

USER MANUAL

DIESEL GENERATOR SETS

**HDE20SS3, HDE40SS3,
HDE80SS3**

Read the manual carefully before using
the engine.

This manual contains important
instructions for safe operation.

Table of Contents

1. Important safety instructions.....	1
1.1 Overview	1
1.2 Safety symbols	1
1.3 General safety measures	2
2. Introduction to the product.....	8
2.1 Identification of the main external parts	8
2.2 Identification of main internal parts	9
2.3 Control panel.....	10
3. Installation	11
3.1 Generator installation	11
3.2 Key points to place the generator set	12
3.3 Indoor installation	13
4. Load connection	15
4.1 Power input to cover the load	15
4.2 Earthing.....	16
4.3 Load connection	17
4.4 Selection of three-phase cables.....	20
5. Service and operation.....	22
5.1 Engine preparation	22
5.2 Start of the generating set.....	25
5.3 Stopping the generator	25
5.4 Control panel.....	26
5.5 Drawer panel.....	26
5.6 Output terminal.....	27
5.7 Earthing.....	27
5.8 Low load operation	28
5.9 After starting	29
5.10 Initial load.....	29
5.11 Emergency shutdown (stop).....	29
6. Periodic maintenance and service	31
6.1 Control cycle.....	31
6.2 Maintenance plan	35
7. Troubleshooting.....	36
7.1 Engine faults and troubleshooting.....	36
7.2 Alternator faults	42
8. Storage	45
9. Technical specifications	46
9.1 Reference to technical standards.....	46
9.2 Adjusted ambient power coefficient.....	47
9.3 Wiring diagram.....	51
9.4 Technical Specifications	52

Foreword

Thank you for purchasing a diesel generator set from this series.

This manual contains information for the proper operation and maintenance of your generator set. The manual also contains important safety and installation information as well as troubleshooting instructions. Please keep this manual with your equipment at all times.

Please operate this equipment only after you have thoroughly read and understood the contents of this manual.

The information contained in this manual is based on the generator manufactured at the time the manual was published. We reserve the right to make changes at any time, without notice and without any obligation.

No part of this manual may be reproduced in any form or by any means without our express written permission.

1. Important safety instructions

1.1 Overview

Read this manual thoroughly before putting the generator set into operation. The manual contains important instructions to follow during operation and maintenance. Safe operation and peak performance can only be achieved with proper operation and maintenance of the equipment. Generator owners and operators are solely responsible for the safe operation of the generator.

Operation, maintenance and installation of the generator set must comply with all applicable local codes. Electricity, fuel, exhaust, moving parts and batteries present hazards that can cause serious injury or death. Only trained and experienced personnel with knowledge of fuels, electricity and machinery should install or adjust the generator set; or shut down and dismantle the generator set.

1.2 Safety symbols

The following symbols used in this manual indicate potentially hazardous conditions for operators, service personnel, or equipment.

Danger

Indicates a hazardous situation , if not avoided, will result in death or serious personal injury.

Warning

Indicates a hazardous situation , if not avoided, could result in death or serious personal injury.

Attention

Indicates a hazardous situation , if not avoided, can lead to a slight or moderate injury.

Note

Indicates information considered important but not related to the hazard (e.g. messages related to property damage).

1.3 General security measures

1.3.1 For operators (operators and operators) of the generating set.

Warning

- Do not operate the generator if you are tired or have consumed any alcohol or drugs.
- Wear suitable clothing when working with the generator. Loose clothing is easily caught by moving parts and can cause serious personal injury.
- The operator of the equipment must be thoroughly trained before operating the equipment.
- Electrical and/or mechanical servicing must only be carried out by suitably trained and experienced service personnel.
- Do not allow any unauthorized person to be in the vicinity of a running generator.
- Keep the generator set out of reach of children and .
- Pay attention to any abnormalities during the running and operation of the generator, such as vibration, noise, exhaust smoke color and leakage. Shut down the generator immediately and correct any problems before restarting the generator.

1.3.2 The fuel and its vapours are flammable.

Warning



- Do not refill the fuel tanks when the engine is running unless they are outside the engine compartment. Fuel contact with a hot engine or exhaust is a potential fire hazard.
- Do not allow open flames, burning cigarettes, sparks, electric arcs or other sources of ignition near the generator or fuel tank.
- The fuel line must be properly secured, fastened and free of leaks. The fuel connection to the engine should be made with an approved flexible pipe. Do not use copper tubing for flexible pipework.
- Flammable fumes can cause the engine to exceed the permissible speed and make it difficult to stop, and this can result in fire, explosion, serious injury or death. Do not operate the equipment in flammable or explosive environments.
- Any spillage that occurs during refueling, topping off or oil changes must be cleaned up before starting the generator.

1.3.3 Waste handling

- Do not dispose of waste fuel/oil down drains or into watercourses to prevent pollution of the environment.
- Fuel/oil drained from the machine should be stored in a container.
- Properly dispose of all waste in accordance with local environmental regulations. This includes liquids, filters, batteries, electrical components, etc.

1.3.4 Exhaust fumes are deadly.

Danger



- The generator produces carbon monoxide, a colourless, odourless gas that can kill you by suffocation. Do not breathe or come into contact with the exhaust fumes.
- The generator must be operated outdoors or in a well-ventilated area. If the generator is operated indoors, it must be located in a well-designed room with proper ventilation.
- Before each start-up of the generator and every eight hours that the equipment is in continuous operation, inspect the exhaust system for corrosion, blockage, or leaks. Do not use the exhaust to heat the space. Ensure that the exhaust manifold is secured and not deformed.

1.3.5 Moving parts can cause serious injury or death.

Danger



- Keep hands, clothing and jewellery away from moving parts.
- Ensure that the fixings on the generator are secure and reliable. Tighten the supports and clamps. The generator enclosure door must be fully closed and locked during operation.
- Before starting work on the generator, disconnect the battery charger from the AC power source and then turn off the battery switch. This will prevent accidental starting of the unit.
- Do not wear loose clothing or jewellery near moving parts or when working on electrical equipment. Loose clothing and jewellery can get caught in moving parts of the equipment.
- If any adjustments need to be made while the unit is running, use extreme caution around hot pipes, moving parts, etc.
- The electric cooling fan can continue to run for several minutes after the unit has stopped. Do not inspect or service until the fan has completely stopped.

1.3.6 Electric shock and arc flashes can cause serious injury or death to persons.

Danger



- Never operate the generator in a humid environment. Water conducts electric current.
- If the output terminals are touched while the generator is running, electric shock and death may result.
- When connecting the generator to a load, the circuit breaker must be in the OFF position and the generator must be stopped. (In parallel operation, all other loads except this unit should be turned off.)
- Before the generator is put into operation, the output terminal cover must be closed and the screws should be tightened.
- The generator generates voltage even at low speed. Before checking and servicing, make sure the generator has stopped completely.
- Touching the circuit inside the control panel will result in a fatal electric shock. Close the control box and tighten the screws before starting the generator.
- Before opening the control box, turn off the circuit breaker and stop the generator. The control box contains live parts (parts).
- The circuit breaker prevents electric shock. When replacing the circuit breaker, use a circuit breaker of the same specification.
- The internal circuits of the control panel can only be checked after the generator unit has been stopped and the ignition has been switched off.

1.3.7 Electrical connection of the generator

Attention

- Connections for standby power to the building's electrical system or to the power grid must be made by a qualified electrician, and the connection must comply with all applicable laws and electrical codes.
- Improper connections can allow the electrical current from the generator to feed back the grid. Such backfeeding can kill power company personnel or others who come into contact with the lines during a power outage, and when power is restored, the generator can explode, burn, or cause a fire in the building's electrical system.

Earthing connection

Attention



- Depending on the system design requirements, the generator neutral point may be required to be connected to earth at the generator site or at a remote location. Refer to the equipment engineering drawings or a qualified electrician for proper installation.

Note

- It is the responsibility of the end user to make sure that the surface of the grounding point is clean and rust-free before connection.
- It is the responsibility of the end user to ensure that a grounding arrangement that complies with local conditions is established and tested prior to use of the equipment.

1.3.8 High temperature

Danger



- The generator door must be securely closed when the generator is in operation. Do not approach or touch the exhaust manifold and mufflers, radiator, cylinder cover, engine block and generator case to avoid serious scalding or burning.
- The generator will remain hot for many minutes after switching off. Inspection and maintenance of the generator set must be carried out only after the generator set has cooled down completely.
- If any inspection or servicing is required while the equipment is running, use extreme caution around hot piping, moving parts, etc.
- The engine coolant is very hot and under high pressure. Do not open the radiator cap until the engine has cooled completely, otherwise steam and hot water will be released and cause serious scalding or injury.
- Check the coolant level before starting the generator each time. Maintain the cooling system before operating the equipment or when the engine is completely stopped and the coolant temperature drops to 50 °C.

1.3.9 Batteries

Warning

- The battery can produce flammable gas that can cause an explosion or serious injury.
- Only charge the battery in a well-ventilated area to avoid explosion.
- When connecting the battery cables, connect the positive terminal first and then the negative terminal. Make sure the polarity is correct to avoid short circuits or sparks that could ignite the flammable gas produced by the battery.
- When performing maintenance on the generator, turn off the battery switch or disconnect the battery.
- The battery electrolyte is dilute sulfuric acid, which can cause serious burns or scalding. If the electrolyte comes into contact with skin or clothing, rinse the affected areas immediately with plenty of clean water. If the electrolyte gets into the eyes, flush the eyes with plenty of water and seek medical attention immediately.
- Check the battery when the engine is stopped.

1.3.10 High noise level

Attention



- The noise level from the generator increases significantly when the door is open.
- If the equipment must be operated with the door open, for example during inspection, the operator must wear protective earplugs to prevent permanent hearing damage.

Noise abatement guidelines:

The noise level given in this manual is not a safety level but a level of emissions generated. There is a correlation between the level of emissions and the noise level. The emission level cannot be taken as a standard for deciding whether noise protection measures should be taken.

Factors influencing the actual noise level include environmental operating conditions and other noise sources (number of generators, working hours in noisy environments, etc.).

1.3.11 Stacking

Attention

- Improper stacking (stacking equipment on top of each other) will cause the generator to fall and cause serious accidents.
- The generator must be placed on a solid flat surface.
- Only one unit may be stacked on top of the other and the outline dimension and weight of the unit on top must be smaller and lighter than on the bottom.
- Do not attempt to operate any generator when it is stacked. Vibration can cause one or both generators to move and fall.

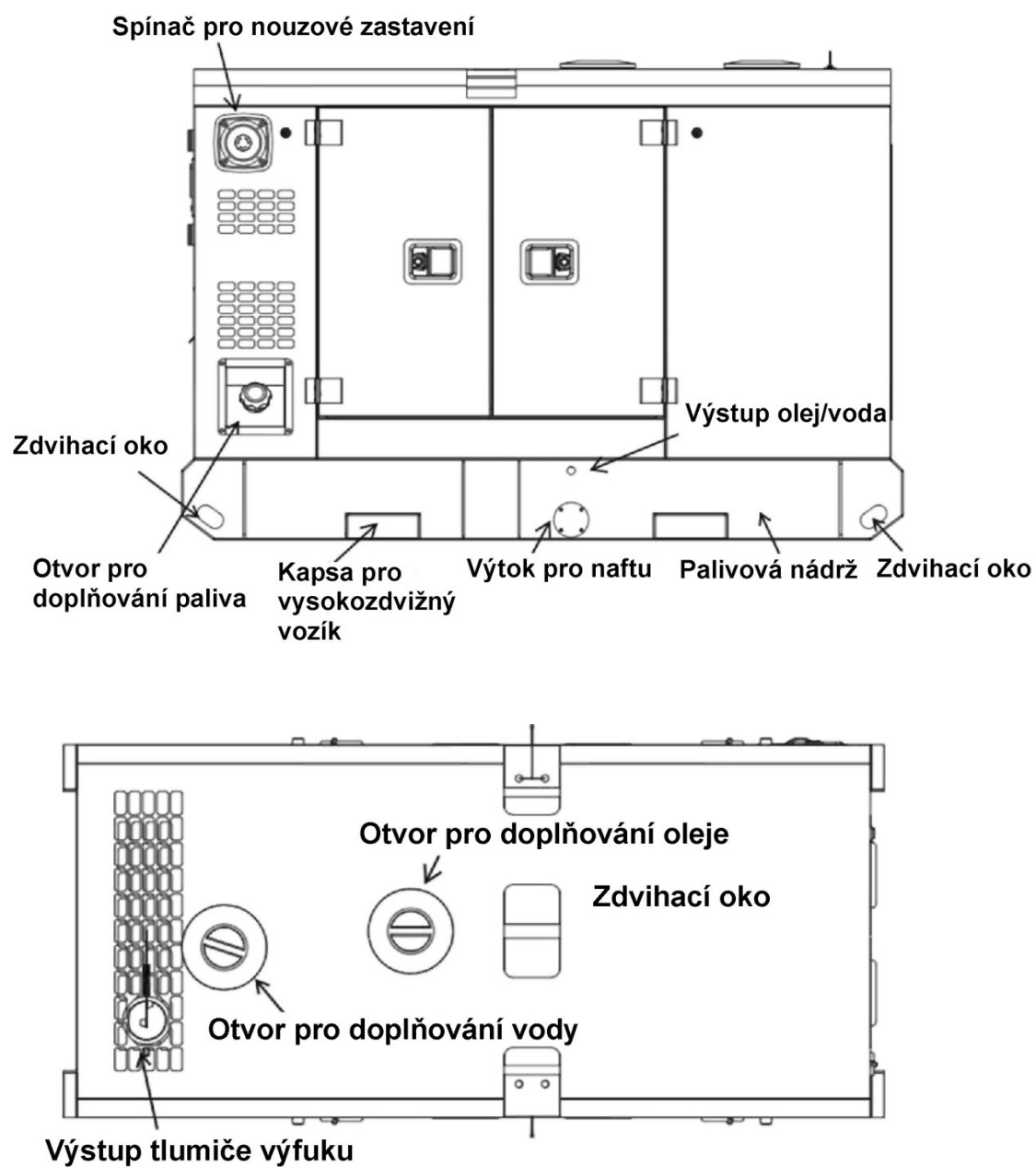
1.3.12 Transport

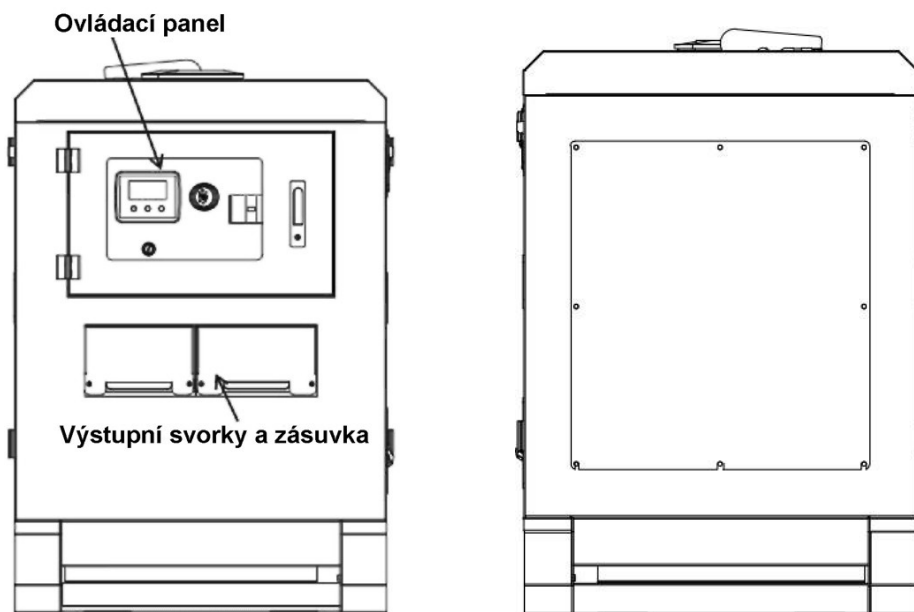
Warning

- Lift the generator using the lifting eye in the middle of the top cover or the four lifting eyes at the bottom. Otherwise, the generator may fall due to insufficient strength. Or the generator can be moved with a forklift.
- Do not stand under the generator when it is raised.
- Do not lift or move the generator while it is in operation.
- Secure the unit properly when transporting it by truck.

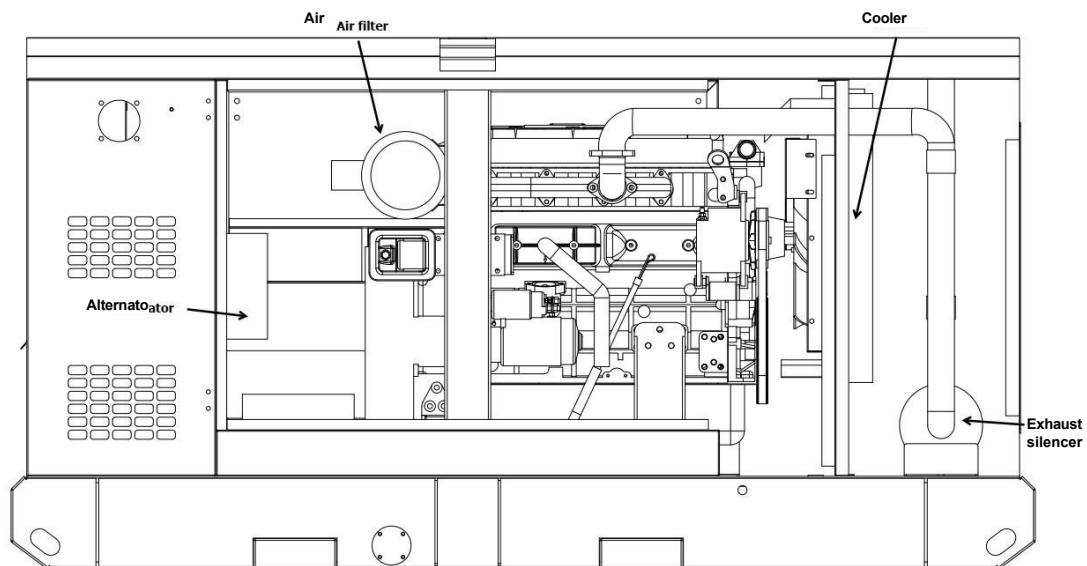
2. Introduction to product

2.1 Identification of the main external parts

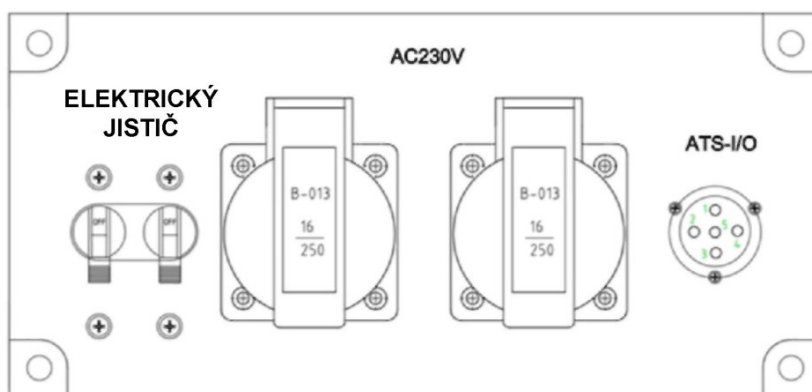
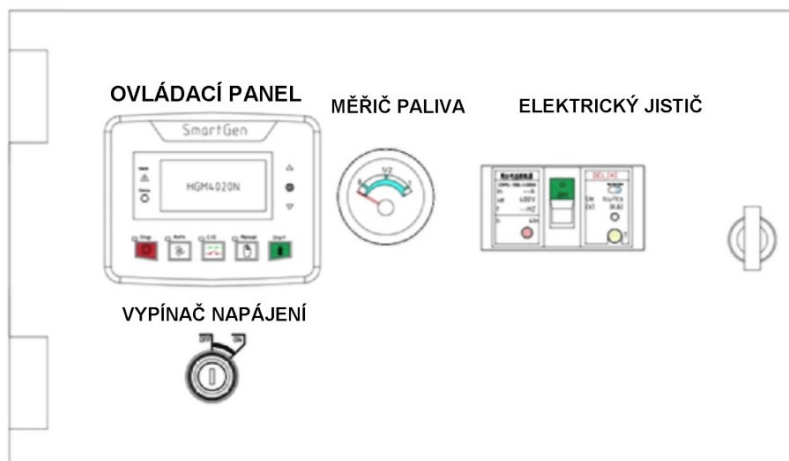




2.2 Identification of the main internal parts



2.3 Control panel



3. Installation

3.1 Installation of generator

The following instructions and tips should be followed during installation.

(1) Please install the unit on a level and sufficiently firm surface to support the generator, with the generator touching the floor at all mounting points. Uneven ground will cause abnormal vibration.

No special foundation is required. A level and suitably firm concrete floor is sufficient to prevent deflections and vibrations and to support the total weight of the unit.

The width and depth of the base must meet the requirements. Typically, the foundation should be 150 mm to

200 mm (6 to 8 inches) deep, and at least as wide and long as the generator. The following formula can be used to calculate the minimum foundation depth:

$$T = K / (D \times W \times L)$$

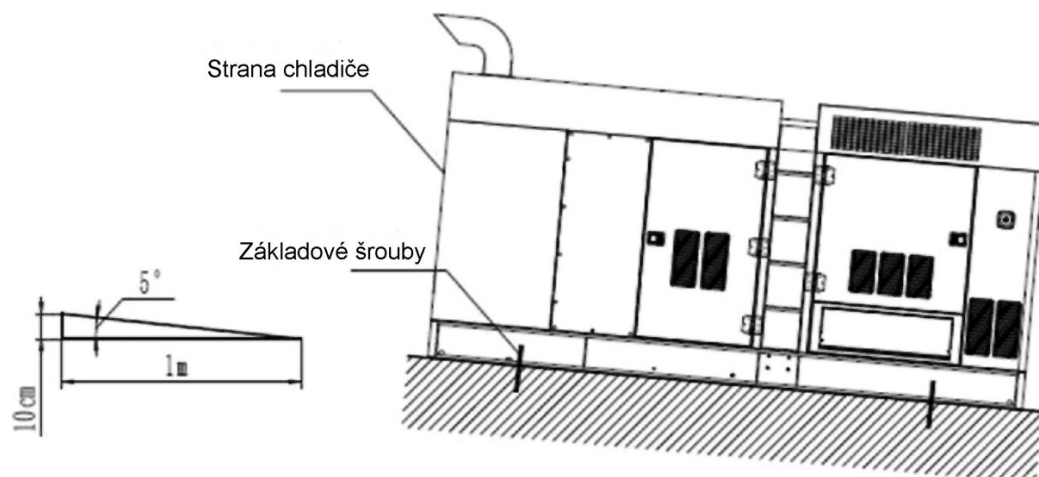
T = foundation thickness in m

K = net weight of the generator in kg

D = density of concrete (take 2403 kg/m³ as reference) W = width of foundation in m

L = length of the foundation in m

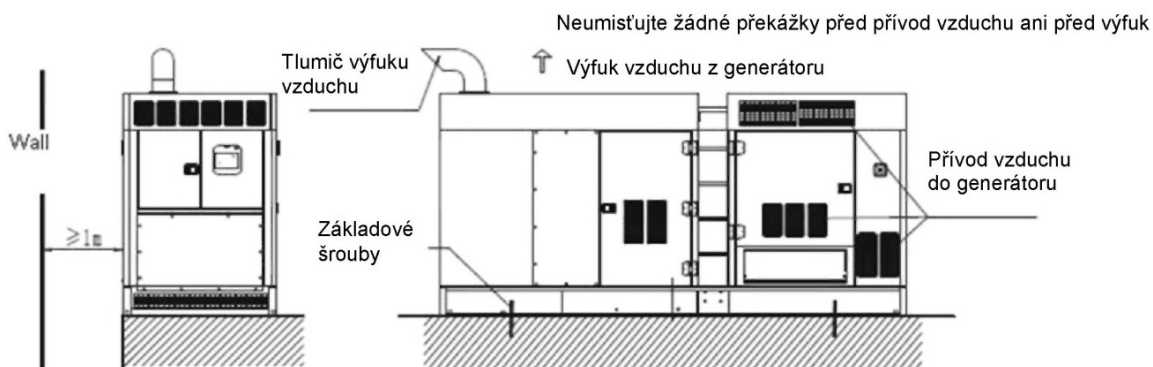
It is essential that the foundation is level, preferably within $\pm 0.5^\circ$ of any horizontal plane.



If the ground or floor may be wet from time to time, the foundation should be raised off the floor. This will ensure dry ground for the generator and its operator. It also minimizes corrosive action on the base frame.

(2) The device must be installed at least 500 mm from any wall. The radiator exhaust (outlet) opening, air inlet and air outlet must not be blocked.

Increased back pressure and reduced cooling air flow will cause the engine to overheat and slow speed.



(3) Operate the generator in an area free of moisture, dust and other contaminants, and with an adequate supply of fresh air. Moisture can cause short circuits and dirt can block the air supply to the cooler.

(4) Position the load with the connection cables as short as possible. If the cables are too long, the electrical resistance increases and the electrical voltage drops, reducing the efficiency of the generator.

3.2 Key points to place the generator set

The location of the genset is influenced by factors such as ventilation, exhaust ducting, wiring, fuel supply and availability for maintenance and servicing. The following key factors should be considered before siting a genset.

Warning

Ventilation

- Insufficient ventilation will cause carbon monoxide poisoning and death.
- Do not use the generator inside a building or in any place with poor ventilation.
- If the generator has to be located in a ventilated area, suitable air inlets should be provided together with adequate exhaust extraction.
- Generator exhaust should not be directed towards offices, residences or pedestrians.

Vibration

- Excessive vibration can shorten the life of the generator.
- The machine must be placed on a firm and level surface.
- Excessive vibrations can seriously affect the local environment.

Noise

- Always operate the generator with all doors securely closed.
- Excessive noise can be dampened by using an insulated machine room with noise dampening.

Safety distance

- Always leave at least one metre of clearance around all filling holes to facilitate servicing of the equipment.
- Leave enough space above the cover for the exhaust and radiator filling.
- To prevent dirt from entering the generator, provide screens on all inlets in some severe operating conditions.

Other information

- The main diesel supply should be as close to the equipment as possible. If the main fuel tank is installed underground, an auxiliary pump and a day tank are required to pump fuel from the main tank to the day tank.
- Applicable fire standards and norms must be met.

3.3 Installation in indoor space

The requirement for the base frame for the indoor installation is the same as in 3.1 and 3.2 above. The engine exhaust must be vented to the outdoors. The exhaust outlet cannot directly face the air inlet/outlet of the building. The air inlet and outlet of the generator set must be at least 1,5 metres away from any block or obstruction.

Warning

The arrangement and installation of the exhaust must be carried out by experts. If the exhaust pipe is of the soft type, the pipe must be placed in a straight line. Sharp bends are forbidden, otherwise the back pressure of the exhaust will be too great, and would adversely affect the operation of the generator.

Drill a hole in the wall according to the diameter of the exhaust pipe and then secure the end of the pipe with screws. It is recommended to install a canopy over the pipe to prevent sand and water from entering the pipe. Install a rainproof cap on the end of the exhaust pipe. The cap will close when the generator is not running and open with the exhaust from the engine when the generator is running.

Warning

Before starting the generator, clean any accumulated sand on the cover. Otherwise, sand may have blocked the piping.

4. Connecting loads

Warning

To prevent personal injury:

Before connecting the generator to the building's electrical system, a licensed electrician must install an isolation (disconnect) switch in the building's main fuse box. The switch is the connection point for generator power and provides the choice of power from the generator or from the main supply to the building. This prevents the generator from feeding the main supply line (preventing backfeeding) when the main supply or feeder has failed or has been shut down for line repair. Backfeeding can cause shock or injury to personnel during line maintenance. Further, damage to the generator and building electrical system could occur when normal operating power and output is restored if the unit is used without an isolation (disconnect) switch.

Warning

To prevent personal injury:

Only connect or disconnect the load to AC outlets or terminals when the engine is stopped. For your safety, close the terminal cover after connecting the load and secure the cover with the locking screws.

4.1 Power input to cover load

Note

Motor loads require a large starting current. If the starting current of the load does not match the output of the generator, the load will not start. When connecting the load to the generator, consider the following:

- In the case of a motor load, the starting current of the motor is 5-8 times greater than the normal operating current, which can cause a short-term overload of the generator and prevent the load from starting. Consult the load manufacturer to determine the starting power required.
- The following formulas are used to calculate the output.

(1) Input power of asynchronous motor with short armature (kVA)

$$\text{Power input (kVA)} = \frac{\text{Motor power rating (kW)}}{\text{Motor efficiency} * \text{motor power factor}}$$

Motor efficiency: 0.8 Motor efficiency: 0.8

Unit power kVA= 1.56 times the rated motor power (kW)

(2) Direct start of asynchronous motor with short cage (by means of knife switch)

Generator output = 2 times rated motor output

(3) Use the contactor to directly start the motor with the cage shorted.

Generator power= 3 times the rated engine power

(4) Use star-delta mode to start the engine with the cage shorted Generator

output = 1.2-1.5 times the rated engine output

When using multiple AC welding machines simultaneously, it is necessary to balance the load.



Therefore, the wiring is equally divided into each phase as shown in the following drawing.

Note

- The input power of each welding machine must be regulated below 1/3 of the generator output power. If an overload occurs, the alternator windings may burn.
- Turn off the circuit breaker at the control panel, then connect the load to the AC output terminals. If there are several motor loads in the circuit, the high input motor should be started first and then the other motors in sequence.

4.2 Earthing

Danger

- Touching the output terminals while the generator is running can cause electric shock and death.
- The circuit breaker must be off when connecting the load to the generator.
- The output terminal cover must be closed and bolted before the generator is put into operation.
- Worn or defective cables must not be used to avoid electric shock. The screws used to secure the cables must be tightened to prevent overheating.

4.2.1 Grounding of the load

Attention

- The grounding on the load side must be connected even if the load is connected to a generator equipped with leakage (leakage) current protection.

- The cross-sections of the earthing cable are selected on the basis of the permissible load and the technical standards for electrical equipment.

4.2.2 Common grounding

The generator cabinet and the load must be grounded separately and independently. However, if it is difficult to achieve independent earthing, the common earthing method can be used.

- For the cable thickness for common earthing, the largest value is selected according to the individual earthing requirements.
- For the common grounding resistance, the smallest value shall be selected according to the individual grounding requirements.
- Tighten and connect all clamps securely.

Note

- If the ground rod is inserted into soil with high moisture content, the upper end must be placed below ground level.
- Do not place the ground rod in an area with foot traffic to avoid disrupting the connection.
- When cables are extended, they must be connected as follows:
The connecting wires are connected by welding or by sleeves with joints taped with insulating tape. In addition, the joints should be positioned so as to allow convenient periodic inspection.
- Do not bury earthing rods within 2 metres of lightning rods
- Do not use a common ground, such as a common ground for the telephone system.

Attention

Bolts must be securely tightened for proper connection to the load to prevent overheating and fire.

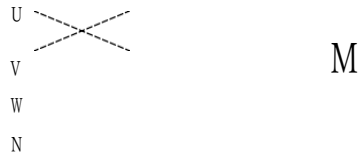
4.3 Connecting loads

(1) Connection method of 3 phase and 4 wire terminals

The cables are connected to the 3-phase connector on the output terminal.

Attention

Before connecting, check the phase and voltage of the load. In addition, check the 3 phase and 4 wire terminals in the output junction box of the device.



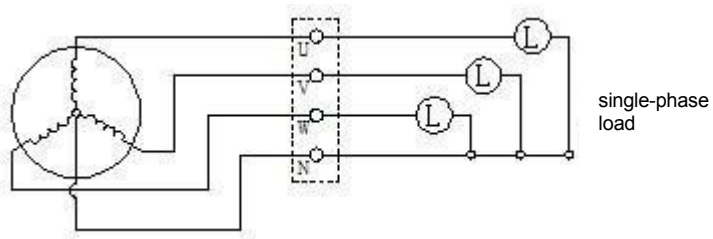
Attention

When using a 3-phase electric motor, interchange any two of the three terminals if the electric motor reverses.

(3) Use modes or combinations of 3-phase connectors:

Note

Please confirm whether the AC current values on the control panel (cannot) exceed the rated current. The permissible current (power) of the generator is the sum of one of each phase and (respectively) three phases. When the AC voltmeter reads 400/416V (50/60Hz), the single phase output voltage must be 230/240V.



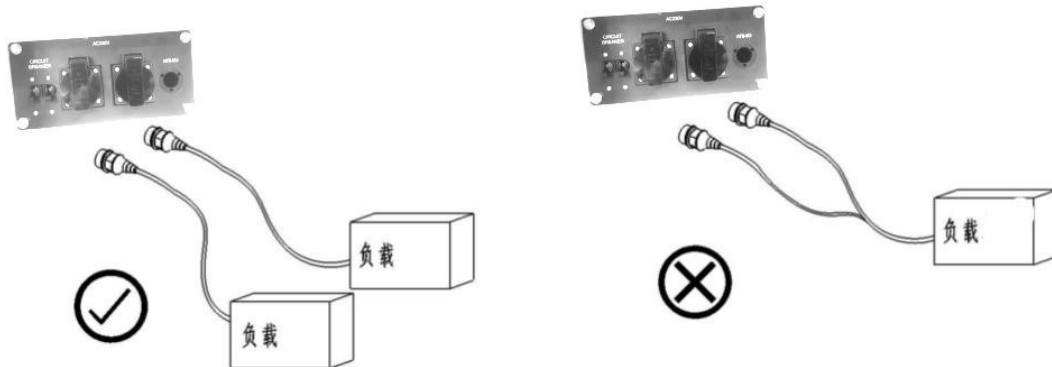
(4) Single output from three-phase generator

Note

- Use a single-phase socket:
Turn the single-phase circuit breaker to the "ON" position, then the outlet is ready for .
- There are two separate sockets in the panel, both their circuits are independent of each other.



- Overload is prohibited in the case of a single-phase socket.



Warning

It is very important to keep the three load phases in balance.

The load capacity of each phase is 1/3 of the rated output of the generator. For example, the rated output of the power plant is 9 kW, each phase can then have an output of 3 kW. When the load is single phase only, the current of the N conductor is three times the rated current of the three phase supply (with three phase ideally symmetrical load, no current passes through the N conductor). The "N" conductor can overheat and burn, and therefore it is not recommended to use one phase for long periods of time. Furthermore, select a proper N conductor with a cross-sectional area \leq UVW to protect the N conductor.

In case that use the tapping only from the U-N or U-N or V-N phase:

The single-phase load shall be \leq 25% of rated output. If the draw from the socket is single-phase, the single-phase current shall be less than the current capacity of the socket.

For both single-phase and three-phase load(s), both conditions must be met simultaneously:

- ① The total current consumption of both single-phase and three-phase must be less than the rated current of the generator.
- ② The unbalanced phase current ratio of UVW shall be \leq 20% of the rated current of the generator.

If the draw from the socket is single-phase, then the single-phase current must be less than the current capacity of the socket.

Warning

If the load runs for a long time or overloads the single-phase output of the three-phase generator, the alternator will run with serious phase asymmetry, resulting in overheating and burning of the alternator.

(5) Load connection notes:

- A switch must be installed between the generator and load terminals to turn the load on or off.
- If the generator circuit breaker is directly used as a load switch, premature failure of the circuit breaker may occur due to frequent tripping and tripping.
- The generator circuit breaker must be in the OFF position when connecting the cable.

Connections should only be made with the engine stopped.

- Do not connect cables to other output wires.
- When you have finished connecting the cables, close the output terminal cover plate and tighten it properly.

4.4 Selection of three-phase cables

Note

Before selecting the cable diameter, the allowable cable current and the distance between the generator and the load must be considered.

If the load current through the cable exceeds the capacity of the cable, the cable will overheat and fail. If the cable is too long, the diameter is too small and the voltage drop across the cable conductor is too large, the input voltage to the load will be reduced and the load may not start.

- The length and cross-sectional area of the cable should be within 5% of the rated voltage as per the following reference.
- The voltage drop value is calculated based on the length, cross section and operating current of the cable for 3 phase and 3 conductor types.

$$\text{Potenciál e (V)} = \frac{1}{58} \times \frac{\text{Délka}}{\text{Oblast průřezů}} \times \frac{\text{Elektrický proud (A)}}{\text{proud (A)}} \times \sqrt{3}$$

The relationship between the permissible current, voltage drop, cross-sectional area and operating current of insulated conductors and cables (single and multi-core) is given in the table below (only for operating voltage of 220 V and voltage drop less than 10 V):

Item number	Cross-sectional area of copper conductor	Single-core current carrying capacity (25) (A)		Voltage drop mv/meter	Frictional current carrying capacity (25) (A)		Voltage drop mv/meter	Quad core current carrying capacity (25 (A)		Voltage drop mv/meter
		VV22	YJV22		VV22	YJV22		VV22	YJV22	
1	1,5 mm ²	20	25	30,86	13	18	30,86	13	13	30,86
2	2,5 mm ²	28	35	18,9	18	22	18,9	18	30	18,9
3	4 mm ²	38	50	11,76	24	32	11,76	25	32	11,76
4	6 mm ²	48	60	7,86	32	41	7,86	33	42	7,86
5	10 mm ²	65	85	4,67	45	55	4,67	47	56	4,67
6	16 mm ²	88	110	2,95	61	75	2,6	65	80	2,6
7	25 mm ²	113	157	1,87	85	105	1,6	86	108	1,6
8	35 mm ²	142	192	1,35	105	130	1,2	108	130	1,2
9	50 mm ²	171	232	1,01	124	155	0,87	137	165	0,87
10	70 mm ²	218	294	0,71	160	205	0,61	176	220	0,61
11	95 mm ²	265	355	0,52	201	248	0,45	217	265	0,45
12	120 mm ²	305	410	0,43	235	292	0,36	253	310	0,36
13	150 mm ²	355	478	0,36	275	343	0,3	290	360	0,3
14	185 mm ²	410	550	0,3	323	400	0,25	333	415	0,25
15	240 mm ²	490	660	0,25	381	480	0,21	400	495	0,21

Note

The above table is based on an ambient temperature of 25 °C. Changes in ambient temperature and the way wires and cables are laid can affect the current carrying capacity. The above table is for guidance only.

5. Service and operation

Note

This section describes the operation of the generator set. The text should be read in conjunction with the control panel and engine operating instructions.

Attention

- Read the "Safety Precautions" at the beginning of this manual.
- Read all warning, caution and warning labels on the generator.
- To avoid the risk of exhaust poisoning, do not operate the engine in an enclosed building without proper ventilation.
- Always switch off the circuit breaker when connecting the load to the generator.

5.1 Preparing engine

- Check fuel, lubricant and coolant levels.
- Check the battery charge level and battery cable connections.
- Turn on the power switch, the controller will enter the self-check mode to check low oil pressure, high water temperature and emergency shutdown, etc., including failure warning. Troubleshoot any problems before further operation.
- Check whether or not the trip solenoid can move freely, whether or not the gearbox mechanics are locked and whether or not all rotating parts are in order.

5.1.1 Refilling diesel fuel

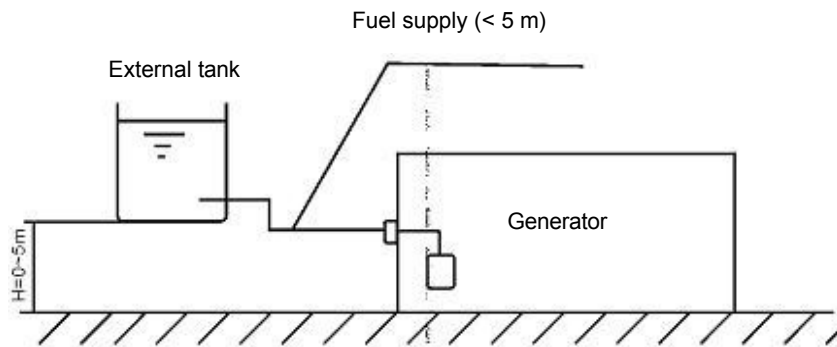
Warning

Please refer to the engine user manual for information on fuel class.

- Do not use the wrong type of fuel to prevent damage to the injection pump and injectors. Using fuel with an incorrect flash point may increase the risk of explosion.
- Clean up any fuel spillage before starting the generator.
- Fill the fuel tank to 90% capacity to allow expansion in warm weather.

5.1.2 External tank refuelling (optional)

- Check all fuel lines for wear and all joints and fittings for tightness.
- Do not place the external tank more than 5 metres from the generator and the base of the tank should not be more than 5 metres above the generator.



Note

Check the external fuel tank regularly. Fuel can overheat due to long periods of idling if there is no fuel in the external fuel tank. Use different quality diesel fuel based on the ambient temperature in real time. If so-called summer diesel is used in winter, the engine freezes and becomes difficult to start.

5.1.3 Topping up the oil

Attention

- Check the oil level on the oil dipstick. First pull out the dipstick, wipe it clean and then reinsert it into the tube and check the level again. Add lubricating oil up to the area between the two scale marks on the dipstick. Be careful not to overfill the oil level.
- Check the oil and make sure it is not dirty or mixed with coolant.
- Start the engine and let it run for 3-5 minutes. Switch off the engine, and after another 3-5 minutes, when the oil has returned to the oil pan, check the oil level again.

Warning

- Oil is very important for engine starting and engine life. Use the prescribed oil. If the type of oil is not correct, it will cause damage to the internal parts of the engine or excessive wear, thus shortening the life of the engine.
- Use SAE10W-30 and SAE15W-40 grade oil that is suitable for normal conditions.
- Clean the area around the oil filler.
- Do not mix different types of oil, otherwise lubrication performance will be reduced.

Warning

5.1.4 Coolant top-up

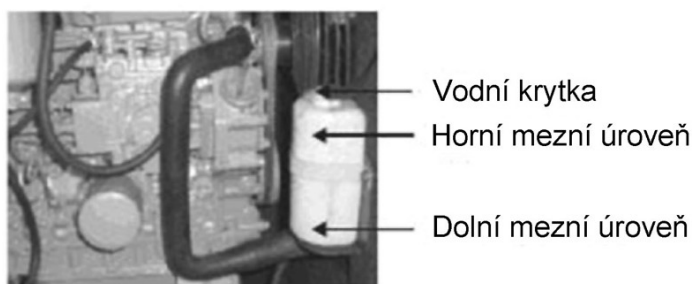
(1) Cooler filling.

Before removing the radiator cap, make sure the engine is completely cool. The coolant is hot, under pressure and can easily cause burns.

- Open the radiator cap and visually check the coolant level. Add the correct mixture of water and antifreeze (the ratio is based on the ambient temperature).
- Slowly add coolant until it reaches the overflow point. Clean up all leaks and spills.
- Make sure the radiator cap is securely fitted. A loose cap will reduce the pressure in the system and cause the coolant to overheat.
- Only pour coolant with anti-corrosion agent. Clean water will freeze in winter and increase in volume, causing damage to cooling system parts. In addition, untreated water causes corrosion inside the lines, reducing cooling efficiency.
- Only add antifreeze of the same brand and in the same ratio.

(2). Expansion tank filling (optional)

- Remove the expansion tank cover. Top up the coolant to the upper mark on the scale. Reinstall the cap.
- Check the condition of the rubber hoses and clamps connecting the expansion tank and radiator. Replace hoses that show cracks.



5.1.5 Test operation

When the generator is used for the first time or immediately after long-term storage, a short test run at zero load should be carried out, which is useful for sufficient lubrication of moving parts and to increase the life of the engine.

Attention

Check the lubricant and coolant levels after running for five minutes. The oil pan and radiator levels will drop when the oil and coolant are at full. Top up fluids to the correct level.

5.2 Start of the generator set

1. Make that the main circuit breaker is in the "OFF" position.
2. Turn the power switch to the "ON" position to put the controller into self-check mode.
3. Press the "MANUAL" button on the remote control. The manual mode light will come on and press the "START" button to start the generator.
 - If the engine cannot be started, it after 30 seconds. In the event of three unsuccessful starts, the generator goes into alarm mode. Check the fuel supply system and battery voltage. Do not forcefully start the engine many times to avoid damaging the engine.
 - In the case of a generator with a preheating system, the generator automatically switches on the preheater after the start signal (preset time is 10 seconds). And then the generator starts after preheating.
4. When the generator is running, switch the main circuit breaker to the "ON" position.

Note

- A long running starter motor consumes a lot of battery power and can even burn it up.
- Preheating the engine also consumes a lot of power. Adjust the preheating time according to the ambient temperature.

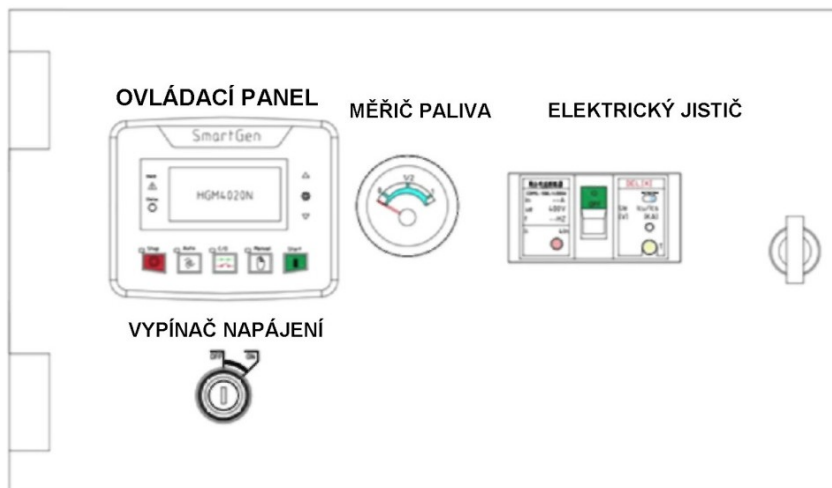
5.3 Stopping generator

1. Disconnect the load from the generator.
2. Switch the main circuit breaker to the "OFF" position.
3. Press the red "STOP" button on the controller to turn off the generator.
4. When the motor comes to a complete stop, turn the power switch to the "OFF" position disconnect power to the controller.

Warning

On some models (see engine manual), the throttle is in the open when the generator is running and will be in the closed position when the generator is stopped.

1. DO NOT press the "STOP" button when the generator is not yet running but the start button is already in the "ON" position. Otherwise, the throttle will be hot and its life will be adversely affected.
2. PRESS the "STOP" button to stop the generator. (In case of ATS connection, the generator will stop automatically.)
3. If a fault is displayed on the driver screen, press the "↑" button to interface the faults and then press the "STOP" button to clear the faults.
4. Do not switch off the generator when the load is connected.



5.4 Control panel

5.4.1 Controller

We use the HGM4020 controller as our standard configuration, but other brands or models are available. To help users fully understand the main features or functions of each controller, we have included an instruction manual with each generator. Please read the operating instructions carefully before commissioning and keep the manuals with the generator at all times.

5.4.2 Fuel gauge

The level in the fuel tank can be easily checked from the fuel gauge control panel.

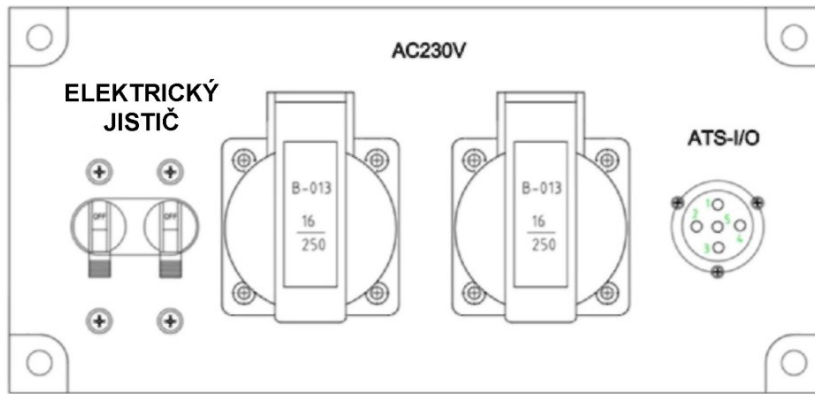
5.4.3 Main circuit breaker

MCCB, MCCB with RCD, MCB three kinds of circuit breakers are optional.

5.4.4 Power switch

5.5 Drawer panel

To facilitate the connection of loads by the user, the generator is equipped with sockets and circuit breakers. (The type of socket varies according to the local application.) The sockets and output terminals are located in different cells with adjustable cover.



5.5.1 ATS connector

Optional part.

5.5.2 Single-phase socket

5.5.3 Interrupter (Disconnecter)

Special element for single-phase socket

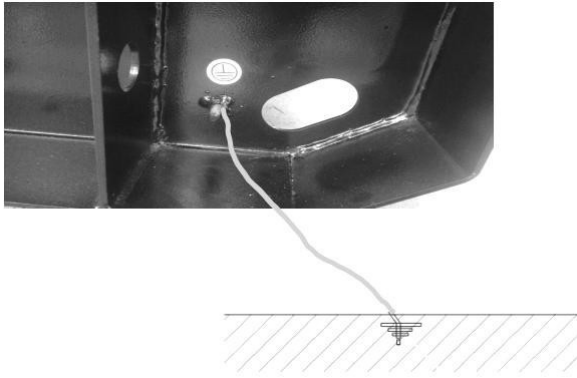
5.6 Output clamp



Connect the cable to the three-phase and four-wire terminals listed above.

5.7 Earthing

Grounding of the generator cover.



Check the generator grounding.

The generator should be grounded to its own earth/floor. Do not connect the phase (N) exclusively used for the three-phase connector directly to the ground wire, it should be connected to the generator's neutral point (N) output.

Warning

When the generator is running or has just stopped running, the coolant will be extremely hot and under high pressure. Do not open the radiator cap or expansion tank cap until the engine has cooled sufficiently to prevent burns.



5.8 Operation at low load

Avoid prolonged no-load or operation.

Operating time below $\frac{1}{4}$ load should be limited to 5 hours. Failure to do so will result in carbon buildup in both the engine and the exhaust, shortening engine life. Low load on a new engine does not generate enough heat to settle the piston rings and causes oil consumption problems.

For long-term operation, $\frac{1}{4}$ load or more is suitable.

5.9 After launch

- a. Make that all parameters on the display panel are within the specified limits.
- b. Check the engine for leaks.
- c. Check the colour of the smoke coming from the exhaust. The exhaust should be colourless or light grey under normal load and slightly darker under heavy load.
- d. Listen for and record unusual sounds and check for excessive vibrations.
- e. Switch the circuit breaker to the "ON" position.

5.10 Initial load

Note

Avoid rapid acceleration or deceleration of the engine during the first 50 hours of operation and avoid heavy loads.

When the equipment has successfully started and is running smoothly and the electrical parameters are normal, the generator circuit breaker can be turned to the ON position.

- a. When the load is connected, readjust the rated speed, frequency and electrical voltage.
- b. Check the parameters on the control display. Parameters must remain within normal limits and no warning lights are flashing.
- c. If you find any abnormalities, shut down the engine and remove and correct any faults.
- d. If the generator shuts down due to depletion, refill the fuel tank and bleed the high pressure fuel line to prevent difficult starting.

5.11 Emergency shutdown (stop)

If you notice dangerous symptoms such as speeding, short circuit, excessive engine noise, fluid leak, etc., turn off the generator by pressing the "Emergency Stop" button.

After repairing the generator, reset the "Emergency Stop" button.

Attention

The main circuit breaker is switched off immediately when the "Emergency stop" button is pressed. The load is switched off (disconnected) and the generator is switched off. The control panel displays an alarm indication.

To resume operation of the generator, reset the "Emergency Stop" button and then press the "Stop" button on the controller until the alarm goes off. Restart the generator set in the normal manner.

Turn on the main circuit breaker when the generator is in normal operation to supply power to the load.

Warning

Emergency shutdown is to the generator. Use emergency shutdown only in extreme situations.

6. Periodic maintenance and service

6.1 Control cycle

6.1.1 After the first 50 hours of operation

- Change the engine oil and filter.
- Check the belt tension at the fan.

6.1.2 Inspection after 250 operating hours

- Change the engine oil and filter.
- Clean or replace the air filter insert.
- Measure the insulation resistance of the generator. (Also check monthly.)
- Check the specific gravity of the electrolyte of the stored battery.

6.1.3 Inspection after 500 operating hours

- Replace the fuel filter insert.
- Clean the radiator.
- Check the terminals and connectors of the electrical circuit wires.
- Perform the checkpoints as in the inspection after 250 operating hours.

6.1.4 Inspection after 1000 operating hours

- Clean the inside of the fuel filter.
- Replace the air filter insert.
- Check and adjust the injection timing.
- Check the anti-vibration isolators for wear.
- Check all rubber and nylon hoses for wear.
- Check the dampening material.
- Make the same entries as for the checks after 250 and 500 operating hours.

6.1.5 Maintenance operations

(1) Oil change

- Leave the engine running for 3-5 minutes to allow the oil to flow freely. Remove the oil drain plug from the engine and drain the oil into a suitable container.
- Replace the oil drain plug.

- Fill the engine with fresh oil up to level H on the dipstick.
- Leave the engine running for five minutes and check the oil level again after allowing the oil to return fully to the oil pan.

(2) Replacing the oil filter.

- Use a filter wrench to remove the oil filter.
- Apply a thin layer of clean engine oil to the seal of the new filter element.
- When installing a new filter, first tighten it by hand and then use the filter wrench to tighten the filter another $\frac{3}{4}$ turn.

(3) Check the belt tension.

- Press the centre of the belt firmly with your thumb and check the degree of sag.
- The belt tension is specified in the engine manual.
- Loosen the bolt that secures the alternator.
- Move the alternator until the belt deflection is between 10 and 15 mm. Tighten the alternator fixing screw.
- Check the belt for oil and dirt that could cause the belt to slip.

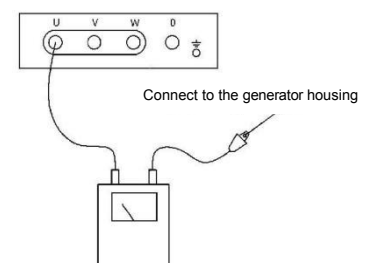
(4) Clean the air filter.

- Remove the filter cartridge from the air filter housing.
- Use compressed air to blow dirt and grime out of the cartridge and housing.
- Check the filter element to see if its paper is torn or deformed.
If you find damage, replace the filter element with a new one.

(5) Measure the insulation .

Danger

- Measure the insulation resistance after the generator has stopped.
- First, remove the wires connecting the AVR and the driver to prevent permanent damage.
- Measure once a month with a 500 V insulation resistance meter (Megaohmmeter or Megger) Test procedure
- Disconnect the three-phase cable from the three-phase terminal on the power supply output terminal. Switch the circuit breaker to the ON position and measure the insulation resistance between the output terminal and the alternator cover. The test voltage should be applied for 60 seconds.
- If the insulation resistance is less than 1 Megaohm, a leakage (insulation damage) has occurred. Clean all dirt, oil and rust from each output terminal, circuit breaker and cables and retest.



(6) Check the battery.

Check the specific gravity (density) of the electrolyte.

If the starter rotation speed is lower than the nominal value, it will lead to a failure to start, so keep the battery fully charged. If the generator does not start even after the battery is fully charged, replace the battery.

If the battery is not sufficiently charged, measure the density of the electrolyte with a density meter. If the residual voltage is less than 75%, recharge the battery.

Before starting the generator, first check the battery voltage if it has not been used for more than 3 months. Charge the battery if the voltage is below 12 V. Starting the generator with low voltage can damage the starter motor.

Calculate the charging ratio based on the measured specific gravity according to the table below:

Temperature (°C)	20	-10	0
Charge ratio %			
100	1,28	1,30	1,29
90	1,26	1,28	1,27
80	1,24	1,26	1,25
75	1,23	1,25	1,24

Note: A tolerance ± 0.01 is allowed.

Charge the battery immediately when the charge ratio is below 75%.

Note

Disconnect the battery cables before charging. Charge the battery in a well-ventilated area.

When disconnecting cables, disconnect the negative cable first. (If you disconnect the positive cable first, it may cause electrical arcing when the cable touches the generator cabinet). When reconnecting the cables, connect the positive cable first and then the negative cable.

Attention

Keep open flames, sparks or any other ignition source away from highly flammable gas. Never create a spark or approach a fire to avoid explosion of flammable gases generated during charging.

If the battery is extremely hot, ie. the electrolyte temperature is above 45 °C, discontinue charging until the electrolyte has cooled down.

Stop charging when the battery is fully charged. Otherwise, overcharging will cause the problems listed below:

- 1) Battery overheating
- 2) Electrolyte loss 3
-) Battery failure

When reconnecting the battery, connect the positive (+) battery lead first and then the negative (-) lead.

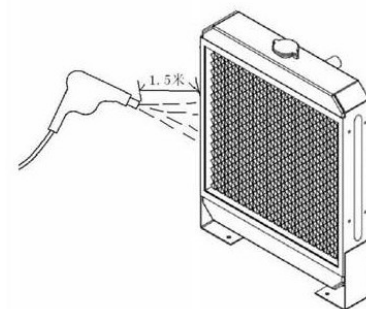
Do not connect the battery poles in reverse as this will burn the .

(6) Replacing the fuel filter

- Remove the fuel filter using a filter wrench.
- Apply a thin layer of engine oil to the new filter sealing ring.
- Hand tighten the new filter, then use the filter wrench to tighten the filter another 2/3 turn.
- After changing the filter and before starting the engine, bleed fuel line.

(7) Cleaning the radiator

When cleaning the radiator, use steam or low-pressure compressed air to clean the radiator cooling fins.



Attention

Do not use high-pressure air, it could damage the cooler. Remove the fan if access to the cooler is blocked.

(8) Check the electrical terminals.

Check all terminals of all circuits for rust, corrosive damage or burns.

(9) Clean the internal fuel tank.

Empty the fuel tank and remove all water and deposits.

(10) Replacing air filter parts Use original parts for replacement.

(11) Check the insulators.

The rubber anti-vibration isolators that support the engine and generator can deform due to heavy wear or oil and water contamination. Contact customer service for proper replacement parts.

(12) Check all rubber and nylon hoses.

Look for cracks, bulges, tears and other signs of wear. Replace elements as necessary.

(13) Check the materials. If parts are not properly loose or damaged, contact customer service for replacement parts.

6.2 maintenance plan

Please refer to the engine manual for maintenance of your diesel engine. The maintenance interval should be shortened in case of severe operating temperatures, in dusty environments or under frequent stopping conditions.

7. Troubleshooting

7.1 Engine faults and their troubleshooting

This section of the manual lists common faults and corrective actions. The user should shut down the engine immediately to minimize damage caused by the fault and prevent a more catastrophic failure. For engine troubleshooting, refer to the engine manual for additional information.

7.1.1 The engine will not start

Possible cause	Corrective measures
1. Fuel supply or supply line failure a. air in the fuel system b. blockage in the fuel system c. injection pump failure d. Fuel injection fault e. incorrect injection advance (angle) f. the fuel cap handle is in the closed position	Bleed the system. Disassemble and clean. Check and correct. Check the condition of the fuel injection; the wear condition of the plunger and oil outlet valve, as well as the oil outlet valve spring for cracks. Check and adjust settings Place the fuel cap handle in the fuel feed position.
2. low engine compression a. wear of piston rings b. stuck piston rings c. valve leakage d. low ambient temperature	Replace worn rings (replace all rings on the piston). Clean the grooves of the rings. Broken or weak valve springs: incorrect valve clearance or leaky valve guides - repair Warm engine with auxiliary equipment according to needs
3. Electrical system faults a. insufficient battery voltage b. poor continuity (interruption) of the electrical circuit c. bad contact between brushes and commutator at starter motor d. insufficient torque transmitted through the clutch disc at the starter; slipping e. The starter gear is disconnected from the flywheel shaft.	Charge the battery to full starting capacity. Check the continuity of the wires and secure connections. Repair or replace the electric brushes and fine sandpaper to clean the commutator surface and then blow off the dust. Add pads and adjust settings. Check the starter function and the rack and .

7.1.2 Unsteady engine operation (irregular running)

Possible cause	Corrective measures
1. air in the fuel system 2. water in the fuel 3. Leaks in the fuel line and joints 4. abnormal speed controller operation 5. gas flow in the cylinder	Vent. Check the water content of the fuel. Check and correct. Check and calibrate the speed controller. Check cylinder head gasket and replace if necessary; check cylinder liner protrusion - reseal if necessary.
6. uneven fuel supply to the cylinders a. uneven fuel delivery from injection pumps b. bad injector nozzle or stuck piston c. broken spring piston at the injection pump	Check and adjust the settings. Check the condition of the fuel injector. Replace or repair as necessary. Replace the spring.

7.1.3 Insufficient engine power or sudden drop in power

Possible cause	Remedies
1. air filter blockage 2. the fuel shut-off lever is not in the fuel feed position; 3. a damaged valve spring or valve stem; 4. valve clearance is outside the intended adjustment 5. low compression 5. wrong angle of advance at the fuel inlet 6. air mixing in the fuel supply system or blockage in the system 7. Insufficient supply; 8. poor fuel spray quality 9. bad seal on the cone washer at the injector; 10. speed controller malfunction; 11. engine overheating; 12. Carbon buildup in the cylinder head 13. exhaust blockage	Clean or replace the filter cartridge. Put the lever in the correct position. Replace. Make the settings. See section 7.2. Check and adjust the settings. See section 7-1, items "a" and "b" Check the fuel injection plunger and outlet valve. Check, clean and adjust the pressure setting. Check, repair or replace the injector. Replace the washer. Check the speed controller and adjust its settings. If necessary, check and repair the cooling system. Remove carbon deposits. Remove blockage/obstacle.

7.1.4 Abnormal noise when the engine is running

Possible cause	Corrective measures
1. premature injection timing causes a rhythmic and ringing metallic knock in the cylinder;	Adjust the angle of advance in the fuel supply.
2. late injection causes noise in the cylinder	Adjust the advance angle of the supply, Replace the piston.
3. Excessive clearance between piston and cylinder, knocking sound from the cylinder after starting, which as the engine warms up.	Replace the parts to achieve the specified
4. Excessive clearance between piston and cylinder, sharp and quiet sound, especially at idle	clearance. Replace the parts to achieve the specified clearance.
5. Excessive play between the main shaft and connecting rod; knocking sound at sudden drop in speed and louder at low speeds.	Replace the pressure plate to ensure the specified clearance.
6. Excessive crankshaft axial play, knocking sound during crankshaft movement at idle speed;	Replace parts and check and adjust valve clearance;
7. Cracked valve spring, bent pushrod or excessive valve clearance, noise or rhythmic knocking from the cylinder head cover.	Check piston and valves for bumping/knocking. Rebuild or replace cylinder head.
8. Valves touching the piston crown, metallic knocking sound from the cylinder head.	Replace the as necessary.
9. Excessive gear backlash due to wear - knocking at sudden drop in revs.	

7.1.5 Abnormal exhaust colour

The smoke from the engine exhaust should be light grey under normal load and dark grey under short-term heavy load. Blue, white or black smoke indicates a malfunction. Blue smoke indicates engine oil in the combustion chamber. White smoke indicates imperfect combustion of fuel in the cylinder or water in the fuel. Black smoke indicates excessive fuel and imperfect

combustion. Possible cause	Corrective measures
1. blue smoke	
a. reassembly of piston ring, stuck or worn rings	Check and reinstall or replace the rings.
b. worn valve guides	Renew the valve guides.
2. white smoke	
a. poor atomization at the injector, leakage;	Adjust injection pressure, check condition of seals on components;

b. water in the cylinder; 3. black smoke	Check and correct the fault.
a. engine overload; b. excessive fuel supply c. Delayed fuel delivery and delayed combustion;	Adjust the settings according to the regulated load. Adjust the volumetric flow rate at the fuel inlet; Adjust the advance angle at the fuel inlet;
d. incorrect valve clearance, poor valve routing, air leakage;	Check valve clearance, valve spring, cone seal and correct any defects.
e. air filter blockage f. low pressure at the turbocharger	Check and correct the fault. Check the operation of the turbocharger.

7.1.6 High engine oil temperature

Possible causes	Corrective measures
1. Excessive engine load 2. oil level too low or too high 3. low piston cooling 4. faulty oil cooler, bypass or poor engine block cooling	Reduce the load. Add or remove engine oil according to specification. Check piston cooling, liner seals. Check, clean and adjust.

7.1.7 Insufficient engine oil pressure

Possible cause	Corrective measures
1. faulty gauge, sensor or broken line 2. lack of engine oil 3. diluted engine oil 4. Wear or incorrect installation of the engine oil pump gears 5. clogged strainer or engine oil filter 6. defective spring in the pressure relief valve or pressure stabilisation valve 7. Engine oil line blockage or leakage	Replace the pressure gauge or sensor or check the piping. Add engine oil to the regulated level. Check engine oil for correct viscosity or dilute. Adjust the backlash or replace the gears. Replace or remove the pump gears. Clean the strainer, change the filter. Check valves for proper operation. □ Check the lines for blockages.

7.1.8 High refrigerant temperature

Possible cause	Corrective measures
1. faulty water temperature gauge or sensor	Check and replace; Top up the coolant.

2. lack of coolant 3. faulty water pump or loose 3. heavy deposits and scale inside the engine block, coolant lines or radiator 4. overloaded engine	Check the pump and belt for proper operation. Remove limescale and deposits. Check the radiator block and clean it as necessary. Reduce the load.
---	---

7.1.9 Insufficient fuel volume/flow in injection pump

Possible cause	Corrective measures
1. cracked control valve or wear of the valve seat; 2. worn piston 3. air leakage through the oil suction screw	Replace the spring and repair the check valve. Replace the piston. Replace the washer and tighten the screw.

7.1.10 Injection pump failure

Possible cause	Corrective measures
1. no fuel supply a. defective fuel pump b. blockage of the fuel filter or supply line c. air in the fuel system d. broken spring of the outlet valve; 2. uneven power supply a. air in the fuel system b. broken spring of the outlet valve; c. worn surface of the fuel discharge valve seat d. broken piston or worn spring e. fragments in the piston path f. low inlet pressure 3. insufficient flow volume in the fuel supply a. leaky outlet valve with fuel leak b. fuel leakage in connection joints c. worn piston.	Check and replace if defective. Clean or replace; Venting Replace the spring. Venting Replace the spring. Replace or repair. Replace the parts. Clean it up. Check the fuel pump and filter. Repair or replace parts. Check and correct. Replace the piston.

7.1.11 Injector faults

Possible cause	Corrective measures
1. low or no fuel supply a. air in the fuel line b. needle valve stuck in the valve body c. excessive play between needle and saddle	Venting Repair or replace□ Replace

valve and valve body d. fuel leakage by leakage; e. low or high fuel supply 2. low injection pressure a. loose pressure control screw b. low spring tension 3. high injection pressure a. stuck needle valve b. injection hole blockage c. the pressure control spring is not adjusted 4. leaking fuel due to leaks a. broken pressure control spring b. damaged contact area needle valve and valve body c. stuck needle valve d. tightening nut deformed e. uneven contact surface of the injector seat 5. poor atomization a. deformation or damage to the needle valve b. needle valve and dirty valve surface c. injector nozzle blockage d. stuck needle valve	Tighten the joint or replace the part. Adjust the flow at the injector on the test bench or replace it. Set to regulated pressure. Replace the spring. Correction Clean the spray nozzle. Make the settings Replace the spring. Repair or replace. Clean or replace; Replace Replace Hum or replace. Replace the part. Clean it up. Clean or replace. Clean or replace.
--	--

7.1.12 Speed controller malfunction

Possible cause	Corrective measures
1. discontinuous speed control a. uneven fuel supply b. fuel blockage or leakage from the injector c. broken fuel pump plunger or broken fuel outlet valve spring 2. idling speed cannot be reached a. the control arm does not extend b. jammed gear ring and gearbox adjusting rod 3. movement block a. deformation of the adjustment spring; b. mismatch between the opening and closing distance of the ball c. excessive play due to wear of the float lever;	Adjust the volume flow rate at the oil inlet. Check or replace injection components or assembly Replace piston or spring Check and adjust settings Check and correct the fault. Check and adjust the settings Replace the spring. Check and calibrate.

4. Uncontrolled spraying (wide open fuel supply) a. high rotation speed	Replace the rod.
b. speed controller malfunction c. Stuck adjusting rod and toothed rack.	Check and adjust the settings.□ Check and correct.□ Check and correct.

7.1.13 Sudden engine shutdown

Possible cause	Corrective measures
1. the crankshaft does not rotate after stopping a. the crankshaft is blocked b. the piston does not move in the cylinder liner 2. free running of the crankshaft after stopping a. air in the fuel system b. Fuel system blockage c. the air filter block or fuel cut-off handle is in the fuel cut-off position	Check the crankshaft and bushing, replace the bushing. Replace the piston and cylinder liner. Vent. Find the cause of the blockage and fix it. Replace the air filter and put the fuel filler cap in the correct position.

7.2 Malfunctions of alternator

7.2.1 Mechanical defects

Errors and malfunctions	Possible cause and corrective action
1. Bearing overheating (> 80 °C) or abnormal noise	- The bearing is installed incorrectly or has failed. - Check the colour. Replace the bearing it has turned blue or the lubricant has turned black.
2. overheating of the generator frame by more 40 °C above ambient temperature	- The air supply is blocked. - Poor ventilation - Excessive tension. - Overload
3. Vibration	- Bad alignment - The rotor is not balanced.
4. Abnormal noise or vibration.	- Short Circuit - Parallel error. - The clutch is broken or damaged. - The shaft is broken or damaged. - Damage to the main stator or short circuit. - Fan failure

7.2.2 Electrical faults

Malfunction and possible cause	Corrective measures
Tension does not build up	
(1) Burnt fuse of the controller	Check all cables and if there is no problem, replace the fuse.
(2) The voltmeter is damaged	Verify the panel meter with a multimeter or other meter known to be accurate.
(3) Defective voltmeter	Check the meter and replace it if necessary. Check the connection plug; make sure all connections are tight and have good contact.
(4) Released AVR connection plug.	Check the surge protector and remove the short circuit.
(5) Short circuit of surge suppressor	Remove the diodes and test them with a multimeter. Replace the defective diode.
(6) Defective diodes	Connect a 12 V battery to the excitation field, + battery to F+ (red wire) and - to F- (black wire) for 15 to 20 seconds. Caution: the generator should remain stationary during flashing.
(7) Lost Residual Magnetism	Carefully check and correct the wiring according to the wiring diagram.
(8) Incorrect connection	Clean, twist and weld the broken wire. Wrap the joint with insulating material.
(9) Disturbance of the excitation field	Clean and tighten the joints again.
(10) Loose connections or poor contact	Repair the break or rewind the anchor. A short circuit will cause the windings to fail and need to be replaced. Find the fault and replace the windings.
(11) The anchor winding is distorted	
(12) Generator armature winding in short circuit	
(13) Interruption or short circuit of the armature winding of the exciter	
(14) Incorrect speed	Check the speed with a speedometer or frequency meter.
(15) AVR protective trip circuits	Correct the problem and adjust the AVR settings. See the AVR manual.
(16) AVR not working	Adjust or replace the AVR. See the AVR manual.

<p>Low voltage during operation.</p> <p>(1) Voltmeter malfunction.</p> <p>(2) The engine speed is too low.</p> <p>(3) The wires are incorrectly connected.</p> <p>(4) The residual voltage is too low.</p> <p>(5) Winding or rectifier failure.</p> <p>(6) AVR malfunction.</p>	<p>Check the voltage with another voltmeter. Check motor speed with a tachometer and correct if necessary.</p> <p>See wiring diagram. See (7) above.</p> <p>Check wiring and resistance and replace if necessary.</p> <p>Adjust or replace the AVR.</p>
<p>Low voltage under load</p> <p>(1) Overload</p> <p>(2) Motor load or induction load</p> <p>(3) Low engine speed</p> <p>(4) The wires are not connected correctly.</p> <p>(5) Voltage drop in the circuit</p>	<p>Reduce the load to the nominal value. Check that the load on the starter motor is within the capacity of the generator.</p> <p>Check the engine speed with a tachometer.</p> <p>Please refer to the wiring diagram. Select power cables with larger cross-section.</p>
<p>Output voltage fluctuation</p> <p>(1) Incorrect speed</p> <p>(2) Unstable speed</p> <p>(3) AVR stability</p> <p>(4) Faulty/loose connections</p> <p>(5) Faulty diodes, surge protector or generator windings.</p> <p>(6) Remote voltage rheostat setting (if used).</p> <p>(7) Defective AVR</p> <p>(8) Defective bearing in worn bearing carrier causing uneven air gap.</p>	<p>Verify the speed using the speedometer</p> <p>Check the stability of the controller.</p> <p>Adjust the stability of the AVR. Refer to the AVR manual. Check all cables for loose or dirty cables.</p> <p>Test the generator with constant excitation (12V battery test).</p> <p>Check the function of the rheostat. See AVR manual.</p> <p>Replace the AVR. See the AVR instructions.</p> <p>Replace the worn bearing. Check the bearing carrier for wear. Replace elements as necessary.</p>
<p>High Voltage</p> <p>(1) Voltmeter malfunction</p> <p>(2) Incorrect wiring</p> <p>(3) AVR settings</p> <p>(4) AVR failure</p> <p>(5) Preliminary potency</p>	<p>Check the voltage with another voltmeter.</p> <p>Please look at the wiring diagram. Set the AVR according to the manual.</p> <p>Replace the AVR.</p> <p>Check the power factor and adjust the AVR according to the load.</p>
<p>The tension rises and then falls.□</p> <p>Bad AVR settings</p>	<p>Set the AVR.</p>

8. Storage

● If the generator is to be stored for more than 90 days, store the generator in a clean and well-ventilated place without moisture.

1) Let the engine run for three minutes and then drain the oil completely from the engine. Change the engine oil filter and fill the engine with fresh engine oil.

2) If the generator is to be stored without , drain all coolant from the engine.

- Open the side door of the cabinet and remove the radiator cover.

- Open the coolant outlet at the bottom of the radiator and drain the coolant from the radiator.

- Open the drain plug on the side of the engine block and drain the coolant from the engine.

- Drain the collection tank, if installed.

- Replace all caps and plugs and close the cover.

3) Drain all fuel from the fuel tank.

4) Lubricate the speed control rod.

5) Clean all dirt and dust from the generator and cover.

6) Disconnect the cable from the (-) terminal of the battery. Charge the battery once a month to maintain the correct level of charge.

7) Cover the controller and cover the unit with plastic or a heavy tarp.

8) After removing the unit from storage and prior to initial startup, prepare the unit in accordance the instructions in Chapter 5.

Please refer to the manual for further engine-related preparations.

9. Technical specifications

9.1 Link to technical standards

GB/T 2820.1-2009 Alternator units with reciprocating internal combustion engine - Part 1: Use, ratio and performance

GB/T 2820.2-2009 Alternator sets with reciprocating internal combustion engine - Part 2: Engine

GB/T 2820.3-2009 Alternator sets driven by reciprocating internal combustion engine - Part 3: Alternators for generator sets

GB/T 2820.4-2009 Alternator sets with reciprocating internal combustion engine - Part 4: Controls and switchgear

GB/T 2820.5-2009 Alternator sets with reciprocating internal combustion engine - Part 5: Generator sets

GB/T 2820.6-2009 Piston combustion alternators - Part 6: Test methods

GB/T 2820.7-2002 Alternator sets with reciprocating internal combustion engine - Part 7: Technical guidelines for specification and design

GB/T 2820.9-2002 Internal combustion piston engine alternator assemblies - Part 9: Measurement and evaluation of mechanical vibration

GB/T 2820.10-2002 Alternator sets with reciprocating internal combustion engine - Part 10: Noise measurement (packet method)

GB/T 4712-2008 Requirements for the arrangement of automatic diesel generator sets

GB/T 6071-2008 Internal combustion piston engine performance - Part 1: Calibration and test method for power, fuel and oil consumption and other requirements for general engines

GB/T 12786-2006 General technical conditions for automatic combustion engine power plant

GB/T 20136-2006 General test method for an internal combustion engine power plant

JB/T 7606-1994 Technical requirements for the final assembly of an internal combustion engine power plant JB/T 10303-2001 Technical conditions for a power-frequency diesel generator set

9.2 Adjusted ambient coefficient power

Modified ambient power factor conditions

Generator rated power conditions:

Altitude: 0 m Ambient temperature: 25°C Relative humidity:
30% Adjusted ambient coefficient: C (Relative humidity 30%)

Altitude (m)	Ambient temperature (°C)				
	25	30	35	40	45
0	1	0,98	0,96	0,93	0,90
500	0,93	0,91	0,89	0,87	0,84
1000	0,87	0,85	0,82	0,80	0,78
2000	0,75	0,73	0,71	0,69	0,66
3000	0,64	0,62	0,6	0,58	0,56
4000	0,54	0,52	0,5	0,48	0,46

Note: When the relative humidity is 60%, the adjusted coefficient is C-0.01.

When the relative humidity is 80 %, the adjusted coefficient is C-0.02. When the relative humidity is 90 %, the adjusted coefficient is C-0.03. When the relative humidity is 100 %, the adjusted coefficient is C-0.04.

Example:

With a rated generator output $P_N=5$ kW, an altitude of 1000 m, an ambient temperature of 35°C and a relative humidity of 80%, the generator output is:

$$P=P_N \times (C-0.02)= 5 \times (0.82-0.02)= 4 \text{ kW}$$

Attention

Environmental conditions:

1000 mbar, 25 °C, relative humidity 30%; nominal value corresponds to ISO 3046.

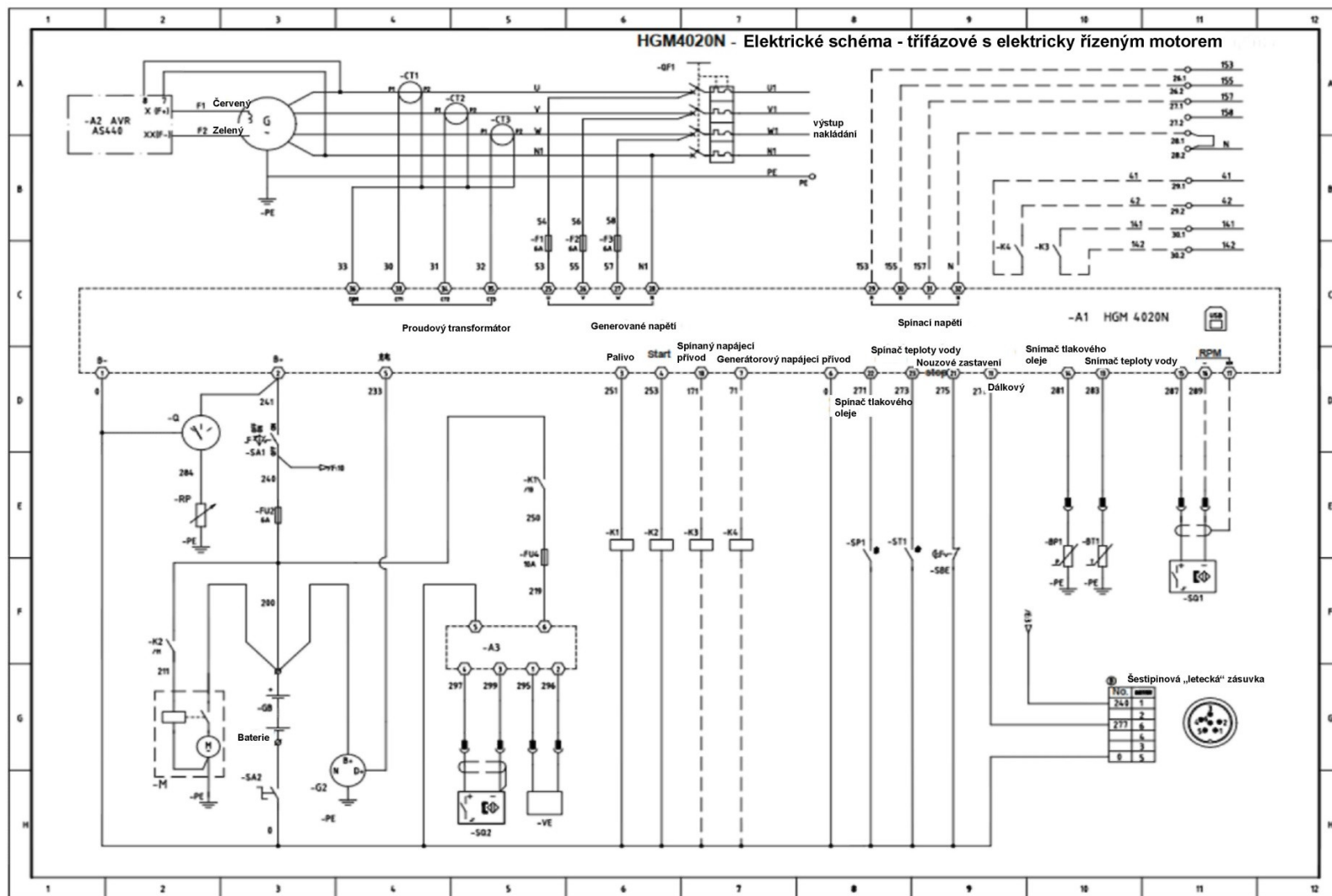
1-P.R.P. Primary power - ISO8528 : Primary power means the maximum continuous operation power in the maintenance interval under changing load conditions. Medium the output should not exceed 80% of the primary output if continuous operation for 24 hours is required.

2-Contingency power (ISO3046 Fuel shutdown power): standby power

means the maximum operating power of the generator. The operating time limit will be 500 hours under varying load or emergency situation. The annual operating time limit should not be longer than

25 hours at 100% load or 200 hours at 90% load. Overloading is not allowed.

9.3 wiring diagram



9.4 Technical specifications

Generator assembly		HDE20SS3	HDE40SS3	HDE80SS3
Main configurations				
Model (super quiet type)		HDE20SS3	HDE40SS3	HDE80SS3
Engine model		HD490C1	HD4105C1	HD4110ZIC1
Alternator model		HHA183-18C	HHA183-30C	HHA223-68C
Controller brand		SMARTGEN	SMARTGEN	SMARTGEN
Controller model		HGM 4020	HGM 4020	HGM 4020
Electrical power				
Frequency	Hz	50	50	50
Primary power	kVA	20	37	80
	kW	16	30	64
Standby power	kVA	22	41	89
	kW	18	33	71
Rated voltage	V	230/400	230/400	230/400
Rated electric current	A	28,9	53,4	115,5
Effect	cosφ	0,8	0,8	0,8
Frequency drop δf_{st}	%	≤5	≤5	≤5
Steady state frequency band β_f	%	≤1,5	≤1,5	≤1,5
Steady state voltage regulation δU_{st}	%	≤ ±2,5	≤ ±2,5	≤ ±2,5
Transient frequency deviation (sudden increase) δf_{yn}^{+}	%	≤-10	≤-10	≤-10
Transient frequency deviation (sudden drop) δf_{dyn}^{-}	%	≤+12	≤+12	≤+12
Frequency recovery time t_f	S	≤5	≤5	≤5
Transient voltage deviation (sudden increase) δU_{yn}^{+}	%	≤-20	≤-20	≤-20
Transient voltage deviation (sudden drop) δU_{dyn}^{-}	%	≤+25	≤+25	≤+25
Voltage recovery time t_U	S	≤6	≤6	≤6
Main data of the generator set				
Dimension (super quiet type)(length×× height)	mm	1720*820*1150	2000*850*1150	2350*970*1350
Clean weight (super quiet type)	kg	815	1060	1440
Fuel tank capacity (super quiet type)	L	92	120	164
Continuous operation at 100% load	Hours	17	14	8
Noise level at 7 m (ultra quiet type)	dBa	51	51	53
Alternator				
Model		HHA183-18C	HHA183-30C	HHA223-68C
Type of connection		To the star - to the series	To the star - to the series	To the star - to the series
Rated power at 1500 rpm	kW	16	30	68
Efficiency	%	84,9	86,6	90,2
Wake-up type		Self-awakening	Self-awakening	Self-awakening
Telephone Interference Factor (TIF)		< 50	< 50	< 50
Telephone Harmonic Factor (THF)		< 2%	< 2%	< 2%
Protection		H	H	H
Insulation		IP23	IP23	IP23
Engine				
Model		HD490C1	HD4105C1	HD4110ZIC1
Speed	rpm	1500	1500	1500
Rated power	kW	21	38	80
Number of cylinders		4	4	4
Arrangement of cylinders		Vertical	Vertical	Vertical
Cooling system		Water cooling	Water cooling	Water cooling
Drilling	mm	90	105	110

Stroke	mm	100	118	118
Stroke volume	L	2,54	4,087	4,3
Compression ratio		18	18	18
Type of control		Electronic	Electronic	Electronic
Air supply system				
Type of suction		Natural	Natural	Turbocharger
Maximum input resistance	kPa	3,5	4	4,9
Air flow	m³/min	1,42	2,28	5,31
Exhaust system				
Exhaust gas temperature (after turbo)	°C	500	500	550
Exhaust flow	m³/min	3,68	5,91	13,53
Maximum exhaust back pressure	kPa	6	6	6
Lubrication system				
Oil volume	L	8	13	17
Class of oil		CD 15W-40	CD 15W-40	CF 15W-40
Oil consumption (as % of consumption)		0,75%	0,77%	0,82%
Low oil pressure warning	kPa	100	100	100
Cooling system				
Coolant volume for the engine	L	5	7,2	7,2
Coolant volume (w/o radiator)	L	9	11,2	18,7
Max. warning temperature of the coolant	°C	95	95	95
Max radiator temperature	°C	50	50	50
Fuel system				
Injection method		Direct	Direct	Direct
Fuel consumption (50%)	L/h	2,98	5,58	12,59
Fuel consumption (75%)	L/h	4,05	6,75	16,27
Fuel consumption (100%)	L/h	5,45	8,8	20,94
Starting the system				
Starter power	kW	3,5	4,5/5	4,5/5
Starting voltage	V	12	12/24	12/24
Battery capacity	Ah	60	80	2x80

* Specifications are subject to change without notice.

Generator set controller			
Controller brand	SmartGen		
Controller model	HGM 4020		
View		Functions	
Main grid voltage (Uab Ubc Uca)	•	The RS485 communication interface allows "Three remote functions" according to MODBUS protocol	•
Main phase voltage (Uab Ubc Uca)	•		
Generator line voltage (Uab Ubc Uca)	•		
Generator phase voltage (Uab Ubc Uca)	•	CAN BUS Port	•
Network frequency	•	ETS (energy for stopping)	•
Sequence of main phases	•	Idle speed control	•
Generator frequency	•	Preheating control	•
Generator phase sequence	•	Speed rise/fall control	•
Load current (A)	•	Emergency start	•
Each phase and total active power (kW)	•	Automatic detection of the number of teeth of the flywheel	•
Reactive power reactive (kAVr)	•		
Apparent power (kVA)	•	Event log, generator with scheduled start and stop, by clock in real time	•
Effect	•		
Accumulate the total power of the generator	•	AMF	•
Percentage of output with load (%)	•	Protection	
Coolant temperature ()°C	•	High coolant temperature	•
Oil pressure (kPa)	•	High/low oil pressure	•
Fuel level (%) Remaining fuel quantity (L)	•	Overvoltage/undervoltage	•
Motor speed []	•	Excessive/excessive frequency	•
Battery voltage	•	Low fuel level	•
Charger voltage (V)	•	Generator overload	•
Operating hours counter	•		
Start times for accumulation	•		

