



USERS MANUAL

M-SQ16

- Three phase - 1500 RPM -

Marine diesel generating set 230/400V-50 Hz
Digital Diesel Control



Art.nr. 40200371

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1 INTRODUCTION

1.1 GENERAL

The M-SQ16 Three Phase Marine Diesel Generating set is manufactured and marketed by WhisperPower.

It is important to read this manual before installing and operating the generating set. Both safety and durability rely very much on the correct identification, installation and a good understanding of ratings, features, design, maintenance and operation procedures.

The information, specifications, illustrations and statements contained within this publication are given with our best intentions and are believed to be correct at the time of going to press.

All of the specifications, provisions and instructions contained in this manual apply solely to standard versions of the WhisperPower M-SQ16 generating set.

This manual is valid for the following models:

| Part number | Description |
|-------------|--|
| 41108305 | M-SQ16 Three Phase 230V-400V 1500rpm |
| 41108306 | M-SQ16 Three Phase 230V-400V 1500rpm-ungrounded |

For other models see other manuals available on our website: www.whisperpower.eu.

Our policy is one of continued development and we reserve the right to amend any technical information without prior notice.

Whilst every effort is made to ensure the accuracy of the particulars contained within this publication neither the manufacturer, distributor, or dealer in any circumstances shall be held liable for any inaccuracy or the consequences thereof.



WARNING

A warning symbol draws attention to special warnings, instructions or procedures which, if not strictly observed, may result in damage or destruction of equipment, severe personal injury or loss of life.



DANGER

This danger symbol refers to electric danger and draws attention to special warnings, instructions or procedures which, if not strictly observed, may result in electrical shock which will result in severe personal injury or loss of life.

1.2 SERVICE AND MAINTENANCE

Regular service and maintenance should be carried out according to the directions in this manual. For service and maintenance one can appeal to the manufacturer or the dealers.

1.3 GUARANTEE

WhisperPower guarantees that this generating set has been built according to good workmanship, according to the specifications in this manual and according to European Community safety regulations.

During production and prior to delivery, all of our generating sets are tested and inspected.

The well functioning of this generating set is subject to guarantee. The period and conditions of this guarantee are laid down in the general conditions of delivery as registered with the Chamber of Commerce and Industries for the North of the Netherlands number 01120025 and are available on request. The guarantee period is two years, limited to 1000 running hours. Some aspects of our guarantee scheme are given here in more detail:

Guarantee does not cover failures that are caused by misuse, neglect or a faulty installation.

Example 1. Faulty installation:

Seawater entering the engine is the most common cause of damage to combustion engines in boats (both to propulsion and generator engines). The entry of water must be avoided under all conditions. Be aware that the conditions in blue water sailing can be extreme. Refer to the installation manual for instructions but remember these are for guidance only as many factors influence the installation of a generator. The ultimate responsibility will always be with the owner to ensure a safe and compliant installation. If in doubt ask!



DAMAGE CAUSED BY THE INGRESS OF WATER IS NEVER COVERED BY GUARANTEE

Example 2: Misuse:

Long term running with no load or too little load can cause the exhaust to get choked with soot or carbon. Cleaning the exhaust is not covered by guarantee.

Example 3: Neglect

Sometimes the seal of the raw water pump starts leaking. Mostly this begins with a little drip and slowly gets worse. Regular visual inspection of the generator is necessary to prevent damage to occur from a leaking water pump. When one finds serious damage after weeks of neglect, guarantee claims will not be honoured.

Example 4: Neglect

Whisper generators have an option for an auto start/stop mode or interval mode.

WhisperPower cannot be held responsible for damage caused by the unattended running generator.

Guarantee means that faulty parts are repaired or replaced free of charge. If necessary, the whole generator unit will be exchanged. Labour necessary to complete repairs on board a vessel executed by an authorized service engineer is covered, but is limited to a reasonable number of hours and reasonable rates in relation to the actual repair work that has to be done.

Travel expenses and travel hours are not covered. Also not covered is the labour required to take a generator out of a boat or for reinstallation. There is no cover for labour needed to get access to the generator, for example to remove equipment or bulkheads etc.

Goods to be delivered under guarantee will be invoiced. Only after the faulty goods are returned will the invoice be credited. Payment in advance may be required or guaranteed by credit card. If after the faulty goods are returned, it is indicated that the failure was not covered by guarantee, a credit will not be issued. For example, if a Printed Circuit Board is returned with clear damage caused by seawater, guarantee will be refused.

Freight costs to deliver spares by normal mail or carriers is covered under guarantee. Special services like express mail, overnight delivery etc. are not covered. Taxes and duties are not covered. For shipments to remote off-shore areas, any additional costs incurred over normal carriage will be invoiced to the customer.

The cost for returning faulty goods is not covered under guarantee.

If any problem arises which could be subject of guarantee, procedures should be followed as described in the guarantee conditions, unauthorised repairs could lead to further damage and violate the guarantee conditions.



Should work take place, which is not in accordance with the guidelines, instructions and specifications contained in this user's manual and the supplementary installation manual, then damage may occur and the generating set may not fulfil its specifications. In all these cases the guarantee may become invalid. Use original spareparts only!

1.4 LIABILITY

WhisperPower does not accept responsibility for damage, injuries or casualties which are the result of operation of the generating set in specific conditions which brings dangers which could not be foreseen, or could be avoided by additional measures. WhisperPower does not accept liability for damage due to use of the generator, possible errors in the manuals and the results thereof.

Automatic start/stop

WhisperPower cannot be held responsible for damage caused by the unattended running generator using the auto-start/stop mode or interval mode.

1.5 IDENTIFICATION

1.5.1 General

Before using this generating set it is very important to identify the set correctly. To communicate for service or ordering parts it is also essential to correctly identify the generating set. Also for the daily operation of the generating set it is necessary that the operator knows the correct specifications.

1.5.2 Identification plate

All required identification data are on the identification plate. For location of the identification plate see figure 1

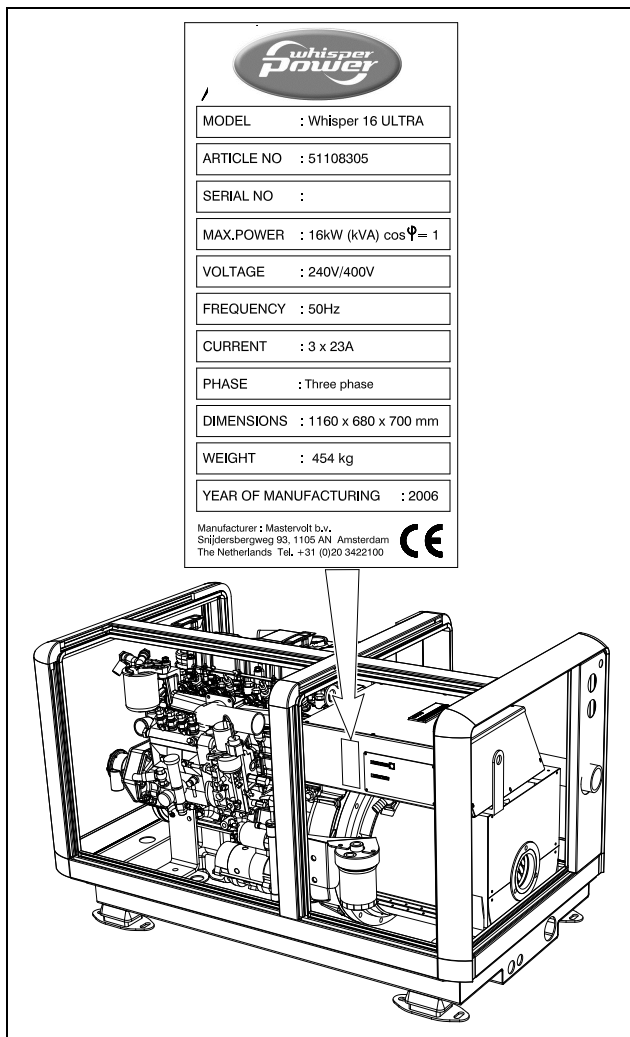


Fig. 1: Location identification plate.

1 The identity of the generating set is given by the SERIAL NUMBER.

When this number is available the manufacturer can trace the specifications of the generating set. On the identification plate are also some basic features of the set:

2 POWER

The identification plate gives the nominal maximum continuous load in kVA (= kW) calculated with power

factor one. When calculating a load one should always take into account the power factor or cos phi of this load. The power should never exceed the nominal power as shown on the identification plate. Power is rated at an ambient temperature of 40°C and a seawater temperature of 25°C. For higher temperatures the generating set has to be derated.

3 VOLTAGE shows the nominal voltage.

This voltage should be within the specified tolerance at the nominal frequency and a balanced load. The M-SQ16 Three Phase can be connected as 3-phase 230/400Volt (STAR) or as 3-phase 230Volt (DELTA).. The alternator is not designed and rated for single phase applications. For single phase applications WhisperPower offers another model that has dedicated windings. The nameplate indicates the connection as made in the factory; **BE AWARE THAT THE CONNECTIONS COULD BE RECONNECTED BY FORMER USERS**

4 FREQUENCY is shown in Hz and is determined by the speed of the engine (RPM). 50 Hz correlates with 1500 rpm. WhisperPower offers generators for 1800 rpm 60 Hz applications as well. When necessary a M-SQ16 Tri Phase model can be reconnected and set for 60 Hz applications. A 60 Hz special manual is available upon request.

5 CURRENT shows the maximum current that is acceptable at the specified frequency, voltage and power factor. The indicated current is the current between two phases that can be taken off three times.

6 WEIGHT shows the net dry weight (approximately) in kg. This is without fuel, oil, packing and external installation equipment

7 CE-marking: the **CE** symbol shows that the generating set is build according to European Community safety regulations. This includes the regulations regarding the safety of pleasure craft, safety of machinery, electric safety and electric magnetic compatibility (EMC) and other relevant directives.

Safety also relies on the installation, application and circumstances. See also the remarks in this manual under SAFETY.

Before changing a factory setting you are advised to consult the manufacturer. When the generating set you have to identify is not new you have to take into account the possibility that former users may have changed the settings. Check the settings (voltage, frequency, rpm) when there is any doubt.

2 INFORMATION

2.1 SAFETY

2.1.1 General

When correctly installed and used in normal circumstances this generating set fulfils EC safety regulations. This generating set could be part of an installation or could be used in a way that additional regulations of the EC or other authorities have to be taken into account.



Circumstances could make it also necessary to take additional measures. Be aware of wet conditions and hazardous environments caused by explosive gases etc

2.1.2 Electrical safety



The voltage of 230 / 400 Volt generated by this generating set is dangerous and if instructions and procedures are not strictly observed may result in electrical shock which will result in severe personal injury or loss of life.

- Check all wiring at least once a year. Defects, such as loose connections, burned cables etc. must be repaired immediately.
- Do not work on the electrical system if it is still connected to a current source. Only allow changes in your electrical system to be carried out by qualified electricians.
- Connection and protection must be done in accordance with local standards.
- **Using the auto-start/stop (interval) mode the generator can start unexpectedly. When working on the electrical system, the 3 Amp fuse must be removed from the control panel and the battery plus cable must be removed from the battery.**



Warning signs indicate parts which could be live.

2.1.3 Earth insulation failures

According to local regulations and depending on the application it could be necessary to take measures for protection against earth insulation failures.

In the standard delivery %neutral+ and %ground+ are not connected. To make a connection between %neutral+ and %ground+ could be necessary as part of a specific insulation failure protection system.

Small pleasure craft in Europe is submitted to The Recreational Craft Directive 94/25/EC. The guidelines of this directive refer to (ISO 13297).

When the installation complies with this standard the %neutral+ and %ground+ should be connected on the generating set.

Be aware that insulation protection systems can be different for different applications and even within the ship there could be different standards for different spaces. We did refer to the Recreational Craft Directive that applies to pleasure craft up to 24 m of length. Sometimes one has to comply with other standards such as the rules of certification societies like Lloyds Register of Shipping or Veritas, regulations for the protection of personal, building legislation, etc. It is of the greatest importance to have expert advice on this issue.



In all situations the transfer switches between shore, inverter and generator should switch both neutral and line(s)

2.1.4 Installation

Whisper generating sets are not self contained and have to be properly installed in enclosed areas such as a machine room.



Installation includes measures to be taken to outlet exhaust fumes which contain carbon monoxide and are extremely dangerous. Carbon monoxide (CO) is an invisible odourless gas. Inhalation produces headache, nausea or death. Installation includes measures for proper ventilation, safe electric connections, safe installation of the starting battery, proper fitting of the cooling system and fuel pipes etc. Refer to the installation manual.

2.1.5 Operation

External moving parts like fans and V-belts are covered by the soundshield and therefore the M-SQ16 is very safe when the soundshield is closed.



Nevertheless take note of the signs on the generating set which show symbols in a triangle indicating danger.



When service has to be carried out while the engine is running, be aware of moving parts like V-belts.

- The generating set should be operated by authorised personnel only.
- Be aware of hot parts and especially parts of the exhaust system and the cooling system.
- If the generating set is unsafe, fit danger notices and disconnect the battery positive (+) lead so that it cannot be started until the condition is corrected.
- Do not attempt to operate the generating set with a known unsafe condition. Disconnect the battery positive (+) lead prior to attempting any repairs or cleaning inside the enclosure.
- Always consult the manual before carrying out maintenance.
- Do not change the settings without consulting the manufacturer. Keep a record of setting changes in this manual.

2.1.6 Fire and explosion



Fuels can be flammable. Proper handling limits the risk of fire and explosion.

- Avoid refilling the fuel tank while the engine is running. When oil or fuel is leaking do not use the generating set.
- Do not run the engine close to explosives or gasses.
- Hydrogen gas generated by charging batteries is explosive. Ensure for proper ventilation. Do not smoke or allow sparks, flames, or other sources of ignition around batteries.
- Keep a fire extinguisher on hand.



Fig. 2: Fire extinguisher port.

- In case of fire do not open the soundshield. To avoid serious injury or death from fire, shut down engines, generator sets and blowers. Break through the label which is indicated by BREAK THROUGH HERE and then immediately discharge entire contents of gaseous portable fire extinguisher through the fire extinguisher port. On the generating set this fire extinguisher port is indicated by the label as shown in figure 2.
- Poor electrical connections or using wiring which is not suited for the rated currents can cause overheating and possibly fire.

2.1.7 Chemicals

- Fuels, oils, coolants, and battery electrolyte can be hazardous to personnel if not treated properly. Do not swallow or have skin contact with these liquids. Do not wear clothing that has been contaminated by fuel or lubricating oil.
- Gaskets may be manufactured from asbestos. Particles of this material should not be inhaled as this may result in fatal diseases.
- On no account allow any unprotected skin to come into contact with the injector spray as the fuel may enter the blood stream with fatal results.
- Engines may be fitted with seals or O-rings manufactured from "viton" or similar material. When exposed to abnormal high temperatures in excess of 400°C an extremely corrosive acid is produced which cannot be removed from the

skin. If signs of decomposition are evident, or if in doubt, always wear disposable heavy duty gloves.

2.2 TRANSPORT, LIFTING AND STORAGE



When lifting the generating set avoid any risk of personal injuries, do not stand under the generating set.

- Use soft slings to avoid damage
- On the engine are two hoist eyes which can be used to take the generator out of the capsule. They can also be used to lift the complete generating set including the capsule.
- After transporting the generating set check for damage before installation.
- Long term storage can have detrimental effects on engine and alternator. The engine should be put through an engine preservation procedure. (Refer to the maintenance chapter)
- The alternator windings tend to condense. To minimise condensation, store the generating set in a dry and warm storage area.
- After removing the generating set from long term storage perform an insulation check. (Refer to the alternator maintenance paragraph for procedures)
- While the battery is stored it should be recharged every 12 weeks.

2.3 THE M-SQ16 THREE PHASE

2.3.1 Features

This generating set includes a diesel engine which is connected by close coupling to an alternator in a sound attenuated capsule. The set is mounted on a steel base frame and mounted securely on anti vibration mounting pads to the capsule base. All cables and hoses are guided through the capsule sides. The set is not self contained and is only operable after proper installation using additional accessories and installation materials.

Installation accessories are listed in the installation manual and are available through the supplier of the generating set. The full automatic Digital Control is based on microprocessor technology. Several automatic start/stop functions can be programmed and monitored (refer to Digital Diesel Control users manual).

2.3.2 Remote control

The full automatic remote control panel including 15 mtr cable comes as standard with the Whisper generating set.

2.3.3 Documentation

Included in the delivery is:

- This users manual (number: 40200371)
- An installation manual (number: 40200381)
- An users manual for DCC (number: 40200261).
- A quick reference guide for DDC (number 40200275)

Not included in the standard delivery but available as options are:

- Parts manual; number: 40200184
- Workshop manual; number: 40200173

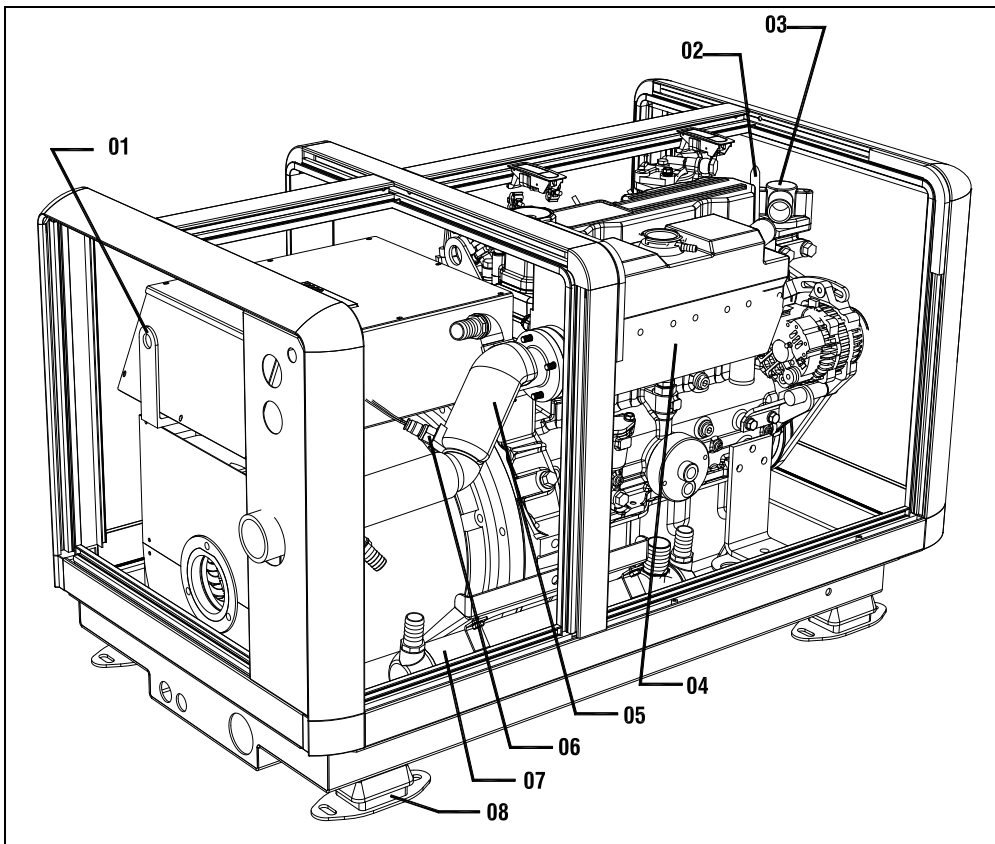
However in this manual there is a list of important parts for maintenance and spare parts as well as a chapter on maintenance and problem solving.

2.3.4 Accessories included in the standard delivery

- Expansion tank, hose and fittings
- Special hose connector for measuring exhaust back pressure (refer to paragraph 5.4.3)

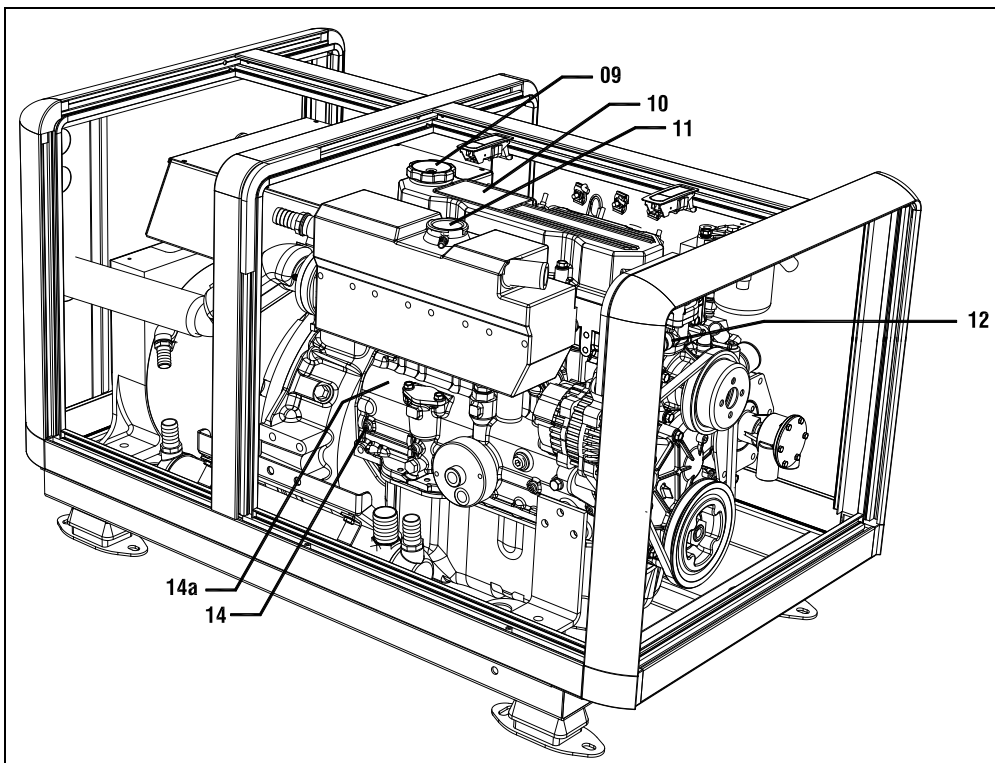
2.4 COMPONENTS

2.4.1 Main components to identify



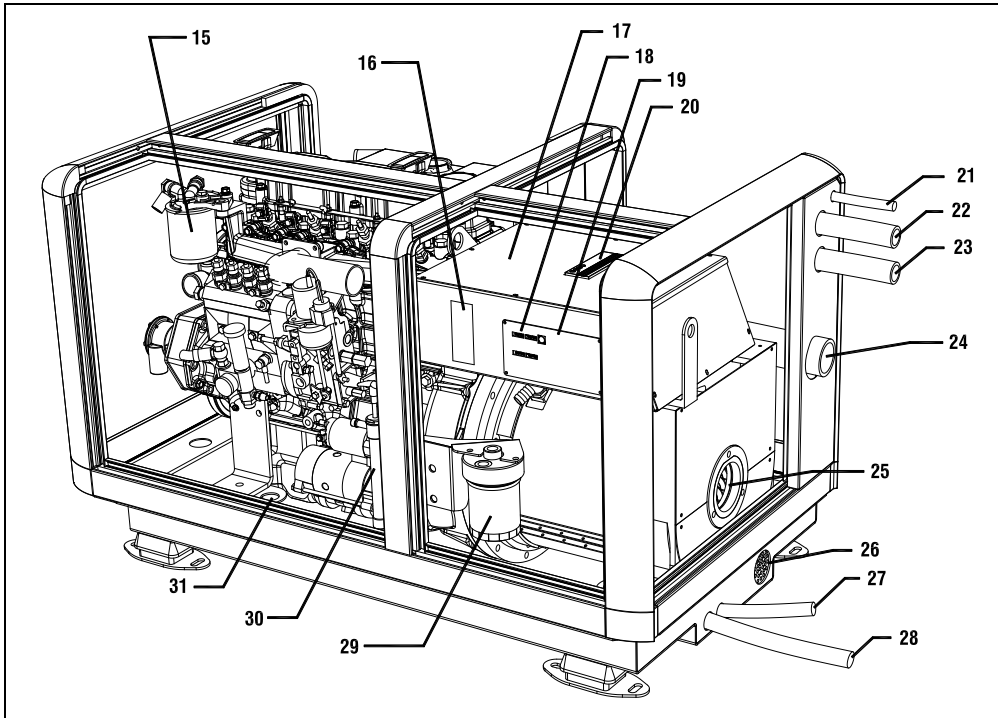
- 01 Hoist eye rear
- 02 Hoist eye front
- 03 Thermostat housing
- 04 Exhaust manifold (watercooled)
- 05 Temperature switch exhaust
- 06 Cooling water injection bend
- 07 Heat exchanger
- 08 Rubber engine mounting

Fig. 3 Rear view main components M-SQ16



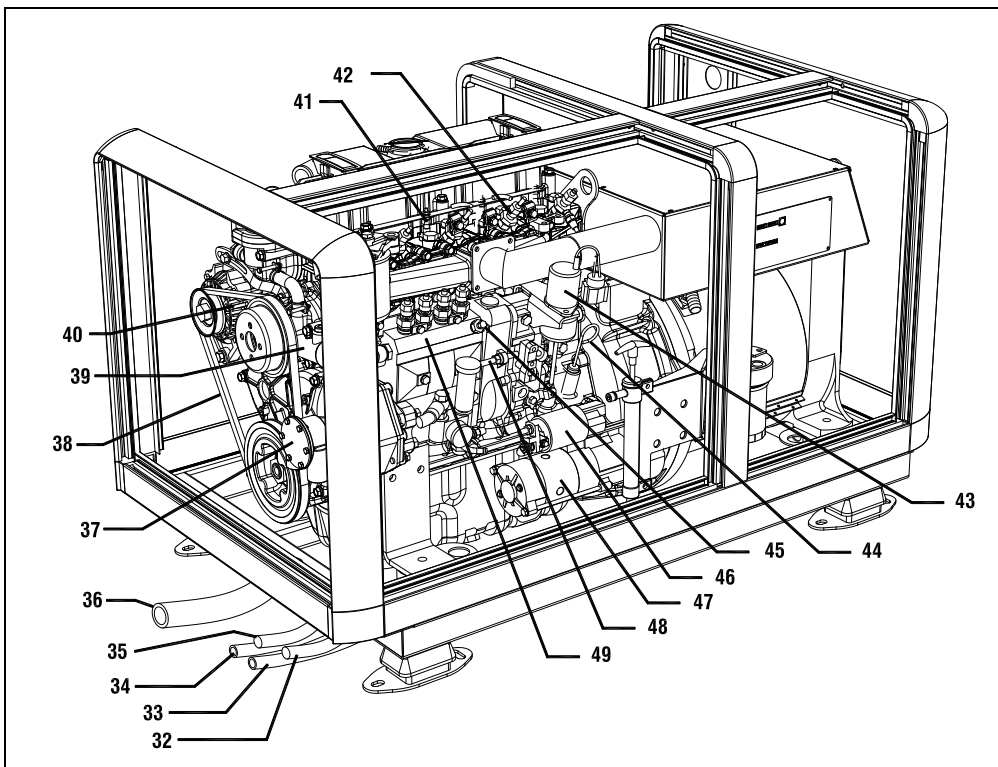
- 09 Filler cap engine oil
- 10 Rocker cover
- 11 Filler cap engine coolant
- 12 Temperature switch coolant
- 14 Engine oil pressure switch
- 14A Engine serial number

Fig. 4: Rear view main components M-SQ16.



- 15 Fuel filter
- 16 Identification plate
- 17 Air cleaner element
- 18 Fuses
- 19 Control panel
- 20 Digital Diesel Control (DDC)
- 21 Expansion tank Ø8mm
- 22 Bypass cooling water out Ø25.4mm
- 23 Bypass cooling water in Ø25.4mm
- 24 Exhaust hose Ø51mm
- 25 Power take off (PTO)
- 26 Engine air intake
- 27 Remote control
- 28 AC power output
- 29 Engine oil filter
- 30 Oil sump handpump
- 31 Failsafe

Fig. 5: Front view main components M-SQ16



- 32 Battery negative (.) 35mm²
- 33 Fuel out Ø8mm
- 34 Fuel in Ø8mm
- 35 Battery positive (+) 35mm²
- 36 Raw water inlet Ø25.4mm
- 37 Raw water pump
- 38 V-belt
- 39 Engine coolant pump
- 40 Alternator (12VDC)
- 41 Glowplug (4x)
- 42 Fuel injector (4x)
- 43 Fuel solenoid
- 44 Engine oil dipstick
- 45 Fuel bleeding screw
- 46 Starter motor solenoid
- 47 Starter motor
- 48 Fuel lift pump for manual priming
- 49 Fuel injection pump

Fig. 6: Front view main components M-SQ16

2.4.2 Generator control panel

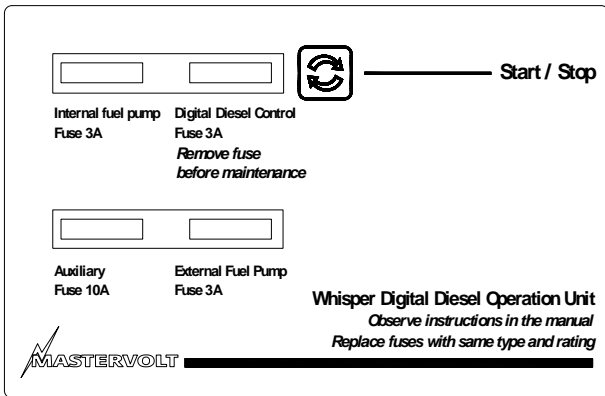


Fig: 7 Control panel.

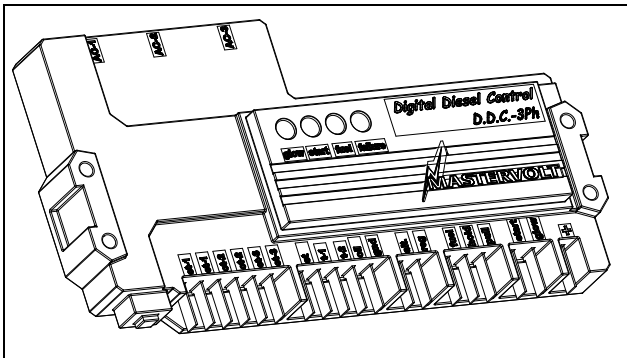


Fig. 8 Digital Diesel Control unit

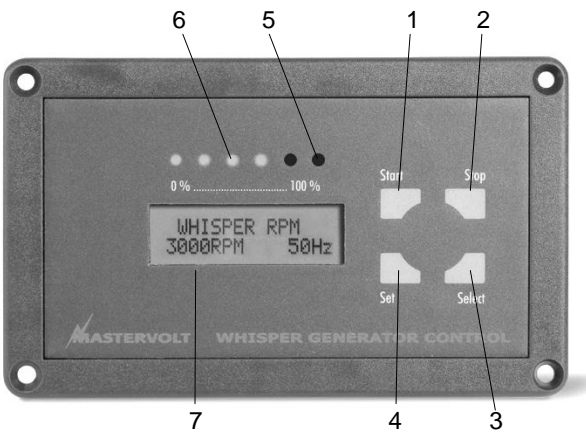


Fig. 9: Digital Diesel remote control panel

2.4.3 Remote control panel

- 1 Start button;
- 2 Stop button;
- 3 Select button;
- 4 Set button;
- 5 Failure lamp;
- 6 Generator load indicator.
- 7 Display

2.5 TECHNICAL INFORMATION

2.5.1 AC alternator

The tri phase synchronous alternator is directly coupled, one bearing, brushless, rotating field design, 6 wire, four pole (1500 RPM) and regulated by an Automatic Voltage Regulator (AVR).

The exciter stator has a residual magnetism, which guarantees self-exciting of the generator on start-up (that thereby generates a residual voltage of about 10% nominal voltage).

The AVR, powered by an auxiliary circuit on the main stator, acts on the exciter stator indirectly controlling the field generated by the main rotor by means of the sequence exciter rotor - diode bridge - main rotor.

The voltage regulator controls and keeps constant the average voltage of one phase. The voltage setting on the AVR can be adjusted with the help of a trimmer \hat{V} (See par.5.3.1)

A frequency control progressively deactivates the machine when the drive motor speed drops below a pre-set, adjustable threshold preventing over-excitement at low operating speeds and abating the load engage effects on the engine.

The AVR works only within limits of the set frequency 50 Hz. When operating below the lower limit of $46 \text{ Hz} \pm 1 \text{ Hz}$ the AVR will stop regulating to avoid overloading the exciter coil. When applying the generator set at 60 Hz the AVR is re-adjustable as well. To operate at 60 Hz the engine RPM and Digital Diesel Control settings must also be changed. For the USA market a dedicated manual (Art. No 50200374) is available for 60 Hz applications. Please refer to the WhisperPower service centre for specific instructions to convert the generating set to 60 Hz.

It is not possible to take off the full power from the M-SQ16 Three Phase by reconnecting the alternator to single phase (or dual voltage 60 Hz). WhisperPower offers dedicated single phase and dual voltage 60 Hz generators

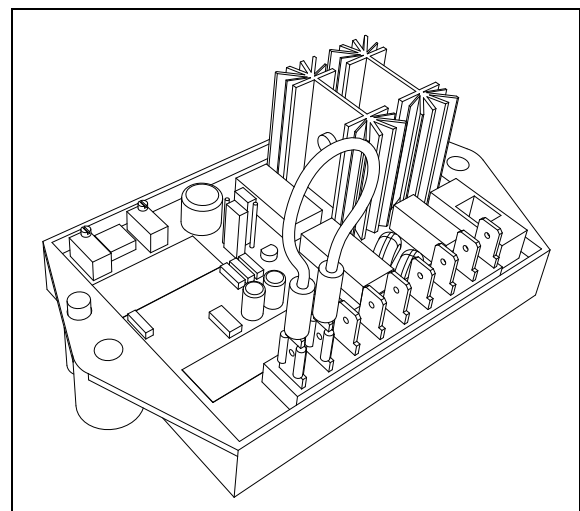


Fig. 10 Automatic Voltage Regulator (AVR).

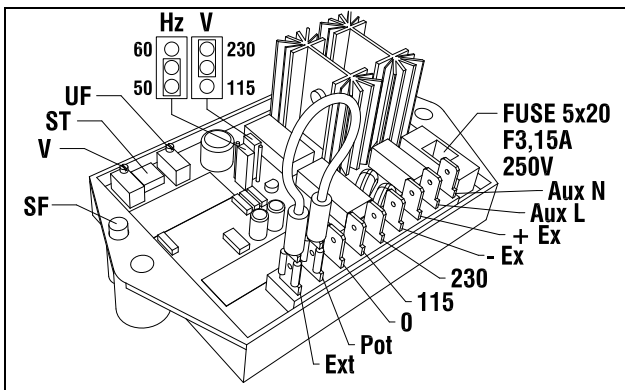


Fig. 11 AVR Setting-components and terminals

The power comes from 6 wires that can be connected in star or delta arrangements to take off different voltages. For tri phase 230/400V use, the alternator should be connected in star. For three phase 230V use the wires should be connected in delta.

Further technical data on the connections of the alternator can be found in drawings and diagrams in this manual.

2.5.2 Engine

The M-SQ16 generating set is based on the Mitsubishi S4Q2 4 cylinder 4 stroke diesel engine. The engine is indirectly injected. The engine is water cooled and the cooling liquid is cooled by a heat exchanger and raw water. The heat exchanger and all other parts which are in direct contact with the raw (sea) water are made of seawater resistant material like naval brass and gunmetal. The engine has been specially adapted for the WhisperPower application and is very different from the standard engine supplied for industrial applications!

2.5.3 Digital Diesel Control system

The standard electrical engine control system is 12 Volt negative earth, non earth return (ungrounded) is available as optional. Check your identification data to determine which system is applied. The system is designed according to the "energise to run" system. The Digital Diesel Control is a very advanced microprocessor based full automatic system. Besides automatic start the system offers many monitoring options. Refer to the separate Digital Diesel Control users manual.

The microprocessor unit is located in the black box on top of the alternator

2.5.4 Battery charger

On the engine is an alternator generating 50 Amp 12V. This current is rectified to charge the battery. The voltage is regulated at $\pm 14.4V$.

2.5.5 Alarms and shut down

In the event of malfunctioning this will be indicated by the failure light, details will be shown on the display and the engine will be shut down. There are three functions guarded: oil pressure, oil temperature and exhaust temperature.

Exhaust temperature too high indicates the cooling water to be blocked.

All alarm switches are closed when no malfunction occur. A contact is cut in the event of an alarm. This means that the generating set will not work when the alarm switches are broken or there is a loose wire. The system therefore is intrinsically safe. The panel will display details about the alarm.

2.5.6 Control

The generating set can be operated by push buttons on the panel on the alternator or by the remote control. By pushing the START button the control system is activated and will start the engine automatically. Pushing the STOP button will stop the engine and the electrical system will be deactivated.

2.5.7 Remote control

All wiring connections from the remote control to the board are made by plug in connectors.

An intermediate communication cable is in the standard supply. If necessary an optional longer 8 wire communication cable can be connected if the standard length does not suit the required distance. Numerous remote control units can be put in parallel by using the connectors on the back of the units. (Refer to installation instructions)

2.5.8 Hour counter

The remote control offers several timer functions that help to schedule maintenance.

2.5.9 Load indicator

On the remote control the load will be indicated on the display and by the LED-bar. The load is measured by current transformers on the alternator. All phases are monitored and overload of all phases or just one or two phases will provoke an alarm or even shut down when the alarm is ignored.

2.5.10 Fuel specification

The engine must only be used with diesel fuel oil which conforms to the standards for use in modern diesel engines. Fuel free from water and contaminants is of the utmost importance.

2.5.11 Oil information

1 Specification:

The oil must be suitable for oil changes as specified in the maintenance chapter. The Mitsubishi engine must be run on heavy duty lubricating oil meeting the requirements of API class CD, CF or CF_4.



It is very important to use the correct oil specification. Very often local oil suppliers recommend a higher class, because they assume that a higher class is allowed. This is not the case. One should not follow these recommendations.

Using the wrong specification will cause high oil consumption.

2 Oil viscosity:

We recommend a multigrade oil 15W40.

3 Oil capacity:

Excluding the oil filter the content of the crankcase is 7 l. Including the oil filter it is 8 l.

Do not overfill with lubricating oil as this may have a detrimental effect on engine performance

4 Oil pressure

- Minimum at idle 98kPa (1 kgf/cm² - 14psi) (1 bar).
- Normal at 1500 rpm \pm 196 to 392 kPa (2-4 kgf/cm² - 28 to 57 psi) (2-4 bar).

2.5.12 Cooling liquid

The engine is cooled by cooling liquid. The capacity of this system of the M-SQ16 is 7.6 litres.

We recommend not using water but cooling liquid that is marketed for the use in combustion engines. Cooling liquid protects the engine against frost to minus 25° C. Also it protects the engine block against corrosion. One can fill the engine via the filling cap on the exhaust manifold. Fill up till the level is just below the filling cap. When the engine is on temperature the liquid will expand and the redundant liquid will be pressed into the expansion tank. This tank has to be filled up till the mark. When cooling liquid is not available clean fresh water could be used with an additive of anti freeze. When using water with anti freeze the right mixture has to be calculated according to the information of the supplier of the anti freeze. When the cooling is based on keel cooling or radiator cooling the capacity of these coolers and piping has to be taken into account calculating the right mixture.

The cooling liquid in the engine is pressurised and has a boiling point above 100° C. The temperature switch in the thermostat housing switches at 110° C. When keel cooling or radiator cooling is applied the cooling system is not pressurised. There should be a special cap on the manifold without valves leaving the connection to the expansion tank open. Refer to the manual on keel cooling and radiator cooling.

2.5.13 Technical data

GENERAL

| | |
|-----------------------------|---|
| Model | M-SQ16 |
| RPM | 1500 |
| Alternator | 3 phase synchronous (air cooled) |
| Engine | Mitsubishi 4 stroke diesel, model S4Q2 (Japan) |
| Number of cylinders | 4 |
| Displacement | 2505 cm ³ |
| Bore X stroke | 88x103 mm |
| Combustion air consumption | 2.5 m ³ /min. |
| Continuous power engine | 16 kW electric power |
| Cooling system | indirect cooling by raw water, 20-25 l/min. |
| Cooling water pump | PTO driven WhisperPower self priming impeller pump, type M16 |
| Fuel lift pump engine | mechanical, additional electric pump (12 V DC) available upon request |
| Starting battery (optional) | 110 Ah 12V |
| Fuel consumption | 2-7 litre/hour, load dependent |
| Control | Digital Diesel Control including automatic start/stop |

ELECTRICAL SPECIFICATIONS

| | |
|---------------------|---|
| Output voltage | 230/400V 50 Hz alternating current (AC) three phase, re-connectable to three phase 230V |
| Output rating: | 16 kVA = 16kW at power factor cos phi = 1 |
| Voltage tolerance | ± 2% (balanced load) |
| Frequency tolerance | ± 3% |
| Alternator | Air cooled, brushless, four pole, twelve wire, synchronous |
| Voltage regulation: | AVR |

MECHANICAL SPECIFICATIONS

| | |
|-------------------------|--|
| Supply includes | Sound shield with steel base, mounted on rubber anti vibration mounts. (Generator set without sound shield is optional) |
| Dimensions hxwx d | 116.0 x 68.0 x 70.0 cm |
| Colour | Metallic silver / grey |
| Weight | 454 kg including sound shield |
| Max. installation angle | 25 degrees |
| Standard supplies | Digital remote panel (+15 m cable), fuel filter, fuel lift pump, user and installation manuals |
| Optional: | Installation kits, mobile (vehicle) version, non earth return (ungrounded), spare part kits, PTO to drive a hydraulic pump |

2.5.14 Wiring codes and colours

| | number | colour | cross section |
|---|--------|--------------|---------------------|
| battery > starter motor | | red | 35 mm ² |
| starter motor > DDC | 1 | red | 6 mm ² |
| starter motor > LCP | 13 | red | 2,5 mm ² |
| battery > ground | | black | 35 mm ² |
| ground > LCP ground (GND) | 2 | black | 4 mm ² |
| DDC > glow plug | 3 | brown | 4 mm ² |
| DDC > starter solenoid | 4 | yellow | 2,5 mm ² |
| DDC > LCD | 5 | grey | 1,5 mm ² |
| DDC > oil pressure switch | 6 | purple | 1 mm ² |
| LCP > oil pressure switch | 6 | purple/black | 1 mm ² |
| DDC > water temperature switch | 7 | blue | 1 mm ² |
| LCP > water temperature switch | 7 | blue/black | 1 mm ² |
| DDC > exhaust temperature switch | 8 | blue/green | 1 mm ² |
| LCP > exhaust temperature switch | 8 | blue/pink | 1 mm ² |
| DDC > fuel solenoid (hold) | 9 | green | 1,5 mm ² |
| DDC > fuel solenoid (pull) | 20 | pink | 2,5 mm ² |
| DDC > fuel solenoid (com.) | 17 | black | 2,5 mm ² |
| B+ terminal alternator > starter motor | 21 | red | 6 mm ² |
| DDC > R terminal alternator | 18 | white | 1,5 mm ² |
| DDC > L terminal alternator | 19 | orange | 1,5 mm ² |
| DDC > current measuring transformer AC1 | 66 | black | 1 mm ² |
| DDC > current measuring transformer AC1 | 66 | red | 1 mm ² |
| DDC > current measuring transformer AC2 | 77 | black | 1 mm ² |
| DDC > current measuring transformer AC2 | 77 | red | 1 mm ² |
| DDC > current measuring transformer AC3 | 88 | black | 1 mm ² |
| DDC > current measuring transformer AC3 | 88 | red | 1 mm ² |
| DDC > LCP | 12 | black | 1,5 mm ² |
| DDC > LCP | 14 | red | 1,5 mm ² |
| DDC > LCP | 16 | red/green | 1,5 mm ² |
| DDC > generator AC output AC1 | 33 | brown | 1 mm ² |
| DDC > generator AC output AC1 | 33 | blue | 1 mm ² |
| DDC > generator AC output AC2 | 44 | brown | 1 mm ² |
| DDC > generator AC output AC2 | 44 | blue | 1 mm ² |
| DDC > generator AC output AC3 | 55 | brown | 1 mm ² |
| DDC > generator AC output AC3 | 55 | blue | 1 mm ² |

DDC=Digital Diesel Control Unit

LCP=Local Control Panel

2.5.15 Lay out control wiring

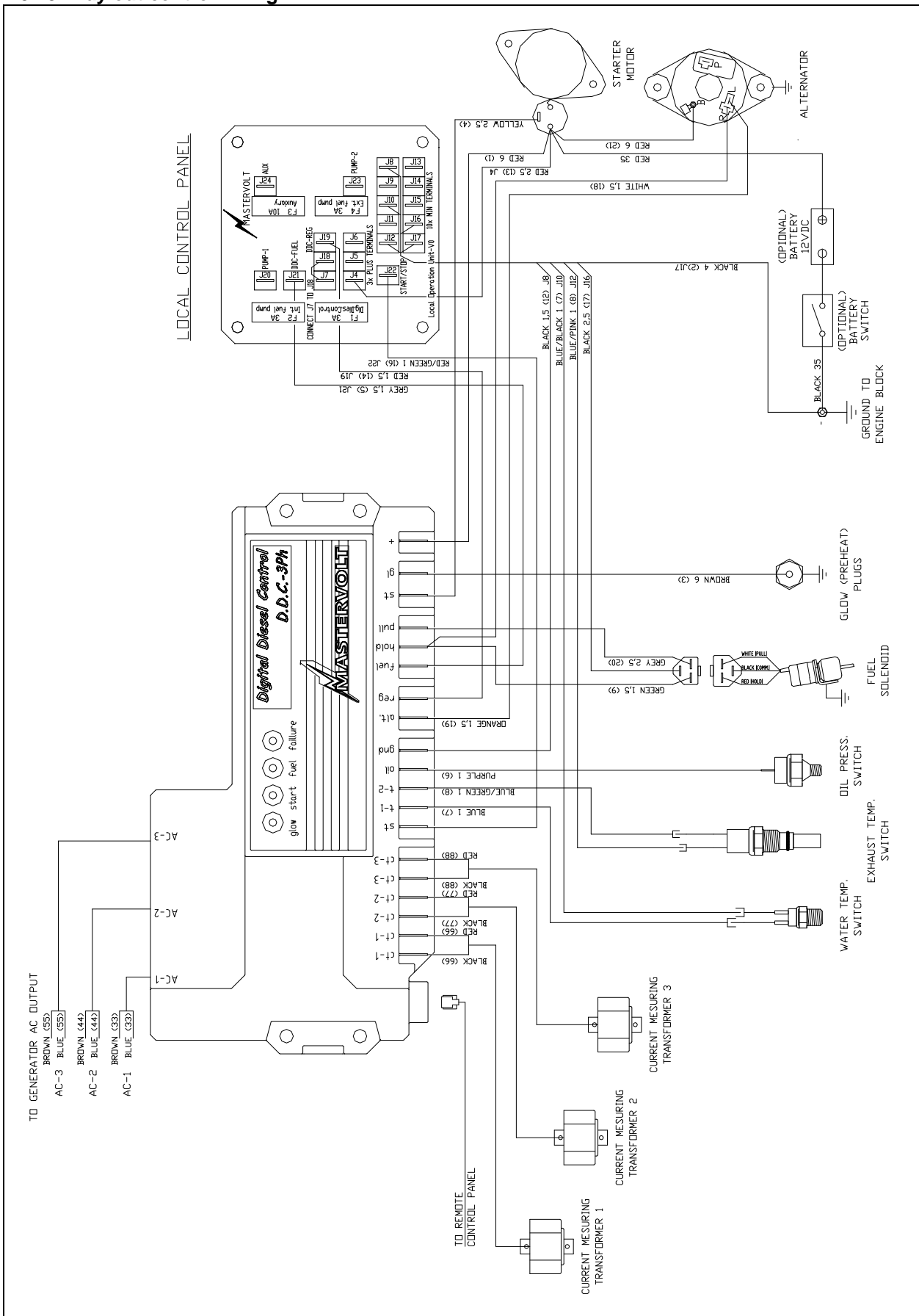


Fig 12: Electrical Diagram control wiring M-SQ16 . three phase

2.5.16 Electrical diagram 230 / 400 V AC / 50 Hz three phase (star configuration)

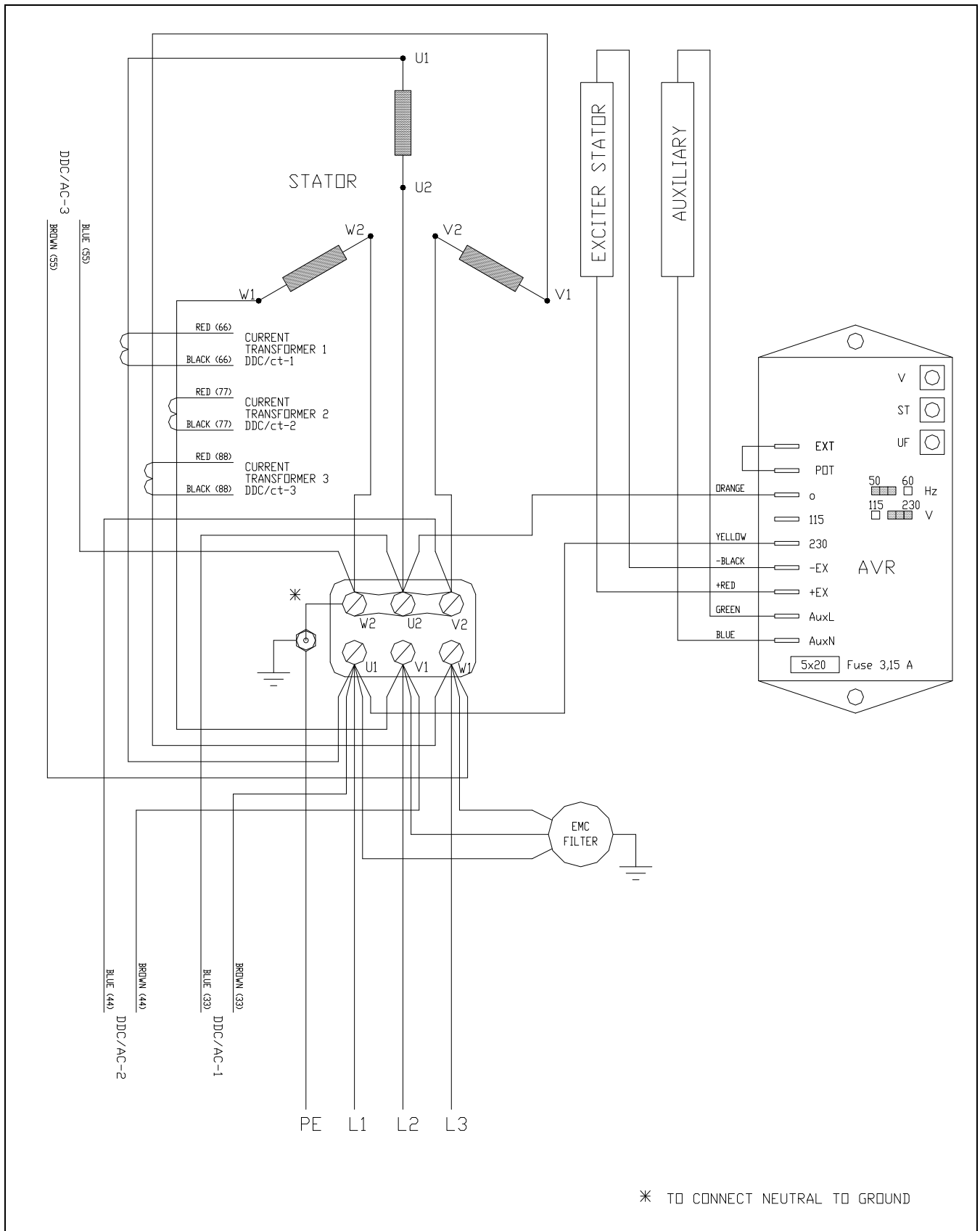


Fig 13: Electrical Diagram 230 / 400 V AC / 50 Hz three phase (star configuration)

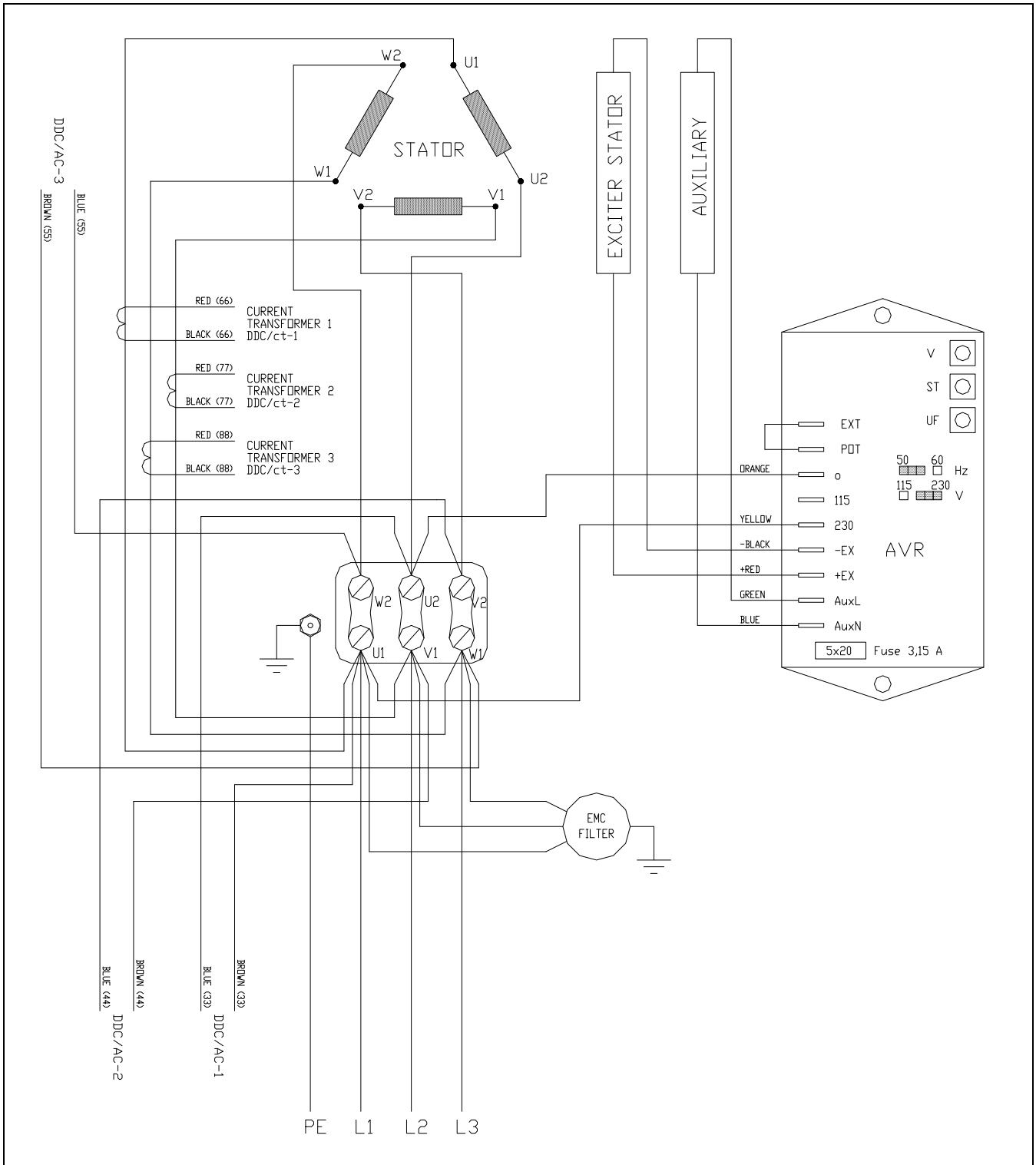
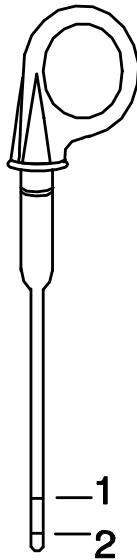
2.5.17 Electrical diagram 230 V AC / 50 Hz three phase (delta configuration)


Fig 14: Electrical Diagram 230 / 400 V AC / 50 Hz three phase (star configuration)

3 OPERATION

3.1 GENERAL

The generating set is operational after full installation and filling up with: fuel, engine lubricating oil and cooling liquid, connecting the battery to earth and connecting the digital remote control panel.



- 1 Maximum oil level
- 2 Minimum oil level

Fig. 15:

3.2 OPERATING INSTRUCTIONS

3.2.1 Summarised operating instructions (daily use)

Routine "pre-start" checks:

- 1 Check oil level (refer to fig. 15).
- 2 Water inlet (all valves open).
- 3 Power source selector switch (off/shore power/generator power). Switch to power source switch "OFF", or switch off all consumers in the usual way.
- 4 Switch on battery switch (when installed).
- 5 Fuel valve: open.

Starting:

Push the start button to initiate the full automatic starting procedure. You can monitor the procedure on the display.

In operation checks:

- 1 Check for abnormal noise or vibration
- 2 Check the voltage
- 3 Check sea water flow at exhaust outlet
- 4 Power source selector switch (off/shore power/generator power). Switch to power source generator.
- 5 Before loading the generating set up to maximum, have it run warm. Continuous load should be restricted to 70 % of maximum load.

Stopping generator:

- 1 Switch off all electrical devices (consumers). If the generating set has been running under full load for a longer period, do not shut it down abruptly. Reduce the electrical load to about 30% of the rated load and let it run for approx. 5 minutes.
- 2 Press the STOP button.
- 3 Close the inlet sea water cock.
- 4 Switch to an other AC power source, if available.

3.2.2 Extended operating instructions

Check when starting the first time or after a longer period of rest:

- 1 If there is any damage caused by transport or installation.
- 2 Check if the installation conforms to the installation instructions.
- 3 Ensure the generating set is free to turn without obstruction.
- 4 Check all hoses and hose connections for leaks.
- 5 Check all cables and cable end terminal connections.
- 6 Check the engine and generator mounting bolts.

Routine "pre-start" checks:

- 1 Check engine oil level.

The generator switches off in the event of insufficient oil-pressure. Even when the oil level is too low the oil pressure can be high enough. Do not run the generator with the oil below the lowest mark in the, because a smaller volume of oil will become contaminated considerably quicker than a larger volume. Therefore we recommend daily oil-checks.

Check oil level prior to starting the engine or at least 5 minutes after the engine has stopped.

- 2 Check sea water cocks. Do not forget the valve of the water outlet in case of a water/exhaust gas separator.
- 3 Check the water strainer.
- 4 Check for leaks.
- 5 Regularly check the siphon vent in the cooling water supply.
- 6 Switch main Power Source Selector switch to "OFF" or switch off all devices.
- 7 Switch on the battery switch.

Starting the generator:

By pushing the start button briefly the electric system is activated, the fuel lift pump starts pumping and the starting procedure will begin (by pushing the Stop button the system is deactivated).

The first time starting up or after running out of fuel it could be necessary to prime the fuel system. (Refer to bleeding fuel system instructions in the maintenance chapter).

A restart protection prevents starting the engine when it is already running, which could cause damage.



In the event of starting problems (numerous attempts are made), close the sea-water inlet cock while cranking to prevent the outlet system and engine to fill up with water.

During the starting process, the cooling water pump is driven with the engine. The cooling water is discharged to the exhaust outlet, because the engine does not run, the exhaust pressure is not high enough to expel this water. Open the valve directly when the engine starts to prevent damaging the impeller.

Water in the cylinder will cause serious damage to the engine. For instance; a bent piston rod or a cracked cylinder head. In fact water in the cylinder is the main cause for engine damage in pleasure craft.

Checks once the generator is in operation:

- 1 Check for abnormal noise or vibration.
- 2 Check the voltage.
- 3 Check coolant flow.

Always check immediately after starting the generator if cooling water flows at the exhaust outlet. If this is not the case, check the cooling water pump. After having become acquainted with the generator you will be able to recognise the coolant flowing through the system by listening for the noise of the water which is expelled.



Be aware that especially in harbours the coolant water inlet can easily be blocked by floating objects.

- 4 Power source selector switch (off/shore power/generator power). Switch to power source generator.

Before loading the generating set up to maximum, have it run warm. The first 50 hours of running the continuous load should be restricted to 70 % of maximum load. Running for long periods at no load or light load in the first 50 hours can cause cylinder glazing and high oil consumption.

Engine load during longer operation:

Please ensure that the generating set is not overloaded. Overloading occurs when the electrical load (demand) is so high that the generator cannot be turned around properly by the diesel engine. Overloading causes the engine to run rough, while using oil and excessive fuel and producing soot by the exhaust. The engine can even stop.

The generator should therefore only be loaded at the maximum rated power for short periods (2-3 hours) only!

The high peak current is meant for the ability to start electrical devices that need a high current for starting especially electric motors and compressors (from a still stand state).

In order to prolong the generating set's life expectancy, the nominal electrical demand on the system should be about 70% or the rated generating set's maximum load. Please note this when switching on your electrical devices! Nevertheless, the M-SQ16 is designed so as not to overheat, even under extreme conditions.

Do not run the generator for very long periods at no load or at very low load. When this is necessary do load the generator at least one hour in 10 hours for minimum 70%. Long term running at too low load will cause the exhaust to be choked by carbon.



Never remove the battery while the engine is running or any electrical cable while the battery is connected in the circuit. Only disconnect the battery with the engine stopped and all switches in "OFF" position

Stopping the generating set:

- 1 Avoid stopping of the generator abruptly after a long period of operation at high load! Doing so, you avoid unnecessary thermal load to your generating set!

Act as follows:

Prior to switching off the generating set, decrease the generator load (i.e. turn off most electrical users) and let the generator run at low load for approx. 5 minutes to allow the engine to get properly cool (the influent sea water must flow through the system in order to cool the engine).

If the generator is operating in a hot environment and you do not act as given above, the excessive heat in the engine can trip the "high temp" alarms. In that case, a restart of the engine is not possible for some time. It is also recommended to switch off electrical users prior to stopping the generator because of the voltage drop that occurs as the engine comes to a halt. Such voltage drops may cause damage to electric motors, compressors (in refrigerators or air conditioners etc.).

- 2 Press the STOP button.
- 3 Close the inlet sea water cock.
- 4 Switch to an other 230V/400V power source, if available.



If the engine is not running and failure and charging LED is blinking, reset by stop button, otherwise it will drain the start battery

4 MAINTENANCE

4.1 ALTERNATOR

The alternator does not require any maintenance. Periodic inspection and cleaning is recommended, depending on environmental conditions.

However when the alternator has been idle for a long period attention to winding condition is recommended.

The condition of windings can be assessed by measurement of insulation resistance to earth. (See 5.3.5 Meggering).

All bearings are greased for life and not regreaseable.

4.2 ENGINE

4.2.1 Preliminary instructions

All regular maintenance can be carried out when the enclosure is open. When oil and dirt has gathered in the enclosure measures have to be taken to avoid spilling oil and polluting the environment.

The first service on the engine should be carried out after 50 hours of its life and after a major overhaul. In the first 50 hours the engine should receive special attention:

Long periods of light or no load running in the first 50 hours may lead to cylinder glazing and high oil consumption.



For the same reason it is of the greatest importance to use the right oil specification

The first time starting up or after running out of fuel it could be necessary to prime the fuel system.

4.2.2 Bleeding fuel lines

- 1 Ensure there is sufficient fuel in the fuel tank.
- 2 Loosen the air bleeding screw (1) 1,5 turns . See Fig 16.
- 3 Unlock lift pump plunger (2) (See fig 16) by turning it to the left.
- 4 Operate the lift pump by hand moving the lift pump plunger up and down, till fuel flows out free of air bubbles.
- 5 Lock lift pump plunger (2) (See fig 16) by pushing it full down and turning it to the right.
- 6 Tighten the air bleeding screw (1)

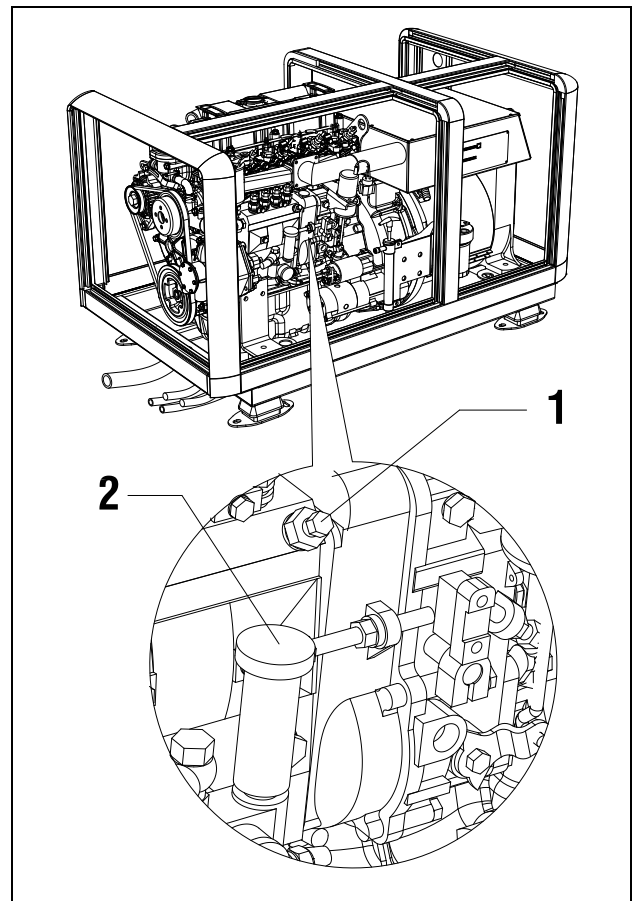


Fig. 16: Bleeding fuel lines 1 = Air bleeding screw
2 = Lift pump plunger

4.2.3 Valve clearance

When the engine is in cold condition both valves (inlet and outlet) should have a clearance between 0.25 mm. The adjustment has to be done at TDC (refer to § 5.4.2).

4.2.4 Replacing fuel filter

Filter change depends on contamination of the fuel, but should be done however, at least every 300 running hours. Before changing the filter, clamp off the supply line. Remove the hoses from filter and attach them on the new filter again. The arrow on the filter housing indicates the direction of the flow. A clogged filter results in a lack of output of the generating set.

4.2.5 Replacing oil filter

The oil filter is in front of the service side. Replacement has to be executed according to the schedule in this manual. Drain the oil using the sump pump and put some tissues under the filter.

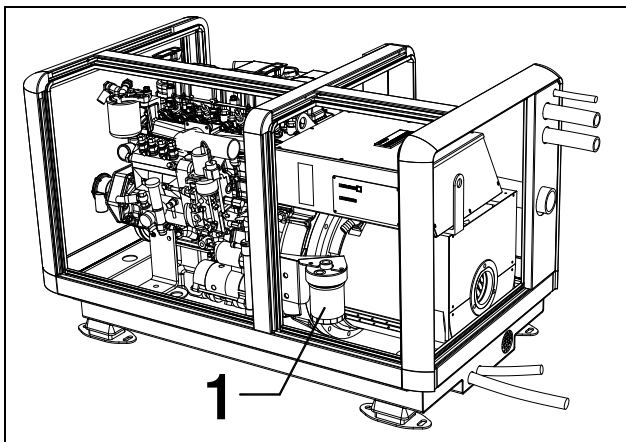


Fig. 17

1 = Oil filter

A smear of oil has to be put on the seal of the filter before fitting the filter. The filter should be fastened manually: when the rubber touches the metal turn 3/4 further.

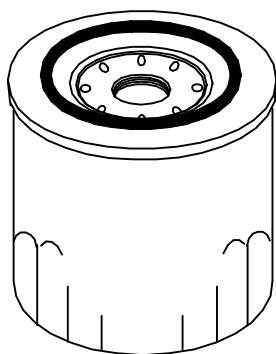


Fig. 18

4.2.6 Readjustment V-beltplacing oil filter

The alternator bracket allows for readjust of the V-belt. Deflections should be 10 mm (refer to fig. 19)

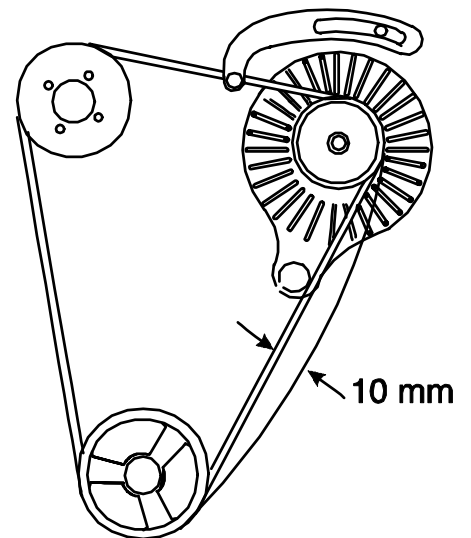


Fig. 19

4.3 REGULAR MAINTENANCE

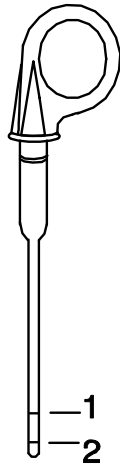
CHECK DAILY:

- Oil level (see fig. 20)

Take care the oil level is never below the mark. Do not add oil when the level is still above the mark

- 1 Minimum oil level
- 2 Maximum oil level

Fig. 20:



CHECK DAILY:

- Level cooling liquid
- Hoses for loose connections or deterioration.
- Water inlet filter.

AFTER FIRST 50 HOURS:

- Change oil and replace the oil filter.
Have the engine run until it is on temperature and stop it. Replace the oil filter. Drain oil by the sump pump into a suitable retainer and fill up with fresh oil. Start the engine again and have it run for 5 minutes. Stop the engine again and pause for a few minutes to let the oil gather in the crankcase. Check the level again and add oil when necessary.
- Check and tighten nuts, bolts, and unions, paying particular attention to the fuel system.
- Observe the exhaust at the normal full load. The exhaust must be free from soot. Do not allow the engine to run with a dirty exhaust without investigating the cause as this may result in an expensive breakdown.
- Check air vent on a regular basis. When the air vent it not working properly the engine can fill up with water by siphoning. Water in the combustion chamber causes serious damage to the engine.
- Check and readjust V-belt.
- Check the electrical connections.

EVERY 150 HOURS:

- Change oil.
- Check the battery acid level (not applicable when WhisperPower batteries are used).
- Check battery terminals for corrosion
- Check and readjust V-belt
- Check impeller raw water pump (durability depends on the purity of the sea water. In sandy water and warm water wear will increase).

When replacing the impeller the gasket between the pump case and the cover should be replaced as well. So when ordering a spare impeller order a gasket as well. Remove the cover to get access to the impeller. Remove the old impeller with the help of two screwdrivers. Install the new impeller and add some grease. Turn the blades in the direction of rotation of the pump i.e. anti clockwise looking at the impeller.

EVERY 300 HOURS:

- Replace the impeller of the raw water pump.
- Retighten the cylinder head bolts and adjust the valve clearance. (Refer to § 5.4.2).
- Replace the oil filter.
- Replace the fuel filter
Replacement depends on the condition of the fuel. We recommend replacement every 300 hours. Isolate the fuel supply and change the element.

EVERY 1000 HOURS:

- Replace the V-belt.
- Retighten cylinder head bolts/adjust + valve clearance.

EVERY 2000 HOURS:

- Check lubricating oil pressure
- Clean and check or replace fuel injector nozzles and check injection pressure.
- Check the air filter element:
The air is taken in via the cover on the alternator. Below this cover is a spongy material which filters the air and holds some electrical components which are cooled by the inlet air. This filter does not require regular maintenance. Only in very dusty circumstances this filter should be cleaned. The spongy material can be washed in solvent or replaced.
- Check the cooling system:
The engine cooling liquid is indirectly cooled by raw water via a heat exchanger. The alternator is cooled by seawater which is pumped by the PTO driven impeller pump through the cooler elements in the generator housing. All parts of the cooling

system are of corrosion free and seawater resistant materials such as brass and gunmetal. In case of gathering of dirt in the system it could be cleaned by compressed air. When overhauling the engine one could clean the parts thoroughly or replace.



When the generator set runs less than 100 hours a year the oil should be changed yearly

4.3.1 Maintenance schedule

| | |
|---|----------------------|
| Check oil level | daily |
| Check water inlet filter | daily |
| Check the level of the cooling liquid | daily |
| Change oil and oil filter | after first 50 hours |
| Check and tighten nuts, bolts, etc. | after first 50 hours |
| Check exhaust | after first 50 hours |
| Check air vent | after first 50 hours |
| Check and readjust V-belt | after first 50 hours |
| Check electrical connections | after first 50 hours |
| Change oil | 150 hours |
| Check battery | 150 hours |
| Check air vent | 150 hours |
| Check and readjust V-belt | 150 hours |
| Check impeller water pump | 150 hours |
| Replace impeller water pump | 300 hours |
| Retighten cylinderhead bolts and readjust valve clearance | 300 hours |
| Replace oil filter | 300 hours |
| Replace fuel filter | 300 hours |
| Retighten cylinderhead bolts , adjust valve clearance | 1000 hours |
| Replace the V-belt | 1000 hours |
| Check lubricating oil pressure | 2000 hours |
| Check injector and injection pressure | 2000 hours |
| Check inlet air filter | 2000 hours |
| Check cooling system | 2000 hours |

4.3.2 Putting out of service

When not using the generating set for a longer period it is recommended to execute an engine preservation procedure.

- 1 Clean the engine.
- 2 Loosen the fuel suction pipe and fuel return and put them in a can with preservation diesel fuel. Start the engine and run the engine warm.
- 3 Drain the hot engine oil and refill with preservation oil.
- 4 Stop the engine and take loose the inlet of the raw water pump. Drain the water from the water lock. Crank the engine having the raw water inlet sucking anti freeze from a can until the pump, heat exchanger and manifold are filled.
- 5 The coolant can stay in the engine
- 6 Disconnect the battery and store it in a place free of frost and dry and charge it regularly.
- 7 Close inlet- and outlet openings with tape.
- 8 Protect the generating set against the influences of bad weather conditions.

This method of preservation will be sufficient for 6 months. Repeat steps 2, 3, and 4, every 6 months. Change oil before using the engine again.

5 TROUBLE SHOOTING

5.1 ALTERNATOR/ ELECTRICAL FAULTS



Beware of parts which are live!



Remove 3 Amp. Fuse in the control panel while working on the generator to prevent the engine from starting

5.1.1 General

Most electrical problems relating to Voltage or Frequency are due to wrong engine speed. Note that RPM and Hz are basically the same. Use the problem solving table to find the cause of a wrong engine speed. When there is no

obvious cause one can adjust the RPM (see special procedures).



CAUTION!

If the voltage is set any higher than its maximum limit, the generator may be damaged.

If the bottom speed is set at too low a frequency, the generator may be damaged. On the other hand too high a frequency can cause voltage drops with high loads.

A failure code is displayed when a hardware failure at the generator is detected.

| <i>Failure code</i> | <i>Problem</i> |
|----------------------|---|
| COMMUNICATION | Communication error between the panel and the generator |
| LOW START BAT | Starter battery voltage too low |
| ALTERNATOR | No output battery charging voltage |
| EXHAUST TEMP | Exhaust temperature is too high |
| WATER TEMP | Coolant temperature is too high |
| OIL PRESSURE | Oil pressure failure |
| AC VOLTAGE | Generator AC output voltage is either too high or too low |
| HIGH CURRENT | Generator is in overload |
| FREQUENCY | Output frequency of the generator is too low |

5.1.2 Trouble shooting table

| PROBLEM | CAUSE | SOLUTION |
|---|---|--|
| No output (Voltage) at all | <ul style="list-style-type: none"> • Circuit breaker "off" or faulty main fuse • Faulty fuse of the AVR | Check switches and fuses and measure directly on the alternator to exclude external causes. Check fuse of the AVR |
| | <ul style="list-style-type: none"> • Low engine RPM. | Check the engine RPM and adjust (refer to special procedures). |
| | <ul style="list-style-type: none"> • Loss of residual magnetism. | Check the residual magnetism and flash the alternator (refer to special procedures). |
| | <ul style="list-style-type: none"> • Faulty AVR | Check by independent excitation if the problem is in the AVR or in the windings and replace AVR if necessary (see special procedures). |
| | <ul style="list-style-type: none"> • Rotor diodes broken. | Check the diode in the rotor (refer to special procedures). The M-SQ16 has one diode in the rotor. |
| Generator output voltage too low when no load is on it (less than 225V between phase and neutral). | <ul style="list-style-type: none"> • Engine is not reaching the rated RPM. | Refer to special procedures to readjust RPM. |
| | <ul style="list-style-type: none"> • Faulty AVR. When slightly too low, adjustment could be necessary | Try to readjust AVR. Check by independent excitation if the problem is in the AVR or in the windings and replace AVR if necessary (see special procedures). |
| | <ul style="list-style-type: none"> • Defective diode | Check the diode in the rotor and replace (refer to special procedures). |
| Generator output voltage too low under load (less than 225V between phase and neutral). In no load condition it is OK | <ul style="list-style-type: none"> • Unbalanced load; check the voltage of the other phases. When the voltages are different this is caused by an unbalanced load. | Bring load in balance. When slightly out of balance, remove the sense wires to the phase with the highest load and check if the voltage on the other phases is not too high. |

| PROBLEM | CAUSE | SOLUTION |
|--|--|---|
| | <ul style="list-style-type: none"> Engine is not reaching the rated RPM. Possibly too much load or engine problems (lack of fuel) Faulty AVR or readjustment necessary | <p>Switch off a load; (part off) consumers See to engine RPM problems</p> <p>Try to readjust the voltage Check by independent excitation if the problem is in the AVR or in the windings and replace AVR if necessary (see special procedures).</p> |
| Generator output voltage too high without load, (more than 235V between phase and neutral) | <ul style="list-style-type: none"> Over-energising due to defective AVR or wrong AVR setting | Check AVR, readjust and replace AVR if necessary (see special procedures).. |
| Generator output voltage too high with load, (more than 235V between phase and neutral) In no load condition it is OK | <ul style="list-style-type: none"> Unbalanced load | <p>Bring load in balance. When slightly out of balance, remove the sense wires to the phase with the highest load and check if the voltage on the other phases is not too low.</p> |
| Generator voltage fluctuates. | <ul style="list-style-type: none"> Disturbances on the electrical system/ user side. AVR reacts on fluctuating load Engine runs irregularly. | <p>Check if electrical load is fluctuating</p> <p>Do not apply strong fluctuating loads</p> <p>When engine runs irregularly see section: "Engine runs irregularly" at the %engine faults+ paragraph.</p> |
| Generator is not able to start an electric motor | If the generator is unable to supply enough power to start an AC electric motor, this is usually because this motor draws too much current during starting | <p>Check the electric motor's current draw required for starting. This should not exceed the rated generator peak output current. This could be remedied by using a "soft-start". Inquire at your nearest WhisperPower dealer or directly at the manufacturer, WhisperPower in the Netherlands.</p> |

5.2 ENGINE FAULTS



Remove 3 Amp. fuse in the control panel while working on the generator to prevent the engine from starting.

5.2.1 General

Most electrical problems relating to Voltage or Frequency are due to wrong engine speed. Note that RPM and Hz are basically the same.

Use the problem solving table to find the cause of a wrong engine speed. When there is no obvious cause one can adjust the RPM (refer to special procedures).

When the engine is not cranking well, starting problems almost always originate from battery problems or poor battery cable connections.

When the engine is cranking, well starting problems almost always originate from lack of fuel or air bubbles in the fuel pipes.



When the engine does not start instantly, prolonged cranking can fill up the exhaust system with cooling water because of the water injected exhaust. When the water enters the cylinder through the valves this will bring severe damage to the engine. When the engine does not start and repeated cranking is necessary shut off the seawater inlet. Open the valve immediately after the engine has started.

A failure code is displayed when a hardware failure at the generator is detected.

| Failure code | Problem |
|----------------------|---|
| COMMUNICATION | Communication error between the panel end the generator |
| LOW START BAT | Starter battery voltage too low |
| ALTERNATOR | No output battery charging voltage |
| EXHAUST TEMP | Exhaust temperature is too high |
| WATER TEMP | Coolant temperature is too high |
| OIL PRESSURE | Oil pressure failure |
| AC VOLTAGE | Generator AC output voltage is either too high or too low |
| HIGH CURRENT | Generator is in overload |
| FREQUENCY | Output frequency of the generator is too low |

5.2.2 Trouble shooting table

| PROBLEM | CAUSE | SOLUTION |
|--|--|--|
| Diesel engine fails to crank, it does not react at all, or the starter makes clicking noises, or the engine cranks very slowly | <ul style="list-style-type: none"> • Almost certainly this is an electrical problem. One other possibility is that the engine is locked by water in the cylinders or there is other severe damage. Display will indicate %LOW START BAT+. | Check on water in the cylinder and further damage by cranking. When there is water in the cylinder, then deactivate the control system, disconnect the battery, remove the glow plugs. Crank the engine to remove the water through the opening of the glow plugs. Check oil on the presence of water and change oil. Find out how the water did enter the cylinder (check the air vent). Take precautions to prevent it from happening again. When there is no mechanical malfunction the problem must be an electric malfunction. |
| No reaction at all | <ul style="list-style-type: none"> • Starter battery switched "OFF". • Faulty fuse on control panel | Check position of the battery switch and switch "ON". Replace fuse |
| No reaction or clicking noises, or slow cranking | <ul style="list-style-type: none"> • Starter battery voltage insufficient (battery too weak). • To thick engine lubricating oil. • Starter motor faulty | Check battery voltage. Recharge the battery. Inspect battery terminals and cables for a good electrical connection (inspect against corrosion, tattered wires, etc.) Change oil for a lower viscosity. Repair the starter motor |
| Starter is turning engine smoothly, but engine fails to start | <ul style="list-style-type: none"> • Out of fuel or faulty fuel, water in the fuel. • Fuel solenoid is not working. • Fuel lift pump is not working. • Fuel filter is blocked. • Air in fuel lines. • Wrong valve clearance. • Low compression because of dirty valves. • Blocked injector. • Loss of compression by wear out or damage | Fill up with fuel or replace with better quality. Check if solenoid comes in; if not check wire connections and circuitry to solenoid (see DC wiring diagram). Check fuel filter and fuel lift pump: clean or replace if necessary. Bleed air from fuel system (see maintenance section). Adjust valve clearance, Clean valves. Take off the injection bent and inspect the outlet port. When little rust in the port clean the valve by taking off the valve spring and rotate until clean. When the outlet port is strongly affected by rust, the exhaust system is not properly installed (see paragraph 5.4.3). Contact WhisperPower service department for advice. Have the injector tested and cleaned if necessary. Repair by WhisperPower service |

| PROBLEM | CAUSE | SOLUTION |
|--|---|--|
| Engine runs irregularly. | <ul style="list-style-type: none"> • Unsuitable contaminated fuel • Lack of fuel. | Fill up with fuel or replace by better quality. |
| | <ul style="list-style-type: none"> • Choked fuel filter. | Check fuel filter and fuel lift pump: clean or replace if necessary. |
| | <ul style="list-style-type: none"> • Disturbances on the electrical system/ user side. | Check if electrical load is fluctuating. |
| | <ul style="list-style-type: none"> • Faulty fuel lift pump. | Try the pump by manual operation. Repair when faulty or replace |
| | <ul style="list-style-type: none"> • Choked air cleaner. • Lack of air. | Check the air intake |
| | <ul style="list-style-type: none"> • Choked exhaust system, exhaust blocked, rubber exhaust hose kinked. | Check the exhaust hose |
| | <ul style="list-style-type: none"> • Air in the fuel pipes | Bleed air from fuel system (see maintenance section). |
| | <ul style="list-style-type: none"> • Blocked injector. | Have the injector tested and cleaned if necessary. |
| | <ul style="list-style-type: none"> • Wrong valve clearance. | Adjust valve clearance. |
| | <ul style="list-style-type: none"> • Temporarily hunting (this will disappear when engine has run in). | |
| Engine speed drops | <ul style="list-style-type: none"> • Too much oil. | Drain oil to proper level. |
| | <ul style="list-style-type: none"> • Lack of fuel. | Check fuel supply system: fuel pump and filter. |
| | <ul style="list-style-type: none"> • Lack of intake air. | Check air intake. |
| | <ul style="list-style-type: none"> • Choked exhaust system, exhaust blocked, rubber exhaust hose kinked. | Check exhaust system. |
| | <ul style="list-style-type: none"> • Generator overloaded | Reduce the electrical load (switch off some consumers). |
| | <ul style="list-style-type: none"> • Defective generator (windings, bearings or other) • Damaged engine | Generator must be sent to manufacturer for repair of damaged bearing or winding. Repair by WhisperPower service |
| Engine does not stop on command | <ul style="list-style-type: none"> • Fuel solenoid is not switching off " • Loss of control | Faulty Digital Diesel Control unit. Stop the engine manually by the stop handle. Check wire connections to fuel solenoid. Check solenoid function. Replace if necessary |
| Engine exhaust smokes | <ul style="list-style-type: none"> • Faint blue smoke - generally the result of light load | Increase load. |
| | <ul style="list-style-type: none"> • Heavy blue smoke - caused by lubricating oil: Overfull oil sump or worn cylinder bore, stuck broken or worn piston rings. | Check the oil level. Check the compression. |
| | <ul style="list-style-type: none"> • Black smoke . incomplete combustion caused by: Overload, choked air cleaner, inlet temperature too high, unsuitable fuel or water in fuel. | Check air cleaner Check the fuel . Check for overload. |
| Engine starts, but stops after 10 seconds | <ul style="list-style-type: none"> • Protection system stops the engine; this can be caused by oil pressure failure, lack of cooling water (exhaust temperature alarm). Overload, loose wire or faulty alarm switch. Digital Diesel Control will help to indicate failure. | See paragraph 2.5.5. and 3.2.2 for information on the alarm system. Bypassing the switches can help to confirm the failure. When there is no real failure, it could be a faulty alarm switch |
| Engine stops by itself (Digital Diesel Control will help to indicate failures) | <ul style="list-style-type: none"> • Overload or short circuit. | Switch off the consumers and test for short circuit. |
| | <ul style="list-style-type: none"> • Lack of fuel. | Check fuel supply system: fuel lines, pump, filter, valves, tank level, etc. |
| | <ul style="list-style-type: none"> • Oil pressure low. (oil pressure switch tripped). | Check oil level. Check engine's oil pressure and have it repaired by WhisperPower. |

| PROBLEM | CAUSE | SOLUTION |
|-----------------------|---|---|
| | <ul style="list-style-type: none"> Excessive heat in cooling system (thermo-switch tripped). Lack of cooling water (exhaust switch tripped). Impeller broken. Cooling water blocked. Water strainer blocked. Air or water in the fuel. Blocked air or fuel filter. | Check cooling water system flow: water pump, inlet water filter, coolant flow. |
| | <ul style="list-style-type: none"> Loss of compression by wear out or damage. | Repair by WhisperPower service. |
| | <ul style="list-style-type: none"> V-belt broken or loose. | Readjust or replace V-belt |
| | <ul style="list-style-type: none"> Thermostat faulty | Check thermostat and replace |
| Sooty, black exhaust. | <ul style="list-style-type: none"> Generator is being overloaded. Digital Diesel Control will indicate %HIGH CURRENT+. | Check electrical load and switch off some consumers |
| | <ul style="list-style-type: none"> Insufficient intake air. | Check intake air paths and filter, clean and replace if necessary. |
| | <ul style="list-style-type: none"> Choked air cleaner. | Replace injector. |
| | <ul style="list-style-type: none"> Fuel injector faulty. | Readjust valve clearance |
| | <ul style="list-style-type: none"> Valve clearance incorrect. | Use better quality diesel. |
| | <ul style="list-style-type: none"> Poor fuel quality. | Use better quality oil. |
| | <ul style="list-style-type: none"> Poor quality lubricating oil. | Increase load and have the engine run for a few hours |
| | <ul style="list-style-type: none"> Continuous running with very low load. | |
| Loss of power | Wrong measurement. Check if the load is measured correctly. Does the Amp meter show the correct value? When calculating the load by multiplying voltage and amps this should be done by using the exact values, taking into account the power factor of the consumers. When any doubt, measure the power directly with an appropriate instrument. | |
| | <ul style="list-style-type: none"> Overfull oil sump. | Bring the oil to the correct level |
| | <ul style="list-style-type: none"> Choked fuel filter. | Replace the fuel filter. |
| | <ul style="list-style-type: none"> Choked air cleaner | Check air inlet openings; clean air cleaner. |
| | <ul style="list-style-type: none"> Exhaust blocked. | Check the exhaust system. |
| | <ul style="list-style-type: none"> Injector blocked. | Have the injector checked. |
| | <ul style="list-style-type: none"> Loss of compression, sticking or damaged piston ring. | Have the compression measured. Clean or replace the rings. |
| | <ul style="list-style-type: none"> Wear out of cylinder. | Have the compression measured and have the engine overhauled. |
| Over-temperature | <ul style="list-style-type: none"> Overload. | Take away the overload. |
| | <ul style="list-style-type: none"> Low level of cooling oil or air in the cooling system | Fill up with liquid and release air bubbles. Check if there are air blocks in the system; see the installation manual |
| | <ul style="list-style-type: none"> Water inlet system blocked. | Check the cooling system thoroughly. |
| | <ul style="list-style-type: none"> Broken impeller. | |
| | <ul style="list-style-type: none"> Water strainer choked | |
| | <ul style="list-style-type: none"> Heat exchanger choked. | |
| | <ul style="list-style-type: none"> Faulty thermostat | Check the thermostat or replace. |

5.2.3 Warnings



Generator must be shut off immediately if:

- Motor RPM suddenly rises or drops.
- Unusual noise comes from generating set.
- Exhaust gases suddenly colour dark.
- Engine failure warning light is on

5.2.4 Service address

If you cannot correct a problem with the aid of the malfunction table, contact your WhisperPower Service Centre or Whisper Power Netherlands, tel: INT+31-512-571550.
www.whisperpower.eu.

5.3 SPECIAL PROCEDURES ALTERNATOR

5.3.1 Automatic voltage regulator

The voltage regulator has a $\pm 2\%$ voltage precision in the machine working range with distortion free loads.

The phase voltage can be adjusted by trimmer **UVI** (see figure 21) from 185 to 290V.

A fuse protects the regulator and generator against overloads and/or faults; a pocket has been provided on the edge of the board to hold a spare fuse (rapid type 20x5 3.15A).

Another trimmer **ISTI** (stability) allows adapting the regulator to the generator parameters.

The regulator has been built to suppress the voltage surges on releasing the load that are below 20% at nominal load.

AVR SETTINGS

To select the AVR settings access the control board after removing the cover. Most adjustments are factory set to ensure satisfactory results in the operating tests on commissioning. Further adjustments may be necessary to ensure optimum operation under specific working conditions.

If the alternator has to operate at 50Hz the jumper **IJI** across the terminals marked 60Hz+ has to be left in place, if it has to operate at 60Hz this jumper should be replaced. The output voltage can be changed by adjusting potentiometer **UVI**. Take the generating set to its nominal speed and turn until the required voltage is obtained.

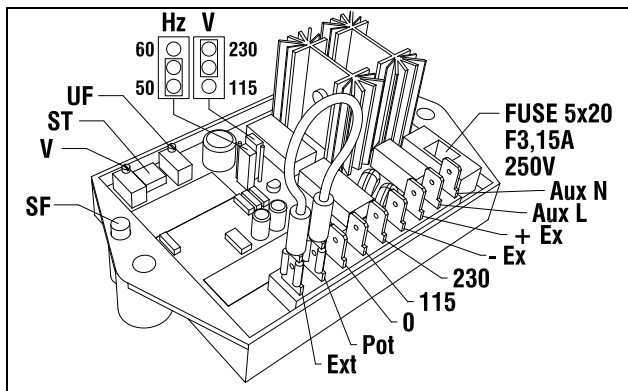


Fig. 21. Automatic Voltage Regulator (AVR)

Setting the bottom speed at 50 (60)Hz: start up rotation of the generating set adjusting it to obtain a frequency of 46 (56)Hz. Turn trimmer **UVI** until the voltage begins to drop. Restore nominal speed.

Caution: if the bottom speed is set at too low a frequency the generator may be damaged. On the other hand, too high a frequency can cause voltage drops with high loads.

5.3.2 Residual voltage check / excitation procedure (flashing)

When residual magnetism disappears there is no residual voltage. Residual magnetism can disappear after the generating set being out of service for a long period or a short circuit. This can be solved by exciting the exciter field coil directly, disconnecting the AVR first. Put 12 Volt directly over the electronic regulator terminals taking polarity into account.

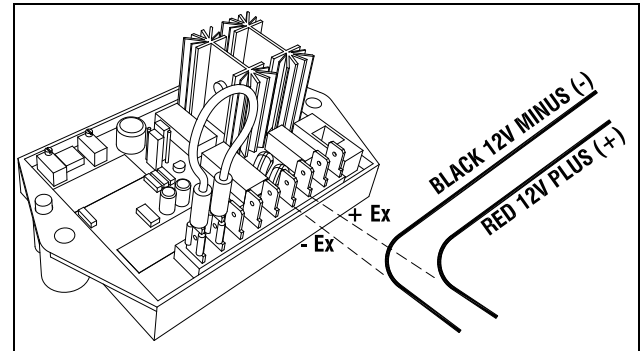


Fig.22: Residual voltage check / excitation procedure.

When using the starter battery fuse it and limit the current with a 30 Ohm resistor. Flashing can be done while the engine is running and the wiring is connected. When a variac (variable power supply) is available one should be able to control the voltage manually.



CAUTION

If the starter set battery is used for exciting one must take care. A short circuit can cause heavy sparking, fire and injuries.

When external excitation does not bring back voltage, the rotating rectifier diodes should be tested and a winding resistant test should be executed.

5.3.3 Testing rotary rectifier diodes

The diodes in the rotor can be checked with a multimeter. The diodes are integrated in a rectifier unit. When all diodes are faulty the alternator will not generate any voltage. When one or more diodes are faulty the alternator will produce too low voltage.

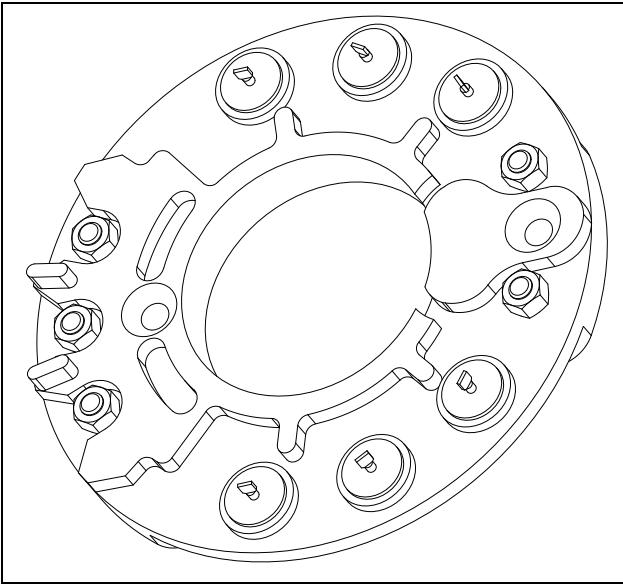


Fig.23: Rotating rectifier diodes.

The flexible leads connected to the diodes should be disconnected at the terminal end, and the forward and reverse resistance checked. A healthy diode will indicate a very high resistance (infinity) in the reverse direction, and a low resistance in the forward direction. A faulty diode will give a full deflection reading in both directions with the test meter on the 10,000 ohms scale, or an infinity reading in both directions. In case of faulty diodes replace the rectifier unit. One can get access to the diode unit by taking off the backend cover of the alternator.

5.3.4 Winding resistant values

If after establishing and correcting any fault on the AVR and diodes, and output is still low when separately excited, then the main rotor, stator auxiliary and exciter stator winding resistance should be checked as the fault must be in one of these windings. The respective leads must be disconnected before taking the readings.

Resistance values should be within 10% of the values given in the table below:

M-SQ16 Three Phase

| | |
|-------------------------------------|-------------|
| • Resistance main stator windings | 0.39 Ohm |
| • Resistance rotor windings | 2.4 Ohm |
| • Resistance auxiliary winding | 7.5 Ohm |
| • Resistance exciter stator winding | 24 Ohm |
| • Resistance exciter rotor winding | 3x 0.32 Ohm |

5.3.5 Meggering

One can try to measure resistance between the housing and the windings with a multimeter which should read infinity. When readings are infinity but a fault is suspected one can do a high voltage resistance test (MEGGERING) This procedure should be carried out by an expert. The AVR should be disconnected during this test. A 500V Megger or similar instrument should be used. The insulation resistance to earth of all windings should be in excess of 2 MOhm. Should the insulation resistance be less than this value, drying out the generator windings is essential. Drying out can be carried out by direct warm air (60-80°C) from a fan heater or similar apparatus into the generator air inlets or outletst

5.4 SPECIAL PROCEDURES ENGINE

5.4.1 Setting the RPM

RPM is set by the manufacturer and should not need readjustment! However a very slight offset after running in could occur. RPM can be measured by a frequency meter. Before readjustment check any other explanation for the wrong speed. Engine speed is set at the factory at nominal 1500 (50 Hz) RPM. A RPM drop of 5% at full load is acceptable. Therefore a no load setting should be at $\pm 1575 \text{ RPM} = 52.5 \text{ Hz}$. Under no circumstances should the RPM be under full load below $1470 \text{ RPM} = 49 \text{ Hz}$. When no cause can be found for a wrong speed, the setting can be adjusted:

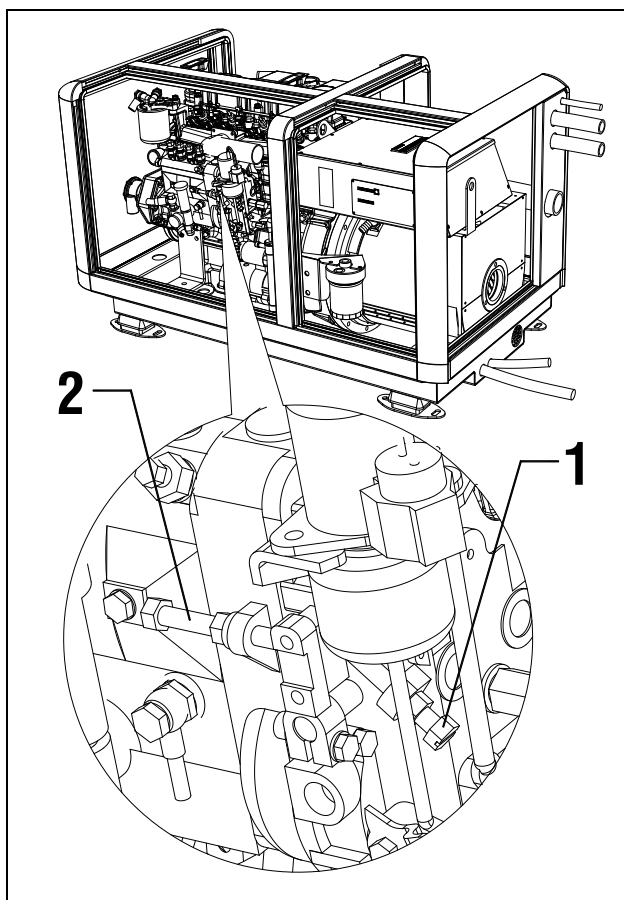


Fig. 24 1 = Adjustment screw operational RPM
2 = Adjustment screw max. RPM

It is very important to identify the correct setting assembly (refer to fig. 24). The screw is to be locked in position with the lock-nut.

5.4.2 Adjusting valve clearance and retightening the cylinder head bolts.

Both procedures have to be carried out with a cold engine. When both procedures are carried out be sure to retighten the cylinder head bolts before adjusting the valve clearance. When retightening the cylinder head bolts, drain the coolant by removing the drain plug.

Loosen the bolts slightly, remove the rocker assembly (the rocker arms, shaft, and stays) and then retighten the bolts to the specified torque in the numerical order illustrated (ref. to fig. 25).

Tightening torque cylinder head bolt: $118 \pm 5 \text{ Nm}$

Rocker stay tightening torque:

Long bolts $15 \pm 2 \text{ Nm}$

Short bolts $12 \pm 1 \text{ Nm}$

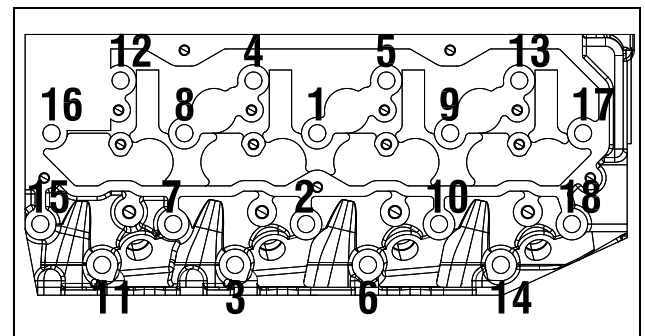


Fig. 25 Tighten sequence cylinderhead bolts

The clearance of both (intake and exhaust) valves should be 0.25 mm in cold condition. Set the piston of the first cylinder to be adjusted to top dead centre (T.D.C.) of compression stroke.

The T.D.C. of compression stroke can be found by aligning the T.D.C. mark (-0-) on the crankshaft pulley with the mark on the gear case (ref. to fig. 26).

First align the T.D.C. mark for the No. 1 cylinder. Confirm that the valves do not move up or down when the crankshaft is turned about 20 degrees in normal and reverse direction of rotation.

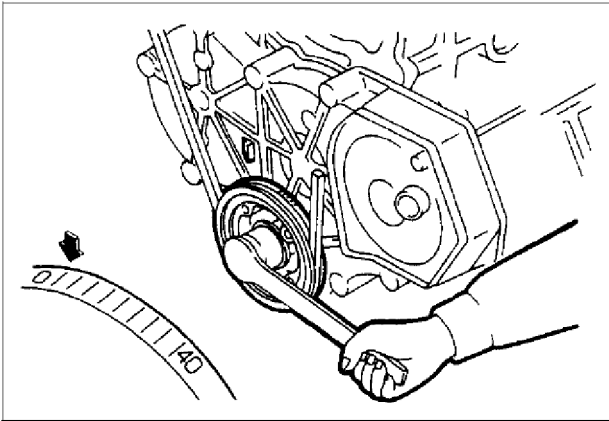


Fig. 26 Finding TDC

If the rocker arms move piston no.1 is on the T.D.C. of the intake or exhaust stroke. In such case turn the crankshaft 360° in the direction of engine rotation again. No. 1 piston is now at T.D.C. of the compression stroke.

After adjusting the valves of cylinder 1 adjust the valve clearance of the remaining cylinders in firing order 1 . 3 . 4 . 2. Turn the crankshaft 180 degrees clockwise from the T.D.C of cylinder 1 to the T.D.C of cylinder 3. and turn the crackshaft 180 degrees further clockwise to the TDC of cylinder 4 and adjust the valves. And again 180 degrees to adjust cylinder 2.

5.4.3 Measuring exhaust backpressure

The exhaust system must be of adequate size -2# 51 mm - and maximal length (refer to installation manual). When any doubt; backpressure has to be measured. An easy way to measure for back-pressure is to use a water column.

A water column can be made visible in a plastic tube along a yardstick and fitting the end to a hose connection to fit in the adaptor on the injection bent after removing the exhaust temperature switch.

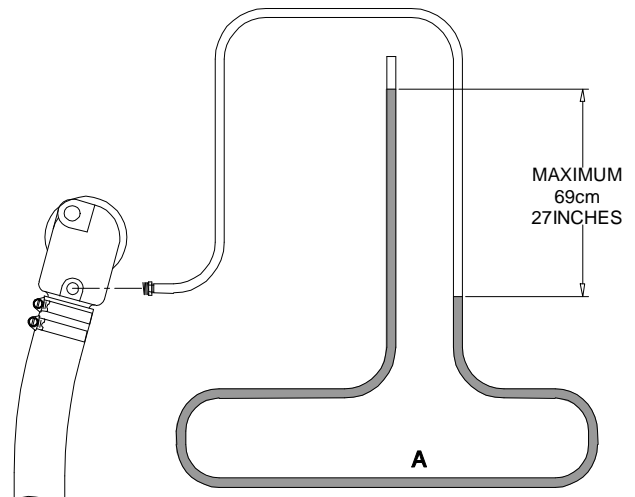


Fig 27: Measuring exhaust backpressure

The bent A hanging down should not be too short helping to damp the pulsating effect of the gas discharge that is characteristic for a one cylinder engine. The water column should be no more than 27 inches (69 cm.) of water (1 PSI - 0,07 bar)

5.4.4 Disassembling instructions

It could be necessary to disassemble the generating set for repair or checks. Following instructions will help:

- 1 The design of the M-SQ16 makes it possible to do most repairs on the spot. The heat exchanger is accessible and can be removed. The connections of the alternator are very accessible as well.
- 2 The sound shield canopy can be disassembled according to exploded view below (figure 28).
- 3 To take the generating set out of the canopy all hose and cable connections have to be taken off. The set is fixed to its base by four rubber mountings and can be loosened by removing the four nuts from the bolts of these mountings. The easiest way to get the generator out of its capsule is by lifting the set with the aid of the lifting eyes.
- 4 Reassembling the generating set one should take care of alignment, cleaning the surfaces between engine and alternator and tighten the bolts crosswise and gradually.
- 5 Test the generating set first outside its capsule and check very carefully for leakages before putting it back in its enclosure..

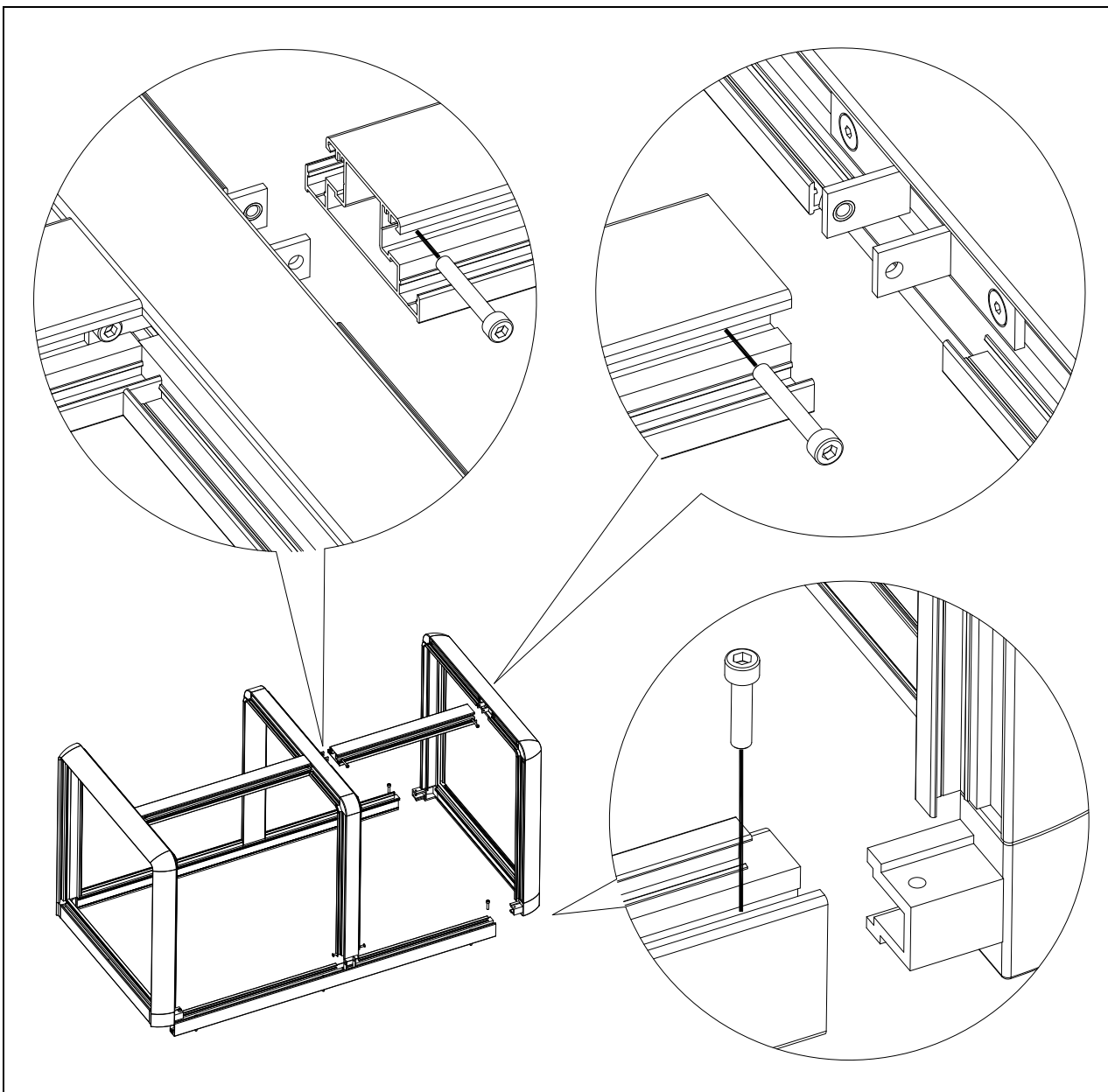


Figure 28: exploded view sound shield M-SQ16

6 SPARE PARTS LIST

A complete parts manual in English is available as an option number: number: 40200184 (***)

A work shop manual in English is available as an option number: 40200173 (***)

We recommend the following spares for service and maintenance.

~ Kit A: parts for regular maintenance parts marked (*)

article no. 40201360

~ Kit B: parts for maintenance + spare parts: all parts marked (*)+(**)

article no. 40201361

~ Kit C: parts for "world travellers" all parts marked (*)+(**)+(***)

article no. 40201362

| ARTICLE NO | DESCRIPTION |
|------------|---|
| 40206122 | Fuel filter (*) |
| 50205120 | V-belt (*) |
| 40203121 | Oil filter (*) |
| 50201370 | Raw water pump complete WhisperPower type M16 (***) (refer to fig. 29) |
| 40206254 | Impeller (50206259) + gasket (50206260) (*) |
| 40206255 | Cover type M16 (**) |
| 50209018 | Bolts cover (**) (6 pcs.) |
| 40206257 | Pump repair kit A consisting of: Shaft (50206267), Bearings (2 pcs) (50206264), O-ring (50206263), Seal (50206262), Shim (50206271) Ring (50206265) Cam (50206269), Screw (50206265); Washer (50206274) Screws (6pcs 50209018) Cover (50206255) |
| 40209010 | Pump repair kit B (**) consisting of: Bearings (2 pcs) (50206264), O-ring (50206263), Seal (50206262), Ring (50206265) |
| 50201549 | Heat exchanger complete with appendages (***) |
| 50201322 | Water hoses with clamps (**) |
| 50209132 | Measuring coil (***) , 3 pieces |
| 50212902 | Rotary diode assembly (**) three phase |
| 50212901 | Voltage regulator |
| 40209161 | Local control panel (***) |
| 50209200 | Digital Diesel Control Unit (***) three phases |
| 50212170 | Fuses 10 Amps(*) |
| 50212154 | Fuses 3 Amps (*) |
| 50212198 | Fuses 20 x 5 / 3.15 Amps (**) |
| 50201366 | Wiring loom complete (***) |
| 40209102 | Digital Diesel Remote control panel (***) |
| 130010915 | Cable remote control 15 mtr, including connectors |
| 50206033 | Overhaul gasket kit / Seal kit (***) |
| 50206030 | Cylinder head gasket kit |
| 50206040 | Glow plug, 4pcs (**) |
| 50203050 | Nozzle injector, 4pcs (**) |
| 50206045 | Thermostat (**) |
| 50206038 | Gasket thermostat (**) |
| 50206034 | Gasket rocker cover (**) |

More extensive parts list on the internet: whisperpower.eu (fast moving parts).

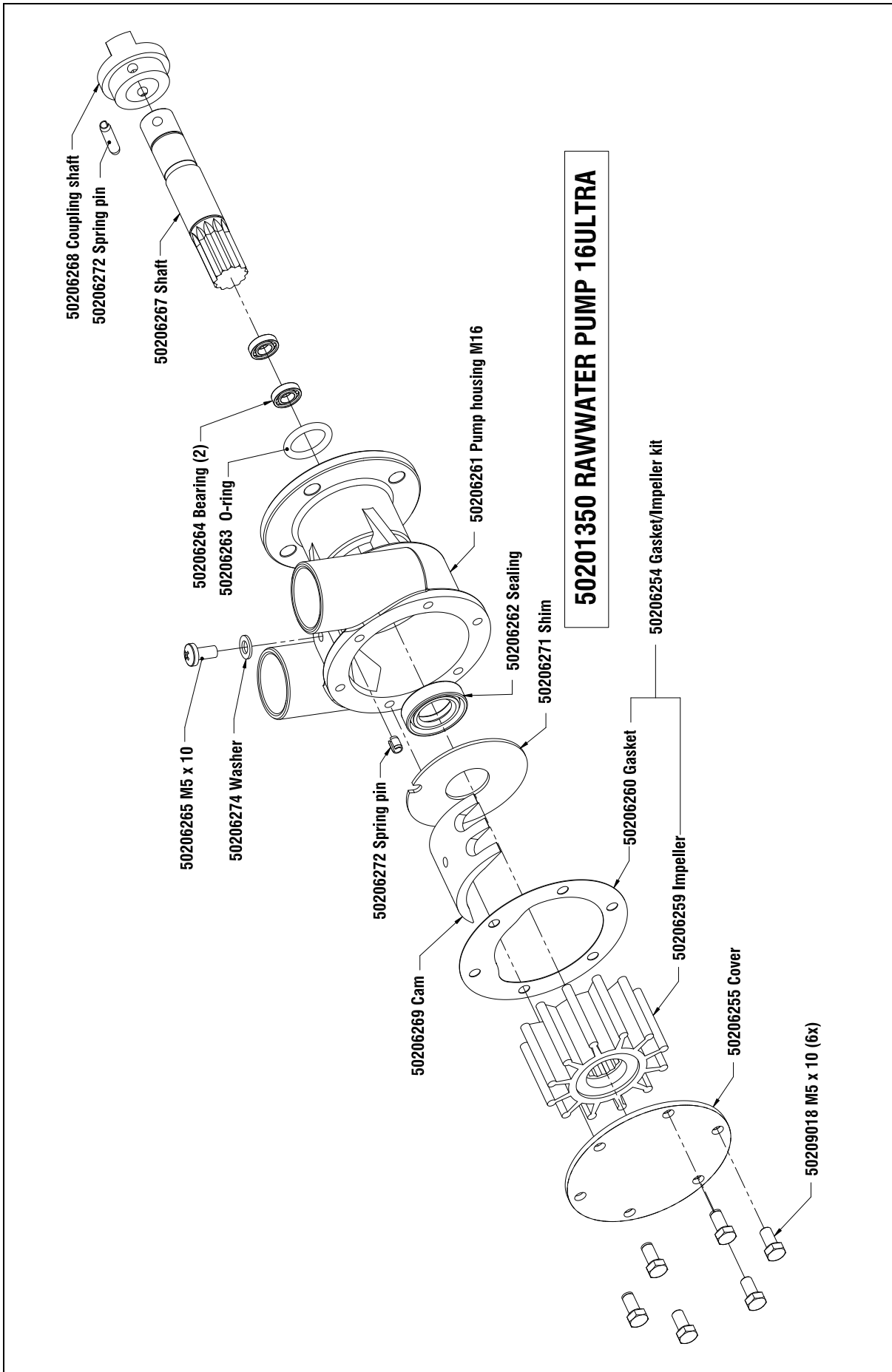


Figure 29: Raw water pump complete WhisperPower type M16



MAINTENANCE LOG

first service after 50 hours:

hour counter:

remarks

next service (every 150 hours)

hour counter:



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