, smoke, oil mist, vapours, engine exhaust fumes or other contaminants.
- Protection from impact from falling objects such as trees or poles, or from motor vehicles or lift trucks.
- Clearance around the generator set for cooling and access for service: at least 1 metre (3ft 3in) around the set and at least 2 metres (6ft 6in) headroom above the set. (See Figure 4b)
- Access to move the entire generator set into the room. Air inlet and outlet vents can often be made removable to provide an access point.
- Limited access to unauthorised personnel.

If it is necessary to locate the generator set outside of the building, the generator set should be enclosed in a weatherproof canopy or container-type housing which is available for all sets.

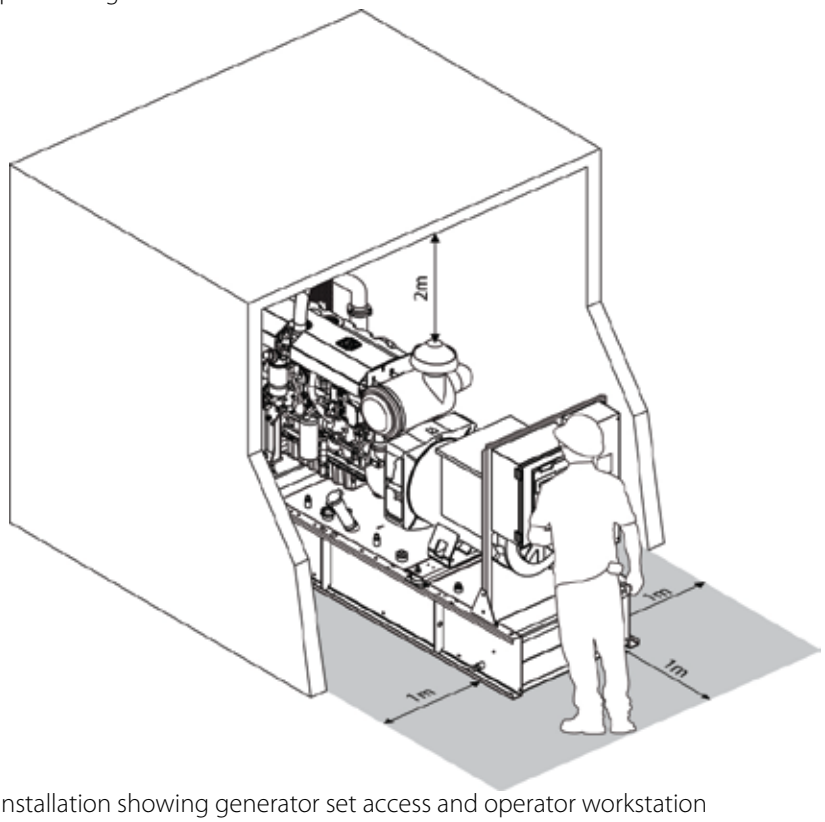


Figure 4b – Typical installation showing generator set access and operator workstation

4.2 Outdoor Installation

Installation and handling is greatly simplified when the generator set has been equipped with an enclosure. Two basic types may be fitted. The first type is a close fitting canopy enclosure. This will be both weatherproof and sound attenuated. The other enclosure type is a walk-in type container, similar to a shipping container. It may be weatherproof or sound attenuated.

These enclosures provide a self contained generator set system that is easily transportable and requires minimal installation. They also automatically give protection from the elements and protection from unauthorised access.

Warning:

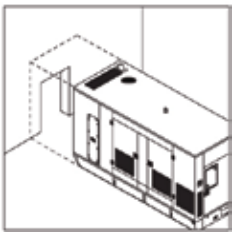
⚠ **Make sure all personnel are out of the canopy or container, if equipped, before closing and latching enclosure doors.**

⚠ **Before closing canopy or enclosure doors, ensure all obstructions (especially hands and fingers) are clear to prevent damage or injury.**

⚠ **For transport purposes, some silencer outlets on generator sets housed in walk-in type enclosures will be fitted with cover plates. These are to be replaced with the supplied stub pipes complete with fitted rain hood.**

⚠ **Ensure there is no debris on the base frame prior to starting, as loose items will cause radiator damage.**

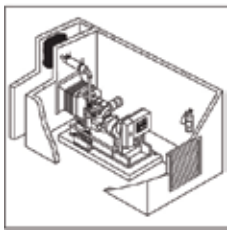
Because enclosed generator sets are easily transportable and may be installed and operated in a temporary location, many of the fixed installation details given in this chapter may not apply. The following considerations must be taken into account when temporarily installing the generator set:



- Locating the generator set where it will be protected from damage and away from the exhaust fumes of other engines or other airborne contaminants such as dust, lint, smoke, oil mist or vapours.

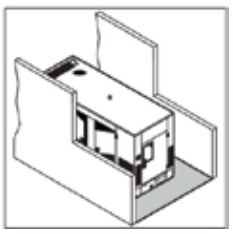
- Ensure the generator set is not positioned in such a way that it will obstruct the entrance or exit to the area where the it is situated.

- Locating the generator set on firm, level ground which will not subside or be otherwise affected by the vibration caused by the operation of the generator set



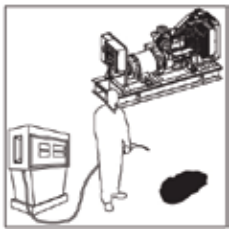
- Ensuring that fumes from the exhaust outlet will not be a hazard especially when wind is taken into account.

- Ensure there is enough area around the generator set for access and serviceability.



- Electrical grounding of the generator set at all times, in accordance with local regulations.

- Providing access to refill the fuel tank when required.



- Protecting electrical cables installed between the generator set and the load. If these are laid on the ground ensure they are boxed in or covered to prevent damage or injury to personnel.

WARNING

⚠ **Enclosed generator sets should be installed outside. In the event that the enclosed generator set is installed inside, adequate fresh cooling air must be provided and that both engine and hot coolant air exhausts must be ducted outside the building. The ducting and exhaust pipework must be designed to minimise back pressure which would have a detrimental effect on generator set performance.**

4.2.1 Positioning of Walk-in Containers

Proper installation of the container is required if successful generation of power is to be achieved. The following information must be considered in the selection of the operating site for the container. The containerised generator set must be placed on a flat surface in order to maintain proper alignment. Containers can be successfully installed on a concrete plinth or level, natural surface. The foundation must bear the static weight of the module plus any dynamic forces from engine operation.

Warning:

⚠ **For generator sets housed in walk-in type containers, crankcase breather outlets terminated at the external face of the enclosure will be plugged. These must be removed prior to operation.**

4.2.2 Concrete Plinth

Setting the container on a concrete plinth is the preferred method for permanent installation for both ISO and Design to Order (DTO) containers. The concrete plinth should have been designed to withstand the weight of the container. Please consult the installer for further details.

4.3 Moving the Generator set

The generator set base frame is specifically designed for ease of moving the set. Improper handling can seriously damage components.

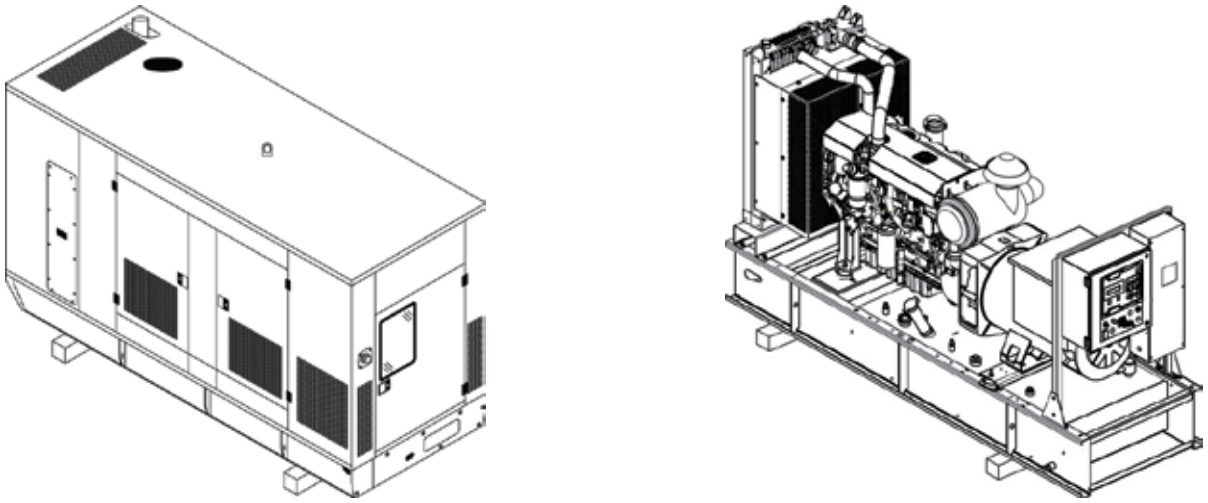


Figure 4c – Open and Closed generator sets on wooden skids

Using a forklift, the generator set can be lifted or carefully pushed/pulled by the base frame. If pushing, do not push the base frame directly with fork.

Warning:

⚠ **Always use wood between forks and the base frame to spread the load and also between the forklift carriage and the side of the canopy to prevent damage.**

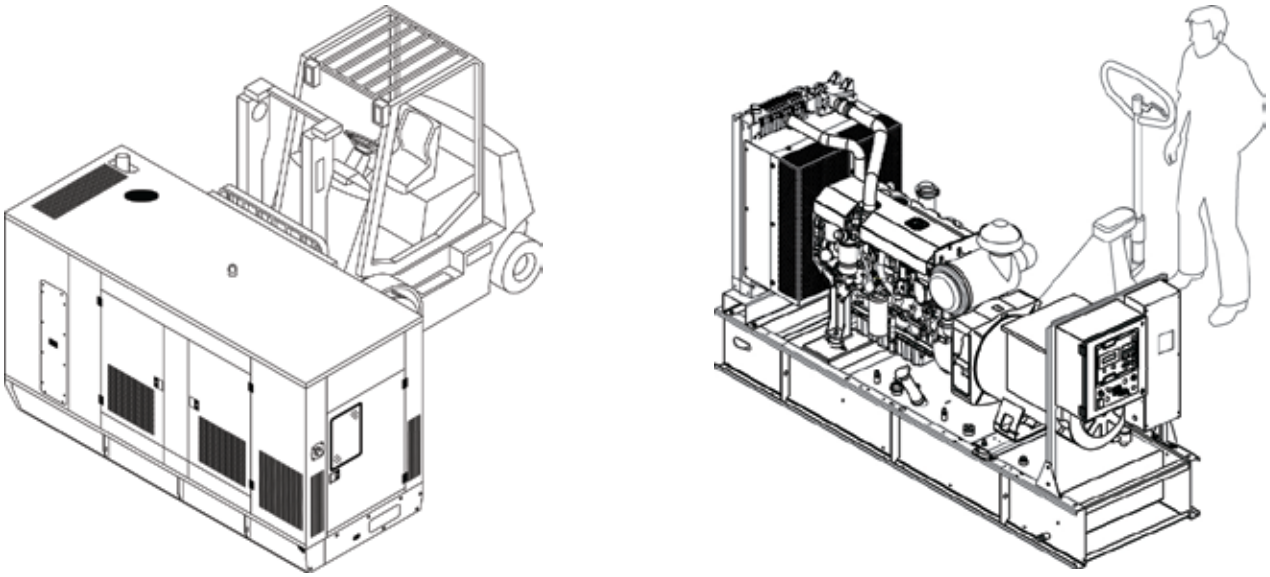
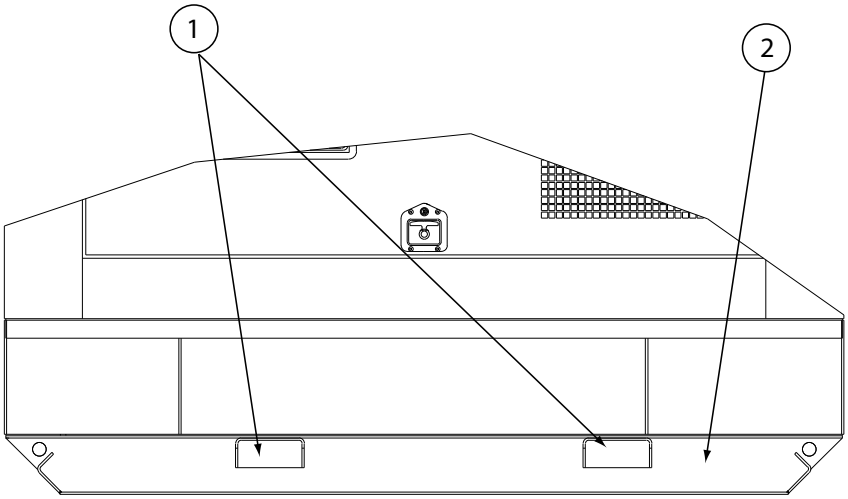


Figure 4d – Transporting a generator set using a forklift truck and forklift trolley



1 - Forklift Pockets
2 - Oil FIeld Skid

Figure 4e – Typical generator set with Oil Field Skid base option

If the generator set will be regularly moved, it should be fitted with the optional Oil Field Skid which provides forklift pockets in the base frame along with eyes for pulling. The smaller sets have forklift pockets in the base frame as standard.

Warning:

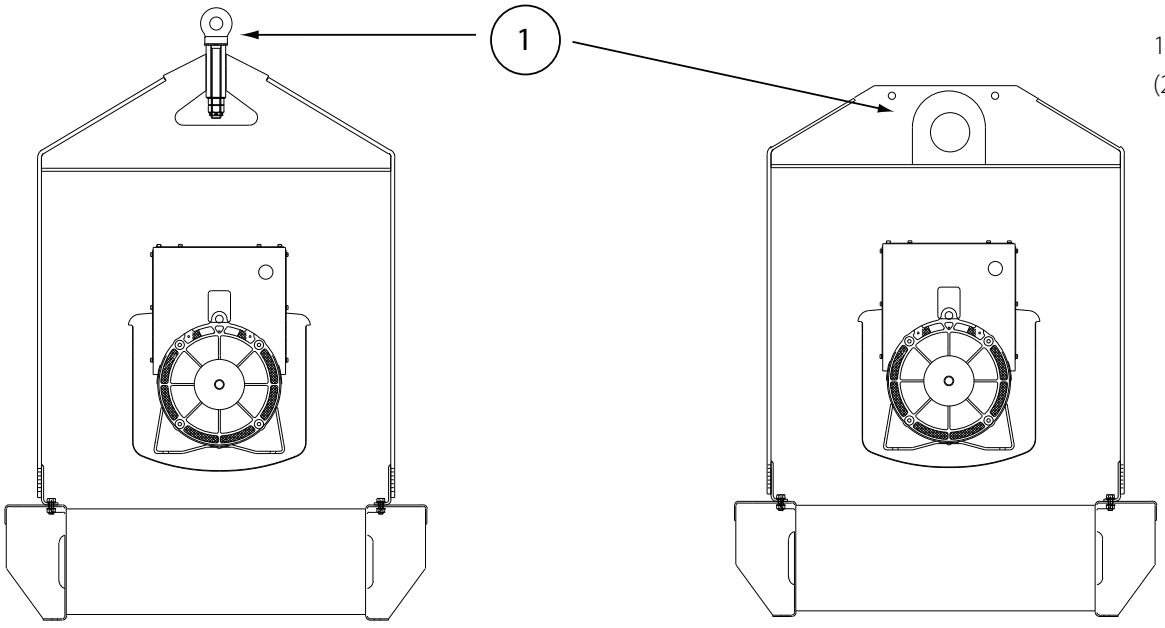
⚠ **Never lift the generator set by attaching to the engine or alternator lifting lugs.**

⚠ **Ensure the lifting rigging and supporting structure is in good condition and is suitably rated.**

⚠ **Keep all personnel away from the generator set when it is suspended.**

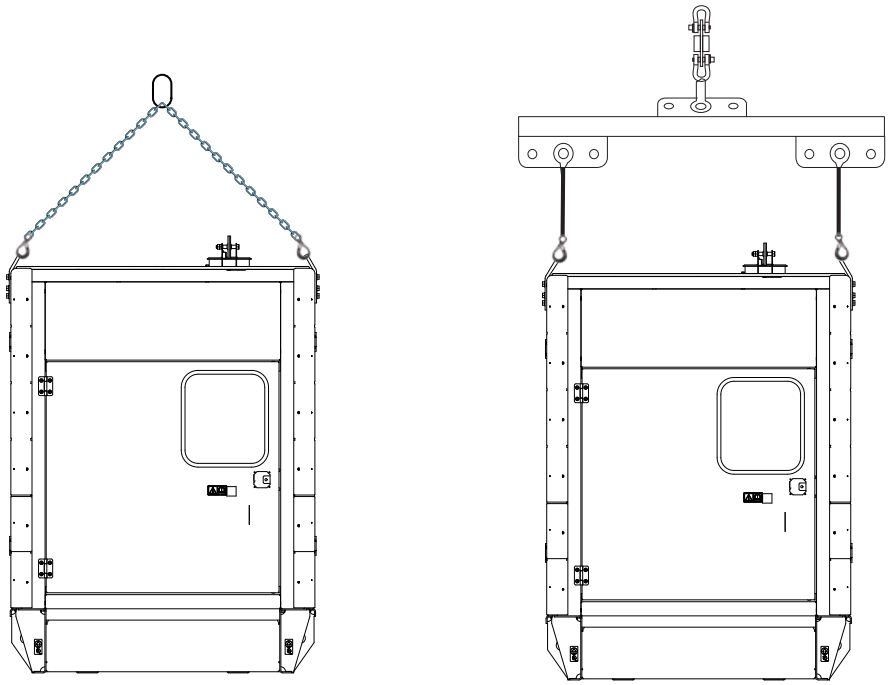
For ease of lifting, enclosed sets have a single or two point lifting facility as standard.

To lift and install the generator set you can use the single / two point lifting points or the lifting points provided on the baseframe. Points of attachment should be checked for cracked welds or loose nuts and bolts before lifting. A spreader bar is required to prevent damage to the generator set whilst lifting from the baseframe (see Figure 4h). It should be positioned over the centre of gravity, to allow a vertical lift. Guide ropes should be used to prevent twisting or swinging of the generator set once it has been lifted clear of the ground. Place the generator set down on a level surface capable of supporting its weight.



1 - Single Point Lift
(26 – 200 kVA Range Only)

Figure 4f – Single Point lift



1 - Two Point Lift
(455 – 625 kVA Product)

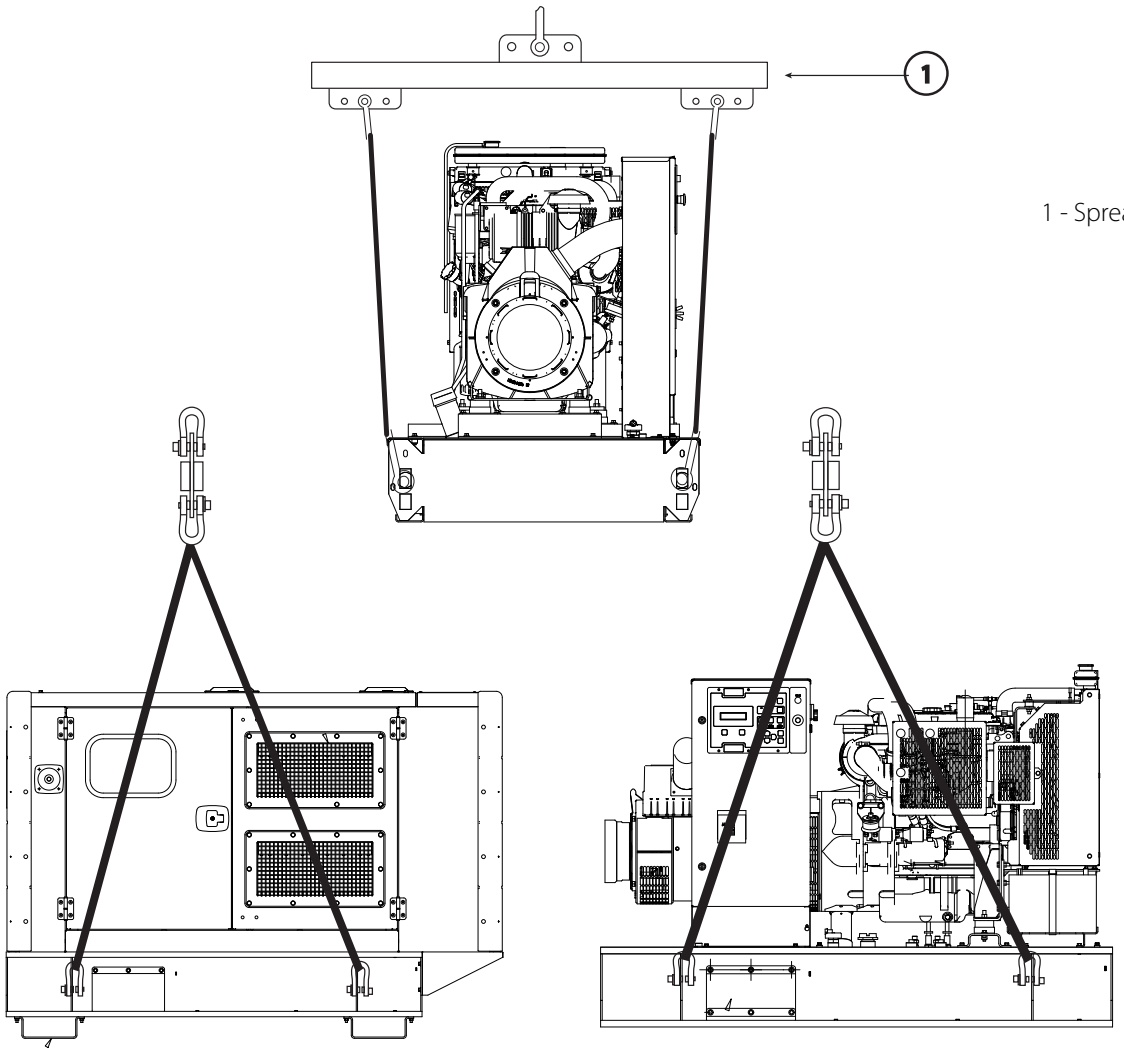
Figure 4g – Two Point lift

Warning

⚠ **Centre of gravity decal is located on the base / canopy of the generator set.**

⚠ **The centre of gravity may not always be located at the centre of the generator set.**

⚠ **Do not attempt to lift in high winds.**



1 - Spreader Bar

Figure 4h – Proper lifting arrangement for installing the generator set (open & enclosed)

4.3.1 Approved Lifting Methods for ISO Walk-in Containers

Containers are manufactured to ISO dimensions, ISO 1496–4:1994(E) and ISO 668:1995(E). To ensure the safety of all personnel involved with the handling of containers, it is important that the correct lifting and handling procedures are employed. The procedures detailed below are derived from ISO 3874:1997(E) and must be followed at all times.

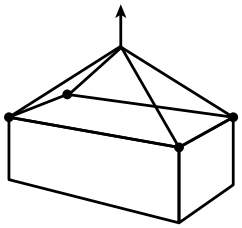
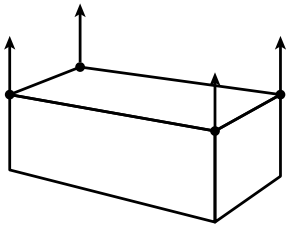
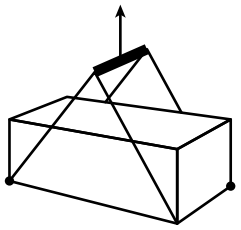
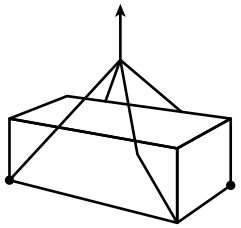
ISO Series 1 Freight Containers			
Lift Description	**Loaded / Unloaded**	**Method**	**Diagram**
Top Lift	Unloaded Only	A single pint lift with rated shackles	
Top Lift	Loaded	A vertical lift by means of a spreader bar and rated CAMLOK-CLB type lugs	
Bottom Lift	Loaded	Lifting from bottom four corner casting using CAMLOK-CLB type lugs and rated spreader beam	
Bottom Lift	Loaded and Unloaded	Lifting from bottom four corner castings using CAMLOK-CLB type lugs and nylon straps	

Figure 4i – Lifting method for ISO Series 1 Freight Containers

4.3.2 Approved Lifting Methods for Non-ISO Walk-in Containers

Containers can be manufactured to non–ISO dimensions. To ensure the safety of all personnel involved with the handling of containers, it is important that the correct lifting and handling procedures are employed. The procedures for handling non-ISO containers are detailed below and must be followed at all times.

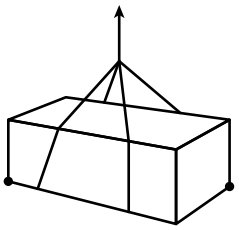
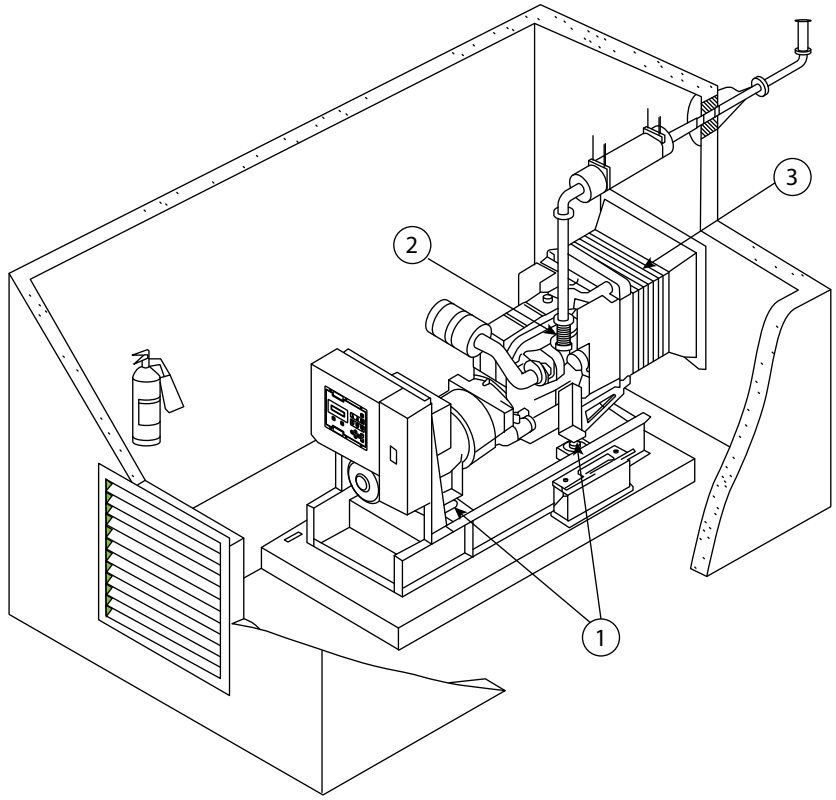
ISO Series 1 Freight Containers			
Lift Description	**Loaded / Unloaded**	**Method**	**Diagram**
Bottom Lift	Loaded and Unloaded	Lifting from bottom four lifting lugs using rated shackles	

Figure 4j – Lifting method for Non-ISO Containers

4.4 Foundations and Vibration Isolation

The generator set is supplied on a rigid base frame that precisely aligns the alternator and engine and needs only be bolted down to a suitably prepared surface.



1. Vibration Isolators
2. Flexible Exhaust Coupling
3. Flexible Air Discharge Duct

Figure 4k – Typical installation highlighting vibration reduction techniques

4.4.1 Foundation

A reinforced concrete pad makes the best foundation for the generator set. It provides a rigid support to prevent deflection and vibration. Typically the foundation should be from 150 mm to 200 mm (6 to 8 inches) deep and at least 150 mm (6 inches) wider and longer than the generator set. The ground or floor below the foundation should be properly prepared and should be structurally suited to carry the combined weight of the foundation pad and the generator set. (If the generator set is to be installed above the ground floor the building structure must be able to support the weight of the generator set, fuel storage and accessories.) Relevant building codes should be consulted and complied with. If the floor is wet from time to time, such as in a boiler room, the pad should be raised above the floor. This will provide a dry footing for the generator set and for those who connect, service or operate it. It will also minimise corrosive action on the base frame.

4.4.2 Vibration Isolation

To minimise engine vibrations being transmitted to the building, the generator set is fitted with vibration isolators. On small and medium sized generator sets these isolators are fitted between the engine/alternator feet and the base frame. This allows the frame to be rigidly bolted to the foundation. On larger generator sets the coupled engine/alternator is rigidly attached to the base frame and the vibration isolators are supplied loose for fitting between the base frame and the foundation. In all cases the sets should be securely bolted to the ground (either through the base frame or through the vibration isolators) to prevent movement.

Vibration isolation is also required between the generator set and its external connections. This is achieved by the use of flexible connections in the fuel lines, exhaust system, radiator air discharge duct, electrical conduit for control and power cables and other externally connected support systems (see Figure 4j).

4.5 Storage

Long term storage can have detrimental effects on both the engine and alternator. These effects can be minimised by properly preparing and storing the generator set.

4.5.1 Engine Storage

The engine should be put through an engine "preservation" procedure that includes cleaning the engine and replacing all the fluids with new or preserving fluids. See the Engine Manual for the proper procedure.

4.5.2 Alternator Storage

When an alternator is in storage, moisture tends to condense in the windings. To minimise condensation, store the generator set in a dry storage area. If possible use space heaters to keep the windings dry.

After removing the generator set from storage, perform an insulation check as discussed in Section 4.12.8. If the readings are lower than prior to storage, it may be necessary to dry out the windings. See the Alternator Manual for procedures.

If the megger reading is below 1MΩ after drying, the insulation has deteriorated and should be reconditioned.

4.5.3 Battery Storage

While the battery is stored, it should receive a refreshing charge every 12 weeks (8 weeks in a tropical climate) up to a fully charged condition.

5. CONTROL SYSTEM DESCRIPTION AND TROUBLE SHOOTING

5.1 Control System Description

An electronic control system has been designed and installed to control and monitor the generator set. Depending on the requirements of the generator set, one of several different standard control systems may be fitted. Other more specialised systems may be fitted for specific installations in which case separate documentation is provided.

These control systems consist of three major components working together:

Control Panel – provides a means of starting and stopping the generator set, monitoring its operation and output and automatically shutting down the generator set in the event of a critical condition arising such as low oil pressure or high engine coolant temperature to prevent major damage to the engine / alternator.

Engine Interface Module (where fitted) - provides switching relays for the Starter Motor Solenoid, Glow Plug and Fuel Solenoid. Each of these circuits is protected with individual fuses mounted in the module. Individual LED's illuminate when each circuit is energised.

Power Output Circuit Breaker - serves to protect the alternator by automatically disconnecting the load in the event of overload or short circuit. It also provides a means of switching the generator set output.

Note:

- Products within the 6.8 – 200 kVA range are not equipped with an EIM but are provided with the switching relays for Starter Motor Solenoid, glow plug and fuel solenoid in the control panel/Relay box. Each of these products is now protected with individual Miniature Circuit Breakers (MCBs) or fuses mounted inside the control panel/relay box.

5.2 1002T and LCP1002 (Quickstart)

The 1002T Series / LCP1002 Control System provides for manual starting and stopping of the generator set and provides protection for the engine against both high engine coolant temperature and low oil pressure.

Before starting or running the generator set, the operator should become fully acquainted with the instruments and controls. The instruments should be observed from time to time while the generator set is running so that any abnormal readings can be detected before problems arise.

5.2.1 Control Panel Instrumentation

Figure 5a shows typical diagrams of each of the control panels. The addition of optional equipment will add items to the panel so the panel fitted on the generator set may be slightly different from the typical ones shown. The following descriptions explain the function of each item on the panels:

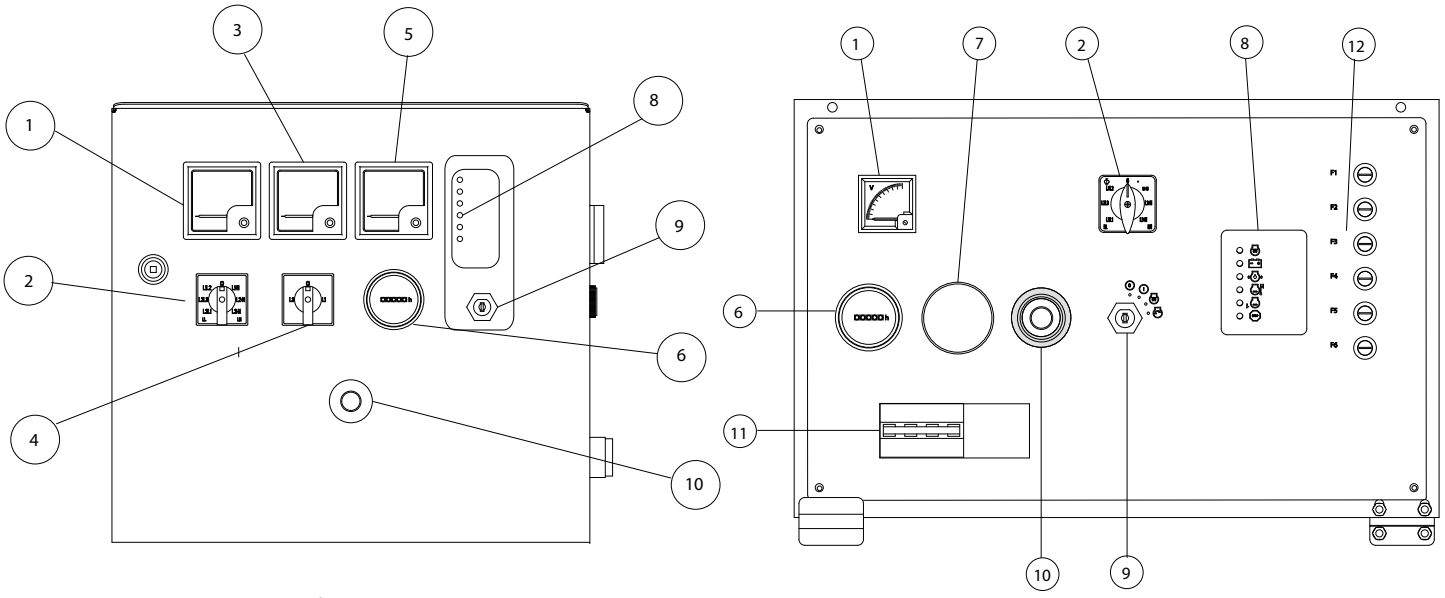
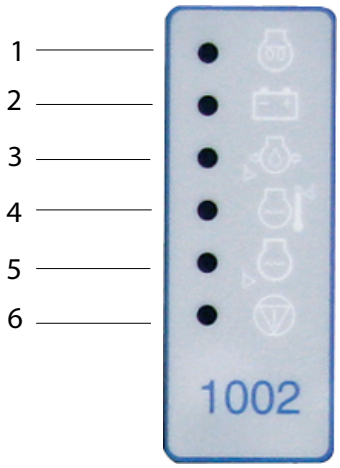


Figure 5a – Layout of 1002T Series and LCP1002 Control Panel

1. AC VOLTMETER – indicates the AC voltage generated at the alternator output terminals. The reading indicated on the voltmeter will vary depending on the position of the voltmeter selector switch (item 2). It should not, however, vary while the generator set is operating. If the meter gives no reading while the generator set is running, ensure that the AC voltmeter selector switch is not in the OFF position.
2. AC VOLTMETER SELECTOR SWITCH – allows the operator to select voltage reading between phases or between a phase and neutral. The OFF position allows the voltmeter "zero" position to be checked while the generator set is running.
3. AC AMMETER – indicates the AC electrical current being delivered which is dependant on the connected load. A separate reading from each of the phases is possible using the ammeter selection switch (item 4). If the meter gives no reading while the generator set is running, ensure that the AC ammeter selector switch is not in the OFF position.
4. AC AMMETER SELECTOR SWITCH – allows the operator to select a current reading from each of the phases. The OFF position allows the ammeter "zero" position to be checked while the generator set is running.
5. FREQUENCY METER – Indicates the output frequency of the generator set. At partial load the frequency will be slightly higher than normal, depending on the droop of the governor. In practice, no load frequencies of approximately 52 and 62 Hz for 50 Hz and 60 Hz respectively, are considered normal. The frequencies will fall, as the generator set is loaded, to 50 Hz and 60 Hz at full load.
6. HOURS RUN METER – indicates the total number of hours of generator set operation. This meter assists with maintenance.
7. DC BATTERY VOLTMETER (where fitted) – indicates the state of charge of the battery. When the engine is at standstill the normal battery voltage will be 12 to 14 volts on a 12 volt system and 24 to 28 volts on a 24 volt system. During starting, the needle will drop to about 70% of normal and oscillate as the engine cranks. Once the engine has started, the needle should return to its normal value. If the battery charging alternator is charging correctly, the voltage reading will always be higher with the generator set running than when it is stopped.
8. FAULT INDICATOR LAMPS (where fitted) – illuminate to indicate that the protective circuitry has sensed the indicated condition. The lamp should be red on conditions for which the system will initiate a shutdown of the generator set. For alarms, the lamp can be red or amber.



1 - Pre-Heat Glow Plugs
2 - Charge Alt Fail
3 - Low Oil Pressure
4 - High Engine Temp
5 - Low Coolant Level
6 - Emergency Stop

Figure 5b – 1002T Fault Lamps

9. KEY SWITCH – A four position switch that provides a means of starting and operating the generator set.

   Position "0" – Off / Reset
   Power is turned off and protection circuitry is reset in this position.

   Position "1" – On
   DC power is supplied to the control system and the fault protection timer relay is initiated.

   Position "⌇⌇⌇" – Thermostart
   DC power is supplied to the thermostart circuit, if fitted.

   Position "↷" – Start
   DC power is supplied to the starter motor to crank the engine. The thermostart circuit is also powered, if fitted.
10. EMERGENCY STOP Push button – A red lock–down push button that immediately shuts down the generator set and will inhibit start until the push button has been released by turning it clockwise. Prior to restarting the generator set, this fault lamp must be reset by turning the key switch to position "O" (off)
11. FUSES – A fuse interrupts excessive current so that the circuit(s) it supplies are protected.
12. OUTPUT CIRCUIT BREAKERS – To protect the alternator, a suitably rated circuit breaker selected for the generator set model output rating, is supplied.

5.2.2 General Information1002T / LCP1002 Control Systems

Figure 5c – 1002T & LCP1002 Control Systems

Controller version is dictated by product configuration, a 1002T or LCP1002 panel may be fitted. Both control systems provide for manual starting and stopping of the generator set and provide protection for the engine against critical failures.

5.2.3 Pre-Start Checks

Warning

⚠ **The following checks detailed below are the only tasks that an operator should undertake.**

The following checks should be performed prior to starting the generator set:

1. Ensure the Control Switch / Key Switch is Off on the 1002T/LCP1002 .

A visual inspection should take only a few minutes and can prevent costly repairs and accidents – For maximum generator set life, visually inspect the generator set before starting. Look for items such as:

- Loose fastenings / fixings, worn belts or loose connections. Repair as necessary.
- The fan and exhaust guards must be at the correct positions and securely fixed. Repair damaged / loose guards or renew missing guards.
- Wipe clean all filler caps before the engine is serviced or fluids are topped up to reduce the chance of any system contamination.
- For any type of leak (coolant, lubricating oil or fuel), clean away the fluid. If a leak is observed, find the source and correct the leak. If a leak is suspected, check the fluid levels frequently until the leak is found and repaired.
- Accumulated grease and/or oil on an engine is a fire hazard. Remove it by steam cleaning or by the use of a high pressure water jet. Avoid high–pressure water on the electronic / electrical components, provide suitable protection were possible.
- Ensure that the coolant pipes are fitted correctly and that they are secure. Check for leaks. Check the condition of all pipes for splits or signs of rubbing.

Fluid levels

2. Check the engine oil and coolant levels – replenish as necessary (see engine handbook for locations).

   Ensure fluids used are as recommended within the engine handbook.

Warning:

⚠ **Do not remove the radiator cap or any component of the cooling system while the engine is running and while the coolant is under pressure, because dangerous hot coolant can be discharged, posing a risk of personal injury.**
Do not add large amounts of cold coolant to a hot system as serious engine damage could result.

Note:

- Diesel engines normally consume lube oil at a rate of 0.25% to 1% of the fuel consumption at full load.
- When adding coolant to the radiator system, always pour slowly to help prevent air from becoming trapped in the engine. Always top up when engine is cold.

Warning:

⚠ **When filling the fuel tank, do not smoke or use an open flame in the vicinity.**

3. Check the fuel level – fill as necessary.

Warning:

⚠ **Before tightening the fan belts, disconnect the battery negative (–) lead to ensure the engine cannot be accidentally started.**

4. Check the condition and tension of the fan and engine alternator belts – tighten as necessary.
5. Check all hoses for loose connections or deterioration – tighten or replace as necessary.
6. Check the battery terminals for corrosion – clean as necessary.

Warning:

⚠ **When working with the batteries, do not smoke or use an open flame in the vicinity. Hydrogen gas from batteries is explosive.**

⚠ **Do not short the positive and negative terminals together.**

7. Check the battery electrolyte level – fill with distilled water as necessary.
8. Check the control panel and the generator set for heavy accumulation of dust and dirt – clean as necessary. These can pose an electrical hazard or give rise to cooling problems.
9. Check the air filter restriction indicator, if fitted – replace the filter as necessary.
10. Clear the area around the generator set of any insecure items that could inhibit operation or cause injury. Ensure cooling air ventilation screens are clear.
11. Visually check the entire generator set for signs of leaks from the fuel system, cooling system or lubrication seals.
12. Periodically drain exhaust system condensate traps, if equipped.
13. Ensure the alternator output circuit breaker is in the "OFF" (handle down) position.

5.2.4 Normal Startup / Shutdown – Key Start Panel (1002T / LCP1002)

The following procedure should be used for normal starts on a generator set equipped with a 1002T Series Key Start Control System:

Note:

- The generator set may be stopped at any time by turning the Key Switch to Position "0" (Off).

1. Complete Pre-Start checks as per Section 5.2.
2. Check the battery voltage by turning the Key Switch from Position "0" (Off) to Position "1" (On) and reading the battery voltmeter. A fully charged battery will indicate 12 to 14 volts on a 12 volt system or 24 to 28 volts on a 24 volt system. Return the Key Switch to Position "0" (Off).

Note:

- In the event of low battery voltage the LED will indicate on the 1002T PCB (see Figure 5a – 8). There is no battery voltmeter on 1002T panel.
- The engine will not start if any fault indicators are illuminated. Reset the control system by turning the Key Switch to Position "0" (Off). Ensure the faults have been corrected prior to attempting to start the generator set.

WHEN ENGINE HAS STARTED

3. Check for any abnormal noise or vibration.
4. Carry out visual checks for system leaks.
5. Check the control panel for indications of engine temperature and oil pressure
6. Switch the alternator output circuit breaker to "ON" (handle up).

Warning:

⚠ **The Key Switch must not be turned to position "⌇⌇⌇" or position "↷", while the engine is running.**

7. Start: Turn the Key Switch from Position "0" (Off) through Position "1" (On) to Position "⌇⌇⌇" (Thermo) to activate the thermostart, if fitted. Hold for 7 seconds to preheat the induction air. After this time, the Key Switch should be further turned to Position "↷" (Start) to crank the engine. When the engine starts, release the Key Switch immediately allowing it to return to Position "1" (On).

   Do not crank the engine for more than 5 to 7 seconds should the engine fail to start. Allow an interval of 10 seconds and always turn the Key Switch to Position "0" (Off) between cranking attempts. If, after 4 cranking attempts, the engine still has not started, refer to a qualified generator set technician to determine the cause of failure to start.

Note:

- Load can now be applied to the generator set. However, the maximum step load that can be accepted in any one step is dependent on the operating temperature of the generator set.

SHUTDOWN:

8. To shut the generator set down, turn off the load by switching the Alternator Output Circuit Breaker to "OFF" (handle down). Allow the generator set to run without load for a few minutes to cool. Then turn the Key Switch to Position "0" (Off). The generator set will shutdown.

   In case of an emergency where immediate shutdown is necessary, the Key Switch should be turned to Position "0" (Off) immediately without disconnecting the load.

Note:

- Turning the Key Switch to Position "0" (Off) will also reset the protective circuits after a fault has been detected. Ensure that the fault has been rectified prior to restarting the generator set.

When high engine temperature is sensed, the red coloured fault lamp labelled "HIGH ENGINE TEMPERATURE" illuminates (see Figure 5b) and the generator set is automatically shut down. The fault lamp will remain illuminated and the engine locked out until the fault has been acknowledged and reset by turning the Key Switch to Position "0" (Off). On some larger models a low coolant level sensor will also cause the generator set to shutdown and will also illuminate the "HIGH ENGINE TEMPERATURE" fault lamp even though the temperature may be in the normal range.

When low lube oil pressure is sensed the "LOW OIL PRESSURE" fault lamp illuminates and the generator set is automatically shut down. Reset is effected by turning the Key Switch to Position "0" (Off).

WARNING

⚠ **If at any time the generator set stops because of a fault, the fault should be rectified before trying to restart the generator set**

5.2.5 Control System Fault Finding / Trouble Shooting Guide 1002T / LCP1002

Fault	Symptom	Remedy
Engine Fails To Start	Engine Does Not Crank When Key Switch Turned To Position " ↷ " (Start)	1. Check Operation Of Key Switch. 2. Check No Fault Lamps Illuminated. Reset, If Required, After Remedying Indicated Fault. 3. Refer To Your Local Dealer.
Engine Stops Due To Low Oil Pressure (All Control Systems)	"LOW OIL PRESSURE" Fault Lamp Illuminates	1. Check Oil Level 2. Refer To Your Local Dealer.
Engine Stops Due To High Coolant Temp	"HIGH COOLANT TEMP" Fault Lamp Illuminates	1. Check Coolant Level. (Be Sure To Allow The generator set To Cool First As Hot Water/Steam Can Be Present When You Remove The Radiator Cap). 2. Refer To Your Local Dealer.
Other Faults	–	Refer To Your Local Dealer.

5.3 PowerWizard 1.0 & 2.0 (Quickstart)

5.3.1 General Information

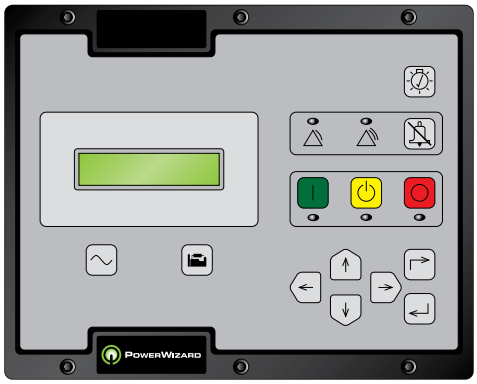
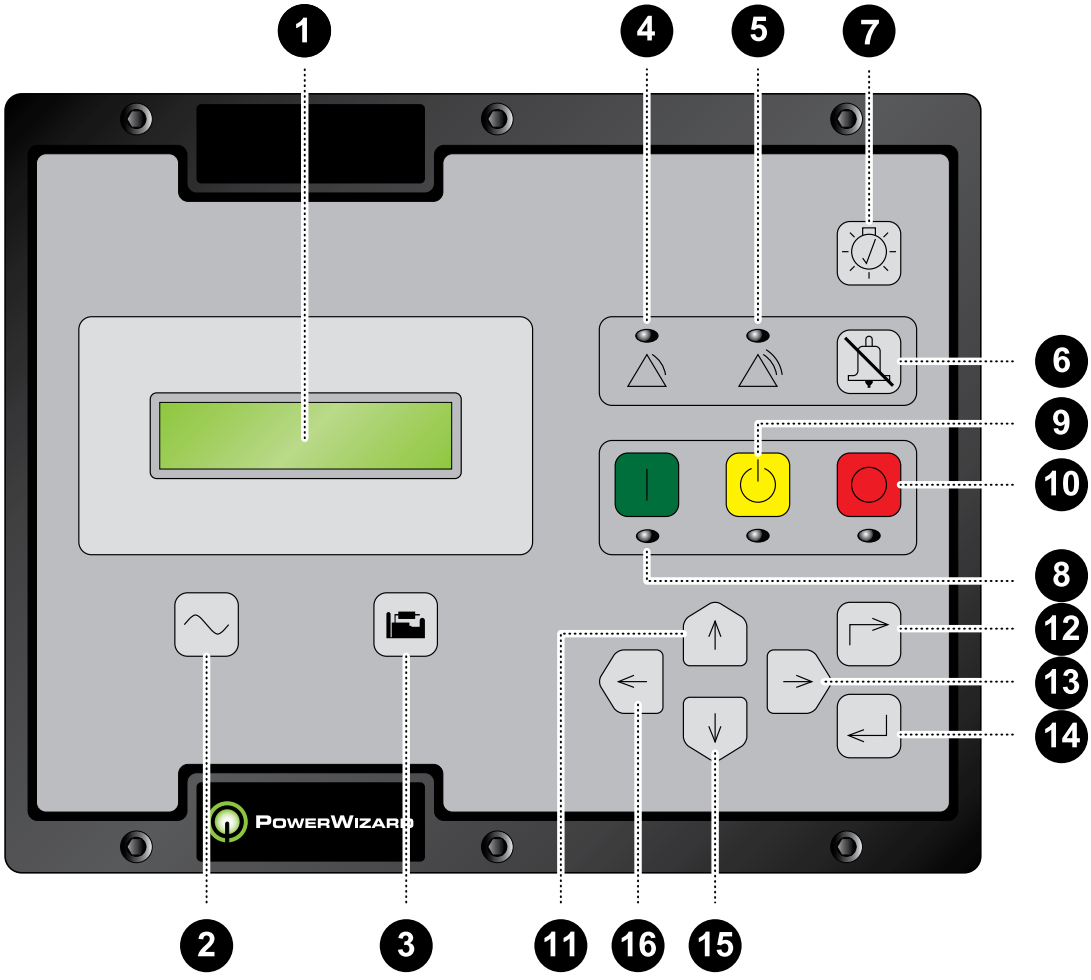


Figure 5d – PowerWizard Control System Panel

The controller is available in two versions, PowerWizard 1.0 and PowerWizard 2.0. These two versions are based on different features.

This guide is intended to cover the PowerWizard generator set control and its application in generator set systems.

5.3.2 PowerWizard Control Module Description



1 - display screen
2 - AC overview hot key
3 - DC overview hot-key
4 - warning lamp
5 - shutdown lamp
6 - alarm acknowledge
7 - lamp test
8 - run
9 - auto
10 - stop
11 - up cursor
12 - escape
13 - right cursor
14 - escape
15 - down cursor
16 - left cursor

Figure 5e – PowerWizard Control Module Description

Pre-Start Checks (applicable to all control systems)

Warning

⚠ **The following checks detailed below are the only tasks that an operator should undertake.**

The following checks should be performed prior to starting the generator set:

1. A visual inspection should take only a few minutes and can prevent costly repairs and accidents – for maximum generator set life, visually inspect the generator set before starting. Look for items such as:
   - Loose fastenings / fixings, worn belts or loose connections. Repair as necessary.
   - The fan and exhaust guards must be at the correct positions and securely fixed. Repair damaged / loose guards or renew missing guards.
   - Wipe clean all filler caps before the engine is serviced or fluids are topped up to reduce the chance of any system contamination.
   - For any type of leak (coolant, lubricating oil or fuel), clean away the fluid. If a leak is observed, find the source and correct the leak. If a leak is suspected, check the fluid levels frequently until the leak is found and repaired.
   - Accumulated grease and / or oil on an engine is a fire hazard. Remove it by steam cleaning or by the use of a high pressure water jet. Avoid high-pressure water on the electronic / electrical components provide suitable protection were possible.
   - Ensure that the coolant pipes are fitted correctly and that they are secure. Check for leaks. Check the condition of all pipes for splits or signs of rubbing.

Fluid levels

2. Check the engine oil and coolant levels – replenish as necessary (see engine handbook for locations). Ensure fluids used are as recommended within the engine handbook.

Warning:

⚠ **Do not remove the radiator cap or any component of the cooling system while the engine is running and while the coolant is under pressure, because dangerous hot coolant can be discharged, posing a risk of personal injury. Do not add large amounts of cold coolant to a hot system as serious engine damage could result.**

3. Check the engine oil and coolant levels – replenish as necessary.

Note:

- Diesel engines normally consume lube oil at a rate of 0.25% to 1% of the fuel consumption.
- When adding coolant to the radiator system, always pour slowly to help prevent air from becoming trapped in the engine. Always top up when engine is cold.

Warning:

⚠ **When filling the fuel tank, do not smoke or use an open flame in the vicinity.**

4. Check the fuel level – fill as necessary.

Warning:

⚠ **Before tightening the fan belts, disconnect the battery negative (–) lead to ensure the engine cannot be accidentally started.**

5. Check the condition and tension of the fan and engine alternator belts – tighten as necessary.
6. Check all hoses for loose connections or deterioration – tighten or replace as necessary.
7. Check the battery terminals for corrosion – clean as necessary.

Warning:

⚠ **When working with the batteries, do not smoke or use an open flame in the vicinity. Hydrogen gas from batteries is explosive.**

⚠ **Do not short the positive and negative terminals together.**

8. Check the battery electrolyte level – fill with distilled water as necessary.
9. Check the control panel and the generator set for heavy accumulation of dust and dirt – clean as necessary. These can pose an electrical hazard or give rise to cooling problems.
10. Check the air filter restriction indicator, if fitted – replace the filter as necessary.
11. Clear the area around the generator set of any insecure items that could inhibit operation or cause injury. Ensure cooling air ventilation screens are clear.

12. Visually check the entire generator set for signs of leaks from the fuel system, cooling system or lubrication seals.
13. Periodically drain exhaust system condensate traps, if equipped.
14. Ensure the Alternator Output Circuit Breaker is in the "OFF" (handle down) position.

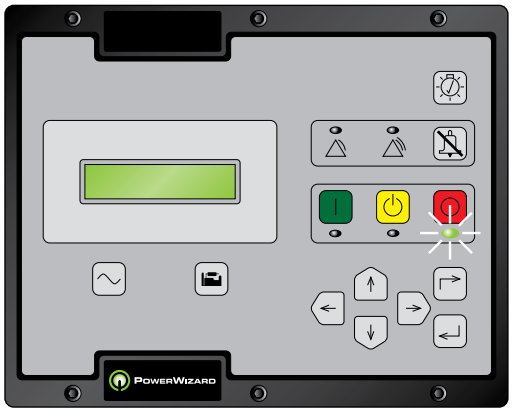
5.3.4 Basic Operation

START Mode

Press Start key

Figure 5f – Basic Operation Start Key

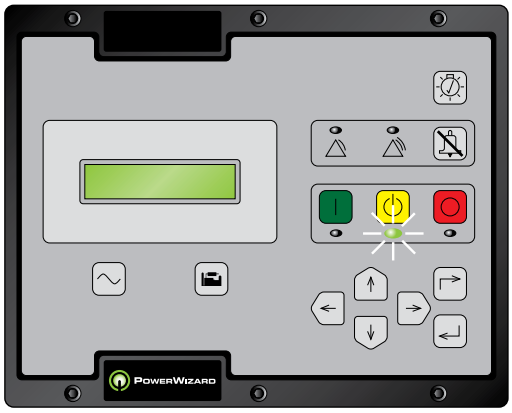
STOP Mode



Press Stop key

Figure 5g – Basic Operation Stop Key

AUTO Mode



Press Auto key

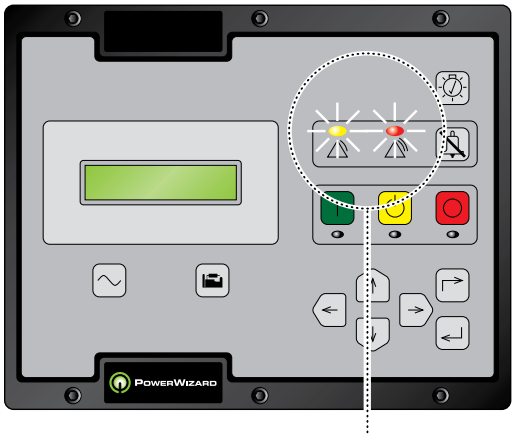
Figure 5h – Basic Operation Auto Key

Note:

- When not using PowerWizard in AUTO mode, a "Not in Auto Mode" activate alarm will sound (where enabled).

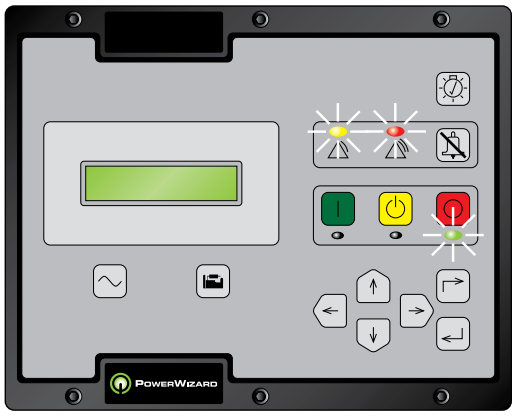
5.3.5 Fault / Alarm Reset Process

1. Fault / Alarm Reset Process



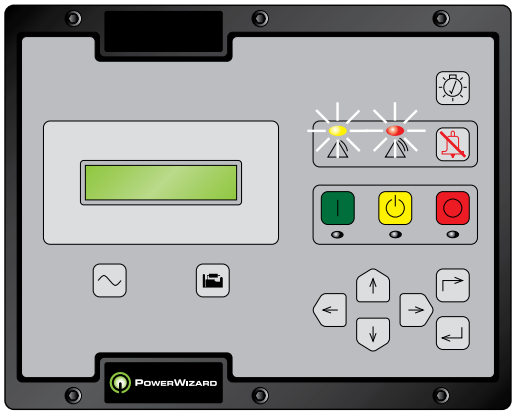
If either of these indication lamps are flashing or solid there is a warning or shurdown

2. Fault / Alarm Reset



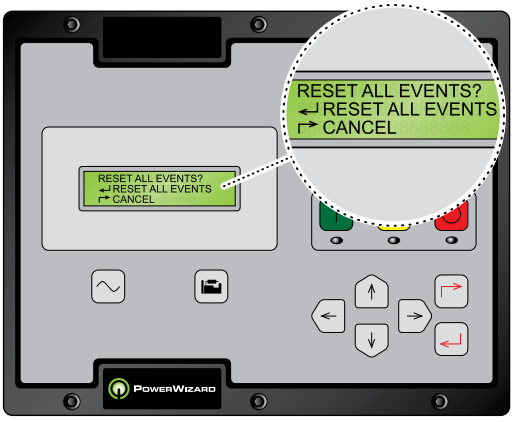
Press **STOP** Key

3. Fault / Alarm Reset



Press and hold **"Alarm Acknowledge"** key for 3 seconds

4. Fault / Alarm Reset Process. The display will show:



Press **ENTER** Key to clear all Warnings and / or Shutdowns

Press **ESCAPE Key to cancel**

Figure 5i – Basic Operation Fault Alarm Reset Process

5.3.6 User Interface Overview

Before starting or running the generator set, the operator should become fully acquainted with the control module's display and push buttons. The display should be observed from time to time while the generator set is running so that any abnormal readings can be detected before problems arise. Figure 5c shows a typical layout of the PowerWizard control panel. Addition of optional equipment may add items to the panel so that the panel fitted on the generator set may be slightly different from the typical one shown. The following descriptions explain the function of each standard item on the panels:

Function Keys:

AC Overview key – The AC Overview key will navigate the display to the first screen of AC information. The AC Overview information contains various AC parameters that summarise the electrical operation of the generator set. (Use the up/down keys to navigate within the AC parameters).

Engine Overview-key – The Engine Overview key will navigate the display to the first screen of engine information. The Engine Overview information contains various engine parameters that summarise the operation of the generator set. (Use the up/down keys to navigate within the Engine parameters).

Lamp Test – Pressing and holding the Lamp Test key will cause all of the LED's and the display screen pixels to turn on.

RUN – Pressing the Run key will cause the engine to enter the run mode.

AUTO – Pressing the Auto key will cause the engine to enter the auto mode.

STOP – Pressing the Stop key will cause the engine to enter stop mode.

Menu Navigators:

Scroll Up – The Scroll Up key is used to navigate up through the various menus or monitoring screens. The Scroll Up key is also used during setpoint entry. During numeric data entry the Scroll Up key is used to increment the digits (0–9). If the setpoint requires selection from a list, the Scroll Up key is used to navigate through the list.

Escape – The Escape key is used during menu navigation in order to navigate up through the menu/sub-menu structure. Each key press causes the user to move backwards/upwards through the navigation menus. The Escape key is also used to exit/ cancel out of data entry screens during setpoint programming. If the Escape key is pressed during setpoint programming, none of the changes made on screen will be saved to memory.

Scroll Right – The Scroll Right key is used during setpoint adjustment. During numeric data entry, the Scroll Right key is used to choose which digit is being edited. The Scroll Right key is also used during certain setpoint adjustments to select or deselect a check box. If a box has a check mark inside, pressing the Scroll Right key will cause the check mark to disappear, disabling the function. If the box does not have a check mark inside, pressing the Scroll Right key will cause a check mark to appear, enabling the function.

Enter – The Enter key is used during menu navigation to select menu items in order to navigate forward/downward in the menu/sub–menu structure. The Enter key is also used during setpoint programming in order to save setpoint changes. Pressing the Enter key during setpoint programming causes setpoint changes to be saved to memory.

Scroll Down – The Scroll Down key is used to navigate down through the various menus or monitoring screens. The Scroll Down key is also used during setpoint entry. During numeric data entry the Scroll Down key is used in order to decrement the digits (0–9). If the setpoint requires selection from a list, the Scroll Down key is used to navigate down through the list.

Scroll Left – The Scroll Left key is used during setpoint adjustment. During numeric data entry, the Scroll Left key is used to choose which digit is being edited. The Scroll Left key is also used during certain setpoint adjustments to select or deselect a check box. If a box has a check mark inside, pressing the Scroll Left key will cause the check mark to disappear, disabling the function. If the box does not have a check mark inside, pressing the Scroll Left key will cause a check mark to appear, enabling the function.

Alarm Indicators:

Yellow Warning Light – A flashing yellow light indicates that there are unacknowledged active warnings. A solid yellow light indicates that there are acknowledged warnings active. If there are any active warnings, the yellow light will change from flashing yellow to solid yellow after the Alarm Acknowledge key is pressed. If there are no longer any active warnings, the yellow light will turn off after the Alarm Acknowledge key is pressed.

Red Shutdown Light – A flashing red light indicates that there are unacknowledged active shutdown events. A solid red light indicates that there are acknowledged shutdown events active. If there are any active shutdown events the red light will change from flashing red to solid red after the Alarm Acknowledge key is pressed. Any condition that has caused a shutdown event must be manually reset. If there are no longer any active shutdown events, the red light will turn off.

Alarm Acknowledge – Pressing the Alarm Acknowledge will cause the horn relay output to turn off and silence the horn (if installed). Pressing the key will also cause any yellow or red flashing lights to turn off or to become solid depending on the active status of the alarms. The Alarm Acknowledge may also be configured to send out a global alarm silence on the J1939 Data Link, which will silence horns on annunciators. Pressing and holding the Alarm Acknowledge key can be used to reset all active warnings or shutdowns.

EMERGENCY STOP Push button – A red lock-down push button that immediately shuts down the generator set and will inhibit start until the push button has been released by turning it clockwise. Prior to restarting the set, this fault must be reset by pressing the "stop" button on the module and resetting the fault in the "event log menu".

Display Preferences for PowerWizard Panels:

To change the display preferences, from the main menu scroll down to the "Preferences" item (last in the menu). Press the "Enter" Key. Scroll down through the preferences menu until the desired display preference is highlighted. Press "Enter" to adjust this preference.

CONTRAST: The display contrast may require adjustment from the factory default depending on viewing angle and ambient temperature. The contrast is adjusted between 0% and 100% by pressing the "Left" and "Right" keys. Pressing "Enter" accepts the changes and "Escape" aborts the changes.

BACKLIGHT: The backlight is usually left at 100%, however on occasions the user may wish to reduce the backlight intensity. The backlight can be adjusted between 0 to 100% by pressing the "Left" and "Right" keys. Pressing "Enter" accepts the changes and "Escape" aborts the changes.

PRESSURE UNITS: The pressure units can be adjusted between kPa/psi/bar. Use the "Left" and "Right" keys to select the preferred pressure units. Pressing "Enter" accepts the new pressure units; pressing "Escape" aborts the change in pressure units.

TEMPERATURE UNITS: The temperature units can be adjusted between ºC and °F. Use the "Left" and "Right" keys to select the preferred temperature units. Pressing "Enter" accepts the change; pressing escape aborts the change.

5.3.7 Alarm Log and Resetting

Note:

- To reset the menu back to the start, press the "Escape" key three times.

Alarm Log

1. From the main menu, highlight "EVENT LOGS" and press the "Enter" key.
2. In order to scroll through the events use the "Up" and "Down" keys. Events are ordered with present events first, active events next and inactive events last. Within these classifications they are ordered by engine run hours (or real time clock on PowerWizard 2.0).
3. Press "Enter" after highlighting an event to see additional information such as SPN, FMI, time and date of first occurrence, time and date of last occurrence (PowerWizard 2.0 only), engine hours at first occurrence, and engine hours at last occurrence.

Shutdown Resetting

A flashing red shutdown light indicates there is an unacknowledged shutdown event. The red shutdown light will change from flashing red to solid red when the "Alarm Acknowledged" key is pressed. Once a fault has been checked and the cause rectified, use the following procedure in order to reset the event:

1. Press the "Stop" key.
2. Enter the "EVENT LOGS" option from the main menu.
3. Select an ECM from the list.
4. Scroll through the events in order to highlight the event to be reset.
5. Make sure the event status is active (not present).
6. Press the "Enter" key.
7. "RESET" will be highlighted if the condition is no longer present and the control is in stop.
8. Press the "Enter" key again. The fault will clear.
9. Press the "Escape" key 3 times in order to get back to the main menu.

Quick Alarm Resetting (see section 5.3.5)

In addition to the above procedure there is also a simplified process for resetting all events. To reset all events:

1. Press the "Stop" key.
2. Press and hold the "Alarm Acknowledge" key for three seconds.
3. Press Enter to reset all events, press Escape to cancel.

Note.

- The PowerWizard must be in stop mode to reset events.
- Active faults cannot be reset.

5.3.8 Security

There are three levels of password protection on the PowerWizard control panel. All of the adjustable setpoints are associated with a specific level of security required to make an adjustment to the parameter. The passwords only affect changing setpoints within the control panel.

The level of password protection that is required for each setpoint is identified on the parameter setpoint entry screen. A security level identification number "1", "2" or "3" next to a padlock symbol is displayed on the parameter setpoint entry screen.
A Level 3 security is used for the most secure setpoints and Level 1 security is used for the least secure setpoints. If the PowerWizard is currently at the required level of protection when viewing a parameter, the padlock will not appear.

If a parameter is displayed with a padlock but no security level identification number next to it, the parameter cannot be changed from the PowerWizard display and the Dealer must be contacted. Level 1 and 2 passwords are disabled when installed. Level 1 and 2 passwords are user level passwords and can be used if desired.

The PowerWizard 2.0 also has a SCADA password, which can be used to secure remote communications.

To view the security menu:

MAIN MENU > CONFIGURE > SECURITY

At the top of the security menu the current security level is displayed. Within the security menu are the following options:

DROP TO MINIMUM LEVEL – used to return the current security level to the lowest level set-up. Highlight and press Enter to drop to minimum security level. If no Level 1 or 2 passwords are set-up the minimum level will be 2. If a Level 2 password is set-up, the minimum level will be 1 and if a Level 1 password is set-up the minimum level will be 0.

ENTER LEVEL 1 OR 2 – used to enter Level 1 or 2 passwords. Highlight and press Enter to proceed to the password entry screen. Passwords can be entered using the cursor keys. In PowerWizard, Level 1 and 2 passwords must be different. An entered password is compared against the stored Level 1 and 2 passwords, if the password is correct the PowerWizard will go to the corresponding security level.

ENTER LEVEL 3 – used to obtain Level 3 access. The Level 3 security password is reserved for critical setpoints that should only be changed by a skilled operative. As such you must contact your Dealer if you require a change associated with a Level 3 password.

CHANGING LEVEL 1 PASSWORD – used to set-up, change or disable a Level 1 password. In order to use this feature the control must be at current security Level 1 or higher. Highlight and press Enter to proceed to the password entry screen. To set-up or change the password, enter the new password using the cursor keys. Passwords may be 16 digits long. To disable the Level 1 security password, set the password to '0'. Press the Enter key to save.

CHANGING LEVEL 2 PASSWORD – used to set-up, change or disable a Level 2 password. In order to use this feature the control must be at current security Level 2 or higher. Highlight and press Enter to proceed to the password entry screen. To set-up or change the password, enter the new password using the cursor keys. Passwords may be 16 digits long. To disable the Level 2 security password, set the password to '0'. Press the Enter key to save.

CHANGING SCADA PASSWORD (PowerWizard 2.0 only) – used to set-up, change or disable a SCADA password. Highlight and press enter to proceed to the password entry screen. To set-up or change the password, enter the new password using the cursor keys. Passwords may be 16 digits long. To disable the SCADA security password, set the password to '0'. Press the Enter key to save.

5.3.9 Real Time Clock Programming (PowerWizard 2.0)

The real time clock provides information for the time and date of an automatic time based start/stop control. It also provides a mechanism for time stamps in the event log. The real time clock is not calibrated and is for information only. The date and time are set by the user.

1. In order to set the time or date format:
   MAIN MENU > CONFIGURE > TIME/DATE.
2. To set the time, highlight the time then press the "Enter" key twice.
3. Use the cursor keys to set the time and press the "Enter" key to save. Press the "Escape" key to return.
4. To set the date, highlight the date then press the "Enter" key twice.
5. Use the cursor keys to set the date and press the "Enter" key to save. Press the "Escape" key to return.
6. To set the date format, highlight either the FORMAT DD/MM/YY or FORMAT MM/DD/YY and press the "Enter" key.
7. Use the cursor keys to select the required date format and press the "Enter" key to save.

5.3.10 Fuel Priming – Engines with Electric Fuel Lift Pump

Certain engines fitted with an electric fuel pump do not have a manual priming feature on the engine. In these circumstances the PowerWizard can be used to energise the fuel lift pump in order to prime the engine.

1. In order to prime the generator set:
   MAIN MENU > CONTROL > ENGINE FUEL PRIMING.
2. To prime the generator set press the right cursor key, this will initiate a 2 minute priming cycle.
3. To exit the priming cycle press the left cursor key.

Note.

- The generator set may only be primed when the generator set is stopped and there are no active or present shutdown conditions.

5.3.11 Additional Features Available

Reduced Power Mode

In reduced power mode the screen will go blank and LED's will flash intermitently. Pressing any key will bring the panel out of reduced power mode. Reduced power mode can be disabled (Refer to your local Dealer).

Remote Annunciation of Faults

The PowerWizard Annunciator is used in remote applications, mounted separately from the generator set to provide remote indication of system operating and alarm conditions.

For further information on these features, please contact your Dealer.

5.3.12 Trouble Shooting Guide for PowerWizard

Fault	Symptom	Remedy
Engine Fails To Start	Engine Does Not Crank When Start Signal Is Given, Either Manually Via Run Key Or Automatically Via A Remote Signal	1. Check All Emergency Stop Push Buttons Are Released 2. Check The Stop Button Light Is Not On 3. Check There Are No Shutdown Events Active. Reset, If Required, After Remedying The Indicated Fault 4. Refer To Your Local Dealer
Engine Stops Due To Low Oil Pressure	"LOW OIL PRESSURE" In Event Log. Red Shutdown Led Illuminates	1. Check Oil Level 2. Refer To Your LocaL Dealer
Engine Stops Due To High Coolant Temp	"HIGH COOLANT TEMP" In Event Log. Red Shutdown Led Illuminates	1. Check Coolant Level In The Radiator. Refer To Safety Section Before Removing The Radiator Cap 2. Refer To Your Local Dealer
Engine Stops Due To Overspeed	"OVERSPEED" In Event Log. Red Shutdown Led Illuminates	1. Verify The Actual Engine Speed 2. Refer To Your Local Dealer
Engine Stops Due To Under-Voltage (Powerwizard 2.0 Only)	"UNDER-VOLTAGE" In Event Log, Red Shutdown Led Illuminates	1. Refer To Your Local Dealer
Engine Stops Due To Over-Voltage (Standard On Powerwizard 2.0, Optional On Powerwizard 1.0)	"Over-Voltage" In Event Log, Red Shutdown Led Illuminates	1. Refer To Your Local Dealer
Generator set Does Not Go On Load	Generator set Is Running But The Load Is Not Being Powered	1. Refer To Your Local Dealer
Generator set Does Not Stop Manually	Generator set Keeps Running After Being Switched Off	1. Check That The Generator set Stops When The Emergency Stop Push button Is Depressed 2. Refer To Your Local Dealer
Generator set Does Not Stop When In Auto Mode	Generator set Does Not Stop After Remote Start Signal Is Removed	1. Check That The Generator set Stops When The Emergency Stop Push button Is Depressed Or The Stop Key Is Held Down For 5 Seconds And The Cooldown Time Is Skipped
Alarm For Not In Auto Mode (Standby Sets Only)	"Not In Auto Mode" Alarm In Event Log, Amber Led Illuminates	1. Check The Module Is In "Auto" Mode 2. Check Emergency Stop Push buttons Are Not Pressed 3. Refer To Your Local Dealer

5.4 PowerWizard 1.1, 1.1+ & 2.1 (Quickstart)

5.4.1 General Information

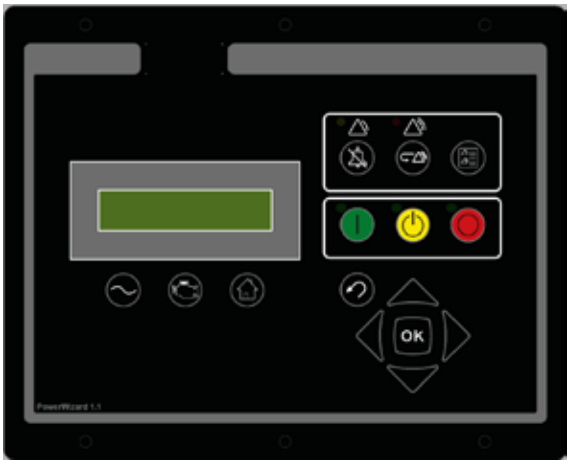
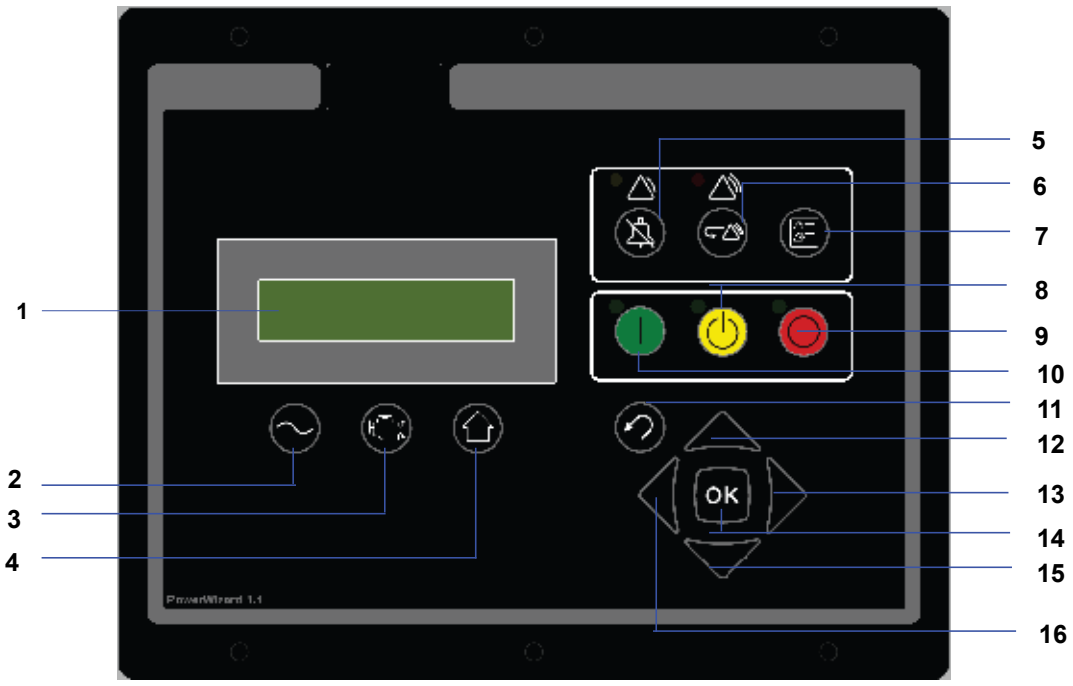


Figure 5j – PowerWizard Control System Panel

The controller is available in three versions, PowerWizard 1.1, 1.1+ and 2.1. These three versions are based on different features. This guide is intended to cover the PowerWizard generator set Control and its application in generator set systems.

5.4.2 PowerWizard Control Module Description



1. Display screen
2. AC overview key
3. Engine overview key
4. Main menu or home key
5. Alarm acknowledge key
6. Event reset key
7. Event log key
8. Auto key
9. Stop key
10. Run key
11. Escape key
12. Up key
13. Right key
14. OK or Enter key
15. Down key
16. Left key

Figure 5k – PowerWizard Control Module Description

5.4.3 Pre-Start Checks (applicable to all control systems)

Warning

⚠ **The following checks detailed below are the only tasks that an operator should undertake.**

The following checks should be performed prior to starting the generator set:

1. A visual inspection should take only a few minutes and can prevent costly repairs and accidents – For maximum generator set life, visually inspect the generator set before starting. Look for items such as:
   - Loose fastenings / fixings, worn belts or loose connections. Repair as necessary.
   - The fan and exhaust guards must be at the correct positions and securely fixed. Repair damaged / loose guards or renew missing guards.
   - Wipe clean all filler caps before the engine is serviced or fluids are topped up to reduce the chance of any system contamination.
   - For any type of leak (coolant, lubricating oil or fuel), clean away the fluid. If a leak is observed, find the source and correct the leak. If a leak is suspected, check the fluid levels frequently until the leak is found and repaired.
   - Accumulated grease and / or oil on an engine is a fire hazard. Remove it by steam cleaning or by the use of a high pressure water jet. Avoid high-pressure water on the electronic/electrical components provide suitable protection were possible.
   - Ensure that the coolant pipes are fitted correctly and that they are secure. Check for leaks. Check the condition of all pipes for splits or signs of rubbing.

Fluid levels

2. Check the engine oil and coolant levels – replenish as necessary (see engine handbook for locations). Ensure fluids used are as recommended within the engine handbook.

Warning:

⚠ **Do not remove the radiator cap or any component of the cooling system while the engine is running and while the coolant is under pressure, because dangerous hot coolant can be discharged, posing a risk of personal injury. Do not add large amounts of cold coolant to a hot system as serious engine damage could result.**

3. Check the engine oil and coolant levels – replenish as necessary.

Note:

- Diesel engines normally consume lube oil at a rate of 0.25% to 1% of the fuel consumption.
- When adding coolant to the radiator system, always pour slowly to help prevent air from becoming trapped in the engine. Always top up when engine is cold.

Warning:

⚠ **When filling the fuel tank, do not smoke or use an open flame in the vicinity.**

4. Check the fuel level – fill as necessary.

Warning:

⚠ **Before tightening the fan belts, disconnect the battery negative (–) lead to ensure the engine cannot be accidentally started.**

5. Check the condition and tension of the fan and engine alternator belts – tighten as necessary.
6. Check all hoses for loose connections or deterioration – tighten or replace as necessary.
7. Check the battery terminals for corrosion – clean as necessary.

Warning:

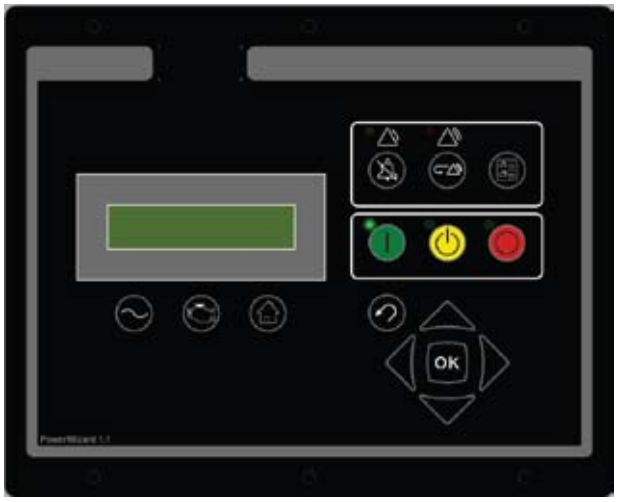
⚠ **When working with the batteries, do not smoke or use an open flame in the vicinity. Hydrogen gas from batteries is explosive.**

⚠ **Do not short the positive and negative terminals together.**

8. Check the battery electrolyte level – fill with distilled water as necessary.
9. Check the control panel and the generator set for heavy accumulation of dust and dirt – clean as necessary. These can pose an electrical hazard or give rise to cooling problems.
10. Check the air filter restriction indicator, if fitted – replace the filter as necessary.
11. Clear the area around the generator set of any insecure items that could inhibit operation or cause injury. Ensure cooling air ventilation screens are clear.
12. Visually check the entire generator set for signs of leaks from the fuel system, cooling system or lubrication seals.
13. Periodically drain exhaust system condensate traps, if equipped.
14. Ensure the Alternator Output Circuit Breaker is in the "OFF" (handle down) position.

5.4.4 Basic Operation

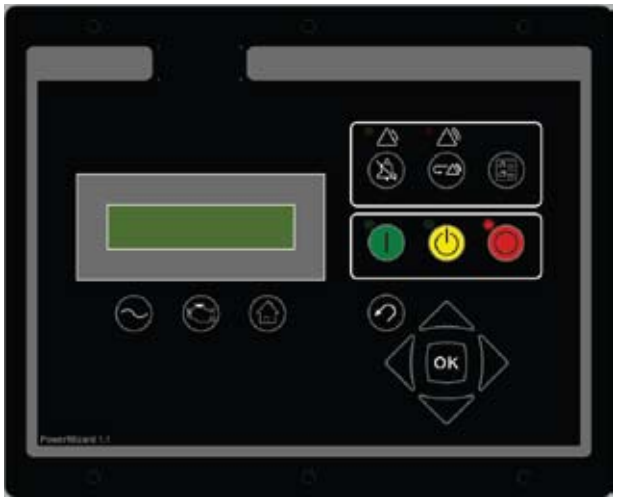
START Mode



Press **START** Key

Figure 5l – Basic Operation Start Key

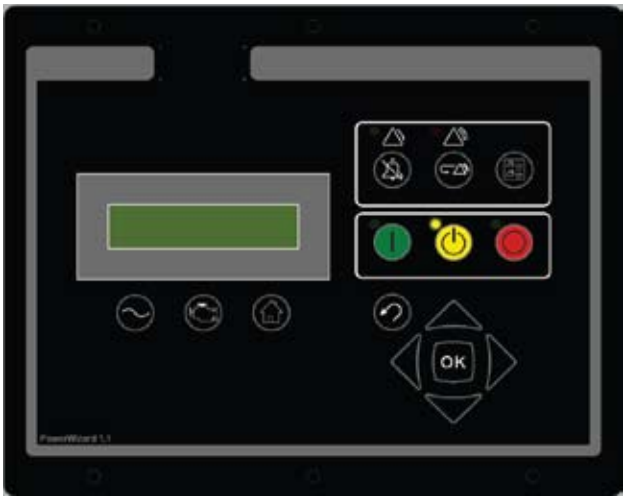
STOP Mode



Press **STOP** Key

Figure 5m – Basic Operation Stop Key

AUTO Mode



Press **AUTO** Key

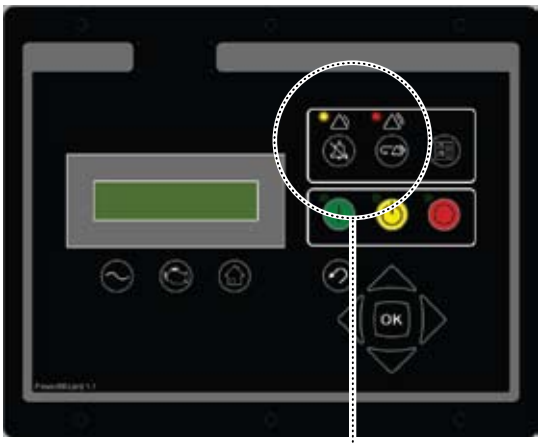
Figure 5n – Basic Operation Auto Key

Note:

- When not using PowerWizard in AUTO mode a "Not in Auto Mode" activate alarm will sound (where enabled).

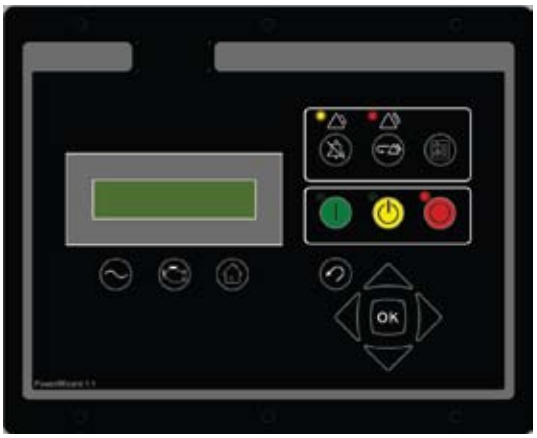
5.4.5 Fault / Alarm Reset Process

1. Fault / Alarm Reset Process



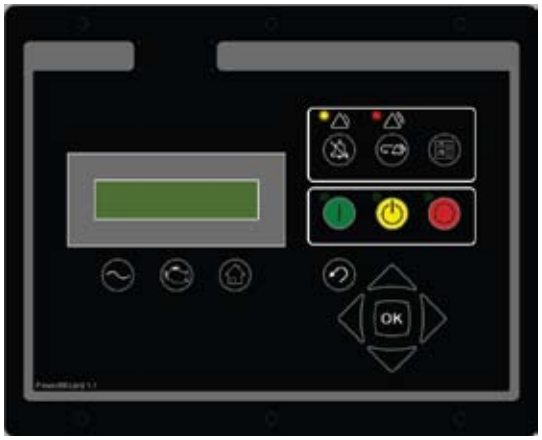
If either of these indication lamps are flashing or solid there is a warning or shurdown

2. Fault / Alarm Reset



Press **STOP** Key

3. Fault / Alarm Reset



Press and hold **"Alarm Acknowledge"** key for 3 seconds

4. Fault / Alarm Reset Process. The display will show:

OK Press **ENTER** Key to clear all Warnings and / or Shutdowns

Press **ESCAPE Key to cancel**

Figure 5o – Basic Operation Fault Alarm Reset Process

5.4.6 User Interface Overview

Before starting or running the generator set, the operator should become fully acquainted with the control module's display and push buttons. The display should be observed from time to time while the generator set is running so that any abnormal readings can be detected before problems arise. Figure 5c shows a typical layout of the PowerWizard control panel. Addition of optional equipment may add items to the panel so that the panel fitted on the generator set may be slightly different from the typical one shown. The following descriptions explain the function of each standard item on the panels:

Function Keys:

AC Overview key – The AC Overview key will navigate the display to the first screen of AC information. The AC Overview information contains various AC parameters that summarise the electrical operation of the generator set. (Use the up/down keys to navigate within the AC parameters).

Engine Overview key – The Engine Overview key will navigate the display to the first screen of engine information. The Engine Overview information contains various engine parameters that summarise the operation of the generator set. (Use the up / down keys to navigate within the Engine parameters).

Main Menu key – The Main Menu key will navigate the display to the main menu screen. Pressing the navigation keys will allow access to menus at all levels.

Control Keys:

RUN – Pressing the Run key will cause the engine to enter the run mode.

AUTO – Pressing the Auto key will cause the engine to enter the auto mode.

STOP – Pressing the Stop key will cause the engine to enter stop mode.

Navigation Keys:

Scroll Up – The Scroll Up key is used to navigate up through the various menus or monitoring screens. The Scroll Up key is also used during setpoint entry. During numeric data entry the Scroll Up key is used to increment the digits (0–9). If the setpoint requires selection from a list, the Scroll Up key is used to navigate through the list.

Escape – The Escape key is used during menu navigation in order to navigate up through the menu/sub-menu structure. Each key press causes the user to move backwards/upwards through the navigation menus. The Escape key is also used to exit/cancel out of data entry screens during setpoint programming. If the Escape key is pressed during setpoint programming, none of the changes made on screen will be saved to memory.

Scroll Right – The Scroll Right key is used during setpoint adjustment. During numeric data entry, the Scroll Right key is used to choose which digit is being edited. The Scroll Right key is also used during certain setpoint adjustments to select or deselect a check box. If a box has a check mark inside, pressing the Scroll Right key will cause the check mark to disappear, disabling the function. If the box does not have a check mark inside, pressing the Scroll Right key will cause a check mark to appear, enabling the function.

Enter / OK – The Enter key is used during menu navigation to select menu items in order to navigate forward/downward in the menu/sub–menu structure. The Enter key is also used during setpoint programming in order to save setpoint changes. Pressing the Enter key during setpoint programming causes setpoint changes to be saved to memory.

Scroll Down – The Scroll Down key is used to navigate down through the various menus or monitoring screens. The Scroll Down key is also used during setpoint entry. During numeric data entry the Scroll Down key is used in order to decrement the digits (0–9). If the setpoint requires selection from a list, the Scroll Down key is used to navigate down through the list.

Scroll Left – The Scroll Left key is used during setpoint adjustment. During numeric data entry, the Scroll Left key is used to choose which digit is being edited. The Scroll Left key is also used during certain setpoint adjustments to select or deselect a check box. If a box has a check mark inside, pressing the Scroll Left key will cause the check mark to disappear, disabling the function. If the box does not have a check mark inside, pressing the Scroll Left key will cause a check mark to appear, enabling the function.

Event Keys and Indicators:

Yellow Warning Light – A flashing yellow light indicates that there are unacknowledged active warnings. A solid yellow light indicates that there are acknowledged warnings active. If there are any active warnings, the yellow light will change from flashing yellow to solid yellow after the Alarm Acknowledge key is pressed. If there are no longer any active warnings, the yellow light will turn off after the Alarm Acknowledge key is pressed.

Red Shutdown Light – A flashing red light indicates that there are unacknowledged active shutdown events. A solid red light indicates that there are acknowledged shutdown events active. If there are any active shutdown events the red light will change from flashing red to solid red after the Alarm Acknowledge key is pressed. Any condition that has caused a shutdown event must be manually reset. If there are no longer any active shutdown events, the red light will turn off.

Alarm Acknowledge – Pressing the Alarm Acknowledge will cause the horn relay output to turn off and silence the horn. Pressing the key will also cause any yellow or red flashing lights to turn off or to become solid depending on the active status of the alarms.

Event Reset Key – Pressing the Event Reset key will reset all events when the control is in the stopped position. However, "Reset All Events" will not reset "Present" events.

Event Log Key – Pressing the Event Log key will navigate to the "Active Events" menu. In order to scroll through the events, use the up and down keys. After highlighting an event, press the "OK" key to see information about the event such as the SPN and the FMI.

EMERGENCY STOP Push button – A red lock-down push button that immediately shuts down the generator set and will inhibit start until the push button has been released by turning it clockwise. Prior to restarting the set, this fault must be reset by pressing the "stop" button on the module and resetting the fault in the "event log menu".

Display Preferences for PowerWizard Panels:

To change the display preferences, from the main menu scroll down to the "Preferences" item (last in the menu). Press the "Enter" Key. Scroll down through the preferences menu until the desired display preference is highlighted. Press "Enter" to adjust this preference.

CONTRAST: The display contrast may require adjustment from the factory default depending on viewing angle and ambient temperature. The contrast is adjusted between 0% and 100% by pressing the "Left" and "Right" keys. Pressing "Enter" accepts the changes and "Escape" aborts the changes.

BACKLIGHT: The backlight is usually left at 100%, however on occasions the user may wish to reduce the backlight intensity. The backlight can be adjusted between 0 to 100% by pressing the "Left" and "Right" keys. Pressing "Enter" accepts the changes and "Escape" aborts the changes.

PRESSURE UNITS: The pressure units can be adjusted between kPa/psi/bar. Use the "Left" and "Right" keys to select the preferred pressure units. Pressing "Enter" accepts the new pressure units; pressing "Escape" aborts the change in pressure units.

TEMPERATURE UNITS: The temperature units can be adjusted between ºC and °F. Use the "Left" and "Right" keys to select the preferred temperature units. Pressing "Enter" accepts the change; pressing escape aborts the change.

VOLUME: Volume is used on some optional parameters (such as fuel consumption rate). It can be selected between Litres, US Gallons and Imperial Gallons using the "Left" and "Right" keys. Pressing "Enter" accepts the new volume units; pressing "Escape" aborts the change to the volume units.

LAMP TEST: This is used to test the LEDs and display. When LAMP TEST is highlighted, pressing OK will turn on all LEDs and display screen.

5.4.7 Alarm Log and Resetting

Note:

- To reset the menu back to the start, please press the "Escape" key three times.

Event Viewing

There are two ways to view events. Pressing the "EVENT LOG" key navigates directly to the "ACTIVE EVENTS" menu. The other way is to use the Main Menu:

1. From the MAIN MENU/VIEW, highlight "EVENT LOGS" and press the "Enter" key. The "ACTIVE EVENTS" menu will be displayed in this menu.
2. In order to scroll through the events use the up and down keys. Events are ordered with present events first, active events next and inactive events last. Within these classifications they are ordered by engine run hours (or real time clock on PowerWizard 2.1).
3. Press "Enter" after highlighting an event to see additional information such as SPN, FMI, time and date of first occurrence, time and date of last occurrence (PowerWizard 2.1 only), engine hours at first occurrence and engine hours at last occurrence.

Quick Shut Down Resetting

In addition to the above procedure there is also a simplified process for resetting all events. To reset all events:

1. Ensure that the control is in the stopped position.
2. Press the "Reset Event" key from any screen.
3. A confirmation prompt will appear.
4. Press the "OK" key to reset all events on all modules. Press the 'ESCAPE" key to cancel the reset operation.

Note:

- The PowerWizard must be in stop mode to reset events.

Present events cannot be reset.

Shut Down Resetting

A flashing red shutdown light indicates there is an unacknowledged shutdown event. The red shutdown light will change from flashing red to solid red when the Alarm Acknowledged key is pressed. Once a fault has been checked and the cause rectified, use the following procedure in order to reset the event:

1. Press the "Stop" key.
2. Enter the "EVENT LOGS" option from the main menu.
3. Select a "Module" from the list.
4. Scroll through the events in order to highlight the event to be reset.
5. Make sure the event status is active (not present).
6. Press the "Enter" key.
7. "RESET" will be highlighted if the condition is no longer present and the control is in stop.
8. Press the "Enter" key again. The fault will clear.
9. Press the "Escape" or "Main Menu" key in order to get back to the main menu.

5.4.8 Security

There are 3 levels of password protection on the PowerWizard control panel. All of the adjustable setpoints are associated with a specific level of security required to make an adjustment to the parameter. The passwords only affect changing setpoints within the control panel.

The level of password protection that is required for each setpoint is identified on the parameter setpoint entry screen. A security level identification number "1", "2" or "3" next to a padlock symbol is displayed on the parameter setpoint entry screen. A Level 3 security is used for the most secure setpoints and Level 1 security is used for the least secure setpoints. If the PowerWizard is currently at the required level of protection when viewing a parameter, the padlock will not appear.

If a parameter is displayed with a padlock but no security level identification number next to it, the parameter cannot be changed from the PowerWizard display and the Dealer must be contacted. Level 1 and 2 passwords are disabled when installed. Level 1 and 2 passwords are user level passwords and can be used if desired.

The PowerWizard 2.1 also has a SCADA password, which can be used to secure remote communications.

To view the security menu:

MAIN MENU > CONFIGURE > SECURITY.

At the top of the security menu the current security level is displayed. Within the security menu are the following options:

DROP TO MINIMUM LEVEL – used to return the current security level to the lowest level set-up. Highlight and press Enter to drop to minimum security level. If no Level 1 or 2 passwords are set-up the minimum level will be 2. If a Level 2 password is set-up, the minimum level will be 1 and if a Level 1 password is set-up the minimum level will be 0.

ENTER LEVEL 1 OR 2 – used to enter Level 1 or 2 passwords. Highlight and press Enter to proceed to the password entry screen. Passwords can be entered using the cursor keys. In PowerWizard, Level 1 and 2 passwords must be different. An entered password is compared against the stored Level 1 and 2 passwords, if the password is correct the PowerWizard will go to the corresponding security level.

ENTER LEVEL 3 – used to obtain Level 3 access. The Level 3 security password is reserved for critical setpoints that should only be changed by a skilled operative. As such you must contact your Dealer if you require a change associated with a Level 3 password.

CHANGING LEVEL 1 PASSWORD – used to set-up, change or disable a Level 1 password. In order to use this feature the control must be at current security Level 1 or higher. Highlight and press Enter to proceed to the password entry screen. To set-up or change the password, enter the new password using the cursor keys. Passwords may be 16 digits long. To disable the Level 1 security password, set the password to '0'. Press the Enter key to save.

CHANGING LEVEL 2 PASSWORD – used to set-up, change or disable a Level 2 password. In order to use this feature the control must be at current security Level 2 or higher. Highlight and press Enter to proceed to the password entry screen. To set-up or change the password, enter the new password using the cursor keys. Passwords may be 16 digits long. To disable the Level 2 security password, set the password to '0'. Press the Enter key to save.

CHANGING SCADA PASSWORD (PowerWizard 2.1 only) – used to set-up, change or disable a SCADA password. Highlight and press enter to proceed to the password entry screen. To set-up or change the password, enter the new password using the cursor keys. Passwords may be 16 digits long. To disable the SCADA security password, set the password to '0'. Press the Enter key to save.

5.4.9 Real Time Clock Programming (PowerWizard 2.1)

The real time clock provides information for the time and date of an automatic time based start/stop control. It also provides a mechanism for time stamps in the event log. The real time clock is not calibrated and is for information only. The date and time are set by the user.

1. In order to set the time or date format:
   MAIN MENU > CONFIGURE > TIME/DATE.
2. To set the time, highlight the time then press the "Enter" key twice.
3. Use the cursor keys to set the time and press the "Enter" key to save. Press the "Escape" key to return.
4. To set the date, highlight the date then press the "Enter" key twice.
5. Use the cursor keys to set the date and press the "Enter" key to save. Press the "Escape" key to return.
6. To set the date format, highlight either the FORMAT DD/MM/YY or FORMAT MM/DD/YY and press the "Enter" key.
7. Use the cursor keys to select the required date format and press the "Enter" key to save.

5.4.10 Fuel Transfer (PowerWizard 2.1)

Fuel pump in connection with fuel level measurement can be controlled to transfer diesel to the fuel tank.

1. In order to set the Fuel Transfer operation:

   MAIN MENU > CONTROL > FUEL TRANSFER
2. To start or stop the fuel pump, highlight the PUMP CONTROL then press the "OK" key.
3. Use the cursor key to select START FUEL PUMP or STOP FUEL PUMP and press the "OK" key.
4. healthyAuto Fuel Load Pump On and Off thresholds are set at 25% and 75% respectively.

5.4.11 Additional Features Available

Reduced Power Mode

In reduced power mode the screen will go blank and LED's will flash intermitently. Pressing any key will bring the panel out of reduced power mode. Reduced power mode can be disabled (Refer to your local Dealer).

Remote Annunciation of Faults

The PowerWizard Annunciator is used in remote applications, mounted separately from the generator set to provide remote indication of system operating and alarm conditions.

For further information on these features, please contact your Dealer.

5.4.12 Trouble Shooting Guide for PowerWizard

Fault	Symptom	Remedy
Engine Fails To Start	Engine Does Not Crank When Start Signal Is Given, Either Manually Via Run Key Or Automatically Via A Remote Signal	1. Check All Emergency Stop Push Buttons Are Released 2. Check The Stop Button Light Is Not On 3. Check There Are No Shutdown Events Active. Reset, If Required, After Remedying The Indicated Fault 4. Refer To Your Local Dealer
Engine Stops Due To Low Oil Pressure	"LOW OIL PRESSURE" In Event Log. Red Shutdown Led Illuminates	1. Check Oil Level 2. Refer To Your LocaL Dealer
Engine Stops Due To High Coolant Temp	"HIGH COOLANT TEMP" In Event Log. Red Shutdown Led Illuminates	1. Check Coolant Level In The Radiator. Refer To Safety Section Before Removing The Radiator Cap 2. Refer To Your Local Dealer
Engine Stops Due To Overspeed	"OVERSPEED" In Event Log. Red Shutdown Led Illuminates	1. Verify The Actual Engine Speed 2. Refer To Your Local Dealer
Engine Stops Due To Under-Voltage (Powerwizard 2.1 Only)	"UNDER-VOLTAGE" In Event Log, Red Shutdown Led Illuminates	1. Refer To Your Local Dealer
Engine Stops Due To Over-Voltage (Standard On Powerwizard 2.1, Optional On Powerwizard 1.1+)	"Over-Voltage" In Event Log, Red Shutdown Led Illuminates	1. Refer To Your Local Dealer
Generator set Does Not Go On Load	Generator set Is Running But The Load Is Not Being Powered	1. Refer To Your Local Dealer
Generator set Does Not Stop Manually	Generator set Keeps Running After Being Switched Off	1. Check That The Generator set Stops When The Emergency Stop Push button Is DepRessed 2. Refer To Your Local Dealer
Generator set Does Not Stop When In Auto Mode	Generator set Does Not Stop After Remote Start Signal Is Removed	1. Check That The Generator set Stops When The Emergency Stop Push button Is Depressed Or The Stop Key Is Held Down For 5 Seconds And The Cooldown Time Is Skipped
Alarm For Not In Auto Mode (Standby Sets Only)	"Not In Auto Mode" Alarm In Event Log, Amber Led Illuminates	1. Check The Module Is In "Auto" Mode 2. Check Emergency Stop Push buttons Are Not PreSsed 3. Refer To Your Local Dealer

5.5 DCP-10 & DCP-20

5.5.1 General Information

Figure 5p – DCP-10 and DCP-20 Control Panels

Illustrated above are the Automatic Start Control Modules (DCP-10 & DCP-20) designed to automatically start and stop the generator set.

The modules also monitor and protect the engine, indicating operational status, fault conditions and metering on the front panel LCD and LED's.

5.5.2 DCP Control Module Description

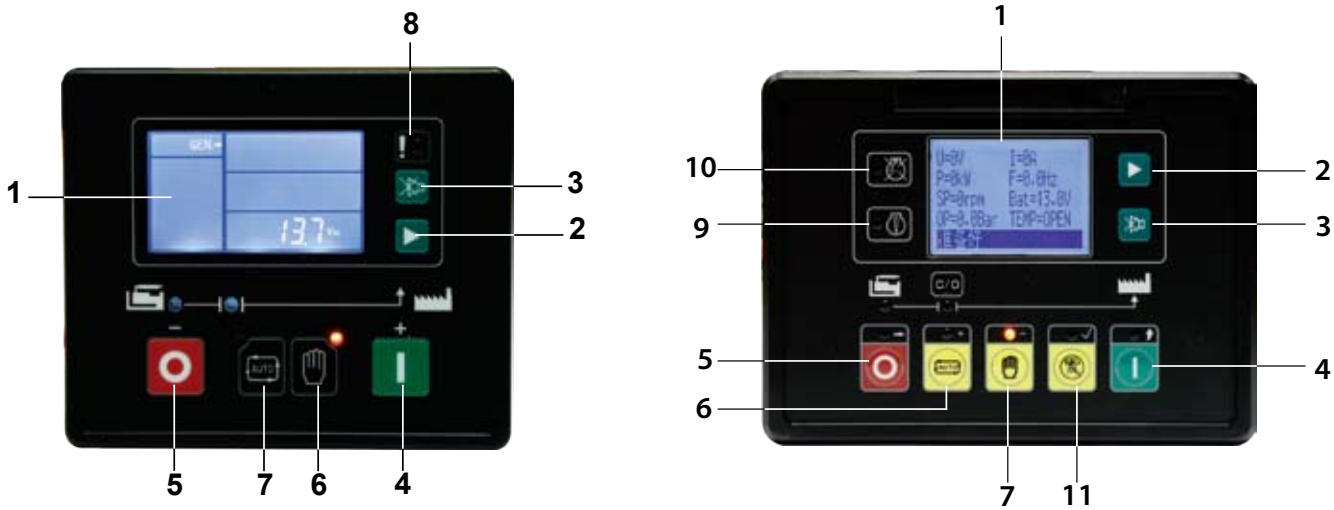


Figure 5q – DCP-10 and DCP-20 Control Module Description

1. Display Screen
2. Scroll Button – Scroll menu, Enter into or exit configuration menu
3. Mute\Lamp Test – For Lamp test press and hold for 2 secs
4. Start Button
5. Stop Button
6. Manual Mode
7. Auto Mode
8. Common Failure LED (DCP-10 Only) – Flashes when Warning occurs, Illuminates permanently when shutdown occurs.
9. Warning LED (DCP-20 Only) – Illuminates permanently until the warning is rectified then automatically turns off.
10. Shutdown LED (DCP-20 Only) – Illuminates permanently shutting engine down
11. Test Mode

5.5.3 Pre-Start Checks (applicable to all control systems)

Warning

⚠ **The following checks detailed below are the only tasks that an operator should undertake.**

The following checks should be performed prior to starting the generator set:

1. A visual inspection should take only a few minutes and can prevent costly repairs and accidents – for maximum generator set life, visually inspect the generator set before starting. Look for items such as:
   - Loose fastenings / fixings, worn belts or loose connections. Repair as necessary.
   - The fan and exhaust guards must be at the correct positions and securely fixed. Repair damaged / loose guards or renew missing guards.
   - Wipe clean all filler caps before the engine is serviced or fluids are topped up to reduce the chance of any system contamination.
   - For any type of leak (coolant, lubricating oil or fuel), clean away the fluid. If a leak is observed, find the source and correct the leak. If a leak is suspected, check the fluid levels frequently until the leak is found and repaired.
   - Accumulated grease and / or oil on an engine is a fire hazard. Remove it by steam cleaning or by the use of a high pressure water jet. Avoid high-pressure water on the electronic / electrical components provide suitable protection were possible.
   - Ensure that the coolant pipes are fitted correctly and that they are secure. Check for leaks. Check the condition of all pipes for splits or signs of rubbing.

Fluid levels

2. Check the engine oil and coolant levels – replenish as necessary (see engine handbook for locations). Ensure fluids used are as recommended within the engine handbook.

Warning:

⚠ **Do not remove the radiator cap or any component of the cooling system while the engine is running and while the coolant is under pressure, because dangerous hot coolant can be discharged, posing a risk of personal injury. Do not add large amounts of cold coolant to a hot system as serious engine damage could result.**

3. Check the engine oil and coolant levels – replenish as necessary.

Note:

- Diesel engines normally consume lube oil at a rate of 0.25% to 1% of the fuel consumption.
- When adding coolant to the radiator system, always pour slowly to help prevent air from becoming trapped in the engine. Always top up when engine is cold.

Warning:

⚠ **When filling the fuel tank, do not smoke or use an open flame in the vicinity.**

4. Check the fuel level – fill as necessary.

Warning:

⚠ **Before tightening the fan belts, disconnect the battery negative (–) lead to ensure the engine cannot be accidentally started.**

5. Check the condition and tension of the fan and engine alternator belts – tighten as necessary.
6. Check all hoses for loose connections or deterioration – tighten or replace as necessary.
7. Check the battery terminals for corrosion – clean as necessary.

Warning:

⚠ **When working with the batteries, do not smoke or use an open flame in the vicinity. Hydrogen gas from batteries is explosive.**

⚠ **Do not short the positive and negative terminals together.**

8. Check the battery electrolyte level – fill with distilled water as necessary.
9. Check the control panel and the generator set for heavy accumulation of dust and dirt – clean as necessary. These can pose an electrical hazard or give rise to cooling problems.
10. Check the air filter restriction indicator, if fitted – replace the filter as necessary.
11. Clear the area around the generator set of any insecure items that could inhibit operation or cause injury. Ensure cooling air ventilation screens are clear.

12. Visually check the entire generator set for signs of leaks from the fuel system, cooling system or lubrication seals.
13. Periodically drain exhaust system condensate traps, if equipped.
14. Ensure the Alternator Output Circuit Breaker is in the "OFF" (handle down) position.

5.5.4 Basic Operation

START Mode

Press **START** Key

STOP Mode

Press **STOP** Key

AUTO Mode

Press **AUTO** Key
(An LED will illuminate to show Auto Mode)

MANUAL Mode

Press **MANUAL** Key
(An LED will illuminate to show Manual Mode)

5.5.5 Fault / Alarm Reset Process - DCP-10

Alarm / Shutdown

Whenever a warning occurs the LED indicator will flash, but the generator set will not shut down.

Once the issue is resolvedthe Warning LED will automatically turn off.

Whenever a shutdown occurs the LED indicator illuminates.. The system is immediately locked out and the generator set stops.

This fault can be reset by pressing the STOP Key. This clears the fault, the LED indicator extinguishes and the generator set is no longer locked out and can be started.

5.5.6 Fault / Alarm Reset Process - DCP-20

Alarm

Whenever a warning occurs the LED indicator illuminates permanently, but the unit will not shut down.

Once the warning is removed or rectified the Warning LED will automatically turn off.

Shutdown

Illuminates permanently when shutdown alarm occurs.

Whenever a shutdown occurs the LED indicator illuminates permanently. The system is immediately locked out and the generator set stops.

This Fault can be reset by pressing the STOP Key. This clears the fault, the LED extinguishes and the generator set is no longer locked out and can be started.

5.5.7 User Interface Overview

Before starting or running the generator set, the operator should become fully acquainted with the control module's display and push buttons. The display should be observed from time to time while the generator set is running so that any abnormal readings can be detected before problems arise. Figure 5q shows a typical layout of the DCP-10 and DCP-20 control panel. Addition of optional equipment may add items, so that the panel fitted on the generator set may be slightly different from the typical one shown. The following descriptions explain the function of each standard item on the panels:

Function Keys:

Scroll Button – The scroll button will allow the user to navigate through the various screens and parameters available to them.

Control Keys:

RUN – pressing the Run key will cause the engine to enter the run mode.

AUTO – pressing the Auto key will cause the engine to enter the auto mode.

MANUAL – pressing the Manual key will cause the engine to enter manual mode.

Navigation Keys – DCP-10

When in parameter setting mode this button is used to increase values.

When in parameter setting mode this button is used to decrease values.

When in parameter setting mode this button will confirm any changes and also exit the configuration menu.

Navigation Keys – DCP-20

When in parameter setting mode this button is used to increase value/scroll down menu.

When in parameter setting mode this button is used to decrease value/scroll up menu.

When in parameter setting mode this button is used to enter into submenu/confirm modification.

When in parameter setting mode this button is used to return to the upper menu.

When in parameter setting mode this button is used to modify the next value.

Used to enter or exit parameter settings, by pressing and holding for 2 seconds.

Event Keys and Indicators:

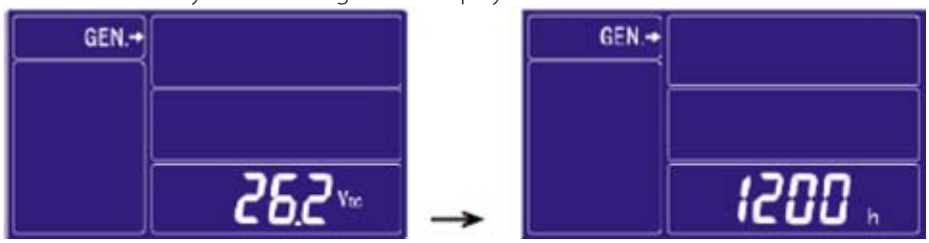
Mute Button – When a failure occurs the alarm buzzer sounds. Pressing the Mute Button will mute the buzzer and the LCD will display the Mute Icon.

Stop Button – Whenever the generator set is at rest pressing the stop button will reset any alarms that have occurred. It will not reset any active events. If a warning or shutdown occurs either text or a symbol will appear on the display indicating what the event is. Please refer to the relevant technical manual for the controller for an accurate description of these events.

Display Preferences for DCP-10 Panel

Pressing any push button will illuminate the backlight and will automatically turn off after a preset time. In normal operating status, you can set the page scroll time to scroll through each screen automatically. Press the scroll button to manually scroll through each screen. When a failure occurs, the LCD displays the corresponding failure icon.

Whenever the controller is in standby the following data is displayed:



When the controller is running normally it cycles through the following data:

Display Preferences for DCP-20 Panel

Each page can display multi-row information simultaneously. Pressing will allow the user to scroll to the next page. The display can also be configured to scroll automatically. When an alarm occurs, the alarm is displayed on the LCD immediately.

When the Generator set is running the LCD scrolls through the screens showing the following data –

Operation	Description	
The voltage/current value displayed on this screen is the average value of 3 phases. Press "▶" to scroll to the next page.	U=380V	I=0A
	P=0kW	F=50.0Hz
	SP=1500rpm	Bat=25.4V
	OP=4.6Bar	TEMP=70°C
	RUN	
This page displays electrical parameters for L1. Press "▶" to scroll to the next page.	V1=220V	U12=380V
	I1=0A	A1=0kVA
	P1=0kW	PF1=1.00
	Q1=0kVAr	
	RUN	
This page displays electrical parameters for L2. Press "▶" to scroll to the next page.	V2=220V	U23=380V
	I2=0A	A2=0kVA
	P2=0kW	PF2=1.00
	Q2=0kVAr	
	RUN	
This page displays electrical parameters for L3. Press "▶" to scroll to the next page.	V3=220V	U31=380V
	I3=0A	A3=0kVA
	P3=0kW	PF3=1.00
	Q3=0kVAr	
	RUN	
This page displays Gen power and average power factor. Press "▶" to scroll to the next page.	G. P=0kW	
	G. A=0kVA	
	G. Q=0kVAr	
	G. PF=1.00	
	RUN	
This page displays running hours, crank attempt and auxiliary sensor level. Press "▶" to scroll to the next page.	Run Hours = 0.0	
	Counters = 0	
	Fuels = 46%	Heat = 40°C
	RUN	
This page displays total active and reactive energy. Press "▶" to scroll to the next page.	G. kWHr = 0	
	G. kVArHr = 0	
	RUN	
Relay Outputs refer to the status of configurable relay output. Digital Inputs refer to the status of configurable inputs. "0" indicates an active Ouput or Input. Press "▶" to scroll to the next page.	Relay Outputs:	
	- - - 0 - - - -	
	Digital Inputs:	
	- - - - - - 0 -	
	RUN	

5.6 Control System Options and Upgrades

A large variety of options may be fitted to customise the control system to a specific installation. The following sections cover the use and operation of some of these options.

5.6.1 Battery Trickle / Switch-Mode Chargers

Both battery chargers are designed to ensure that the starter batteries maintain their charge even if the generator set is not operated for long periods.

Control switches for the chargers are not normally fitted to prevent inadvertent switching off of the charger. However, as additional options, an "ON"/"OFF" switch and a Battery Charger Boost Control may be fitted. The Boost Control overrides the automatic control mechanism of the charger that would normally reduce charging level as the battery becomes charged. This can allow faster charging of the battery. However, care must be taken to only use the boost control for a short time to avoid overcharging the battery and/or boiling the battery dry.

The control system will automatically disconnect the charger on startup of the generator set. While the engine is running the batteries are charged by the engine driven battery charging alternator.

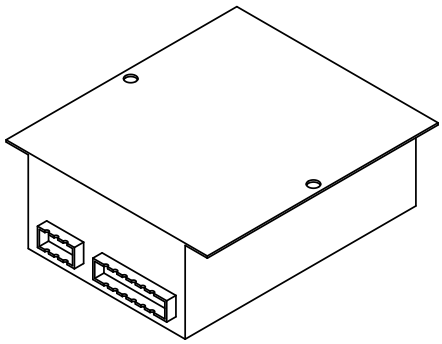


Figure 5r – Battery Charger

The switch-mode charger is an automatic battery charger, when the voltage drops below a preset voltage level it will automatically enter an increased charging voltage state (Boost). Once the batteries have reached this level, the charger will switch back to its normal 'float' voltage. This prevents the battery from over charging, which in turn prevents over gassing and subsequently maximises battery life.

5.6.2 Heaters

Immersion type heaters (engine heaters) may be fitted in the engine coolant system to ensure that the engine is easy to start and able to take load more quickly.

Alternator anti-condensation heaters (alternator heaters) may be fitted to the alternator stator winding to keep them dry in humid conditions.

Panel anti-condensation heaters (panel heaters) may be fitted in the control panel to keep moisture levels down.

Control switches are not normally fitted but may be fitted as an additional option. With or without control switches, the heaters are automatically disconnected on engine start up.

5.6.3 Electric Fuel Transfer Pumps

Fuel transfer pumps are required when fuel must be transferred from a bulk storage tank to the generator set day tank.

Note:

- Manual control of the electric fuel transfer pump or pumps (customer provides their own) is not provided with the 26 – 200 kVA product.

The controls consist of two illuminated push buttons on the control panel door or separate box under the panel. The red button is a combined trip lamp and stop button. The green button is a run lamp and manual start push button.

To operate the pump manually, ensure the red push button is in the "ON" position (pulled out). Press and hold the green push button to manually run the pump. The pump will only run in the manual mode while the green button is held in.

To operate the pump in automatic mode, ensure that the red push button is in the "ON" position (pulled out). The pump will start running automatically when the fuel level is low and will illuminate the green run lamp. When the tank is full, the pump is turned off and the green lamp is extinguished.

Figure 5s – Electric Fuel Pump

The red lamp will illuminate if there has been an electrical overload.

Care must be taken to ensure that the pump is primed with fuel prior to operation to lubricate the seals. Also, the pump should never be run when the bulk tanks are empty or when valves on the fuel fill lines are closed.

5.6.4 Meters / Gauges

The following additional meters or gauges may be fitted to the control panel:

- Three ammeters mounted on the panel instead of one ammeter and a selector switch. This allows a continuous indication of the current flowing in each phase, not applicable for PowerWizard as this module will display all phase currents. (Not applicable to 26 – 200 kVA product).
- Kilowatt (kW) Meter to provide accurate readings of the load being supplied by the generator set, not applicable for PowerWizard as the PowerWizard 2.1 can display kilowatts (Not applicable to 26 – 200 kVA product).
- Lube Oil Temperature Gauge to monitor the lubricating oil temperature when the engine is operating. The normal operating temperature should be approximately 90° – 110°C (195° – 230°F), not applicable for PowerWizard 1.1 and 2.1+ as the modules will display this.
- Ammeter for Battery Trickle Charger to monitor the current flow to the battery. It is used to observe the charging current being supplied by the battery trickle charger. When the batteries are fully charged this current will be small (less than 5 Amps) but with a partially discharged battery this current may be as high as 40 Amps (Not applicable to 26 – 200 kVA product).

5.6.5 Speed / Voltage Control

Three controls may be fitted to adjust the speed or voltage of the generator set: Speed Adjust Potentiometer, a Raise/Lower Switch and a Voltage Adjust Potentiometer. These should only be adjusted by a qualified generator set technician according to instructions in the Technical Manual. For some electronic engines, speed can be adjusted on the PowerWizard 2.1+ module.

5.6.6 Alarm Signalling

Three options may be fitted to the control panel to supplement the standard alarm indications of the alarm lamps:

- A panel mounted alarm siren will sound when an alarm condition is indicated. An Alarm Mute push button is fitted on the panel to silence the siren.
- An audible alarm siren supplied loose will sound when an alarm condition is indicated. It can be fitted at a convenient location. An Alarm Mute push button is fitted on the panel to silence the siren.
- A set of volt free contacts for common alarm change over in the event of an alarm condition. These are for connection to an existing alarm system. These contacts remain in the "alarm" state until the control system is reset.

5.6.7 Automatic Preheat Control

Glow plugs operate automatically prior to and during engine cranking. The automatic cranking sequence will be delayed by the preheating period.

5.6.8 Remote Annunciator Panels

Available on PowerWizard.

Remote Annunciator may be fitted to PowerWizard Panels (16 channel) .

6. OPERATION

6.1 Priming Procedure for 1100 Series

Warning:

⚠ **Please wear appropriate Personal Protective Equipment (Section 2.2) before carrying out any of the following procedures as the operator will be in direct contact with diesel fuel. There will also be a risk of spillage.**

Note:

- Please see engine manual to ascertain engine model. If unsure please consult your local Dealer.
- Please see section 3.2 / 3.3 on where the fuel fill can be found on generator set

Following fuel filter servicing or draining of the low pressure fuel system for any reason, re-prime the fuel system as follows.

6.1.1 Products fitted with the small Perkins pre-filter / water separator

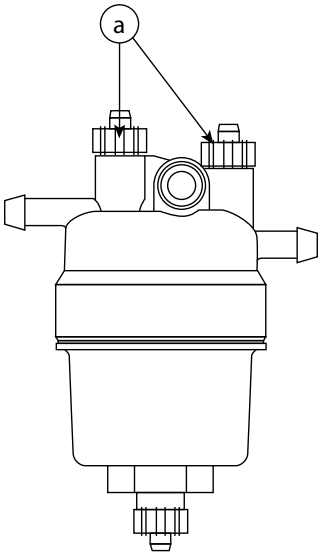


Figure 6a – Example of pre-filter / water seperator

Note:

- Do not open the vent screws (a) when the fuel system is being primed, as diesel fuel will be discharged.

With Fuel Supply from the Base Tank

- Operate the priming switch for the standard pre-set 2 minute priming cycle (See section 5.3.10).
- Start engine.
- In the event of a failure to start the engine within 3 crank cycles, see the "Troubleshooting" section of this procedure for the repeat prime procedure.

With Fuel Supply from a Remote Tank

- Ensure fuel lines from the remote tank are full of fuel, the pump should never be run when bulk tanks are empty or when valves on the fuel fill lines are closed.
- With the fuel supply switched to remote tank, carry out the priming procedure.

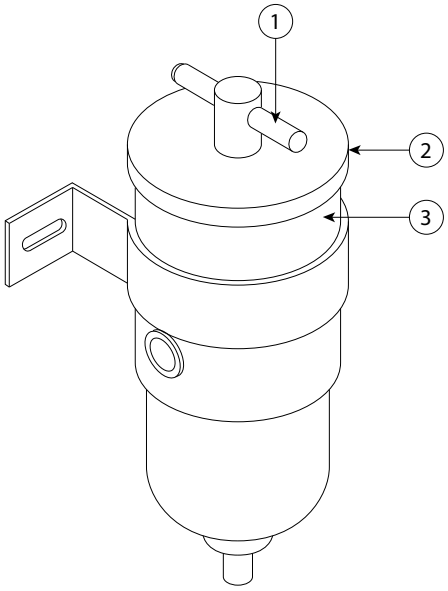
The PowerWizard control panel can be used to energise the fuel lift pump in order to prime the engine as follows:

1. In order to prime the generator set:
   MAIN MENU > CONTROL > ENGINE FUEL PRIMING.
2. To prime the set press the right cursor key, this will initiate a 2 minute priming cycle.
3. To exit the priming cycle press the left cursor key.

Note:

- The generator set may only be primed when the generator set is stopped and there are no active or present shutdown conditions.

6.1.2 Products fitted with the Racor Pre-Filter / Water Separator (Option)



1 - T Handle
2 - Racor Lid
3 - Racor Filter

Figure 6b – Example of a Racor

With Fuel Supply from the Base Tank

Following Racor element change or if the Racor unit is drained for any reason, then repriming of the unit, as specified by Racor, will be required:

- Remove T-handle (1) and lid from the top of the unit.
- Screw T-handle into centre tube finger tight.
- Fill the assembly with clean fuel to just above the top of the element. This ensures the "dirty" side of the unit is completely filled with fuel.
- Lubricate the lid gasket (2) and T-handle (1) o-ring with clean fuel.
- Replace the lid (2) taking care to seat the gasket correctly and tighten the T-handle (1) – do not use tools.
- Operate the priming switch (if fitted) to give the system a 2 minute prime.
- Start engine.
- In the event of a failure to start the engine within 3 crank cycles, see the "troubleshooting" section of this procedure for the repeat prime procedure.

With Fuel Supply from a Remote Tank

If the fuel lines from the remote tank are empty:

- Carry out the manual filling procedure of the Racor unit as detailed above.
- Operate the priming switch for 2 minutes.
- Re-fill the Racor unit as detailed above.
- Re-prime for a further 2 minutes.
- Start engine.
- In the event of a failure to start the engine after 3 crank cycles, see the 'troubleshooting ' section of this procedure for the repeat prime procedure.

If the fuel lines from the remote tank are full:

- Carry out the priming procedure as detailed in fuel supply from base tank.

6.1.3 Troubleshooting

Having completed the designated priming procedure, if the engine does not start, there may be air in the Pressure Regulator Valve (PRV) return loop hose.

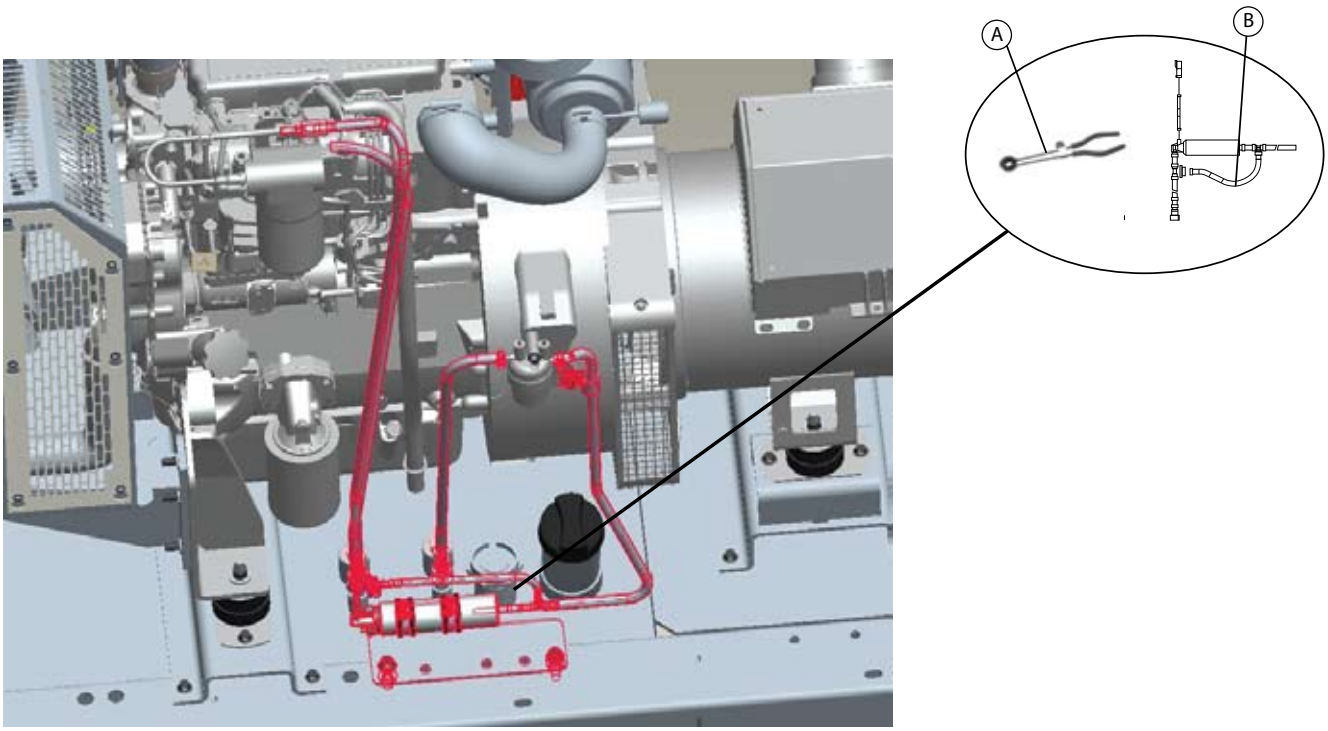


Figure 6c – Tooling (Not supplied) & Pressure Regulator Valve (PRV) return loop hose

1. Close the PRV return loop hose (B). Use Tooling (A) in order to close the PRV return loop hose (B). A typical example of Tooling (A) is shown in the illustration.
2. Repeat the priming procedure that is applicable to the configuration of the fuel system.
3. Release Tooling (A).
4. Start engine. Allow engine to run until smooth operation has been ensured and the pump is free from air.

6.1.4 Starting with Jump Start Cables

WARNING

⚠ **Improper jump start cable connections can cause an explosion resulting in personal injury.**

⚠ **Prevent sparks near the batteries. Sparks could cause vapors to explode. Do not allow jump start cable ends to contact each other or the engine.**

If the installation is not equipped with a backup battery system, it may be necessary to start the engine from an external electrical source.

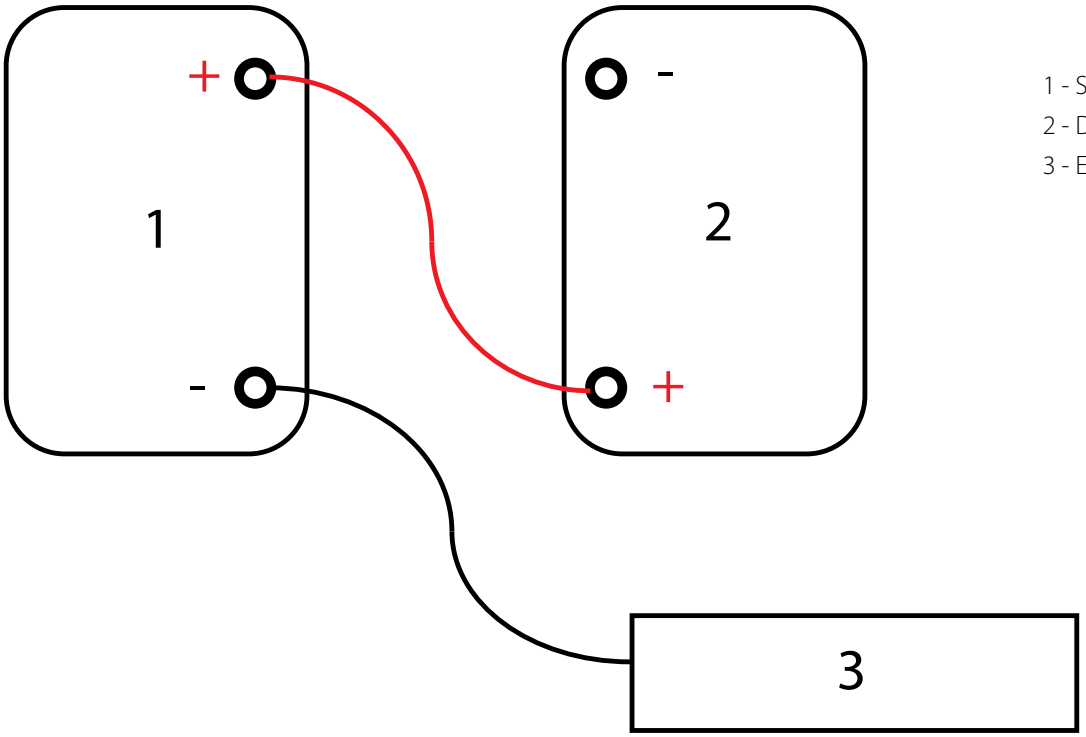
After jump starting, the alternator may not be able to fully recharge batteries that are severely discharged. The batteries must be charged to the proper voltage with a battery charger.

Use a battery that is sourced with the same voltage as the electric starting motor. Use ONLY equal voltage for jump starting. The use of higher voltage will damage the electrical system.

Ensure that the main power switch is in the OFF position before jump start cables are attached to the engine that is being started.

1. Turn the start switch on the stalled engine to the OFF position. Turn off all accessories.
2. Connect one positive end of the jump start cable to the positive cable terminal of the discharged battery. Connect the other positive end of the jump start cable to the positive cable terminal of the charging or starting source.
3. Connect one negative end of the jump start cable to the negative cable terminal of the charging or starting source. Connect the other negative end of the jump start cable to the stalled engine block or to the chassis ground. This procedure helps to prevent potential sparks from igniting combustible gases that are produced by some batteries.
4. Charge the batteries. The engine will not continue to run after starting if the batteries have not been charged.
5. Start the engine.
6. Immediately after the stalled engine is started, disconnect the jump start cables in reverse order.

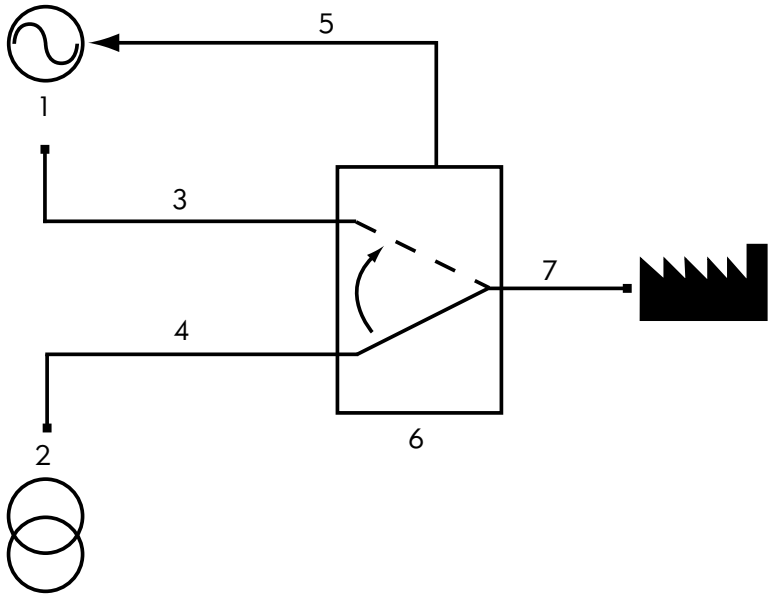
Consult your local Dealer for more information.



1 - Starting Source Battery
2 - Discharged Battery
3 - Engine Block / Chasis Ground

7. LOAD TRANSFER PANELS

When the generator set is required to automatically provide switching to standby power in the event of mains failure, an optional load transfer panel is required. These transfer panels are designed to sense when the mains have failed, signal the generator set to start, switch the load from the failed mains to the generator set and then switch it back after the mains supply is re-established.



1 - Generator set
2 - Mains
3 - Load Fed from Generator set
4 - Load Fed from Mains
5 - Two Wire Control
6 - Load Transfer Panel
7 - Load

Figure 7a – Function of a Load Transfer Panel

There are two models of Load Transfer Panels available: The CTI and the ATI Series Intelligent Transfer Panels. The User Guide for these panels will be included in this manual, if chosen at time of order. Consult your local Dealership for further information.

Figure 7b – CTI and ATI Series Intelligent Transfer Panels

7.1 Engine Interface Module Description (where fitted)

The Engine Interface Module is a sealed, engine mounted module that provides switching relays for the Starter Motor Solenoid, Glow Plug and Fuel Solenoid. Each of these circuits is protected with individual fuses mounted in the module. Individual LED's illuminate when each circuit is energised.

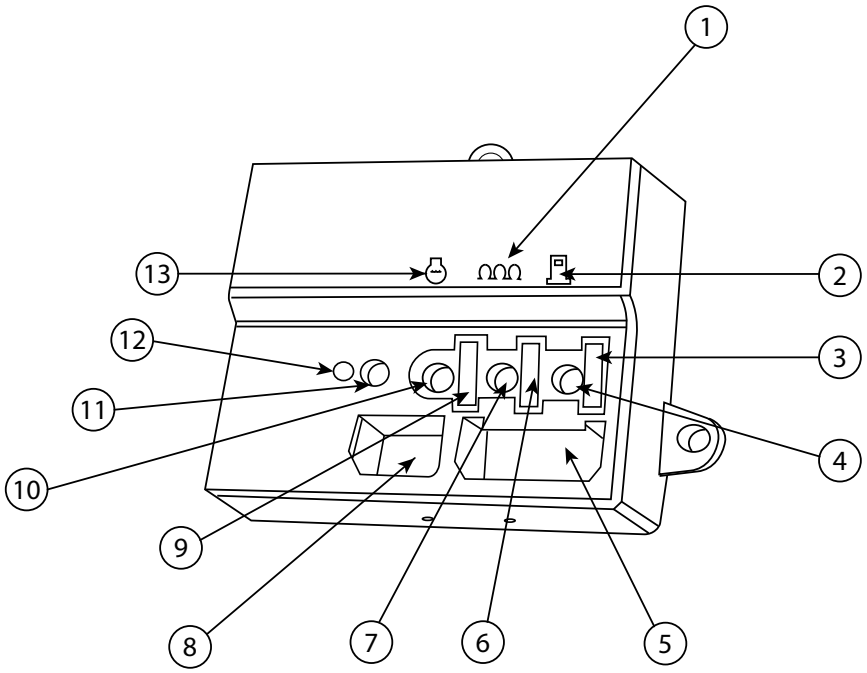
There are two versions of the Engine Interface Module available:

EIM Basic: The EIM is utilised in conjunction with the LCP1002 Keystart Panel / PowerWizard Autostart Panels. It consists of three relays to carry currents associated with the Fuel Control Solenoid, Starter Motor Solenoid and the Glow Plug. The module is powered directly from the battery.

EIM Plus: The EIM plus is used in conjunction with the LCP1002 keystart panel.

Overspeed Signal (EIM Plus only): The EIM Plus monitors the speed signal from the magnetic pick-up. If the engine speed rises above a certain pre-setable value, the module sends a zero volt signal to the generator set control panel to activate the Overspeed Fault circuitry.

The Overspeed Set Point is factory set at 55 Hz for 50 Hz sets and 66 Hz for 60 Hz sets. This can be adjusted using the adjustment screw accessed through the hole beside the Overspeed Set-up LED. While the engine is running at the rated speed (1500 rpm for 50 Hz or 1800 rpm for 60 Hz) the adjustment screw should be adjusted until the Overspeed Set-up LED just goes out. This sets the overspeed value at 10% above the speed at which the generator set is operating.



1. Glow Plug Symbol
2. Fuel Symbol
3. Fuel Solenoid Fuse
4. Fuel LED
5. Main Connector Socket
6. Glow Plug Fuse
7. Glow Plug LED
8. Secondary Socket
9. Starter Solenoid Fuse
10. Starter LED
11. Overspeed Set-up LED
12. Overspeed Adjuster
13. Starter Symbol

Figure 7c – Engine Interface Module (EIM)

7.2 Output Circuit Breaker Description

The alternator output circuit breaker is of sufficient rating for the generator set output. Electrical output is switchable through this device, with "ON" being indicated by the handle being up. The breaker will carry its rated current continuously but will trip to off position if the rating on any one phase is exceeded for a period depending on the percentage overload and the circuit breaker characteristics.

Warning

⚠ **Maintenance and/or replacement of circuit breakers should only be completed by a fully trained technican.**

8. ELECTRONIC ENGINE FAULT DETECTION FLASH CODES

Perkins 1306–E87 electronic engines automatically record engine faults in the Electronic Control Module (ECM) to assist the engineer in troubleshooting. The fault codes can be read using the red and amber lamps situated on the top of the relay box, as shown in the picture below.

1. Relay Box – This interfaces between the Electronic Control Module (ECM) and the control panel.
2. Amber Light – If lit indicates an active fault. Please contact your local Dealership for assistance. The generator set may continue to run but may be on reduced power.
3. Red Light – Used for flash code reading, this will not light in normal operation.
4. Push Buttons – Push buttons 1 & 0 are used for fault code reading only.
5. Diagnostic Plug – This is used for communication with a laptop / PC. This should only be used by an authorised technician. Please consult your local Dealership.

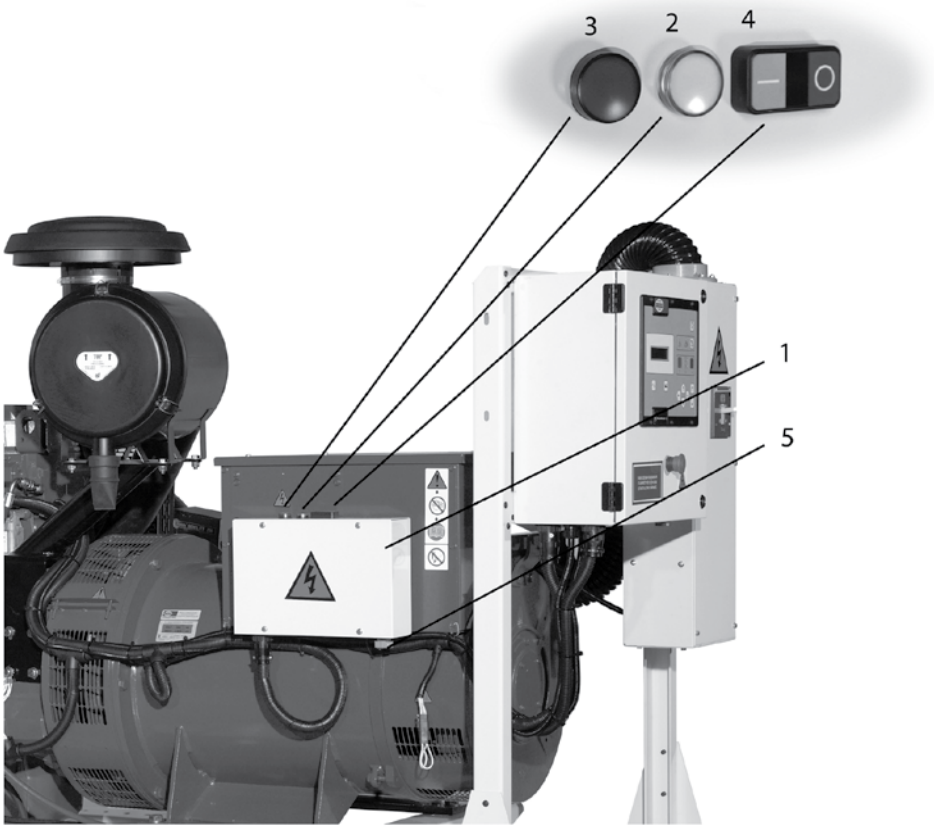


Figure 8a – 1306-E87 Electronic Engines Relay Box

Note:

- The engine protection systems e.g. low oil pressure, high coolant temperature, are within the control of the generator set control panel. These sensors will shut the engine down before the ECM sensors.

9. MAINTENANCE

Warning:

⚠ **The following procedures should only be carried out by a qualified technician.**

A good maintenance programme is the key to long generator set life. Maintenance and service should only be carried out by qualified technicians. Records of this work should be kept to aid in developing an efficient maintenance programme.

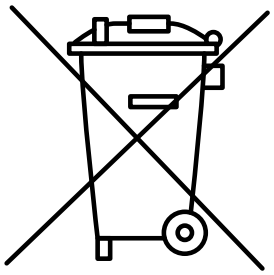
In general, the generator set should be kept clean. Do not permit liquids such as fuel or oil film to accumulate on any internal or external surfaces or on, under or around any acoustic material, if fitted. Wipe down surfaces using an aqueous industrial cleaner. Do not use flammable solvents for cleaning purposes.

Any acoustic material with a protective covering that has been torn or punctured should be replaced immediately to prevent accumulation of liquids or oil film within the material.

Refer to a qualified generator set technician for details of required preventative maintenance.

9.1 Battery Removal and Fitting

Batteries, as used in generators, by law, must not be disposed of with household waste.



Batteries contain hazardous materials and in the charged state, each cell contains electrodes of lead metal (Pb) and lead (IV) dioxide (PbO_2) in an electrolyte of about 33.5% w/w (6 Molar) sulphuric acid (H_2SO_4). In the discharged state both electrodes turn into lead (II) sulphate ($PbSO_4$) and the electrolyte loses its dissolved sulphuric acid and becomes primarily water.

It can be damaging to the environment to send these to landfill, burning batteries can also cause atmospheric pollution.

Dealing with lead acid batteries can be hazardous so it is important to follow all safety guidelines.

- Battery acid can burn clothing and skin and even cause blindness if it leaks, so wear protective clothing when inspecting a battery prior to its disconnection / transportation.
- Disconnect the battery safely before inspecting it (see below).
- Before removing a battery, carry out a thorough inspection of its condition. Use a torch if visibility is poor to check all sides of the battery for any marks, dents or leaks.
- If the battery has any severe dents or leaks then contact a professional battery engineering service for assistance and get it repaired or replaced, do not attempt to remove it.
- During transport, cover the terminals so they cannot be shorted out.
- Keep the battery upright at all times.
- When removing a battery for whatever reason always ensure all load is removed before disconnecting the battery so that no sparks are created. Disconnect the negative cable first followed by the positive cable to avoid short circuit against any metal framework, then remove the hold down clamp or strap securing the battery base. The battery can be fairly heavy so be careful when lifting and carrying the battery. Seek assistance if required.
- When refitting the battery, ensure the terminal posts are correctly aligned with the cables to avoid wrong connection and place the new battery into the hold-down tray and reattach the hold–down clamp or strap. Attach and tighten the positive battery cable to the positive terminal first. Then attach and tighten the negative battery cable to the negative terminal.

9.2 Preventative Maintenance

Depending on the application of the generator set, requirement for preventative maintenance will vary.

The preventative maintenance requirements associated with the engine are detailed in the Engine Manual, which should be reviewed in conjunction with this section. Maintenance intervals for the engine may be more frequent than those shown in this section.

Warning:

⚠ **The following procedures should only be carried out by a qualified technician.**

⚠ **Operators should only perform the Pre-Start Check tasks detailed in the Control System Description – Section 5.**

Daily or at Each Startup:

(For standby sets these procedures may be performed weekly.) A walk around inspection should be performed on a daily basis and prior to starting the engine. The Pre-Start checks contained in Section 5 should be performed during this walk around. Procedures for performing the checks on the engine can be found in the Engine Manual that may contain additional requirements to those in Section 6.

Every Two Weeks:

(For standby sets that have not been run.) Perform an operational check on the generator set by starting and running it for only 5 minutes.

Every Month:

(For standby sets that have not been run on load.) Perform an operational and load check on the generator set by starting and running the generator set on at least 50% load for 1 to 2 hours.

Warning:

⚠ **Do not run diesel engines at low loads for long periods.**

Every Twelve Months or 500 Hours:

Repeat the daily procedures plus the following:

1. Check all control system safety devices by electrically simulating faults.
2. Clean all battery cap vents.
3. Tighten all exhaust connections.
4. Tighten all electrical connections.
5. Perform other engine maintenance as specified in the Engine Manual.
6. Start the engine and observe the instrument panel to ensure that all gauges and meters are operating properly.

9.3 Alternator Preventative Maintenance

There is no routine maintenance required on the alternator, however observe the following recommendations:

- Periodically inspect the alternator winding condition and carry out general cleaning.
- Periodically inspect the cable connections between the alternator and the circuit breaker.
- See your local Dealer.

9.4 Engine Preventative Maintenance

See the Engine Manual provided with this manual pack for information on regular maintenance required to keep the engine operating efficiently.

9.5 Decommissioning, Dismantling and Disposal

Please consult your local Dealer and local regulations regarding the disposal of materials on your generator set

Most of the Iron, steel and copper from the generator set can be taken by companies specialising in recycling scrap metal

Some components such as electrical cable, electronic accesories and plastics require specialist treatment. Please consult a specialist company regarding the removal of such items

NOTES

InteliNano NT®

Operator Guide

Copyright © 2011 ComAp s.r.o.

ComAp, spol. s r.o.
Kundratka 17, 180 00 Praha 8, Czech Republic
Tel: +420 246 012 111, Fax: +420 266 316 647
E-mail: info@comap.cz, www.comap.cz

TABLE OF CONTENTS

1 Operator Interface AMF and MRS 3
2 Display Screens Structure 5
2.1 AMF main screens structure 5
2.2 MRS main screens structure 6
3 Alarms, Events and History 7
3.1 Events 8
3.2 Warnings 9
3.3 Shutdowns 9
3.4 ECU Messages 10
4 Start and Stop engine 11
4.1 AMF in MANUAL mode 11
4.2 MRS in MANUAL mode 11
4.3 AMF in AUTO mode 11
4.4 MRS in AUTO mode 11

1 Operator Interface AMF and MRS

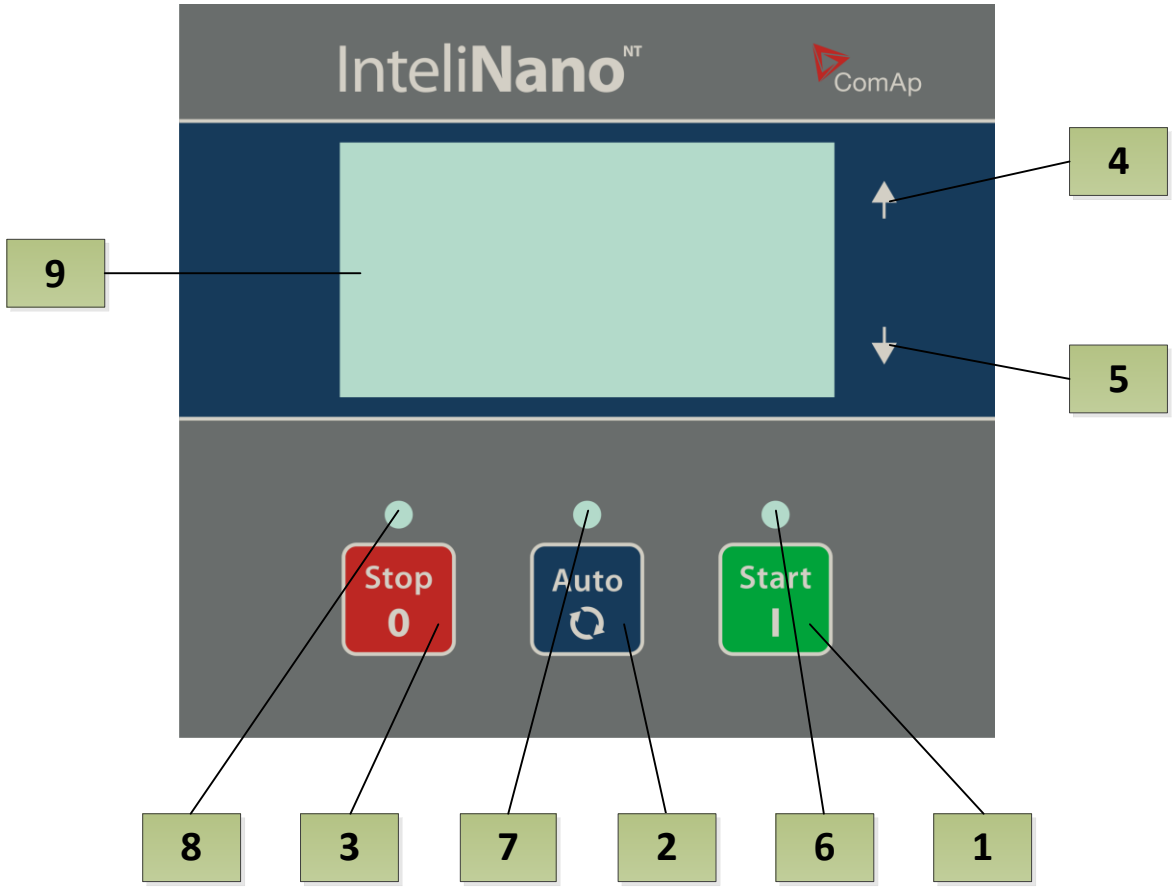


Figure 1.1

GEN-SET CONTROL BUTTONS		
Position	Button	Description
1	Start I	Start (Start) button. Works in Manual mode only. Press this button to initiate the start sequence of the engine - in Manual operating mode only. This button is also used to confirm changes in setup mode.
2	Auto	Auto (Auto) button is dedicated for switching between auto and manual operating mode.
3	Stop 0	Stop (Stop) button. Press this button to initiate the stop sequence of the gen-set when engine is running - in Manual operating mode only. This button is also used to cancel changes in setup mode, to go back or to exit and for alarm confirmation.
4		Up (▲) button for move up or value increasing.
5		Down (▼) button for move down or value decreasing.

GEN-SET OPERATION INDICATORS	
Position	Indicator Description
6	**Engine operation.** Green LED is blinking, if engine is starting, cooling or stopping. When LED is on the engine is running and is loaded or ready to load.
7	**Operating mode.** When the green LED is on, the controller is in Auto operating mode. When is off the controller is in Manual mode.
8	**Alarm red LED.** The LED will blink when there is one or more active warning or active shutdown alarm. The LED is on when the active shutdown alarm is confirmed and the engine can't be started.
9	Graphic B/W display, 128x64 pixels

2 Display Screens Structure

The displayed information is structured into "screens". Use ▲ and ▼ button to switch over the screens.

2.1 AMF main screens structure

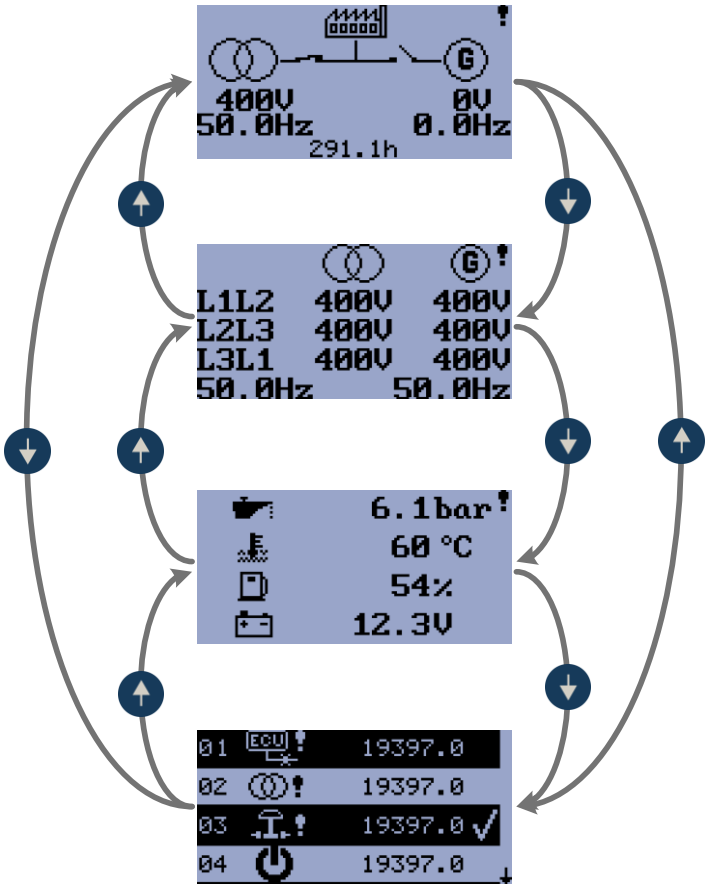


Figure 2.1

First screen contain basic information about voltage and frequency measurement on mains and generator side. Also there is displayed position (status) of MCB and GCB and running hours counter. When any alarm occurs the general warning symbol will be displayed on the LCD's upper right corner

Second screen contain detail voltage and frequency information.

Third screen shows the senders information – oil pressure; coolant temperature; fuel level and battery voltage.

Fourth screen shows last alarms or events.

2.2 MRS main screens structure

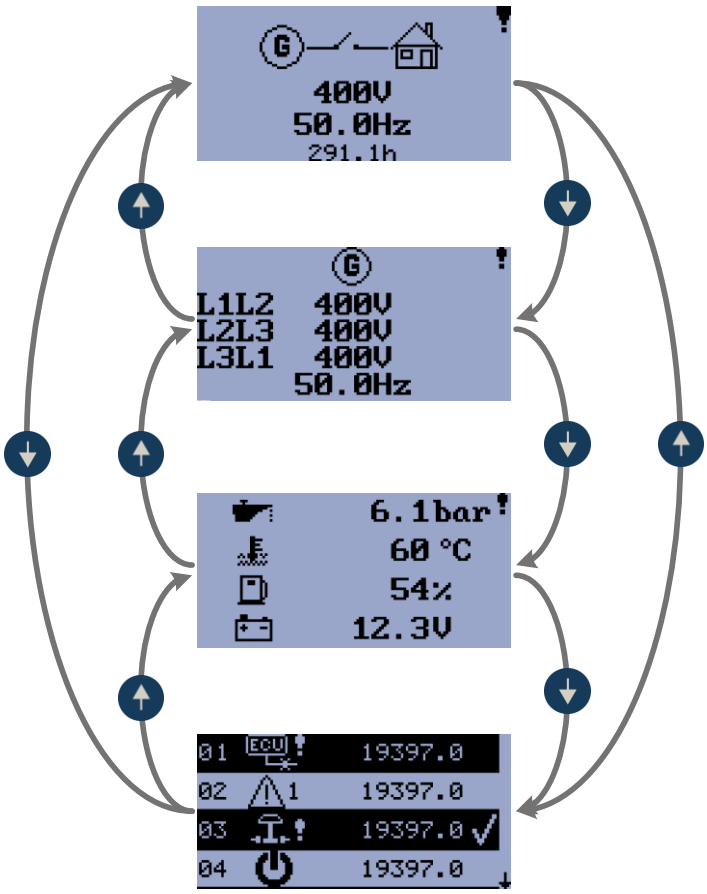


Figure 2.2

First screen contains basic information about generator voltage and frequency measurement Also there is displayed position (status) of GCB (only when is configured) and running hours counter. When any alarm occur the general warning symbol will be displayed on the LCD's upper right corner

Second screen contain detail voltage and frequency information.

Third screen shows senders information – oil pressure; coolant temperature; fuel level and battery voltage.

Fourth screen shows last alarms or events.

3 Alarms, Events and History

Following alarms and records are available:

- *Event*
- *Warnings*
- *Shutdowns*
- *ECU Messages*

Four records can be displayed simultaneously on the LCD screen. Total capacity is 10 records the **Figure 3.1** is an example of how the history is organized. The last screen in this example is showing the four latest events.
To view further history records you have to wait 3 second till down arrow stops blink, then press ▼ button. See **Chyba! Nenalezen zdroj odkazů.** and **Figure 3.2**. For alarm (shutdown) confirmation press Stop button.

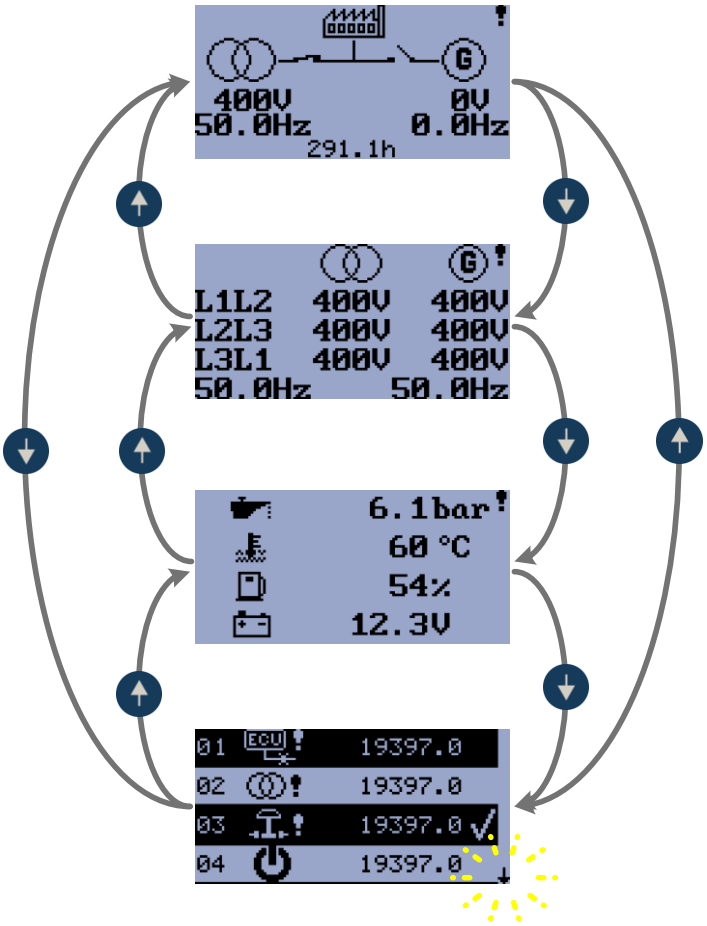


Figure 3.1

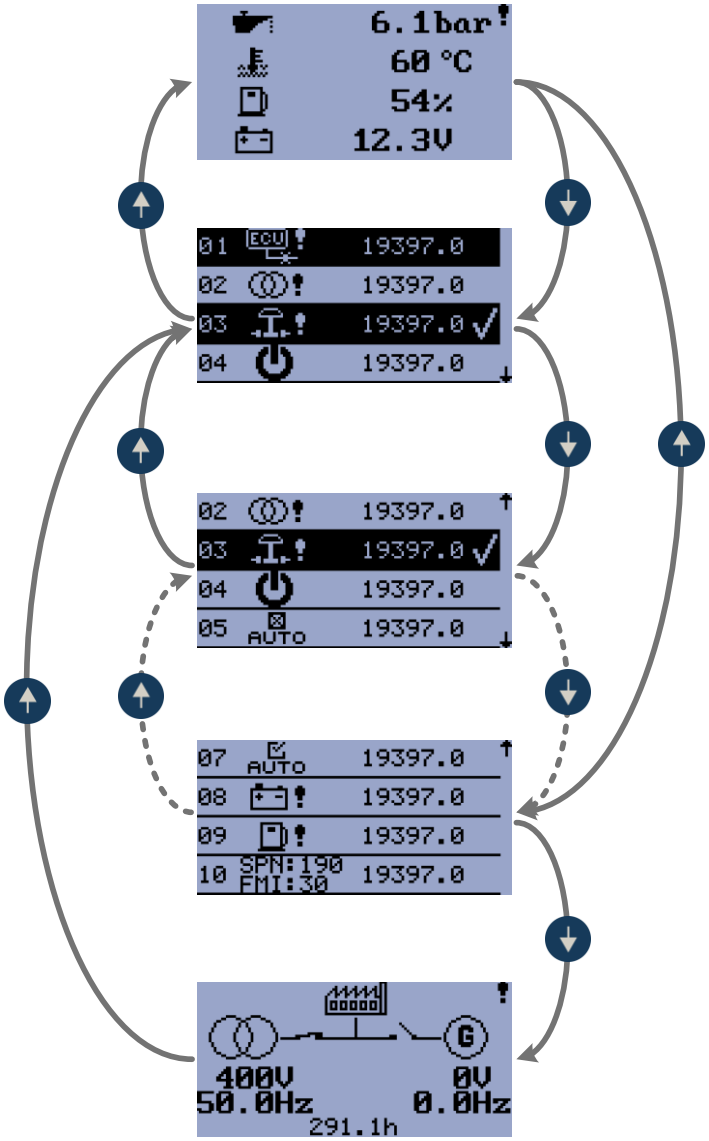


Figure 3.2

3.1 Events

Every event listed in table below is saved in history with running hours stamp see **Figure 3.3**.

Figure 3.3
EVENT – POWER ON

3.2 Warnings

3.2.1 Active warning

When a warning occurs, ***O04 Alarm*** output will close and the red LED above **Stop** button will blink. Warning symbol will blink in the upper-right corner of the LCD and the proper warning symbol will be displayed in the history with running hours stamp. Active warning can't be confirmed

Figure 3.4
ACTIVE WARNING – LOW BATTERY

3.2.2 Inactive warning

When a warning becomes inactive, ***O04 Alarm*** output will open, the red LED above **Stop** button will stop blinking, and the warning symbol on main screen will go out.

Figure 3.5
INACTIVE WARNING – LOW BATTERY

3.3 Shutdowns

3.3.1 Shutdown procedure

The **InteliNano**[NT] controller opens outputs ***O05 GCB Close/Open***, ***O01 Starter***, ***O08 Prestart*** and ***O02 Fuel Solenoid*** and closes ***O03 Stop Solenoid*** to stop the engine immediately. ***O04 Alarm*** output is closed. Active or not confirmed protection disables start.

3.3.2 Active unconfirmed shutdown

When a shutdown occurs, the ***Shutdown procedure*** will start, the red LED above **Stop** button blinks, the shutdown symbol will blink in the upper right corner of LCD, and the proper shutdown symbol is displayed in history with running hours stamp. The record in history is negative, see Chyba! Nenalezen zdroj odkazů.. For shutdown alarm confirmation press **Stop** button.

Figure 3.6
ACTIVE UNCONFIRMED SHUTDOWN – EMERGENCY STOP

3.3.3 Active confirmed shutdown

When an active shutdown is confirmed the red LED above the Stop button stops blinking. The record in history stays negative with confirmation symbol at the end. *O04 Alarm* output is open.

Figure 3.7
ACTIVE CONFIRMED SHUTDOWN – EMERGENCY STOP

3.3.4 Inactive unconfirmed shutdown

O04 Alarm output is closed, red LED above Stop button blinks. Shutdown symbol is displayed in upper-right corner of the LCD, and proper warning symbol is displayed in history with running hours stamp. See **Figure 3.8**. For shutdown alarm confirmation press Stop button

Figure 3.8
INACTIVE UNCONFIRMED SHUTDOWN – EMERGENCY STOP

3.3.5 Inactive confirmed shutdown

O04 Alarm output is opened. It is possible to start engine when all shutdowns are inactive and confirmed.

Figure 3.9
INACTIVE CONFIRMED SHUTDOWN – EMERGENCY STOP

3.4 ECU Messages

Figure 3.10
ECU MESSAGE

Diagnostic messages are read and displayed in the history behind the ECU Warning symbol. For Standard J1939 SPN (Suspect Parameter Number) and FMI (Failure Mode Identifier) are shown. Detail SPN/FMI code specification see in:

- SAE Truck and Bus Control and Communications Network Standards Manual, SAE HS-1939 Publication
- Or refer to corresponding engine manufacturer's ECU error codes list.

Complete list of text diagnostic messages for each ECU can be found in ComAp Electronic Engines Support manual.

4 Start and Stop engine

4.1 AMF in MANUAL mode

Green LED above Auto button is off (controller is in MANUAL mode). When there is no any active shut down alarm you can start the engine by pressing Start button. Green LED above button will blink. LED is blinking during starting, cooling or stopping procedure. When the engine is already started, the green LED will stop blink and start lights continuously, the generator is ready to load. When you press Start button again the MCB will open. Another press of this button will close GCB.

Press Stop button to stop the engine. First press will open the GCB, next press will close MCB and next press start cooling stopping procedure. When you press this button again the controller will stop engine immediately. For fast load transfer and the engine stop press and hold Stop button till load will be transferred and engine stops.

4.2 MRS in MANUAL mode

Green LED above Auto button is off (controller is in MANUAL mode). When there is no any active shut down alarm you can start the engine by pressing Start button. Green LED above button will blink. LED is blinking during starting, cooling or stopping procedure. When the engine sis already started, the green LED will stop blink and start lights continuously. The generator is ready to load. When you press Start button again the GCB will close – only when the GCB is configured.

Press Stop button to stop the engine. First press will open the GCB and next press start cooling and stopping procedure. When you press this button again the controller will stop the engine immediately. For fast engine stop press and hold Stop button till engine stops.

4.3 AMF in AUTO mode

Green LED above Auto button is on (controller is in AUTO mode). You can't start the engine or transfer the load by pressing Start button. The controller will start automatically when all conditions for start and load transfer will be reached. The engine in AUTO mode can't be stopped by pressing Stop button.

Engine can be started or stopped via binary input ***Remote Start/stop*** **or** ***Remote Start And Load*****.** For more detail see IN-NT AMF Reference guide.

4.4 MRS in AUTO mode

Green LED above Auto button is on (controller is in AUTO mode). You can't start the engine or connect the load by pressing Start button. The controller will start automatically when all conditions for start and load connection will be reached. The engine in AUTO mode can't be stopped by pressing Stop button.

Engine can be started or stopped via binary input ***Remote Start/stop*** **or** ***Remote Start And Load*****.** For more detail see IN-NT AMF Reference guide.

HTC GRINDER HTC2500

GENSET 110kVA

REFERENTIE LEVERANCIER : 501219939	REFERENTIE KLANT :

KEMPER EN KI- VAN TWIST DIESEL B.V.

KEMPER EN VAN TWIST DIESEL B.V.
KEERWEER 62
POSTBUS 156
3316 KA DORDRECHT
TEL : +31 (0)78-6326600
FAX : +31 (0)78-6136746
INFO@KVT.NL
WWW.KVT.NL

HTC SWEDEN
KLEVVAGEN 7

61492 SODERKOPIG
TEL: +46 (0)121-29400
FAX: +46 (0)121-15212
INFO@HTC-SWEDEN.COM
WWW.HTC-FLOORSYSTEMS.COM

0	1	2	3	4	5	6	7	8	9

Groep	Plaats	Pagina	Kopnaam	Uitgave	Datum laatste wijziging	Laatste wijziging door
HTC	COM	1	COVER SHEET	1	4-11-2012	arjan
HTC	COM	2	INHOUDSOPGAVE	1	4-11-2012	arjan
HTC	COM	3	CODING AND WIRE NUMBERS	1	4-11-2012	arjan
HTC	CAB	6	CABINE AND ENGINE WIRING 1	1	4-11-2012	arjan
HTC	CAB	7	CABINE AND ENGINE WIRING 2	1	4-11-2012	arjan
HTC	CAB	8	CABINE AND ENGINE WIRING 3	1	4-11-2012	arjan
HTC	DP	6	NEW DISTRIBUTION PANEL, MAIN CIRCUIT	1	4-11-2012	arjan
HTC	DP	7	NEW DISTRIBUTION PANEL, AUXILIARY CIRCUIT	1	4-11-2012	arjan

1 3

KEMPER EN KI-VAN TWIST DIESEL B.V.

Revisie	Datum

Getekend : A.J. van Veldhoven
Gecontroleerd :
Status : AS BUILT
Aanmaakdatum : 5-11-2012

Project :

HTC GRINDER HTC2500
GENSET 110kVA
HTC GRINDER HTC2500
INDEX

Tekeningnummer :
501219939
Uitgave : 1

==
= HTC
++
+ COM

Bladzijde : 2
Aantal pagina's : 8

DECLARATION OF USED TERMINAL(S) STRIPS

+ENG-X1 = TERMINAL STRIP X1 ENGINE PANEL

+ENG-X2 = TERMINAL STRIP X2 ENGINE PANEL

+DP-X = TERMINAL STRIP X DISTRIBUTION PANEL

+DP-X3 = TERMINAL STRIP X3 DISTRIBUTION PANEL

WIRE COLORS

MAIN CURRENT (PHASE)	400 Vac	BROWN 2,5mm²
MAIN CURRENT (PHASE)	230 Vac	BROWN 2,5mm²
MAIN CURRENT (NEUTRAL)	0 Vac	BLUE 1,0 / 2,5mm²
EARTH	PE	YELLOW / GREEN 2,5mm²
MAIN CURRENT (PHASE)	230 Vac	BROWN 1,0mm²
MAIN CURRENT (SWITCHED)	230 Vac	BLACK 1,0mm²
MAIN CURRENT (NEUTRAL)	0 Vac	BLUE 1,0mm²
MEASUREMENT	(m)A	GREY 1,0 / 2,5mm²
AUXILIARY CURRENT	24 Vdc	WHITE 1,0 / 2,5mm²

KEMPER EN KI-VAN TWIST DIESEL B.V.

Revisie	Datum		
		Getekend	: A.J. van Veldhoven
		Gecontroleerd	:
		Status	: AS BUILT
		Aanmaakdatum	: 5-11-2012

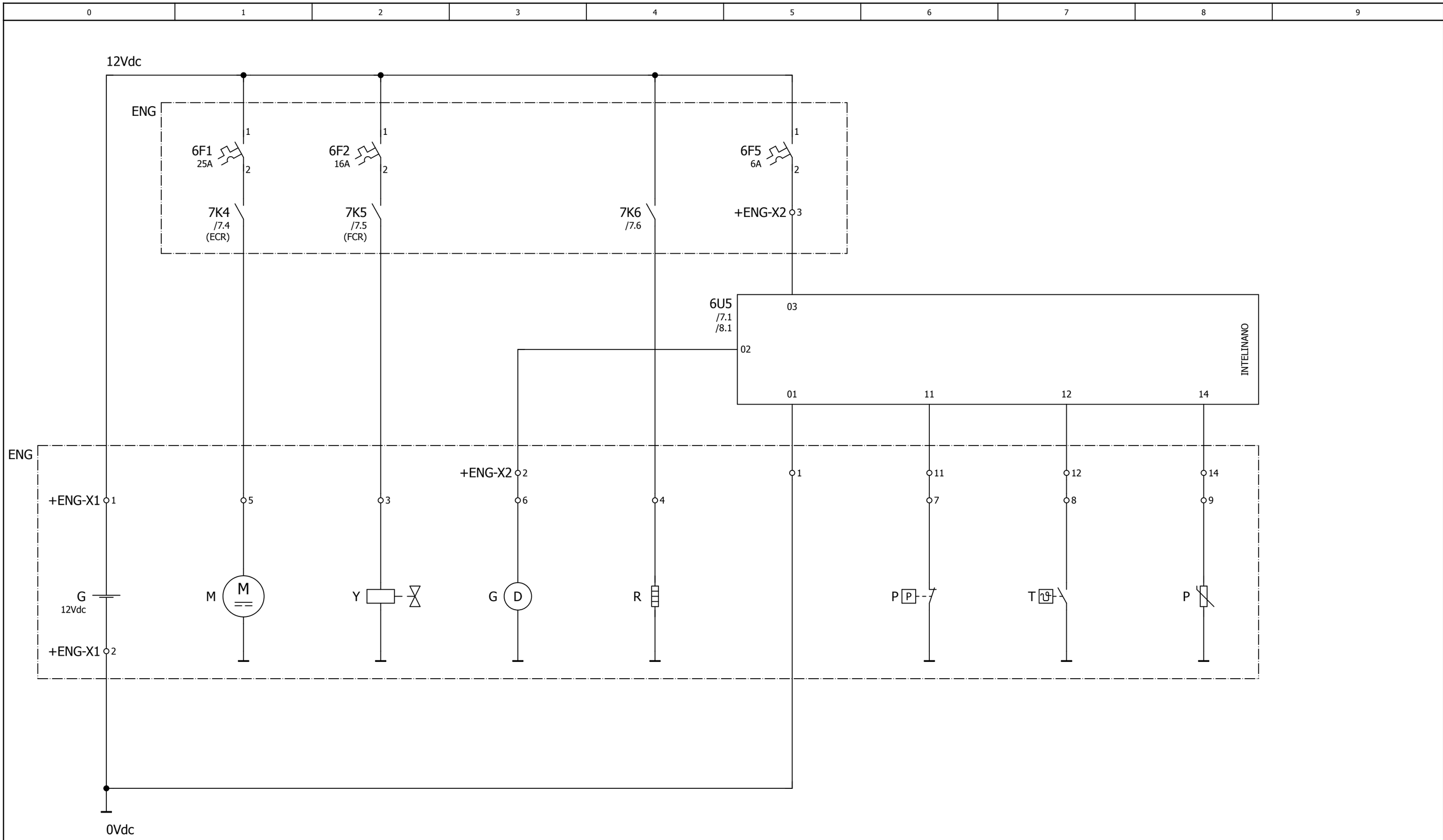
Project :

HTC GRINDER HTC2500
GENSET 110kVA
HTC GRINDER HTC2500
CODING AND WIRE NUMBERS

Tekeningnummer :
501219939
Uitgave :1

== = HTC ++ + COM

Bladzijde : 3
Aantal pagina's : 8



START BATTERY 12Vdc

ENGINE START MOTOR

ENGINE FUEL VALVE

ENGINE ALTERNATOR

ENGINE GLOW PLUG

SUPPLY ENGINE CONTROLLER

ENGINE OIL PRESSURE TOO LOW

ENGINE COOLANT TEMP. TOO HIGH

ENGINE OIL PRESSURE MEASUREMENT

+COM/3

KEMPER EN KI- VAN TWIST DIESEL B.V.

		Getekend	: A.J. van Veldhoven
		Gecontroleerd	:
		Status	: AS BUILT
Revisie	Datum	Aanmaakdatum	: 5-11-2012

Project :

HTC GRINDER HTC2500
GENSET 110kVA
HTC GRINDER HTC2500
CABINE AND ENGINE WIRING 1

Tekeningnummer :

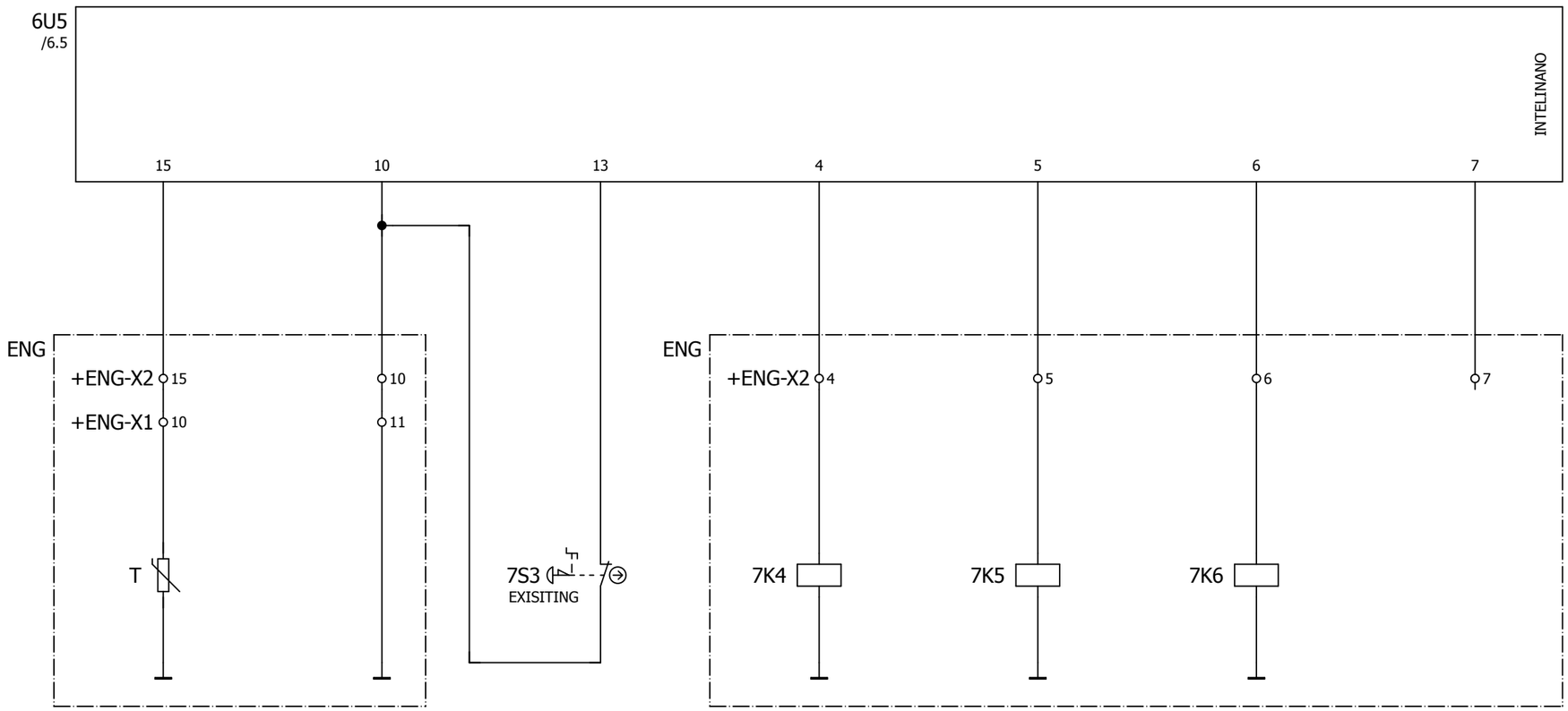
501219939

Uitgave :1

==
= HTC
++
+ CAB

Bladzijde : 6

Aantal pagina's : 8



M	V
/6.1	

ENGINE COOLANT TEMP. MEASUREMENT

COMMON

EMERGENCY STOP IN CABIN

START

M	V
/6.2	

OPERATION FUEL

M	V
/6.4	

ENGINE OIL PRESSURE TOO LOW

SPARE

KEMPER EN KI- VAN TWIST DIESEL B.V.

		Getekend	: A.J. van Veldhoven
		Gecontroleerd	:
		Status	: AS BUILT
Revisie	Datum	Aanmaakdatum	: 5-11-2012

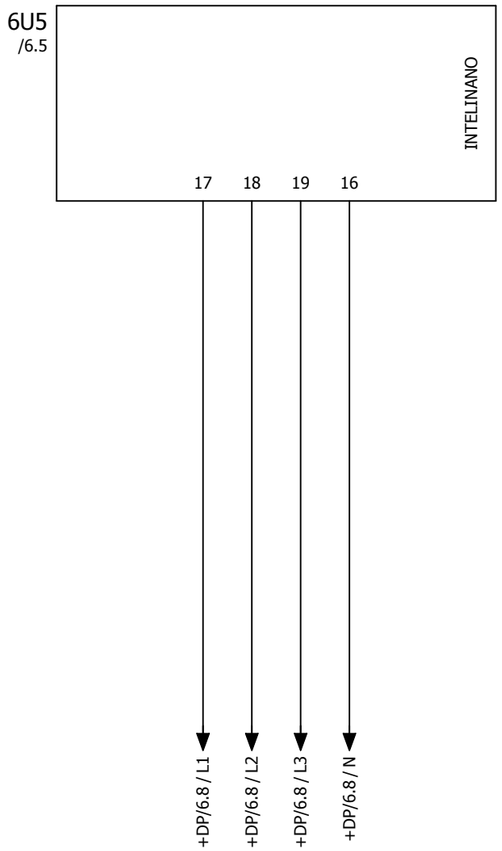
Project :

HTC GRINDER HTC2500
GENSET 110kVA
HTC GRINDER HTC2500
CABINE AND ENGINE WIRING 2

Tekeningnummer :
501219939
Uitgave :1

==
= HTC
++
+ CAB

Bladzijde : 7
Aantal pagina's : 8



GENERATOR
VOLTAGE FROM
DISTIBUTION PANEL

KEMPER EN KI- VAN TWIST DIESEL B.V.

		Getekend	: A.J. van Veldhoven
		Gecontroleerd	:
		Status	: AS BUILT
Revisie	Datum	Aanmaakdatum	: 5-11-2012

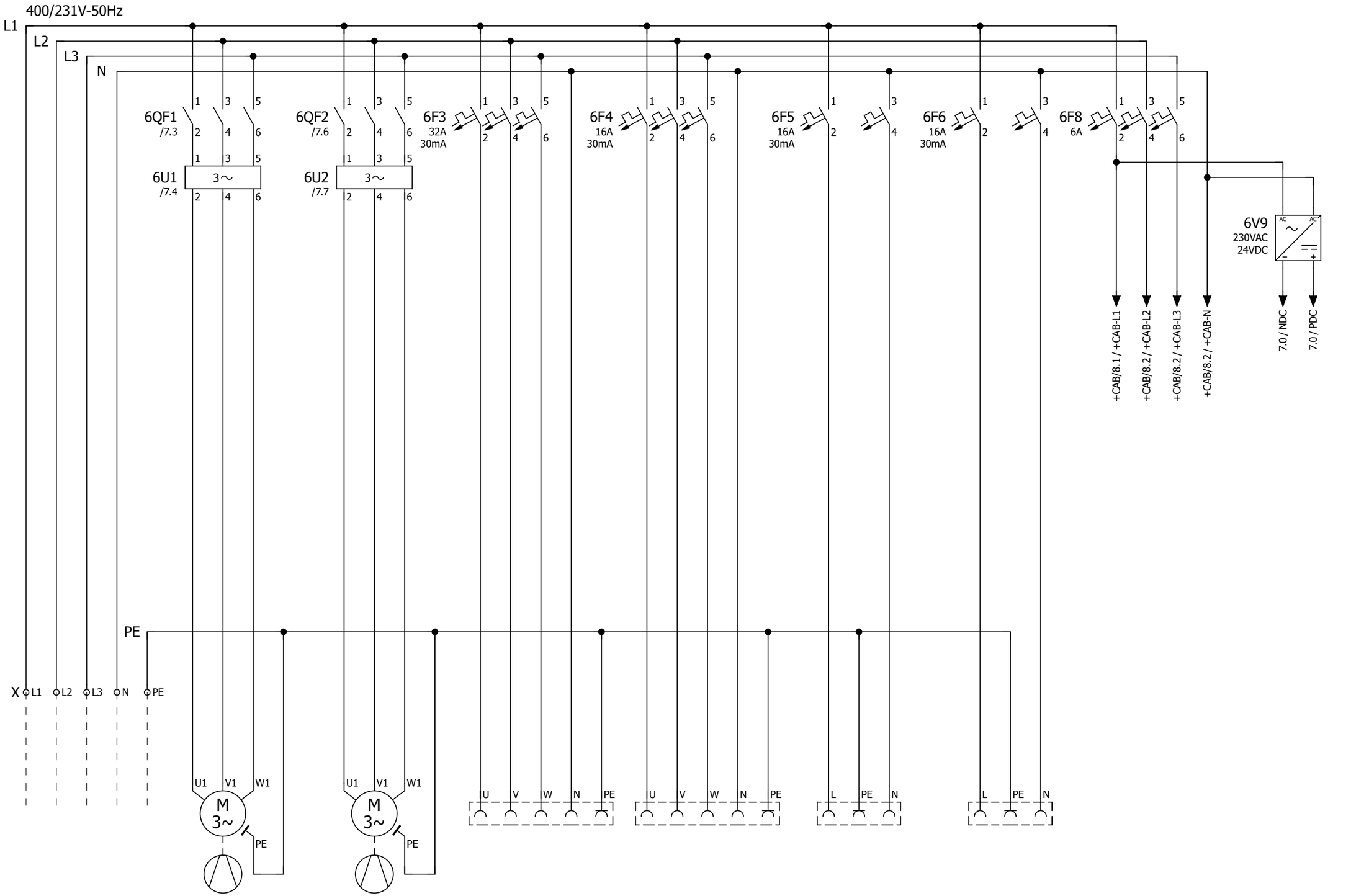
Project :

HTC GRINDER HTC2500
GENSET 110kVA
HTC GRINDER HTC2500
CABINE AND ENGINE WIRING 3

Tekeningnummer :
501219939
Uitgave :1

==
= HTC
++
+ CAB

Bladzijde :
8
Aantal pagina's : 8



MAIN SUPPLY FROM MAIN BREAKER IN MAIN CONTROL CABINET

VAC MOTOR1

VAC MOTOR2

SOCKET 32A 5P

SOCKET 16A 5P

SOCKET 16A 3P

SOCKET 16A 3P

GENERATOR VOLTAGE TO CONTROLLER

+CAB/8

KEMPER EN KI-VAN TWIST DIESEL B.V.

		Getekend	: A.J. van Veldhoven
		Gecontroleerd	:
		Status	: AS BUILT
Revisie	Datum	Aanmaakdatum	: 5-11-2012

Project :

HTC GRINDER HTC2500
GENSET 110kVA
HTC GRINDER HTC2500
NEW DISTRIBUTION PANEL, MAIN CIRCUIT

Tekeningnummer :

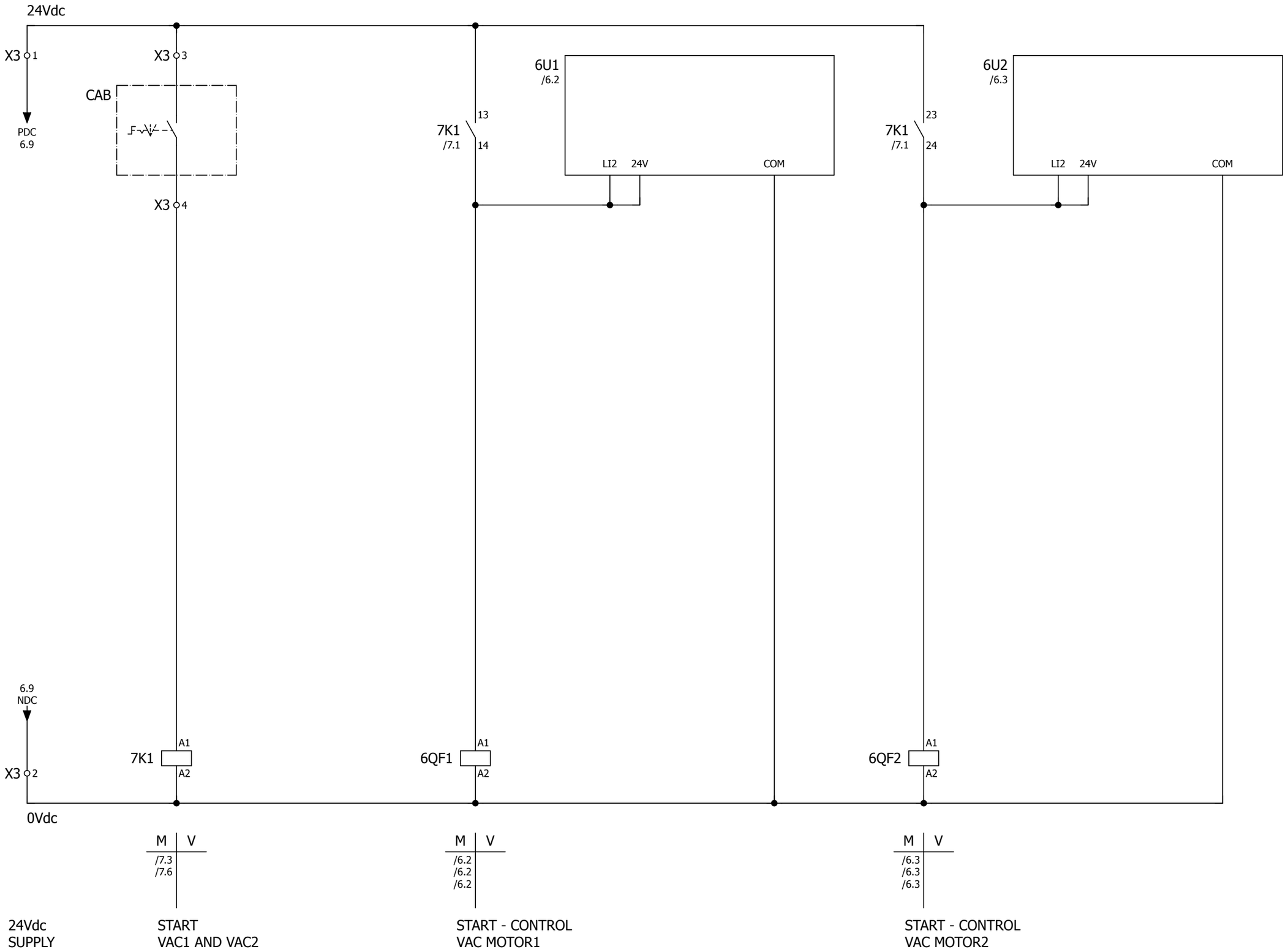
501219939

Uitgave :1

==	
=	HTC
++	
+	DP

Bladzijde : 6

Aantal pagina's : 8

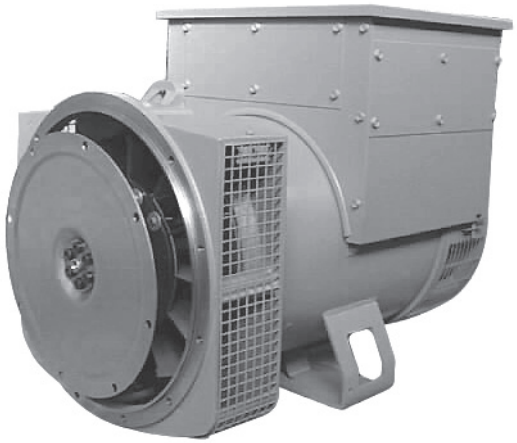


6

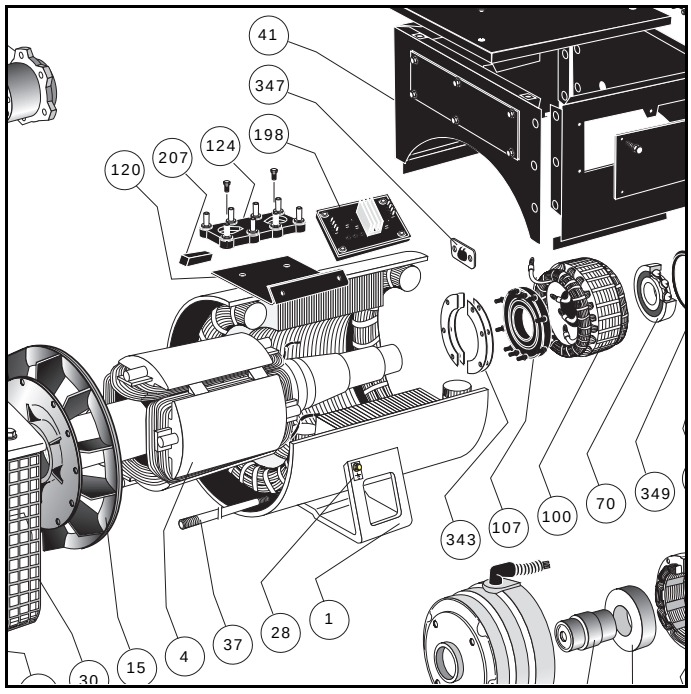
KEMPER EN KI- VAN TWIST DIESEL B.V.				Getekend : A.J. van Veldhoven	Project :	HTC GRINDER HTC2500 GENSET 110kVA HTC GRINDER HTC2500 NEW DISTRIBUTION PANEL, AUXILIARY CIRCUIT	Tekeningnummer : 501219939	== = HTC ++ + DP	Bladzijde : 7
				Gecontroleerd :					
				Status : AS BUILT			Uitgave :1		Aantal pagina's : 8
		Revisie	Datum	Aanmaakdatum : 5-11-2012					

ALTERNATORS

3608 en - 04.2006 / c



PART NUMBER 277 - 800



LL 2000 - 3000

ALTERNATORS

Installation and maintenance

LL 2000 - 3000
ALTERNATORS

This manual concerns the alternator which you have just purchased.

The latest addition to a whole new generation of alternators, this range benefits from the experience of the world's leading manufacturer, using advanced technology and incorporating strict quality control.

We wish to draw your attention to the contents of this maintenance manual. By following certain important points during installation, use and servicing of your alternator, you can look forward to many years of trouble-free operation.

1 - RECEIPT

1.1 - Standards and safety measures 3

1.2 - Inspection.....3

1.3 - Identification.....3

1.4 - Storage 3

2 - TECHNICAL CHARACTERISTICS

2.1 - Electrical characteristics 4

2.2 - Mechanical characteristics.....4

3 - INSTALLATION - COMMISSIONING

3.1 - Assembly 5

3.2 - Inspection prior to first use.....5

3.3 - Terminal connection diagrams.....6

3.4 - Commissioning 8

3.5 - Settings.....8

4 - SERVICING - MAINTENANCE

4.1 - Safety measures 9

4.2 - Regular maintenance..... 9

4.3 - Fault detection 9

4.4 - Mechanical defects 10

4.5 - Electrical faults..... 10

4.6 - Dismantling, reassembly..... 12

4.7 - Installation and maintenance of the PMG ... 14

4.8 - Table of characteristics..... 15

5 - SPARE PARTS

5.1 - First maintenance parts 16

5.2 - Technical support service 16

5.3 - Exploded view, parts list 17

1 - RECEIPT

1.1 - Standards and safety measures

Our alternators comply with most international standards and are compatible with:
- the recommendations of the
International Electrotechnical Commission
IEC 34-1, (EN 60034)
- the recommendations of the
International Standards Organisation ISO 8528
- the European Community directive 89/336/EEC on Electromagnetic Compatibility (EMC)
- the European Community directives
73/23/EEC and 93/68/EEC (Low Voltage Directive)
They are CE marked with regard to the LVD (Low Voltage Directive) in their role as a machine component. A declaration of incorporation can be supplied on request.
Before using your generator for the first time, read carefully the contents of this installation and maintenance manual, supplied with the machine. All operations performed on the generator should be undertaken by qualified personnel trained in the commissioning, servicing and maintenance of electrical and mechanical components. This maintenance manual should be retained for the whole of the machine's life and be handed over with the contractual file.
The various operations described in this manual are accompanied by recommendations or symbols to alert the user to potential risks of accidents. It is vital that you understand and take notice of the different warning symbols used.

CAUTION

Warning symbol for an operation capable of damaging or destroying the machine or surrounding equipment.

Warning symbol for general danger to personnel.

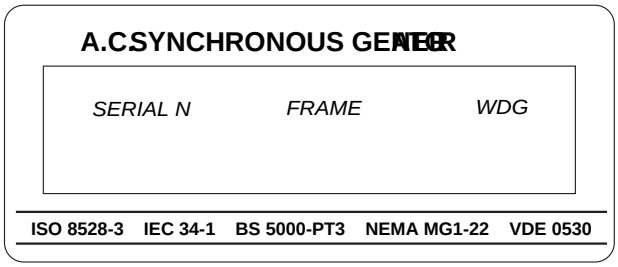
Warning symbol for electrical danger to personnel.

1.2 - Inspection

On receipt of your alternator, check that it has not suffered any damage in transit. If there are obvious signs of knocks, contact the transporter (you may able to claim on their insurance) and after a visual check, turn the machine by hand to detect any malfunction.

1.3 - Identification

The alternator is identified by means of a nameplate glued to the frame.
Make sure that the nameplate on the machine conforms to your order.
The machine name is defined according to various criteria (see below).



Nameplate

So that you can identify your machine quickly and accurately, we suggest you fill in its specifications on the nameplate below.

1.4 - Storage

Prior to commissioning, machines should not be stored in humid conditions: at relative humidity levels greater than 90%, the machine insulation can drop very rapidly, to just above zero at around 100%. The state of the anti-rust protection on unpainted parts should be monitored.
For storage over an extended period, the machine can be placed in a sealed enclosure (heatshrunk plastic for example) with dehydrating sachets inside, away from significant and frequent variations in temperature to avoid the risk of condensation during storage.
If the area is affected by vibration, try to reduce the effect of these vibrations by placing the generator on a damper support (rubber disc or similar) and turn the rotor a fraction of a turn once a fortnight to avoid marking the bearing rings.

LL 2000 - 3000
ALTERNATORS
TECHNICAL CHARACTERISTICS

2 - TECHNICAL CHARACTERISTICS

2.1 - Electrical characteristics

2000 - 3000 alternators are machines without sliprings or revolving field brushes, wound as "2/3 pitch", 12-wire; the insulation is class H and the field excitation system is available in either "SHUNT", "AREP" or "PMG" versions (see AVR manual).

2.1.1 - Options

- Stator temperature detection probes
- Space heaters

Interference suppression conforms to standard EN 55011, group 1, class B. (Europe).

2.2 - Mechanical characteristics

- Steel frame
- Cast iron end shields
- Protected ball bearings, greased for life
- Mounting arrangements:

IM 1201 (MD 35) foot and flange mounted, single-bearing with SAE coupling disc.
IM 1001 (B 34) double-bearing with SAE flange and standard cylindrical shaft extension.

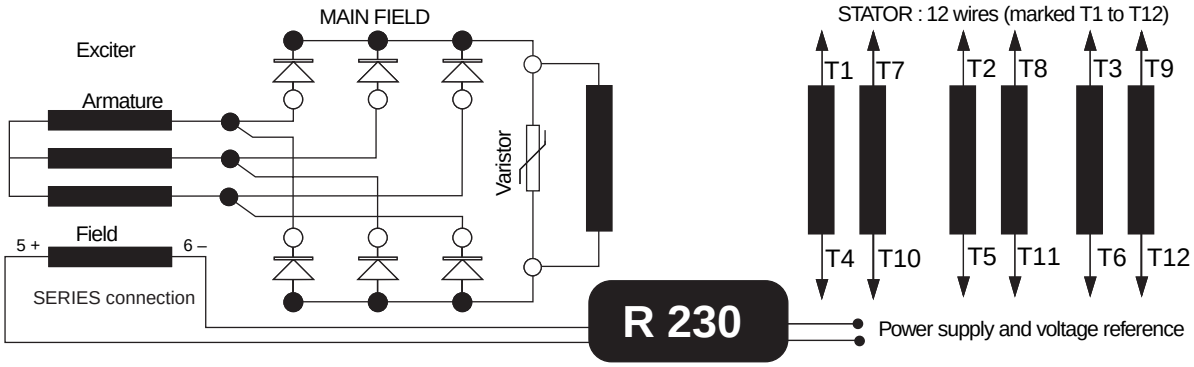
- Drip-proof machine, self-cooled
- Degree of protection: IP 23

2.2.1 - Mechanical options

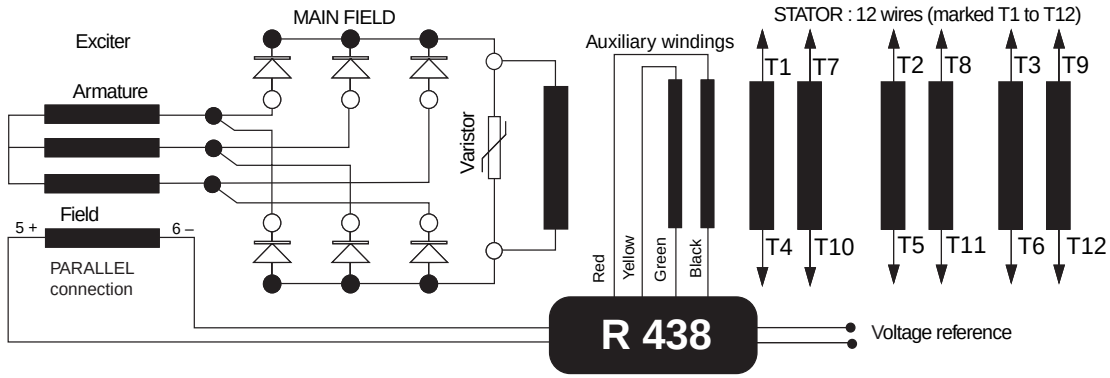
- Air inlet filter
- Regreasable ball bearings
- IP 44 protection

2.1.2 - SHUNT system with R 230 AVR

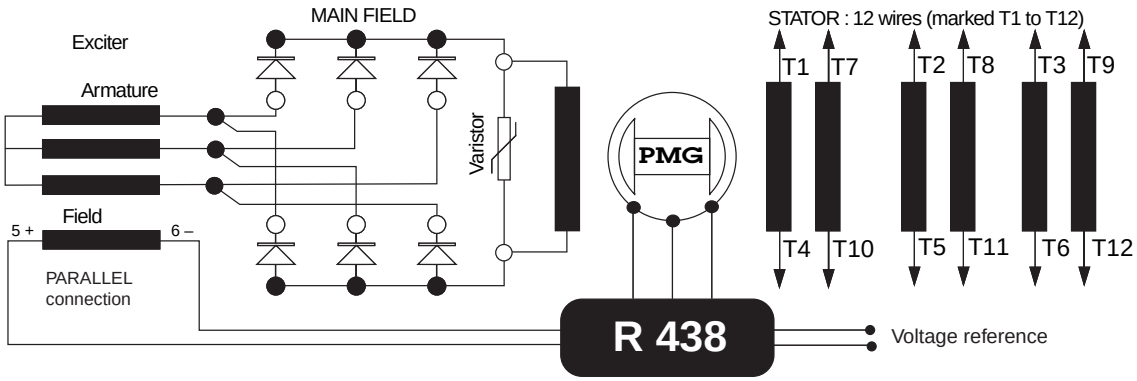
Other version R 231 AVR for dedicated single-phase or R 448 for additional function



2.1.3 - AREP system with R 438 AVR



2.1.4 - PMG system with R 438 AVR



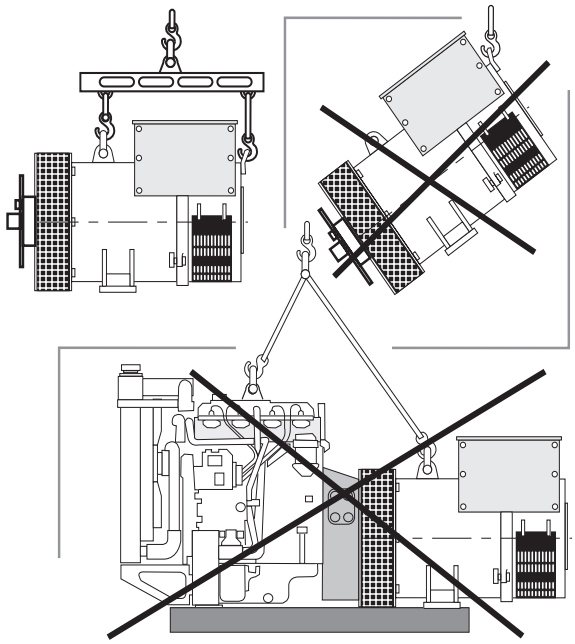
3 - INSTALLATION

3.1 - Assembly

All mechanical handling operations must be undertaken using approved equipment.
Whilst being handled, the machine should remain horizontal.

3.1.1 - Handling

The generously-sized lifting rings are for handling the alternator alone. They must not be used to lift the genset. Choose a lifting system which respects the positioning of the rings.



3.1.2 - Coupling

3.1.2.1 - Single-bearing alternator

Before coupling the two machines, check that both are compatible by:
- undertaking a torsional analysis of the transmission on both units
- checking the dimensions of the flywheel and its housing, the flange, coupling discs and offset

CAUTION

When coupling the alternator to the prime mover, the holes of the coupling discs should be aligned with the flywheel holes by cranking the engine.
Do not use the alternator fan to turn the rotor.
Tighten the coupling disc screws to the recommended torque (see section 4.6.2) and check that there is lateral play on the crankshaft.

3.1.2.2 - Two-bearing alternator

- Semi-flexible coupling

Careful alignment of the machines is recommended, checking that the concentricity and parallelism of both parts of the coupling does not exceed 0.1 mm.

CAUTION

This alternator has been balanced with a half-key.

3.1.3 - Location

Ensure that the ambient temperature in the room where the alternator is placed cannot exceed 40 °C for standard power ratings (for temperatures > 40 °C, apply a derating coefficient). Fresh air, free from damp and dust, must be able to circulate freely around the air intake grilles on the opposite side from the coupling. It is essential to prevent not only the recycling of hot air from the machine or engine, but also exhaust fumes.

3.2 - Inspection prior to first use

3.2.1 - Electrical checks

Under no circumstances should an alternator, new or otherwise, be operated if the insulation is less than 1 megohm for the stator and 100,000 ohms for the other windings.
There are three possible methods for restoring the above minimum values.
a) Dry out the machine for 24 hours in a drying oven at a temperature of approximately 110 °C (without the AVR).
b) Blow hot air into the air inlet, having made sure that the machine is rotating with the exciter field disconnected.
c) Run in short-circuit mode (disconnect the AVR):
- Short-circuit the three output terminals (power) using connections capable of supporting the rated current (try not to exceed 6 A/ mm^2)
- Insert a clamp ammeter to monitor the current passing through the short-circuit connections
- Connect a 48 Volt battery in series with a rheostat of approximately 10 ohms (50 W) to the exciter field terminals, respecting the polarity
- Open all the alternator openings fully
- Run the alternator at its rated speed, and adjust the exciter field current using the rheostat to obtain the rated output current in the short-circuit connections

Note: Prolonged standstill: In order to avoid these problems, we recommend the use of space heaters, as well as turning over the machine from time to time. Space heaters are only really effective if they are working continuously while the machine is stopped.

LL 2000 - 3000
ALTERNATORS
INSTALLATION

3.2.2 - Mechanical checks

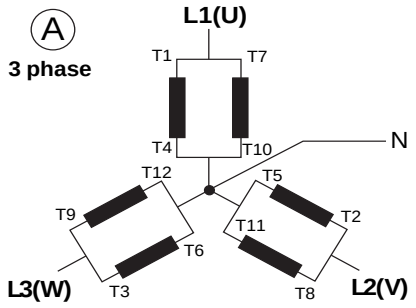
Before starting the machine for the first time, check that:
- the fixing bolts on the feet are tight
- the cooling air is drawn in freely
- the protective grilles and housing are correctly in place
- the standard direction of rotation is clockwise as seen from the shaft end (phase rotation in order 1-2-3). For anti-clockwise rotation, swap 2 and 3.
- the winding connection corresponds to the site operating voltage (see section 3.3)

3.3 - Terminal connection diagrams

To modify the connection, change the position of the terminal cables. The winding code is specified on the nameplate.

Any intervention on the alternator terminals during reconnection or checks should be performed with the machine stopped.

Connection codes A — 3 phase

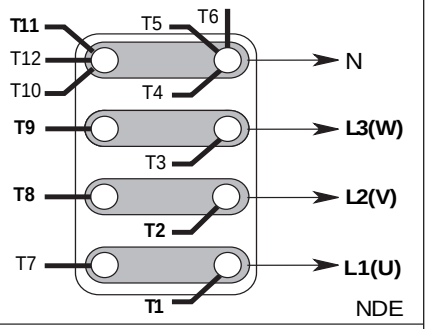


L.L voltage

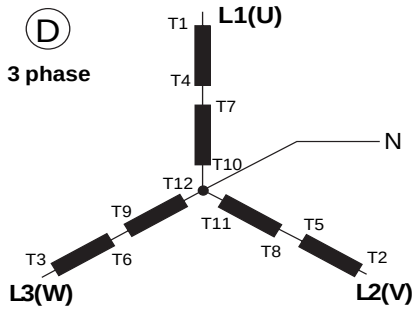
Winding	50 Hz	60 Hz
6	190 - 208	190 - 240
7	220 - 230	-
8	-	190 - 208

R230 voltage detection :
0 => (T8) / 110V => (T11)
R438 voltage detection :
0 => (T3) / 220V => (T2)

Factory connection



Connection codes D — 3 phase



L.L voltage

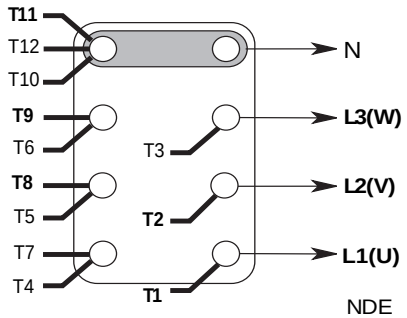
Winding	50 Hz	60 Hz
6	380 - 415	380 - 480
7	440 - 460	-
8	-	380 - 416

R230 voltage detection :
0 => (T8) / 110V => (T11)
R438 voltage detection :
0 => (T3) / 380V => (T2)

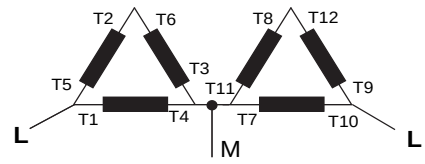
9	500 - 525	600

Winding 9 : R438 voltage detection + transformer (See specific diagram)

Factory connection



Connection codes FF — 1 phase



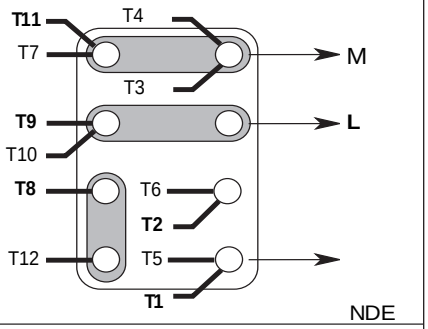
LM voltage = 1/2 LL voltage

L.L voltage

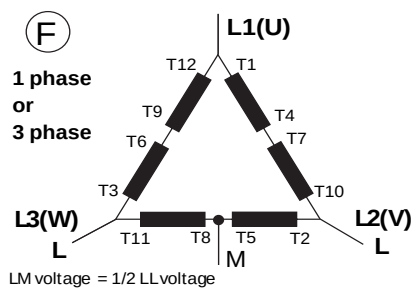
Winding	50 Hz	60 Hz
6	220 - 240	220 - 240
7	250 - 260	-
8	200	220 - 240

R230 voltage detection :
0 => (T1) / 110V => (T4)
R438 voltage detection :
0 => (T10) / 220V => (T1)

Factory connection



Connection codes F — 1 phase or 3 phase



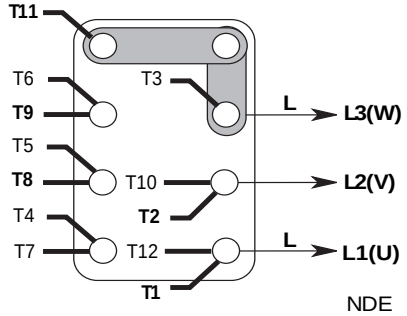
LM voltage = 1/2 LL voltage

L.L voltage

Winding	50 Hz	60 Hz
6	220 - 240	220 - 240
7	250 - 260	-
8	200	220 - 240

R230 voltage detection :
0 => (T8) / 110V => (T11)
R438 voltage detection :
0 => (T3) / 220V => (T2)

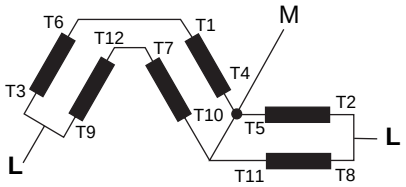
Factory connection



LL 2000 - 3000
ALTERNATORS
INSTALLATION

Connection codes

(G) 1 PH — Connection not recommended



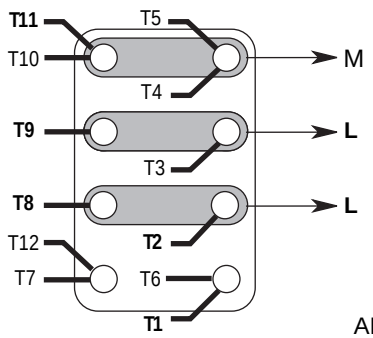
LM voltage = 1/2 LL voltage

L-L voltage

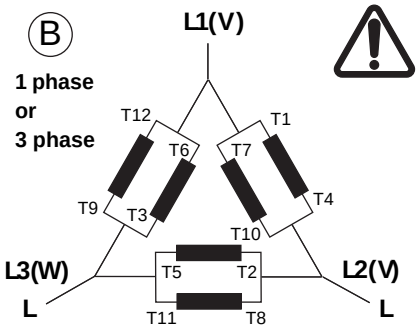
Winding	50 Hz	60 Hz
6	220 - 240	220 - 240
7	250 - 260	-
8	200	220 - 240

R230 voltage detection :
0 => (T8) / 110V => (T11)
R438 voltage detection :
0 => (T3) / 220V => (T2)

Factory connection

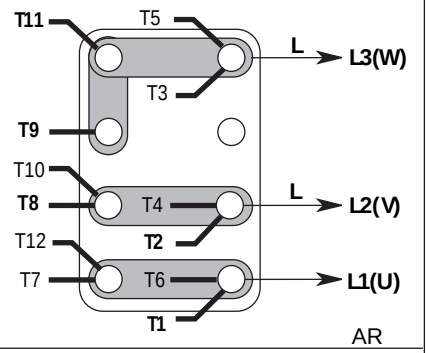


(B) 1 phase or 3 phase



Winding	50 Hz	60 Hz
6	110 - 120	120
7	120 - 130	-
8	-	110 - 120

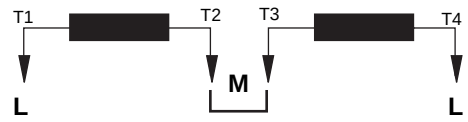
R230 voltage detection :
0 => (T8) / 110V => (T11)
R438 voltage detection :
0 => (T3) / 110V => (T2)



WARNING : Connection (B) is not possible with a standard machine in serie 3000.

SINGLE PHASE 4 LEADS - DEDICATED WINDING

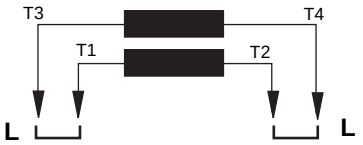
SERIES CONNECTION



Winding	50 Hz		60 Hz		Connection			
	L - L	L - M	L - L	L - M		L	L	M
M	220-240	110-120	220-240	110-120	T2-T3	T1	T4	T2-T3
M1	-	-	220-240	110-120				

R231 voltage detection : 0 => (T1) / 110V => (T2)

PARALLEL CONNECTION

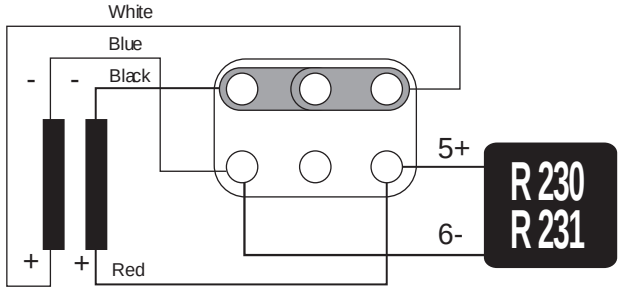


Winding	50 Hz		60 Hz		Connection			
	L - L	L - M	L - L	L - M		L	L	M
M	110-120	-	110-120	-	T1-T3 T2-T4	T1-T3	T2-T4	-
M1	-	-	110-120	-				

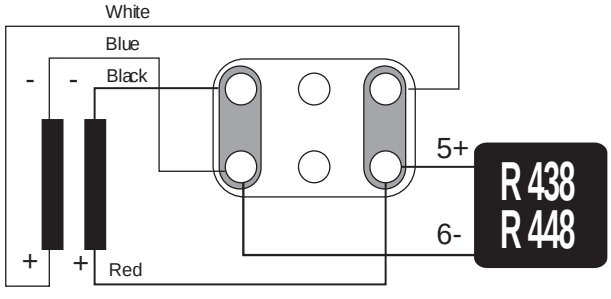
R231 voltage detection : 0 => (T1) / 110V => (T2)

3.3.1 - Exciter field connection

Series connection (SHUNT)

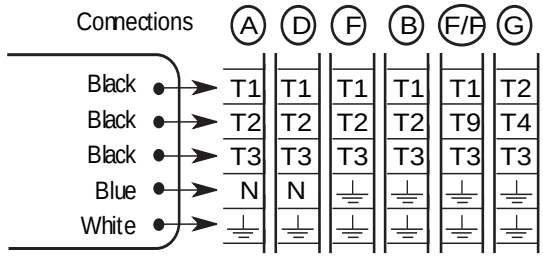


Parallel connection (AREP / PMG)

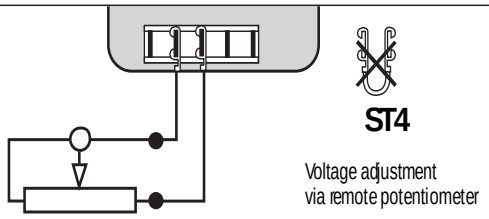


3.3.2 - Option connection diagram

R 791 Interference suppression kit (standard for CE marking)



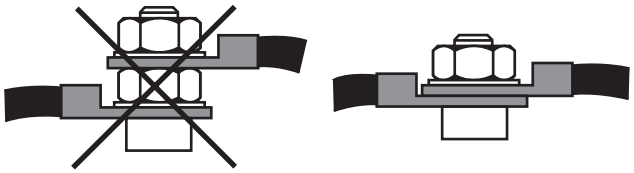
Voltage potentiometer



3.3.3 - Connection checks

Electrical installations must comply with the current legislation in force in the country of use.

Check that:
- The residual circuit-breaker complies with legislation on protection of personnel in force in the country of use, and has been correctly installed on the alternator power output as close as possible to the alternator. (In this case, disconnect the blue wire of the R 791 interference suppression module linking the neutral)
- Any protective devices in place have not tripped
- If there is an external AVR, the connections between the alternator and the cubicle are made in accordance with the connection diagram
- There is no short-circuit between phase or phase-neutral between the alternator output terminals and the generator set control cabinet (part of the circuit not protected by circuit-breakers or cubicle relays)
- The machine has been connected with the busbar separating the terminals as shown in the terminal connection diagram



3.4 - Commissioning

The machine can only be started up and used if the installation is in accordance with the regulations and instructions defined in this manual.
The machine is tested and set at the factory. When first used with no load, make sure that the drive speed is correct and stable (see the nameplate). On application of the load, the machine should achieve its rated speed and voltage; however, in the event of abnormal operation, the machine setting can be altered (follow the adjustment procedure: see section 3.5). If the machine still operates incorrectly, the cause of the malfunction must be located (see section 4.4).

3.5 - Setting up

The various adjustments during tests must be made by a qualified engineer. Take care that the drive speed specified on the nameplate is reached before commencing adjustment. After operational testing, replace all access panels or covers.
The AVR is used to make any adjustments to the machine.

4 - SERVICING / MAINTENANCE

4.1 - Safety measures

Servicing or troubleshooting must be carried out strictly in accordance with instructions so as to avoid the risk of accidents and to maintain the machine in its original state.

All such operations performed on the alternator should be undertaken by personnel trained in the commissioning, servicing and maintenance of electrical and mechanical components.
Before any intervention on the machine, ensure that it cannot be started by a manual or automatic system and that you have understood the operating principles of the system.

4.2 - Regular maintenance

4.2.1 - Checks after start-up

After approximately 20 hours of operation, check that all fixing screws on the machine are still tight, plus the general state of the machine and the various electrical connections in the installation.

4.2.2 - Cooling circuit

It is advisable to check that circulation of air is not reduced by partial blocking of the air intake and outlet grilles: mud, fibre, grease, etc.

4.2.3 - Bearings

The bearings are permanently greased: approximate life of the grease (depending on use) = 20,000 hours or 3 years. Monitor the temperature rise in the bearings, which must not exceed 60 °C above the ambient temperature. Should this value be exceeded, the machine must be stopped and checks carried out.

4.2.4 - Electrical servicing

Cleaning product for the windings

CAUTION

Do not use: trichlorethylene, perchlorethylene, trichloroethane or any alkaline products.

Certain strictly defined pure volatile degreasing agents can be used, such as:
- Normal petrol (without additives); inflammable
- Toluene (slightly toxic); inflammable
- Benzene (or benzine, toxic); inflammable
- Ciclohexare (non toxic); inflammable

Cleaning of the stator, rotor, exciter and diode bridge

The insulating components and the impregnation system are not at risk of damage from solvents (see the list of authorized products).
Avoid letting the cleaning product run into the slots. Apply the product with a brush, sponging frequently to avoid accumulation in the housing. Dry the winding with a dry cloth. Let any traces evaporate before reassembling the machine.

4.2.5 - Mechanical servicing

CAUTION

Cleaning the machine using a water spray or a high-pressure washer is strictly prohibited.
Any problems arising from such treatment are not covered by our warranty.
The machine should be cleaned with a degreasing agent, applied using a brush. Check that the degreasing agent will not affect the paint.
Compressed air should used to remove any dust.
If filters have been added to the machine after manufacture and do not have thermal protection, the service personnel should clean the air filters periodically and systematically, as often as necessary (every day in very dusty atmospheres).
Cleaning can be performed using water for dry dust or in a bath containing soap or detergent in the case of greasy dust. Petrol or chloroethylene can also be used.
After cleaning the alternator, it is essential to check the winding insulation (see sections 3.2 and 4.8).

4.3 - Fault detection

If, when commissioned, the alternator does not work normally, the source of the malfunction must be identified.
To do this, check that:
- the protective devices are fitted correctly
- the connections comply with the diagrams in the manuals supplied with the machine
- the speed of the unit is correct (see section 1.3)

Repeat the operations defined in section 3

4.4 - Mechanical defects

Fault		Action
Bearing	Excessive overheating of one or both bearings (temperature > 80 °C on the bearing retainers with or without abnormal noise)	- If the bearing has turned blue or if the grease has turned black, change the bearing. - Bearing not properly seated. - End shields misaligned (flanges not properly fitted).
Temperature abnormal	Excessive overheating of alternator frame (more than 40 °C above the ambient temperature)	- Air flow (intake-outlet) partially clogged or hot air is being recycled from the alternator or engine - Alternator operating at too high a voltage (> 105% of Un on load) - Alternator overloaded
Vibration	Excessive vibration	- Misalignment (coupling) - Defective mounting or play in coupling - Rotor balancing fault
	Excessive vibration and humming noise coming from the machine	- Alternator operating in single-phase mode (single-phase load or faulty contactor or installation fault) - Stator short-circuit
Abnormal noise	Alternator damaged by a significant impact, followed by humming and vibration	- System short-circuit - Mis-paralleling Possible consequences - Broken or damaged coupling - Broken or bent shaft end - Shifting and short-circuit of main field - Fan fractured or coming loose on shaft - Irreparable damage to rotating diodes or AVR

4.5 - Electrical faults

Fault	Action	Effect	Check/Cause
No voltage at no load on start-up	Connect between E- and E+ a new battery of 4 to 12 volts, respecting the AVR polarities, for 2 to 3 seconds	The alternator builds up and its voltage is still correct when the battery is removed.	- Lack of residual magnetism
		The alternator builds up but its voltage does not reach the rated value when the battery is removed.	- Check the connection of the voltage reference to the AVR - Faulty diodes - Armature short-circuit
		The alternator builds up but its voltage disappears when the battery is removed	- Faulty AVR - Field windings disconnected - Main field winding open circuit. Check the resistance
Voltage too low	Check the drive speed	Correct speed	Check the AVR connections (AVR may be faulty) - Field windings short-circuited - Rotating diodes burnt out - Main field winding short-circuited - Check the resistance
		Speed too low	Increase the drive speed (Do not touch the AVR voltage pot. (P2) before running at the correct speed.)
Voltage too high	Adjust AVR voltage potentiometer	Adjustment ineffective	Faulty AVR
Voltage oscillations	Adjust AVR stability potentiometer	If no effect: try normal/rapid recovery modes (ST2)	- Check the speed: possibility of cyclic irregularity - Loose connections - Faulty AVR - Speed too low when on load (or LAM set too high)
Voltage correct at no load and too low when on load (*)	Run at no load and check the voltage between E+ and E- on the AVR	Voltage between E+ and E- SHUNT < 20 V - AREP/PMG < 10 V	- Check the speed (or LAM set too high)
		Voltage between E+ and E- SHUNT > 30 V - AREP/PMG > 15 V	- Faulty rotating diodes - Short-circuit in the main field. Check the resistance - Faulty exciter armature
(*) Caution: For single-phase operation, check that the sensing wires coming from the AVR are correctly connected to the operating terminals			
Voltage disappears during operation (**)	Check the AVR, the surge suppressor, the rotating diodes, and replace any defective components	The voltage does not return to the rated value	- Exciter winding open circuit - Faulty exciter armature - Faulty AVR - Main field open circuit or short-circuited
(**) Caution: Internal protection may be activated (overload, open circuit, short-circuit)			

4.5.1 - Checking the winding

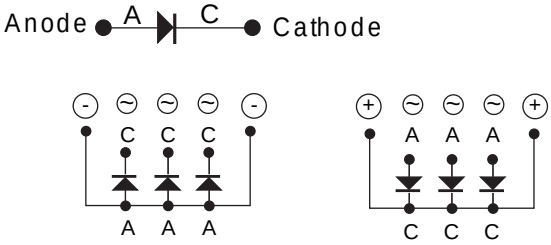
You can check the winding insulation by performing a high voltage test. In this case, you must disconnect all AVR wires.

CAUTION

Damage caused to the AVR in such conditions is not covered by our warranty.

4.5.2 - Checking the diode bridge

Diode bridge



A diode in good working condition allows the current to flow in only one direction, from anode to cathode.

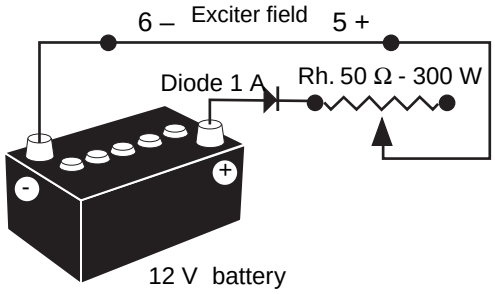
4.5.3 - Checking the windings and rotating diodes using separate excitation

During this procedure, make sure that the alternator is disconnected from any external load and inspect the terminal box to check that the connections are fully tightened.

1) Stop the unit, disconnect and isolate the AVR wires.
2) There are two ways of creating an assembly with separate excitation.

Assembly A: Connect a 12 V battery in series with a rheostat of approximately 50 ohms - 300 W and a diode on both exciter field wires (5+) and (6-).

ASSEMBLY A



Assembly B: Connect a "Variac" variable power supply and a diode bridge on both exciter field wires (5+) and (6-).

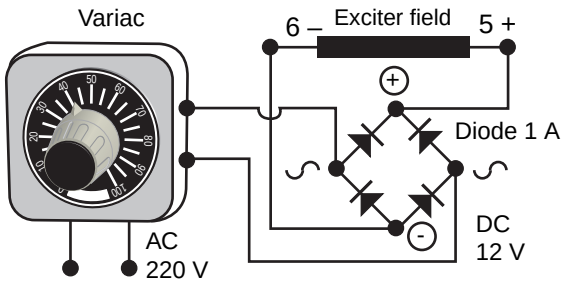
Both these systems should have characteristics which are compatible with the field excitation power of the machine (see the nameplate).

3) Run the unit at its rated speed.

4) Gradually increase the exciter field supply current by adjusting the rheostat or the Variac and measure the output voltages on L1 - L2 - L3, checking the excitation voltage at no load and at full load (see machine nameplate or ask for the factory test report).

When the output voltage is at its rated value and balanced within 1% for the rated excitation level, the machine is in good working order. The fault therefore comes from the AVR or its associated wiring (ie. sensing, auxiliary windings).

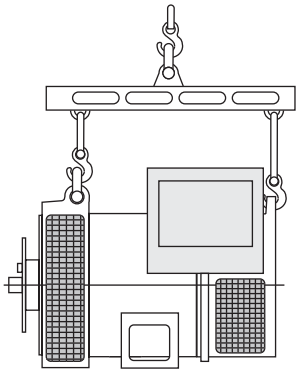
ASSEMBLY B



4.6 - Dismantling, reassembly (see sections 5.4.1/5.4.2)

CAUTION

During the warranty period, this operation should only be carried out in an approved workshop or in our factory, otherwise the warranty may be invalidated.
Whilst being handled, the machine should remain horizontal (rotor not locked when moved).



4.6.1 - Tools required

To fully dismantle the machine, we recommend using the tools listed below:
- 1 ratchet spanner + extension
- 1 torque wrench
- 1 set of flat spanners: 7 mm, 8 mm, 10 mm, 12 mm
- 1 socket set: 8 mm, 10 mm, 13 mm, 16 mm, 18 mm, 21 mm, 22 mm, 24 mm
- 1 size 5 Allen key (eg. Facom: ET5)
- 1 size 6 Allen key (eg. Facom: ET6)
- 1 size 10 Allen key (eg. Facom: ET10)
- 1 size 14 Allen key (eg. Facom: ET14)
- 1 T20 and T30 TORX bit
- 1 puller (eg. Facom: U35)
- 1 puller (eg. Facom: U32/350).

4.6.2 - Screw tightening torque

IDENTIFICATION	screw Ø	Torque N.m
Field terminal block screw	M4	4 N.m
Field screw	M6	10 N.m
Diode bridge/RP	M6	5 N.m
Diode nut	M5	4 N.m
2000 tie rod	M12	57 Nm
3000 tie rod	M14	90 Nm
Earth screw	M8	26 Nm
2000 disc/shaft screw	M12	110 Nm
3000 disc/shaft screw (*)	M16	250 Nm
3000 turbine screw	M6	5 Nm
Grille screws	M6	5 Nm
Cover screws	M6	5 Nm
Terminal block nut	M10	20 Nm

(*) : 3000 - SAE 11 1/2 ; BF 134706
3000 - SAE 10 ; BF 127707
3000 - SAE 14 ; BF 134208

4.6.3 - Access to connections and the regulation system

The terminals are accessed directly by removing the terminal box lid [48].
To access the AVR adjustment potentiometers, the side plate [367] should be removed.

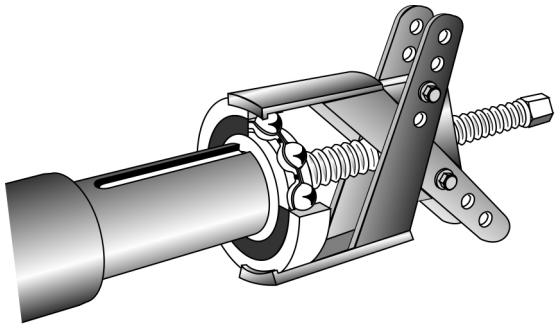
4.6.4 - Accessing, checking and replacing diodes

4.6.4.1 - Dismantling
- Remove the air intake grille [51]
- Remove the surge suppressor [347]
- Disconnect the 6 diodes using an ohmmeter or a battery lamp (see section 4.5.2)

4.6.4.2 - Reassembly
- Replace the bridges, respecting the polarity (see section 4.5.1)
- Replace the surge suppressor [347]
- Refit the air intake grille [51]
- Replace the terminal box lid [48]

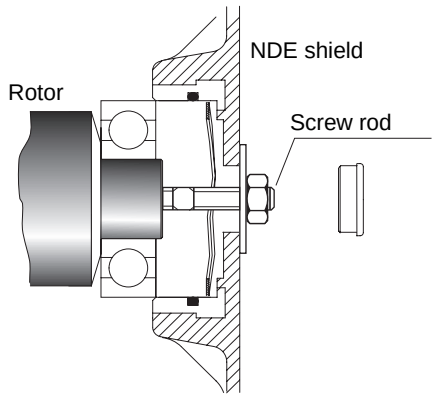
4.6.5 - Replacing the NDE bearing on single-bearing machines

4.6.5.1 - Dismantling
- Remove the terminal box lid [48]
- Remove the air intake grille [51]
- Unscrew the fixing clamps on the power output cables, remove the connector from the exciter and the R 791 module.
- Remove the 4 nuts on the tie rods
- Remove the NDE shield [36] using a puller: eg. U.32 - 350 (FACOM)
- Remove the ball bearing [70] using a screw puller



4.6.5.2 - Reassembly
- Heat the inner slipring of a new bearing by induction or in a drying oven at 80 °C (do not use an oil-bath) and fit it to the machine.
- Place the preloading wavy washer [79] in the shield and fit a new O ring seal [349].
Refit the NDE shield and pass the bundle of wires between the top bars of the shield.
- Refit the fixing clamps on the cables, the R 791 module and the exciter connector.

- Refit the air intake grille [51].
- Replace the terminal box lid [48].



4.6.6 - Replacing the bearings on two-bearing machines

4.6.6.1 - Dismantling

- Uncouple the alternator from the prime mover.
- Remove the 8 assembly screws.
- Remove the DE shield [30].
- Remove the NDE shield (see section 4.6.5.1)
- Remove both ball bearings [60] and [70] using a puller with a central screw.

4.6.6.2 - Reassembly

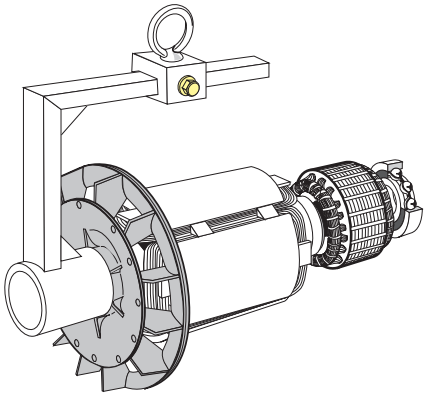
- Heat the new bearings by induction or in a drying oven at 80 °C (do not use an oil-bath) and fit them to the machine.
- Check that both the preloading wavy washer [79] and the new O ring seal [349] have been fitted on the NDE shield [36]. Refit the NDE shield and pass the bundle of wires between the top bars of the shield.
- Refit the DE shield [30] and tighten the 4 fixing screws.
- Check that the machine assembly is correctly mounted and that all screws are tightened.

4.6.7 - Accessing the main field and stator

4.6.7.1 - Dismantling

Follow the procedure for dismantling the bearings (see sections 4.6.5.1 and 4.6.6.1)

- Remove the coupling disc (single-bearing machine) or the DE end shield (two-bearing machine) and insert a tube of the corresponding diameter on the shaft end or a support made according to the following diagram.



- Rest the rotor on one of its poles, then slide it out. Use the tube as a lever arm to assist dismantling.
- After extraction of the rotor, be careful not to damage the fan. If the fan is dismantled, it is essential that it is replaced for the 2000.

NOTE: If intervention is required on the main field (rewinding, replacement of components), the rotor assembly must be rebalanced.

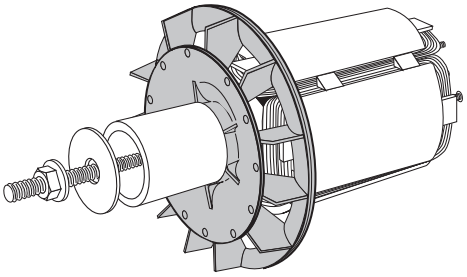
4.6.7.2 - Reassembling the main field

- Follow the dismantling procedure in reverse order.

Take care not to knock the windings when refitting the rotor in the stator.

- If the fan is being replaced on the 2000, assemble the parts as shown in the following diagram. Fit a tube and a threaded screw.

On the 3000 the fan is fixed by screws on the hub.



Follow the procedure for reassembling the bearings (see sections 4.6.5.2 and 4.6.6.2).

After operational testing, replace all access panels or covers.

4.7 - Installation and maintenance of the PMG

For the 2000 - 3000, the PMG reference is PMG 1.

4.7.1 - Mechanical characteristics

The components are:
- An adaptation shaft (to position the rotor on the shaft extension)
- A tie rod and nut for assembling the rotor on the shaft
- A rotor with 16 magnets
- An assembly consisting of: housing + wound stator + plastic connection sheath + plastic ferrules
- The housing closure cover (4 CBLXS M5 screws)
- 4 HM6 screws (for fixing the housing to the NDE shield)

If mounting in kit form, follow the following instructions (see section 5.4):
1 - Remove the PMG cover [297] and the alternator NDE shield seal.
2 - Mount the PMG housing assembly [290] on the shield using the 4 HM6 screws.
3 - Put a coating of anti-vibration adhesive on the tie rod [295] and fix it on the alternator shaft extension.
4 - Mount the magnetized rotor on the adaptation shaft, then using 2 threaded rods screwed into the rotor, slide the assembly onto the tie rod.
5 - Install the cable gland washer [296].
6 - Tighten the assembly with the M10 nut.
7 - Close the PMG with the cover [297].
8 - Pierce the cover (Ø 21 hole) and insert the plastic sheath and its ferrule.
9 - Connect the PMG to the AVR (see sections 2.5 and 4.7.2).

4.7.2 - Electrical connection

Mounting the PMG-1 on a SHUNT machine
(when using an R438):
- Disconnect the connection wires from the R 230 and remove the AVR.
- Take out both the R 230 voltage reference wires, marked 2 and 3, by removing them from the terminals (T8 and T11) in which they are inserted.
- Use these same wires for voltage sensing on the R 438 by inserting them in terminals T2 (wire 2) and T3 (wire 3).
- Fit the AVR support plate fitted with the R 438 (2 HM6 screws tightened to 10 Nm).
- Connect the 3 PMG wires (14/15/16), the 2 exciter field wires (5/6) and the 2 previously mentioned voltage sensing wires (2/3) according to the connection diagram no. 2725-02-98.
- Modify the connection by replacing the single jumper on the connector located on the terminal box rear panel with 2 jumpers (see internal connection diagram).

Mounting the PMG-1 on an AREP machine
- Connect the 3 PMG wires (14/15/16), to terminals X1, X2, Z2 on the AVR. The 4 auxiliary winding wires X1.X2.Z1.Z2 should be isolated using the domino fitting supplied with the kit. Both exciter field wires (5/6) and the voltage sensing wires (2/3) remain in place.

Electrical characteristics of the PMG
Stator phase/phase resistance 20 °C: 0.7 Ω
No-load voltage : 73 V

4.8 - Electrical characteristics table

Alternator - 4 pole - 50/60 Hz - No. 6 standard winding. (400V- 50 Hz for the excitation values)
The voltage and current values are given for no-load operation and operation at rated load with separate field excitation. All values are given at ± 10% (for exact values, consult the test report) and are subject to change without prior warning.

SHUNT 2000 : resistances at 20°C (Ω)

2014	L/N stator	Rotor	Field	Armature
B	0,155	1,35	19,5	0,23
D	0,128	1,41	19,5	0,23
H	0,0836	1,76	19,5	0,23
J	0,0631	1,96	19,5	0,23

SHUNT 2000 : field excitation current i exc (A)
Symbols : "i exc": excitation current of the exciter field.

2014	B	D	H	J
No-load	0,5	0,5	0,4	0,5
At rated load	1,6	1,7	1,5	1,6

For 60Hz machines the "i exc" values are approximately 5 to 10 % less.

AREP ou PMG 2000 : resistances at 20°C (Ω)

2024 2034	L/N stator	Rotor	Auxil. wind. : X1, X2 (*)	Auxil. wind. : Z1, Z2 (*)	Field	Armature
B	0,155	1,35	0,32	0,52	4,9	0,23
D	0,128	1,41	0,29	0,5	4,9	0,23
H	0,0836	1,76	0,26	0,44	4,9	0,23
J	0,0631	1,96	0,21	0,4	4,9	0,23

(*) AREP

AREP or PMG 2000 : field excitation current i exc (A)
Symbols : "i exc": excitation current of the exciter field.

2024 - 2034	B	D	H	J
No-Load	1	1	0,9	1
At rated load	3,2	3,4	3	3,2

For 60Hz machines the "i exc" values are approximately 5 to 10 % less.

SHUNT 2000 Dedicated single phase : resistances at 20°C (Ω)

2014	L/L stator	Rotor	Field	Armature
B	0,058	1,35	13,9	0,23
D	0,047	1,41	13,9	0,23
F	0,037	1,57	13,9	0,23
H	0,028	1,76	13,9	0,23
J	0,02	1,96	13,9	0,23

SHUNT 2000 Dedicated single phase : field excitation current i exc (A) - 240 V - 60 Hz - Winding M1
Symbols : "i exc": excitation current of the exciter field.

2014	B	D	F	H	J
No-Load	0,6	0,7	0,65	0,65	0,8
At rated load	1,8	1,8	1,6	1,6	1,6

SHUNT 3000 : resistances at 20°C (Ω)

3014	L/N stator	Rotor	Field	Armature
B	0,55	2,37	19,5	0,5
F	0,0235	3,32	19,5	0,5
H	0,0186	3,66	19,5	0,5

SHUNT 3000 : field excitation current i exc (A)
Symbols : "i exc": excitation current of the exciter field.

3014	B	F	H
No-Load	0,5	0,6	0,6
At rated load	2	1,9	2

For 60Hz machines the "i exc" values are approximately 5 to 10 % less.

AREP or PMG 3000 : resistances at 20°C (Ω)

3024 3034	L/N stator	Rotor	Auxil. wind. : X1, X2 (*)	Auxil. wind. : Z1, Z2 (*)	Field	Armature
B	0,046	2,58	0,28	0,44	4,9	0,5
F	0,0238	3,36	0,17	0,28	4,9	0,5
H	0,0193	3,74	0,16	0,21	4,9	0,5

(*) AREP

AREP 3000 : field excitation current i exc (A)
Symbols : "i exc": excitation current of the exciter field.

3024 - 3034	B	F	H
No-Load	1	1,15	1,2
At rated load	4	3,7	4

For 60Hz machines the "i exc" values are approximately 5 to 10 % less.

SHUNT 3000 Dedicated single phase : resistances at 20°C (Ω)

3014	L/L stator	Rotor	Field	Armature
B	0,019	2,58	18,4	0,5
D	0,014	2,97	18,4	0,5
F	0,009	-	18,4	0,5

SHUNT 3000 Dedicated single phase : field excitation current i exc (A) 240 V - 60 Hz - Winding M1
Symbols : "i exc": excitation current of the exciter field.

3014	B	D	F
No-Load	0,45	0,45	0,6
At rated load	1,30	1,25	1,35

5 - SPARE PARTS

5.1 - First maintenance parts

Emergency repair kits are available as an option.
They contain the following items :

No.	Description	Qty	2000	Part number
	Emergency Kit (Shunt)	1		922-216
198	Voltage regulator (AVR)	1	R 230	922-197
343	Diode bridge assembly	1	LSA 432 9 03/ 04	922-230
347	Surge suppressor	1	LSA 432 1 13	922-231
	AVR fuse	2	250 V - 8 A / slow	922-222
	Emergency Kit (AREP/MPG)	1		922-217
198	Voltage regulator (AVR)	1	R 438	922-045
343	Diode bridge assembly	1	LSA 432 9 03/ 04	922-230
347	Surge suppressor	1	LSA 432 1 13	922-231
	AVR fuse	2	250 V - 8 A / slow	922-222
	Other parts			
60	D.E. bearing	1	6312 2RS/C3	
70	N.D.E. bearing	1	6307 2RS/C3	922-111

No.	Description	Qty	3000	Part number
	Emergency Kit (Shunt)	1		922-218
198	Voltage regulator (AVR)	1	R 230	922-197
343	Diode bridge assembly	1	LSA 432 9 03/ 04	922-230
347	Surge suppressor	1	LSA 432 1 13	922-231
	AVR fuse	2	250 V - 8 A / slow	922-222
	Emergency Kit (AREP/MPG)	1		922-219
198	Voltage regulator (AVR)	1	R 438	922-045
343	Diode bridge assembly	1	LSA 432 9 03/ 04	922-230
347	Surge suppressor	1	LSA 432 1 13	922-231
	AVR fuse	2	250 V - 8 A / slow	922-222
	Other parts			
60	D.E. bearing	1	6315 2RS/C3	
70	N.D.E. bearing	1	6309 2RS/C3	922-232

5.2 - Technical support service

Our technical support service will be happy to provide any information you require.

When ordering spare parts, you should indicate the complete machine type, its serial number and the information indicated on the nameplate.

Address your enquiry to your usual contact.

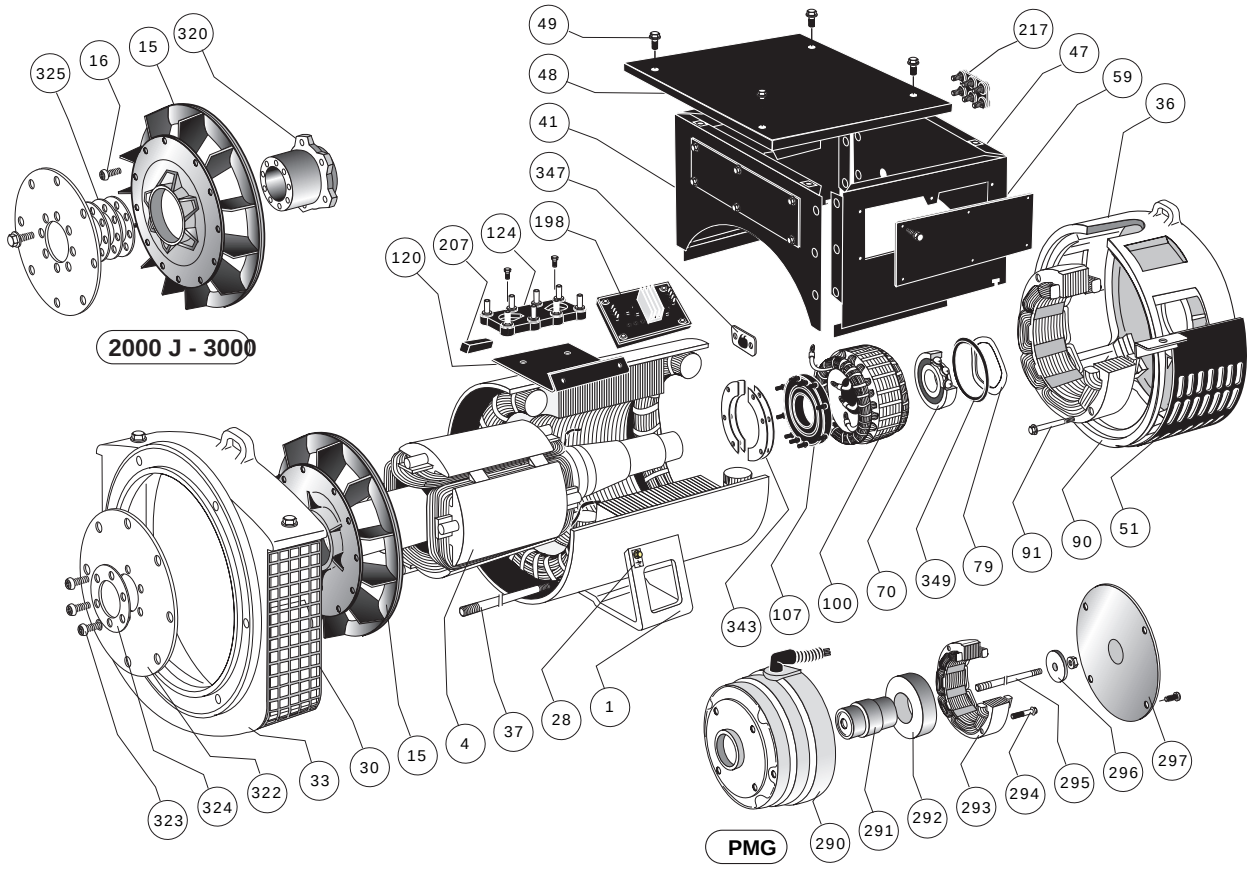
CAUTION

Part numbers should be identified from the exploded views and their description in the parts list.
Our extensive network of "service stations" can dispatch the necessary parts without delay.
To ensure correct operation and the safety of our machines, we recommend the use of original manufacture spare parts.
In the event of failure to comply with this advice, the manufacturer cannot be held responsible for any damage.

LL 2000 - 3000
ALTERNATORS
SPARE PARTS

5.4 - Exploded views, parts list

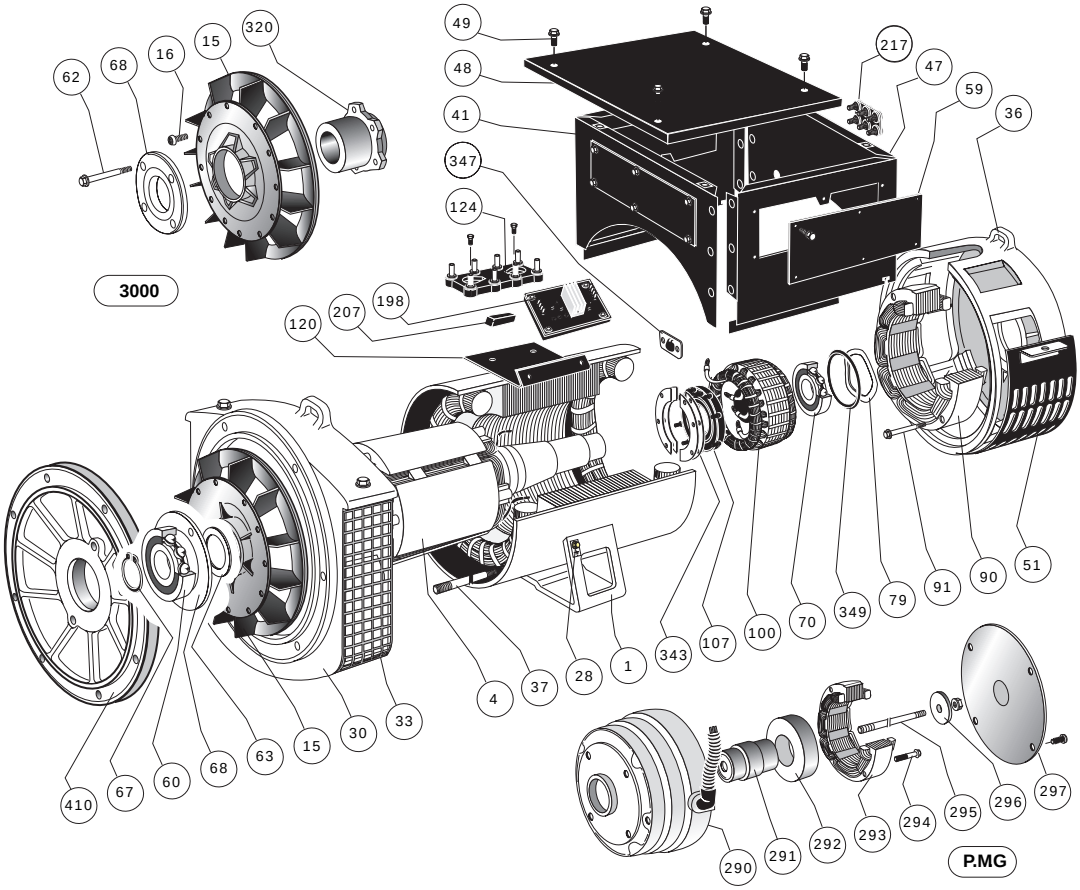
5.4.1 - Single-bearing



N°	Nbr	Description	N°	Nbr	Description
1	1	Stator assembly	120	1	Terminal block support (AREP)
4	1	Rotor assembly	124	1	Terminal block
15	1	Fan	198	1	Voltage regulator (AVR)
16	6	Fixing screws (3000 only)	207	1	AVR damper seal
28	1	Earth terminal	217	1	Terminal block
30	1	DE shield	290	1	PMG housing
33	1	Air outlet grille	291	1	Adaptation shaft
36	1	Shield on exciter end	292	1	Magnetic rotor
37	4	Tie rod	293	1	Stator
41	1	Cover front panel	294	2	Fixing screws
47	1	Cover rear panel	295	1	Tie rod
48	1	Cover top panel	296	1	Cable gland washer + nut
49	34	Fixing screws	297	1	End plate
51	1	Air intake grille	320	1	Hub (2000J & 3000 only)
59	3	Inspection door	322	1	Coupling disc
70	1	NDE bearing	323	-	Fixing screws
79	1	Preloading wavy washer	324	1	Clamping washer (2000 B,D,H)
90	1	Exciter field	325	-	Spacer shim (2000 J - 3000)
91	4	Exciter field fixing screw	343	1	Diode bridge assembly
100	1	Exciter armature	347	1	Surge suppressor
107	1	Diode crescent support	349	1	"O" ring

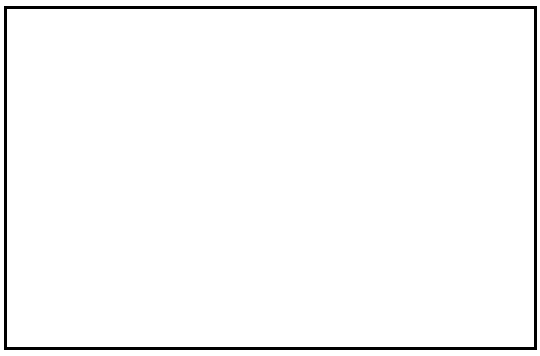
LL 2000 - 3000
ALTERNATORS
SPARE PARTS

5.4.2 - Two-bearing



N°	Nbr	Description	N°	Nbr	Description
1	1	Stator assembly	90	1	Exciter field
4	1	Rotor assembly	91	4	Exciter field fixing screw
15	1	Fan	100	1	Exciter armature
16	6	Fixing screws (3000)	107	1	Diode crescent support
28	1	Earth terminal	120	1	Terminal block support (AREP)
30	1	DE shield	124	1	Terminal block
33	1	Air outlet grille	198	1	Voltage regulator (AVR)
36	1	Shield on exciter end	207	1	AVR damper seal
37	4	Tie rod	217	1	Terminal block
41	1	Cover front panel	290	1	PMG housing
47	1	Cover rear panel	291	1	Adaptation shaft
48	1	Cover top panel	292	1	Magnetic rotor
49	34	Fixing screws	293	1	Stator
51	1	Air intake grille	294	2	Fixing screws
59	3	Inspection door	295	1	Tie rod
60	1	DE bearing	296	1	Cable gland washer + nut
62	2/4	Bearing retainer fixing screw	297	1	End plate
63	1	Cable gland washer (2000 only)	320	1	Hub (3000)
67	1	Circlips	343	1	Diode bridge assembly
68	1	Inner bearing retainer	347	1	Surge suppressor
70	1	NDE bearing	349	1	"O" ring
79	1	Preloading wavy washer	410	1	End shield

LL 2000 - 3000
ALTERNATORS
NOTES



HTC Sweden AB

Professional floor systems

Användarhandbok / Operating Instructions

HTC 55 D

HTC 75 D

HTC 86 D

Pullman Ermator

HTC

FÖRORD

Bäste kund,
Tack för att Ni valt HTC Sweden som leverantör.

Vi önskar Er lycka till med Er nya stoftsugare av modell HTC 55D/75D och 86D och hoppas att den motsvarar Era förväntningar.

Vi har valt Pullman-Ermator AB som tillverkar av stoftsugare. Pullman-Ermator har sedan 1967 producerat produkter för professionell stofthantering och har genom åren erhållit en gedigen kompetens inom området.

Kontakta oss på HTC Sweden eller Pullman-Ermator eller någon av våra återförsäljare för information om våra och deras övriga produkter. Ni kan även gå in på vår hemsida, www.htc-sweden.com eller www.pullman-ermator.se.

Viktigt!

Denna instruktionsbok behandlar endast stoftavskiljaren HTC 55D, 75D och 86D.

Stoftavskiljaren HTC 55D, 75D och 86D får endast användas för hantering av torrt, ej explosivt, material.

Om stoftsugaren används för andra ändamål eller hanteras på annat sätt än vad denna instruktionsbok beskriver, frånsäger sig Pullman-Ermator AB allt ansvar.

Beakta speciellt avsnitt Säkerhetsföreskrifter.

Läs instruktionsboken innan stoftsugaren tas i bruk.

De reservdelar som används till stoftsugaren skall vara godkända av Pullman-Ermator AB.

Uppackning

Var noga med att kontrollera att stoftsugaren är oskadad att inga synliga märken finns på sladden, slangar och tillbehör.

Säkerhetsföreskrifter

Handhavande

Varning

- En elkabel som har klämskador eller torrsprickor kan vara farlig att använda och skall omedelbart bytas ut. Risk för personskada.

Varning

- Anslut ej maskinen till ett ojordat uttag. Risk för personskada.

Varning

- Se till att uppställningsplatsen är stabil, så att inte stoftsugaren välter. Risk för person- och egendomsskada.

Varning

- Risk för klämskada vid hantering av exenterlås.

Varning

- Maskinen får ej användas i miljöer där explosiva gaser förekommer. Stor risk för explosion.

Service

Varning

- Dra ut kontakten från stoftsugaren vid underhållarbete. Risk för personskada.

Varning

- I samband med byte av huvudfilter och vid byte av absolufilter kan hälsovådligt damm spridas. Operatören bör därför bära skyddsglasögon, skyddshandskar, andningsmask med skyddsklass FFP2. Risk för personskada.

Varning

- Stick ej hål på något filter. Risk för dammspridning.

Handhavande

Maskinen är avsedd för uppsugning och avskiljning av torrt icke brännbart damm med explosionsgränsvärde > 0.1mg/m^3.
Med start knappen startas sidokanalfläkten.
Därvid sugs stoftblandad luft med stor hastighet, via sugslang, genom inloppet. I cyklonen dämpas hastigheten varvid det grövre stoftet avskiljs, dels genom centrifugalkraft och dels genom sin egenvikt. Luft och restpartiklar passerar sedan tubfiltren där avskiljning sker.
Aggregatet är utrustat med filterrensning enl. principen reverserad luftpuls.
Det avskiljda stoftet samlas i cyklonen tills maskinen stängs av, och faller då genom botten-luckan ner i uppsamlingspåsen.

Drift

Innan användning skall utbildning, information och anvisningar genomföras i handhavandet av maskinen och det avskilda dammet.
Anslut maskinen till ett eluttag med spänning enligt maskinens namnskylt.
Med jämna mellanrum bör filtret rensas. Det är lämpligt i samband med avslutat arbetspass eller när maskinen tappar orken.
Tillvägagångssätt: Dra skjutluckan, som sitter placerad på stoftsugarens inloppsrör, till dess övre läge, låt maskinen arbeta upp vakuum några sekunder, tryck sedan snabbt ner spaken och släpp upp långsamt. Upprepa proceduren 5-10 ggr. Skulle sugeffekten fortfarande vara dålig, är filterbyte nödvändigt.
Gör alltid en filterrensning innan plastsäcken byts. Vid byte av plastsäck skall en plast stripes dras åt precis under hållaren. Ytterliggare en plast stripes monteras och påsen klipps mellan de två stripsen.
Använd endast original longopac plastpåse. Se avsnitt Tillbehör.

Filterbyte

I samband med byte av filter kan hälsovådligt damm spridas. Operatören bör bära skyddsglasögon, skyddshandskar, andningsmask med skyddsklass FFP2.

Stäng av maskinen och drag ur stickproppen ur eluttaget.

Huvudfilter

Lossa de två hållarna mellan cyklon topp och undre tank samt de två hållarna placerade på anslutningsröret ner mot absolut filterna. Vrid sedan cyklontoppen framåt. Vrid filterplattan 10 grader motsols och lyft sedan ur hela filterpaketet och sänk sakta ner dem i lämplig påse, (OBS! var försiktig, stoftet kan vara hälsofarligt).
Förslut påsen med filterna omedelbart.
Montera nytt komplett filterpaket i mellantank, rotera tank och montera topplock.
Endast **original filterpaket** får användas. Se avsnitt Tillbehör.

Absolutfilter

Vrid undan cyklontoppen enligt ovan. Lossa de tre hänkena och lyft av filterlocket, lyft därefter varsamt ur mikrofilterpatronerna och placerade den i lämplig plastpåse, som omedelbart förslutes. Sätt i två nya patroner. Montera tillbaka filterlocket.
Vid filterbyte skall även packningar bytas, dessa kommer med filterna.

OBS

- Absolutfiltret ska ej rengöras utan bytas när det är förbrukade.

OBS

- Absolutfiltrets drifthållbarhet minskar och kan helt förstöras om det utsätts för vatten.

Service

- **Vid rengöring och service av maskinen måste maskinen stängas av och stickproppen dras ur eluttaget.**
- Undvik rengöring med hjälp av högtryckstvätt. Om detta är nödvändigt, se till att ej rikta strålen mot maskinens öppningar, speciellt motorns inlopp/utlopp för kylluften.
- Innan den använda maskinen flyttas från arbetsområdet, skall den rensugas eller avtvättas. Dessutom skall sugslangen demonteras.
- All övrig utrustning måste anses förorenat och skall behandlas därefter.
- Om möjligt skall ett avskiljt anpassat rum användas.
- Lämplig personlig skyddsutrustning skall användas.
- Alla förorenade delar, som vid skötsel- eller reparationsarbete ej kan rengöras tillfredsställande, måste omhändertas i tätt förslutbara påsar för omhändertagande enligt gällande bestämmelser.
- Om maskinen skall användas för annan användning, är det mycket viktigt att maskinen saneras ordentligt så, att hälsofarligt damm ej sprids vidare.

Tillbehör

ART.NR	BENÄMNING	
200600596	Komplett filterpaket	(1 st/maskin)
200600595	MF5500 Hepafikter	(2 st/maskin)
1337032	Städset	
1376013	Longopack uppsamlingspåse. (4-pack)	

Övriga tillbehör och reservdelar enligt bifogade sprängskisser.

Garanti

På samtliga Industri dammsugare med tillbehör gäller 12 månaders fabriksgaranti avseende material- och tillverkningsfel. Ingrepp i sugaren får ej ske utan tillverkarens godkännande.
Garantin omfattar ej fel som uppstått genom normalt slitage, ovarsamhet, felaktig användning, obehörigt ingrepp eller att sugaren kopplats till felaktig spänning.
Vid reklamation skall sugaren eller överenskommen del därav returneras till oss eller vårt ombud för garantiundersökning och för eventuell garantireparation eller utbyte.

Felsökning

HTC 55D, HTC 75D och HTC 86D är konstruerade och anpassade för en krävande miljö och uppgift, men användaren bör dock beakta att aggregaten innehåller precisionstillverkade komponenter som bör skyddas mot hårda slag och stötar. Filter, tätningar, infästningar och anslutningar är omsorgsfullt anpassade och utvalda för operatörens arbetsmiljö. Det är därför naturligtvis av stor vikt att operatör och servicepersonal behandlar aggregatet med insikt och kunskap, detta för att maskinen skall tjäna felfritt för det ändamål den är avsedd för.

Problem	**Orsak**	**Åtgärd**
Motorn går inte	El ej ansluten Strömbrytare trasig	Anslut el Byt strömbrytare
Motorn stannar direkt efter start.	Felaktig säkring	Anslut till rätt säkring
Motorn går men suger ej	Sugslang ej ansluten Stopp i slangen Plastsäck saknas	Anslut slangen Rensa slangen Montera plastsäck
Motorn går men suger dåligt	Hål på sugslangen Igensatt filter Motorkåpan dåligt monterad Stoft har fastnat i i cyklonens lucka Packningar defekta	Byt slang Rensa eller byt filter Justera Rensa cyklonen. OBS! Skyddsutrustning! Byt aktuell packning
Maskinen blåser ut damm	Filtret har lossnat eller gått sönder	Kontrollera och byt vid behov
Onormalt maskinljud		Beställ service

SPARA DENNA INSTRUKTION!

DECLARATION

EG-deklaration om överensstämmelse
EU-declaration of conformity

Tillverkare
Manufacturer

Pullman-Ermator AB
Industrivägen 10
777 91 Smedjebacken
Sverige/Sweden

Produktbeteckning/
Product designation

Stoftavskiljare HTC 55D, 75D samt 86D.
Vacuum cleaner HTC 55D, 75D and 86D.

EU-riktlinjer
EU-guidelines

Produkten i fråga överensstämmer med följande EU-riktlinje:
The product in question conforms to the following EU-guidelines:
Maskindirektivet
Machinery directive……. 89/392/EEC
EMC-direktivet
EMC-directive…….. 89/336/EEC, tillägg: 93/68/ECC
LVD-direktivet
LVD-directive…….. 73/23/ECC, tillägg: 93/68/ECC

Överensstämmelse med dessa riktlinjer dokumenteras genom att följande
standarder tillfredsställs:
Conformity with these guidelines is documented through compliance with the following standards:

Harmoniserade europastandarder
Harmonized European standards EN291-2, EN292-2,
tillägg/annex: EN60335-2-2 ed 3

Nationella standarden
National standards EMCO-TUB(61),NO 202/92

Pullman-Ermator AB

Torbjörn Begntsson
General Manager

Introduction

Dear Customer,.
We thank you for choosing HTC Sweden AB as your supplier.

We hope that the vacuume cleaner of model HTC 55D, 75D and 86D will be to your satisfaction and meet your expectations.

We have chosen Pullman-Ermator AB as the manufacture of our product. They have been a manufacture of professional dust extractor since 1967 and have thru the years built up a know how in this area.

You can always contact us to get information about our product program and Pullman-Ermator by visit
www.htc-sweden.com or www.pullman-ermator.se .

Notice!

This instruction cover only the vacuum cleaner type HTC 55D, 75D and 86D.

The vacuum cleaner, HTC 55D, 75D and 86D can only be used for dry, non explosive material.

If the vacuum cleaner is used for other applications or been used in other ways than explained in this instruction book, Pullman-Ermator AB will not take any responsibility.

Before using the machine, please carefully read the safety regulations.

Read the complete instruction book before using the vacuum cleaner.

All spare part used for the vacuum cleaner type HTC 55D, 75D and 86D must be recognized by Pullman-Ermator

Un packing

When unpacking the machine, please check that the vacuum cleaner, hoses and accessories do not have any transportation damages.

Safety Instructions

Handling

Warning

- Cables damaged through crunching or cracking can be dangerous if used and should be replaced immediately. Risk of personal injury.

Warning

- Do not connect the machine to an unearthed socket. Risk of personal injury.

Warning

- Make sure the assembly area is firm, so the vacuum cleaner do not tip over. Risk of personal and material injury.
-

Warning

- Risk for pinch injuries when handling the toggle fastener.

Warning

- The machine must not be use in environments where explosive gases can occur. Large risk for explosions.

Service

Warning

- Remove the plug from the wall socket when carrying out maintenance work. Risk of personal injury.

Warning

- Health impairing dust can be spread when the coarse filter and the absolute filter are replaced. Accordingly, the user should wear protective glasses, protective gloves, and a breathing mask conforming to protection class FFP2

Warning

- Do not puncture the absolute filer. Risk for dust dispersion.

Handling

The machine is for sucking and separating dry, not combustive dust with limit value of explosion >0.1mg/m^3.
The motor is started by the switch. Dust laden air is then sucked through the inlet valve at high speed via the suction hose. The air is slowed down by the cyclone and coarse dust particles are separated out, partly by centrifugal force and partly by gravity. Air and finer particles then pass through the tube filter where separation is made. The machine is designed for filter cleaning by reverse air pulse.
The separated dust accumulates in the cyclone until the machine is switched off, when it drops through the bottom flap into the plastic bag.

Using

Before using must the user be educated in handling the vacuum cleaner and the hazardous dust.
Connect the electric plug to an outlet with correct voltage (see the designation plate).
From time to time the filter must be cleaned. This must be done before changing the plastic bag. Even appropriate when the working is completed or when there is poor suction.
Procedure: Unplug the hose so that the inlet will be covered. Cover the intake of the overpressure valve (placed between the two hoses connecting the main tank the cover for the micro filters), let the machine build up vacuum for a few seconds then quickly push down on the top handle and release it slowly. Repeat the procedures 5-10 times. If suction remains poor, the filter should be replaced.
The plastic bag may only be replaced after cleaning the filter.
The plastic bag must be tied up after removing.
Only use original parts.

Change of filter

Risk of dust dispersion - Personal safety equipment

Health impairing dust can be spread during change of filter. Accordingly, the user should wear protective glasses, protective gloves, and a breathing mask conforming to protection class FFP2.

Shut off the machine and pull the plug out of the socket.

Main filter
Loosen the two latches between the tank and the lower cykon. Loosen the two latches at the hose connection between the tank and the absolute filter cover. Rotate the tank foreword. Rotate the filter plate counter clock vice 10 deg and lift filter and holder gently up side down and draw a plastic bag over the filter unit. Lift the filter gently and pinch up the bag by hand and then tie the bag up. This bag must be taken care of in a proper way.
Insert a new complete filter package in reversed order. Only original filter may be used.

Absolute filter
Loosen the three latches holding the filter cover, carefully lift the filters up and into a proper plastic bag. This bag must be taken care of in a proper way. Insert new filters in reversed order.

Service

When cleaning and servicing the machine, You must switch off the machine and pull out the plug from the outlet.

- Avoid cleaning with high pressure cleaner. If necessary do not point at the openings on the machine, especially the opening for the cooling air.
- Before moving the machine from the working area, the machine must be cleaned. Furthermore must the inlet be locked with the expanding plug attached.
- All other equipment must be regarded contaminated and be treated thereafter.
- If possible use a special suitable room.
- Proper personnel protective equipment must be used.
- All parts after service, which are contaminated, must be taken core of in a proper way in plastic bags according to all regulations.
- If the vacuum cleaner has to be used for other purposes, it is extremely important that the vacuum cleaner will be cleaned, to avoid spreading of hazardous dust.

Accessories

PART.NO.	DESCRIPTION	
200600596	Complete filter set	(1 pcs/machine)
200600595	MF5500 Hepa filter	(2 pcs/machine)
1337032	Cleaning set	
1376013	Longopack plastic bag (4-pack).	

Other spare parts, see enclosed spare parts list.

Warranty

All Vacuum cleaners and accessories have a 12-month factory warranty for material and manufacturing defects. Do not attempt to repair the suction apparatus without the consent of the manufacture.
The warranty does not cover defects which are the result of normal wear and tear, negligence, defective use, unauthorised repair or the suction apparatus being connected to the incorrect voltage.
In the event of any complaint, the suction apparatus or an agreed part of it must be returned to us or our authorised representative for warranty examination and for any warranty repair or replacement.

Problem solving

HTC 55D, HTC 75D and HTC 86D are manufactured and made for a severe environment and tasks, but the user must notice that the machine contents of components which must be protected from hits and blows. Filter, sealing connections are carefully chosen for the environment of the operator. Therefore must the machine be treated with knowledge as to work correctly for many years.

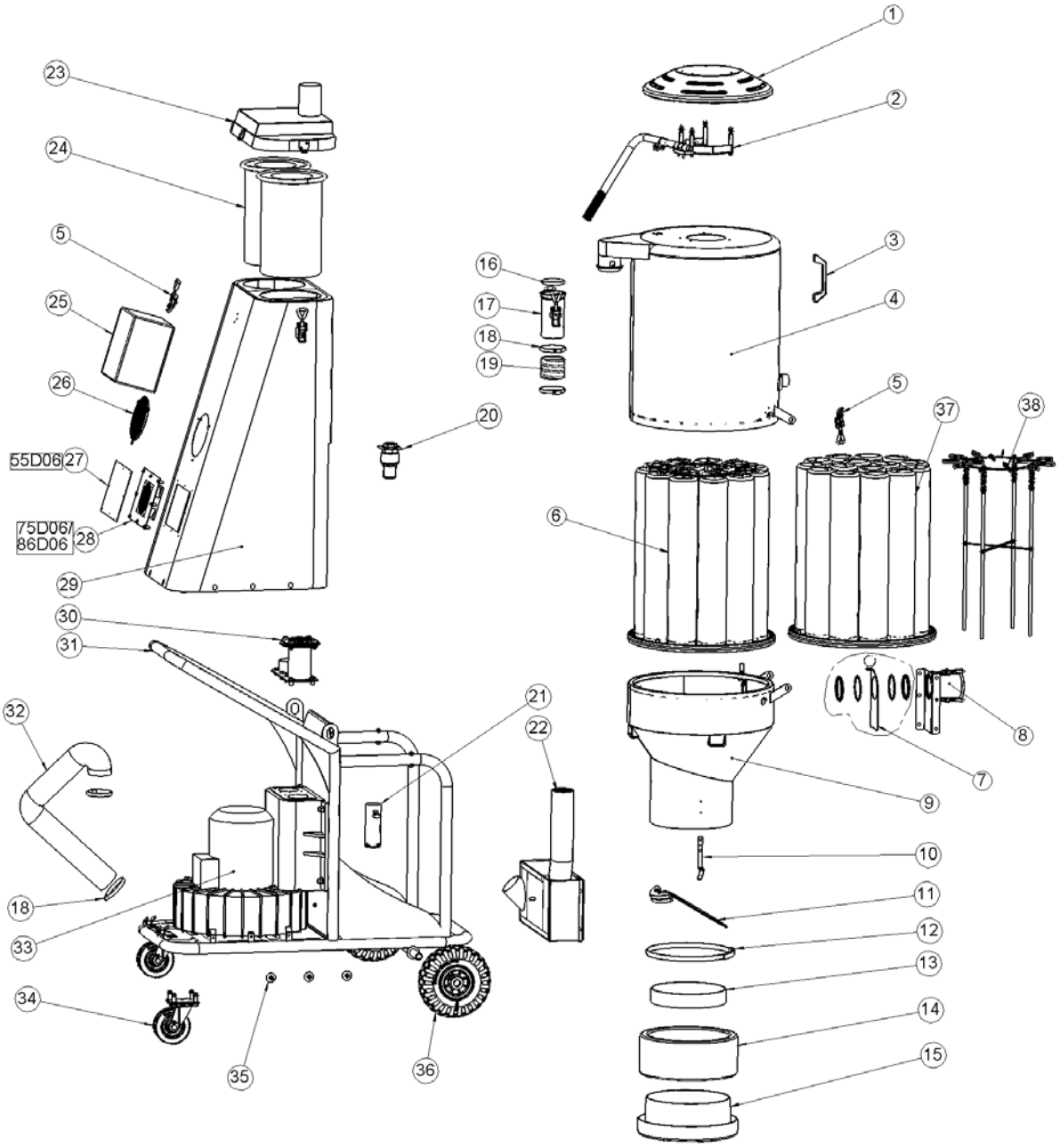
Problem	**Cause**	**Procedure**
Motor don't start	No current	Connect the machine
	Defect switch	Change
Motor stops immediately	Wrong fuse	Connect to proper fuse
Motor runs, but no suction	Hose not connected	Connect the hose
	Hose blocked	Clean the hose
	No plastic bag	Mount plastic bag
Motor runs, but poor suction	Damage on the hose	Change hose
	Blocked filter	Change filter
	Top cover loose	Adjust
	Dirt in the flap	Clean the flap. Use protective equipment
	Defect sealing	Change current sealing
Dust is blowing from motor	Defect or loose filter	Adjust or change
Abnormal noise		Order service

SAVE THESE INSTRUCTIONS!

TEKNISKA DATA
TECHNICAL PERFORMANCE

HTC 55D – HTC 75D – HTC 86D

	HTC 55D	HTC 75D	HTC 86D
MÄRKSPÄNNING Voltage/Spannung/Tension	400 VAc, 3-fas 50Hz (3x200VAc 3fas 50/60Hz)	208 VAc, 3-fas 60 Hz	460 VAc, 3-fas 60Hz
EFFEKTUTTAG Power/Leistung/Puissance	5500 W	7500 W	8600 W
MAX LUFTMÄNGD Airflow/Luftstrom/Débit dàir	600 m3/h	600m3/h	600m3/h
MAX UNDERTRYCK Vacuum/Unterdruck/Dépression	28 kPa	28 kPa	28 kPa
SUGSLANG Hose/Schlauch/Tuyau	10m x ∅ 76mm 7.5 ∅ 50mm	10m x ∅ 76mm 7.5m x ∅ 50mm	10m x ∅ 76mm 7.5m x ∅ 50mm
INLOPPSRÖR Inlet/Einlass/Entrée	∅ 76mm	∅ 76mm	∅ 76mm
FINFILTER Finefilter/Feinfilter/Filtre	>99.5% Filteryta 2.3m^2	>99.5% Filteryta 2.3m^2	>99.5% Filteryta 2.3m^2
MIKROFILTER Microfilter/Mikrofilter/Filtre micro	>99.95% Filteryta 5m^2	>99.95% Filteryta 5m^2	>99.95% Filteryta 5m^2
LJUDNIVÅ Soundlevel/Geräuschpegel/Niveau de bruit	74 dB(A)	74 dB(A)	74 dB(A)
UPPSAMLINGSSÄCK Plastic bag/Fangsack/Sac collecteur	Longopack	Longopack	Longopack
DIMENSION LxBxH Dimensions/Abmessung/Dimension	1250x690x1750 mm	1250x690x11750 mm	1250x960x1750mm
VIKT Weight/Gewicht/Poids	189 kg	189 kg	189 kg


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
55D06
27
75D06/
86D06
28
29
30
31
32
18
33
34
35
36
5
37
38

Pos	Antal / Qty	HTC55D	HTC75D	HTC86D	Benämning / Description
1	1	200600656			Täckhuv / Top cover
2	2	200600655			Filterrens sats / Filter cleaning unit
3	1	200600658			Handtag / Handle
4	1	200600657			Tank komplett / Tank complete
5	5	200600606			Excenterlås sats / Excentric lock kit
6	1	200600596			Filter paket komplett / Filter package complete
7	1	200600652			Ventilskiva inkl. packning / Valve incl. gasket
8	1	200600653			Slanganslutning / Hose connection
9	1	200600620			Bottenkon komplett / Lower tank complete
10	2	200600654			Spänne sats / Holder kit
11	1	200600621			Fallucka komplett / Flap complete
12	1	1371001			Rem / Belt
13	1	1351162			Glidskydd / Anti skid
14	0,25	1376013			Longopac / Longopac
15	1	200500110			Longopac hållare / Holder for longopac
16	1	1351239			O-ring / O-ring
17	1	200600101			Rör hona / Tube
18	4	1357072			Slangklämma / Hose clamp.
19	0,1m	1332039			Slang / Hose
20	1	200600611			Säkerhetsventil sats / Protection valve kit
21	1	200500220			Buntbandslåda / Strip holder
22	1	200500018			Ljuddämpare komplett / Silencer complete
23	1	200600017			Lock komplett / Cover complete
24	2	200600595			HEPA filter sats / HEPA filter kit
25	1	1262008	1262009	1262010	Elskåp komplett / Electrical box complete
26	1	200600659			Galler sats / Grating kit
27	1	200600600	NA	NA	Inspektionslucka sats / Inspection cover kit
28	1	NA	200600601		Lucka med fläkt sats / Cover with fan kit.
29	1	200600660			Motorsvep komplett / Motor cover complete
30	1	200600607			Motortopp sats / Motor top set
31	1	200500036			Vagn / Wagon
32	1m	1332040			Slang / Hose
33	1	5352002	5352004	5352003	Sidokanal fläkt / Side Channel blower
34	2	200600608			Länkhjul sats / Wheel kit
35	1	200600609			Skruv sats / Screw kit motor cover
36	2	200600610			Hjul sats / Wheel kit
37	1	200600618			Fitersats / Filter kit
38	1	200600612			Filter sträckare / Filter stretcher

www.htc-sweden.com

HTC Sweden AB
P.O. Box 69
SE-614 22
Söderköping - Sweden
Tel: +46(0)121-294 00
Fax: +46(0)121-152 12
www.htc-sweden.com

ANVÄNDARHANDBOK
OPERATION INSTRUCTIONS

HTC 24C

HTC 55C

Table of contents

HTC 24C / 55C Manual (SV) 2
HTC 24C / 55C Manual (EN) 5
HTC 24C / 55C Teknisk data / Technical performance 8
HTC 24C Exploded view 9
HTC 24C Spare part list 10
HTC 55C Assemble instruction 11
HTC 55C Exploded view 13
HTC Spare part list 14

HTC 24C / 55C Manual (SV)

STUDERA DENNA MANUAL NOGA FÖRE ANVÄNDNING OCH GE AKT PÅ SAMTLIGA ANVISNINGAR, SPECIELLT SÄKERHETEN.

DENNA MANUAL ÄR INGEN REPARATIONSHANDBOK.

1. SÄKERHETSINSTRUKTION

VARNING: Denna utrustning kan innehålla hälsofarligt damm. I sådant fall får tömnings- och skötselarbete, inklusive avlägsnande av dammuppsamlingsbehållare, endast göras av fackmän, som bär lämplig skyddsutrustning. Får icke användas utan fullständigt filtersystem.

1.2 MILJÖN

- Utsätt inte maskinen för väta. Får ej användas i fuktiga och våta utrymmen eller i närheten av lättantändliga vätskor eller gaser.

1.3 ÖVRIG OMSORG

- Tänk på att efter användning hänga upp slangar.
- Kontrollera alltid att maskinen är oskadad innan användning. Skador måste först åtgärdas av behörig personal.

1.4 FARLIGT DAMM

- Vid hantering av uppsuget stoft skall andningsskydd, skyddsglasögon och handskar användas.
- Kontrollera också de lokala miljö- och hälsoföreskrifterna.
- Ej tillåtet att suga vätskor eller explosiva gaser och ångor.

1.5 SUGSKADOR

- Sugöppning får aldrig appliceras mot bar hud eftersom det höga vakuumet kan förorsaka bristningar i blodkärl då föravskiljaren är ansluten till industrisugare.

2. MASKINFUNKTION

Maskinen är avsedd för avskiljning av större damm partiklar.

Föravskiljaren måste alltid vara ansluten till en sugare med rätt effekt. När sugaren startas sugs stoftblandad luft in med stor hastighet, via sugslang, genom inloppet. I cyklonen dämpas hastigheten varvid det grövre stoftet avskiljs, dels genom centrifugalkraft och dels genom sin egenvikt. Luft och restpartiklar lyfts sedan genom cyklonen och upp genom cyklontoppen. Denna luftblandning går nu vidare till Sugaren.

Det avskiljda stoftet samlas i cyklonen tills maskinen stängs av, och faller då genom bottenluckan ner i uppsamlingspåsen.

3. SERVICE

- **Vid rengöring och service av maskinen får den ej var ansluten till någon sugare.**
- Undvik rengöring med hjälp av högtryckstvätt. Om detta är nödvändigt, se till att ej rikta strålen mot maskinens öppningar,
- Innan den använda maskinen flyttas från arbetsområdet, skall den rensugas eller avtvättas. Dessutom skall sugslangen demonteras.
- All övrig utrustning måste anses förorenat och skall behandlas därefter.
- Om möjligt skall ett avskiljt anpassat rum användas.
- Lämplig personlig skyddsutrustning skall användas.
- Alla förorenade delar, som vid skötsel- eller reparationsarbete ej kan rengöras tillfredsställande, måste omhändertas i tätt förslutbara påsar för omhändertagande enligt gällande bestämmelser.
- Om maskinen skall användas för annan användning, är det mycket viktigt att maskinen saneras ordentligt så, att hälsofarligt damm ej sprids vidare.

4. TILLBEHÖR

ART.NR	**BENÄMNING**
1376013	Longopack uppsamlingspåse.

Övriga tillbehör och reservdelar enligt bifogade sprängskisser.

7. GARANTI

På samtliga Pullman sugare med tillbehör gäller 12 månaders fabriksgaranti avseende material- och tillverkningsfel.

Ingrepp i sugaren får ej ske utan tillverkarens godkännande. Garantin omfattar ej fel som uppstått genom normalt slitage, ovarsamhet, felaktig användning, obehörigt ingrepp eller att sugaren kopplats till felaktig spänning.

Vid reklamation skall sugaren eller överenskommen del därav returneras till oss eller vårt ombud för garantiundersökning och för eventuell garantireparation eller utbyte.

8.FELSÖKNING

HTC 24C och HTC 55C är konstruerade och anpassade för en krävande miljö och uppgift, men användaren bör dock beakta att aggregaten innehåller precisionstillverkade komponenter som bör skyddas mot hårda slag och stötar. Tätningar, infästningar och anslutningar är omsorgsfullt anpassade och utvalda för operatörens arbetsmiljö. Det är därför naturligtvis av stor vikt att operatör och servicepersonal behandlar aggregatet med insikt och kunskap, detta för att maskinen skall tjäna felfritt för det ändamål den är avsedd för.

Problem	**Orsak**	**Åtgärd**
Logopackpåsen	Packning vis luckan	Byt packning
Sugs upp	kan vara skadad	Rensa eller byt filter
	Motorkåpan dåligt	Justera
	monterad	
	Stoft har fastnat i	Rensa cyklonen. OBS!
	i cyklonens lucka	Skyddsutrustning!
	Packningar defekta	Byt aktuell packning

HTC 24C / 55C Manual (EN)

PLEASE READ THIS MANUAL CAREFULLY BEFORE ASSEMBLING AND FOLLOW ALL INSTRUCTIONS, ESPECIALLY SAFETY.

THIS MANUAL IS NOT A REPAIR GIUDE.

SAFETY INSTRUCTIONS

WARNING: This equipment contents hazardous dust. Only authorised persons may empty and maintanance the equipment, inclusive removing the plastic bag and filter.

Proper personnel protective equipment must be used.

1.2. ENVIRONMENT

- May never be used in wet spaces or near toxic or explosive gases or liquids.

1.3 CARE

- Always tidy away hoses after use to prevent accidents.
- Ensure that the machine is undamaged before using. Any damage has to be measured.

1.4 HAZARDOUS DUST

- Face masks, safety goggles and gloves must be worn when changing bags and/or filter.
- Check local health- and safety regulations.
- Not permitted to suck liquids or explosive gases.

1.5 SUCTION INJURIES

- Never place the suction piece against bare skin as the pressure can cause burst blood vessels when pre-separator is attached to a vacuum cleaner.

2. OPERATING

The machine is ment for pre-separating dry, not combustive dust.

The pre-separator must be attached to a vacuum cleaner with right effect. When the vacuum cleaner is started the dust laden air is then sucked through the inlet valve at high speed via the suction hose. The air is slowed down by the cyclone and coarse dust particles are separated out, partly by centrifugal force and partly by gravity. Air and finer particles then lift through the tank and thru the hoses attached to the vacuum cleaner.

The separated dust accumulates in the cyclone until the vacuum cleaner is switched off, when it drops through the bottom flap into the plastic bag.

3. SERVICE

When cleaning and servicing the machine, You must switch off the machine and pull out the plug from the outlet.

- Avoid cleaning with high pressure cleaner. If necessary do not point at the openings on the machine, especially the opening for the cooling air.
- Before moving the machine from the working area, the machine must be cleaned. Furthermore must the inlet be locked with the expanding plug attached.
- All other equipment must be regarded contaminated and be treated thereafter.
- If possible use a special suitable room.
- Proper personnel protective equipment must be used.
- All parts after service, which are contaminated, must be taken core of in a proper way in plastic bags according to all regulations.
- If the vacuum cleaner has to be used for other purposes, it is extremely important that the vacuum cleaner will be cleaned, to avoid spreading of hazardous dust.

4. ACCESSORIES

PART.NO.	DESCRIPTION
1376013	Longopack plastic bag

Other spare parts, see enclosed spare parts list.

5. WARRANTY

All Pullman suction devises and accessories have a 12-month factory warranty for material and manufacturing defects. Do not attempt to repair the suction apparatus without the consent of the manufacture.

The warranty does not cover defects which are the result of normal wear and tear, negligence, defective use, unauthorised repair or the suction apparatus being connected to the incorrect voltage.

In the event of any complaint, the suction apparatus or an agreed part of it must be returned to us or our authorised representative for warranty examination and for any warranty repair or replacement.

6. PROBLEM SOLVING

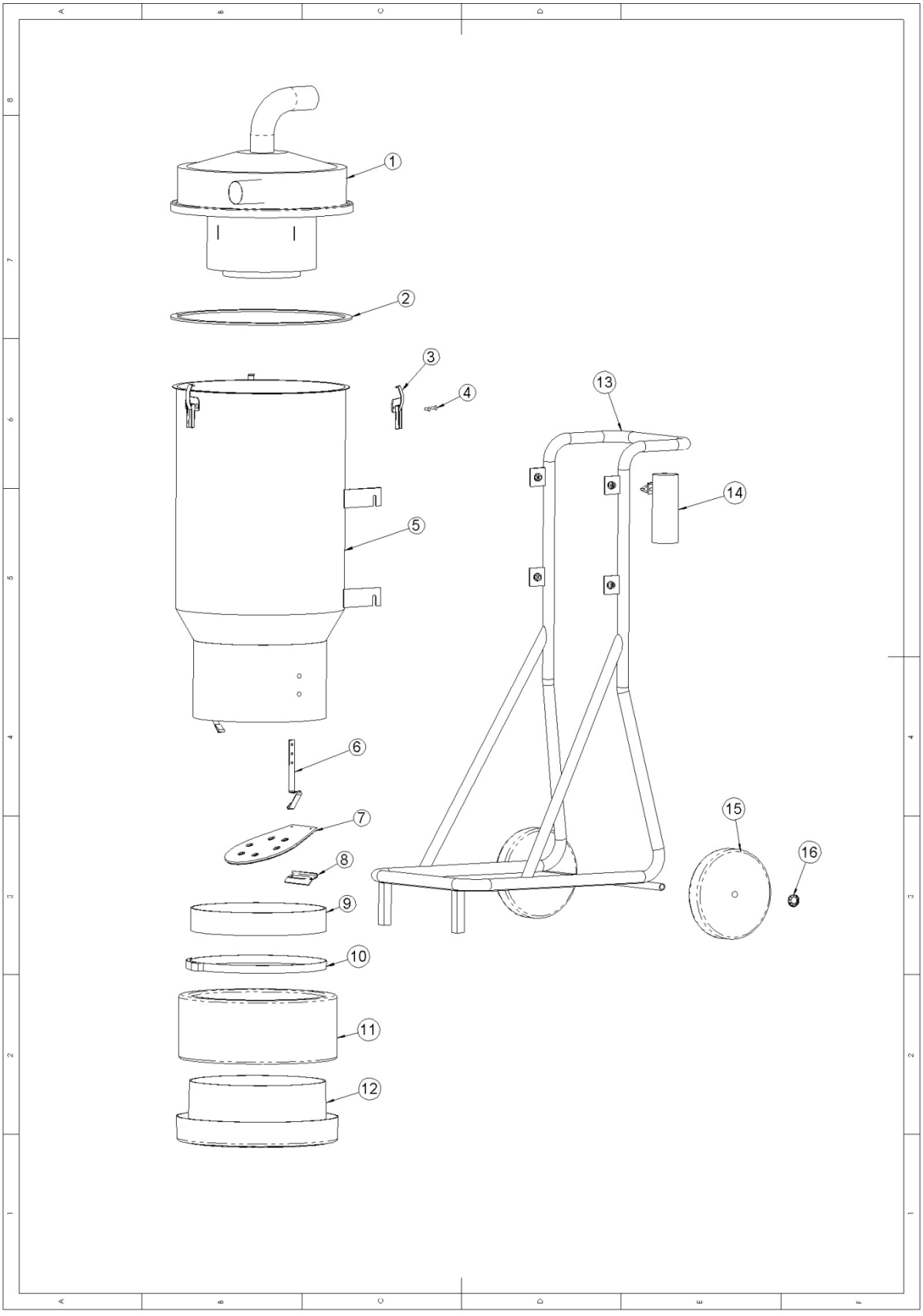
HTC 24C and HTC 55C is manufactured and made for a severe environment and tasks, but the user must notice that the machine contents of components which must be protected from hits and blows. Sealing connections are carefully chosen for the environment of the operator. Therefore must the machine be treated with knowledge as to work correctly for many years.

Problem	**Cause**	**Procedure**
Poor suction	Damage on the hose	Change hose
	Top cover loose	Adjust
	Dirt in the flap	Clean the flap.
		Use protective equipment
	Defect sealings	Change current sealing

HTC 24C / 55C Teknisk data / Technical performance

	HTC 24C	HTC 55C
SUGSLANG – HOSE	2.5m x Ø 50 mm	10m x ∅ 76mm
INLOPPSRÖR - INLET	Ø 50mm	∅ 76mm
DIMENSION HxBxL	1430x500x700 mm	1975x740x850 mm
VIKT - WEIGHT	22 kg	67 kg

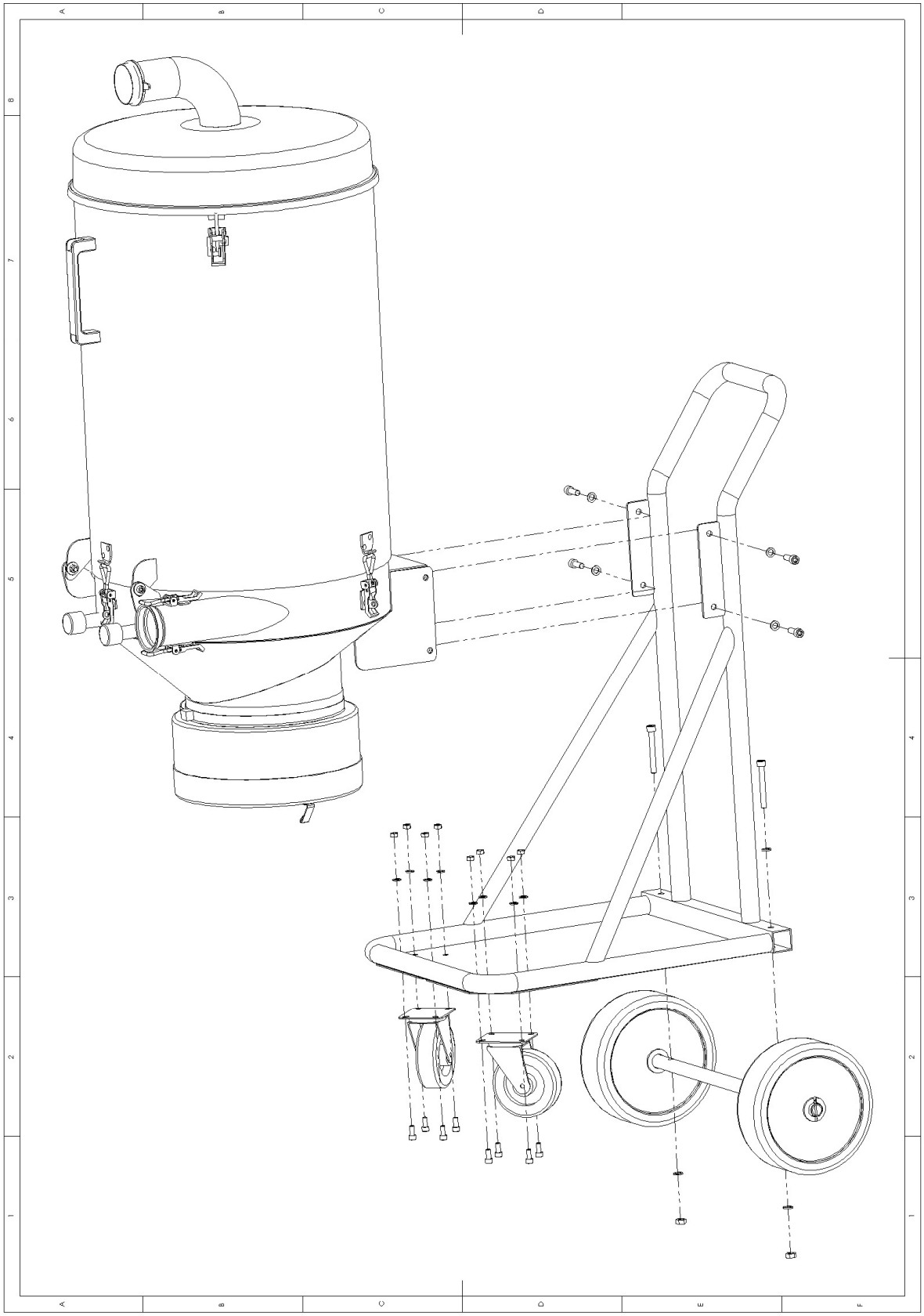
HTC 24C Exploded view



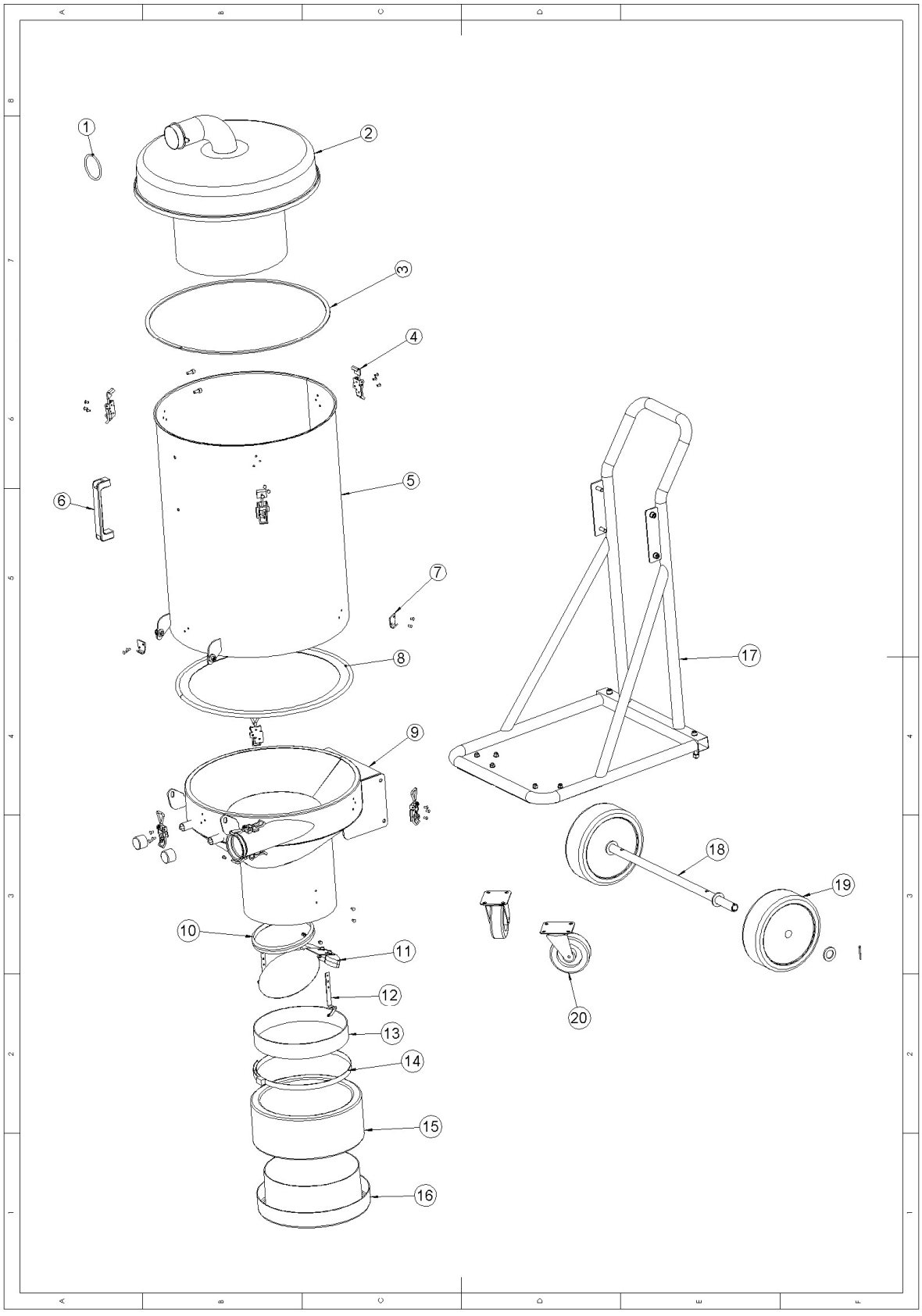
HTC 24C Spare part list

No.	Description	Part no	Qty
1	24C TOP PART	DISCONTINUED	
2	SEALING STRIP TUBE FILTER	11331	1
3	CLAMP	DISCONTINUED	
4	POP RIVET	310449	6
5	CYCLON	DISCONTINUED	
6	LONGOPAC FIXING	10100	2
7	FLAP FOR HTC 26D	591851201	1
8	WEIGHT	DISCONTINUED	
9	ANTI-SLIP	591729601	1
10	BELT	11086	1
11	LONGOPAC	593446401	1
12	LONGOPAC HOLDER	591847501	1
13	CHASSIS	DISCONTINUED	
14	STRIPE HOLDER	DISCONTINUED	
15	WHEEL	DISCONTINUED	
16	LOCKING WASHER	DISCONTINUED	

HTC 55C Assemble instruction



HTC 55C Exploded view



HTC Spare part list

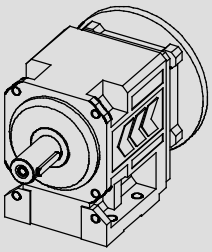
No.	Description	Part no	Qty
1	O-RING 76MM	593377401	1
2	55C TOP PART	DISCONTINUED	1
3	GASKET	DISCONTINUED	1
4	EXCENTRIC LOCK	DISCONTINUED	4
5	CYCLON	DISCONTINUED	1
6	HANDLE	DISCONTINUED	1
7	EXCENTRIC LOCK HOOK	DISCONTINUED	4
8	SEAL RING HTC 55C	11329	1
9	BOTTOM CONE	DISCONTINUED	1
10	V-RING	11220	1
11	WEIGHT	DISCONTINUED	1
12	LONGOPAC FIXING	10100	2
13	ANTI-SLIP, RUBBER	591729601	1
14	BELT HTC 26D	11086	1
15	LONGOPAC	593446401	1
16	LONGOPAC HOLDER	591847501	1
17	CHASSIS	DISCONTINUED	1
18	WHEEL AXEL	DISCONTINUED	1
19	WHEEL	DISCONTINUED	2
20	SWIVELING CASTER	DISCONTINUED	2

Drift- och underhållsmanual

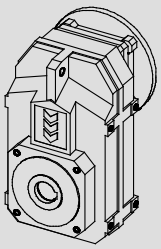
Explosionsskyddade drifter enligt direktiv 94/9/EG

Operating and maintenance manual

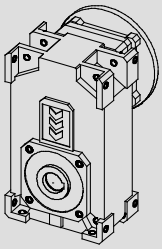
Explosion-Protected Drives Complying with Directive 94/9/EC



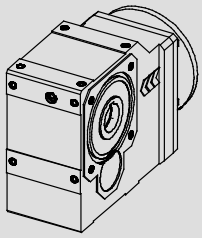
MAS – HU
Rak kuggväxelenhet
Helical gear units



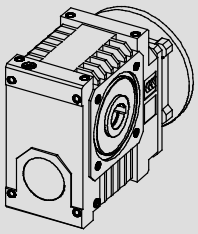
MAS – ASA
Tappväxelenhet
Shaft mounted gear units



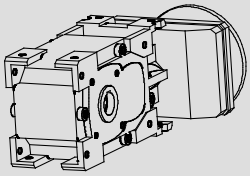
MAS – FUA
Parallellaxelväxelenhet
Parallel shaft gear units



MAS – KUA
Vinkelkuggväxelenhet
Helical bevel gear units



MAS – SUA
Kuggsnäckväxelenhet
Helical worm gear units



MAS – CSA
Vinkelkuggväxelenhet "Klassisk"
Angle parallel shaft gear units

MAS –Växelenheter
MAS –Gear units

BA04 MAS ATEX
08/2008
Svenska – English
Version 20111125

watt drive
the system drive.

	Innehållsförteckning	Sida
1.	**Information**	
1.1	Generell information	3
1.2	Säkerhets- och informationsmärkning	3
2.	**Säkerhetsinformation**	
2.1	Generell säkerhetsinformation, transport	4
2.2	Säkerhetsinformation för användning i områden där potentiell explosion kan uppstå	4 5
2.3	Checklista	
3.	**Växelenhetens konstruktion**	
3.1	Principkonstruktion – Rak kuggväxelenhet	7
3.2	Principkonstruktion - Tappväxelenhet	8
3.3	Principkonstruktion – Parallellaxelväxelenhet	9
3.4	Principkonstruktion - Kuggsnäckväxelenhet	10
3.5	Principkonstruktion - Vinkelkuggväxelenhet	11
3.6	Principkonstruktion - Vinkelkuggv. enh. "Klassisk"	12
3.7	Typ skylt, enhetsbenämning	13
4.	**Mekanisk installation**	
4.1	Förvaring	14
4.2	Förarbeten	15
4.3	Uppsättning av växelenheten	15
4.4	Växelenheter med solid axel	17
4.5	Montage och demontage av växelenh. m hålaxel	18
4.6	Montage och demontage av klämkoppling	19
4.7	Montage och demontage av skyddskåpa	21
4.8	Montage av std. motorer på IEC adapter	21
4.9	Montage av std. motorer på SERVO adapter	22
4.10	Montage av momentstag	24
5.	**Idrifttagande**	
5.1	Oljenivå i växelenheten vid leverans	25
5.2	Temperaturmätning	25
5.3	Kontroll av växelenheten	26
5.4	Drifttagning av växelenheter/växelmotorer i EX miljö	26
6.	**Inspektion och underhåll**	
6.1	Inspektion och underhållsintervaller	27
6.2	Inspektion och underhållsarbete på växelenheten	28
7.	**Driftstörningar**	
7.1	Driftstörningar på växelenheten	28
8.	**Tabell med åtdragningsmoment**	29
9.	**Smörjmedel**	29
10.	**Monteringslägen och smörjmedelsmängd**	
10.1	Rak kuggväxelenhet	30
10.2	Enstegs kuggväxelenhet	31
10.3	Tappväxelenhet	32
10.4	Parallellaxelväxelenhet	33
10.5	Vinkelkuggväxelenhet	34
10.6	Vinkelkuggväxelenhet "Klassik"	35
10.7	Kuggsnäckväxelenhet	36
10.8	Oljenivå kontroll på växlar med oljenivåplugg och vertikal montering	37
11.	**Tillverkardeklaration**	
11.1	Drifter enligt Kategori I M2	37
11.2	Drifter enligt Kategori II 2G och II 2D	39
11.3	Drifter enligt Kategori II 3G och II 3D	41
12.	**WATT DRIVE Partner**	42

	Contents	Page
1.	**Information**	
1.1	General information	3
1.2	Safety and information markings	3
2.	**Safety information**	
2.1	General safety information, transport	4
2.2	Safety information for use in areas where explosions can potentially occur	4
2.3	Check lists	5
3.	**Gear unit construction**	
3.1	Basic design principles helical gear unit	7
3.2	Basic design prin. Shaft mounted gear unit	8
3.3	Basic design prin. Parallel shaft gear unit	9
3.4	Basic design prin. Helical worm gear unit	10
3.5	Basic design prin. Helical bevel gear units	11
3.6	Basic d. prin. Angle parallel shaft gear unit	12
3.7	Nameplate, unit designation	13
4.	**Mechanical installation**	
4.1	Bearing system	14
4.2	Preparatory work	15
4.3	Setting up the gear unit	15
4.4	Gear unit with solid shaft	17
4.5	Installation and removal of hollow-shaft gear unit	18
4.6	Installation and removal of shrink disc	19
4.7	Installation and removal of protection cap	21
4.8	Install. of stand. Motors on the IEC adaptors	21
4.9	Install. of stand. Motors on the SERVO adaptors	22
4.10	Installation of torque arms	24
5.	**Start up**	
5.1	Oil level in the gear unit as delivered	25
5.2	Temperature measurement	25
5.3	Inspecting the gear unit	26
5.4	Starting the gear unit / gear motors in explosion areas	26
6.	**Inspection and maintenance**	
6.1	Inspection and maintenance intervals	27
6.2	Inspection and maintenance work on gear u.	28
7.	**Malfunctions**	
7.1	Malfunctions on the gear unit	28
8.	**Table of Tightening torques**	29
9.	**Lubricants**	29
10.	**Mounting positions and lubricant capacity**	
10.1	Helical gear unit	30
10.2	Single stage helical gear unit	31
10.3	Shaft mounted gear unit	32
10.4	Parallel shaft gear unit	33
10.5	Helical bevel gear units	34
10.6	Angle parallel shaft gear unit	35
10.7	Helical worm gear unit	36
10.8	Oil level control of gear units with oil level plug at vertical mounting position	37
11.	**Declaration of conformity**	
11.1	Gear units of category I M2	37
11.2	Gear units of category II 2G and II	39
11.3	Gear units of category II 3G and II 3D	41
12.	**WATT DRIVE Partner**	42

1. Information

1.1 Generell Information

Denna Drift- och Skötselinstruktion (DS) är en del av den växelenhet som är levererad och ni måste läsa den innan ni startar arbetet med växel enheten. Instruktionerna i DS måste följas. Förvara denna DS i växelenhetens närhet.

OBS: Vi åtar oss inget ansvar för skador eller driftstörningar orsakade p.g.a. att man ignorerat denna DS.

I egenskap att vidareutveckla produkterna, reserverar sig Watt Drive för att göra förändringar av särskilda komponenter eller monteringar som förbättrar produkten, medan man bibehåller dess huvudsakliga karakteristik.

Avsedd användning:
Drivenheterna/drivmotorerna är avsedda för kommersiella system, och ska endast användas i enlighet med den bifogade informationen i Watt Drives tekniska dokumentation. De följer gångbara standarder och specifikationer och även de krav, som är enligt Direktiv 94/9/EG.

De explosionsskyddade växelenheterna av serien

- **H**... Rak kuggväxelenhet
- **A**... Tappväxelenhet
- **F**... Parallellaxelväxelenhet
- **S**... Kuggsnäckväxelenhet
- **K**... Vinkelväxelenhet
- **C**... Vinkelväxelenhet "Klassisk“

enligt följande bygg/design föreskrifter:
Utrustningsgrupp I, Kategori M2 och
Utrustningsgrupp II, Kategori 2G (Ex-atmosfär Gas) och 2D (Ex-atmosfär Damm).

Växelenhet
- K.. 40.,
- H.. 41E,
- H.. 51E

Skall inte användas i områden där det finns risk för explosioner.

1.2 Säkerhets- och informationsmärkning

Alla säkerhets- och varningsinstruktioner måste följas utan undantag!

!!	Varning för **elektrisk fara**, t.ex. arbete under spänningssatt maskin. Varning för **mekanisk fara**, t.ex. arbete med lyftanordningar.
S	Viktiga instruktioner för **säkerhet** och **störningsfri drift**.
E	Viktiga instruktioner om **explosionsskydd**.

1. Information

1.1 General information

These Operating Instructions (OI) are part of the gear unit as supplied, and you must read them before you work with the gear unit. The instructions in the OI must be followed. Keep the OI close to the gear unit.

Note: We assume no liability for damages or disruptions of operations resulting from the failure to observe this OI.

In order to develop the product further, Watt Drive reserves the right to make modifications to the individual components or assemblies that it believes to be useful to improve the product, while maintaining its essential characteristics.

Use as intended:
The drive units / drive motors are intended for commercial systems, and may only be used in accordance with the information provided in the Watt Drive technical documentation. They meet valid standards and specifications as well as the requirements set forth in Directive 94/9/EC.

The explosion-protected gear units of series

- **H**... Helical gear unit
- **A**... Shaft mounted gear unit
- **F**... Parallel shaft gear unit
- **S**... Helical worm gear unit
- **K**... Helical bevel gear units
- **C**... Angle parallel shaft gear unit

meet the design specifications of:
Equipment group 1, Category M2 and
Equipment group II, Category 2 G (ex atmospheres gas) and 2D (ex atmospheres dust).

The gear unit
- K.. 40.,
- H.. 41E,
- H.. 51E

Must not be used in areas where there is a risk of explosions.

1.2 Safety and information markings

All safety and warning instructions must be followed without exception!

!!	Warning of **electrical danger**, e.g. working with live machines. Warning of **mechanical danger**, e.g. working with hoisting equipment.
S	Important instructions for **safe, trouble-free operation**.
E	Important information on **explosion protection**.

2. Säkerhetsinformation

2.1 Generell säkerhetsinformation, transport

Vid leverans, måste enheten kontrolleras så att inga skador har uppstått under transporten. Om det konstaterats en skada, kan det vara nödvändigt att se till så att enheten inte tas i drift.

Kunden är ansvarig att se till så att driften monteras enligt god ingenjörs praxis.
Instruktionerna i denna Drift- och Skötselmanual måste följas för att uppfylla de angivna egenskaperna hos driv-enheten och om eventuella garantianspråk ska godkännas.

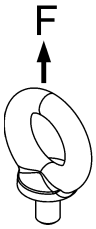
Se till att Ni aldrig tar en skadad produkt i drift!

Läs denna Drift och Skötsel instruktion noga innan ni påbörjar montage, installation eller underhållsarbete.

Lyftöglan som används (ingår i levererade enheter fr.o.m. växel enhet storlek 110) uppfyller DIN 580; de innehållande kraven måste tas i beaktande.
Lyftöglorna måste vara ordentligt fastskruvade. Dom är dimensionerade för att klara av växelenhetens egenvikt och även för växelmotorns vikt.
Ingen ytterligare last kan appliceras.

Gänga	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
m [kg]	140	230	340	700	1200	1800	3600

Massan m [kg] motsvarar maximal anvisad last i riktning F för bultens axel.



2. Safety information

2.1 General safety information, transport

After being delivered, the unit must be inspected for any damage that may have occurred during transport. If the unit's condition warrants, it may be necessary to take action to prevent the unit from being put into operation.

The customer is responsible for setting up the drive in accordance with good engineering practices.
The instructions in these Operation Instructions must be followed to achieve the confirmed characteristics of the drive units and if any warranty claims are to be met.

Make certain that you never put damaged products into operation!

Read these Operating Instructions carefully before you begin any setup, installation, or maintenance work.

The ring bolts that are used (contained in the items supplied beginning with gear unit size 110) comply with DIN 580; the requirements contained therein must be observed.
The ring bolts must be securely tightened. They are designed to hold the gear unit's own weight and that of the gear motor.
No additional loads may be applied.

Thread	**M8**	**M10**	**M12**	**M16**	**M20**	**M24**	**M30**
m [kg]	140	230	340	700	1200	1800	3600

The mass m [kg] corresponds to the maximum dependent load in tension in direction F of the bolt axis.

2.2 Säkerhetsinformation för användning i områden där potentiell explosion kan uppstå

E Användning av växelenhet/växelmotorer i gas-blandningar eller dammansamlingar kan, i kombination med värme, lastlager och rörliga delar, orsaka explosion, vilket kan resultera i dödsfall eller allvarlig skada.

Installation, uppstart, underhåll och reparationsarbete på växelenheten/växelmotorn, så även för elektrisk kringutrustning, får endast utföras av kvalificerad teknisk personal, iakttagande av följande punkter:

- Drift- och Skötselinstruktioner
- Märkskylten på växelenheten/växelmotorn
- Alla övriga projektunderlag, monteringsmanualer, drift- manualer
- Driftspecifika specifikationer och krav gällande för driv- enheten
- Gällande nationella/regionala regler (explosions-förebyggande, säkerhet, olycksfallsförebyggande)

Ingen explosiv atmosfär får finnas närvarande när arbete skall utföras, så som transport, lagring, uppmontering, elektrisk anslutning, uppstart, underhåll och reparation.

2.2 Safety information for use in areas where explosions can potentially occur

E The use of gear units/gear motors in gas mixtures or dust concentrations that are capable of exploding in combination with hot, load bearing and moving parts, can result in death or serious injury.

Installation, start up, maintenance and repair work on the gear unit / gear motor as well as on electrical accessory equipment may only be performed by qualified technical personnel, taking the following items into account:

- Operating Instructions
- Information labels/tags on the gear unit / gear motor
- All other project documents, setup manuals, operating manuals
- Drive-specific specifications and requirements belonging to the drive unit
- Valid national/regional regulations (explosion prevention, safety, accident prevention)

No explosive atmospheres may be present when any work is performed, such as transport, placing in storage, setup, electrical connection, start up, maintenance and repair.

Uppgifter som transport, placering i lager, uppsättning, elektrisk anslutning, uppstart, underhåll, reparationer får endast utföras av kvalificerad personal.

Montage- och underhållsarbeten får endast utföras när växelenheten är avstängd. Det får inte finnas någon last på driften och åtgärder måste vidtagas för att förhindra att driften ofrivilligt kopplas på.

En drivmotor kopplad till drivenheten får endast användas under de förhållanden som anges i avsnittet "Start av växelenhet/växelmotor i Ex-områden“.

Användningen av drivenheten via frekvensomriktare får endast förekomma om det är angivet på drivenhetens märkskyllt.

Activities such as transport, placing in storage, setup, electrical connection, start up, maintenance, repair may only be performed by qualified specialists.

Installation and maintenance work may only be performed when the gear units are shut down. There must be no load on the drive and steps must be taken to prevent units from being actually turned on.

A drive motor connected to the drive unit may only be operated under the conditions set forth in the section on "Starting up Gear Units / Gear Motors in the Ex Area."

Operation of the drive unit by means of a frequency inverter may only occur if the specifications shown on the drive unit nameplate have been carried out.

2.3 Checklista

E **Kontrollera följande innan uppstart i en potentiell explosionsmiljö:**

2.3 Check lists

E **Check the following before starting up in a potential explosion area:**

	Information se kapitel	Utförd
Undersök leveransen omedelbart vid mottagandet efter eventuella transportskador. I vissa fall är det inte rekommendabelt att starta enheten. Ta bort eventuella transportsäkringar innan uppstart.	2.1	
Stämmer de angivna uppgifterna på typskylten för växelenheten med de lokala Ex-användnings-området överens? – Redskapsgrupp – Ex-kategori – Atmosfär – Temperaturklass – Maximal yttemperatur	3.7	
Är det säkerställt att ingen omgivande explosionsbenägen atmosfär, olja, syra, gas, ånga eller strålning, finns närvarande vid installationen av växelenheten?	2.2	
Är det säkerställt att växelenheten är tillräckligt ventilerad och att ingen utomstående värmekälla kan överföras till enheten (t.ex. via axelkoppling)? Kylluften får inte överstiga en temperatur på 40 °C .	4.3	
Överensstämmer monteringsläget på typskylten med verkligt monteringsläge?	10	
Är luftpluggen placerad på rätt ställe (i enlighet med monteringsläget)?	10	
Avlägsna luftpluggens transportskydd innan idrifttagning.	4.3	
Har alla ingående och utgående element ett ATEX-godkännande?	4.4	
Har motorn ett motsvarande ATEX-godkännande?	4.8	
Finns det monterat beröringsskydd för roterande delar?	4.7	
I de fall klämkoppling förekommer: har denna kontrollerats?	4.6	
Är alla luftnipplar och ventiler åtkomliga?		

	Information see chapter	checked
Inspect the shipment immediately after it has been received for any transport damages. In some cases it may not be advisable to start up the unit. Remove any transport protection before starting up.	2.1	
Do the data on the nameplate of the drive unit agree with the local explosion usage area on the drive unit nameplate? - Instrument group - Ex-category - Atmosphere - Temperature class - Maximum surface tension	3.7	
Has it been ascertained that no atmosphere is capable of exploding, oils, acid, gases, vapours, or radiation are present when the gear unit is being installed?	2.2	
Has it been ascertained that the gear unit is adequately ventilated and that no outside source of heat can be transferred into the unit (for example via clutches)? The cooling air must not exceed a temperature of 40°C.	4.3	
Does the mounting position on the nameplate correspond to the actual mounting position?	10	
Is the vent plug located at the correct location (in compliance with the installation position)?	10	
Please remove the transportation lock on the breather plug before usage.	4.3	
Do all input and output elements have an ATEX approval?	4.4	
Does the motor have a corresponding ATEX approval?	4.8	
Are guards provided around rotating parts to prevent personnel from coming into contact with them?	4.7	
In the case of a shrink disc version: has the expansion been checked?	4.6	
Are all bleed screws and valves freely accessible?		

E **Under uppstart i en Ex miljö, kontrollera följande:**

E **During start up in an EX area, test the following:**

	Information se kapitel	Utförd
Har en provkörning genomförts?	5.2	
Efter ca 3 timmar, mät yttemperaturen. En skillnad på 60 K från omgivningstemperaturen får ej överskridas, även om yttemperaturen kommer upp till maximala 90°C.	5.2	

	Information see chapter	checked
Has a dry run been performed?	5.2	
After about 3 hours, measure the surface temperature. A difference of 60 K from the ambient temperature must not be exceeded, although the surface temperature may reach 90°C maximum.	5.2	

3. Växelenhetens konstruktion

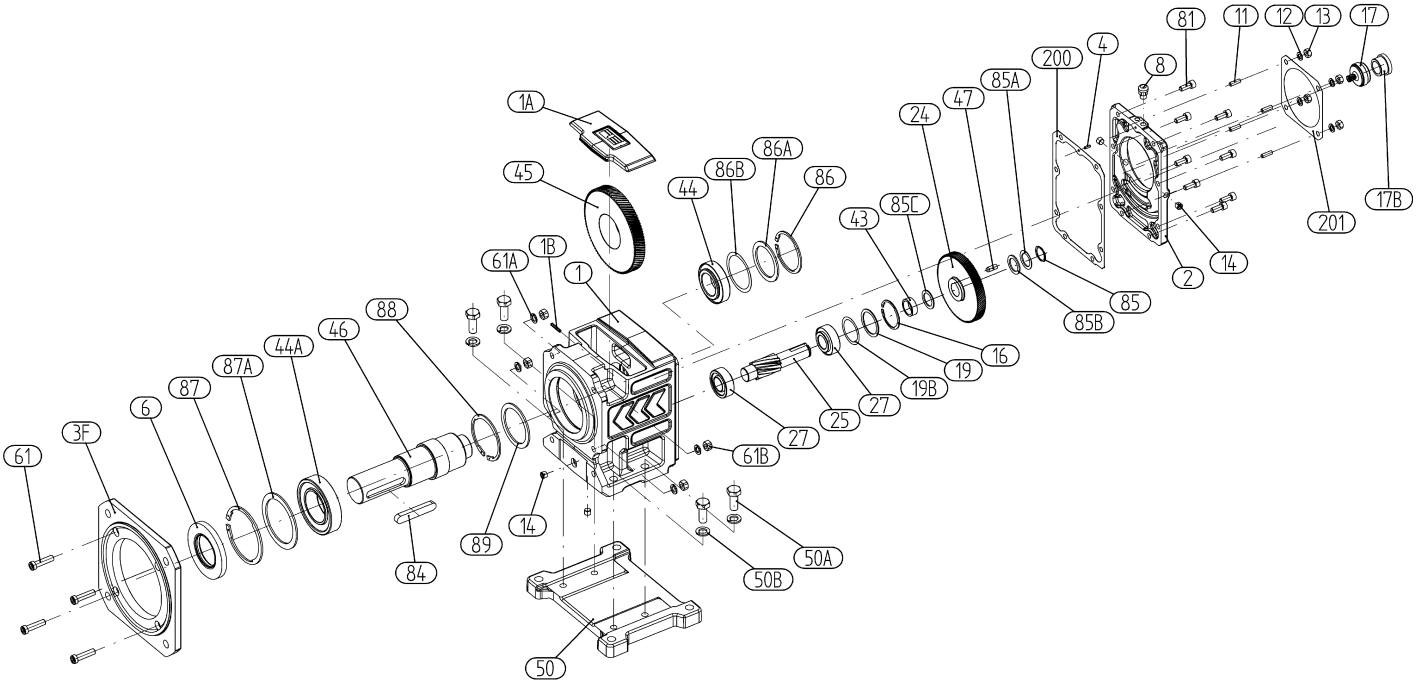
Följande typritningar visar principiellt konstruktionen för de olika serierna i teorin.
Avvikelser från andra växelstorlekar och konstruktionsvariationer är möjliga per växelserie.

3.1 Principkonstruktion – rak kuggväxel typ HU

3. Gear unit construction

The following drawings basically show the construction of the various dry series in theory.
Deviations from other gear unit sizes and design versions are possible per gear unit series.

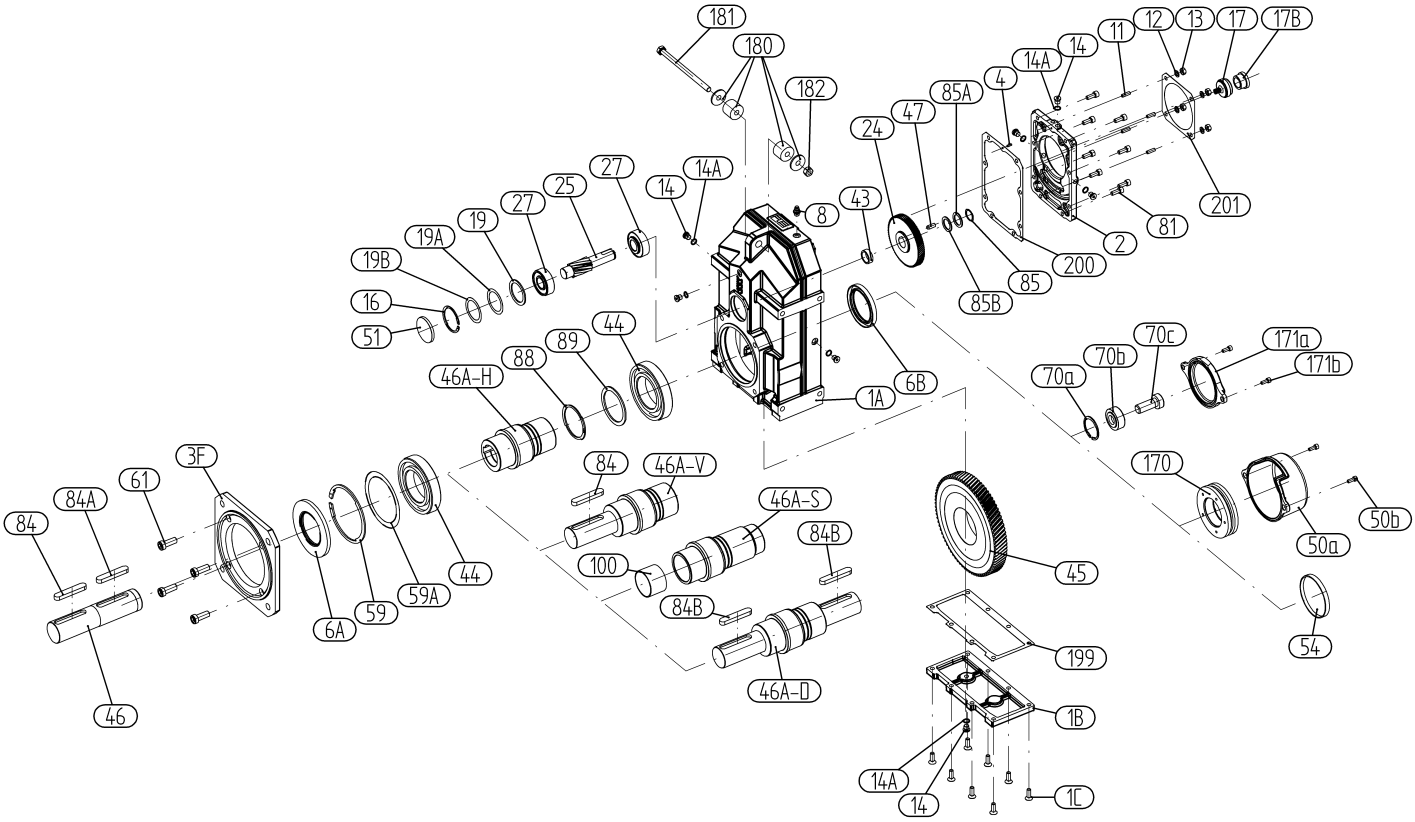
3.1 Basic design principles helical gear unit



1	Växelhus	Gear case	46	Utgående axel	Output shaft
1A	Täcklock	Cover plate	47	Cylindrisk kil	Cylindrical pin
1B	Konisk tapp	Taper pin	50	Fotplatta	Foot plate
2	Motorfläns	Case cover	50A	Sexkants bult	Hexagon head screw
3F	Utgående fläns	Output flange	50B	Fjäder bricka	Spring washer
4	Styrstift	Dowel pin	61	Insexskruv	Socket head cap screw
6	Axeltätning	Shaft seal	61A	Fjäderbricka	Spring washer
8	Luftplugg	Vent plug	61B	Sexkantsmutter	Hexagon nut
11	Pinnbult	Stud bolt	81	Insexskruv	Socket head cap screw
12	Fjäderbricka	Spring washer	84	Kil	Key
13	Sexkantsmutter	Hexagon nut	85	Låsring	Circlip
14	Plugg	Plug	85A	Hållbricka	Supporting ring
16	Låsring	Circlip	85B	Justeringsbricka	Adjusting disc
17	Pinjong (1:a steget)	Module-pinion	85C	Justeringsbricka	Adjusting disc
17B	Axel hylsa	Pinion shaft	86	Låsring	Circlip
19	Hållbricka	Supporting ring	86A	Hållbricka	Supporting ring
19B	Justeringsbricka	Adjusting disc	86B	Justeringsbricka	Adjusting disc
24	Kugghjul	Gear wheel	87	Låsring	Circlip
25	Axelpinjong	Pinion shaft	87A	Hållbricka	Supporting ring
27	Koniska rullager	Taper roller bearing	88	Låsring	Circlip
43	Distansring	Distance sleeve	89	Hållbricka	Supporting ring
44	Koniska rullager	Taper roller bearing	200	Packning	Gasket
44A	Koniska rullager	Taper roller bearing	201	Packning	Gasket
45	Kugghjul slutsteget	Gear wheel end stage			

3.2 Principkonstruktion – tappväxel typ ASA

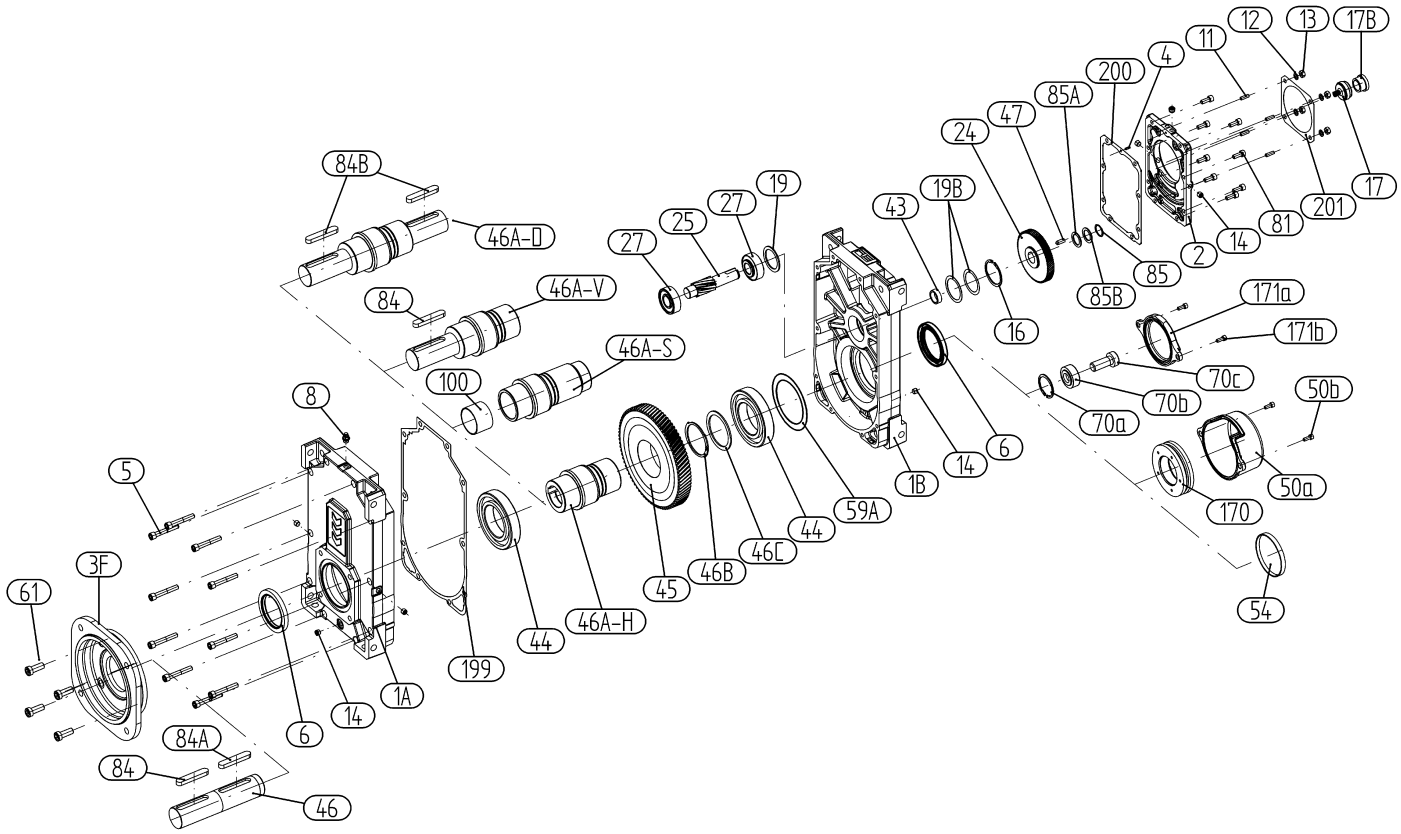
3.2 Basic design principles shaft mounted gear unit



1A	Växelhus	Gear case	46A-D	Dubbel utgående axel	Output shaft on both sides
1B	Täcklock	Cover plate	47	Cylinder kil	Cylindrical pin
1C	Skruvar med försänkta huvud	Countersunk head screw	50a	Skyddskåpa för klämkoppl.	Protection cap for shrink disc
			50b	Insexskruv	Socket head cap screw
2	Motorfläns	Case cover	51	Täckbricka	Cover
3F	Utgående fläns	Output flange	54	Täckbricka	Cover
4	Styrstift	Dowel pin	59	Låsring	Circlip
6A	Axeltätning	Shaft seal	59A	Packningsbricka	Adjusting disc
6B	Axeltäning	Shaft seal	61	Insexskruv	Socket head cap screw
8	Luftplugg	Vent plug	70a	Låsring	Circlip
11	Pinnbult	Stud bolt	70b	Spännhylsa	Tension disc
12	Fjäderbricka	Spring washer	70c	Insexskruva	Socket head cap screw
13	Sexkants mutter	Hexagon nut	81	Insexskruv	Socket head cap screw
14	Plugg	Plug	84	Kil	Key
14A	Packning	Gasket	84A	Kil	Key
16	Låsring	Circlip	84B	Kil	Key
17	Pinjong (1:a steget)	Modul-pinion	85	Låsring	Circlip
17B	Axel hylsa	Pinion shaft	85A	Justeringsbricka	Adjusting disc
19	Hållbricka	Supporting ring	85B	Justeringsbricka	Adjusting disc
19A	Justeringsbricka	Adjusting disc	88	Låsring	Circlip
19B	Justeringsbricka	Adjusting disc	89	Bricka	Supporting ring
24	Kugghjul	Gear wheel	100	Glykordur-Bussning	Glykodur bush
25	Axelpinjong	Pinion shaft	170	Klämkopplingssats	Shrink disc set
27	Koniska rullager	Taper roller bearing	171a	Skyddsåpa för hålaxel	Protection-cap for hollow shaft
43	Distansring	Distance sleeve	171b	Insexskruv	Socket head cap screw
44	Spårkullager	Deep groove ball bearing	180	Gummipufferset	Rubber buffer set
45	Kugghjul slusteg	Gear wheel end stage	181	Sexkantsskruv	Hexagon head cap screw
46	Enkel utgående axel (lös)	Input shaft	182	Mutter	Hexagon nut
46A-H	Hålaxel	Hollow shaft	199	Packning till huset	Case gasket
46A-S	Klämkoppling m. hålaxel	Shrink disc hollow shaft	200	Packning	Gasket
46A-V	Enkel utgående axel	Output shaft	201	Packning	Gasket

3.3 Principkonstruktion – tappväxel typ FUA

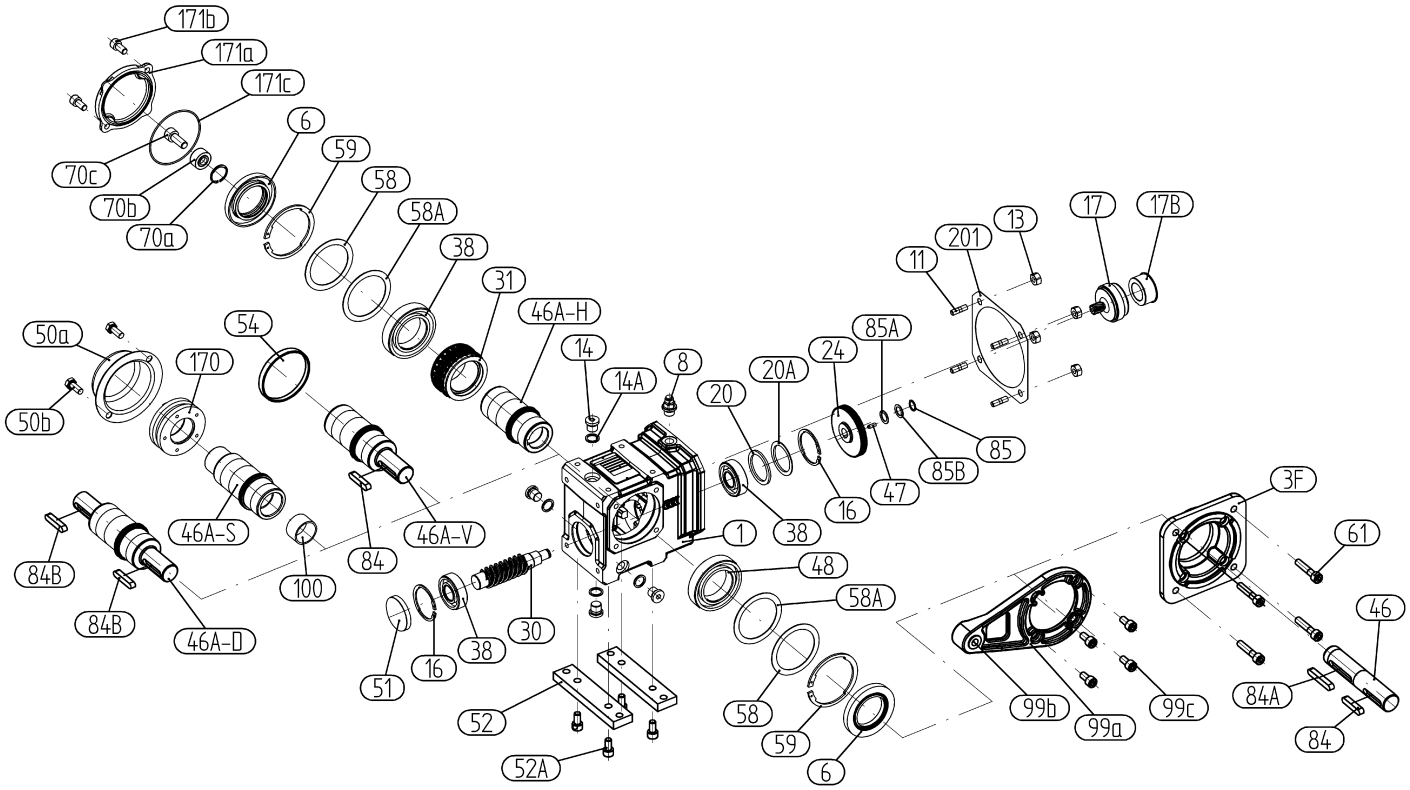
3.3 Basic design principles parallel shaft gear unit



1A	Växelhus	Gear case	46A-V	Enkel utgående axel	Output shaft
1B	Växelhus	Gear case	46A-D	Dubbel utgående axel	Output shaft on both sides
2	Motorfläns	Case cover	46B	Låsring	Circlip
3F	Utgående fläns	Output flange	46C	Bricka	Supporting ring
4	Styrstift	Dowel pin	47	Cylinderkil	Cylindrical pin
5	Insexskruv	Socket head cap screw	50a	Skyddskåpa för klämkoppling	Protection cap for shrink d.
6	Axeltätning	Shaft seal	50b	Insexskruv	Socket head cap screw
8	Luftplugg	Vent plug	54	Tätningslock	Cover
11	Pinnbult	Stud bolt	59A	Packningsbricka	Adjusting disc
12	Fjäderbricka	Spring washer	61	Insexskruv	Socket head cap screw
13	Mutter	Hexagon nut	70a	Låsring	Circlip
14	Plugg	Plug	70b	Spännhylsa	Tension disc
16	Låsring	Circlip	70c	Insexskruv	Socket head cap screw
17	Pinjong 1:a steg	Modul-pinion	81	Insexskruv	Socket head cap screw
17B	Axelhylsa	Pinion shaft	84	Kil	Key
19	Bricka	Supporting ring	84A	Kil	Key
19B	Packningsbricka	Adjusting disc	84B	Kil	Key
24	Kugghjul	Gear wheel	85	Låsring	Circlip
25	Axelhylsa	Pinion shaft	85A	Bricka	Supporting ring
25	Axelhylsa	Pinion shaft	85B	Packningsbricka	Adjusting disc
27	Koniska rullager	Taper roller bearing	86	Packningsbricka	Adjusting disc
43	Distansring	Distance sleeve	100	Glykordur-Bussning	Glykodur bush
44	Spårkullager	Deep groove ball bearing	170	Klämkopplingssats	Shrink disc set
45	Kugghjul slutsteg	Gear wheel end stage	171a	Skyddskåpa för hålaxel	Protection cap for hollow s.
45	Kugghjul slutsteg	Gear wheel end stage	171b	Insexskruv	Socket head cap screw
46	Enkel utgående axel (lös)	Insert shaft	199	Packning till huset	Case gasket
46A-H	Hålaxel	Hollow shaft	200	Packning	Gasket
46A-S	Klämkoppling m. hålaxel.	Shrink disc hollow shaft	201	Packning	Gasket

3.4 Principkonstruktion – Kuggsnäckväxel typ SUA

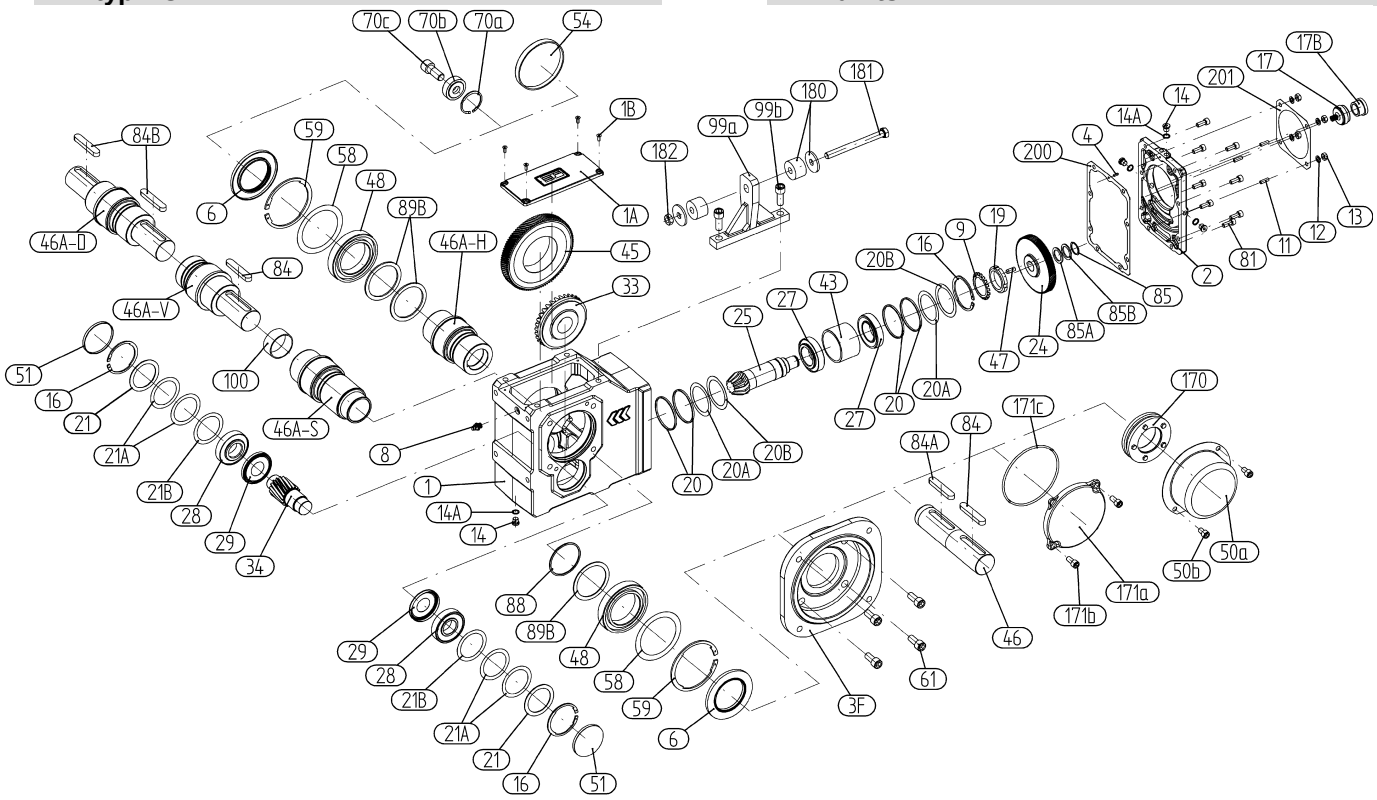
3.4 Basic design principles helical worm gear unit



1	Växelhus	Gear case	51	Tätningslock	Cover
3F	Utgående fläns	Output flange	52	Fotplatta	Foot plate
6	Axeltätning	Shaft seal	52A	Insexskruv	Socket head cap screw
8	Luftplugg	Vent plug	54	Tätningslock	Cover
11	Pinnbult	Stud bolt	58	Packningsbricka	Adjusting disc
13	Mutter	Hexagon nut	58A	Packningsbricka	Adjusting disc
14	Plugg	Plug	59	Låsring	Circlip
14A	Packning	Gasket	61	Insexskruv	Socket head cap screw
16	Låsring	Circlip	70a	Låsring	Circlip
17	Pinjong 1:a steg	Modul-pinion	70b	Spännhylsa	Tension disc
17B	Axelhylsa	Pinion shaft	70c	Insexskruv	Socket head cap screw
20	Bricka	Supporting ring	84	Kil	Key
20A	Packningsbricka	Adjusting disc	84A	Kil	Key
24	Kugghjul	Gear wheel	85	Låsring	Circlip
30	Snäckskruv	Worm shaft	85A	Packningsbricka	Adjusting disc
31	Kugghjul	Worm wheel	85B	Packningsbricka	Adjusting disc
38	Spårkullager	Deep groove ball bearing	99a	Momentarm	Torque arm
46	Enkel utgående axel (lös)	Insert shaft	99b	Flexibel bussning	Flexible bush
46A-D	Dubbel utgående axel	Output shaft on both sides	99c	Insexskruv	Socket head cap screw
46A-H	Hålaxel	Hollow shaft	100	Glykordur-Bussning	Glykodur bush
46A-S	Klämförband m. hålaxel	Shrink disc hollow shaft	170	Klämkopplingssats	Shrink disc set
46A-V	Enkel utgående axel	Output shaft	171a	Skyddskåpa för hålaxel	Protection-cap for hollow s.
47	Cylinderkil	Cylindrical pin	171b	Insexskruv	Socket head cap screw
48	Spårkullager	Deep groove ball bearing	171c	O-rings tätning	O-ring seal
50a	Skyddskåpa för klämkoppling	Protection cap for shrink d.	201	Packning	Gasket
50b	Sexkantsskruv	Hexagon head cap screw			

3.5 Principkonstruktion – Vinkelkuggväxel typ KUA

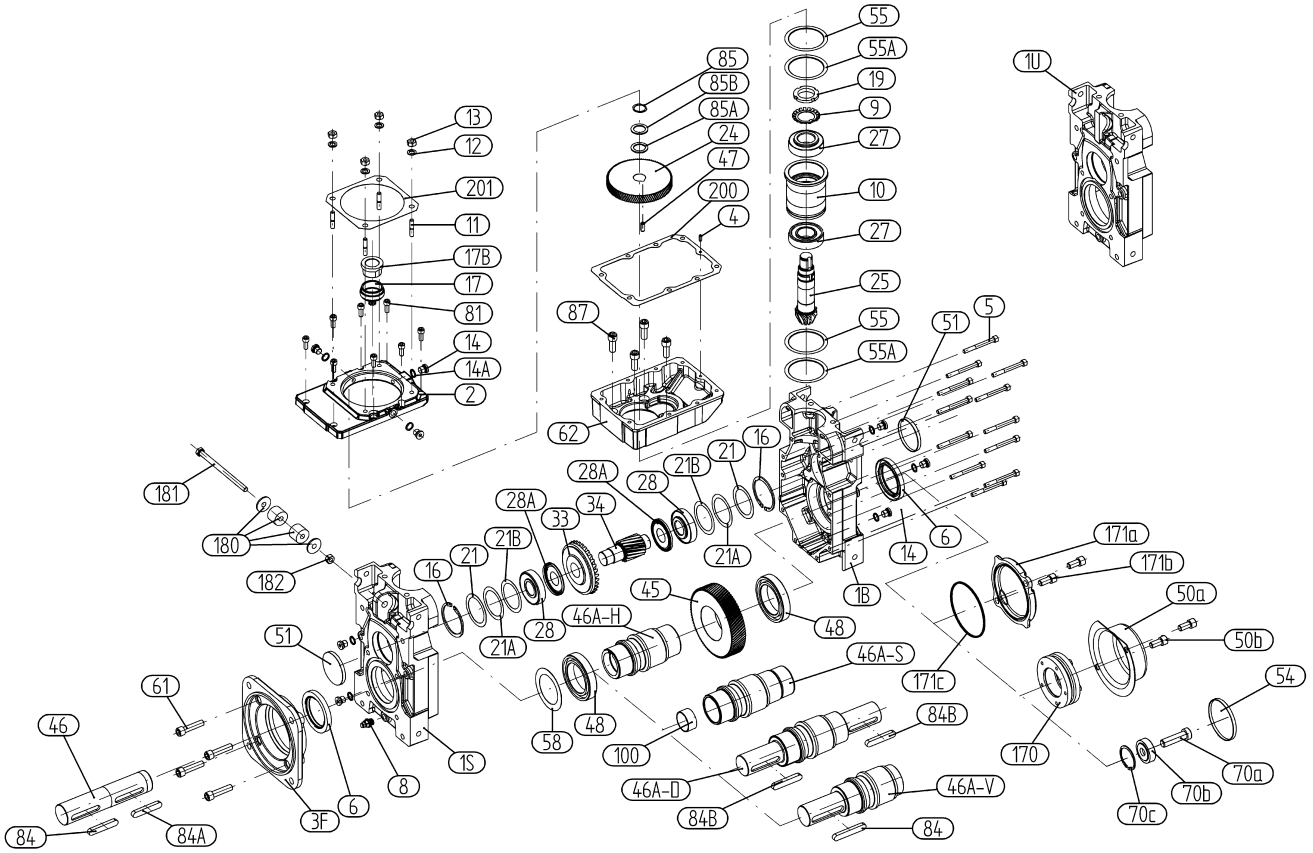
3.5 Basic design principles helical bevel gear units



1	Växelhus	Gear case	46A-V	Enkel utgående axel	Output shaft
1A	Skyddsplatta	Cover plate	46A-D	Dubbel utgående axel	Output shaft on both sides
1B	Försänkta skruvar	Countersunk screw	47	Cylinderkil	Cylindrical pin
2	Motorfläns	Case cover	48	Spårkullager	Deep groove ball bearing
3F	Utgående fläns	Output flange	50a	Skyddskåpa för klämkoppling	Protection cap for shrink d.
4	Styrstift	Dowel pin			
6	Axeltätning	Shaft seal	50b	Sexkantsskruv	Hexagon head cap screw
8	Luftplugg	Vent plug	51	Tätningslock	Cover
9	Låsningsskims	Locking shim	54	Tätningslock	Cover
11	Pinnbult	Stud bolt	58	Packningsbricka	Adjusting disc
12	Fjäderbricka	Spring washer	59	Låsring	Circlip
13	Mutter	Hexagon nut	61	Insexskruv	Socket head cap screw
14	Plugg	Plug	70a	Låsring	Circlip
14A	Packning	Gasket	70b	Spännhylsa	Tension disc
16	Låsring	Circlip	70c	Insexskruv	Socket head cap screw
17	Pinjong 1:a steg	Modul-pinion	81	Insexskruv	Socket head cap screw
17B	Axelhylsa	Pinion shaft	84	Kil	Key
19	Spår mutter	Groove nut	84A	Kil	Key
20	Bricka	Supporting ring	84B	Kil	Key
20A	Packningsbricka	Adjusting disc	85	Låsring	Circlip
20B	Packningsbricka	Adjusting disc	85A	Bricka	Supporting ring
21	Packningsbricka	Adjusting disc	85B	Packningsbricka	Adjusting disc
21A	Packningsbricka	Adjusting disc	88	Låsring	Snap ring
21B	Packningsbricka	Adjusting disc	89B	Bricka	Supporting ring
24	Kugghjul 1a steget	Gear wheel 1st stage	99a	Momentarm	Torque arm
25	Axelhylsa	Bevel gear pinion shaft	99b	Sexkantsskruv	Hexagon head cap screw
27	Koniska rullager	Taper roller bearing	100	Glykordur-Bussning	Glycodur bush
28	Koniska rullager	Taper roller bearing	170	Klämbussningsats	Shrink disc set
29	Nilosring	Nilos-ring	171a	Skyddskåpa för hålaxel	Protection cap for hollow s.
33	Kugghjul	Bevel gear wheel	171b	Insexskruv	Socket head cap screw
34	Axelhylsa	Pinion shaft	171c	O-rings tätning	O-ring seal
43	Distansring	Distance sleeve	180	Gummibussningssats	Rubber buffer set
45	Kugghjul slutsteg	Gear wheel end stage	181	Sexkantsskruv	Hexagon head cap screw
46	Enkel utgående axel (lös)	Insert shaft	182	Mutter	Hexagon nut
46A-H	Hålaxel	Hollow shaft	200	Packning	Gasket
46A-S	Klämkoppling m. hålaxel.	Shrink disc hollow shaft	201	Packning	Gasket

3.6 Principkonstruktion – Vinkelkuggväxel "Klassisk" typ CSA

3.6 Basic design principles angle parallel shaft gear unit



1U	Växelhus – UNIB.	Gear case - UNIBLOCK	46A-V	Enkel utgående axel	Output shaft
1S	Växelhus – SUP.	Gear case - SUPPORT	46A-D	Dubbel utgående axel	Output shaft on both sides
1B	Växelhus	Gear case	47	Cylinderkil	Cylindrical pin
2	Motorfläns	Case cover	48	Spårkullager	Deep groove ball bearing
3F	Utgående fläns	Output flange	50a	Skyddskåpa för klämkoppling	Protection cap for shrink d.
4	Styrstift	Dowel pin	50b	Insexskruv	Socket head cap screw
5	Insexskruv	Socket head cap screw	51	Tätningslock	Cover
6	Axeltätning	Shaft seal	54	Tätningslock	Cover
8	Luftplugg	Vent plug	55	Packningsbricka	Adjusting disc
9	Låsningsskims	Locking shim	55A	Packningsbricka	Adjusting disc
10	Lager säte	Bearing carrier	58	Packningsbricka	Adjusting disc
11	Pinnbult	Stud bolt	61	Insexskruv	Socket head cap screw
12	Fjäderbricka	Spring washer	62	Första stegets växelhus	Primary gear case
13	Mutter	Hexagon nut	70a	Låsring	Circlip
14	Plugg	Plug	70b	Spännhylsa	Tension disc
14A	Dichtring	Gasket	70c	Insexskruv	Socket head cap screw
16	Låsring	Circlip	81	Insexskruv	Socket head cap screw
17	Pinjong 1:a steg	Modul-pinion	84	Kil	Key
17B	Axelhylsa	Pinion shaft	84A	Kil	Key
19	Nutmutter	Groove nut	84B	Kil	Key
21	Packningsbricka	Adjusting disc	85	Låsring	Circlip
21A	Packningsbricka	Adjusting disc	85A	Packningsbricka	Adjusting disc
21B	Packningsbricka	Adjusting disc	85B	Packningsbricka	Adjusting disc
24	Kugghjul 1a steget	Gear wheel 1st stage	87	Insexskruv	Socket head cap screw
25	Axelhylsa	Bevel gear pinion shaft	100	Glykordur-Bussning	Glykodur bush
27	Koniska rullager	Taper roller bearing	170	Klämbussningssats	Shrink disc set
28	Koniska rullager	Taper roller bearing	171a	Skyddskåpa för hålaxel	Protection cap for hollow s.
28A	Nilosring	Nilos ring	171b	Insexskruv	Socket head cap screw
33	Kugghjul	Bevel gear wheel	171c	O-rings tätning	O-ring seal
34	Axelhylsa	Pinion shaft	180	Gummibussningssats	Rubber buffer set
45	Kugghjul slutsteg	Gear wheel end stage	181	Sexkantsskruv	Hexagon head cap screw
46	Enkel utgående axel (lös)	Insert shaft	182	Mutter	Hexagon nut
46A-H	Hålaxel	Hollow shaft	200	Packning	Gasket
46A-S	Klämkoppling m. hålaxelw.	Shrink disc hollow shaft	201	Packning	Gasket

3.7 Märkskylt

3.7 Nameplate, unit designation

(Beispielhafte Darstellung) / (Typical appearance)

Förklaringar:

II Utrustniknggsgrupp
2 Kategori
D EX - atmosfär
c Skyddstyp
120° Temperaturklass eller maximal yttemperatur

Legend:

II Instrument group
2 Category
D EX Atmosphere
c Type of ignition protection
120° Temperature class or maximum surface temperature

4. Mekanisk installation
4.1 Förvaring

Följande punkter måste tas i beaktande vid lagring av växelenheter:

Generellt:

Lagring av växelenheter måste generellt ske i slutet utrymme.

Omgivningstemperatur max. 25°C (77°F)

Relativ luftfuktighet max. 80 %

Växelenheterna skall skyddas mot exponering av solljus eller UV ljus.

Inga aggressiva eller korrosiva ämnen får lagras i växelenhetens närhet.

Växelenheten skall förvaras i samma position som det är tänkt att den skall monteras i vid drift.
Växelenhetens utgående/hålaxel skall roteras 1-2 varv var 6 månad, för att säkerställa att alla ingående delar smörjs av oljan i växeln.

Enheten skall skyddas från mekanisk belastning eller andra utomstående krafter.

Långtidsförvaring:

När växelenheter skall förvaras längre tid än **12 månader**, måste de fyllas helt med olja av den oljetyp som anges på typskylten.

4. Mechanical installation
4.1 Bearing system

The following items must be taken into account when storing the gear units:

General:

In general, the storage of drive units must be done in closed rooms.

Ambient temperature max. 25°C (77°F)

Relative humidity max. 80%

The drive units are to be protected from exposure to the sun or UV light.

No aggressive or corrosive materials are to be stored in the vicinity of the unit.

The gear units are to be stored in the same position that is intended for a later use.
The gear units are to be rotated 1-2 revolutions on the output side every 6 months to ensure that the interior parts are wetted with lubricant.

The units are to be protected from mechanical loads and exposure to outside forces.

Long-term storage:

When the gear units are to be stored for longer than **12 months**, they must be completely filled with lubricant per the nameplate or lubricant plate.

De blanka omålade ytorna på växelenhetens utsida skall skyddas med korrosionsskyddsmedel (kontroll var 6 månad är rekommendabelt). Rostskyddsmedlet måste bytas ut efter ett år.

Före uppstart av växelenheten, tappa ur oljan. Om det finns fler än en oljekammare, se till att alla kamrar har tömts.

Packningarna krymper, speciellt efter en längre period av stillastående. Före uppstart måste skruvarna efterdras.

Avslutningsvis: fyll växelenheten med den oljetyp och oljemängd som står på typ skylten.

Om växelenheten har blivit förvarad **längre tid än 24 månader** innan den tas i bruk, måste den läckage-kontrolleras. Om det finns några synliga sprickor på tätningar eller liknande, måste dessa delar bytas ut.

4.2 Förarbeten

Kontroll av växelenheten:

Växelenheten får inte tas i bruk såvida inte:

E Informationen på växelenhetens märkskylt motsvarar de lokala gränserna för Ex användningsområde (Explosionsgrupp, Kategori, Zon, Temperaturklass, maximal yttemperatur).

Ingen förorsakad skada, t.ex. vid förvaring eller transport är synlig, och ingen potentiellt explosiv atmosfär är närvarande under installation.

Och särskilt, axeltätningarna, täckkåporna och skydds-huvarna inte är skadade.

Inget läckage eller oljeförlust är synbar.

Ingen korrosion eller annan indikation på felaktig förvaring eller förvaring under fuktiga förhållanden.

All förpackningsmaterial är borttaget.

Som en generell regel måste drivaxlar och flänsytor rengöras från all korrosionsskyddsmedel, vanligt rengörningsmedel kan användas.

S **VIKTIGT:** Tätningläppen på axeltätningen får inte komma i kontakt med rengöringsmedlet.
→ **Materialet kan skadas!**

Kontrollera monteringsläget:

Växelenheten får endast användas enligt det specificerade monteringsläget som finns angivet på typ-skylten. Monteringsläget får inte ändras under monteringen.

Unfinished, bare-metal parts on the outside of the unit are to be protected with a corrosion protection product (inspection every 6 months is recommended). The corrosion protection must be replaced after one year.

Before starting the gear unit, drain the lubricant from it. If more than one lubricant chamber is present, make certain that all of the lubricant chambers have been drained out.

Gasket settles, especially after a longer period without loading. Before starting the screws must be retightening.

Then fill the gear unit with the lubricant type specified on the nameplate using the specified quantity of lubricant.

If the gear units are stored for **longer than 24 months** before being put into service, they must be checked for leaks. If there are any visible cracks on the surfaces of sealing elements, such parts must be replaced.

4.2 Preparatory work

Inspecting the gear unit:

The gear unit must not be put into operation unless:

E The information on the gear unit specifications plate matches the permissible local Ex usage area (instrument group, category, zone, temperature class, maximum surface temperature).

No damage caused, for example, by storage or transport, is apparent, and no potentially explosive atmosphere is present upon installation,

And in particular, the shaft seals, cover caps, and guard hoods are not damaged.

No leaks or loss of oil are visible.

No corrosion or other indication of improper storage or storage under damp conditions is present.

All of the packaging materials were removed.

As a general rule, drive shafts and flange surfaces must have all corrosion protection products and dirt cleaned from them, standard commercial solvents can be used.

S **IMPORTANT:** The sealing lips on the shaft seals must not be allowed to come in contact with the solvent.
→ **Material can be damaged!**

Check the mounting position:

The gear unit may only be operated in the specified mounting position, which may be found on the nameplate. The mounting position must not change during operation.

4.3 Uppsättning av växelenheten

Omgivningstemperatur:

E Växelenheter enligt Kategori IM2, II2G och II2D får endast användas vid omgivningstemperaturer -20° C (4°F) till +40°C (104°F).
I de fallen med avvikande omgivningstemperartur, måste man kontakta Watt Drive.

E **Temperaturklass/Yttemperatur:**

Växlarna är klassificerade enligt ATEX 95 enligt Temperatur klass T4 eller 120°C (248°F) maximal yttemperatur.

Kapslingsklass:

Växlarna uppfyller kapslingsklass IP 65.

E Kontrollera att drivelement som t.ex. kopplingar, remmar och remskivor m.m. såväl som drivmotorn, som är monterad eller kopplad till växeln, även uppfyller ATEX.

Inga explosiva ämnen finns närvarande när växel-enheten monteras.

Oljans dränerings- och luftplugg måste finnas åtkomlig!

Korrekt oljenivå för monteringsläget är angivet från fabriken.
En ändring av monteringsläget får inte utföras om inte det har godkänts av Watt Drive.
ATEX-godkännandet ogiltigförklaras om inte de förutsatta bestämmelserna uppfylls!

Växelns avluftning:

E **Växelenhet med luftplugg:**

Luftplugg med transportsäkring är monterad på det fördelaktigaste stället för angivet monteringsläge.
Gummisäkringen måste helt tas bort innan enheten tas i drift.

S **Luftpluggen** aktiveras innan enheten tas i drift genom att helt avlägsna den **transportsäkring** som beskrivs nedan:

4.3 Setting up the gear unit

Ambient temperature:

E The gear units of categories IM2, II2G, and II2D may only be used at ambient temperatures from -20°C (-4°F) to +40°C (104°F)
In the event of deviating ambient temperatures, you must contact Watt Drive.

E **Temperature class / surface temperature:**

The drives are classified according to ATEX 95 into temperature class T4 or 120°C (248°F) max. surface temperature.

Protection type:

The drives conform to protection type IP 65.

E Make certain that drive elements such as clutches, belts, etc. as well as drive motors that are attached or connected to the gear units also conform to ATEX.

No explosive atmosphere may be present when the gear units are set up.

Oil drain plugs and vent plugs must be fully accessible!

The proper oil level for the mounting position is designed at the plant.
A change in the mounted position must not be made unless this is discussed in advance with Watt Drive.
The ATEX approval will be null and void if this advance approval is not obtained!

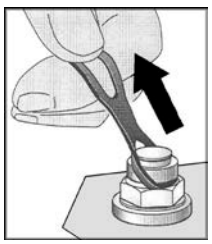
Bleeding the gear unit:

E **Gear unit with vent plug:**

The vent **plug with transport locking** device is installed at the proper position for the mounting position.
The rubber strip must be completely torn off before the unit is put into operation.

S The **vent plug** is to be activated before the unit is put into operation by completely removing the **transport protection** as described below:

Informationsskylt (röd)



Information labels (red)

Växeldrifter utan luftplugg:

Växelenheter i slutet (tätt) utförande levereras utan luftplugg.

Detta gäller för följande växel enhetstyper:
H. 40A,S; H. 41E; H. 50A,S,C; H51E; H. 55A,S,C;
H. 60E,A,S,C; H. 65A,C
A.. 46A; A.. 56A,S,C; A.. 66A,S,C
F.. 55A,S,C; F.. 65A,S,C
K.. 40A; K.. 50A,C; K.. 60A,C

Målning av växelenheter:

Om växelenheten ska målas eller delvis ommålas, se till att luftpluggen och axeltätningarna är noggrant maskerade. Ta bort maskeringstejpen när målningen är färdig.

För att förebygga otillåten uppvärmning av växelenheten måste följande observeras:

Se till att enheten har ohindrad tillgång till kylluft (max. 40°C, 104°F).

Tillräckligt utrymme måste finnas omkring växelenheten.

Kylluften för växelenhetens motor måste kunna blåsa obehindrat omkring växelenheten.

Växelenheten får inte kapslas in helt och hållet.

Växelenheten får inte exponeras av het utblåsningsluft från andra enheter.

Ingen värme får transporteras till växelenheten (t.ex. från fundamentet).

4.4 Växelenheter med solid axel

Alla utgående axlar är försedda med ett korrosionsskyddande medel vid leverans. Detta måsta tas bort med ett konventionellt rengöringsmedel.

Viktigt!
Rengöringsmedlet får **inte** komma i kontakt med axeltätningarna!
Utgående axlar tillverkas upp till en diameter 50mm enligt toleransklass ISO k6 och fr.o.m. 55mm enligt toleransklass ISO m6.
Alla utgående axlar är försedda med gängat centrumhål enligt DIN 332, som används vid montage av driv elementen.

Viktigt!
Se till att förebygga så att inga slag eller mekaniska stötar på axeländen förekommer för att inte skada axelns lagring.

Viktigt!

Gear drives lacking a vent plug:

Sealed-design gear drives are supplied without a vent plug.

This applies to the following gear unit types:
H. 40A,S; H. 41E; H. 50A,S,C; H51E; H. 55A,S,C;
H. 60E,A,S,C; H. 65A,C
A.. 46A; A.. 56A,S,C; A.. 66A,S,C
F.. 55A,S,C; F.. 65A,S,C
K.. 40A; K.. 50A,C; K.. 60A,C

Painting the gear unit:

If the gear unit will be painted or partially repainted, make certain that the vent plug and the shaft seals are carefully masked. Remove the masking tape after the painting work is completed.

In order to prevent access heating of the gear unit, the following must be observed:

Make certain that the unit has unhindered access to cooling air (max. 40°C, 104°F).
Sufficient clearance must be provided around the gear unit.

The cooling air for gear unit motors must be able to flow unhindered around the gear unit.

The gear unit must not be completely boxed in with housing.

The gear units must not be exposed to hot exhaust air from other units.

No heat must be transferred into the gear unit (for example from the foundation).

4.4 Gear unit with solid shaft

All output shafts are provided with a corrosion protection product upon delivery. This product must be removed with a conventional solvent.

! Important !
The solvent must not be allowed to come into contact with the shaft seals!
The output shafts are manufactured with a diameter of 50 mm in ISO k6 tolerance class and beginning at a diameter 55 mm in ISO m6 tolerance class.
All output shafts are equipped with DIN 332 tapped center holes that are used to tighten the transfer elements.

! Important !
Make certain to prevent all impacts and mechanical shocks on the end of the shaft since the output bearing system can be damaged.

! Important !

S Mekaniska drivelement som tillför radiell last på utgående axeln måste monteras så nära utgående axelns lagring som möjligt!

Drivenhet och kringutrustning måste förses med beröringsskydd.

E **Ingående och utgående element måste uppfylla ATEX.**
Tillförande kraftöverföringsenheter måste vara balanserade och ej orsaka oacceptabla radiella eller axiella krafter (se katalog för tillåtna värden).

4.5 Montage och Demontage av växelenheter med hålaxel
4.5.1 Montage

Kundsidans maskinaxel måste vara noggrant rengjord och kontrollerad så att skador som repor eller valkar ej förekommer innan hålaxelväxeln monteras.

Före fastdragning av hålaxelväxelenheten på maskinaxeln, måla ytan på maskinaxeln med smörjpasta (Bild 1) t.ex. Klüber-Paste 46MR401.

Hålaxelväxelenheter måste alltid monteras på sådant sätt att inga axiella krafter tillförs den utgående sidans lagersystem.

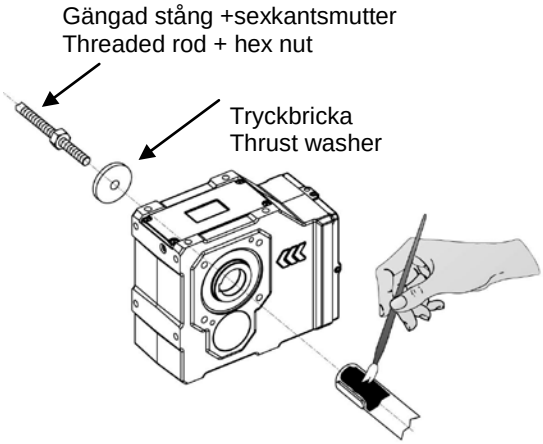


Bild 1: Fastdragning av kundaxel med eller utan ansats på axeln
Fig. 1: Tightening the customer shaft with or without shoulder

Montage:
Dra växelenheten med hålaxeln på maskinaxeln (fig.1). Montera i distansring pos. 10 då det är en kundaxel utan ansats på axeln, låsringen, pos. 3 och bricka, pos. 2 in i hålaxeln och dra ihop allt med bulten, Pos.4.
Se Kapitel. 8 på sida 29 för åtdragningsmoment.

S Mechanical drive elements that apply radial forces to the output shaft must be installed as close as possible to the output shaft bearings!

Drive and PTO elements must be equipped with so many people have them.

E **Input and output elements must comply with ATEX.**

Add-on power transfer elements should balance and must not cause any unacceptable radial or axial forces (see Catalogue for acceptable values).

4.5 Installation and removal of hollow-shaft gear units
4.5.1 Assembling

The customer-side machine shaft must be carefully cleaned and checked for any damage such as grooves or compressed areas before the hollow-shaft gear unit is installed.
Before tightening the hallow-shaft gear unit onto the machine shaft, paint the surface of the machine shaft with lubricating paste (Figure 1) such as Klüber-Paste 46MR401.

The hollow-shaft gear units must always be installed in such a way that no axial forces are applied to the output shaft bearing system.

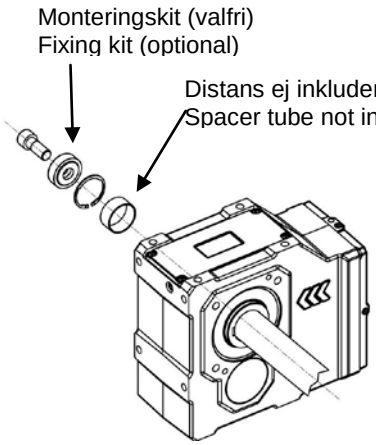


Bild 2: Montering av kundaxel med Watt monteringskit utan ansats på axeln
Fig. 2: Mounting the customer shaft using a WATT mounting set without a shoulder

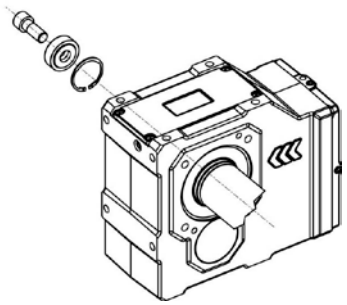


Bild 3: Montering av kundaxel med Watt monterings kit med ansats på axeln
Fig. 3: Mounting the customer shaft using a WATT mounting set with a shoulder

Installation:
Draw the gear unit with hollow shaft onto the machine shaft (Fig. 1). Insert the spacer ring, item 10, with there is a customer shaft without a shoulder, the circlip, item 3, and washer, item 2, into the hollow shaft and attach using the bolt, item 4.
See section 8 on page 29 for the bolt tightening torque.

4.5.2 Demontage

4.5.1 Assembling

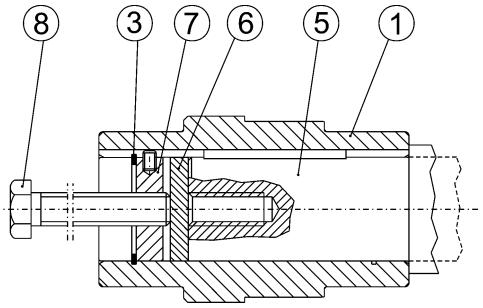


Bild 5: Demontage av kundaxel
med eller **utan** ansats på axeln

Fig. 5: Removing the customer shaft
with or **without** shoulder

1) Hålaxel
2) Skiva
3) Låsring DIN 472
4) Insexskruv DIN 6912 (kundspecificerad, längd enligt maskinaxelns längd)
5) Kundaxel med gängat centrumhål DIN332, Bl.2 Form DR
6) Tryckskiva
7) Domkraftmutter
8) Domkraftskruv
9) Insexskruv DIN 6912 (del av monteringskit Watt insticks axel)
10) Distans (endast vid maskinaxel utan ansats på axeln)

1) Hollow shaft
2) Disc
3) Circlip DIN 472
4) Socket head screw DIN 6912 (to customer specification, length according to machine shaft length)
5) Customer's shaft °)
6) Thrust washer
7) Jack nut
8) Jack screw
9) Socket head screw DIN 6912 (part of fixing kit for WATT insert shaft)
10) Spacer tube (only with machine shafts without shoulders)

Demontage:
Ta bort skruv pos. 4,skiva (2) och låsring (3), placera tryckskiva (6) och domkraftmuttern (7) i hålaxeln, sätt i låsringen och ta bort växelenheten från axeln med domkraftskruven (8).

Delarna 4, 6, 7, 8 och 10 är inte inkluderade i växelenheten. Delarna 2, 3 och 9 är inkluderade i monteringskit GMBSBSD . . .

Removal:
Remove the screw (4), disc (2) and circlip (3), place the thrust washer (6) and jack nut (7) in the hollow shaft, insert the circlip and remove the gear unit from the shaft with jack screw (8).

Parts 4, 6, 7, 8 and 10 are not supplied with the gear unit. Parts 2, 3 and 9 are included in fixing kit GMBSBSD . . . . . .

4.6 Montage och Demontage av klämkoppling

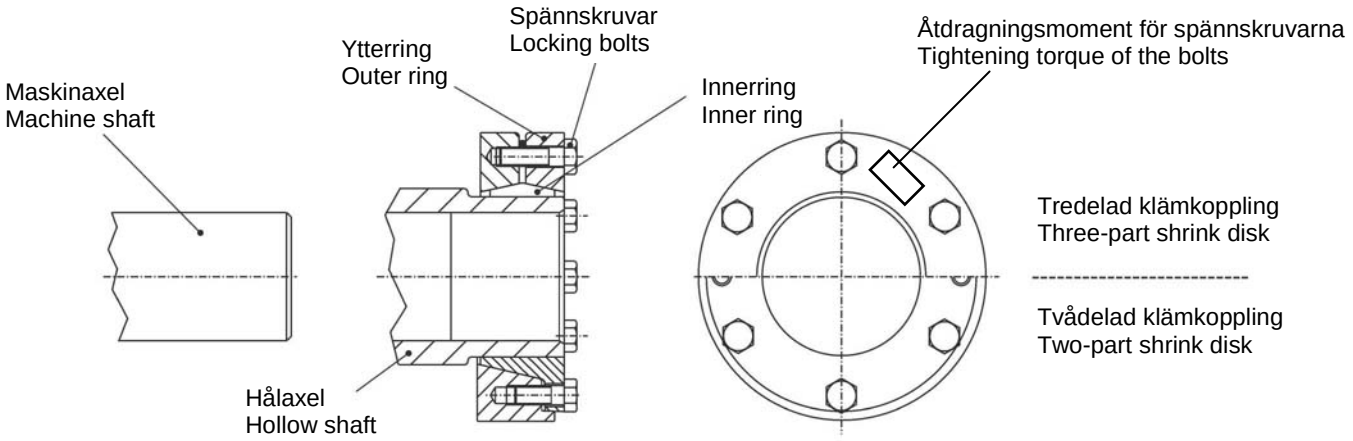
4.6.1 Montage:

Klämkopplingarna levereras klara för montage. De behöver inte tas isär före första monteringen.

4.6 Installation and removal of shrink disks

4.6.1 Installation:

The shrink discs are supplied ready to install. They must not be taken apart prior to the first installation.



1. Noggrann avfettning av hela hålaxeln.
   → **måste vara ABSOLUT fettfritt!**
2. Avfetta även maskin axeln för det området där kläm-kopplingen skall vara.
   → **måste vara ABSOLUT fettfritt!**
3. För på klämkopplingen på hål axeln .
   Hålaxelns yttre sida där klämkopplingen ska sitta ska fettas in.

S **VARNING!**
DRA ALDRIG ÅT SPÄNNSKRUVARNA FÖRE AXEL-INSTALLATIONEN!

4. Trä på hålaxeln på maskinaxeln.
5. Dra åt spännskruvarna jämnt fördelat och i rätt ordning (se ritning).

Dra åt alla skruvar successivt flera gånger tills de åstadkommer det nödvändiga åtdragningsmomentet. Kontrollera med en momentnyckel.
Åtdragningsmomentet för skruvarna -> finns instansat på klämkopplingen.

S **VIKTIGT!**
DRA EJ ÅT SKRUVARNA I DIAGONALT MOTSATT SEKVENS!
Antalet spännskruvar beror på storleken på kläm-kopplingen!

TIPS:
Efter montaget kan man markera hålaxeln respektive maskinaxeln med ett streck (använd en penna) för att kontrollera hållbarheten vid igångkörning (under last).

4.6.2 Demontage:

Proceduren är liknande monteringen, men i motsatt ordning.

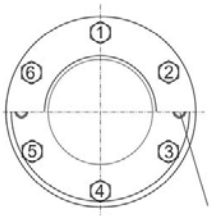
1. Lossa spännskruvarna likformigt och i ordning.
   Lossa endast varje skruv ca ett kvarts varv i början.
   Ta inte bort spännskruvarna helt och hållet.
2. Tryck av innerringen med hjälp av domkraft muttern.
   Ta bort eventuell rost som kan ha bildats på maskin-axeln före hålaxeln.
3. Ta bort maskinaxeln genom att föra av hålaxeln från maskinaxeln.

Steg 2 endast nödvändigt för **tvådelad** klämkoppling!

1. Carefully degrease the complete hollow-shaft hole.
   → **must be ABSOLUTELY free of grease!**
2. Degrease the machine shaft in the area that the shrink disc clamps to.
   → **must be ABSOLUTELY free of grease!**
3. Slip the shrink disk onto the hollow shaft. The outer surface of the hollow shaft may be greased in the area of the shrink disk seat.

S **! WARNING !**
NEVER TIGHTEN THE LOCKING BOLTS BEFORE SHAFT INSTALLATION!

3. Push the hollow shaft onto the machine shaft.
4. Tighten all the locking bolts uniformly and in the right sequence (see figure).



Domkraftmutter
Jack nut

Tighten all the bolts successively several times until they display the required tightening torque. Check with a torque wrench.
Tightening torque of the bolts -> see lettering on the shrink disc.

S **! IMPORTANT!**
DO NOT TIGHTEN THE BOLTS IN DIAGONALLY OPPOSITE SEQUENCE!
The number of locking bolts depends on the size of the shrink disks!

TIP:
After installation you can sign the hollow shaft respectively the machine shaft with a stroke (use a pencil) to detect a slipping during the initial operation (under load).

4.6.2 Removal:

The procedure is similar to installation, but in reverse order.

1. Undo the locking bolts uniformly and in sequence.
   Only undo each locking bolt about a quarter turn initially. Do not remove the locking bolts completely.
2. Press the inner ring off using the jack nut.
   Remove any rust beforehand that may have formed on the machine shaft in front of the hollow shaft.
3. Remove the machine shaft and then slip the hollow shaft off the machine shaft.

Step 2 only required for **two-part** shrink disk !

4.7 Montage och Demontage av skyddskåpa

E **Klämkopplingsversioner så väl som hålaxel-versioner kräver en skyddskåpa för att förebygga att personer ej kommer i kontakt med rörliga delar.**
De måste alltid användas då beröringsskyddet inte kan uppnås på något annat vis.

!! Före installation, måste skyddskåpan kontrolleras så den ej är skadad, vilket kan ha uppstått under transporten. **Skadad skyddskåpa får ej monteras, då de kan ge upphov till friktion/nötning**.
Alla montageskruvar skall användas och säkras med gänglåsningsmedel (medium styrka). Åtdragningsmoment se Kap. 8 på sidan 29.

4.7 Installation and removal of protection cap

E **The shrink disc versions as well as the hollow-shaft versions require cover guards to prevent personnel from coming in contact with them.**
The must always be used whenever the prevention of contact cannot be achieved by any other means.

!! Before being installed, the cover guards must be inspected for any damage that might have occurred during transport. **Damaged cover guards must not be installed, since they can possibly cause abrasion**.
All of the fixing bolts are to be used and secured by wetting them with a thread-locking adhesive (medium strength). See section 8 on page 29 for the bolt tightening torque.

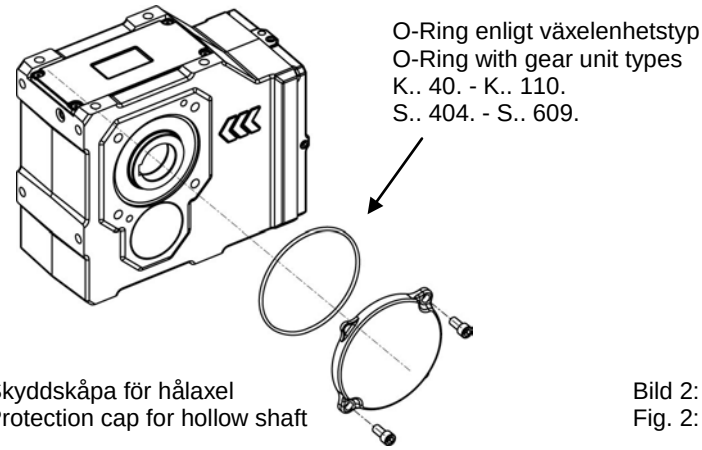


Bild 1: Skyddskåpa för hålaxel
Fig. 1: Protection cap for hollow shaft

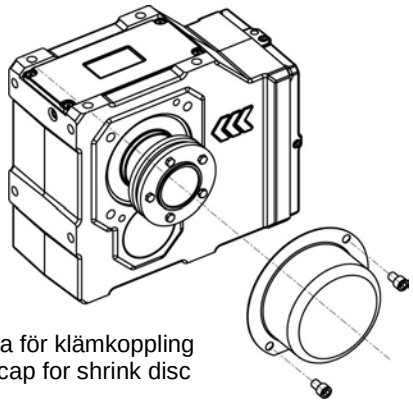


Bild 2: Skyddskåpa för klämkoppling
Fig. 2: Protection cap for shrink disc

4.8 Montage av standardmotorer (IEC 60072, DIN EN 50347) på IEC-adapter

E **Endast IEC – motorer, som har tillräcklig klassning för gällande ATEX zon angivet på motorns typskylt, får monteras. För växelenheter enligt ATEX kategori 2D, måste motorerna uppfylla minst kapslingsklass IP6x.**

Watt Drives tillhandahåller IEC-adapter i storlekarna 100/112, 132, 160 och 180 med en integrerad, frigående klokoppling. IEC-adaptarna har en oljetät konstruktion, med gränsytan mellan växelhuset och IEC-adaptern tätad.

<u>Tillvägagångssätt för montage av IEC standard motorer på IEC adapterna IA63 – IA90, IA200, IA225:</u>

1. Rengör motoraxeln och flänsytorna på motorn och adaptern samt kontrollera pm det finns eventuella skador.
2. Före montage, smörj in motoraxeln med smörjmedel som t.ex. Klüberpaste 46 MR 401.
3. Applicera gänglåsningsmedel (1) på montage skruvarna (medium styrka).

4.8 Installation of standard motors (IEC 60072, DIN EN 50347) on the IEC adaptors

E **Only IEC motors that have a sufficient rating for the ATEX zone per the motor nameplate may be installed. With ATEX category 2D gear units, the motor must be at least protection type IP6x.**

Watt Drive supplies IEC adapters in sizes 100/112, 132, 160, 180 with an integrated, play-free claw coupling. The IEC adapters have an oil-tight design, with the interface being sealed between the gears and the adapter.

<u>Assembly procedure for IEC standard motor on the IEC adapter IA63 – IA90, IA200 and IA225:</u>

1. Clean the motor shaft and the flange surfaces of the motor and adapter and check for damage.
2. Before installing, wet the motor shaft with lubrication paste, such as Klüber Paste 46 MR 401.
3. Wet the fixing screws (1) with thread-locking adhesive (medium strength).

4. Sätt ihop motor och adapter samt dra åt montage-skruvarna med erforderligt åtdragningsmoment. Åtdragningsmoment se Kap. 8. på sida 29.

4. Then place the motor on the adapter and tighten the bolts to the specified torque. See section 8 on page 29 for the bolt tightening torque.

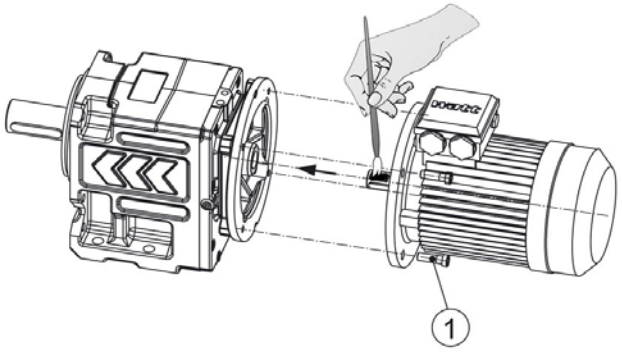


Bild 1: Principskiss för montage av standard motorer på IEC-adapter

Fig. 1: Exposition for assembling standard motors on an IEC adapter

E **Tillvägagångssätt för montage av IEC standard motorer på IEC adapterna IAK100, IAK112, IAK132, IAK160, IAK180:**

Den korrekta monteringspositionen måste beaktas när halvan av kopplingen monteras på motorns axel. Kopplingshalvan skall monteras i jämnhöjd med motorns axel (se Bild 2 på sida 22).

1. Avlägsna adapterns skydd (1) och ta bort kopplingshalvan som följer med (3).
2. Rengör motorns axel (2) och ytorna på motorns fläns samt adapterns anläggningsyta.
3. Värm kopplingshalvan (3) till ungefär 80°C (176°F) och montera den på motor axeln.
4. Kopplingshalvan skall monteras i jämnhöjd med axeln framkant, som har det borrade hålet (se diagram!).
5. Sätt fast kilen (4) och kopplingshalvan med hjälp av bultarna (5) använd det specificerade fastsättningsmomentet T_A (M5 → ungefär 2.5Nm, M8 →ungefär 10Nm). Använd en lagom stor låsningsanordning för detta ändamål.
6. Kontrollera att kopplingshalvan är placerad korrekt.
7. Kontaktytan mellan motorn och adaptern skall tätas med med hjälp av lämpligt silikonmaterial.
8. Monteras motorn på adaptern, kopplingens klor måste passas kopplingens mjukdel (6) på båda halvorna.
9. Sätt fast motorn på adaptern genom att använda lämpliga fastsättningsbultar. (observera fastsättningsmomenten i kapital 8 på sida 29, använd minst klass 8.8 på fastsättningsbultarna).

E **Assembly procedure for IEC standard motor on the IEC adapter IAK100, IAK112, IAK132, IAK160 and IAK180:**

The correct assembly position must be observed when fitting the half coupling supplied onto the motor shaft. The half coupling should be fitted flush to the motor shaft (see figure 2 on page 22).

1. Remove the adapter cover (1) and remove the half coupling provided (3).
2. Clean the motor shaft (2) and the flange surfaces on the motor and adapter.
3. Heat the half coupling (3) to approx. 80°C (176°F) and fit onto the motor shaft.
4. The half coupling is fitted flush to the shaft panel with the end of the bore hole (see diagram!).
5. Secure the key (4) and the fitted half coupling using a set pin (5) using the specified tightening torque T_A (M5 → approx. 2.5Nm, M8 → approx. 10Nm). Use a "medium-tight" screw locking adhesive for this purpose.
6. Check that the half coupling is seated correctly.
7. The contact surface between the motor and adapter should be sealed using the appropriate silicon.
8. Fit the motor onto the adapter; the coupling claws must engage with the coupling star (6) on both sides.
9. Fasten the motor onto the adapter using the appropriate fastening screws (observe screw tightening torques chapter 8 on page 29, minimum strength class 8.8).

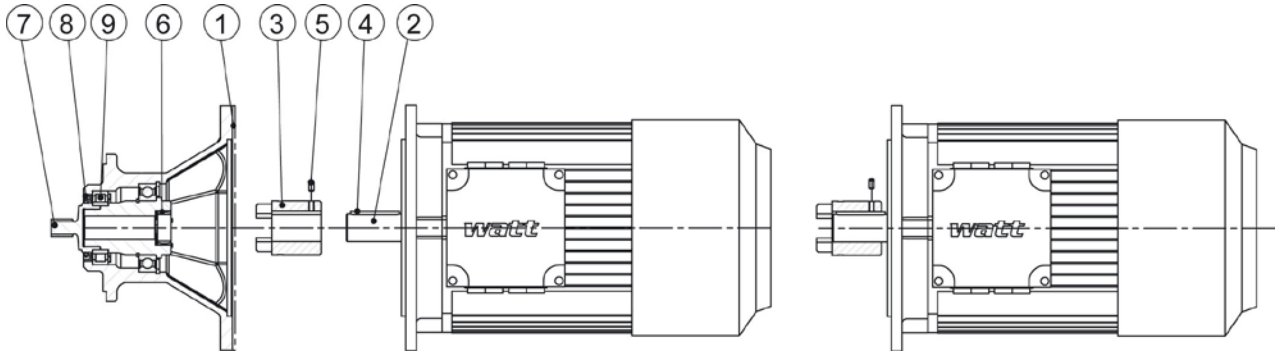


Bild 2: Monterng av IEC standard motor

Fig. 2: Installing an IEC motor

S **OBSERVERA !**
Vid montage av pinjong (7) måste lagret (9) på växelsidan i IEC-adaptern fyllas med fett, enligt nedanstående tabell, innan montage av tätningen (8).

S **! ATTENTION !**
In case of independent pinion assembling (7) the bearing (9) on the gearside must to be filled with the amount of grease mentioned below before assembling the seal ring (8).

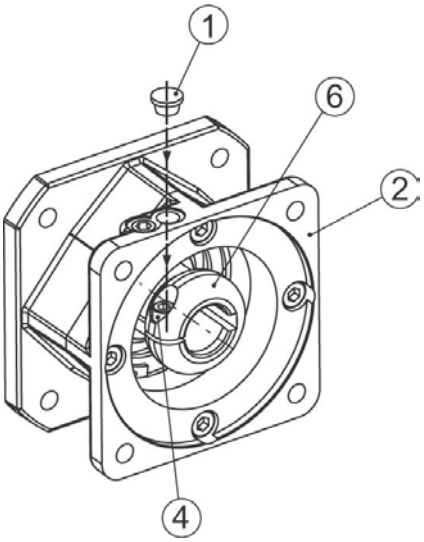
IEC-adapter storlek (IAK) / Size of adapter (IAK)	Fettmängd NLGI 1 – DIN / Amount of grease NLGI 1 – DIN 51818
100/112	6 g
132	0 g
160/180	20 g

4.9 Montering av servo motorer på servoadapter

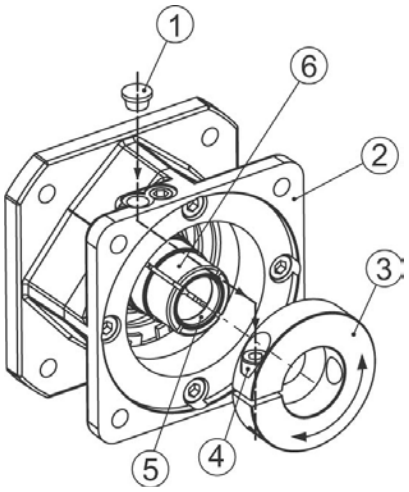
Om motorer med **kil** användas är det nödvändiga glappet vid motorns montage reducerat till 0, om adapterns skruvar är fixerade. En lämplig servoadapter (6) skall väljas och användas utifrån motorns axeldiameter.
För att motorer med **axlar utan kil (jämna runda axlar)** skall kunna överföra den nödvändiga kraften mellan motorns axel och servoadapterns axel (6), som överför motorns moment, används spännringen (3). Monteringen av andra motoraxeldiameter görs genom slitsade spännbussningar (5). Normala axlars utseende och koncentricitet är tillräckligt om de är enligt DIN 42955. Motorflänsens centreringsdiameter enligt DIN EN 50348 och mootrns axeln enligt DIN 748.

4.9 Installation of servo motors on the SERVO adapters

If motors with **key** are used, the necessary gap for the motor assembling, is reduced to 0, if the screw on the adapter input is fixed. According to the motor shaft diameter a suitable adapter shaft (6) is used.
For motors with **smooth motor shaft** the necessary circular force between the motor and the adapter shaft (6), which transmits the motor torque, is generated by a clamping ring (3). The assembling of different motor shaft diameters is made by slotted clamping bushes (5).
Normal shaft run- out and concentricity according to DIN 42955 for motor shafts and flanges are sufficient. The centering diameter of the motor flanges according to DIN EN 50347, the motor shaft according to DIN 748.



Principbild på servoadapter med **kil**.
Sectional view servo adapter with **key**.



Principbild på servoadapter med **jämn axel (utan kil)**
Sectional view servo adapter with **smooth shaft**.

Montering av motorn:

1. Rengör motorn axel. Den måste vara absolut ren från fett.
2. Ta bort plastpluggen (1) från monteringshålet på adapterns hus (2).
3. Sätt adapterns axel (6) i linje med klämringen (3), förlängningen av momentnyckeln måste komma på rätt plats i klämringens skruv (4).
4. Montera motorn på adapterns hus (2). Det är att föredra att monteringen sker vertikalt. **OBSERVERA**: Vinkla inte motorns axel!
5. Skruva fast motorn.
6. Dra åt klämringens skruv (4) med momentnyckel, åtdragningsmoment $\mathbf{M_a}$ enligt tabell 1.
7. Sätt tillbaka plastpluggen (1) i dess hål på adapterns hus.

OBSERVERA: Demontering av motorn kan bara göras i ett rotorläge.

Assembling of the motor:

1. Clean the motor shaft, it has to be absolutely grease - free.
2. Remove the plastic plug (1) out of the mounting hole of the adapter housing (2).
3. Align the adapter shaft (6) respectively the clamping ring (3), the extension of the torque spanner has to click into place in the clamping screw (4).
4. Fix the motor to the adapter housing (2). Prefer the *vertical assembling*. **Attention:** Don't tilt the motor shaft !
5. Screw the motor in place.
6. Tighten the clamping screw (4) with the torque spanner, tightening torque $\mathbf{M_a}$ table 1.
7. Close the mounting hole of the adapter housing with the plastic plug (1).

Attention: The motor disassembling can only be done in one rotor position!

S **Tabell 1**: Åtdragningsmoment M_a för klämringens skruv på WATT servoadapter med kil och med jämn axel (utan kil):

S **Table 1**: tightening torque M_a for the clamping screw of the WATT servo adapter with key and with smooth shaft:

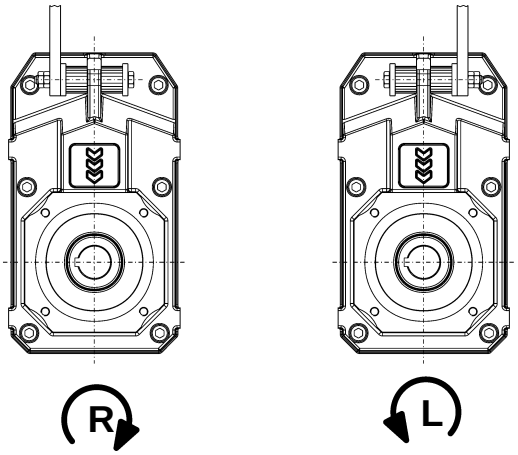
Klämskruvs dimension Clamping screw	„s“	M_a [Nm]
M6	5	9,5
M8	6	20
M10	8	48
M12	10	94

4.10 Montage av momentstag

S **VIKTIGT!**
Kontrollera rotationsriktningen på hålaxeln!
Elasten (plasten) i gummibussningenheten skall belastas under sammantryckningen i huvudrotationsriktningen.

Se kapitel 8 på sedan 29 för bultarnas åtdragningsmomnet.

Tappväxelenhet
Shaft mounted gear unit



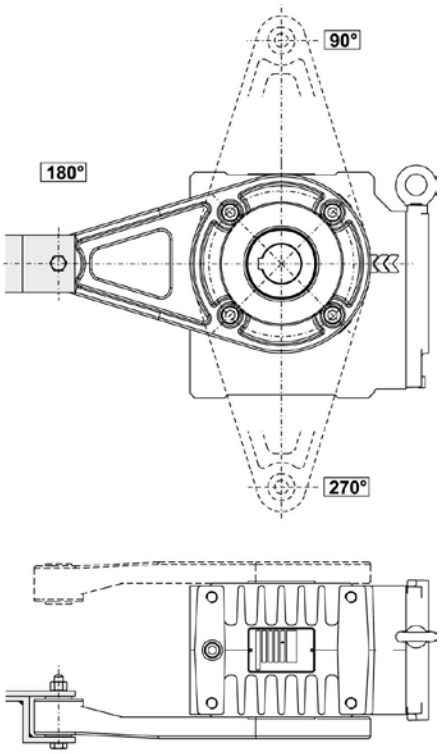
R ... Medurs / Clockwise

L ... Moturs/ Counter clockwise

4.10 Installation of torque arms

S **! IMPORTANT !**
Pay attention to the direction of rotation of the hollow shaft!
The elastomers in the rubber bumper set are to be loaded under **compression** in the main working direction of rotation!
See section 8 on page 29 for the bolt tightening torque.

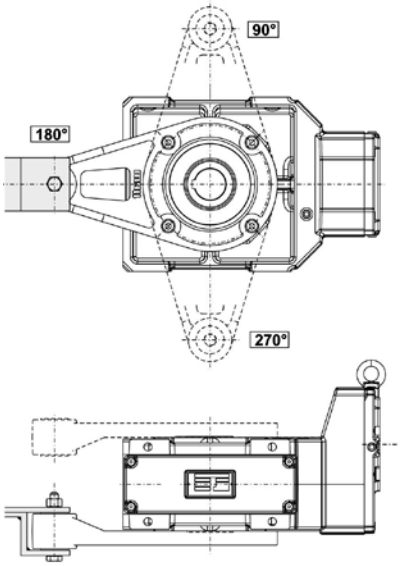
Kuggsnäckväxel enhet
Helical worm gear unit



Vinkelkuggväxelenhet

(*) . . . Bussningen måste ha lager på båda sidor.

K.. 40. - K.. 77.

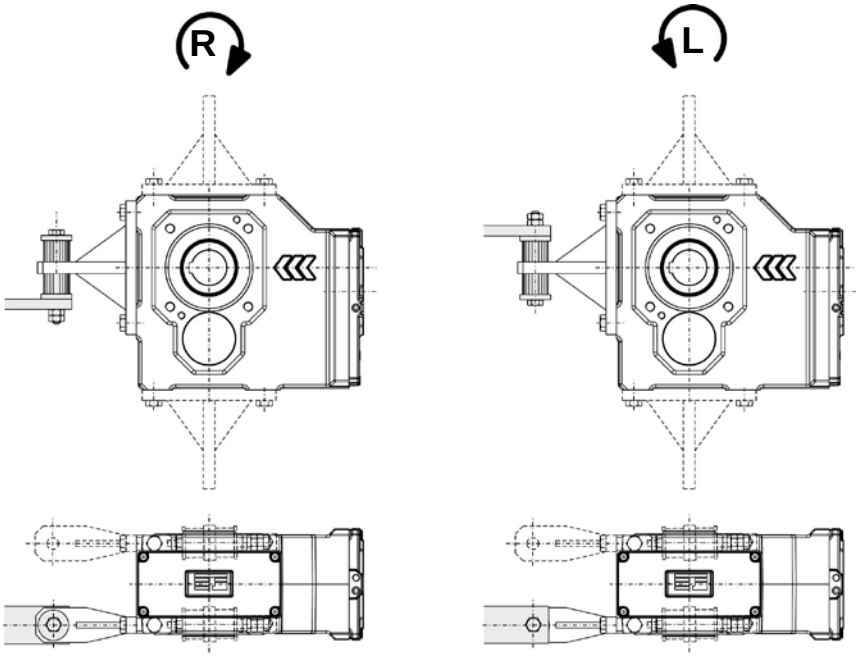


(*)

Helical bevel gear unit

(*) . . . Bushing must have bearings on both sides.

K.. 80. - K.. 136.



5. Idrifttagande
5.1 Oljenivå i växelenheten vid leverans

E **En erforderlig oljenivå för gällande monteringsläge är bestämt av fabriken.** (Se växelenhetens typskylt för den gällande mängd olja).

E **En ändring av monteringsläget får inte utföras förrän det har diskuterats i förväg med Watt Drive.**
ATEX godkännande ogiltigförklaras om inte de förutsatta bestämmelserna uppfylls!

S Om växelenheten är öppnad, för t.ex. att reparera, måste den fyllas med korrekt olja och korrekt oljemängd som finns angivet på typskylten, före den blir åter i drift.
Smörjmedel se Kap. 8 på sidan 27. För mängden smörjmedel, se växelenhetens typskylt.

5.2 Temperaturmätning

E Informationen för ATEX temperaturklass och/eller maximala yttemperaturen på typskylten är baserad på mätningar tagna vid normal montering och omgivningens förhållande. Montering av enheten i ett trångt utrymme, t.ex. kan märkbart ändra temperaturförhållandena.

5. Start up
5.1 Oil level in the gear unit as delivered

E **The proper oil level for the mounting position is designed by the plant.** (See gear unit nameplate for the precise amount of oil to add.)

E **A change in the mounted position must not be made unless this is discussed in advance with Watt Drive.**
The ATEX approval will be null and void if this advance approval is not obtained!

S If the gear unit is opened, for example: to make repairs, it must be filled with the correct lubricant in the correct amount as stated on the nameplate before being put back into service.
For lubricants, see section 8 on page 27. For the amount of lubricant, see the gear unit nameplate.

5.2 Temperature measurement

E The information on the ATEX temperature class and/or the maximum surface temperature on the nameplate are based on measurements taken on normal mounting and ambient conditions. Installing the unit in a tight area, for example, can significantly change the temperature conditions.

Under uppstart, måste yttemperaturen mätas vid maximala arbetsförhållanden. Den maximala yttemperaturen är nådd efter ca 3 timmar, och den får inte överstiga 90°C.
Yttemperaturen skall mäta med standard kommersiellt tillgängliga temperturmätningsinstrument.

S **Vid högre temperaturer, måste driften stängas av omedelbart och Watt Drive kontaktas.**

5.3 Kontroll av växelenheten

Under uppstart, måste växelenheten bli testad vid maximal belastning för:

- Ovanliga ljud
- Vibrationer och oönskade svängningar
- Rökbildning

Under provkörning skall växelenheten testas för:

- Läckage
- Vid klämkopplingstyper: Efter borttagning av skydds-kåpan, kontrollera om eventuella rörelser har uppstått mellan hålaxel och maskinaxel. Återmontera skydds-kåpan.

E **Driften måste stängas av om någon abnormitet besläktad med orsakerna i listan ovanför har upptäckts under inspektion. Kontakta Watt Drive.**

5.4 Drifttagning av växelenheter/växelmotorer i EX miljö

E **Växelenhet:**
Överbelastning av växelenheten måste förhindras. Data angivet på växelenheten får ej överskridas.

E **Växelmotorer monterade i ett nätverk:**
Typskyltsdata för växelenheten och motorn måste matcha driftsvillkoren.

E **Växelmotorer drivna via en frekvensomriktare:**
Växelmotorn måste vara godkänd drift av en frekvens-omriktare.

Frekvensomriktarens parametrar måste säkerställas så att:

- växelmotorn inte blir överlastad
- typskyltens data inte överskrids.

E **De specificerade inspektions- och underhålls-intervallerna måste observeras.**

During start up, the surface temperature must be measured in the maximum operating condition. The max. surface temperature is reached in about 3 hours, and it must not exceed 90°C. The surface temperature shall be measured with standard commercially available temperature-measuring instruments.

S **At higher temperatures, the drive must be shut down immediately and Watt Drive must be contacted.**

5.3 Inspecting the gear unit

During start up, the gear unit must be tested under maximum load for:

- unusual noises
- vibrations and unusual oscillations
- smoke formation

Following the trial run, the gear unit is to be checked for:

- Leaks
- With shrink disc types: After removing the cover cap, check whether any relative movement has occurred between the follow shaft and the machine shaft. Then reinstall the cover guard.

E **The drive must be shut down if any abnormalities relative to the items listed above have been noted upon inspection. Contact Watt Drive.**

5.4 Starting the gear unit / gear motors in explosion areas

E **Gear unit:**
Overloading of the gear units must be prevented. The data stated on the gear unit must not be exceeded.

E **Gear motors operating on a network:**
The nameplate data for the gear unit and motor must match the service conditions.

E **Gear motors operating by means of an inverter:**
The gear motor must be approved for operation on an inverter.

The inverter's parameters must ensure that:

- the gear motor is not overloaded
- the nameplate data are not exceeded.

E **The specified inspection and maintenance intervals must be observed.**

6. Inspektion och Underhåll

Växelenheter av modell serien H, A, F, K i storlek 40, 50, 55, 60, 65 är **underhållsfria**, ett oljebyte är ej nödvändigt. För dessa växelenheter ingår det ingen luftplugg, det finns **ingen oljetappnings**-, oljenivå- respektive oljefyllningsplugg.

Växelenheter av modell serien H, A, F, K, C i storlek 70, 75, 80, 85, 110, 130, 133, 136 och för alla kugg-snäckväxlar S, måste ett **oljebyte** utföras i samband med underhållsperioderna. Växelenheterna är utrustade med oljetappnings- respektive oljefyllningsplugg för de vanligaste monteringslägena.

För speciella applikationer under svåra/aggressiva omgivningsförhållanden måste ett oljebyte ske frekvent!

6. Inspection and maintenance

Gear units of the model range H, A, F, K, size 40, 50, 55, 60, and 65 are **maintenance-free**, an oil change is not necessary. The gear units are executed without breather plug, there are **no oil drain-**, oil level respectively oil filling screws.

In the case of gear units of model range H, A, F, K, C size 70, 75, 80, 85, 110, 130, 133, 136 and all helical worm gear units, an **oil change** has to be executed corresponding to the maintenance periods. The gear units are executed with oil drain-, respectively oil filling screws for the main mounting positions.

For special applications under difficult/aggressive ambient conditions an oil change has to be done frequently!

6.1 Inspektions- och Underhållsintervall

Tidsintervall	Inspektions- och Underhållsarbete
månadsvis	– Växelenheter måste kontrolleras om ljudförändringar (fortlöpande oljud hos växeln eller lagren) – Kontrollera husets temperatur (max. 90°C 194°F) – Visuell kontroll av tätningar efter läckage – Ta bort dammansamlingar
var 3 månad	– Rengör runt omkring luftpluggen
varje halvår	– Kontrollera gummibussningsenheten – Kontrollera monteringsskruvarna så att de är åtdragna
var 5 000 drifttimme, ej senare än vart 4 år	– Visuell kontroll av axeltätningarna; om den ej är användbar byt axeltätningen.
var 10 000 drifttimme, ej senare än vart 5 år	– **Oljebyte:** Rak kuggväxel H. 70. - H. 136. Parallellaxelkuggväxel F.. 75. - F.. 136. Tappväxel A.. 76. - A.. 86. Vinkelkuggväxel K.. 70. - K.. 136. Vinkelkuggväxel C.. 70. - C.. 130.
var 20 000 drifttimme, ej senare än vart 5 år	– **Oljebyte:** alla kuggsnäckväxelenheter
var 10 år	Generell renovering

6.1 Inspection and maintenance intervals

Time interval	Inspection and maintenance work
monthly	- gear units must be checked for noise changes (running noise of the gearing and rolling bearings) - Check the housing temperature (max. 90°C 190°F) - Visible inspection of seals for leakage - Remove dust deposits
every 3 months	- Clean the exterior of the vent plug
every half year	- Check the rubber buffer set - Check the fixing bolts to make certain they are tight
every 5.000 service hours, no later than every 4 years	- Visual check of the shaft seals; if applicable replace the shaft seals
every 10.000 service hours, no later than every 5 years	- **Oil change:** Helical gear unit H. 70. - H. 136. Parallel shaft gear unit F.. 75. - F.. 136. Shaft mounted gear unit A.. 76. - A.. 86. Helical bevel gear unit K.. 70. - K.. 136. Angle parallel shaft gear unit C.. 70. - C.. 130.
every 20.000 service hours, no later than every 5 years	- **Oil change:** all helical worm gear units
every 10 years	General recovery

6.2 Inspektions- och Underhållsarbeten för växelenheten

E Inga explosiva ämnen får användas eller finnas i närheten vid underhålls- eller reparationsarbeten. Underhåll och reparation får endast utföras av kvalificerad personal.

!! Installations- och underhållsarbeten får endast utföras då växelenheten är frånslagen.

!! Det får inte finnas någon last på driften, och förebyggande åtgärder skall vidtas så att enheten ej ska kunna starta.

E **Visuell kontroll av tätningar för läckage:**
Se till att ingen växel olja försvinner och att inga oljespår kan upptäckas. Särskilt vid axeltätningarna och täcklocken, men även tätningsytorna måste kontrolleras.

!! **Kontroll av gummibussningkit:**
Gummibussningskittet måste kontrolleras mot visuell skada, så som sprickor på ytan, och de måste bytas ut vid somliga tillfällen.

E **Utbyte av axeltätning:**
Ta bort alla dammansamlingar som har bildats på växelenheten. Om växelenheten är försedd med skyddskåpa, ta bort denna också samt rengör den. Därefter återmontera skyddskåpan (se Kap. 4.7, sidan 16).

!! **Utbyte av axeltätning:**
Koppla ifrån växelmotorn från den elektriska kraftkällan och vidtag åtgärder så att strömmen ej kan slås på av misstag.
(Viktigt: tillåt växelenheten att kylas av!)

Vid utbyte av axeltätning, se till att, beroende på utförande, en tillräcklig mängd fett appliceras mellan dammläppen och tätningsläppen.

Vid användning av dubbel tätning, fyll en tredjedel av utrymmet mellan dem med fett.

Total översyn:
Total översyn skall utföras av Watt Drive eller en verkstad auktoriserad av Watt Drive.

7. Driftstörningar
7.1 Driftstörningar på växelenheten

Om det finns ett fortlöpande oljud, eller om olja läcker ut, stäng av växelenheten och kontakta Watt Drive.

Var vänlig och meddela följande information om hjälp behövs:

- Data från typskylten
- Typ av problem
- Tidpunkt då det upptäcktes samt omständigheterna kring problemet
- Möjliga orsaker

6.2 Inspection and maintenance work on gear unit

E No explosive atmosphere may be prevented in any maintenance or repair work. Maintenance and repair work must only be performed by qualified specialists in the field.

!! Installation and maintenance work may only be performed when the gear units are shut down.

!! There must be no load on the drive, and steps must be taken to prevent units from being actually turned on.

E **Visible inspection of seals for leakage:**
Make certain that no gear oil is escaping and that no oil traces can be found. In particular, the shaft seals and locking caps, as well as the sealing surface must be checked.

!! **Check the rubber buffer set:**
The rubber buffer set must be checked for visible damage, such as cracks on the surface, and they must be replaced in some cases.

E **Change the shaft seals:**
Remove any layers of dust that have accumulated on the gear unit. If the gear unit design included a cover guard, remove it and clean it too. Then reinstall the cover guard (see section 4.7, page 16).

!! **Change the shaft seals:**
Disconnect the gear motor from the electrical power source and take steps to prevent the power from being turned on unintentionally.
(Important: Allow the gear unit to cool down!)

When changing the shaft seal, make certain that, depending on the design, a sufficient deposit of grease is present between the dust lip and the sealing lip.

When using double seals, fill one-third of the space between them with grease.

General overhaul:
The general overhaul is to be performed by Watt Drive or by a shop authorized by Watt Drive.

7. Malfunctions
7.1 Malfunctions on the gear unit

If there are unusual running noises, or if oil is leaking out, turn the gear unit off and contact Watt Drive.

Please provide the following information if help is needed:

- Data from the nameplate
- Type of problem
- Time the problem occurred and circumstances accompanying the problem
- Possible cause

8. Tabell för åtdragningsmoment

Giltig för skruvar som uppfyller klass 8.8:

- Utgående fläns
- Momentarm
- Fotplatta
- Motorfläns
- Skyddslock
- Motormontering

8. Table of Tightening Torques

Valid for screw property class 8.8 :

- Output flange
- Torque arms
- Foot plates
- Input cover
- Protection caps
- Motor mounting

Skruvar i hållbarhetsklass 8.8 Screw property class 8.8	
Gänga Thread	Åtdragningsmoment Ma [Nm] - Tolerans +10% Tightening torque Ma [Nm] - tolerance +10%
M5	5,5
M6	10
M8	25
M10	45
M12	75
M16	190
M20	380
M24	650

9. Smörjmedel

Om en speciell överenskommelse gällande smörjmedel inte har uppförts, skall växelenheten levereras oljefylld. (Se tabell nedan).
Den specificerade växelfyllnadsmängden är angiven på växelenhetens typskylt.
Följande smörjmedelstabell visar de smörjmedel som är godkända för Watt växel enheter.

För kugg-, tapp-, parallellaxel- och vinkelkuggväxelenheter vid omgivningstemperaturer:
-10°C upp till +60°C (14°F upp till 140°F)

Castrol	**ALPHA SP 220**	KLÜBER LUBRICATION	**Klüberoil GEM 1-220**
ARAL	**DEGOL BG 220**	Mobil	**Mobilgear 630**
BP	**Energol GR-XP 220**	Shell	**Shell Omala Oil 220**
Esso	**Spartan EP 220**		

Syntetiska smörjmedel för kuggsnäckväxelenheter vid omgivningstemperaturer:
-20°C upp till +80°C (-4°F upp till 176°F)

Shell	**Tivela S460**	Esso	**Glycolube S460**
ARAL	**DEGOL GS 460**	KLÜBER LUBRICATION	**Klübersynth GH6-460**
Castrol	**Alpha SYN PG 460**	BP	**Enersyn SG-XP 460**

Blanda inte olika typer av smörjmedel!

Smörjmedel för andra omgivningsförhållanden på begäran.
Livsmedelsgodkänd och biologiskt nedbrytbara smörjmedel på begäran.

9. Lubricants

If a special agreement regarding the lubricant is not reached, the gear units shall be delivered factory-filled. (See table below.)
The specified gear fill amount is stated on the gear unit nameplate.
The following lubricant table shows the lubricants that are approved for the WATT gear units.

For helical, shaft-mounted, parallel shaft, helical bevel and angle parallel shaft gear units at ambient temperatures:
-10°C up to +60°C (14°F up to 140°F)

Castrol	**ALPHA SP 220**	KLÜBER LUBRICATION	**Klüberoil GEM 1-220**
ARAL	**DEGOL BG 220**	Mobil	**Mobilgear 630**
BP	**Energol GR-XP 220**	Shell	**Shell Omala Oil 220**
Esso	**Spartan EP 220**		

Synthetic lubricant for helical worm gear units at ambient temperatures:
-20°C up to +80°C (-4°F up to 176°F)

Shell	**Tivela S460**	Esso	**Glycolube S460**
ARAL	**DEGOL GS 460**	KLÜBER LUBRICATION	**Klübersynth GH6-460**
Castrol	**Alpha SYN PG 460**	BP	**Enersyn SG-XP 460**

Do not mix different types of lubricant.

Lubricants for other ambient conditions on request.
Food proofed and biodegradable lubricants on request.

10. Monteringsformer och smörjmängder
10.1 Raka kuggväxlar

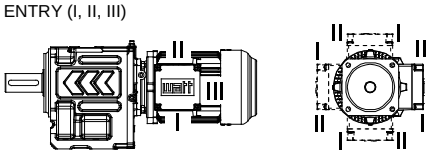
Monteringsform

10. Mounting positions and lubricant capacity
10.1 Helical gear units

MOUNTING POSITIONS

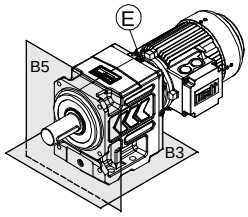
Placering av uttagslådan (A,B,C,D) samt kabelgenomföringarna (I, II, III)

POSITION of TERMINAL BOX (A,B,C,D) and CABLE ENTRY (I, II, III)

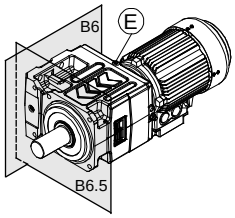


Ⓔ… Placering av luftplugg
Position of the vent plug

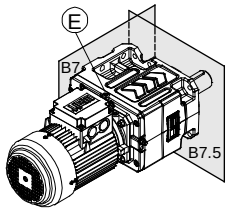
B3/B5



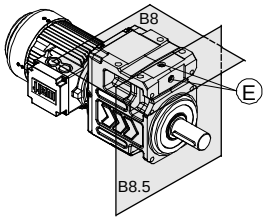
B6



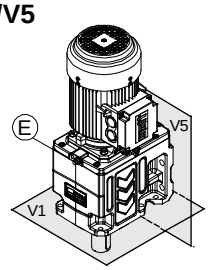
B7



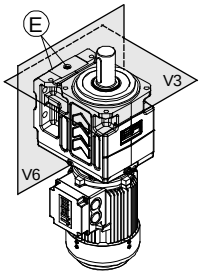
B8



V1/V5



V3/V6



Växelstorlekarna H40, H50, H55, H60, H65 - Har inga luftpluggar monterade oavsett monteringsform som standard

Gear unit sizes H40, H50, H55, H60, H65 - no vent plugs used in any mounting position as standard.

SMÖRJMÄNGDER

LUBRICANT CAPACITY

Typ / Type			Monteringsform/Mounting positions					
			B3/B5	B6	B7	B8	V1/V5	V3/V6
2-stegs 2-stage	H. 40A,S		0,3 l			0,5 l °)	0,35 l	0,5 l °)
	H. 50A,S		0,5 l			0,7 l	0,6 l	0,7 l
	H. 55A		0,6 l			0,8 l	0,7 l	0,8 l
	H. 60A,S		0,7 l			1,0 l	0,9 l	1,0 l
	H. 65A	≤ WAR114+IA+NA+SA+WN	0,9 l			1,2 l	1,3 l	1,2 l
		≥ WAR134	1,2 l			1,7 l	1,3 l	1,7 l
	H. 70A,S	≤ WAR114+IA+NA+SA+WN	1,3 l			1,8 l	1,8 l	1,8 l
		≥ WAR134	1,6 l			2,3 l	1,8 l	2,3 l
	H. 80A	≤ WAR114+IA+NA+SA+WN	1,9 l			2,6 l	2,6 l	2,6 l
		≥ WAR134	2,2 l			3,0 l	2,6 l	3,0 l
	H. 85A,S	≤ WAR114+IA+NA+SA+WN	2,2 l			3,0 l	3,0 l	3,0 l
		≥ WAR134	2,5 l			3,4 l	3,0 l	3,4 l
	H. 110A,S		6,0 l	5,5 l	5,5 l	9,0 l	9,0 l *)	7,0 l
	H. 130A,S		8,5 l	7,5 l	7,5 l	12,0 l	12,0 l *)	12,0 l
	H. 133A,S		15,0 l	13,0 l	13,0 l	19,5 l	24,0 l *)	18,0 l
	H. 136A		24,0 l	21,0 l	25,0 l	28,0 l	27,5 l *)	34,0 l
3-stegs 3-stage	H. 50C		0,75 l			1,05 l °)	0,95 l *)	1,05 l °)
	H. 55C		0,8 l			1,15 l	1,05 l *)	1,15 l
	H. 60C		1,05 l			1,3 l	1,3 l *)	1,3 l
	H. 65C		1,2 l			1,6 l	1,6 l *)	1,6 l
	H. 70C		1,7 l			2,2 l	2,35 l *)	2,2 l
	H. 80C		2,5 l			3,3 l	3,6 l *)	3,3 l
	H. 85C		2,6 l			3,6 l	4,0 l *)	3,8 l
	H. 110C		8,0 l	6,5 l	6,5 l	10,0 l	12,0 l *)	9,0 l
	H. 130C		11,5 l	9,0 l	9,0 l	15,0 l	17,0 l *)	13,5 l
	H. 133C		20,0 l	14,0 l	14,0 l	22,0 l	29,0 l *)	24,0 l
	H. 136C		26,0 l	22,0 l	28,0 l	31,0 l	42,5 l *)	36,0 l
4-stegs 4-stage	H. 70D		2,5 l				2,7 l *)	2,5 l
	H. 80D		3,6 l				3,8 l *)	3,6 l
	H. 85D		4,2 l				4,5 l *)	4,2 l
	H. 110D		9,5 l	7,0 l	7,0 l	10,5 l	13,0 l *)	9,5 l
	H. 130D		14,0 l	9,5 l	9,5 l	15,5 l	19,0 l *)	14,0 l
	H. 133D		22,5 l	14,5 l	14,5 l	22,5 l	30,0 l *)	24,5 l
	H. 136D		29,0 l	23,0 l	29,0 l	34,0 l	50,0 l *)	42,0 l
5-st. 5-st.	H. 110F		10,0 l	7,5 l	7,5 l	11,0 l	13,5 l *)	10,0 l
	H. 130F		14,5 l	10,0 l	10,0 l	16,0 l	18,5 l *)	14,5 l
	H. 133F		23,0 l	15,0 l	15,0 l	23,0 l	30,5 l *)	25,0 l
	H. 136F		32,0 l	24,0 l	30,0 l	35,0 l	50,5 l *)	42,5 l

*) … Riktvärden. Fyll enligt oljenivån! Se sidan 37.
°) …-0,1 l med IA+NA+SA+WN

*) … Orientative values. Fill on oil-level ! See page 37.
°) …-0,1 l at IA+NA+SA+WN

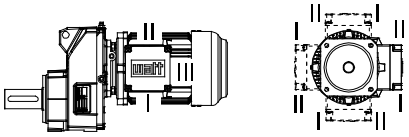
10.2 1-stegs raka kuggväxlar

MONTERINGSFORM

10.2 Single stage helical gear units

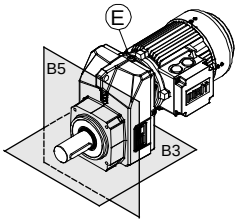
MOUNTING POSITIONS

Placering av uttagslådan (A,B,C,D) samt kabelgenomföringarna (I, II, III)
POSITION of TERMINAL BOX (A,B,C,D) and CABLE ENTRY (I, II, III)

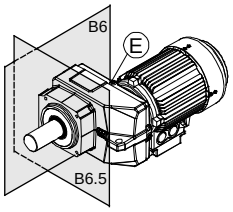


Ⓔ… Placering av luftplugg
Position of the vent plug

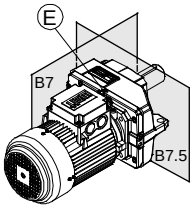
B3/B5



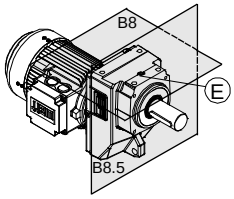
B6



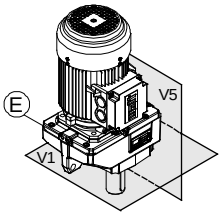
B7



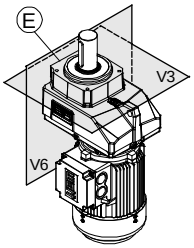
B8



V1/V5



V3/V6



Växelstorlekarna H41E, H51E, H60E -
Har inga luftpluggar monterade oavsett monteringsform som standard.

Gear unit sizes H41E, H51E, H60E –
no vent plugs used in any mounting position as standard.

SMÖRJMÄNGD

LUBRICANT CAPACITY

Typ / Type			Monteringsform/Mounting positions					
			B3/B5	B6	B7	B8	V1/V5	V3/V6
1-steg 1-stage	H. 41E		0,35 l					
	H. 51E		0,4 l					
	H. 60E	≤ WAR114+IA+NA+SA+WN	0,5 l					
		≥ WAR134	0,9 l					1,1 l
	H. 70E	≤ WAR114+IA+NA+SA+WN	1,0 l					
		≥ WAR134	1,3 l					1,5 l
	H. 80E	≤ WAR114+IA+NA+SA+WN	1,5 l					
		≥ WAR134	1,8 l					2,1 l
	H. 110E		4,5 l			5,5 l	4,5 l	5,5 l *)

*) … Riktvärden. Fyll enligt oljenivån! Se sidan 37.

*) … Orientative values. Fill on oil-level ! See page 37.

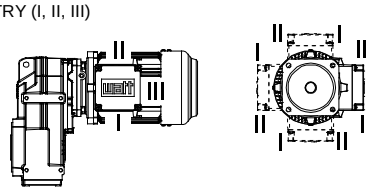
10.3 Tappväxlar

MONTERINGSFORM

10.3 Shaft mounted gear units

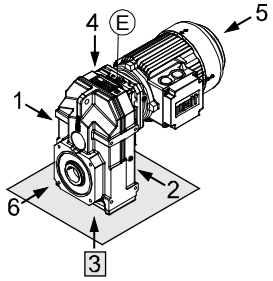
MOUNTING POSITIONS

Placering av uttagslådan (A,B,C,D) samt kabelgenomföringarna (I, II, III)
POSITION of TERMINAL BOX (A,B,C,D) and CABLE ENTRY (I, II, III)

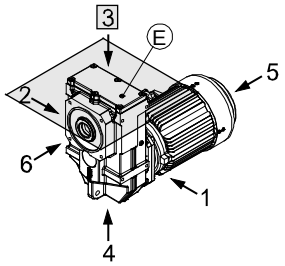


Ⓔ… Placering av luftplugg
Position of the vent plug

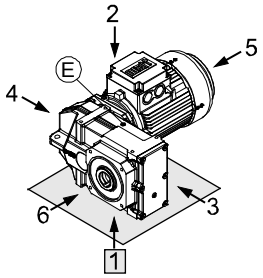
H3..



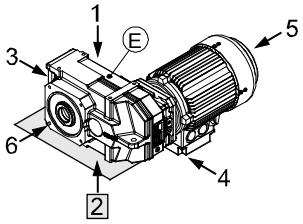
H4..



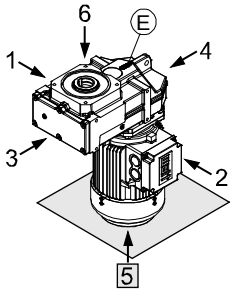
H1..



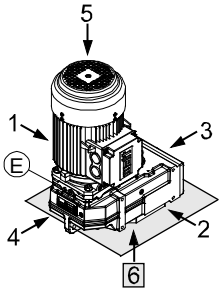
H2..



V5..



V6..



Växelstorlekarna A46, A56, A66 -
Har inga luftpluggar monterade oavsett monteringsform som standard. Med undantag av A66C med monteringsformen V6, som måste ha luftplugg.

Gear unit sizes A.. 46., A.. 56., A.. 66.-
no vent plugs used in any mounting position as standard. Exception A66C for the mounting position V6. For this gear unit a vent plug must be used.

SMÖRJMÄNGD

LUBRICANT CAPACITY

Typ / Type			Monteringsform/Mounting positions					
			H1	H2	H3	V6	H4	V5
2-stegs 2-stage	A.. 46A,S		0,9 l			1,05 l	1,1 l	
	A.. 56A,S		0,9 l		1,3 l	1,5 l	1,3 l	
	A.. 66A,S	≤ WAR114+IA+NA+SA+WN	1,8 l		2,7 l	3,3 l	2,7 l	
		≥ WAR134	2,2 l		3,3 l	3,3 l	3,3 l	
	A.. 76A,S	≤ WAR114+IA+NA+SA+WN	3,1 l		4,5 l	5,5 l	4,5 l	
		≥ WAR134	3,4 l		5,1 l	5,5 l	5,1 l	
	A.. 86A,S	≤ WAR114+IA+NA+SA+WN	6,0 l		9,0 l	10,9 l	9,0 l	
		≥ WAR134	6,4 l		9,8 l	10,9 l	9,8 l	
3-st. 3-st	A.. 56C		1,1 l		1,7 l	1,8 l *)	1,7 l	
	A.. 66C		2,0 l		3,4 l	3,8 l *)	3,4 l	
	A.. 76C		3,2 l		5,5 l	6,1 l *)	5,5 l	
	A.. 86C		6,0 l		10,0 l	11,9 l *)	10,0 l	
4-st. 4-st.	A.. 76D		3,5 l		6,2 l	6,5 l *)	6,2 l	
	A.. 86D		6,2 l		11,0 l	12,2 l *)	11,0 l	

*) … Riktvärden. Fyll enligt oljenivån! Se sidan 37.

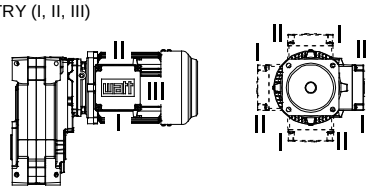
*) … Orientative values. Fill on oil-level ! See page 37.

10.4 Parallellaxelväxlar

MONTERINGSFORM

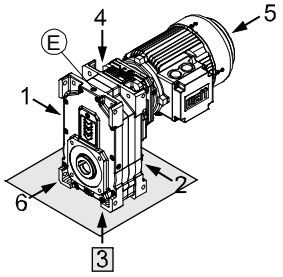
Placering av uttagslådan (A,B,C,D) samt kabelgenomföringarna (I, II, III)

POSITION of TERMINAL BOX (A,B,C,D) and CABLE ENTRY (I, II, III)

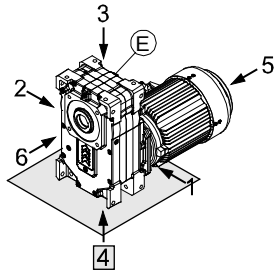


Ⓔ… Placering av luftplugg
Position of the vent plug

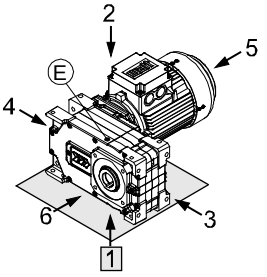
H3..



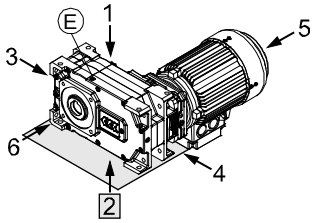
H4..



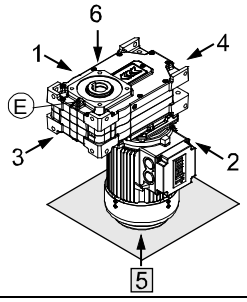
H1..



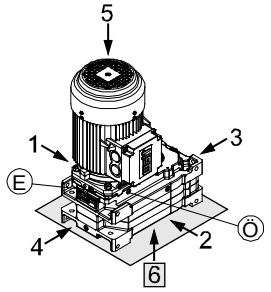
H2..



V5..



V6..



Växelstorlekarna F55, F65 -
Har inga luftpluggar monterade oavsett monteringsform som standard. Med undantag av F65C med monteringsformen V6, som måste ha luftplugg.

10.4 Parallel shaft gear units

MOUNTING POSITIONS

Gear unit sizes F.. 55., F.. 65. -
no vent plugs used in any mounting position as standard. Exception F65C for the mounting position V6. For this gear unit a vent plug must be used.

SMÖRJMÄNGD

LUBRICANT CAPACITY

	Typ / Type		Monteringsform/Mounting positions					
			H1	H2	H3	V5	H4	V6
2-stegs 2-stage	F.. 55A,S		0,9 l		1,2 l		1,3 l	1,45 l
	F.. 65A,S	≤ WAR114+IA+NA+SA+WN	1,7 l		2,2 l		2,7 l	3,0 l
		≥ WAR134	2,0 l		2,8 l		3,2 l	3,0 l
	F.. 75A,S	≤ WAR114+IA+NA+SA+WN	3,0 l		3,9 l		4,6 l	5,5 l
		≥ WAR134	3,3 l		4,2 l		5,2 l	5,5 l
	F.. 85A,S	≤ WAR114+IA+NA+SA+WN	5,6 l		7,5 l		8,6 l	10,5 l
		≥ WAR134	6,0 l		8,0 l		9,4 l	10,5 l
	F.. 110A,S		8,0 l		11,0 l		14,0 l	14,0 l *)
	F.. 130A,S		13,0 l		17,0 l		23,0 l	23,0 l *)
3- 3-	F.. 136A		26,0 l		39,0 l			47,0 l *)
3-stegs 3-stage	F.. 55C		1,1 l		1,6 l		1,8 l	1,8 l *)
	F.. 65C		2,0 l		3,0 l		3,2 l	3,5 l *)
	F.. 75C		3,2 l		5,0 l		5,0 l	6,1 l *)
	F.. 85C		5,9 l		9,0 l		9,0 l	11,5 l *)
	F.. 110C		9,0 l		14,0 l		15,0 l	17,0 l *)
	F.. 130C		14,0 l		23,0 l		25,0 l	28,0 l *)
4- 4-	F.. 136C		27,0 l		46,0 l	41,0 l	41,0 l	51,5 l *)
4-st. 4-st.	F.. 75D		3,4 l		5,8 l	5,5 l		6,4 l *)
	F.. 85D		6,1 l		10,2 l	9,6 l		11,9 l *)
	F.. 110D		9,5 l		15,0 l	14,0 l	15,4 l	17,4 l *)
	F.. 130D		14,5 l		26,5 l	23,5 l	25,5 l	29,0 l *)
5- 5-	F.. 136D		28,0 l		49,0 l	42,0 l		52,5 l *)

*) … Riktvärden. Fyll enligt oljenivån! Se sidan 37.

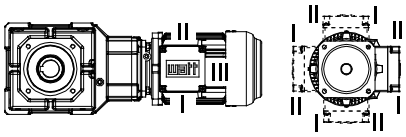
*) … Orientative values. Fill on oil-level ! See page 37.

10.5 Vinkelkuggväxel

MONTERINGSFORM

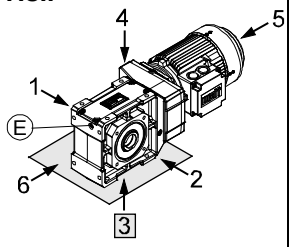
Placering av uttagslådan (A,B,C,D) samt kabelgenomföringarna (I, II, III)

POSITION of TERMINAL BOX (A,B,C,D) and CABLE ENTRY (I, II, III)

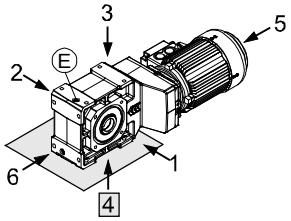


Ⓔ… Placering av luftplugg
Position of the vent plug

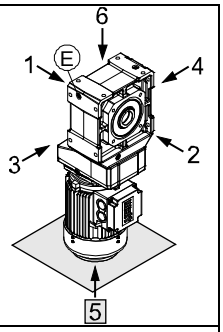
H3..



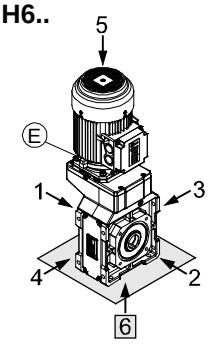
H4..



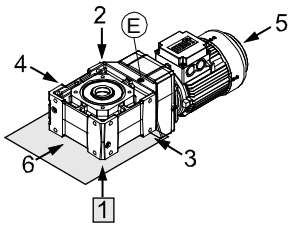
H5..



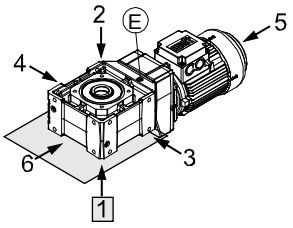
H6..



V1..



V2..



Växelstorlekarna K40, K50, K60 -
Har inga luftpluggar monterade oavsett monteringsform som standard.

Gear unit sizes K40, K50, K60 -
no vent plugs used in any mounting position as standard.

10.5 Helical bevel gear units

MOUNTING POSITIONS

SMÖRJMÄNGD

LUBRICANT CAPACITY

Typ / Type			Monteringsform/Mounting positions					
			H3	H4	V1	V2	H5	H6
2-stegs 2-stage	K.. 40A		0,7 l		1,0 l			
	K.. 50A		0,8 l		1,2 l			1,25 l
	K.. 60A	≤ WAR114+IA+NA+SA+WN	1,3 l		2,0 l			2,1 l
		≥ WAR134	1,6 l		2,3 l			2,1 l
	K.. 70A	≤ WAR114+IA+NA+SA+WN	2,3 l			3,9 l	2,6 l	4,1 l
		≥ WAR134	2,8 l			4,1 l	3,2 l	4,1 l
	K.. 75A	≤ WAR114+IA+NA+SA+WN	3,0 l			5,0 l	3,0 l	5,5 l
		≥ WAR134	3,4 l			5,3 l	3,6 l	5,5 l
3-stegs 3-stage	K.. 77A	≤ WAR114+IA+NA+SA+WN	2,6 l	3,5 l	2,6 l		3,5 l	5,0 l
		≥ WAR134	2,8 l	4,1 l	2,8 l		4,1 l	5,0 l
	K.. 80A	≤ WAR114+IA+NA+SA+WN	4,5 l	6,4 l	4,5 l		5,8 l	8,8 l
		≥ WAR134	4,7 l	7,0 l	4,7 l		6,4 l	8,8 l
	K.. 85A	≤ WAR114+IA+NA+SA+WN	7,6 l	10,7 l	7,6 l		9,6 l	15,5 l *)
		≥ WAR134	7,9 l	11,3 l	7,9 l		10,2 l	15,5 l *)
	K.. 110A		13,0 l	19,0 l	13,0 l		18,0 l	25,0 l *)
	K.. 136A		30,0 l	44,0 l	30,0 l		39,0 l	61,0 l *)
3-st. 3-st.	K.. 50C		1,0 l		1,5 l			1,6 l *)
	K.. 60C		1,5 l		2,4 l			2,6 l *)
	K.. 70C		2,7 l			4,4 l	3,0 l	4,6 l *)
	K.. 75C		3,4 l			5,8 l	3,4 l	6,2 l *)
4-stesgs 4-stage	K.. 77C		3,8 l		3,0 l		3,9 l	5,7 l *)
	K.. 80C		6,7 l		4,8 l		6,2 l	9,7 l *)
	K.. 85C		11,0 l		8,0 l		10,0 l	16,2 l *)
	K.. 110C		17,0 l	21,0 l	14,0 l		20,0 l	29,0 l *)
	K.. 136C		40,0 l	47,0 l	32,0 l		42,0 l	67,0 l *)
4-st. 4.st.	K.. 70D		3,0 l			4,8 l	3,3 l	5,0 l *)
	K.. 75D		3,7 l			6,2 l	3,7 l	6,4 l *)
5-stegs 5-stage	K.. 77D		4,4 l		3,5 l		4,4 l	5,9 l *)
	K.. 80D		7,0 l		5,3 l		6,7 l	9,7 l *)
	K.. 85D		11,2 l		8,5 l		10,5 l	16,0 l *)
	K.. 110D		21,0 l	22,5 l	15,0 l		22,0 l	28,5 l *)
	K.. 136D		45,0 l	50,0 l	33,0 l		45,0 l	68,0 l *)

*) … Riktvärden. Fyll enligt oljenivån! Se sidan 37.

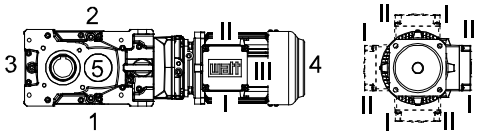
*) … Orientative values. Fill on oil-level ! See page 37.

10.6 Vinkelkuggväxel

MONTERINGSFORM

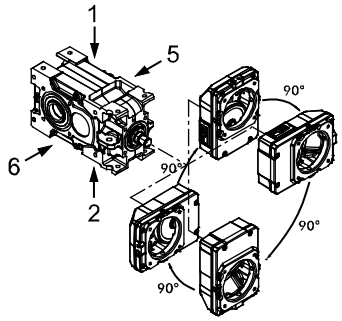
Placering av uttagslådan (A,B,C,D) samt kabelgenomföringarna (I, II, III)

POSITION of TERMINAL BOX (A,B,C,D) and CABLE ENTRY (I, II, III)

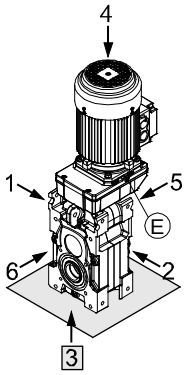


Ⓔ… Placering av luftplugg
Position of the vent plug

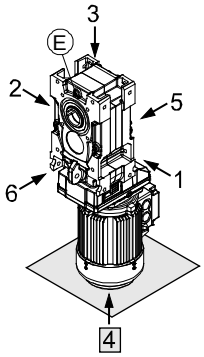
Placering av försteget mot sida 1, 2, 5 oder 6
Position of primary gear unit towards side 1, 2, 5 or 6



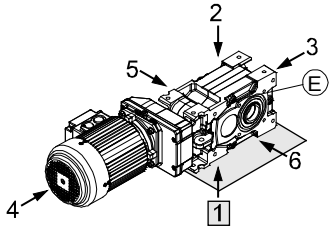
H3..



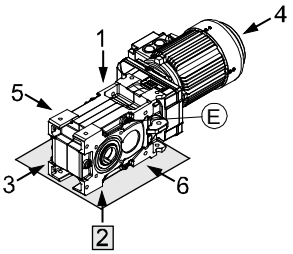
H4..



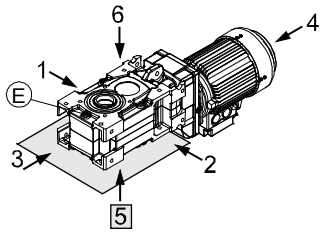
H1..



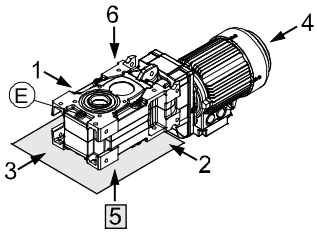
H2..



V5..



V6..



Alla vinkelkuggväxlar har luftpluggar i alla monteringspositioner som standard.

SMÖRJMÄNGD

Typ / Type			Monteringsform/Mounting positions					
			H1	H2	V5	H3	H4	V6
3-stegs 3-stage	C.. 70A	≤ WAR114+IA+NA+SA+WN	2,2 l			3,0 l	2,4 l	2,2 l
		≥ WAR134	2,6 l			3,0 l	3,0 l	2,6 l
	C.. 80A	≤ WAR114+IA+NA+SA+WN	3,7 l			5,6 l	4,0 l	3,7 l
		≥ WAR134	4,2 l			5,6 l	4,6 l	4,2 l
	C.. 85A	≤ WAR114+IA+NA+SA+WN	7,2 l			10,5 l	7,2 l	
		≥ WAR134	7,7 l			10,5 l	7,7 l	
	C.. 110A		9,0 l		12,0 l	15,5 l *)	12,0 l	
	C.. 130A		12,5 l		15,0 l	23,0 l *)	15,0 l	
4-stegs 4-stage	C.. 70C		2,7 l			3,6 l *)	2,7 l	
	C.. 80C		5,6 l			6,5 l *)	5,6 l	
	C.. 85C		9,5 l			11,5 l *)	9,5 l	
	C.. 110C		15,0 l			19,5 l *)	15,0 l	
	C.. 130C		21,0 l			28,0 l *)	21,0 l	
5-stegs 5-stage	C.. 70D		3,6 l			3,9 l *)	3,6 l	
	C.. 80D		6,5 l			7,0 l *)	6,5 l	
	C.. 85D		10,5 l			11,9 l *)	10,5 l	
	C.. 110D		18,0 l			20,0 l *)	18,0 l	
	C.. 130D		25,0 l			29,0 l *)	25,0 l	

*) … Riktvärden. Fyll enligt oljenivån! Se sidan 37.

10.6 Angle parallel shaft gear units

MOUNTING POSITIONS

All angle parallel shaft gear units have vent plugs in all mounting positions as standard.

LUBRICANT CAPACITY

*) … Orientative values. Fill on oil-level ! See page 37.

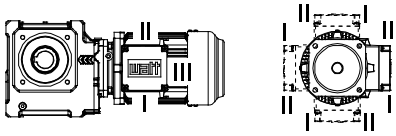
10.7 Kuggsnäckväxel

MONTERINGSFORM

10.7 Helical worm gear units

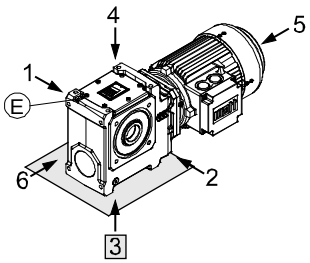
MOUNTING POSITIONS

Placering av uttagslådan (A,B,C,D) samt kabelgenomföringarna (I, II, III)
POSITION of TERMINAL BOX (A,B,C,D) and CABLE ENTRY (I, II, III)

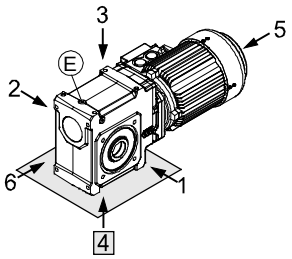


Ⓔ… Placering av luftplugg
Position of the vent plug

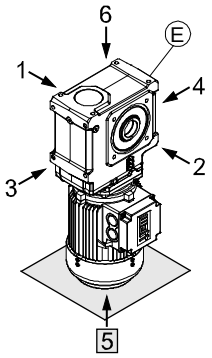
H3..



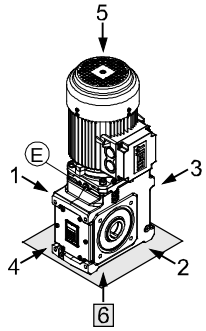
H4..



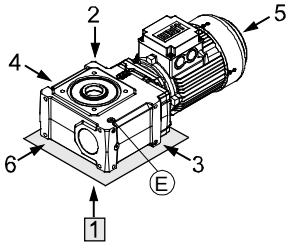
H5..



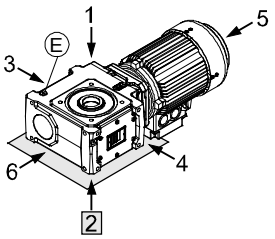
H6..



V1..



V2..



Alla kuggsnäckväxlar har luftpluggar i alla monteringspositioner som standard.

All helical worm gear units have vent plugs in all mounting positions as standard.

SMÖRJMÄNGD

LUBRICANT CAPACITY

Typ / Type		Monteringsform/Mounting positions					
		H3	V1	V2	H6	H5	H4
2-stegs 2-stage	S.. 404A,B,S	0,5 l				0,55 l	
	S.. 454A,B,S	0,5 l				0,55 l	
	S.. 455A,B,S	0,65 l			0,75 l	0,85 l	0,65 l
	S.. 506A,B,S	1,1 l			1,45 l		1,1 l
	S.. 507A,B,S	1,2 l			1,6 l		1,2 l
	S.. 608A,B	1,8 l			2,6 l	2,4 l	1,8 l
	S.. 609A,B ≤ WAR114+IA+NA+SA+WN	2,1 l			3,0 l	2,7 l	2,1 l
	S.. 609A,B ≥ WAR134	2,4 l			3,0 l	3,3 l	2,7 l
3-st. 3-st.	S.. 506C	1,35 l			1,8 l *)	1,8 l	1,35 l
	S.. 507C	1,45 l			1,9 l *)	1,9 l	1,45 l
	S.. 608C	2,1 l			3,0 l *)	2,3 l	2,1 l
	S.. 609C	2,4 l			3,5 l *)	3,1 l	2,4 l

*) … Riktvärden. Fyll enligt oljenivån! Se sidan 37.

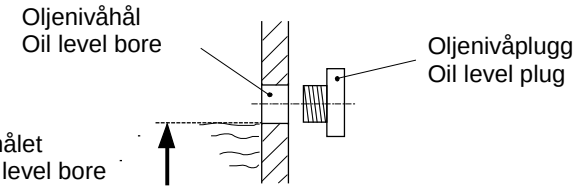
*) … Orientative values. Fill on oil-level ! See page 37.

10.8 Oljenivåkonroll på växlar med oljenivåplugg vid vertikala monteringsformer

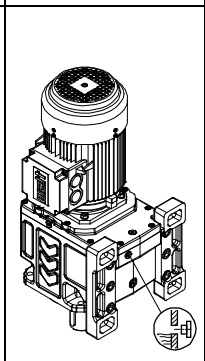
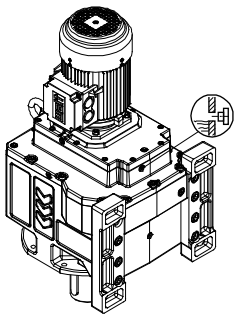
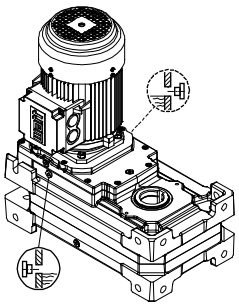
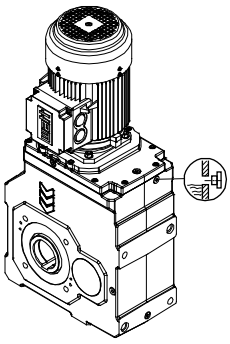
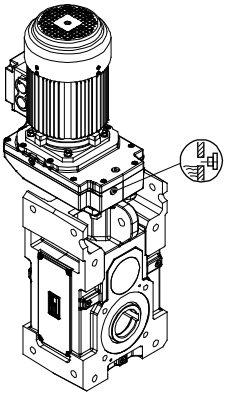
!! - Bryt spänningen till växelmotorn!
- Ta bort oljenivåpluggen
- Kontrollera oljenivån.

10.8 Oil level control of gear units with oil level plug at vertical mounting position

!! - De-energized the geared motor!
- Remove the oil level plug.
- Check the oil level.

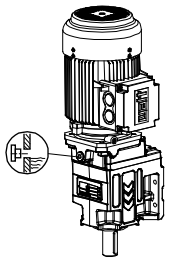
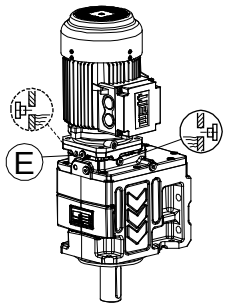
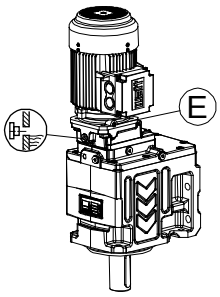
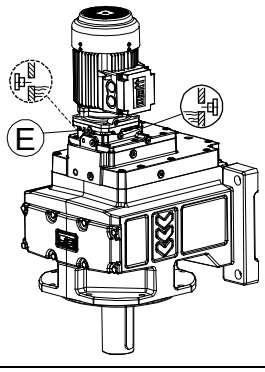
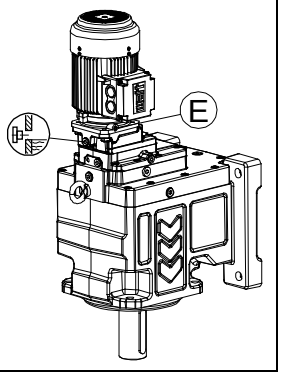


Korrekt oljenivå = Underkanten av oljenivåhålet
Correct oil fill level = Bottom edge of the oil level bore

Växelstorlek Gear unit size	H. 110E H. 110A,S H. 130A,S H. 133A,S H. 136A	H. 136C	F.. 110A,S F.. 130A,S F.. 136A	K.. 85A K.. 110A K.. 136A	C.. 110A C.. 130A
Monteringsform Mounting pos.	**V1/V5**	**V1/V5**	**V6**	**H6**	**H3**
Placering av oljenivåpluggen Position of the oil level plug					

3-, 4- och 5-stegs växlar för att exempelgöra på raka kuggväxlar.

3-, 4- and 5-stage gear units to exemplify on helical gear unit.

H. 50C – 65C A.. 56C, 66C F.. 55C, 65C K.. 50C, 60C S.. 506C – 609C	H. 70C – 133C, 136D A.. 76C, 86C F.. 75C – 136C K.. 70C – 136C C.. 70C – 130C	H. 70D – 85D A.. 76D, 86D F.. 75D, 85D K.. 75D – 85D C.. 70D – 85D	H. 110D – 133D, 136F F.. 110D – 136D K.. 110D, 136D C.. 110D, 130D	H. 110F – 133F F. 110F – 130F
				

Ⓔ…. Placering av luftplugg / Position of the vent plug

11. Konformitetsdeklaration
11.1 Drifter enligt kategori I M2

11. Declaration of conformity

WATT DRIVE Antriebstechnik GmbH
Wöllersdorfer Straße 68, A-2753 Markt Piesting, Austria
Tel.: +43-(0)2633/404-0, Fax: +43-(0)2633/404-220
Email: watt@wattdrive.com, Web: www.wattdrive.com

HKL.FGB.GT.007.000.10.05

EG - Konformitätserklärung

im Sinne der EG-Richtlinie Explosionsschutz 94/9/EG, Anhang VIII

Die unten bezeichneten Produkte der **WATT DRIVE Antriebstechnik GmbH** sind konform mit den Vorschriften der EG-Richtlinie 94/9/EG - Explosionsschutz für nicht elektrische Geräte innerhalb der Bedingungen:

Gerätegruppe I, Kategorie M2

Produkt:	**Typenbezeichnung:**
- Stirnradgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	H.
- Aufsteckgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	A.
- Flachgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	F.
- Stirnradschneckengetriebe mit Motor-Adapter oder Eintriebswellen-Modul	S.
- Kegelstirnradgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	K.
- Kegelflachgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	C.

Die Übereinstimmung oben bezeichneter Produkte mit den Vorschriften der EG-Richtlinie 94/9/EG wird durch die Einhaltung folgender Normen nachgewiesen:

DIN EN 1127-1
DIN EN 13463-1
DIN EN 13463-5
DIN EN 13463-8

WATT DRIVE Antriebstechnik GmbH hinterlegt die gemäß 94/9/EG, Anhang VIII geforderten Unterlagen bei benannter Stelle:

TÜV Österreich, Nr. 0408

Markt Piesting, 03.10.2005
Datum

Richard Osmetz
Richard Osmetz - Techn. Leiter

11.1 Gear units of category I M2

WATT DRIVE Antriebstechnik GmbH
Wöllersdorfer Straße 68, A-2753 Markt Piesting, Austria
Tel.: +43-(0)2633/404-0, Fax: +43-(0)2633/404-220
Email: watt@wattdrive.com, Web: www.wattdrive.com

HKL.FGB.GT.008.000.10.05

EC - Conformity Declaration

as defined by EC Directive "Explosion Protection" 94/9/EC, Appendix VIII

The below named products of **WATT DRIVE Antriebstechnik GmbH** correspond with the provisions of the EC Directive 94/9/EC - explosion protection for non-electrical equipment within the conditions:

Equipment group I, Category M2

Product:	**Type designation:**
- Helical gear units with adapter modul or input shaft unit modul	H.
- Shaft mounted gear units with adapter modul or input shaft unit modul	A.
- Parallel shaft gear units with adapter modul or input shaft unit modul	F.
- Helical worm gear units with adapter modul or input shaft unit modul	S.
- Helical bevel gear units with adapter modul or input shaft unit modul	K.
- Angle parallel shaft gear units with adapter modul or input shaft unit modul	C.

The compliance of the above named products with the provisions of this EC Directive is proven by their conformance to the following standards:

DIN EN 1127-1
DIN EN 13463-1
DIN EN 13463-5
DIN EN 13463-8

WATT DRIVE Antriebstechnik GmbH will archive the documents required according to 94/9/EC, Appendix VIII at the following location:

TÜV Austria, Nr. 0408

Markt Piesting, 03.10.2005

Date

Richard Osmetz - Technical Manager

11.2 Drifter enligt Kategori II 2G och II 2D

WATT DRIVE Antriebstechnik GmbH
Wöllersdorfer Straße 68, A-2753 Markt Piesting, Austria
Tel.: +43-(0)2633/404-0, Fax: +43-(0)2633/404-220
Email: watt@wattdrive.com, Web: www.wattdrive.com

HKL.FGB.GT.003.002.10.05

EG - Konformitätserklärung

im Sinne der EG-Richtlinie "Explosionsschutz" 94/9/EG, Anhang VIII

Die unten bezeichneten Produkte der **WATT DRIVE Antriebstechnik GmbH** sind konform mit den Vorschriften der EG-Richtlinie 94/9/EG - Explosionsschutz für nicht elektrische Geräte innerhalb der Bedingungen:

Zone 1 und 21, Gerätegruppe II, Kategorie 2G und 2D

Produkt:	**Typenbezeichnung:**
- Stirnradgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	H.
- Aufsteckgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	A.
- Flachgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	F.
- Stirnradschneckengetriebe mit Motor-Adapter oder Eintriebswellen-Modul	S.
- Kegelstirnradgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	K.
- Kegelflachgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	C.

Die Übereinstimmung oben bezeichneter Produkte mit den Vorschriften der EG-Richtlinie 94/9/EG wird durch die Einhaltung folgender Normen nachgewiesen:

DIN EN 1127-1
DIN EN 13463-1
DIN EN 13463-5
DIN EN 13463-8

WATT DRIVE Antriebstechnik GmbH hinterlegt die gemäß 94/9/EG, Anhang VIII geforderten Unterlagen bei benannter Stelle:

TÜV Österreich, Nr. 0408

Markt Piesting, 03.10.2005
Datum

Richard Osmetz
Richard Osmetz - Techn. Leiter

11.2 Gear units of category II 2G and II 2D

WATT DRIVE Antriebstechnik GmbH
Wöllersdorfer Straße 68, A-2753 Markt Piesting, Austria
Tel.: +43-(0)2633/404-0, Fax: +43-(0)2633/404-220
Email: watt@wattdrive.com, Web: www.wattdrive.com

HKL.FGB.GT.004.002.10.05

EC - Conformity Declaration

as defined by EC Directive "Explosion Protection" 94/9/EC, Appendix VIII

The below named products of **WATT DRIVE Antriebstechnik GmbH** correspond with the provisions of the EC Directive 94/9/EC - explosion protection for non-electrical equipment within the conditions:

Zone 1 and 21, Equipment group II, Category 2G and 2D

Product:	**Type designation:**
- Helical gear units with adapter modul or input shaft unit modul	H.
- Shaft mounted gear units with adapter modul or input shaft unit modul	A.
- Parallel shaft gear units with adapter modul or input shaft unit modul	F.
- Helical worm gear units with adapter modul or input shaft unit modul	S.
- Helical bevel gear units with adapter modul or input shaft unit modul	K.
- Angle parallel shaft gear units with adapter modul or input shaft unit modul	C.

The compliance of the above named products with the provisions of this EC Directive is proven by their conformance to the following standards:

DIN EN 1127-1
DIN EN 13463-1
DIN EN 13463-5
DIN EN 13463-8

WATT DRIVE Antriebstechnik GmbH will archive the documents required according to 94/9/EC, Appendix VIII at the following location:

TÜV Austria, Nr. 0408

Markt Piesting, 03.10.2005
Date

Richard Osmetz - Technical Manager

11.3 Drifter enligt Kategori II 3G och II 3D

WATT DRIVE Antriebstechnik GmbH
Wöllersdorfer Straße 68, A-2753 Markt Piesting, Austria
Tel.: +43-(0)2633/404-0, Fax: +43-(0)2633/404-220
Email: watt@wattdrive.com, Web: www.wattdrive.com

HKL.FGB.GT.005.000.10.05

EG-Konformitätserklärung

im Sinne der EG-Richtlinie "Explosionsschutz" 94/9/EG, Anhang VIII

Die unten bezeichneten Produkte der **WATT DRIVE Antriebstechnik GmbH** sind konform mit den Vorschriften der EG-Richtlinie 94/9/EG - Explosionsschutz für nicht elektrische Geräte innerhalb der Bedingungen:

Zone 2 und 22, Gerätegruppe II, Kategorie 3G und 3D

Produkt:	**Typenbezeichnung:**
- Stirnradgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	H.
- Aufsteckgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	A.
- Flachgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	F.
- Stirnradschneckengetriebe mit Motor-Adapter oder Eintriebswellen-Modul	S.
- Kegelstirnradgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	K.
- Kegelflachgetriebe mit Motor-Adapter oder Eintriebswellen-Modul	C.

Die Übereinstimmung oben bezeichneter Produkte mit den Vorschriften der EG-Richtlinie 94/9/EG wird durch die Einhaltung folgender Normen nachgewiesen:

DIN EN 1127-1
DIN EN 13463-1
DIN EN 13463-5
DIN EN 13463-8

WATT DRIVE Antriebstechnik GmbH hält die gemäß 94/9/EG geforderten Unterlagen zur Einsicht bereit.

Markt Piesting, 03.10.2005

Datum

Richard Osmetz

Richard Osmetz - Techn. Leiter

11.3 Gear units of category II 3G and II 3D

WATT DRIVE Antriebstechnik GmbH
Wöllersdorfer Straße 68, A-2753 Markt Piesting, Austria
Tel.: +43-(0)2633/404-0, Fax: +43-(0)2633/404-220
Email: watt@wattdrive.com, Web: www.wattdrive.com

HKL.FGB.GT.006.000.10.05

EC-Declaration of Conformity

as defined by EC Directive "Explosion Protection" 94/9/EC, Appendix VIII

The below named products of **WATT DRIVE Antriebstechnik GmbH** correspond with the provisions of the EC Directive 94/9/EC - explosion protection for non-electrical equipment within the conditions:

Zone 2 and 22, Equipment group II, Category 3G and 3D

Product:	**Type designation:**
- Helical gear units with adapter modul or input shaft unit modul	H.
- Shaft mounted gear units with adapter modul or input shaft unit modul	A.
- Parallel shaft gear units with adapter modul or input shaft unit modul	F.
- Helical worm gear units with adapter modul or input shaft unit modul	S.
- Helical bevel gear units with adapter modul or input shaft unit modul	K.
- Angle parallel shaft gear units with adapter modul or input shaft unit modul	C.

The compliance of the above named products with the provisions of this EC Directive is proven by their conformance to the following standards:

DIN EN 1127-1
DIN EN 13463-1
DIN EN 13463-5
DIN EN 13463-8

WATT DRIVE Antriebstechnik GmbH will make available the documents required according to 94/9/EC, Appendix VIII for reference purposes.

Markt Piesting, 03.10.2005
Date

Richard Osmetz
Richard Osmetz - Technical Manager

12. WATT DRIVE Partner

12. WATT DRIVE Partner

Huvudkontor
Headquarter

Austria
WATT DRIVE Antriebstechnik GmbH
Wöllersdorfer Straße 68
2753 Markt Piesting

Tel: +43 / 2633 / 404-0
Fax: +43 / 2633 / 404-220
E-mail: watt@wattdrive.com
Web: www.wattdrive.com

Amerika
DieQua Corporation
180 Covington Drive
60108-3105 Bloomingdale / Chicago / Illinois

Tel: +1 / 630 / 980 1133
Fax: +1 / 630 / 980 1232
E-mail: info@diequa.com
Web: www.diequa.com

Belgium
Vermeire-Belting
Rue de la Filature 41
4800 Ensival-Verviers

Tel: +32 / 87 / 32 23 60
Fax: +32 / 87 / 31 50 71
E-mail: vermeire.belting@vermeire.com
Web: www.vermeire.com

China
Wattage Machinery (Shenzhen) Co. Limited
Unit A3, G/F, Block 5, Chuangye Industrial Area,
No.3 Industrial District, Shasan shangxiawei,
Shajing, Baoan, Shenzhen

Tel: +86 / 755 / 81 49 03 87
Fax: +86 / 755 / 81 49 03 94
E-mail: stiff@ritech-hk.com
Web: www.wattage.com.cn

China
Wattage Machinery (Shenzhen) Co. Limited
Unit 502, 5#, No.7 Building, Xudong Shihua Estate,
Wuchang, Wuhan

Tel: +86 / 27 / 86 72 0 881
Fax: +86 / 27 / 86 72 0 881
E-mail: stiff@ritech-hk.com
Web: www.wattage.com.cn

China - Hong Kong
Ritech Automation & Equipment Ltd.
Units 1-2, 10/F, South China Industrial Building, No.1
Chun Pin Street, Kwai Chung, N.T.,
Hong Kong

Tel: +852 / 2410 1819
Fax: +852 / 2410 1735
E-mail: stiff@ritech-hk.com
Web: www.ritech-hk.com

Czech republic
WATT DRIVE Pohonné systémy, s.r.o.
Polovnícka 8
03601 Martin

Tel: +421 / 43 / 430 36 30
Fax: +421 / 43 / 428 72 20
E-mail: office@wattdrive.sk
Web: www.wattdrive.sk

Croatia
STREL-PROM d.o.o.
Poljana Zvonimira Dražica 8
10000 Zagreb

Tel: +38 / 5 1 38 35 500
Fax: +38 / 5 1 38 35 500
E-mail: prodaja@strel-prom.hr
Web: www.strel-prom.hr

Denmark
Regal A/S
Industrivej 4
4000 Roskilde

Tel: +45 / 46 77 70 00
Fax: +45 / 46 75 76 20
E-mail: regal@regal.dk
Web: www.regal.dk

Egypt
El-Watania for Engineering & Trading
270 A Sudan st.
El Mohandseen

Tel: +202 / 302 56 48
Fax: +202 / 303 86 13
E-mail: watnia@hotmail.com
Email2: hamouda161@hotmail.com

England
Drummotors and More LTD
49 Cyprus Road
LE2 8QT Leicester

Tel: +44 / 0116 / 283 8344
Fax: +44 / 0116 / 283 1544
E-mail: sales@drummotorsandmore.com
Web: www.drummotorsandmore.com

England
MOTION DRIVES AND CONTROLS LTD.
Unit 1A, Budbrook Ind. Estate, Budbrooke Road
CV34 5XH Warwick

Tel: +44 / 1926 / 41 15 44
Fax: +44 / 1926 / 41 15 41
Web: www.motiondrivesandcontrols.co.uk

Finland
LONNE SCANDINAVIA OY
Hernepellontie 11
00560 Helsinki

Tel: +358 / 9 / 3424 300
Fax: +358 / 9 / 34243099
E-mail: info.finland@lonne.com
Web: www.lonne.com

France
SERAX Transmissions
147, Rue Cambetta
59559 Comines Cedex

Tel: +33 / 825 827 124
Fax: +33 / 825 827 125
E-mail: contact@serax.fr
Web: www.serax.fr

Germany
WATT DRIVE GmbH
Eickelstraße 4
59759 Arnsberg

Tel: +49 / 2932 / 96 81-0
Fax: +49 / 2932 / 96 81-81
E-mail: info@wattdrive.de
Web: www.wattdrive.de

Germany
Max Lamb GmbH & Co KG
Am Bauhof 2
97076 Würzburg

Tel: +49 / 931 / 2794-0
Fax: +49 / 931 / 2745 57
E-mail: ant@lamb.de
Web: www.lamb.de

China - Hong Kong
Ritech Automation & Equipment Ltd.
Units 1-2, 10/F, South China Industrial Building, No.1 Chun Pin Street, Kwai Chung, N.T.,
Hong Kong
Tel: +852 / 2410 1819
Fax: +852 / 2410 1735
E-mail: stiff@ritech-hk.com
Web: www.ritech-hk.com

Hungary
IRAMKO Trade Kft.
Szabadkikötö út 4.
1211 Budapest

Tel: +36 / 1 / 425 7354
Fax: +36 / 1 / 425 7355
E-mail: info@wattdrive.hu
Web: www.wattdrive.hu

Hungary
RABITS JOSEF
Lófuttató 4
9400 Sopron

Tel: +36 / 99 336 105
Fax: +36 / 99 508 9 11
E-mail: rabits@axelero.hu
Web: www.rabits.hu

India
M/S RAJDEEP AUTOMATION PVT. LTD
143 Vadgaon Dhayari, 3rd Flr, Sinhaghad Road
411041 Pune
Tel: +91 / 20 / 243 93 755
Tel 2: +91 / 20 / 937 100 51 03
Fax: +91 / 20 / 243 93 756
E-mail: shrenik@pn2.vsnl.net.in
Email2: rajdeep@bom5.vsnl.net.in
Web: www.rajdeepindia.com

Indonesia
PT. CAHAYA SURYA MANDIRI
Sunter Bisma Timur II DI/23
14340 Sunter Agung - Jakarta

Tel: +62 / 21 / 6583 - 4993
Tel 2: +62 / 21 / 6530 - 6499
Fax: +62 / 21 / 6583 -0291
E-mail: cahayasurya@cbn.net.id

Ireland
PRIORY MARKETING
Great Connell
Newbridge, Co. Kildare

Tel: +353 / 45 43 53 42
Fax: +353 / 45 43 55 09
E-mail: priorymarketing@eircom.net
Web: www.priorymarketing.com

Italy
BIANCHI CUSCINETTI SpA
Transmissioni E Componenti
Via G. Zuretti, 102
20125 Milan

Tel: +390 / 26 78 61
Fax: +390 / 26 70 10 62
E-mail: info@bianchicuscinetti.it
Web: www.bianchicuscinetti.it

Belgium + Luxembourg
Vermeire-Belting
Rue de la Filature 41
4800 Ensival-Verviers

Tel: +32 / 87 / 32 23 60
Fax: +32 / 87 / 31 50 71
E-mail: vermeire.belting@vermeire.com
Web: www.vermeire.com

Korea
WATT DRIVE Co.,Ltd
1213, World Meridian Venture Center #60-24, Gasan-Dong,
Geumcheon-Gu,
153-023 Seoul Korea

Tel: +82 / 2 / 2113-7230 to 7232,
Tel 2: +82 / 2 / 894-1230
Fax: +82 / 2 / 2113-7233
Fax2: +82 / 2 / 894-1243
E-mail: wdk@wattdrive.co.kr
Web: www.wattdrive.co.kr

Korea
Watt Drive Süd Korea Co.,Ltd
#1114, Han Lim Human Tech. Building, Keum jeong -
Dong, Gun po-City
435-82 Kyung gi do

Tel: +82 / 31 / 479-7920
Fax: +82 / 31 / 479-7922
E-mail: sang@wattdrivesudkorea.com
Email2: seo@wattdrivesudkorea.com

Lithuania
Arheda
Smelynes g. 112
35113 Panevezys

Tel: +370 / 45 / 581 573
Fax: +370 / 45 / 510 971
E-mail: info@arheda.lt
Web: www.arheda.lt

Lithuania
UAB “Nautega”
V. Maciuleviciaus 53
04310 Vilnius

Tel: +370 / 5 / 2491249
Fax: +370 / 5 / 2491250
E-mail: info@nautega.lt
Web: www.nautega.lt

Malaysia
WATT EURO-DRIVE (Malaysia) Sdn Bhd
No. 17 Jalan Bulan U5/8, Bandar Pinggiran Subang 2
40150 Shah Alam

Tel: +603 / 785 91626
Tel 2: +603 / 785 91613
Fax: +603 / 785 91623
E-mail: info@wattdrive.com.my

Myanmar
I.E.M Company Limited
No. 116, 157th Street, Tamwe Township
Yangon, Myanmar

Tel: +95 / 1 / 540 673
Tel 2: +95 / 1 / 546 064
Fax: +95 / 1 / 540 673
E-mail: yangoniemmya@mptmail.net.mm
Web: www.iemmyanmar.com

Netherlands
MAK AANDRIJVINGEN
Pascallaan 26
Postbus 462
8200 AL Lelystad

Tel: +31 / 320 / 266 966
Fax: +31 / 320 / 266 999
E-mail: info@mak.nl
Web: www.mak.nl

Norway
LÖNNE SCANDINAVIA AS
Liamyrane 12
5132 Nyborg

Tel: +47 / 55 39 10 00
Fax: +47 / 55 39 11 00
E-mail: info.norway@lonne.com
Web: www.lonne.com

Philippines
AVESCO Marketing Corporation
810 AVESCO Building, Aurora Blvd.Corner Yale St., Cubao
Quezon City
PO Box 3531 Manila

Tel: +63 / 2 / 912 8881
Fax: +63 / 2 / 912 2911
Fax2: +63 / 2 / 912 2999
Fax3: +63 / 2 / 912 2352
E-mail: inquiry@avesco.com.ph
Web: www.avesco.com.ph

Philippines
ARIZONA Marketing Corporation
99 F. Manalo St., Cubao
1109 Quezon City

Tel: +63 / 2 / 726 5991
Tel 2: +63 / 2 / 416 5991
Fax: +63 / 2 / 723 2359
E-mail: info@arizonamktg.com
Web: www.arizonamktg.com

Poland
RADIUS
Al Korfantego 83
40-161 Katowice

Tel: + 48 / 32 / 259 21 19
Fax: +48 / 32 / 254 26 76
E-mail: info@radius.pl
Web: www.radius.pl

Poland
TECHNO - Import s.c.
Al. Pilsudskiego 135
92-318 Lódz

Tel: +48 / 42 67 40 979
Fax: +48 / 42 67 40 979
E-mail: watt@wattdrive.pl
Web: www.wattdrive.pl

Poland
ARCHIMEDES Sp. z. o. o.
ul. Polna 133
87-100 Torún

Tel: +48 / 56 / 623 05 90
Tel 2: +48 / 56 / 623 82 46
Fax: +48 / 56 / 653 94 55
E-mail: info@archimedes.pl
Web: www.archimedes.pl

Rumania
WATT DRIVE MOTOR S.R.L
Timisoara Str. Sagovici Samuil Nr. 115
1900 Judet TIMIS

Tel: 0256 227 418
Mobil: 0722218885, 0726444121
Fax: 0256 227 418
E-mail: oficiu@wattdrivemotor.ro
Web: www.wattdrivemotor.com

Russia
OOC “InCoSystems”
13, Groholsky per., building 2
129090 Moscow

Tel: +7 / 095 / 974 1223
Fax: +7 / 095 / 974 1224
E-mail: wattdrive@incosystems.ru
Web: www.incosystems.ru

Serbia and Montenegro
EMG INVEXIM Engineering
Durmitorska 3
11000 Belgrade

Tel: +381 / 11 / 366 0042
Tel 2: +381 / 11 / 268 4456
Fax: +381 / 11 / 366 0100
E-mail: office@emg.co.yu
Web: www.emg.co.yu

Singapore
WATT Euro-Drive (Far East) Pte Ltd
67B, Joo Koon Circle
629082 Singapore

Tel: +65 / 6 862 2220
Fax: +65 / 6 862 3330
E-mail: watteuro@pacific.net.sg
Web: www.wattdrive.com

Slovakia
WATT DRIVE Pohonné systémy, s.r.o.
Polovnícka 8
03601 Martin

Tel: +421 / 43 / 430 36 30
Fax: +421 / 43 / 428 72 20
E-mail: office@wattdrive.sk
Web: www.wattdrive.sk

Slovenia
Branko Skribe s.p. (Watt Drive)
Bolfenška 58
2000 Maribor

Tel: +386 / 2 / 6290304
Mobil: +386 / 41 / 674 828
Fax: +386 / 2 / 6290305
E-mail: sb.elektronika@siol.net

Spain
Atcor / Geryma S.A.
Carretera del Medio 141-143
08907 L,Hospitalet de Llobregat Barcelona

Tel: +34 / 93 335 91 53
Fax: +34 / 93 335 20 89
E-mail: info@atcorgeryma.com
Web: www.atcorgeryma.com

Sweden
BEVI EL AB
Bevivägen 1, Box 41
38421 BLOMSTERMÅLA

Tel: +46 / 499 / 27100
Fax: +46 / 499 / 20008
E-mail: sales@bevi.se
Web: www.bevi.com

Switzerland
Elektromotorenwerk Brienz AG
Mattenweg 1
3855 Brienz

Tel: +41 / 33 / 951 31 31
Fax: +41 / 33 / 951 34 55
E-mail: info@emwb.ch
Web: www.emwb.ch

Taiwan
TAIWAN GONG JI CHANG CO., LTD.
No. 1, Alley 15, Lane 39, Neixi Rd.
Luzhu Shiang, Taoyuan County 33852

Tel: +886 / 3 / 324 1000
Fax: +886 / 3 / 324 5566
E-mail: koki@ms9.hinet.net

Thailand
Sap Inter Supply Co., Ltd.
2/11 moo 12 Sukhontasawad Road, Ladprao
10230 Bangkok

Tel: +66 / 2 / 907 7523-8
Tel 2: +66 / 2 / 553 0890-4
Fax: +66 / 2 / 907 7521
Fax 2: +66 / 2 / 553-1447
E-mail: sales@sapinter.co.th
Web: www.sapinter.co.th

WATT Drives the World

WATT DRIVE ANTRIEBSTECHNIK GMBH
A-2753 Markt Piesting
Wöllersdorfer Straße 68
Austria, EUROPE
Tel.: +43 / 2633 / 404-0
Fax: +43 / 2633 / 404-220
Email: watt@wattdrive.com
Web: www.wattdrive.com

BEVI®

Bevivägen 1, SE-384 30 Blomstermåla
Telefon: +46 499 271 00 • Fax +46 499 200 08
E-mail: sales@bevi.se • production@bevi.se

watt drive
the system drive.

BA.MA.GT.041.004.08.08
BM.WMBA.ATEX