# PowerBloc EG
## Combined Heat and Power

Hoval


# Technical Information and Installation Manual
# Output range 43 to 532 kWe

4212933/00 - 03/14

Subject to modifications

# Contents

# 1. An Introduction to Hoval Combined Heat and Power

## 1.1. Foreword

These instructions have been written to give a brief description of the PowerBloc EG (43-530) combined heat and power plant (CHP plant), their installation, commissioning, operation and subsequent preventative maintenance.

The installation of CHP plant and their ancillary equipment is normally carried out by a competent Engineer, and for the purpose of this manual they are regarded as the installer, and, as such, it is their responsibility to ensure that they have read and understood the contents of this manual before installing and operating the CHP plant. As the manufacturer, Hoval cannot accept any responsibility for any damage, faults or injuries caused by non compliance with this published document.

A copy of this manual must be available on site at all times as the operating personnel will need to be able to reference it as quickly as possible. It is imperative that this manual has been read and understood before operating the CHP plant.

Hoval, or Hoval approved Engineers will commission the CHP plant. It is essential that the installer and the operator of the CHP plant are present at the commissioning handover as they can then be instructed on the day-to-day use and operation of the CHP plant. If this is not possible, or additional training is required, a further site visit can be arranged through Hoval.



## 1.2. Introduction

A Hoval combined heat and power plant consists of a gas fuelled internal combustion engine coupled to a three-phase synchronous generator. With the CHP plant it is designed that both the electricity and heat generated are utilised resulting in high efficiencies, much more efficient than a typical fossil fuel power station.

Hoval CHP plant is generally supplied skid mounted and housed within a sound reduction casing for installation into a suitable building plant room. Alternatively the CHP plant can be supplied within a complete packaged plant room for external siting.

The CHP plant has highly sophisticated controls as it is responsible for the fully automatic operation of the plant. In addition to controlling the engine and monitoring all of its values, the controls are also responsible for the synchronisation of the generator to the grid and the dissipation of heat from the engine to the connected heating circuit. The emissions from the exhaust system are measured and tightly controlled to their set values. If necessary the Hoval CHP plant can be equipped to be back-up power generation should the electrical power from the mains fail. Should this be required, Hoval Technical should be contacted for assistance.

The controls from the CHP plant are from Noris Automation GmbH which are all interfaced from one central hub that can be interrogated by the touch-screen interface. Many different external interfaces can be configured, however these need to be confirmed at time of order as they may result in hardware changes. These interfaces can be either read from a master controls system or over other media such as the internet. Remote control such as the internet interface can be used to quickly rectify faults caused by changing operating conditions.

All Hoval CHP's are built with select, quality components. All models contain MAN natural gas engines and Marelli synchronous generators, and controlled with suitably certified equipment.

# 2. Safety Information

## 2.1. Safety Information Introduction

The CHP plant is manufactured to a very high level to ensure that it complies with all safety requirements and regulations. However, due to the nature of the equipment dangers are present and these may pose a risk if it is operated improperly or by untrained personnel.

The operator on site is responsible to ensure that only trained and authorised personnel can enter, operate and maintain the CHP plant.

Safety must never be compromised when operating or maintaining the CHP plant.

The operator on site should inspect the plant on a daily basis for any signs of damage or defects and report them immediately.

Any unauthorised modifications are prohibited as this may affect safety and correct functionality of the plant.

Before work commences for example on a preventative maintenance or break-down visit the controls must be locked off against an inadvertent start-up.

**A permit-to-work system should be put in place by the operator prior to all such work being undertaken.**

The exhaust system must be sealed, insulated and not have any leaks. If a gas escape is detected the CHP plant must be switched off immediately and an appropriate specialist investigate the issue. Drain points must be fitted where required.

Used oil and coolant must be disposed of in accordance to the local regulations.

## 2.2. Specific Warnings

**Danger of death / explosion** due to a potentially explosive atmosphere in the confinements of the CHP plant, as a result of a gas leakage.

If you detect an acrid smell in the confinements of the CHP plant, combustible gas has escaped into the air surrounding the CHP plant.

- No naked flames!
- Prevent Sparking! Do not operate any electrical devices such as switches or telephones.
- If the gas escape can be heard, leave the area immediately!
- If possible and it is safe to do so close the isolation valve.
- Open all external windows and doors!
- Warn any other persons in the danger zone and instruct them to leave!
- Prevent others from entering the danger zone!
- Call the fire service from a position away from the danger zone!
- Contact National Grid Gas Emergencies on 0800 111 999.

Note: all gas work must be performed by qualified and competent personnel.

**Danger of death / fire** as a result of a gas leakage or present combustible materials / liquids.

- No naked flames!
- If possible and it is safe to do so, close the main gas isolation valve.
- Do not enter any confined spaces!
- Alert any persons in the danger zone and instruct them to leave!
- Call the emergency services from a safe location!
- Do not attempt to put out the fire yourself unless you are confident in doing so AND you are not putting yourself at any risk.
- A fire extinguisher should be available in the plant room where the CHP plant is installed
- A dry powder fire extinguisher must be in-date and to current standards.

**Danger of death** as a result of asphyxiation.

An insufficient air supply can lead to dangerous escapes of exhaust gases.

• If the ventilation is insufficient isolate the CHP plant and take it out of operation.
• Ensure all ventilation openings are unrestricted and free of any blockages.

**Danger of death** as a result of electric shocks.

Caution, even if the mains switch is isolated on the panel, labelled components within the control panel may still be live. High voltages are present in the electrical equipment and cables on the CHP plant. Touching any of the live components could lead to fatal injury!

• The CHP plant must always be de-energised before commencing work. Protective covers must only be removed once bare contacts are de-energised.
• Never touch expose or bare cables / contacts.
• All electrical work on the CHP plant must be performed by a Qualified Electrician.
• Only open the control cabinet when necessary.

**Danger of serious injury** through crushing or severing of body parts.

Depending on which mode of control the CHP plant is in, it may start-up inadvertently without any prior warning.

• Never reach into the inside of the CHP plant whilst it is running.
• Before working on the plant always ensure that it is switched into the off position.
• Only remove protective covers when necessary. Always replace the protective covers as soon as is practical to do so.

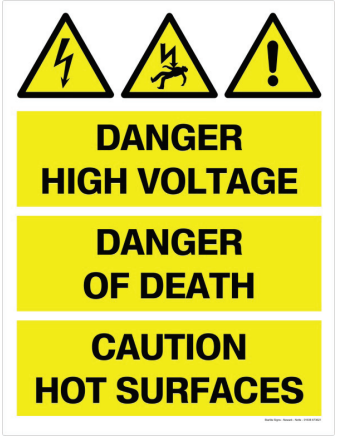
**Danger of injury / hand injuries** as a result of sharp edges.

• Always wear protective gloves when working on the CHP plant.
• Due to a danger of acid burns, suitable protection must be worn when working on the batteries.

**Danger of injury / burns** caused by very hot components, operating materials and heating water.

The CHP plant reaches very high temperatures. Even after being turned off and left to cool some components may still be hot (for example the turbocharger can run at 700°C).

• Never touch any components of the CHP plant whilst it is in operation or shortly after operation unless you are sure it is safe to do so.
• Check the temperature of specific components before touching them or performing work on the CHP plant.

# 3. Important Notes

## 3.1. Acceptance of Delivery

A visual inspection upon delivery should be performed including a check to ensure all components are present. In the event of there being damage or missing parts, the necessary steps should be followed as specified in the delivery contract.

The cost for correcting the damage shall be taken over by the individual risk bearer.

## 3.2. Scope of Guarantee

The guarantee does not cover defects caused by:

- Non-observance of these instructions
- Non-observance of the MAN engine instructions
- Incorrect installation
- Unauthorised modifications
- Improper use
- Contaminated operating media (gas, water, combustion air)
- Unsuitable chemical additives in the water circuits
- Damage due to excessive force
- Corrosion due to halogen compounds
- Corrosion due to nonconforming water quality

## 3.3. Instruction Manuals

As well as this document please refer to the specific MAN engine and Marelli / Stamford Generator manuals. A copy of all documentation should be kept with the CHP plant.
Additional sources of information:

- Hoval catalogue
- Standards and regulations

## 3.4. Standards

When installing, operating and maintaining the CHP plant you must comply with all country-specific laws, standards and directives.

The installation must be in accordance with current I.E.E. Regulations, Engineering Networks Association G59/3 recommendations, relevant British & European standards and Codes of Practice, Building Regulations and Local Authority ByLaws.

# 4. Technical Data

## 4.1. PowerBloc EG (43-104) Technical Data

| PowerBloc | | | | EG-43 | EG-50 | EG-63 | EG-70 | EG-104 |
|---|---|---|---|---|---|---|---|---|
| Electrical output | | | kW | 22 - 43 | 25 - 50 | 31 - 63 | 35 - 70 | 52 - 104 |
| Thermal output +/-5% | | | kW | 40 - 65 | 53 - 81 | 58 - 95 | 67 - 114 | 77 - 142 |
| Fuel input +/-5% | | | kW | 78 - 129 | 92 - 145 | 99 - 177 | 122 - 204 | 151 - 282 |
| Electrical efficiency | | 100% | % | 33.3 | 34.5 | 35.6 | 34.3 | 36.9 |
| | | 75% | % | 30.8 | 31.1 | 34.5 | 33.3 | 35.9 |
| | | 50% | % | 28.2 | 27.2 | 31.3 | 28.7 | 34.4 |
| Thermal efficiency | | 100% | % | 50.4 | 55.8 | 53.7 | 55.9 | 50.3 |
| | | 75% | % | 51.0 | 56.3 | 54.7 | 55.3 | 50.2 |
| | | 50% | % | 51.3 | 57.6 | 58.6 | 54.9 | 51.0 |
| Total efficiency | | 100% | % | 83.7 | 90.3 | 89.3 | 90.2 | 87.2 |
| | | 75% | % | 81.8 | 87.4 | 89.2 | 88.6 | 86.1 |
| | | 50% | % | 79.5 | 84.8 | 89.9 | 83.6 | 85.4 |
| CHP coefficient at full load | | | | 0.66 | 0.62 | 0.66 | 0.61 | 0.73 |
| Heating system | | | | | | | | |
| Working temperature max | | | °C | 90 | 90 | 90 | 90 | 90 |
| Return temperature min/max | | | °C | 50 - 70 | 50 - 70 | 50 - 70 | 50 - 70 | 50 - 70 |
| Volumetric heating flow | | | $m^3/h$ | 3.1 | 3.5 | 4.1 | 4.9 | 6.1 |
| Working pressure min/max [1] | | | bar | 1 - 2.5 | 1 - 2.5 | 1 - 2.5 | 1 - 2.5 | 1 - 2.5 |
| Hydraulic resistance | | | mbar | 50 - 60 | 50 - 60 | 50 - 60 | 50 - 60 | 50 - 60 |
| Natural gas pressure min/max | | | mbar | 18 - 100 | 18 - 100 | 18 - 100 | 18 - 100 | 18 - 100 |
| Natural gas consumption | | | $m^3/h$ | 12.94 | 14.54 | 17.75 | 20.46 | 28.28 |
| Exhaust gas temperature | | | °C | 120 | 120 | 120 | 120 | 120 |
| Required exhaust back pressure | | | kPa | 1.5 | 1.5 | 1.5 | 1.5 | 1.5 |
| Exhaust gas flow - wet | | | kg/h | 159 | 192 | 361 | 272 | 594 |
| Exhaust gas flow - dry | | | $Nm^3/h$ | 129 | 156 | 288 | 221 | 474 |
| Standard emission rate @5% $O_2$ | Nitrogen Oxides | | $mg/Nm^3$ | <125 | <125 | <500 | <250 | <500 |
| | Carbon monoxides | | $mg/Nm^3$ | <150 | <150 | <300 | <300 | <300 |
| Supply air temperature | | | °C | 10 - 30 | 10 - 30 | 10 - 30 | 10 - 30 | 10 - 30 |
| Supply air flow | | | $m^3/h$ | 2500 | 3000 | 3140 | 4000 | 4200 |
| Combustion air | | | $m^3/h$ | 125 | 151 | 290 | 214 | 478 |
| Extract air temperature max | | | °C | 50 | 50 | 50 | 50 | 50 |
| Extract air flow | | | $m^3/h$ | 2375 | 2849 | 2850 | 3786 | 3722 |
| Radiation heat max | | | kW | 12 | 15 | 15 | 20 | 19 |
| Dimensions | | | | | | See table of dimensions | | |
| Weight | | Dry | kg | 1900 | 2000 | 2100 | 2100 | 3200 |
| | | Flooded | kg | 2000 | 2100 | 2200 | 2200 | 3400 |
| Acoustic level at 1m [2] | | | dB(A) | 62 | 62 | 70 | 70 | 70 |
| Exhaust gas acoustic level at 10m | | | dB(A) | 65 | 65 | 70 | 70 | 70 |
| As above with optional secondary silencer | | | dB(A) | 52 | 52 | 55 | 55 | 50 |
| Engine Manufacturer | | | | MAN | MAN | MAN | MAN | MAN |
| Model | | | | E0834 E312 | E0834 E302 | E0834 LE302 | E0836 E302 | E0836 LE202 |
| ISO standard power | | | kW | 47 | 54 | 68 | 75 | 110 |
| Normal rotation speed | | | r/min | 1500 | 1500 | 1500 | 1500 | 1500 |
| Fuel | | | | Natural gas | Natural gas | Natural gas | Natural gas | Natural gas |
| Cylinder | | | | 4R | 4R | 4R | 6R | 6R |
| Swept volume | | | $dm^3$ | 4.58 | 4.58 | 4.58 | 6.87 | 6.87 |
| Bore | | | mm | 108 | 108 | 108 | 108 | 108 |
| Stroke | | | mm | 125 | 125 | 125 | 125 | 125 |
| Mean effective pressure | | | Mpa | 0.821 | 0.943 | 1.19 | 0.873 | 1.281 |
| Mean piston speed | | | m/s | 6.3 | 6.3 | 6.3 | 6.3 | 6.3 |
| Compression ratio | | | | 13:1 | 13:1 | 11:1 | 13:1 | 11:1 |
| Lubricating oil consumption | | | kg/h | 0.075 | 0.075 | 0.05 | 0.1 | 0.125 |
| Lubricating oil volume | | | $dm^3$ | 9/13 | 9/13 | 17/25 | 24/34 | 24/34 |
| Weight-dry | | | kg | 430 | 430 | 495 | 520 | 605 |
| Generator Manufacturer | | | | Marelli | Marelli | Marelli | Marelli | Marelli |
| Model | | | | MJB200MB4 | MJB225SA4 | MJB225SB4 | MJB225MA4 | MJB250MA4 |
| Mode | | | | Synchronous | Synchronous | Synchronous | Synchronous | Synchronous |
| Continuous output | | | kVA | 55 | 64 | 80 | 88 | 130 |
| Rotating speed | | | r/min | 1500 | 1500 | 1500 | 1500 | 1500 |
| Efficiency | | | % | 94.2 | 93.7 | 93.6 | 94.0 | 94.8 |
| Voltage | | | V | 400 | 400 | 400 | 400 | 400 |
| current | | | A | 62 | 72 | 91 | 101 | 150 |
| Frequency | | | Hz | 50 | 50 | 50 | 50 | 50 |
| Ingress protection class | | | | IP23 | IP23 | IP23 | IP23 | IP23 |
| Insulation system | | | | H | H | H | H | H |
| Warming class | | | | F | F | F | F | F |
| Weight | | | kg | 300 | 345 | 350 | 390 | 530 |

[1] High pressure model with 5.5bar maximum heating system working pressure available.

[2] Noise data recorded when complete with sound reduction housing.

The above quoted data is based on Natural Gas with a calorific value of 36.0 MJ/Nm³ (10.0 kWh/Nm³) and a Methane value greater than 80
Efficiency data was obtained under standard atmospheric conditions: air pressure 100 kPa, air temperature 298°K, relative air moisture 30%

Clamp power at generator with cos φ = 1.0
Hoval follows a policy of continued improvement and reserves the right to change specifications without notice.

## 4.2. PowerBloc EG (140-250) Technical Data

| PowerBloc | | | EG-140 | EG-210/80 | EG-240 | EG-250 |
|---|---|---|---|---|---|---|
| Electrical output | | kW | 70 - 140 | 104 - 210 | 118 - 240 | 125 - 254 |
| Thermal output +/-5% | | kW | 130 - 207 | 172 - 298 | 220 - 365 | 185 - 321 |
| Fuel input +/-5% | | kW | 225 - 384 | 308 - 559 | 397 - 669 | 374 - 680 |
| Electrical efficiency | 100% | % | 36.5 | 37.6 | 35.9 | 37.3 |
| | 75% | % | 34.2 | 36.3 | 33.4 | 36.5 |
| | 50% | % | 31.1 | 33.8 | 29.7 | 33.4 |
| Thermal efficiency | 100% | % | 53.9 | 53.3 | 54.5 | 47.2 |
| | 75% | % | 55.7 | 54.5 | 55.6 | 47.9 |
| | 50% | % | 57.7 | 55.8 | 55.4 | 49.5 |
| Total efficiency | 100% | % | 90.4 | 90.9 | 90.4 | 84.5 |
| | 75% | % | 89.9 | 90.8 | 89.0 | 84.4 |
| | 50% | % | 88.8 | 89.6 | 85.1 | 82.9 |
| CHP coefficient at full load | | | 0.68 | 0.70 | 0.66 | 0.79 |
| Heating system | | | | | | |
| Working temperature max | | °C | 90 | 90 | 90 | 90 |
| Return temperature min/max | | °C | 50 - 70 | 50 - 70 | 50 - 70 | 50 - 70 |
| Volumetric heating flow | | $m^3/h$ | 8.9 | 12.8 | 15.7 | 13.8 |
| Working pressure min/max (1) | | bar | 1 - 2.5 | 1 - 2.5 | 1 - 2.5 | 1 - 2.5 |
| Hydraulic resistance | | mbar | 50 - 60 | 50 - 60 | 50 - 60 | 50 - 60 |
| Natural gas pressure min/max | | mbar | 18 - 100 | 18 - 100 | 18 - 100 | 18 - 100 |
| Natural gas consumption | | $m^3/h$ | 38.52 | 56.07 | 67.10 | 68.20 |
| Exhaust gas temperature | | °C | 120 | 120 | 120 | 120 |
| Required exhaust back pressure | | kPa | 1.5 | 1.5 | 2.0 | 1.5 |
| Exhaust gas flow - wet | | kg/h | 503 | 1199 | 879 | 1392 |
| Exhaust gas flow - dry | | $Nm^3/h$ | 409 | 989 | 713 | 1111 |
| Standard emission rate @5% $O_2$ | Nitrogen Oxides | $mg/Nm^3$ | <250 | <500 | <250 | <500 |
| | Carbon monoxides | $mg/Nm^3$ | <300 | <300 | <300 | <300 |
| Supply air temperature | | °C | 10 - 30 | 10 - 30 | 10 - 30 | 10 - 30 |
| Supply air flow | | $m^3/h$ | 5300 | 6200 | 7900 | 7220 |
| Combustion air | | $m^3/h$ | 396 | 965 | 700 | 1120 |
| Extract air temperature max | | °C | 50 | 50 | 50 | 50 |
| Extract air flow | | $m^3/h$ | 4904 | 5235 | 7200 | 6100 |
| Radiation heat max | | kW | 25 | 22 | 36 | 31 |
| Dimensions | | | | | See table of dimensions | |
| Weight | Dry | kg | 3600 | 4400 | 4550 | 4300 |
| | Flooded | kg | 3800 | 4600 | 4750 | 4500 |
| Acoustic level at 1m (2) | | dB(A) | 70 | 70 | 70 | 70 |
| Exhaust gas acoustic level at 10m | | dB(A) | 70 | 70 | 70 | 70 |
| As above with optional secondary silencer | | dB(A) | 55 | 55 | 55 | 55 |
| Engine Manufacturer | | | MAN | MAN | MAN | MAN |
| Model | | | E2876 E312 | E2876 LE202 | E2842 E312 | E2848 LE322 |
| ISO standard power | | kW | 150 | 220 | 300 | 265 |
| Normal rotation speed | | r/min | 1500 | 1500 | 1500 | 1500 |
| Fuel | | | Natural gas | Natural gas | Natural gas | Natural gas |
| Cylinder | | | 6R | 6R | 12V | 8V |
| Swept volume | | $dm^3$ | 12.82 | 12.40 | 21.93 | 14.62 |
| Bore | | mm | 128 | 126 | 128 | 128 |
| Stroke | | mm | 166 | 166 | 142 | 142 |
| Mean effective pressure | | Mpa | 0.936 | 1.42 | 0.912 | 1.450 |
| Mean piston speed | | m/s | 8.3 | 8.3 | 7.1 | 7.1 |
| Compression ratio | | | 12:1 | 12.6:1 | 12.5:1 | 17:1 |
| Lubricating oil consumption | | kg/h | 0.125 | 0.15 | 0.15 | 0.175 |
| Lubricating oil volume | | $dm^3$ | 19/28 | 35/70 | 22/30 | 30/70 |
| Weight-dry | | kg | 830 | 985 | 1300 | 1052 |
| Generator Manufacturer | | | Marelli | Marelli | Marelli | Marelli |
| Model | | | MJB250LA4 | MJB315MA4 | MJB315MB4 | MJB315MB4 |
| Mode | | | Synchronous | Synchronous | Synchronous | Synchronous |
| Continuous output | | kVA | 178 | 263 | 300 | 318 |
| Rotating speed | | r/min | 1500 | 1500 | 1500 | 1500 |
| Efficiency | | % | 94.8 | 95.6 | 96.0 | 96.0 |
| Voltage | | V | 400 | 400 | 400 | 400 |
| current | | A | 202 | 303 | 346 | 367 |
| Frequency | | Hz | 50 | 50 | 50 | 50 |
| Ingress protection class | | | IP23 | IP23 | IP23 | IP23 |
| Insulation system | | | H | H | H | H |
| Warming class | | | F | F | F | F |
| Weight | | kg | 660 | 1060 | 1200 | 1200 |

(1) High pressure model with 5.5bar maximum heating system working pressure available.
(2) Noise data recorded when complete with sound reduction housing.

The above quoted data is based on Natural Gas with a calorific value of 36.0 MJ/Nm³ (10.0 kWh/Nm³) and a Methane value greater than 80
Efficiency data was obtained under standard atmospheric conditions: air pressure 100 kPa, air temperature 298°K, relative air moisture 30%

Clamp power at generator with cos φ = 1.0
Hoval follows a policy of continued improvement and reserves the right to change specifications without notice.

## 4.3. PowerBloc EG (365-530) Technical Data

| PowerBloc | | | EG-365 | EG-404 | EG-460 | EG-530 |
|---|---|---|---|---|---|---|
| Electrical output | | kW | 182 - 365 | 202 - 404 | 229 - 461 | 262 - 532 |
| Thermal output +/-5% | | kW | 280 - 496 | 297 - 520 | 332 - 584 | 355 - 665 |
| Fuel input +/-5% | | kW | 514 - 955 | 560 - 1045 | 626 - 1174 | 712 - 1342 |
| Electrical efficiency | 100% | % | 38.2 | 38.6 | 39.3 | 39.6 |
| | 75% | % | 37.5 | 38.0 | 38.9 | 38.7 |
| | 50% | % | 35.4 | 36.1 | 36.6 | 36.8 |
| Thermal efficiency | 100% | % | 51.9 | 49.8 | 49.7 | 49.6 |
| | 75% | % | 52.1 | 51.4 | 50.3 | 49.8 |
| | 50% | % | 54.5 | 53.0 | 53.0 | 49.9 |
| Total efficiency | 100% | % | 90.1 | 88.4 | 89.0 | 89.2 |
| | 75% | % | 89.6 | 89.4 | 89.2 | 88.5 |
| | 50% | % | 89.9 | 89.1 | 89.6 | 86.7 |
| CHP coefficient at full load | | | 0.74 | 0.78 | 0.79 | 0.80 |
| Heating system | | | | | | |
| Working temperature max | | °C | 90 | 90 | 90 | 90 |
| Return temperature min/max | | °C | 50 - 70 | 50 - 70 | 50 - 70 | 50 - 70 |
| Volumetric heating flow | | $m^3/h$ | 21.3 | 22.4 | 25.1 | 28.6 |
| Working pressure min/max (1) | | bar | 1 - 2.5 | 1 - 2.5 | 1 - 2.5 | 1 - 2.5 |
| Hydraulic resistance | | mbar | 50 - 60 | 50 - 60 | 50 - 60 | 50 - 60 |
| Natural gas pressure min/max | | mbar | 18 - 100 | 18 - 100 | 18 - 100 | 18 - 100 |
| Natural gas consumption | | $m^3/h$ | 95.79 | 104.82 | 117.75 | 134.60 |
| Exhaust gas temperature | | °C | 120 | 120 | 120 | 120 |
| Required exhaust back pressure | | kPa | 1.5 | 1.5 | 1.5 | 1.5 |
| Exhaust gas flow - wet | | kg/h | 1989 | 2126 | 2616 | 2872 |
| Exhaust gas flow - dry | | $Nm^3/h$ | 1587 | 1698 | 2085 | 2292 |
| Standard emission rate @5% $O_2$ | Nitrogen Oxides | $mg/Nm^3$ | <500 | <500 | <500 | <500 |
| | Carbon monoxides | $mg/Nm^3$ | <300 | <300 | <300 | <300 |
| Supply air temperature | | °C | 10 - 30 | 10 - 30 | 10 - 30 | 10 - 30 |
| Supply air flow | | $m^3/h$ | 10500 | 11500 | 14509 | 17313 |
| Combustion air | | $m^3/h$ | 1600 | 1700 | 2109 | 2313 |
| Extract air temperature max | | °C | 50 | 50 | 50 | 50 |
| Extract air flow | | $m^3/h$ | 8900 | 9800 | 12400 | 15000 |
| Radiation heat max | | kW | 45 | 49 | 62 | 75 |
| Dimensions | | | See table of dimensions | | | |
| Weight | Dry | kg | 5250 | 5250 | 5950 | 6400 |
| | Flooded | kg | 5450 | 5450 | 6150 | 6600 |
| Acoustic level at 1m (2) | | dB(A) | 70 | 70 | 70 | 70 |
| Exhaust gas acoustic level at 10m | | dB(A) | 70 | 70 | 70 | 70 |
| As above with optional secondary silencer | | dB(A) | 55 | 55 | 55 | 55 |
| Engine Manufacturer | | | MAN | MAN | MAN | MAN |
| Model | | | E2842 LE322 | E2842 LE322 | E3262 LE202 | E3262 LE202 |
| ISO standard power | | kW | 380 | 420 | 478 | 550 |
| Normal rotation speed | | r/min | 1500 | 1500 | 1500 | 1500 |
| Fuel | | | Natural gas | Natural gas | Natural gas | Natural gas |
| Cylinder | | | 12V | 12V | 12V | 12V |
| Swept volume | | $dm^3$ | 21.93 | 21.93 | 25.8 | 25.8 |
| Bore | | mm | 128 | 128 | 132 | 132 |
| Stroke | | mm | 142 | 142 | 157 | 157 |
| Mean effective pressure | | Mpa | 1.387 | 1.532 | 1.480 | 1.71 |
| Mean piston speed | | m/s | 7.1 | 7.1 | 7.85 | 7.85 |
| Compression ratio | | | 12:1 | 12:1 | 12:1 | 12:1 |
| Lubricating oil consumption | | kg/h | 0.2 | 0.2 | 0.175 | 0.175 |
| Lubricating oil volume | | $dm^3$ | 40/90 | 40/90 | 102 | 102 |
| Weight-dry | | kg | 1420 | 1420 | 1849 | 1849 |
| Generator Manufacturer | | | Marelli | Marelli | Marelli | Marelli |
| Model | | | MJB355MA4 | MJB355MA4 | MJB355MB4 | MJB400LA4 |
| Mode | | | Synchronous | Synchronous | Synchronous | Synchronous |
| Continuous output | | kVA | 459 | 506 | 578 | 664 |
| Rotating speed | | r/min | 1500 | 1500 | 1500 | 1500 |
| Efficiency | | % | 96.5 | 96.5 | 96.6 | 96.6 |
| Voltage | | V | 400 | 400 | 400 | 400 |
| current | | A | 527 | 583 | 665 | 768 |
| Frequency | | Hz | 50 | 50 | 50 | 50 |
| Ingress protection class | | | IP23 | IP23 | IP23 | IP23 |
| Insulation system | | | H | H | H | H |
| Warming class | | | F | F | F | F |
| Weight | | kg | 1800 | 1800 | 2050 | 2530 |

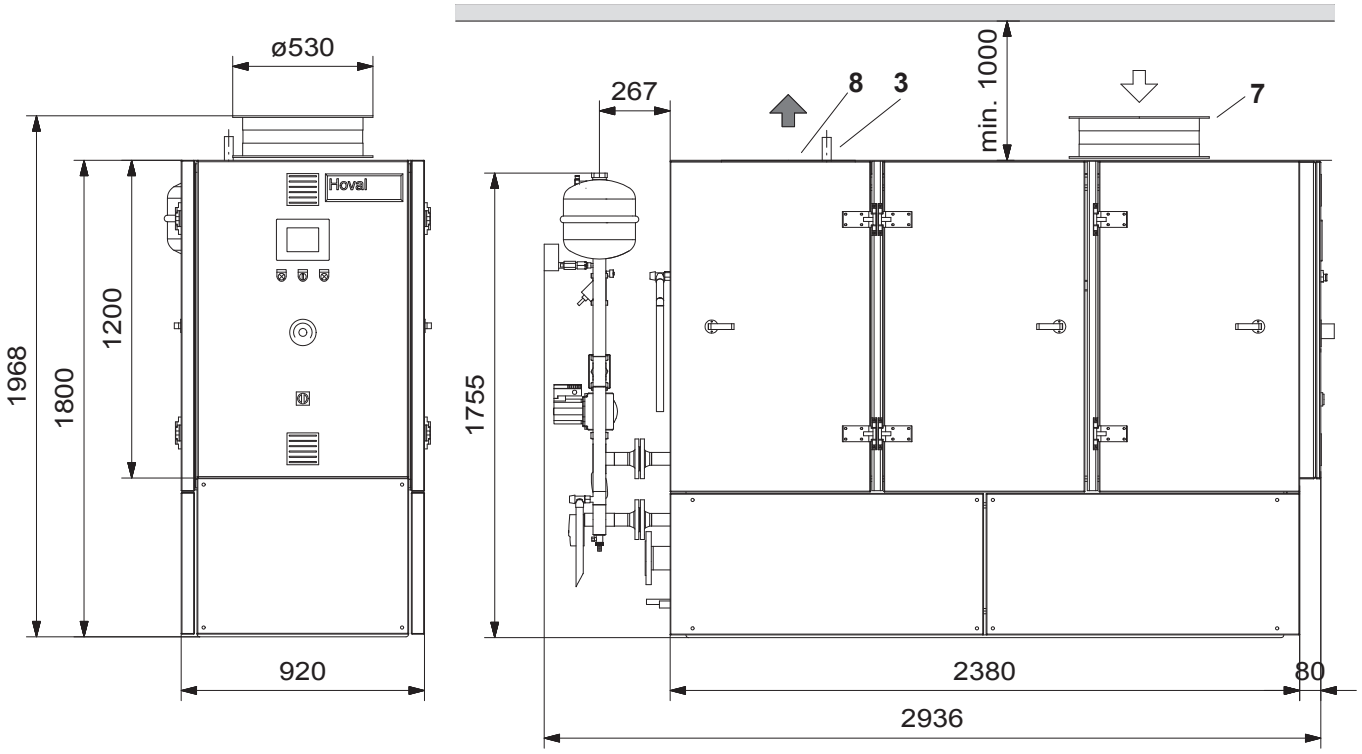
(1) High pressure model with 5.5bar maximum heating system working pressure available.
(2) Noise data recorded when complete with sound reduction housing.

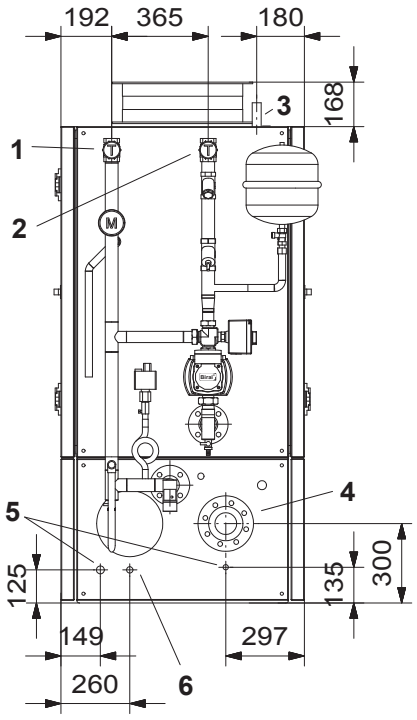
The above quoted data is based on Natural Gas with a calorific value of 36.0 MJ/Nm³ (10.0 kWh/Nm³) and a Methane value greater than 80
Efficiency data was obtained under standard atmospheric conditions: air pressure 100 kPa, air temperature 298°K, relative air moisture 30%

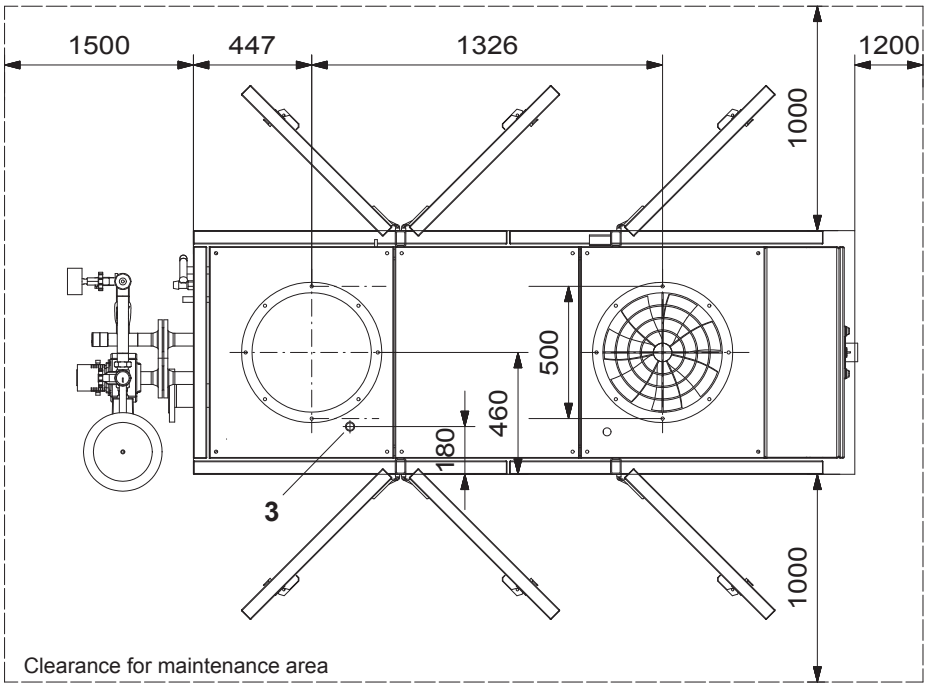
Clamp power at generator with cos φ = 1.0
Hoval follows a policy of continued improvement and reserves the right to change specifications without notice.

## 4.4. PowerBloc EG (43-50) Dimensions

1000mm minimum clearance required for ventilation air supply and extract air.



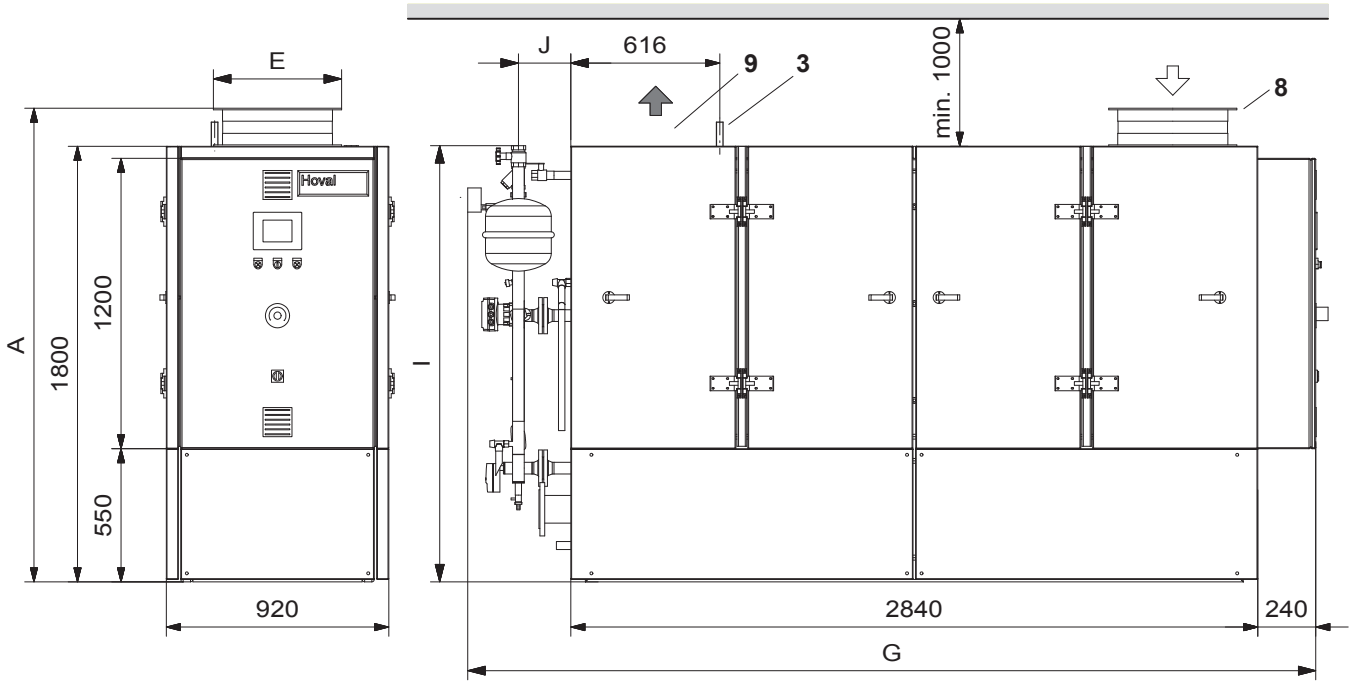

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| Model | Flow | Return | Gas Inlet | Exhaust Outlet | Condensate Drain | Drain | Supply Air | Extract Air |
| EG-43 | DN32 | DN32 | 1" | DN80 PN10 | 1" | 1/2" | 500mm | 500mm |
| EG-50 | DN32 | DN32 | 1" | DN80 PN10 | 1" | 1/2" | 500mm | 500mm |

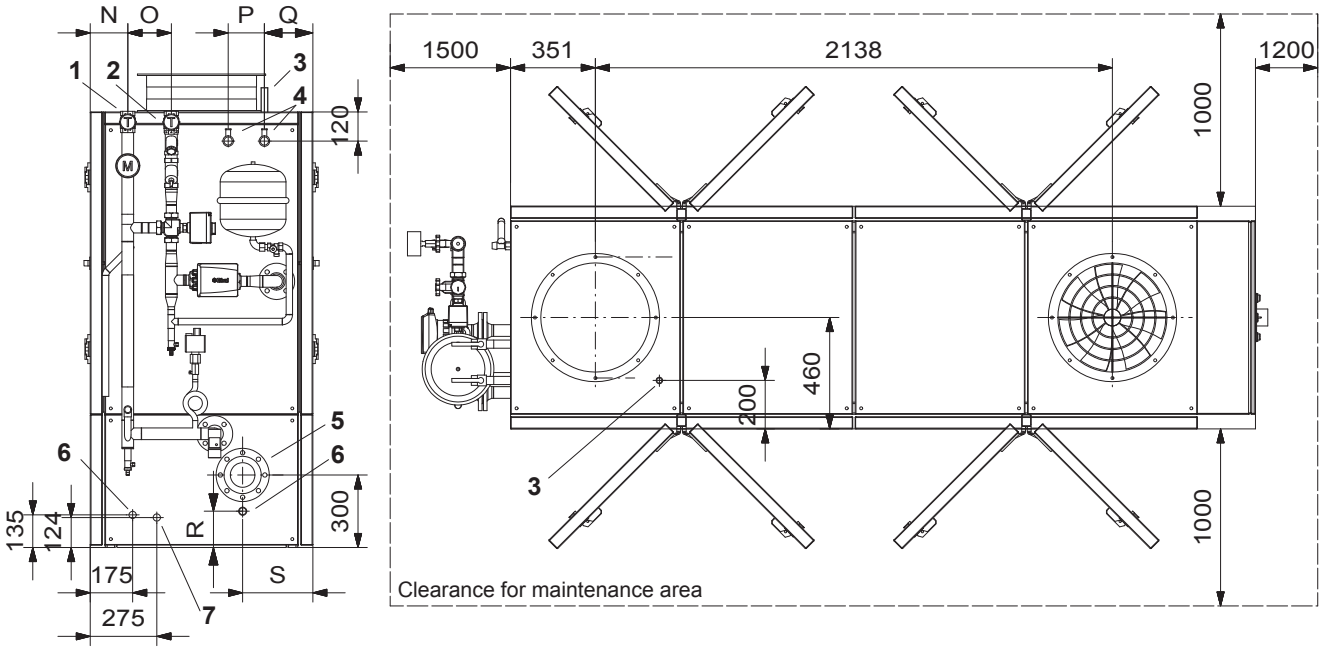
I**mportant Note:**

Supply air and extract air connections must either both be ducted to an outside wall or both to ventilate into the plant room (which has suitable natural ventilation). You must NOT duct just ONE of the connections to an external source.

## 4.5. PowerBloc EG (63-70) Dimensions

1000mm minimum clearance required for ventilation air supply and extract air.




| Model | A | E | G | I | J | N | O | P | Q | R | S |
|---|---|---|---|---|---|---|---|---|---|---|---|
| EG-63 | 1957 | Ø530 | 3506 | 1802 | 205 | 155 | 180 | 150 | 200 | 150 | 290 |
| EG-70 | 1998 | Ø590 | 3514 | 1812 | 217 | 194 | 345 | - | - | 141 | 320 |

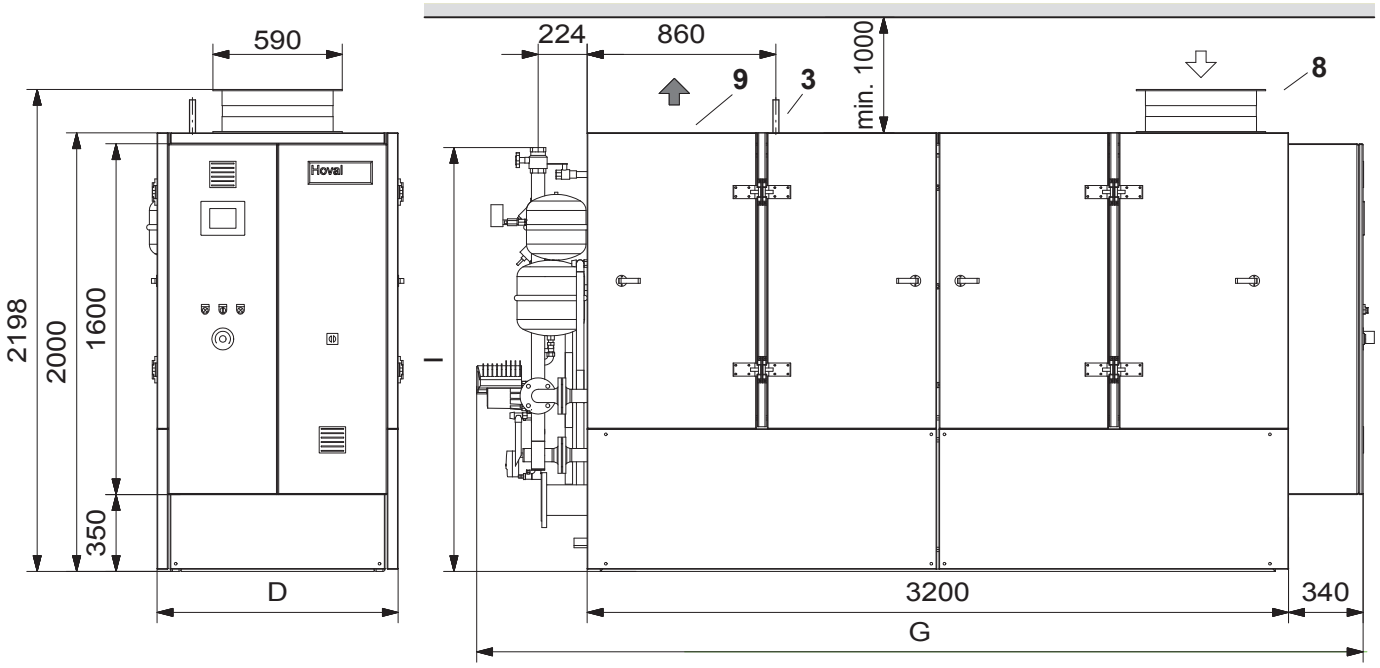
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Model | Flow | Return | Gas Inlet | Mixture Cooling | Exhaust Outlet | Condensate Drain | Drain | Supply Air | Extract Air |
| EG-63 | DN40 | DN40 | 1" | 3/4" | DN100 PN10 | 1" | 1/2" | 500mm | 500mm |
| EG-70 | DN40 | DN40 | 1" | - | DN100 PN10 | 1" | 1/2" | 560mm | 560mm |

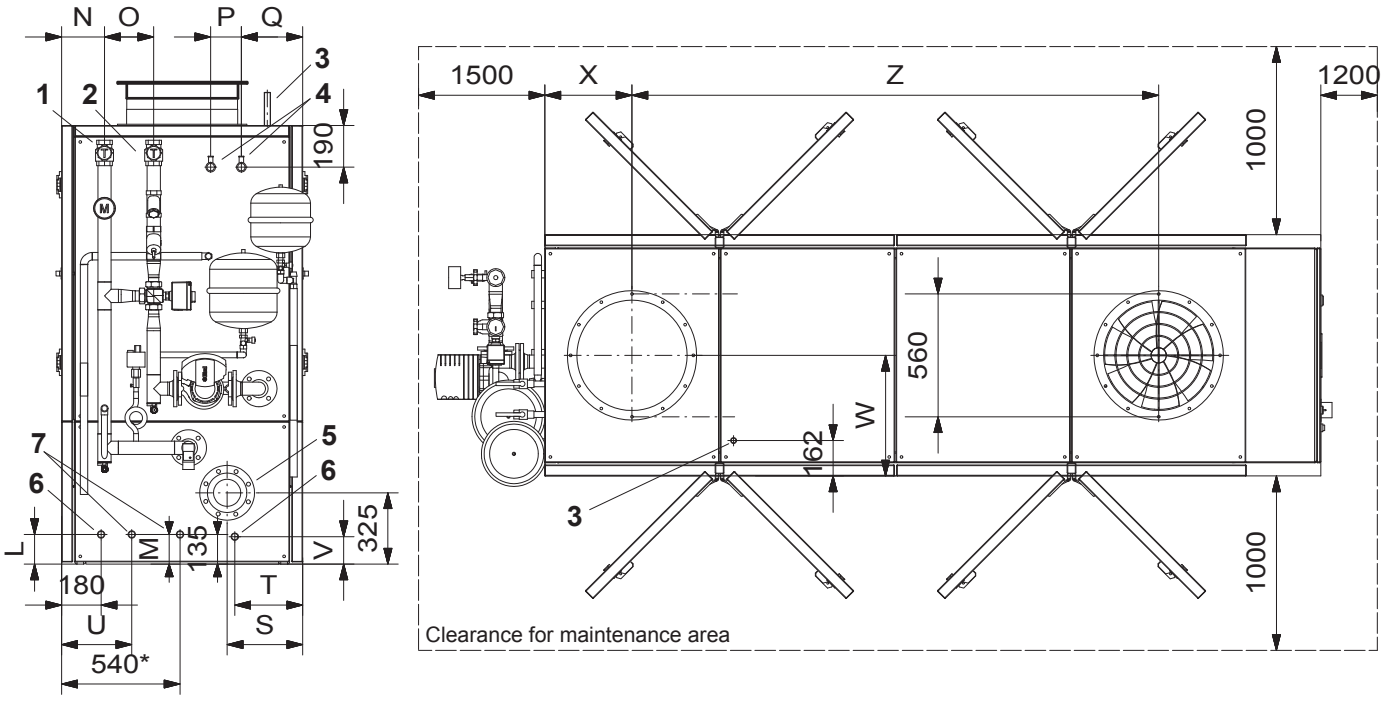
**Important Note:**

Supply air and extract air connections must either both be ducted to an outside wall or both to ventilate into the plant room (which has suitable natural ventilation). You must NOT duct just ONE of the connections to an external source.

## 4.6. PowerBloc EG (104-140) Dimensions

1000mm minimum clearance required for ventilation air supply and extract air.




| Model | D | G | I | L | M | N | O | P | Q | S | T | U | W | X | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EG-104 | 1100 | 4044 | 1933 | 135 | 135 | 196 | 225 | 140 | 280 | 345 | 310 | 320 | 550 | 398 | 2403 |
| EG-140 | 1120 | 4144 | 2074 | 125 | 114 | 252 | 453 | - | - | 335 | 347 | 328 | 560 | 458 | 2275 |

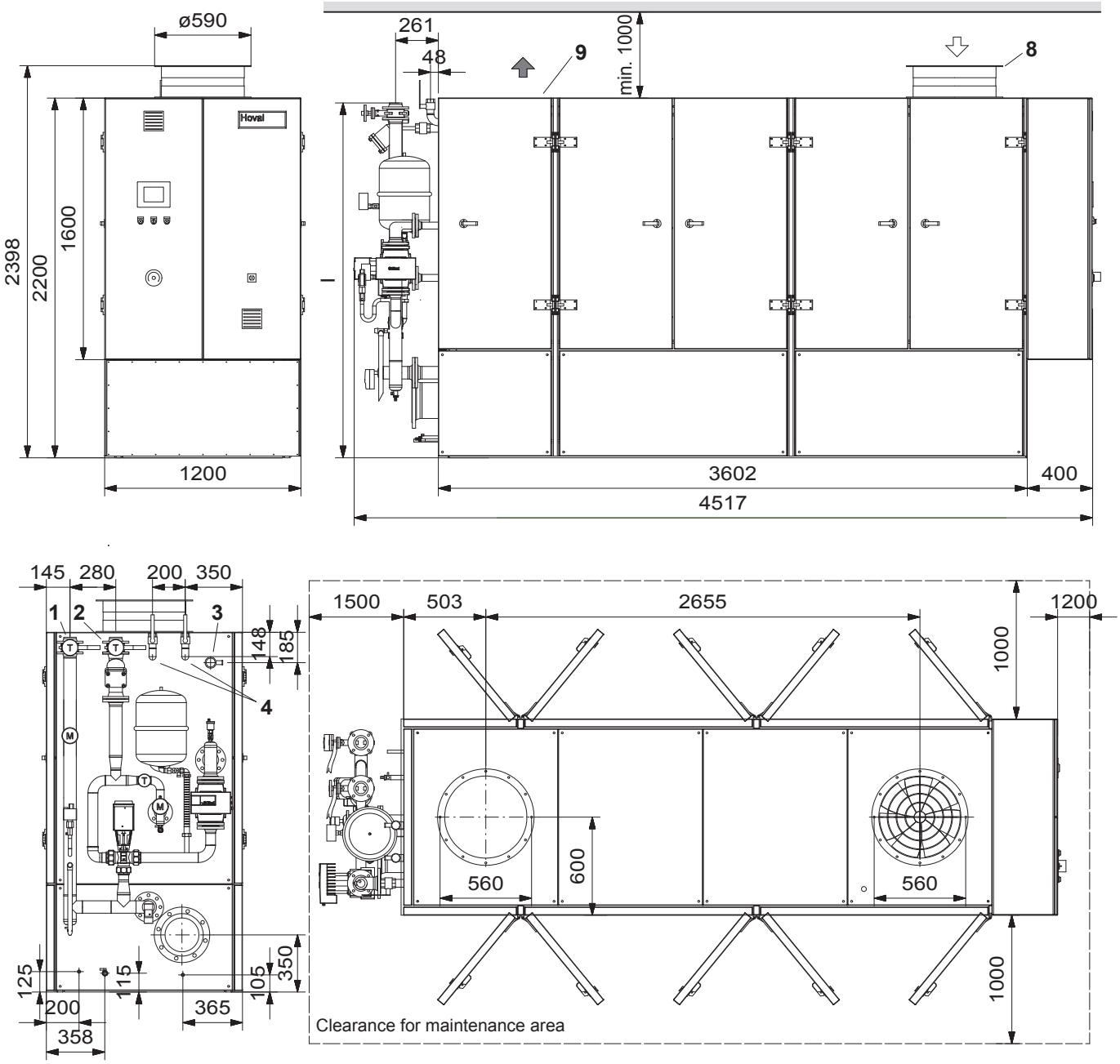
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Model | Flow | Return | Gas Inlet | Mixture Cooling | Exhaust Outlet | Condensate Drain | Drain | Supply Air | Extract Air |
| EG-104 | DN50 | DN50 | 1 1/2" | 3/4" | DN125 PN10 | 1" | 1/2" | 550mm | 550mm |
| EG-140 | DN50 | DN50 | 1 1/2" | - | DN125 PN10 | 1" | 1/2" | 550mm | 550mm |

I**mportant Note:**

Supply air and extract air connections must either both be ducted to an outside wall or both to ventilate into the plant room (which has suitable natural ventilation). You must NOT duct just ONE of the connections to an external source.

## 4.7. PowerBloc EG (210/80) Dimensions

1000mm minimum clearance required for ventilation air supply and extract air.




| Model | I |
|---|---|
| EG-210/80 | 2180 |

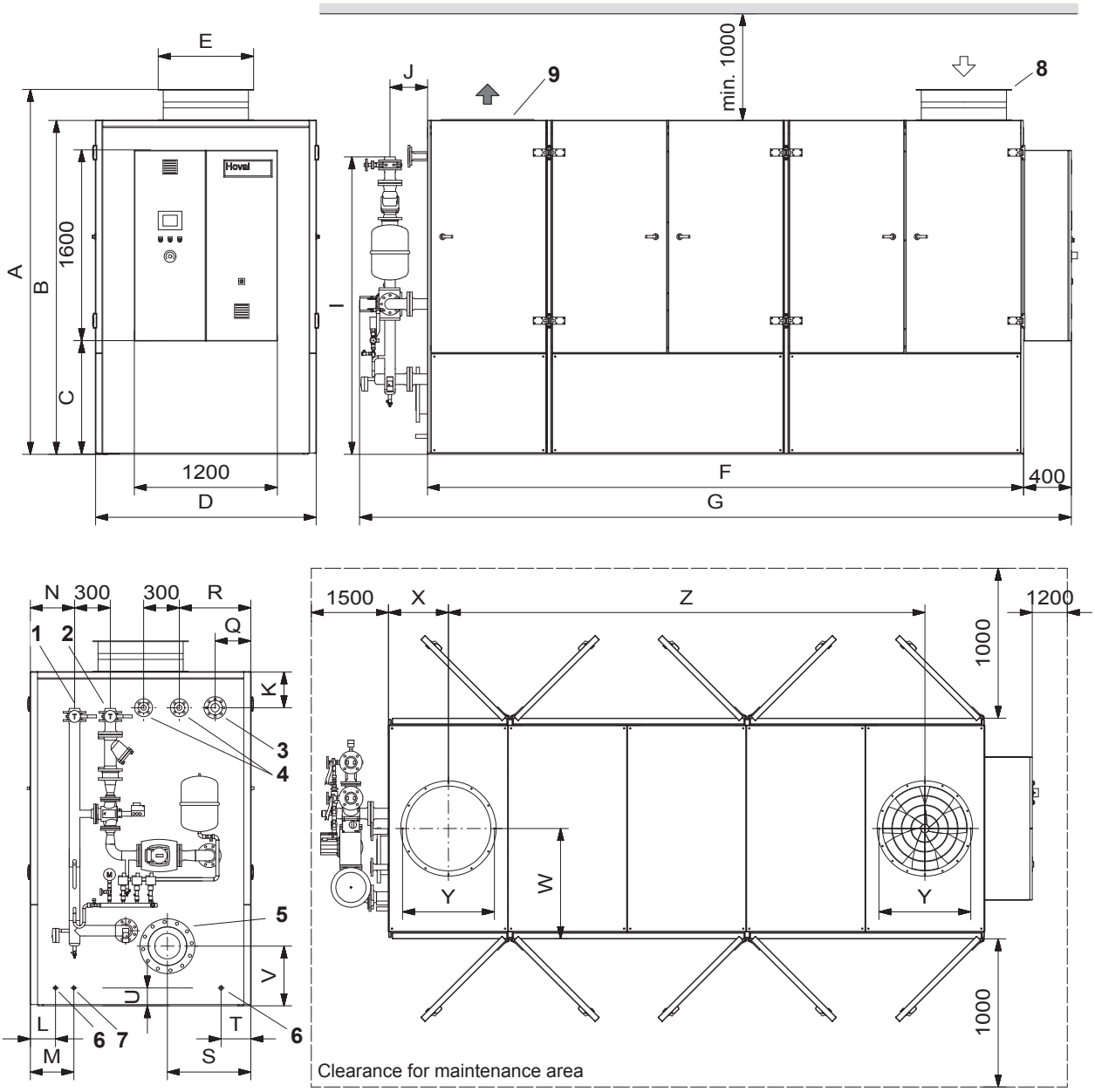
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Model | Flow | Return | Gas Inlet | Mixture Cooling | Exhaust Outlet | Condensate Drain | Drain | Supply Air | Extract Air |
| EG-210/80 | DN65PN6 | DN65PN6 | 1 1/2" | - | DN200 PN10 | 1" | 1/2" | 550mm | 550mm |

**Important Note:**

Supply air and extract air connections must either both be ducted to an outside wall or both to ventilate into the plant room (which has suitable natural ventilation). You must NOT duct just ONE of the connections to an external source.

## 4.8. PowerBloc EG (240-530) Dimensions

1000mm minimum clearance required for ventilation air supply and extract air.




| Model | A | B | C | D | E | F | G | I | J | K | L | M | N | Q | R | S | V | W | X | Y | Z |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EG-240 | 2395 | 2200 | 345 | 1600 | Ø650 | 3800 | 4769 | 2225 | 311 | 200 | 200 | 380 | 421 | 200 | - | 400 | 350 | 800 | 380 | 559 | 3048 |
| EG-250 | 2400 | 2200 | 355 | 1600 | Ø650 | 3800 | 4742 | 2205 | 288 | 200 | 211 | 365 | 418 | 200 | 300 | 450 | 500 | 800 | 380 | 559 | 3036 |
| EG-365 | 2726 | 2500 | 655 | 1720 | Ø720 | 4500 | 5470 | 2460 | 315 | 300 | 211 | 365 | 368 | 300 | - | 570 | 500 | 860 | 450 | 634 | 3597 |
| EG-404 | 2726 | 2500 | 650 | 1720 | Ø720 | 4500 | 5470 | 2490 | 315 | 300 | 211 | 365 | 371 | 300 | 600 | 570 | 500 | 860 | 450 | 634 | 3597 |
| EG-460 | 3060 | 2800 | 950 | 1850 | Ø800 | 5000 | 5970 | 2460 | 315 | 300 | 211 | 365 | 300 | 300 | - | 700 | 500 | 925 | 500 | 711 | 3996 |
| EG-530 | 3060 | 2800 | 950 | 1850 | Ø800 | 5000 | 5970 | 2460 | 315 | 300 | 211 | 365 | 300 | 300 | 600 | 700 | 500 | 925 | 500 | 711 | 3996 |

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 |
|---|---|---|---|---|---|---|---|---|---|
| Model | Flow | Return | Gas Inlet | Mixture Cooling | Exhaust Outlet | Condensate Drain | Drain | Supply Air | Extract Air |
| EG-240 | DN65PN6 | DN65PN6 | 2" | - | DN200PN10 | 1" | 1/2" | 550mm | 550mm |
| EG-250 | DN65PN6 | DN65PN6 | 2" | 1 1/4" | DN200PN10 | 1" | 1/2" | 550mm | 550mm |
| EG-365 | DN80PN6 | DN80PN6 | 2" | - | DN250PN10 | 1" | 1/2" | 625mm | 625mm |
| EG-404 | DN80PN6 | DN80PN6 | 2" | 1 1/4" | DN250PN10 | 1" | 1/2" | 625mm | 625mm |
| EG-460 | DN80PN6 | DN80PN6 | DN65PN16 | - | DN300PN10 | 1" | 1/2" | 700mm | 700mm |
| EG-530 | DN80PN6 | DN80PN6 | DN65PN16 | DN40PN6 | DN300PN10 | 1" | 1/2" | 700mm | 700mm |

**Important Note:**

Supply air and extract air connections must either both be ducted to an outside wall or both to ventilate into the plant room (which has suitable natural ventilation). You must NOT duct just ONE of the connections to an external source.

# 5. Installation Requirements

**Notes on installation and the Operation of the CHP plant**

Regular preventative maintenance needs to be performed on the CHP plant to ensure it operates correctly. As well as these scheduled service visits the site operator needs to frequently check the CHP plant to ensure that everything is operating as designed.

## 5.1. Site Requirements

- A suitable flat, solid, level and fire proof base must be provided to suit the flooded weight of the CHP plant concerned (not provided by Hoval).
- The CHP plant must be installed by competent persons and in accordance with the assembly instructions.
- The CHP plant must be commissioned by Hoval or by a specialist approved by Hoval.
- All building regulations must be adhered to in regards to the installation, the air duct work and the flue arrangement.
- All electrical regulations must be adhered to when connecting the power (i.e. G59/3 application must be completed).
- The relevant Gas standards must be adhered to when connecting the Gas pipe-work.
- All regulations with regard to the heating water system must be adhered to.
- All health & safety regulations applicable to the plant must be adhered to at all times.

## 5.2. Additional Notes for the Installer

When installing your new CHP plant you need to be aware of several items:

**Vibration Insulation Mat**

Rubber Vibration Insulation Matting is provided with the CHP plant, supplied loose. When the CHP is sited these insulation strips must be placed under the framework of the skid arrangement before services are connected.

**Flexible Pipe Connections**

It is imperative that the incoming gas pipe, the heating system flow pipe, the heating system return pipe and the exhaust connection are all connected to the CHP skid with flexible connections. This is so the vibrations of the engine are not transmitted through the pipework back through the building.

**Condensate Drains**

The condensate from the exhaust connection must be piped to drain in Stainless Steel. A suitable trap must be fitted in line before reaching the drain point. Note this must all be done in Stainless Steel.

**Electrical Connections / Cable Management**

Any links between the CHP plant and the cable management must be done so with flexible connections. All cable management (trunking, conduit, cable tray) must not be fixed to the CHP plant.

**Existing Electrical Supply**

Please be aware the voltage on site must be within the tolerances of the current standards. The electrical loadings on each phase must be within 10% of one another. For example if L1 is 1000A then L2 and L3 must be between 910A and 1000A or 1000A and 1100A.

**Ventilation**

Ventilation can be done in either of two ways, the first being open to the plantroom and secondly as a room-sealed device. If the inlet and extract air ventilation connections are open to the plant room then the plant room must have suitable ventilation as per BS644. If this does not suit the installation both connections can be ducted to an external wall (with a minimum distance of 1m between inlet and extract connection. In all installations the maximum temperatures stated in BS6644 must be adhered to.

## 5.3. Readiness for Operation

### Gas Supply

A supply of gas at the required quality (see technical data table). This must be above the minimum pressure of 18mbar at full output, and at all times the CHP plant is operating.

### Lubricating Oil in the Engine

The engine oil must always be filled to the correct level with a suitable lubricant. Details of the oil specification can be found in the engine manual.

### Cooling Water

he coolant must be maintained at the required level. The coolant circuit is pressurised so must remain sealed at all times. The coolant must be to the appropriate standard as specified in the engine manual to ensure adequate protection against corrosion.

### Heating Water

The heating water circuit to extract heat from the CHP plant must meet the minimum quality (see detailed specification further in the manual). The circulation pump for this circuit must be operational and above the stated minimum flow rate.

### Starter Battery

The battery should always be fully charged and the fluid level maintained to its upper marking.

## 5.4. Further Important Information

- The installation of the CHP plant must be reported to and approved by the relevant energy supply companies.
- Certificates must be available prior to commissioning from the appropriate specialists for the gas purge test and also a pressure test for the exhaust system.
- Approval must be sought before piping the condensate to drain.

## 5.5. Waste Disposal

The disposal of any un-needed items such as packaging should be done so in an environmentally friendly manner.
Upon servicing the waste lubricating oil must be disposed of correctly. Proof of disposal must be documented and archived.

### Modifications

Modifications to the CHP plant without written approval are not permitted.

# 6. Water Quality

## 6.1. Heating Water

**The European Standard EN 14868 and the directive VDI 2035 must be observed.**

– European standard BSEN 14868:2005 and VDI guideline 2035 must be observed. Particular note must be taken of the following regulations.

– Hoval CHP plant, boilers and water heaters are suitable for heating systems without significant oxygenation (system type 1 in accordance below with BSEN 14868:2005).

– Systems with;
  – **Continuous** oxygenation (e.g. floor heating without diffusion-proof plastic pipes) or,
  – **Intermittent** oxygenation (e.g. frequent topping up required) must be fitted with a system separator.

– Treated heating water must be checked at least once per year or more frequently as specified by the inhibitor manufacturer.

– If, in the case of existing systems (e.g. boiler replacement), the water quality of the existing heating water complies with VDI 2035, it is not recommended that the system be refilled. VDI 2035 also applies to top-up water.

– Before filling new systems, or, if applicable, existing systems, the heating system must be professionally cleaned and flushed. The heating system must be flushed before the CHP is filled.

– Components of the CHP plant that come into contact with water are made of ferrous materials and stainless steel.

– Due to the risk of stress corrosion cracking in the stainless steel component of the boiler, the combined chloride, nitrate and sulphate content of the heating water must not exceed a total of 200mg/l.

– Once the heating has been in operation for 6–12 weeks, the pH value of the heating water should be between 8.3 and 9.5.

– A suitable freezing-protection agent should be used, if the CHP plant and associated pipework are likely to be subjected to temperatures below 2°C.

**Water for filling and topping up the system:**

– For an installation using a Hoval CHP, untreated drinking water is generally best suited as the heating medium, i.e. as filling and replacement water. However, as not all drinking water is suitable for use as as filling and replacement water the water quality must fulfil the standard set in VDI 2035. Should the mains water available not be suited for use then it must be desalinated and/ or be treated with inhibitors. The stipulations of EN 14868 must be observed.

– In order to maintain a high level of efficiency and to avoid overheating of the heating surfaces the values given in the table should not be exceeded (dependent on boiler performance ratings - for multi-boiler plants rating of smallest boiler applies - and on the water content of the plant).

The total quantity of water used to fill and top up the system during the equipments life must not exceed a value equivalent to three times the water content of the system.

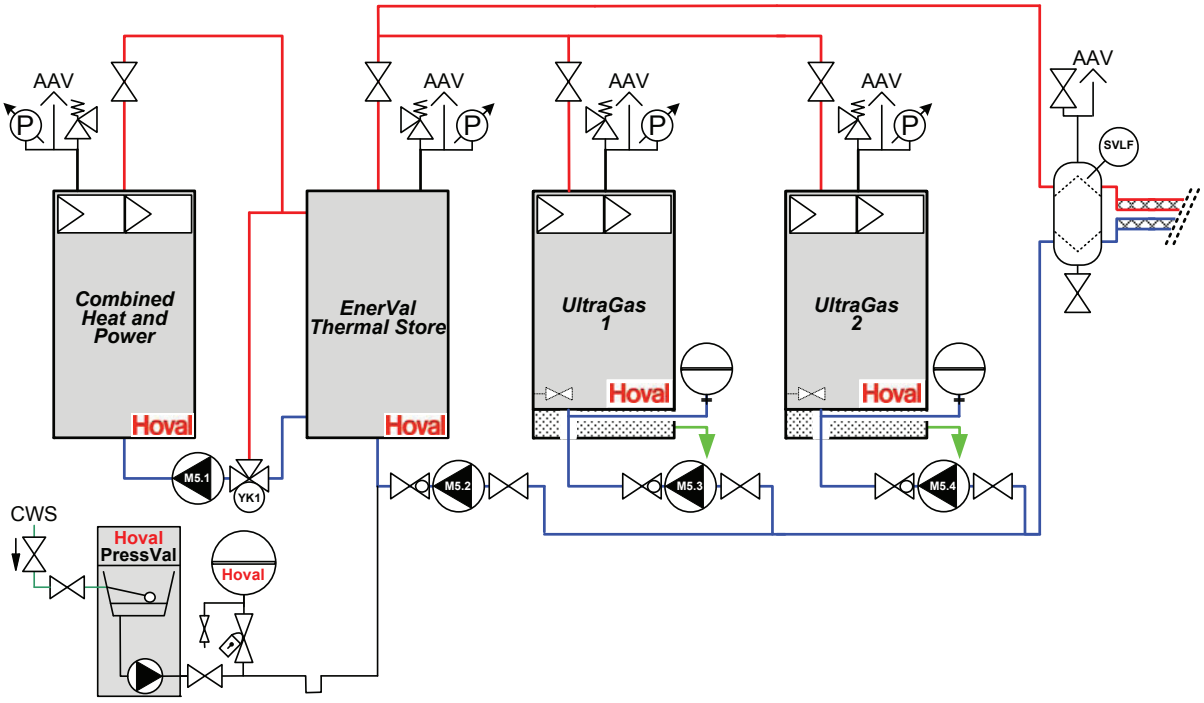
**Water Specification Limit Values**

| | | | |
|---|---|---|---|
| Electrical conductivity | (µS) | | < 100 |
| Oxygen | ($O_2$) | mg/l | < 0.05 |
| Chloride | | mg/l | < 200 |
| Copper | (Cu) | mg/l | < 0.05 |
| Total Iron | (Fe) | mg/l | < 0.05 |
| Alkaline earths | | mmol/l | < 0.02 |
| Total hardness | | °dH | < 0.1 |
| Phosphate | ($PO_4$) | mg/l | 5 - 10 |

# 7. Typical Pipework Schematics

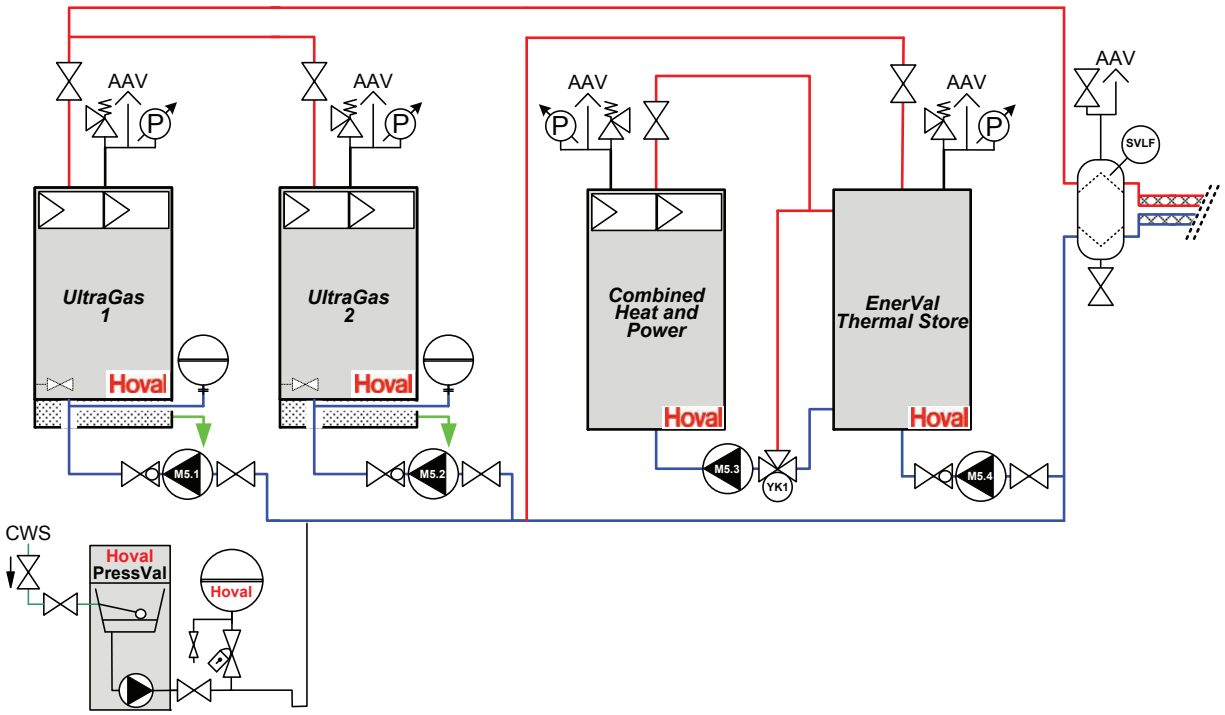
## 7.1. CHP in Parallel

The most efficient way of operating a CHP installation providing the Building Management System has the appropriate controls.




## 7.2. CHP in Series

The easiest way of fitting the CHP into building with a limited control system. This arrangement works by pre-heating the return to the boilers.




**Note: The above schematics are indicative and only show the basic principle. All installations should be in accordance with local regulations.**

# 8. Construction

## 8.1. Construction of The CHP Plant

- A skid-mounted unit complete with a sound reduction casing or mounted within an insulated container installed complete with heat exchangers and exhaust gas silencer.
- Combustion air and all ventilation requirements are met with the fan-assisted inlet and extract air system.
- All pipe work to the flanged connections and the heat exchangers containing useful heat are fully insulated.
- Anti-vibration mounting points are used between the main frame of the skid and the engine and generator assembly stopping nuisance vibrations being transferred through the unit.
- Various information points and test points on the CHP plant are available on all of the water circuits and on the exhaust system.

## 8.2. The Gas Engine

A MAN gas engine with spark ignition is used in the CHP plant. This engine has electronic speed control with automatic ignition complete with all required filtration, lubrication and cooling systems required. The full specification of the engine as follows:

- Crankcase with cylinder block in one piece, made of cast iron, sealed at the bottom by an oil sump and at the rear by the flywheel control housing
- Cylinder heads with moulded-in vortex intake ducts and valve seat inserts shrunk into the cylinder heads
- Light alloy pistons, cooled by pressurised oil from oil injection nozzles
- Angled connecting rods, a crankshaft with 7 bearings, steel-backed cast lead bronze bearing shells
- Valves mounted vertically and with replaceable valve guides
- One inlet valve and one outlet valve per cylinder, camshaft mounted on 7 bearings
- Forced-feed lubrication with oil filter in the main flow and cooling by means of oil cooler
- Automatic oil refill device
- Crankshaft ventilation with oil separator and connection to combustion air
- Closed-circuit engine cooling, pump with three-phase motor, safety valve and expansion tank
- Air intake via dry-air filter, directly from the installation room via supply air device
- Pre-engaged drive starter motor 24V
- Electronic high-performance ignition with solid-state low-voltage distribution, one ignition coil per cylinder
- Gas-air mixer, gas control damper for output and speed control
- Actuator for speed and output control
- Turbo-charger and intercooler (on some models)

## 8.3. The Generator

The main components of the generator are the internally-poled rotor and the wound stator complete with exciter circuit and voltage regulator using an auxiliary winding. The three-phase alternating voltage induced in the exciter circuit is rectified via the rotating diode disc and fed to the generator revolving field. Voltage stabilisation for the main generator under alternating loads is maintained by changing the field current via the thyristor actuator in the voltage regulator.

## 8.4. Engine Cooling Water Heat Exchanger

The engine cooling water heat exchanger transfers the heat from the gas engine to the external heating water system. Inside the heat exchanger, the warm engine cooling water and the cooler heating water are in counterflow, ensuring optimum heat transfer. The heat exchanger hydraulically separates the cooling water and the heating water.

## 8.5. Exhaust Gas Heat Exchanger

In the exhaust gas heat exchanger, energy is recovered from the exhaust gas. The exhaust gas mass flow is routed over a water circuit flowing through the exhaust gas heat exchanger. The exhaust gas flows through the heat exchanger tubes on the primary side, thereby transferring its heat to the heating water (secondary side). The operating temperatures for the exhaust gas are approx. 600°C at the inlet and approx. 120°C at the outlet, and the operating temperature on the heating water side is approx. 90°C.

## 8.6. Engine Cooling Circuit

The cooling circuit of the gas engine is equipped with a separate expansion tank and pump which is routed via the engine cooling water heat exchanger. The engine cooling water is first routed into the cooling ducts of the engine housing, where it absorbs the transferred heat and then flows back into the engine cooling water heat exchanger. The engine cooling water heat exchanger transfers the heat to the heating water. The cooling water is always a mixture of antifreeze and a corrosion protection agent. For the full specification see the MAN manual.

## 8.7. Heating Water Circuit

The heating water circuit flows first through the engine cooling water heat exchanger and then through the exhaust gas heat exchanger. The CHP plant is equipped with a circulation pump which pumps a constant volume of water through the exchangers. In addition, a three-way valve is installed to regulate a constant return temperature of 70°C to the engine cooling water heat exchanger. The heat extraction system is also equipped with the relevant safety devices for temperature and pressure.

## 8.8. Exhaust Catalytic Convertor

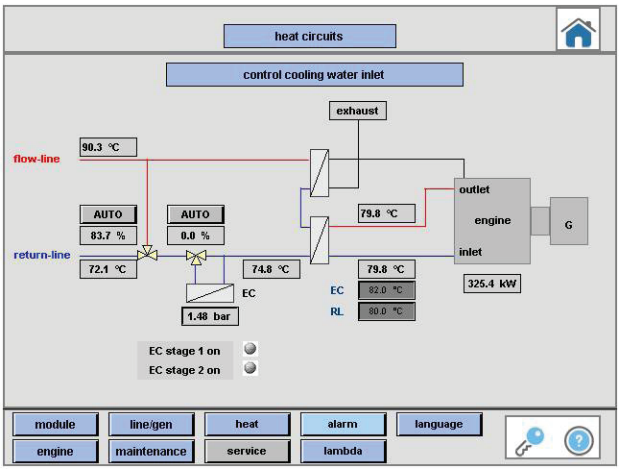
The closed-loop three-way catalytic convertor and the oxidation catalyst in the case of turbocharged engines reduce the pollutants in the engine exhaust gases.

## 8.9. Ventilation

The CHP plant is equipped with a supply air fan which is operated in two stages. The first stage is designed to supply adequate combustion air to the engine and allow the radiant heat to be extracted. The second stage is switched on as required via a temperature sensor in the sound reduction capsule or container. The supply air is drawn in by a fan via an on-site supply air duct. The extract air should be routed to outdoors via an extract air duct (not by Hoval). Please refer to the technical data section for further information.

## 8.10. Monitoring Device

The engine and generator unit is monitored and controlled via a processor control system. All values of the engine, the exhaust and the heating water system are monitored in terms of pressure and temperature and then displayed on the touch-screen display. These values are then relayed out to a webpage for remote monitoring and can also be visible on the Building Management System (subject to the necessary interfaces being installed).

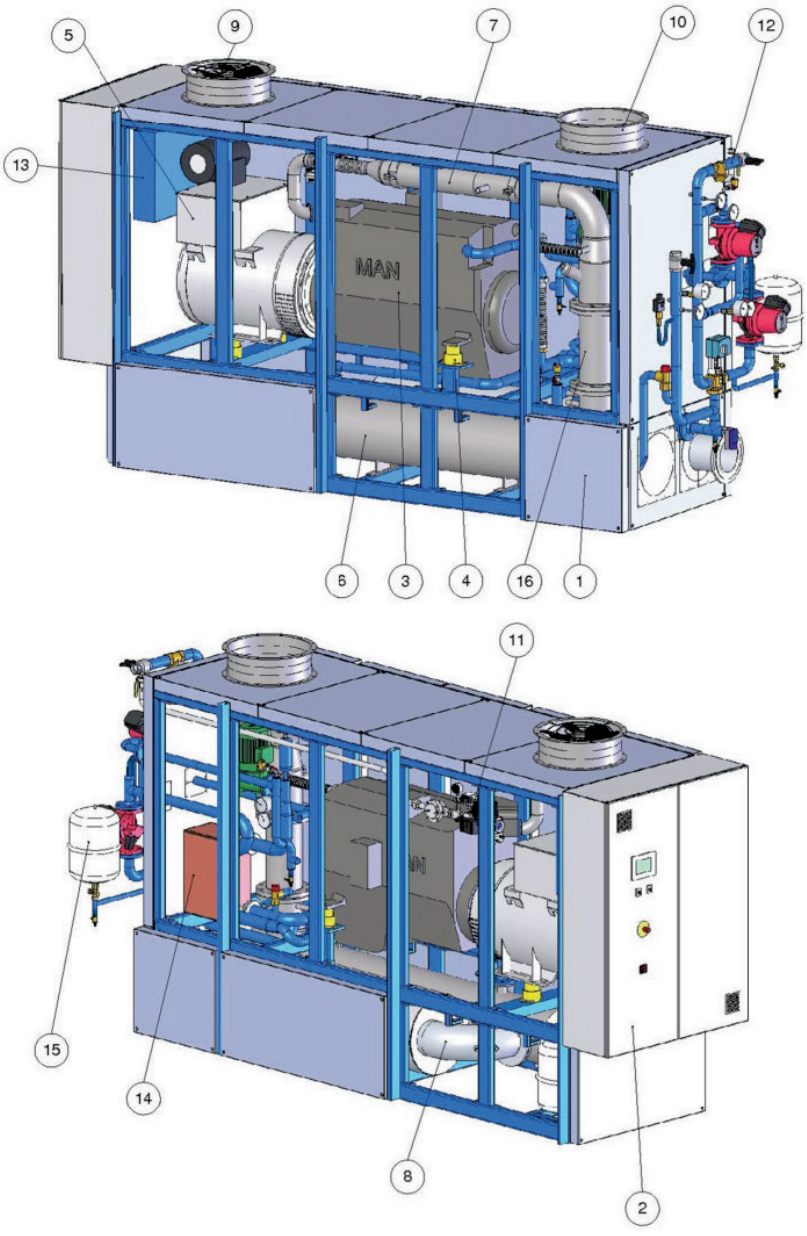


# 9. Functional Description

## 9.1. Functional Description of the CHP Plant

The gas engine directly drives the generator which then generates a current that is fed out to the distribution main. Excess electricity can then be exported to the utility grid providing the relevant approvals (G59) are in place.

A by-product of this power generation is heat produced by the gas engine. This is absorbed into the heating circuit via engine coolant and an exhaust gas heat exchanger. This method of energy production is commonly known as co-generation or combined heat and power generation because it simultaneously generates electricity and useable heat.



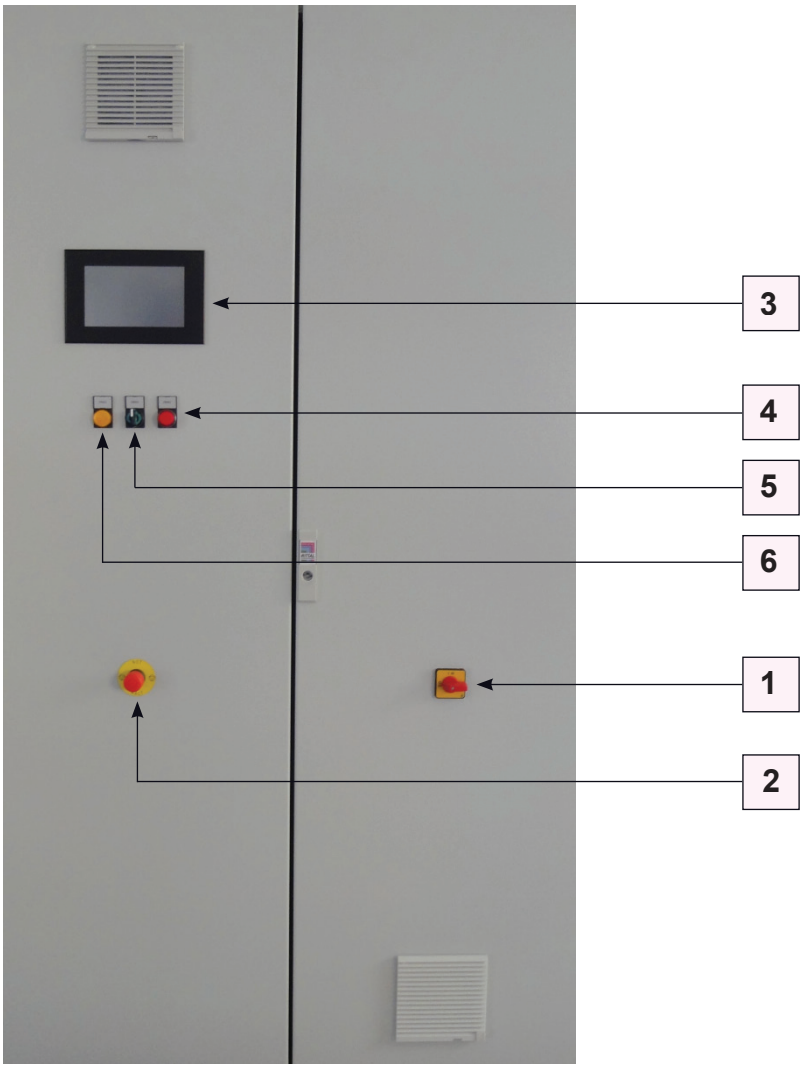

1. Sound reduction capsule (covers not shown)
2. Control panel
3. MAN gas engine
4. Anti-vibration mounts
5. Electrical generator
6. Exhaust gas heat exchanger
7. Exhaust gas pipe
8. Exhaust silencer
9. Ventilation air intake fan
10. Ventilation extract air duct connection
11. Gas train
12. Heating system components
13. Lubricating oil tank
14. Engine coolant heat exchanger
15. Expansion vessel
16. Catalytic convertor

# 10. Control Panel - Overview

## 10.1. Control Panel

The CHP plant control cabinet requires its own dedicated 3-phase 400Vac supply as this is used to operate all auxiliary equipment such as pumps and the ventilation fan. The control panel also incorporates a battery charging system to act as a main failure back-up and also as a supply for the engine starter motors.

All functionality is accessible from the front of the control cabinet. The control cabinet should only be opened for service purposes, by suitably qualified and trained personel.




1. Door mounted isolator

The door mounted isolator immediately stops the engine and inhibits it from operating. Note that the fans and the lighting (if supplied containerised) are still live after switching off the door mounted isolator.

2. Emergency stop button

The emergency stop button immediately shuts down the engine. The auxiliary circuits are switched off when this button is pressed. To avoid an overheating condition due to latent heat within the engine the Manual/Automatic switch should be put to ‘0’ and the emergency stop released. The RESET should then be pressed, this will then restart the pumps to cool the engine.

**Note:** On a containerised CHP unit an external emergency stop button (with break glass) along with an alarmed gas detection device are also supplied.

3. 7" graphic touch display

The main control functionality of the CHP plant is accessed using the touch screen controller. This will display all operating conditions and allow the adjustment of parameters providing the correct service codes have been input.

4. Red RESET/Fault illuminated pushbutton

The red light will illuminate when the CHP plant is in a fault condition. A detailed description of the fault is available on the touch screen controller in the alarm menu. If the fault condition has cleared then this button can then be pressed for 3 seconds to clear the fault.

5. M-0-A illuminated selector switch (Manual – Off – Automatic)

When illuminated, this indicates that the CHP plant is running. The selector switch has three positions:
- Manual: The CHP plant will start up and control to the set-point set on the display.
- Off: The CHP plant will be in an "off" condition.
- Automatic: The CHP plant will control dependant on the signals received from the Building Management System.

6. Yellow warning indicator lamp

The yellow lamp will illuminate when the CHP plant is in a warning condition. The warning condition will not stop the machine. If the minor problem is not rectified and worsens this will then develop into a fault. A detailed
description of the warning is available on the touch screen controller in the alarm menu.

### 10.2. Overview of Functionality

All of the control processes for efficient and safe operation are carried out by the controller within the CHP plant control cabinet. Below is a brief overview of these main functions:

- Manual and automatic operation
- Complete CHP safety system with warning messages and self protection
- Mains and generator monitoring
- Automatic engine starter
- Electronic speed control for the rotating assembly
- Synchronisation, frequency and power output control
- Electrical output control
- Flow temperature control
- Mains back-up operation (optional)
- Remote diagnosis and interrogation available
- Operating hours, service hours, start and kWh counter.

### 10.3. Manual and Automatic Operation

The operating mode is selected with the mode selector switch on the control cabinet door. This switch has three positions, Manual - Off - Automatic.

Manual mode is available to operate the CHP plant on site without the need for a Building Management System. This will then automatically control to a set-point on the touch screen.

Automatic mode allows the CHP plant to respond to an external start/stop signal as well as an analogue control signal to adjust the set-point for site requirements.

When the switch is positioned to ‘0’ the unit will perform a safe shut-down and then stop.

### 10.4. Safety System

The CHP plant contains its own safety protection to ensure the correct running of the equipment. There are two tiers of safety within the CHP controls, firstly the warnings and secondly the faults. There are multiple information points measured: engine speed, water pressure, mixture pressure, water temperature, oil temperature, exhaust temperature, battery voltage, and oil level.

### 10.5. Grid Monitoring

The CHP plant controller has a function where it monitors the electricity from the national grid. In the event of a fault it will disconnect from the national grid in approximately 100ms. The following signals are monitored: Overvoltage/undervoltage, over-frequency/under-frequency and vector surge.

### 10.6. Generator Monitoring

The CHP plant controller also monitors the generator in the same way as it monitors the electricity from the national grid. The following electrical signals are monitored: Overvoltage/undervoltage, over-frequency/ under-frequency, over-current, reverse power and differential current.

### 10.7. Engine Control

The touch-screen controller operates the engine and has the following control: Safe start and shutdown, starter and ignition, control of both gas valves, control of auxiliary equipment, speed control, engine over-run control and gas leak detection.

### 10.8. Speed Control

The CHP plant controller has a speed regulator to control the engine between 1440 and 1560 rpm. This controller will ramp the engine up to this speed on start-up and down from this speed when it is in its cool-down cycle. When the generator is synchronised this speed is maintained by the frequency from the grid.

### 10.9. Power Output Control

When the CHP plant is synchronised the control is switched from speed control to power set-point control. In automatic mode this set-point is derived from the building management system controls but in manual this set-point is input on the touch screen controller. The safety circuits can interrupt this set-point, for example if a warning signal is apparent the CHP plant will run at the pre-set reduced set-point.

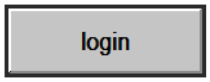
### 10.10. Lambda Control

In order to respond to minor changes in the gas quality, the exhaust gas is measured with a lambda sensor. This acts to automatically adjust the fuelling to suit the current site conditions.

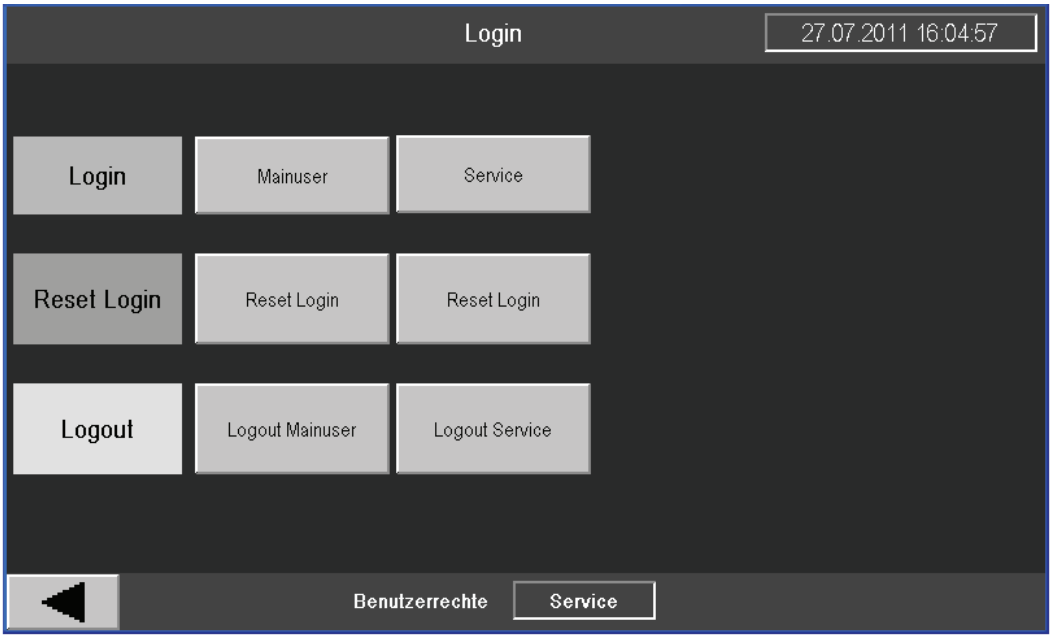
### 10.11 Touch Screen Display

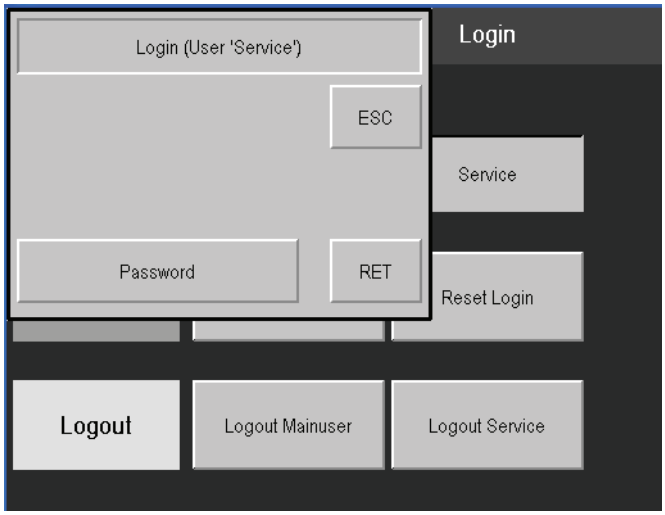
The display is used as the interface to the CHP, showing all measured values as well as any error or warning messages. All of the operating parameters can be adjusted although the manufacturer’s access code is
required to do this.

# 11. Controls Overview

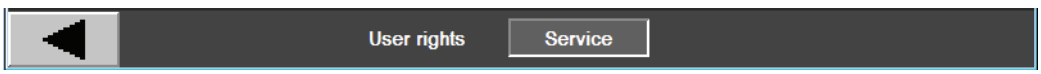



The service menu is restricted from unauthorised access. Pressing the login button allows access to input the password. Here you can either log in at **user** or **service level**.



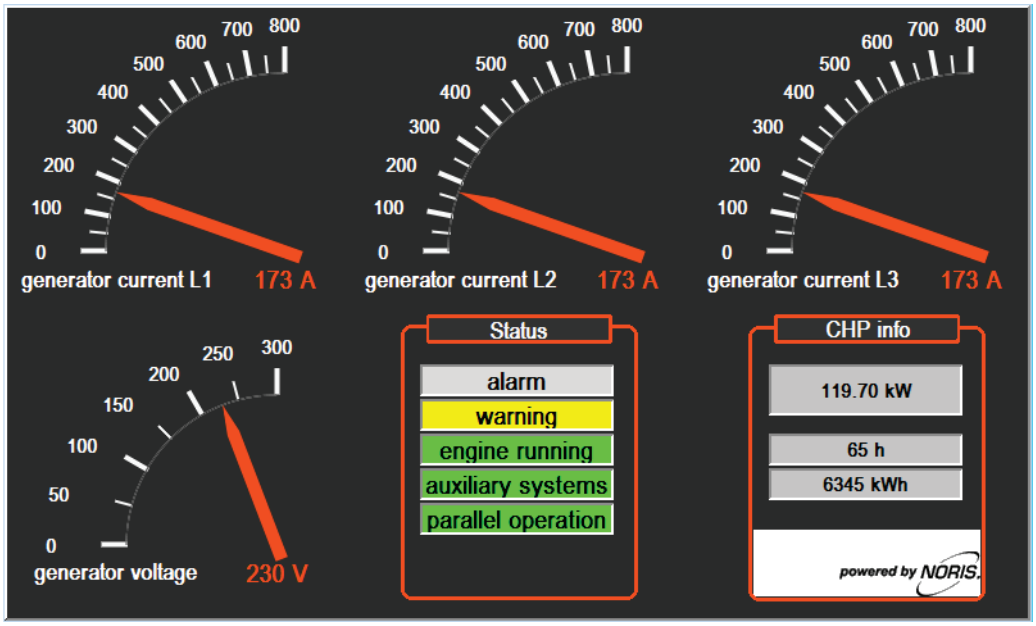

If the entered password is valid the authorisation will change at the bottom of the screen.




Please note to change any of the values explained in this manual you must first log in at the user level as detailed above.

## Overview of Start Screen

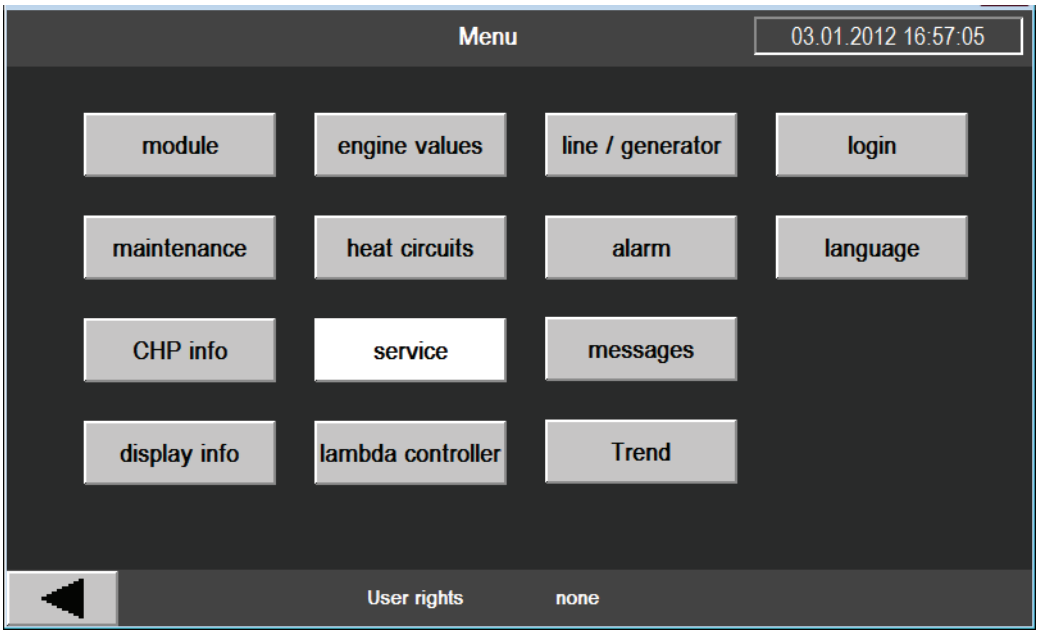
The start screen provides an overview of the CHP outputs and a display of the accumilated running hours with the kWh produced.




The main menu opens by tapping anywhere on the touch screen.

You can go back to the previous page by tapping this arrow button from any other screen.

## Main menu




To display actual values and operate the CHP controller, the sub-menus, which are described in the following pages, are accessed by tapping the corresponding touch screen buttons shown in the menu.

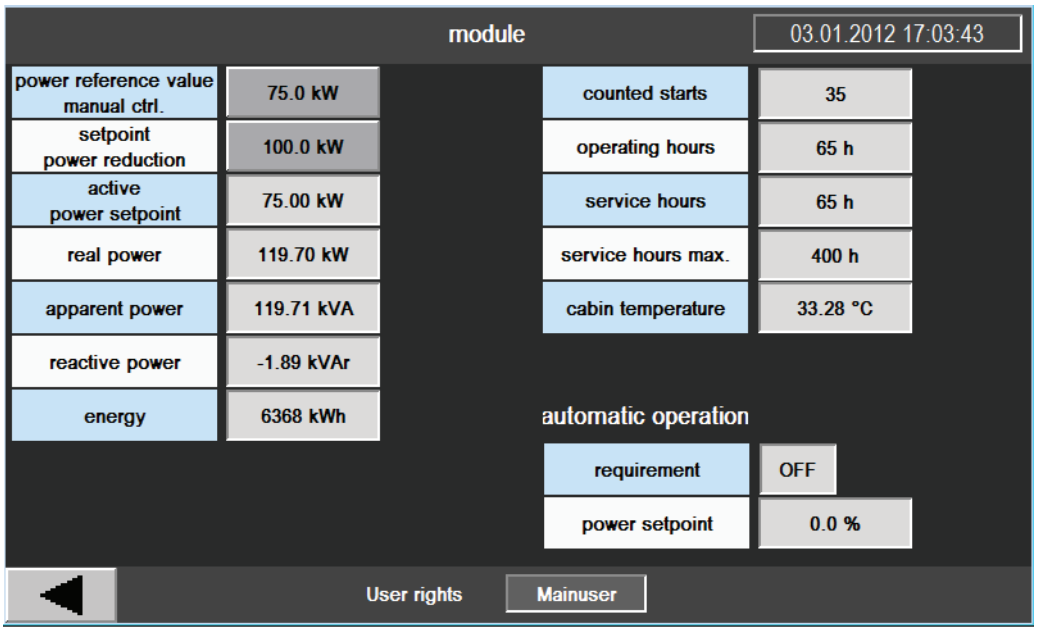
module

This menu item shows an overview of the current status of the CHP plant.

The following set-points can be set for the power output in the top left area **(only to be adjusted by Competent personnel):**

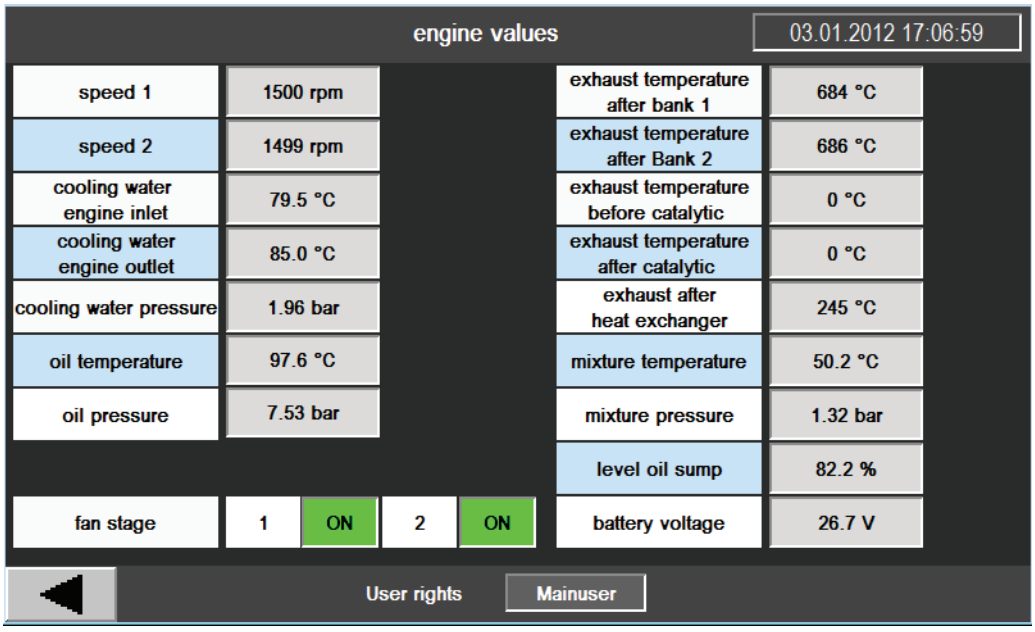
Set-point for manual mode
Set-point for power reduction mode

The signals from the Building Management System are shown in Automatic mode in the bottom right area.



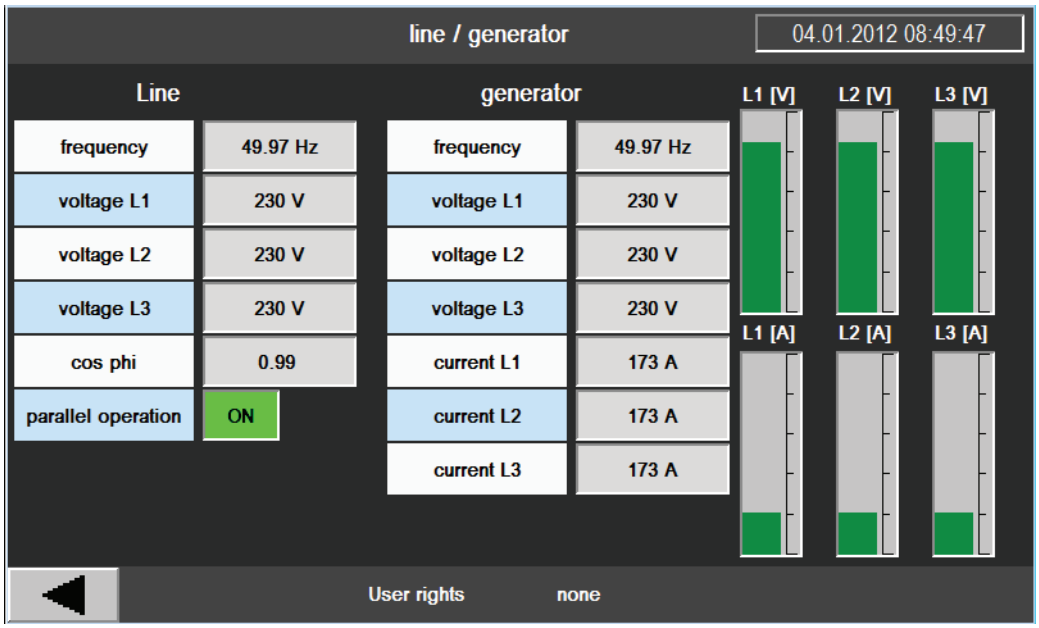

engine values

The important engine operating values are displayed in the engine values section.



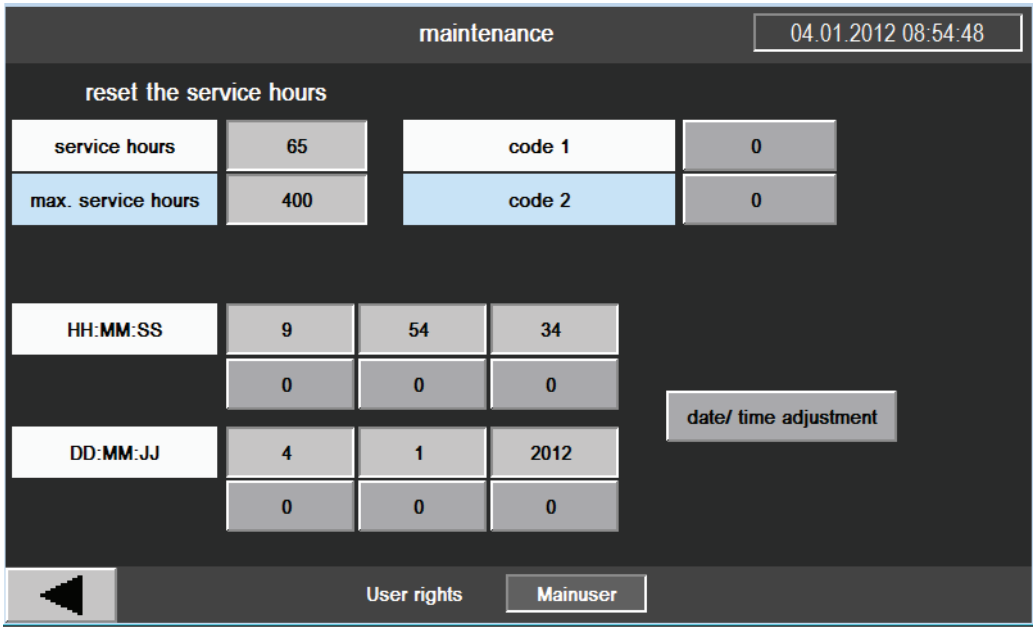
line / generator

The important generator information is displayed on this screen. The active bar graphs on the right show the current outputs of the generator.



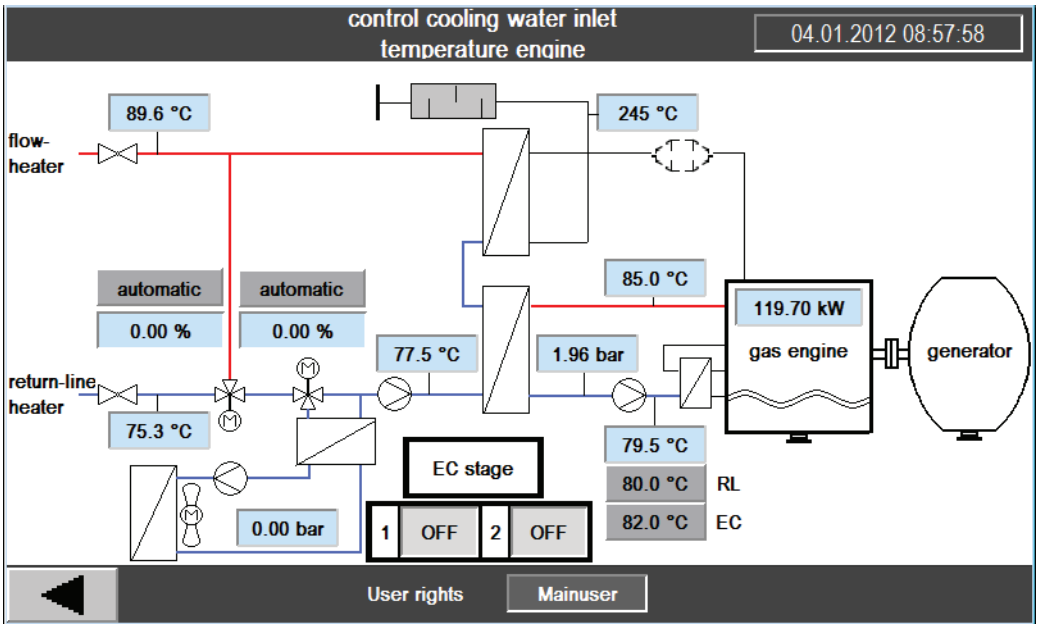

maintenance

The maintenance menu is important for being able to view when the next service is required. Here you also have the button where you can reset the service hours when a service has been performed. Please note, access codes will be required.

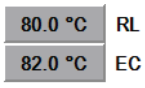


heat circuits

The heating circuits on the CHP plant controller can be viewed and adjusted in this menu.




The set-point values for the control circuit can be set by buttons. A keypad for entering the target value opens up when the button is pressed. **Please note only authorised and trained personnel should make any adjustments.**





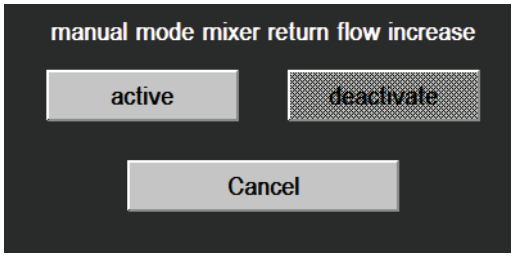
### EC - Emergency Cooling

Temperature set-point for engine inlet cooling water maximum temperature. If this set-point overshoots the engine is cooled via the emergency cooling system.

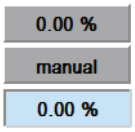
### RL - Return Temperature Boost

Temperature set-point for engine inlet cooling water minimum temperature. When the temperature drops below this value the temperature is boosted by reducing the heat extraction function.

The 3-port mixing valves for return temperature control or emergency cooling control can be operated in manual mode for test purposes. This is accessed by the window below when you select manual operation.



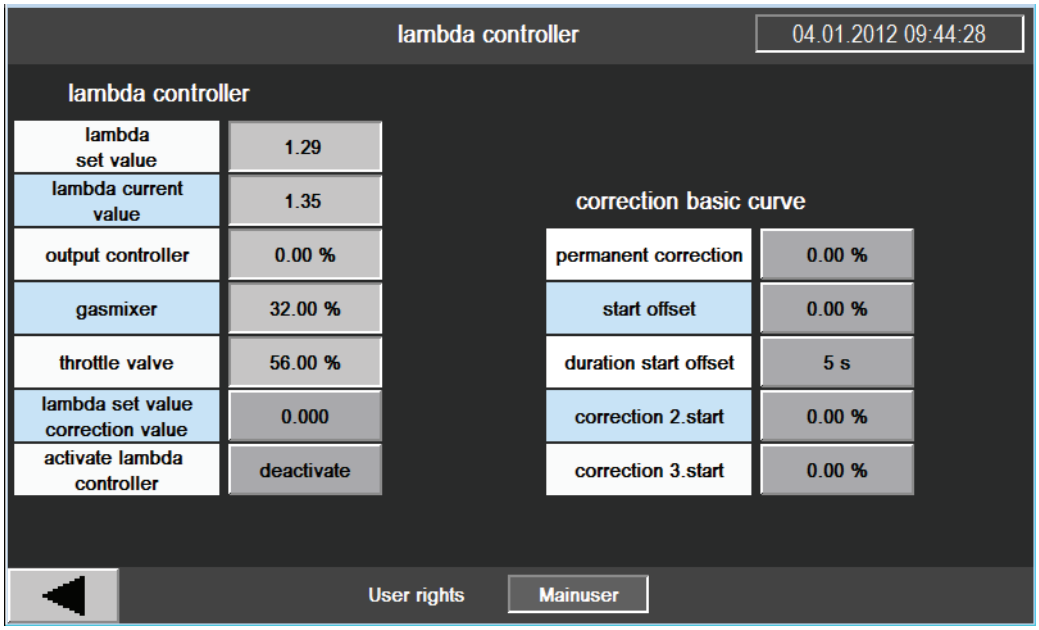

When active is selected the valve will display "manual" on the schematic. The set-point for manual mode is entered as a valve position. This is a value from 0-100%. When in manual mode the warning lamp will illuminate and a warning message will be displayed in the alarm list.





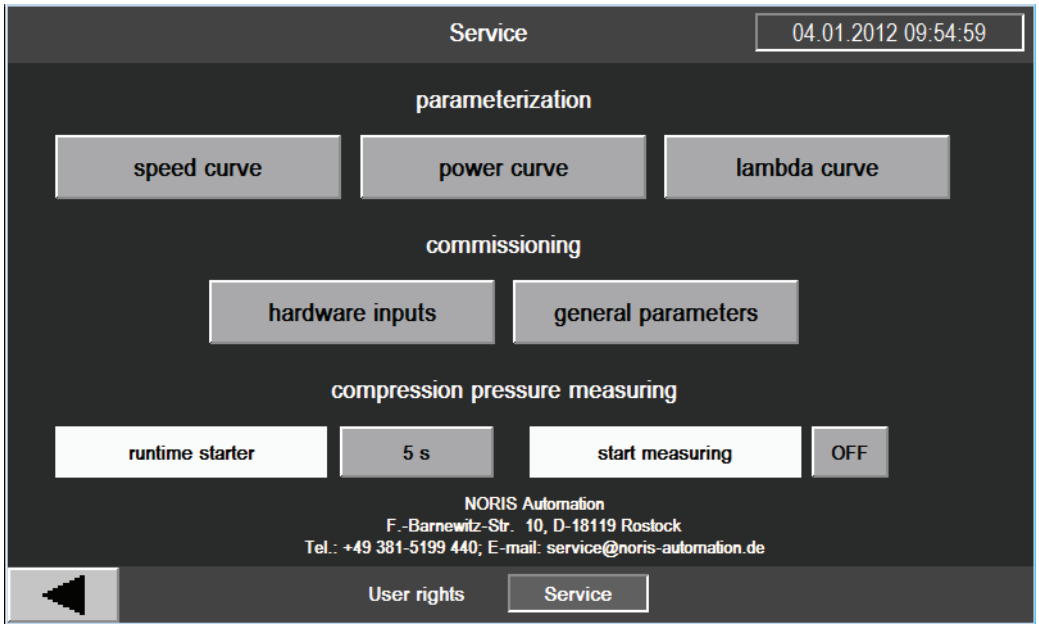
The lambda value for the engine to control this setting automatically can be set within this menu. It is advised that this is not adjusted unless you are a competent, trained engineer.

For more detailed information regarding the lambda menu please see the Noris Automation controls manual. This menu should only be entered by a competent, trained engineer.



service

Settings in the service menu must only be adjusted by competent and trained persons. All options within this menu are described within their menu sets.



# 12. Pre-Commissioning

## 12.1 Engine

- Site must have sufficient access for the delivery and removal of the engine oil containers
- Only use engine oil as approved by MAN
- Fill engine with oil as detailed in the MAN assembly instructions
- The oil level should never exceed maximum
- The engine must be checked for oil leaks.

Coolant must be mixed correctly and added to the coolant circuit. This coolant must be of a suitable specification and approved by MAN engines. The coolant circuit must be fully de-aerated.

## 12.2. Oil Supply

- Fill the lubricating oil tank observing all safety and environmental regulations
- Check for leaks.

## 12.3. Gas Supply

- Approval must be in place for the use of Natural Gas
- Gas purge test and tightness test certificates need to be available prior to commencement of commissioning
- The Natural Gas supply must be installed to the current industry standards.

## 12.4. Heating Water System

- The heating water system must have been flushed, filled and de-aerated
- The water must be to the quality as specified earlier in this manual
- All safety equipment must be operational
- Sufficient pressure and flow must be available
- Heating load must be available for commissioning.

## 12.5. Electrical Connection

- A power cable for the CHP plant must be installed for the use of the auxiliary equipment
- Cabling must be installed to export electricity
- Grid monitoring cabling must be installed to ensure synchronisation is possible
- Electrical earthing must be to current standards
- The G59/3 application must be in place and certification available
- All connections to the Building Management System must be in place
- An internet connection must be set-up to allow for remote monitoring
- All electrical connections must be tested to the latest relevant standards.

# 13. Maintenance and Servicing

## 13.1 Overview

The CHP plant must have its preventative maintenance carried out at the required intervals, as specified in the MAN engine manual. This must be performed and logged to keep the warranty valid. If a service is missed the
warranty is void. All maintenance work on the CHP plant must be performed by a Hoval or Hoval approved Engineer using MAN approved components. Inadequate or improper maintenance to the CHP plant will cause
severe damage that may not be repairable. Hoval accepts no responsibility for any damage caused by a lack of maintenance. For the full service schedule please refer to the MAN operating and maintenance manual for the specific engine.

Before commencing any work on the CHP plant all operating values displayed on the touch screen controller must be recorded.

A fault log must be kept to allow for conclusions to be drawn and help diagnose any problems.

The CHP plant must be safely shut down and be locked off from operating to ensure the plant does not operate while it is being worked on.

A permit-to-work system should be put in place by the operator prior to all such work being undertaken.

## 13.2. Oil Change

After the CHP plant has been switched off it should be left to stand for 10 minutes. After this time the oil consumption since the last service can be measured and the engine can be checked for any oil leaks. The oil can then be drained from the bottom of the sump until it is empty of oil, and the oil filters can then be replaced. Once the filters have been re-fitted and the drain valve closed, oil can then be added to the maximum level on the dipstick. Only use oil as specified in the MAN engine manual.

The maximum oil level should not be exceeded. Used oil should always be analysed in accordance with the MAN requirements.

## 13.3. Spark plugs

Depending on the service level performed the spark plugs must be either checked or replaced. When checking a spark plug the gap must be checked and adjusted if necessary. They should then be re-fitted to the engine and tightened to a torque of 27 Nm.

### 13.4. Air Filter

The air filter must be cleaned or replaced depending on the service level. The airbox must be checked to ensure it is making a good seal so that all air entering the engine is passing through the air filter.

### 13.5. Valve Clearance

As mechanical tappets are used on the Hoval CHP plant, the valve clearance must be checked as prescribed in the maintenance schedule and readjusted if necessary in accordance with the engine manufacturer's
instructions.

### 13.6. Starter Battery

When the CHP plant has starter motor batteries, they must be checked for any signs of leakage and the level of fluid checked. If they require topping up this must be done with distilled water.

Some CHP plants do not have starter batteries and are driven directly off the grid. In this case all cabling to the starter motor and the earthing must be checked.

### 13.7. Engine Coolant Pressure

If the coolant pressure in the engine is too low then this must be topped up. The correct ratio of water and antifreeze must be used. The antifreeze used must be to the correct specification as published in the MAN engine manual.

### 13.8. Generator

The generator electrical connections must be checked and cleaned each visit. Additional to this the generator should require no further maintenance.

### 13.9. Post Service

Upon completion of the service the maintenance hours must be reset on the touch screen controller. After a service, the service checklist must be completed and the CHP plant must be put back into automatic operation and restarted.

**Important note:** The above are for guidance only and the full servicing requirements are detailed in the MAN operations and maintenance manual for the specific engine.

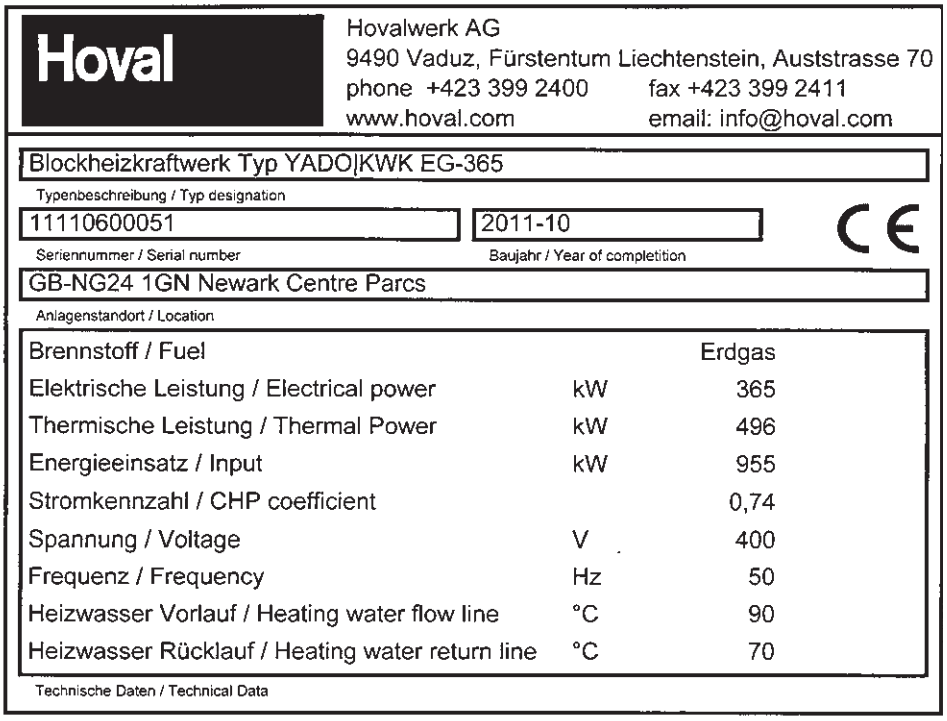
# 14. Customer Service

## 14.1. Contacting Hoval

If you have any queries regarding the CHP plant please have to hand the serial number found on the data badge and the full address of the site.
Important Contacts:

| | |
|---|---|
| Hoval Head Office: | +44(0) 1636 672 711 |
| Hoval Service: | +44(0) 1636 593 413 |
| Hoval Spares: | +44(0) 1636 593 412 |

Below is an example of a typical data badge:



Hoval

Hovalwerk AG
9490 Vaduz, Fürstentum Liechtenstein, Auststrasse 70
phone +423 399 2400 fax +423 399 2411
www.hoval.com email: info@hoval.com

Blockheizkraftwerk Typ YADO|KWK EG-365
Typenbeschreibung / Typ designation

11110600051 (Seriennummer / Serial number) | 2011-10 (Baujahr / Year of completition) | CE

GB-NG24 1GN Newark Centre Parcs
Anlagenstandort / Location

| | | |
|---|---|---|
| Brennstoff / Fuel | | Erdgas |
| Elektrische Leistung / Electrical power | kW | 365 |
| Thermische Leistung / Thermal Power | kW | 496 |
| Energieeinsatz / Input | kW | 955 |
| Stromkennzahl / CHP coefficient | | 0,74 |
| Spannung / Voltage | V | 400 |
| Frequenz / Frequency | Hz | 50 |
| Heizwasser Vorlauf / Heating water flow line | °C | 90 |
| Heizwasser Rücklauf / Heating water return line | °C | 70 |

Technische Daten / Technical Data

## 14.2. Remote Servicing:

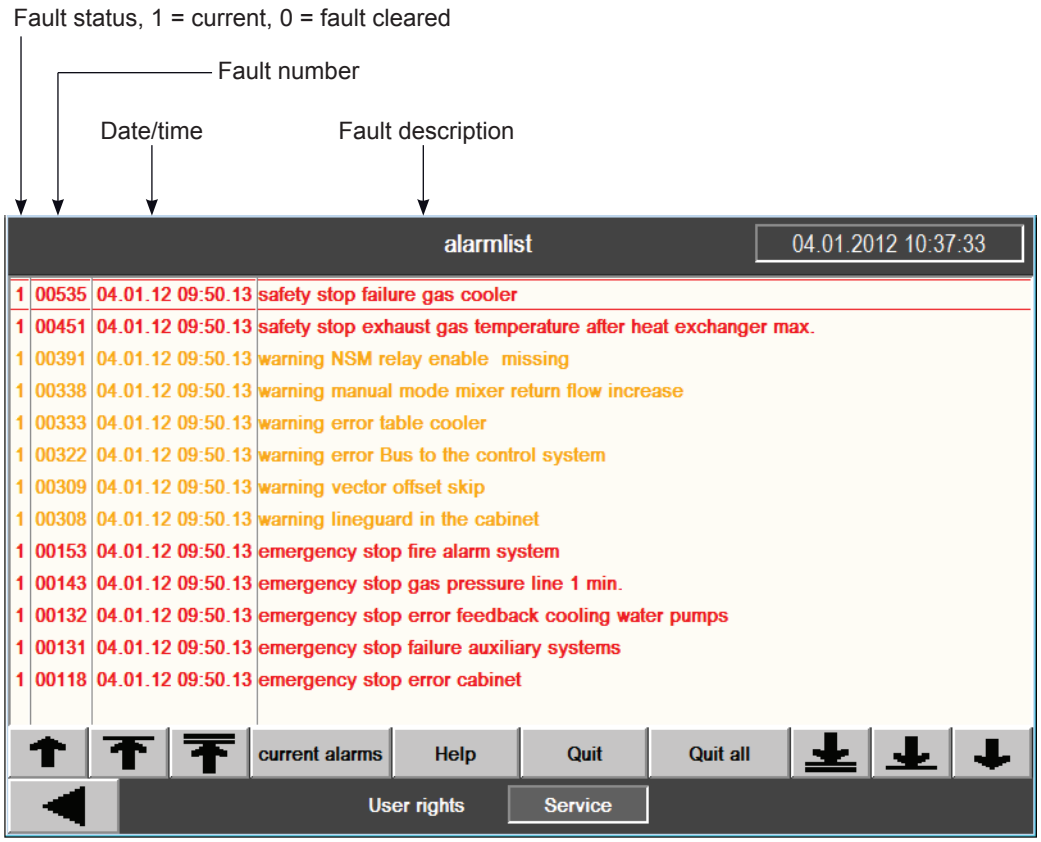
Providing the internet connection has been successfully set-up and commissioned to the CHP plant, Hoval have the ability to log-in to the controller and potentially diagnose any issues you may have without having to wait for an Engineer to attend site. Subject to suitable internet connection (provided by others).

# 15. Fault Finding

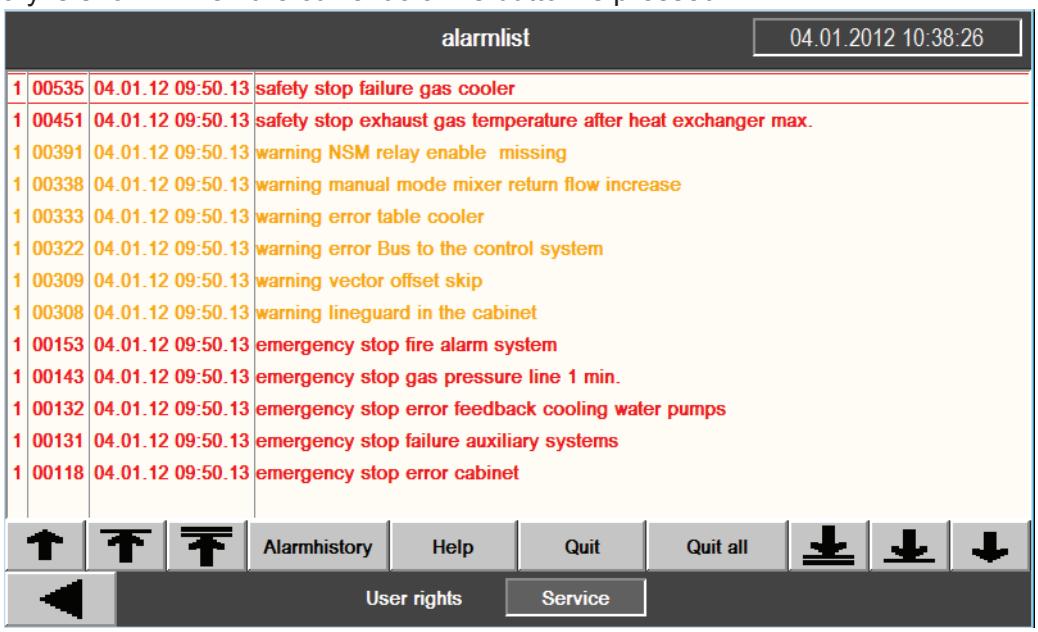

## 15.1.Alarms

Pressing the alarm button enters you into the current alarms menu. Here you will be able to see any current alarms or warnings and their current status. Alarms will be shown in red text and warnings shown in yellow text.

A history of alarms is shown when the current alarms button is pressed.




The alarm history is shown when the current alarms button is pressed.



## 15.2. Fault Codes

When monitoring the CHP plant over the internet and using the remote monitoring software the faults will be denoted by the letters WA, SS or ES followed by a fault number.

**Key**

**WA** – Warning – The CHP plant will continue to run as this fault is only a warning that should correct itself. For all Warning faults subtract 200 from the fault number.

**SS** – Safety Shutdown – The CHP plant will safely shutdown then resume operation once the issue is rectified. If the same fault happens three times within 24 hours a manual reset will then be required. For all Safety Shutdown faults subtract 400 from the fault number.

**ES** – Emergency Stop – The CHP plant will shut down immediately and require manually resetting before resuming operation.

*Example: Fault Code SS 402, this will be a safety shutdown due to excessive generator current L2. This is worked as 402 - 400 = 002.*

| Fault No. | | Description |
|---|---|---|
| 001 | - | generator current L1 |
| 002 | - | generator current L2 |
| 003 | - | generator current L3 |
| 005 | - | return power |
| 007 | - | overspeed 1 |
| 008 | - | no speed signal (pick_up) |
| 009 | - | overspeed 2 |
| 010 | - | gas mixer 1 |
| 012 | - | butterfly valve |
| 013 | - | battery voltage |
| 016 | - | level oil sump max. |
| 017 | - | level oil sump min. |
| 018 | - | cooling water pressure max. |
| 019 | - | Cooling water pressure min. |
| 020 | - | lubrication oil pressure max. |
| 021 | - | lubrication oil pressure min. |
| 024 | - | mixture pressure |
| 029 | - | cooling water temperature engine inlet |
| 030 | - | cooling water temperature engine outlet |
| 031 | - | power reduction and cooling water temperature engine outlet |
| 032 | - | oil temperature |
| 033 | - | power reduction oil temperature min. |
| 035 | - | mixture temperature |
| 036 | - | power reduction, high mixture temperature |
| 040 | - | return temperature heating circuit before mixer |
| 041 | - | power reduction, high return temperature before mixer |
| 042 | - | return temperature heating circuit after mixer |
| 043 | - | flow temperature heating circuit |
| 045 | - | cabin temperature |
| 046 | - | room temperature |
| 047 | - | exhaust gas temperature after bank 1 |
| 048 | - | exhaust gas temperature after bank 2 |
| 049 | - | exhaust gas temperature before catalyst |

| Fault No. | | Description |
|---|---|---|
| 050 | - | exhaust gas temperature after catalyst |
| 066 | - | lambda actual value |
| 071 | - | power reduction, high exhaust gas temperature after engine bank 1 |
| 072 | - | power reduction, high exhaust gas temperature after engine bank 2 |
| 073 | - | pressure emergency cooler circuit |
| 100 | - | overvoltage line L1 |
| 101 | - | overvoltage line L2 |
| 102 | - | overvoltage line L3 |
| 103 | - | undervoltage line L1 |
| 104 | - | undervoltage line L2 |
| 105 | - | undervoltage line L3 |
| 106 | - | overfrequency line |
| 107 | - | underfrequency line |
| 108 | - | Mains monitoring tripped in the cabinet |
| 109 | - | vector offset skip |
| 112 | - | overvoltage generator |
| 113 | - | undervoltage generator |
| 114 | - | overfrequency generator |
| 115 | - | underfrequency generator |
| 116 | - | generator difference current monitoring |
| 118 | - | error control cabinet |
| 122 | - | error Bus to the control system |
| 123 | - | emergency stop signal |
| 124 | - | error safety chain |
| 125 | - | generator switch tripped |
| 126 | - | power switch tripped |
| 127 | - | failure ignition |
| 129 | - | error gas mixer line 1 |
| 131 | - | failure auxiliary systems |
| 133 | - | error heat dump |
| 143 | - | gas pressure line 1 min |
| 144 | - | gas pressure line 1 max |
| 145 | - | gas density line 1 |
| 151 | - | gas detector unit pre gas alarm |
| 152 | - | gas detector unit main gas alarm |
| 153 | - | fire alarm system |
| 171 | - | safety pressure limiter min. |
| 172 | - | safety pressure limiter 1 max |
| 173 | - | safety pressure limiter 2 max |
| 174 | - | safety temperature limiter 1 max |
| 175 | - | safety temperature limiter 2 max |
| 177 | - | service hours exceeded warning |
| 178 | - | service hours exceeded stop |
| 180 | - | false start |
| 181 | - | connection time generator contactor exceeded |
| 185 | - | lambda controller fault |
| 191 | - | NSM relay enable missing |
| 192 | - | NSM relay power reduction stage 1 |
| 193 | - | NSM relay power reduction stage 2 |
| 194 | - | stop by NSM relay |
| 195 | - | message stop remote services |
| 196 | - | message stop by remote services |
| 197 | - | message stop by remote services |
| 198 | - | warning test program is active |

### 15.3. Gas Leaks

- Detectable by an acrid smell
- On a containerised CHP the gas detection alarm will sound
- Close the main gas valve
- Ventilate the plant room and inform the Site Manager
- Do not operate any electrical switchgear
- Inform Hoval Service

### 15.4. Oil Leaks

- Shut down the CHP plant
- Close the valve to the automatic oil refill tank
- Soak up any leaked oil and dispose of it in accordance to local environmental regulations
- Inform Hoval Service

### 15.4. Heating Circuit Leaks

- Shut down the CHP plant and close the incoming isolation valves
- Soak up any leaked water and dispose of it in accordance to the local environmental regulations
- Inform Hoval Service

### 15.6. Exhaust Gas Leaks

- Detectable by a smell of exhaust gas
- Close the main gas valve
- Ventilate the plant room and inform the Site Manager
- Do not operate any electrical switchgear
- Inform Hoval Service

Please refer to the Safety Information as detailed on pages 5 and 6 of this manual.

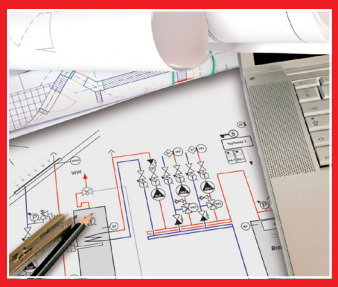
# Notes

# Notes

# Notes

## One-stop shopping

With us you can easily incorporate gas, oil, heat pump, solar, CHP, or biomass energy solutions into your heating system.



## Technical advice

We are happy to assist you and your planning partners in developing intelligent systems, allowing you to take advantage of our expertise and the experience of our specialists.


## After sales

For specialist commissioning and maintenance of your Hoval equipment, contact our service and spares department.

**Hoval Ltd**
**Northgate**
**Newark-on-Trent**
**Nottinghamshire**
**NG24 1JN**
**United Kingdom**

**Phone 01636 672 711**
**Fax 01636 673 532**
**email boilersales@hoval.co.uk**
**www.hoval.co.uk**

MARCH 2014

**Responsibilty for energy and environment**



Hoval