# 175D

# Project Guide – Marine

# Four-stroke high-speed diesel engine compliant with IMO Tier II/IMO Tier III

Revision..... **10.2025/12.0**

2025-10-30 - 12.0

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# 175D IMO Tier II/IMO Tier III Project Guide – Marine

## Four-stroke high-speed diesel engine

2025-10-30 - 12.0

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# Project Guide overview – Preface

The Project Guide contains five main sections:

The section General description of the 175D, Page 13 helps to understand the basic engine concept.

The section Engine and operation, Page 25 helps to select the appropriate engine rating and speed for your intended use.

The section Specification for engine supplies, Page 397 specifies the properties of the engine supplies, such as:

- Gas oil/diesel oil (DMA)
- Urea solution
- Engine coolant

The section Technical data and engine performance, Page 107 states for the different ratings and speeds, the accomplished performance data, such as:

- Power
- Consumption
- Speed

The section Engine room and application planning, Page 413 provides the information necessary for setting up the engine in your ship, such as:

- Foundation
- Engine automation and control
- Exhaust gas system
- Fuel oil system
- Cooling water system
- Gearbox and propeller arrangements

## Documents after commissioning

For the phase after commissioning two documents will be provided:

- **Operating & maintenance manual for operating the engine**
  This document is targeted at operators and fleet owners.
- **Spare parts catalogue providing an overview of the available Everllence-certified parts for maintenance and servicing**
  This document is targeted at installation and commissioning engineers, operators, and fleet managers.



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# 1 General description of the 175D

## 1.1 Engine description 175D IMO Tier II and IMO Tier III

### 1.1.1 Engine views

**12V175D – Mechanical propulsion**

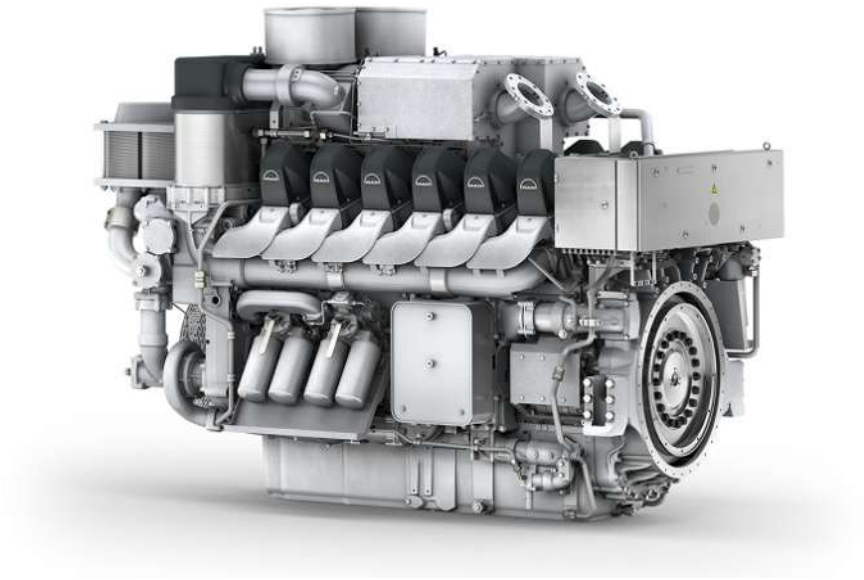


Figure 1: 12V175D-MH/MM with horizontal exhaust gas outlet and attached seawater cooler and seawater pump – Coupling side



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Figure 2: 12V175D-MH/MM with horizontal exhaust gas outlet and attached seawater cooler and seawater pump – Counter coupling side

**12V175D – Mechanical propulsion (typical e.g. for tug application)**

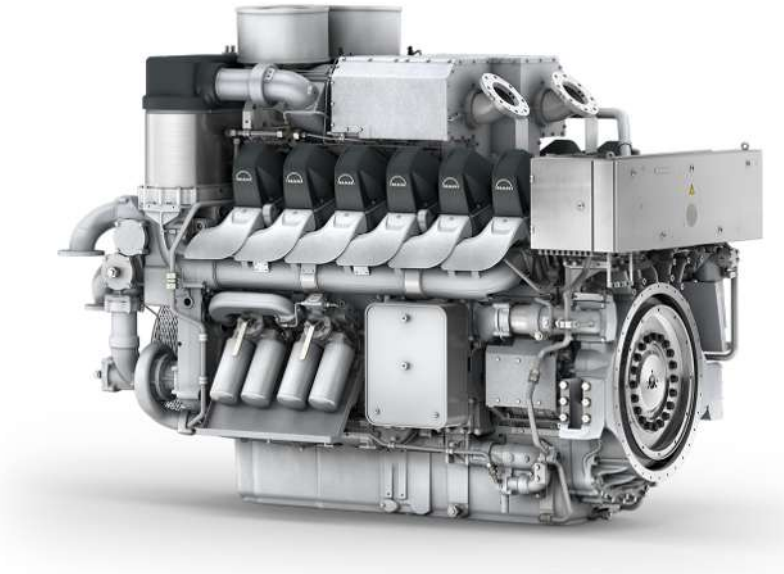


Figure 3: 12V175D-MH/MM with horizontal exhaust gas outlet, power take off (PTO) on counter coupling side, and HT/LT cooling for central or box cooling system – Coupling side

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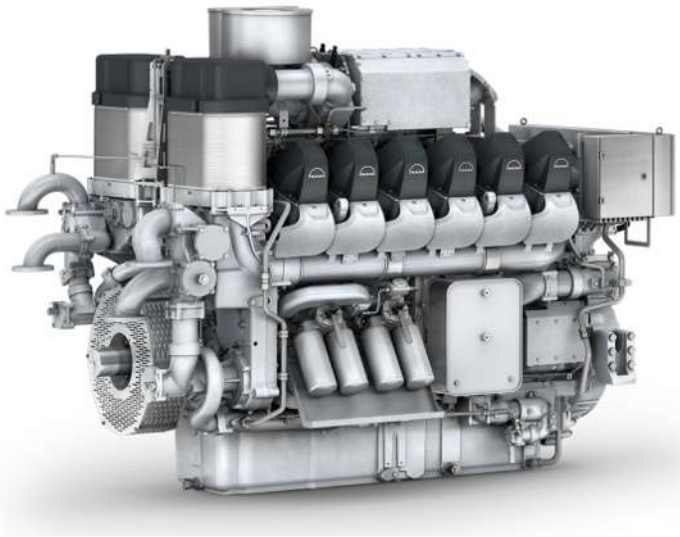


Figure 4: 12V175D-MH/MM with horizontal exhaust gas outlet, power take off (PTO) on counter coupling side, and HT/LT cooling for central or box cooling system – Counter coupling side

**12V175D – GenSet – Air cooled**



Figure 5: 12V175D-MA/MEM/MEL with air cooled generator and HT/LT cooling for central cooling system – Coupling side – Right hand bank of cylinders



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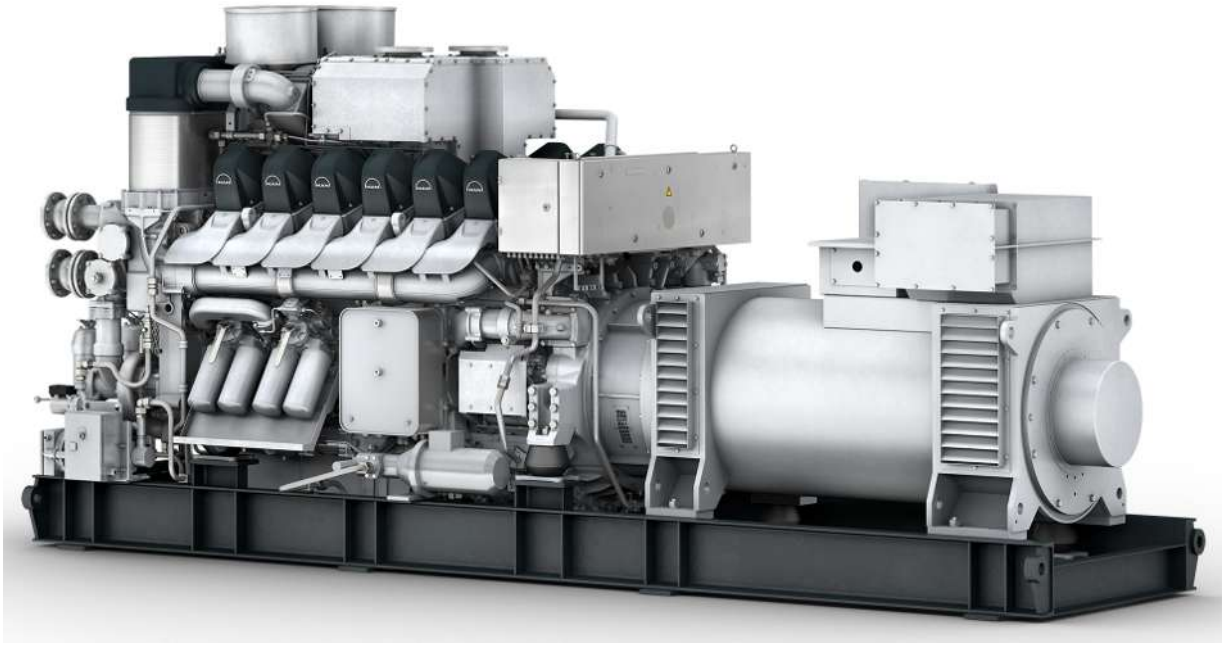


Figure 6: 12V175D-MA/MEM/MEL with air cooled generator and HT/LT cooling for central cooling system – Coupling side – Left hand bank of cylinders

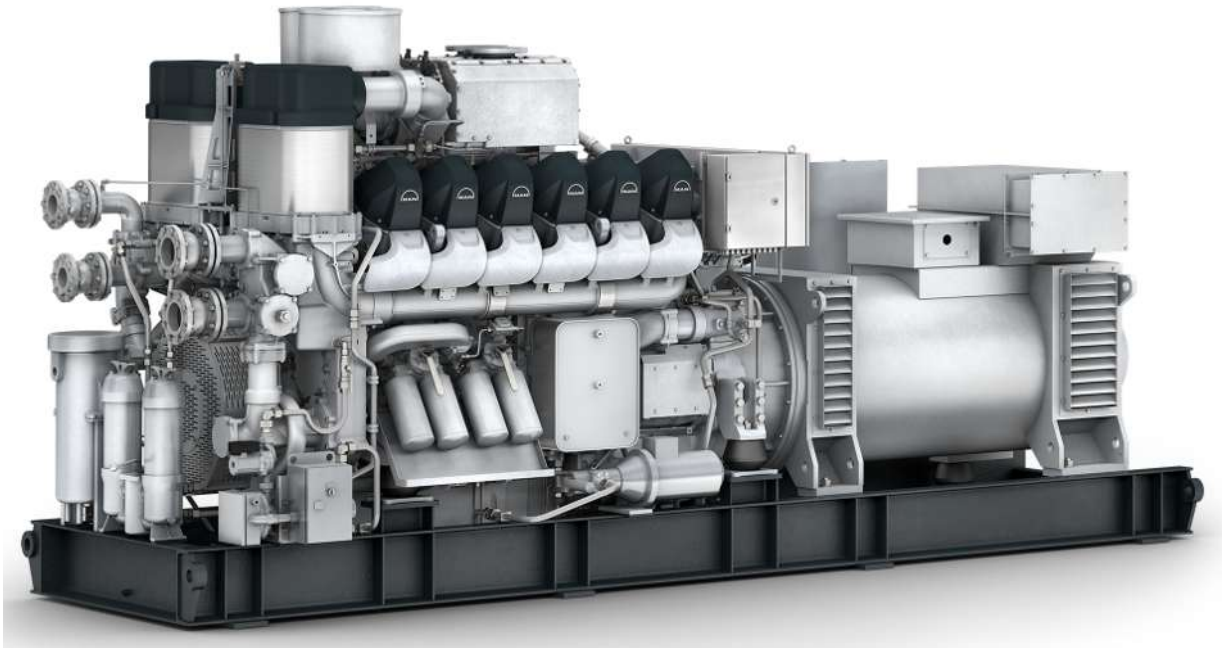


Figure 7: 12V175D-MA/MEM/MEL with air cooled generator and HT/LT cooling for central cooling system – Counter coupling side – Left hand bank of cylinders

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**Cross section**

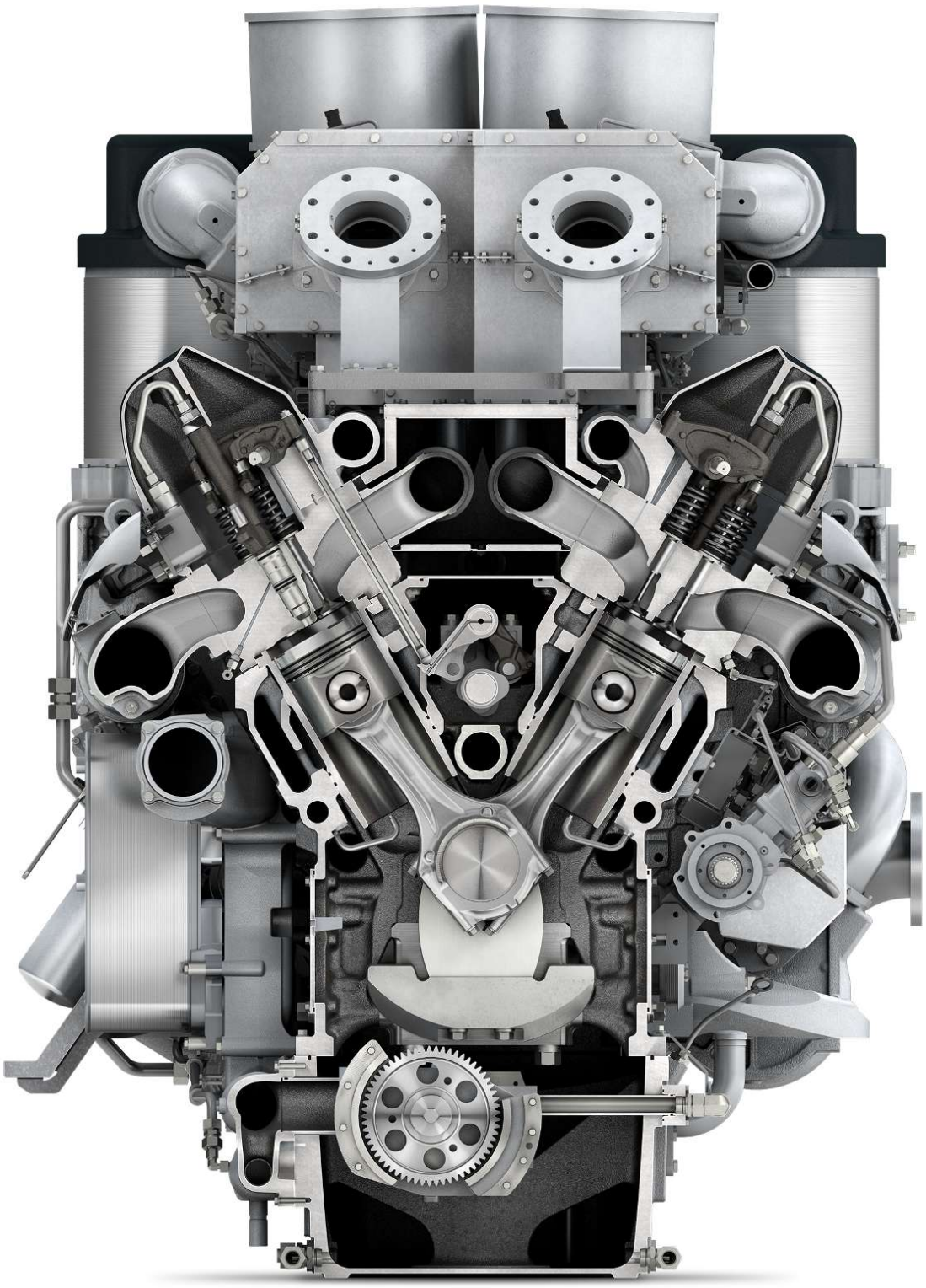


Figure 8: Cross section 12V175D-MH/MM with horizontal exhaust gas outlet – Front view



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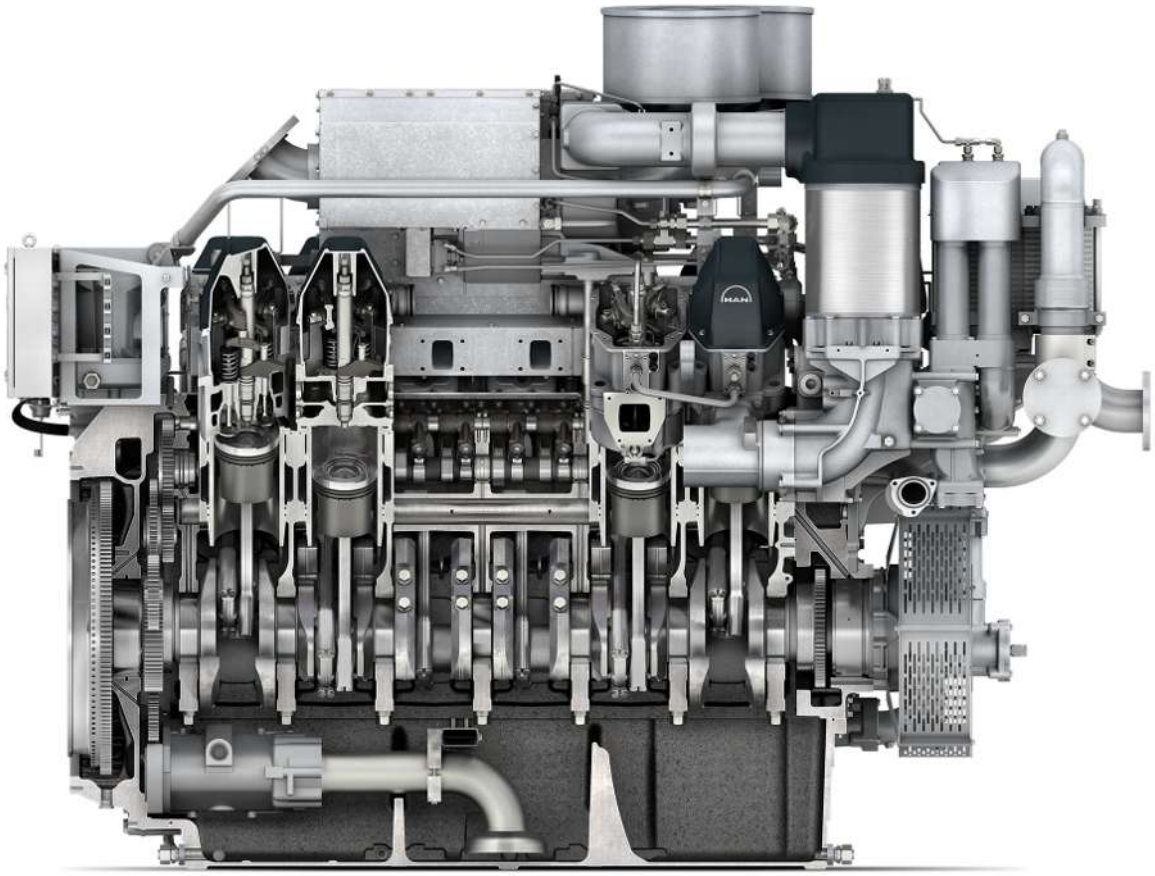


Figure 9: Cross section 12V175D-MH/MM with horizontal exhaust gas outlet and attached seawater cooler and seawater pump – Side view

### 1.1.2 About the 175D engine

Compact, reliable and efficient

With the 175D, Everllence has developed a power pack setting future standards in the high-speed engine industry. In three variants of 12, 16 and 20 cylinders, the 175D is available with an output ranging from 1,440 kW to 4,400 kW. It is optimised for propelling ferries, offshore supply vessels, tug boats, fishing vessels, super-yachts and any kind of naval applications.

The 175D is compact, reliable and efficient - properties that are of essential importance for use on all marine applications to allow safe manoeuvrability in the most challenging and roughest conditions. The powerful light-duty versions, on the other hand, provide an optimal power to weight ratio and highest compactness. Actually, the 20V175D-ML with 4,400 kW at 2,000 rpm is the most powerful high-speed engine in the world.

It is also an eco-friendly engine, being designed from the outset with compliance to the latest and future exhaust-gas-emission requirements. It utilises a compact and flexible SCR system, which enables vessel designers to optimise space on board to the maximum.

The best in class fuel consumption optimises operating costs and tank volumes. Also the long lube oil exchange intervals contribute to low operating costs and a low environmental footprint.

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User-friendliness

The compact and robust engine is designed for user-friendliness and efficiency: Simple commissioning, simple operation, simple maintenance. The long times between overhauls (TBO) make the 175D a future standard in sustainability and reduce maintenance costs significantly.

Everllence is also creating a stir on the high-speed market with its service concept for the 175D, which follows Everllence "one-face-to-the-customer" strategy. 175D customers have full access to the world's Everllence PrimeServ service network with over 120 locations worldwide. A service support point is available in all major ports. With "175D Primeserv Assist" remote monitoring and maintenance will be possible worldwide. Customers can rely on the global and high-quality service standards provided by 175D PrimeServ everywhere.

For additional information, visit the new 175D website on Everllence 175D.

### 1.1.3 Additional information

The 175D is equipped with a 4-valve ductile iron cylinder head with double-wall injection piping. The steel piston with jet oil cooling drives the connecting rod, which drives the surface hardened, fully balanced, shot peened crank shaft.

The engine has the following characteristics:

- Single piece casted crank case ensuring a high level of rigidity
- Surface hardened and fully mass balanced crank shaft for enhanced running smoothness
- Mono block steel piston design in combination with chrome-ceramic piston rings ensuring long-term durability
- Ductile cast iron cylinder head in cross-flow design featuring optimised flow characteristics
- Closed crank case ventilation
- Resilient mounting

Common rail injection

The 175D injection system uses the latest common rail technology with up to 2,200 bar rail pressure and flexible setting of injection timing, duration and pressure. This flexibility allows an optimised engine setting for each specific operating profile. The modular common rail system with minimised number of pipes facilitates maintenance.

The common rail injection has the following characteristics:

- Accumulator in the injector for low shot-to-shot deviation
- Pressure directly on the needle, triggering fast actuation and multi injection
- Mechanically driven high pressure pump directly attached to the gear wheel, minimising energy loss
- Suction throttle for efficient pump control at every load point
- Double-walled high pressure pipes throughout ensuring high security of personnel
- Quick indication of the leakage location
- Conveyance of break leakage in case of damage at the high pressure sealing surfaces
- Duplex fuel filter, complete with change-over cock enabling one filter element to be exchanged while engine is running
- Engine mounted mechanical fuel feed pump



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Fuel

The 175D is designed for distillate fuels according to DIN EN 590, ASTM D975, or DMA (ISO 8217). Refer to details in the engine specification.

**Operation with FAME - transesterified biofuel (optional)**

In case of intended use of FAME fuels according to EN-14214 or ASTM D6751 and according to the additional requirements of Everllence (see section FAME (transesterified biofuel) specification, Page 400)

- Special considerations for fuel handling, storage and fuel preparation to be considered
- To be clarified, if special equipment on engine or within plant is needed
- Change of engine performance to be clarified

Contact Everllence if this option is needed.

**Operation with synthetic fuels**

Synthetic fuels such as HVO, BTL, CTL, GTL according to DIN EN 15940 differ in the procedure of production, but are identical in their fuel properties and need to comply to the requirements of Everllence ( see section HVO)

In case of intended use of these synthetic diesel fuels:

- Special considerations for fuel handling, storage and fuel preparation have to be considered
- To be clarified, if special equipment on engine or within plant is needed
- Change of engine performance to be clarified

Due to the lower volumetric heat value than DMA in case of fixed engine setting a minor increase of the specific fuel consumption ($\Delta be_{42,700,\ ISO}$ <+1,5%, and a slight decrease of $NO_X$-emissions is expected.

Contact Everllence if this option is needed.

Lube oil concept

The lube oil system has the following characteristics:

- Integrated lube oil pump, lube oil cooler and filter
- Centrifugal filter for extended lube oil change intervals (optional)
- Oil pan designed for the specified inclination of the engine
- Oil pan holding the complete lube oil volume

Cooling water system

The cooling water system has the following characteristics:

- Integrated cooling system, consisting of lube oil cooler, charge air cooler, and cylinder cooling
- Integrated cooling water pumps
- Seawater pump and seawater cooler optional

Charge-air system

- Compact charge-air cooling system
- Compact air filter for easy replacement

Turbochargers

The 175D is equipped with a constant pressure turbocharging system. The high efficiency turbochargers type Everllence TCR are specially developed for the 175D and adopted to its specific performance characteristics.

The turbochargers have following characteristics:

- Robust components
- Equipped with silencers
- Vertically or optionally longitudinal inclined exhaust gas outlets

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SaCoS 5000

The 175D is equipped with the classification society compliant safety and control system SaCoS 5000. SaCoS 5000 combines all functions of modern engine management into one complete system.

SaCoS 5000 offers:

- Integrated self-diagnosis functions
- Future prove design
- Digital ready
- Maximum reliability and availability
- Simple use and diagnosis
- Quick exchange of modules
- Propulsion Optimisation Interface

  The Propulsion Optimisation Interface serves with engine parameters and at an early stage gives information about upcoming limitation. This allows a smooth and look ahead control of the CPP propulsion system.

### Cyber security

The marine certified safety and control system SaCoS 5000 is compliant to the IACS UR E27 requirements for cyber resilience on-board equipment, which will get mandatory for ships contracted for construction or after 1st July 2024. A confirmation of compliance will be given by the main classification societies, ensuring the utmost benefit for our customers.

### PrimeServ Assist - CEON (optional feature)

Everllence PrimeServ Assist is our solution to support our customers in monitoring and assessing the condition of their equipment. Equipment connected to our Everllence CEON cloud platform is monitored by Everllence's advanced analytics running in the Everllence CEON platform to detect degradations and optimisation potentials. Everllence experts analyse root causes and define mitigating actions based on this data.

Benefits:

- Availability: Ensuring 24/7 engine availability by monitoring operating values and pro-actively advising on operating tasks.
- Efficiency: Optimize equipment performance and reduce fuel consumption and emissions by detecting degradations of performance influencing parameters over time.
- Maintenance: Reduce maintenance cost by evaluating aging of individual components over time and pro-active advising counter measures.

| Available options | Basic package | Add-on package |
|---|---|---|
| 175D with SaCoS 5000 | X | + Lube oil monitoring |
| Everllence AKA battery energy storage system | X | |
| Everllence SCR system | X | |
| Everllence Alpha propeller | X | |

Table 1: Available options PrimeServ Assist CEON

Starting system

- Engine mounted electrical starters (engine mounted air starters, as option)

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Mechanical safety

- Jacketed high pressure fuel oil lines compliant with SOLAS Chapter II-2, Reg. 4.2.2.5.2
- Screened fuel and lube oil lines compliant with SOLAS Chapter II-2, Reg. 4.2.2.5.3
- Admissible surface temperature compliant with SOLAS Chapter II-2, Reg. 4.2.2.6

## 1.2 SCR system description for 175D IMO Tier III variants

### 1.2.1 General

Exhaust gas after treatment

The 175D Tier III engine will be supplied with a dedicated SCR system, that is designed for full performance optimisation, easy operation and providing long maintenance intervals.

Scope of supply

In this case the engine is delivered together with following SCR system components:

**Main components of the SCR system**

- Urea mixing unit (including thermal insulation) with short connection cable
- Urea dosing device (urea filter, urea pump module, distributor block, urea injector, 1 m flexible hoses to connect injectors to hard piping at site)
- Dosing cabinet
- SCR reactor (including thermal insulation); optional with shock frame
- SCR control unit with ambient condition sensor
- IMO Tier III certificate

Not included in scope of supply:

- Urea storage tank incl. urea level detection
- Urea piping, shut-off valves, drain tray below pump module and filter
- Thermomechanical compensation
- Key switch for turning on and off urea injection
- Electrical wiring of components

### 1.2.2 Additional information

For SCR (selective catalytic reduction), ammonia ($NH_3$) converts nitrogen oxides in the exhaust gas to harmless nitrogen and water within a catalyst. Since ammonia is a combustible substance, urea is used as substitute, reducing the hazard for crews, passengers, and the environment. Urea is harmless and easily transported when handled as aqueous urea solutions of 32.5% or 40%.

The SCR system has a modular structure. For each turbocharger outlet a separate system is used, including an urea injector, urea mixing unit and SCR reactor (in special cases two turbocharger outlets of a 16V engine can be joined for one SCR system). The 2- and 4-line diagrams of the SCR system are placed in section SCR system installation, Page 500, see figure Simplified urea flow diagram 2-line system, Page 503 and figure Simplified urea flow diagram 4-line system, Page 504.

The start-up and continuous operation of the SCR system runs in automatic mode. During engine operation, the engine control system sends all relevant parameters to the SCR control system, controlling the urea amount.

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With a key switch, which is not scope of supply, the urea injection can be turned on and off.

The ship operator must document the SCR operation. A signal "SCR operation active" is available. The automation system of the vessel must record this signal.

### Aqueous urea solution specification

The SCR system is capable to be run with 32.5% ("AdBlue™") and 40% urea solution, see specification within section Specification of urea solution, Page 402 accordingly.

The urea concentration to be used in service has to be specified in advance by the operator and the SCR system will be delivered by Everllence with proper parameter setting for the respective urea concentration. It is not allowed to run the SCR system with "intermediate" urea concentration between 32.5% and 40%. In case a change in urea concentration is planned, only Everllence an authorised person is allowed to change the respective parameter setting within urea dosing control.

### Temperature regulation

A minimum exhaust gas temperature upstream of the SCR catalyst is required to ensure its proper performance. This minimum exhaust gas temperature regulates automatically by the continuously adjustable waste gate. If the temperature downstream of the turbine falls below the set minimum exhaust gas temperature value, the waste gate opens gradually to blow-off exhaust gas upstream of the turbine, until the exhaust gas temperature downstream of the turbine (and thus upstream of the SCR catalyst) has reached the required level.

### Pressure drop over the SCR system

The differential pressure is measured up- and downstream of the reactor. The designed pressure drop over the whole SCR system (mixing pipe and SCR muffler) is considered within the engine application.

Boundary conditions for SCR operation

Consider following boundary conditions for the SCR operation:

- Temperature control of temperature turbine outlet:
  - By adjustable waste gate (attached to engine).
  - Set point 310°C as minimum temperature before SCR (if active).
  - Set point 280°C as minimum temperature before SCR (if deactivated).
- Lube oil:
  - With the SCR system 10W-40 lube oils are permitted, as specified within section Specification of lubricating oil for operation with gas oil (MGO), Page 408.
- Fuel:
  - In line with stated specifications.
- SCR operation with active urea injection is ensured for ≥ 25% output.

IMO requirements for handling of SCR operation disturbances:

- If there is SCR malfunction, IMO regulations allow, that the system will be turned off and the ship's journey will be continued to the port of destination. There, the ship must be repaired, if the emission limits of the harbor/ sea area would be exceeded.



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| | |
|---|---|
| | Online service:<br>▪ For 175D IMO Tier III systems, Everllence recommends the use of PrimeServAssist. |
| Performance coverage for SCR system | ▪ Performance guarantee for engine plus SCR as defined above in paragraph Boundary conditions for SCR operation, Page 23.<br>▪ Guarantee for engine plus SCR for marine applications to meet IMO Tier III level as defined above in paragraph Boundary conditions for SCR operation, Page 23 (details will be handled within the relevant contracts).<br>▪ Everllence will deliver an IMO Tier III certificate and act as “applicant” (within the meaning of the IMO).<br>▪ The engine´s certification for compliance with $NO_x$ limits according to $NO_x$ technical code will be done as a standard according scheme A. Certification has to be in line with IMO Resolution MEPC 198(62), adopted 15 July 2011. |
| Sound attenuation | The Everllence SCR-LPH has a minimum sound attenuation of 10 dB for frequencies ≥ 100 Hz. |
| Heat radiation | For information on the amount of heat radiation of the SCR system, see the heat radiation table in the corresponding performance data section. |

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# 2 Engine and operation

## 2.1 Overviews

### 2.1.1 Engine

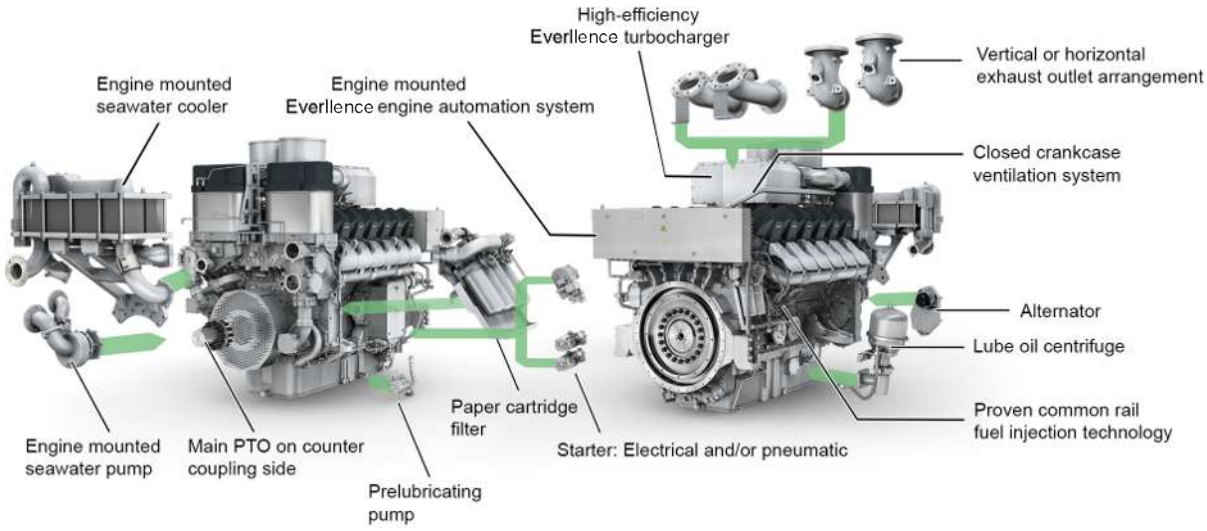



Figure 10: Engine exploded view



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### 2.1.2 Engine plus SCR system components for Tier III application

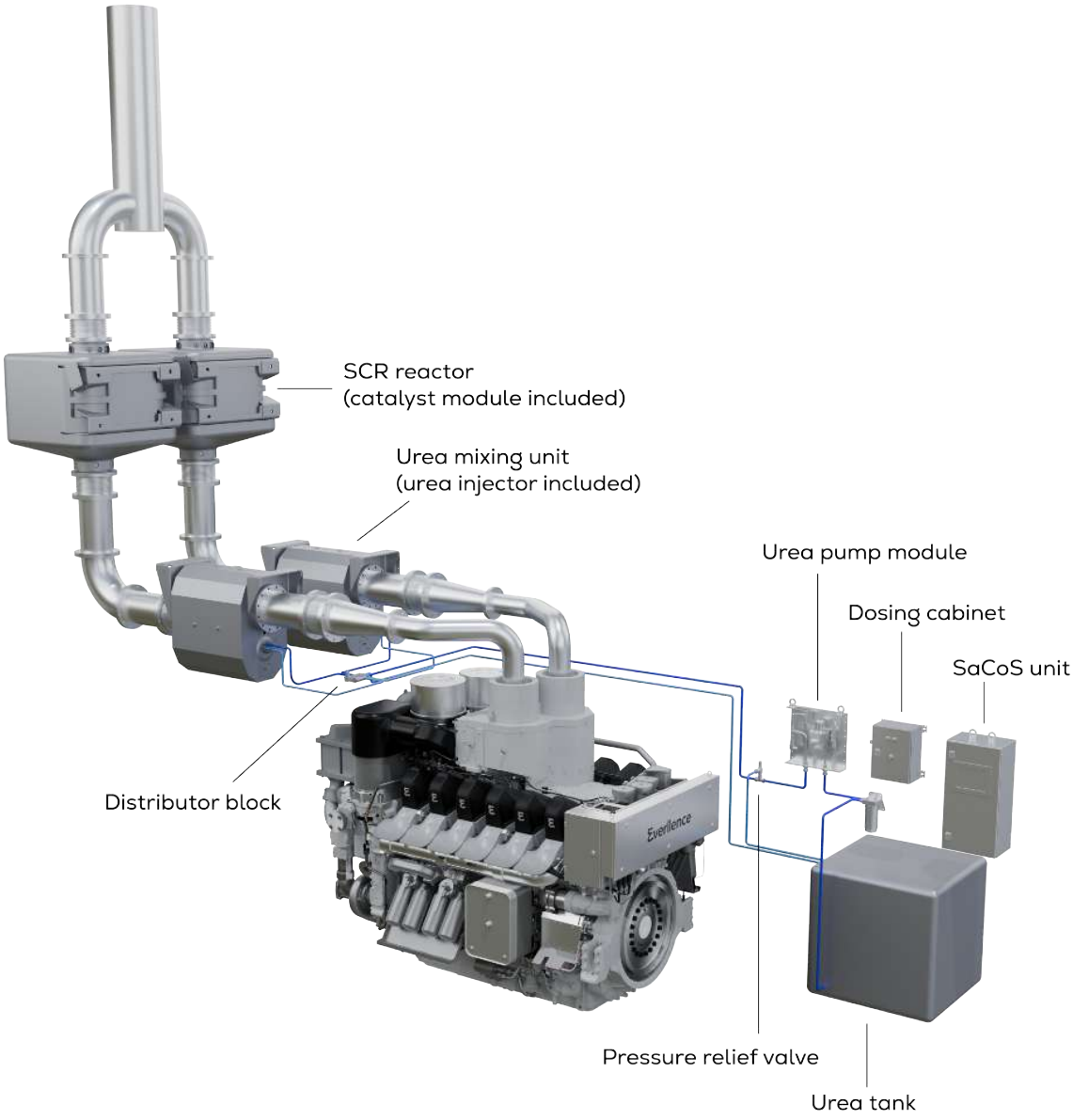



Figure 11: Components of the 2-line SCR system – Vertical overview



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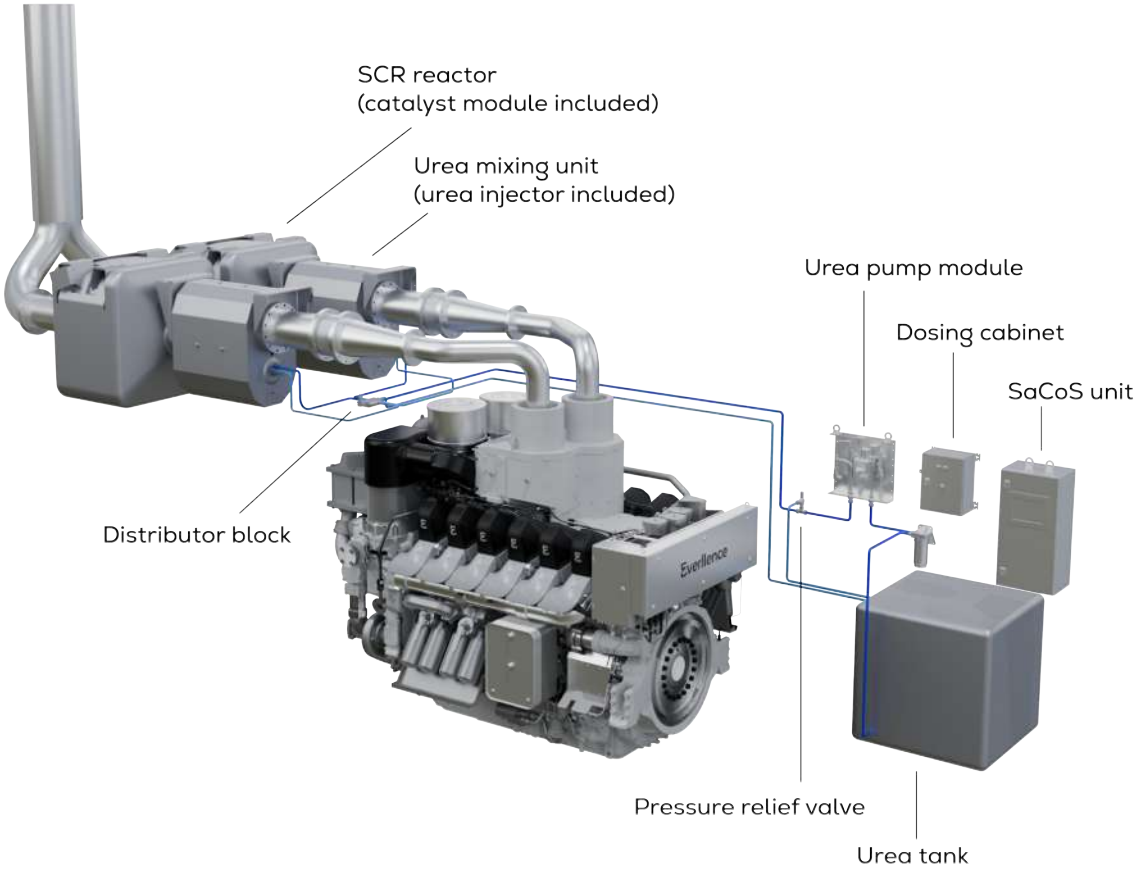



Figure 12: Components of the 2-line SCR system – Horizontal overview



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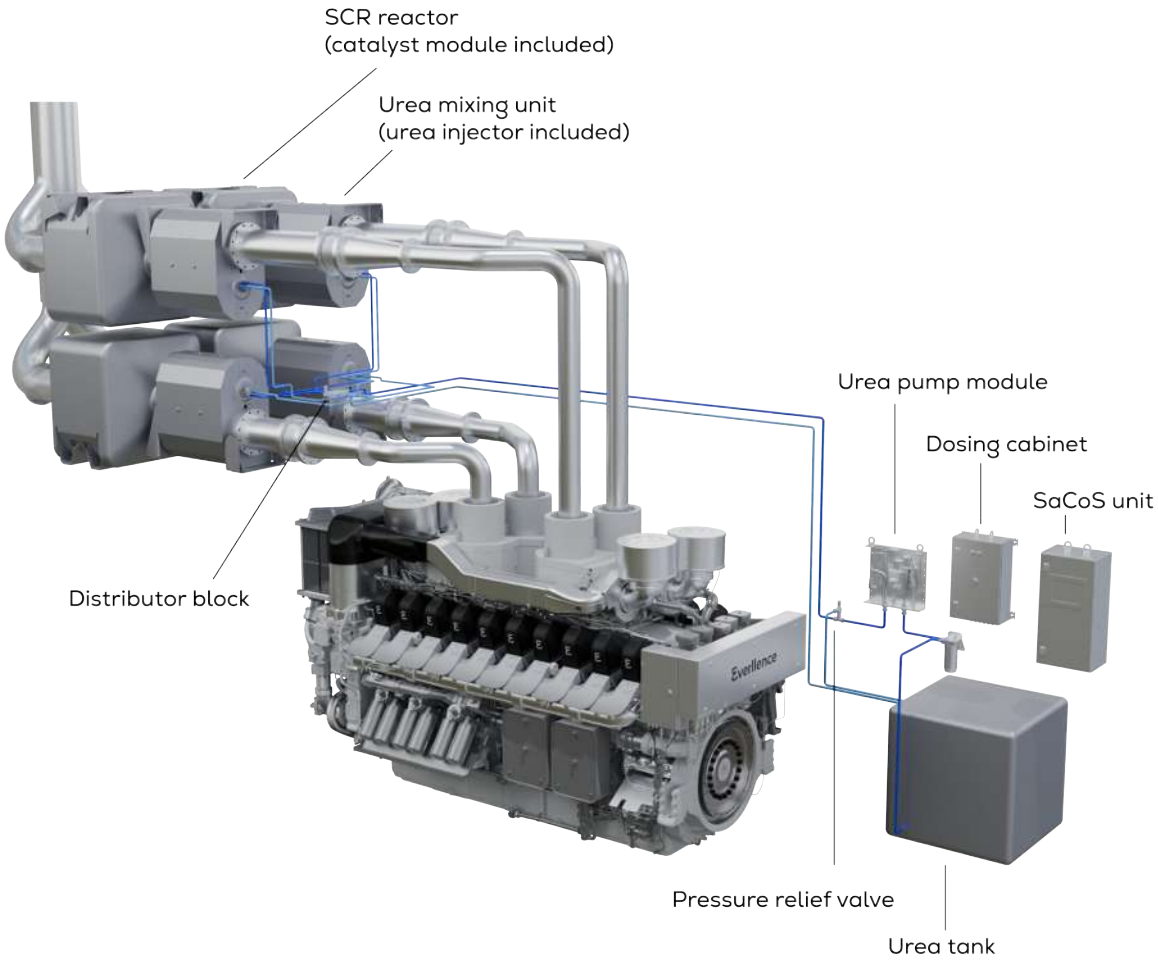


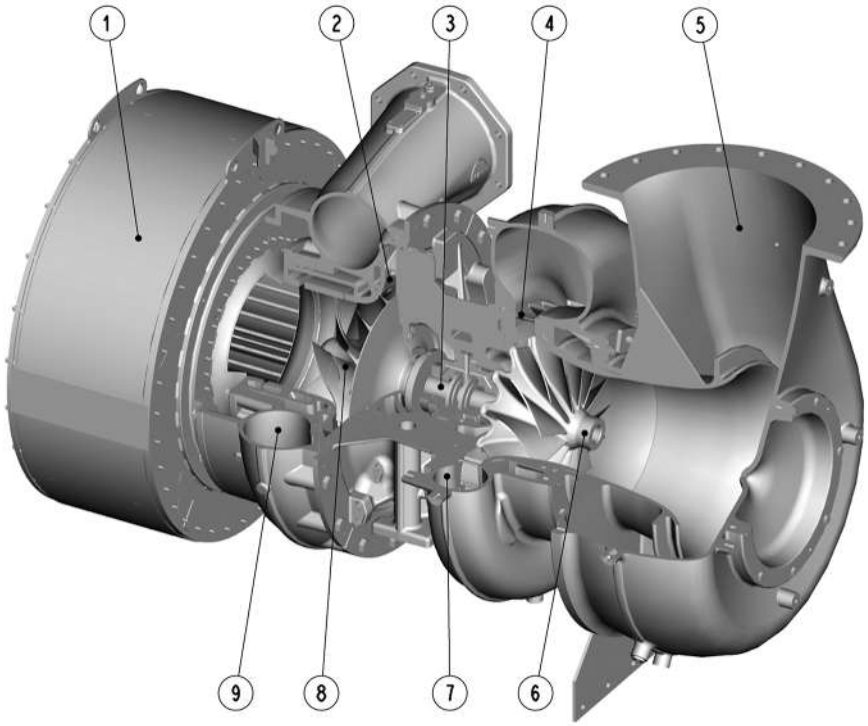

Figure 13: Components of the 4-line SCR system – Horizontal overview



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### 2.1.3 TCR turbocharger

**View of a TCR type turbocharger**




1 Silencer
2 Diffuser
3 Semi-floating bearings
4 Turbine nozzle ring
5 Gas outlet casing
6 Turbine rotor
7 Gas admission casing
8 Compressor wheel
9 Compressor casing

Figure 14: TCR type turbocharger



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### Loads on connections and flanges

All turbocharger casing flanges, with the exception of the turbine outlet, may only be subjected to loads generated by the gas forces. The specified maximum values must be observed, taking external forces and torques into consideration.

This necessitates the use of compensators directly at the turbine inlet, at the turbine outlet and downstream of the compressor.

The compensators must be pre-loaded in such a manner that thermal expansion of the pipes and casings does not exert forces or torques in addition to those generated by the air and gas.

- Forces and torques according to API standard 617.
- Effective direction implemented in accordance with Everllence standard.
- Minimise anticipated loads as far as possible.
- Parameters include forces of fluids, masses and compensators.

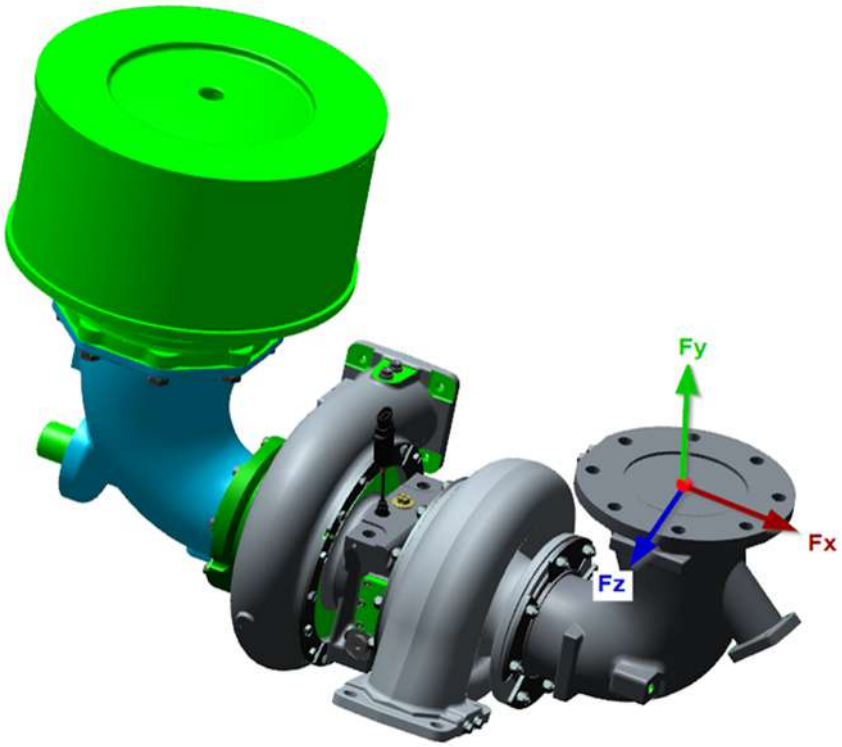



Figure 15: Allowable external forces at outlet flange

| Turbocharger | Direction | Turbine outlet casing |
|---|---|---|
| TCR10 | Fx | 275 N |
| | Fy | 275 N |
| | Fz | 275 N |
| TCR12 | Fx | 333 N |
| | Fy | 333 N |
| | Fz | 333 N |

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## 2.2 Dimensions and weight

### 2.2.1 Engine for mechanical application – Dimensions and weight

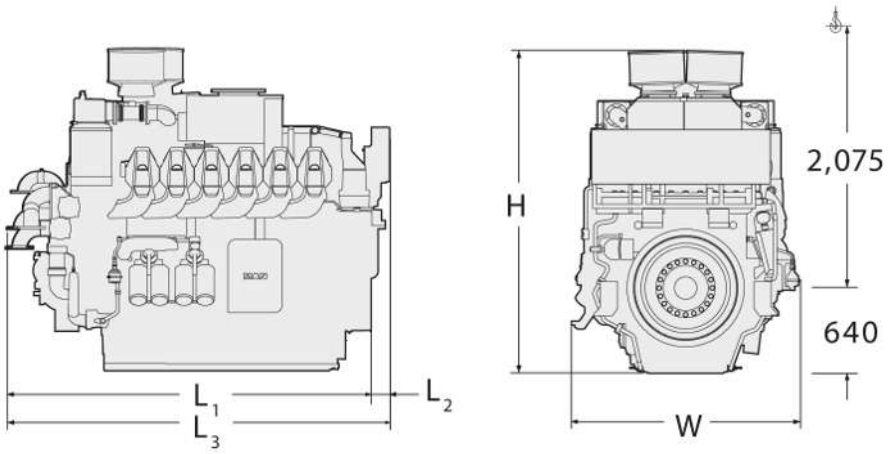



Figure 16: Engine dimensions 12V

| No. of cylinders, config. | $L_1$ [1)] | $L_2$ | $L_3$ [1)] | H | W | Dry weight [1)] |
|---|---|---|---|---|---|---|
| | mm | | | | | t |
| 12V | 2,733.5/ 2,866.5 | 167 | 2,900.5/ 3,033.5 | 2,295 | 1,661 | 8.8/9.35 |

[1)] Standard/option: With seawater cooler.

Engine weight may vary due to various configurations. The dimensions given are for guidance only and may vary due to various configurations.

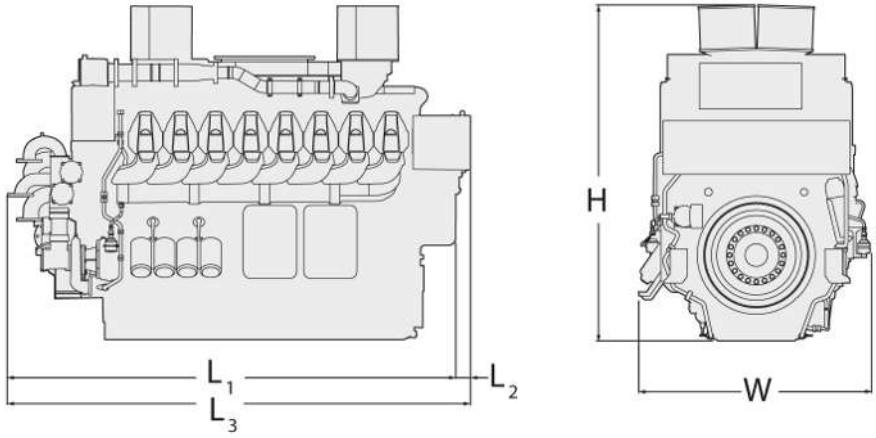



Figure 17: Engine dimensions 16V

| No. of cylinders, config. | $L_1$ [1)] | $L_2$ | $L_3$ [1)] | H | W | Dry weight [1)] |
|---|---|---|---|---|---|---|
| | mm | | | | | t |
| 16V | 3,253.5/ 3,386.5 | 167 | 3,420.5/ 3,553.5 | 2,316 | 1,661 | 11/11.6 |



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| No. of cylinders, config. | $L_1$ [1)] | $L_2$ | $L_3$ [1)] | H | W | Dry weight [1)] |
|---|---|---|---|---|---|---|
| | mm | | | | | t |

[1)] Standard/option: With seawater cooler.

Engine weight may vary due to various configurations. The dimensions given are for guidance only and may vary due to various configurations.

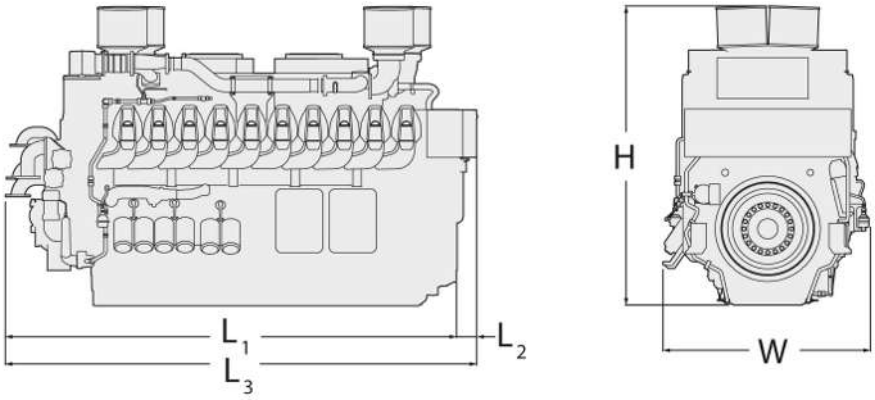



Figure 18: Engine dimensions 20V

| No. of cylinders, config. | $L_1$ [1)] | $L_2$ | $L_3$ [1)] | H | W | Dry weight [1)] |
|---|---|---|---|---|---|---|
| | mm | | | | | t |
| 20V | 3,773.5/ 3,906.5 | 167 | 3,940.5/ 4,073.5 | 2,297 | 1,647 | 13.2/13.8 |

[1)] Standard/option: With seawater cooler.

Engine weight may vary due to various configurations. The dimensions given are for guidance only and may vary due to various configurations.

### 2.2.2 GenSet dimensions and weight

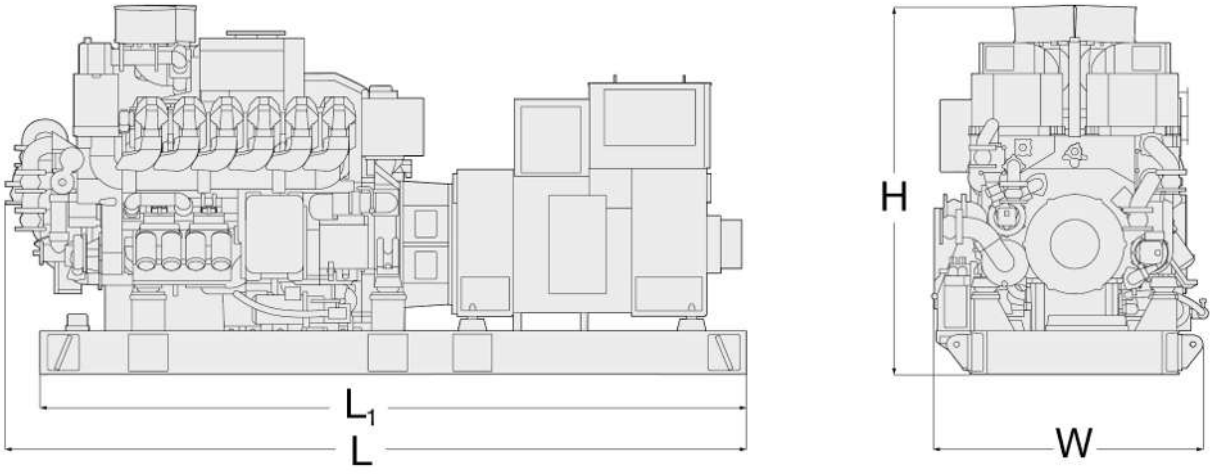



Figure 19: General GenSet arrangement 12V175D with air-cooled alternator and without baseframe attached seawater cooler



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| No. of cylinders, config. | L | $L_1$ | H | W | Dry weight |
|---|---|---|---|---|---|
| | mm | | | | t |
| 12V | 5,140 | 4,900 | 2,555 | 1,880 | 19.0 |
| GenSet dimensions and weight shown are for guidance only. Details may vary due to different configurations. | | | | | |

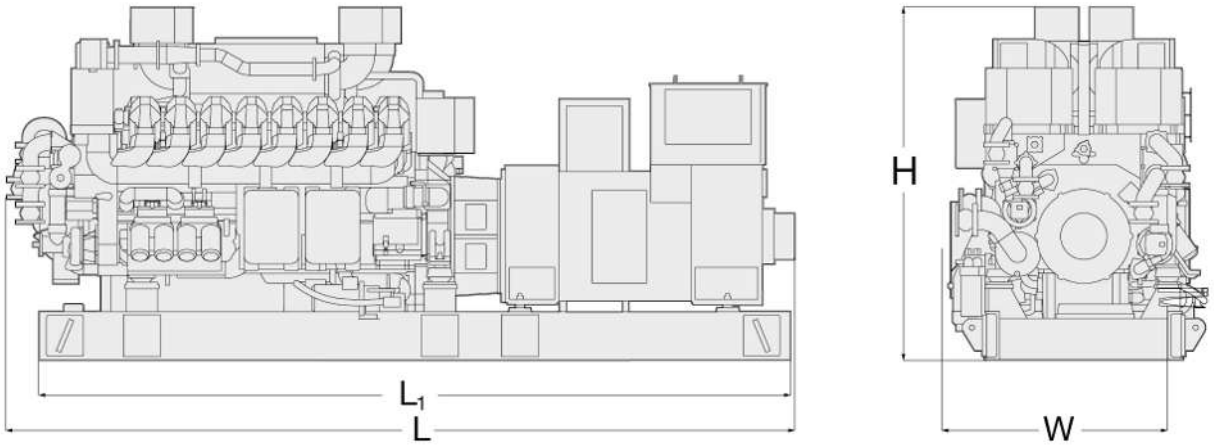



Figure 20: General GenSet arrangement 16V175D with air-cooled alternator and without baseframe attached seawater cooler

| No. of cylinders, config. | L | $L_1$ | H | W | Dry weight |
|---|---|---|---|---|---|
| | mm | | | | t |
| 16V | 5,780 | 5,500 | 2,575 | 1,880 | 22.7 |
| GenSet dimensions and weight shown are for guidance only. Details may vary due to different configurations. | | | | | |

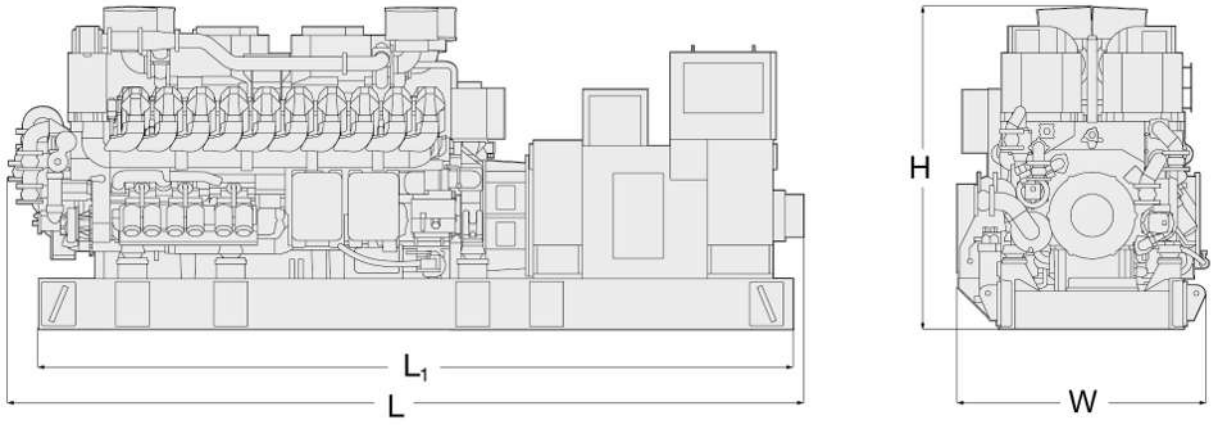



Figure 21: General GenSet arrangement 20V175D with air-cooled alternator and without baseframe attached seawater cooler

| No. of cylinders, config. | L | $L_1$ | H | W | Dry weight |
|---|---|---|---|---|---|
| | mm | | | | t |
| 20V | 6,300 | 6,000 | 2,555 | 1,980 | 26.8 |
| GenSet dimensions and weight shown are for guidance only. Details may vary due to different configurations. | | | | | |



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### 2.2.3 SCR system components

Main components of the SCR are the urea mixing unit and the SCR reactor.

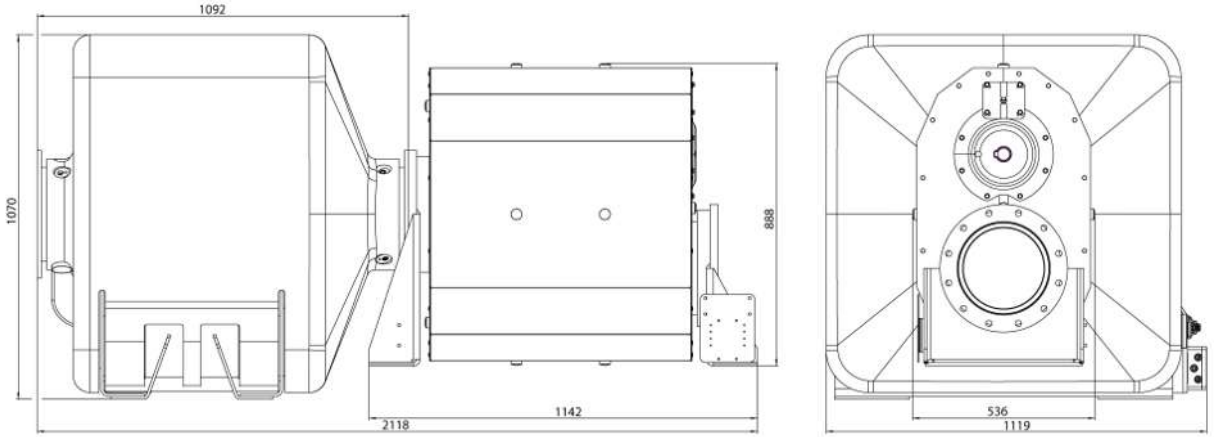



Figure 22: SCR reactor and urea mixing unit [final dimensions project specific]

For further details and regarding installation see section SCR system, Page 491.

### 2.2.4 Engine installation drawings

A general installation drawing covering the engine variant and all optional equipment will be supplied for each project.

Note also the section 3D Viewer – A support programme to configure the engine room, Page 413.

General dimensions and weights are given in sections Dimensions and weight, Page 31 and Maintenance space and requirements, Page 505.

## 2.3 Approved applications and destination/suitability of the engine

#### Approved applications

The 175D is designed as multi-purpose drive. It has been approved by type approval as marine main engine and auxiliary engine by all **main classification societies** (ABS, BV, CCS, ClassNK, DNV, KR, RINA, LR, and BKI).

As marine main engine[1)] it may be applied for mechanical or electric propulsion[2)] for applications as:

- Work boats
- Ferries
- Tugs
- Navy vessels
- Yachts

For the applications named above, the 175D has to be applied for multi-engine plants only.

The engine 175D as marine auxiliary engine may be applied for electric power generation for auxiliary duties for application as:

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- Auxiliary GenSet[2)]

Note:
The engine is not designed for operation in hazardous areas. The ship´s own systems must ensure, that the atmosphere of the engine room is monitored and if it detects a gas-containing atmosphere the engine stops immediately.

[1)] In line with rules of classifications societies each engine whose driving force may be used for propulsion purpose is stated as main engine.

[2)] Not used for emergency case or fire fighting purposes.

### Offshore

For offshore applications it may be applied as mechanical or electric propulsion or as auxiliary engine for applications for:

- Platforms/offshore supply vessels
- Anchor handling tugs
- General all kinds of service & supply vessels

Hereby it can be applied for multi-engine plants.

Due to the wide range of possible requirements such as flag state regulations, fire fighting items, redundancy, inclinations, and dynamic positioning modes, all project requirements must be clarified at an early stage.

Note:
The engine is not designed for operation in hazardous areas. The ship´s own systems must ensure, that the atmosphere of the engine room is monitored and if it detects a gas-containing atmosphere the engine stops immediately.

### Destination/suitability of the engine

Note:
Regardless of their technical capabilities, engines of our design and the respective vessels in which they are installed, must always be operated in line with the legal requirements, as applicable, including such requirements that may apply in the respective geographical areas in which such engines are actually being operated.

Operation of the engine outside the specified operated range, not in line with the media specifications or under specific emergency situations (for example, suppressed load reduction or engine stop by active "Override", triggered fire-fighting system, crash of the vessel, fire, or water ingress inside engine room) is declared as not intended use of the engine (for details see engine-specific operating manuals). If an operation of the engine occurs outside of the scope of supply of the intended use, a thorough check of the engine and its components must be performed by supervision of the Everllence service department. These events, the checks, and measures must be documented.

### Electric and electronic components attached to the engine – Required engine room temperature

In general, our engine components meet the high requirements of the Marine Classification Societies. The electronic components are suitable for proper operation within an air temperature range from 0°C to 55°C.

Relevant design criteria for the engine room air temperature:



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Recommended minimum air temperature in the area of the engine and its components
≥ 5°C.

Maximum air temperature in the area of the engine and its components
≤ 55°C.

Note:
Condensation of the air at engine components must be prevented.

Note:
It can be assumed that the air temperature in the area of the engine and attached components will be 5–10 K above the ambient air temperature outside the engine room. If the temperature range is not observed, this can affect or reduce the lifetime of electrical/electronic components at the engine or the functional capability of engine components. Air temperatures at the engine > 55°C are not permissible.

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## 2.4 Engine design

### 2.4.1 Engine designation

The engine designation helps to identify the engine according to the naming.

The following example shows the designation for a 12V cylinder high-speed diesel engine with 175 mm cylinder bore diameter operating with distillate diesel fuel and applicable for marine heavy duty rating.

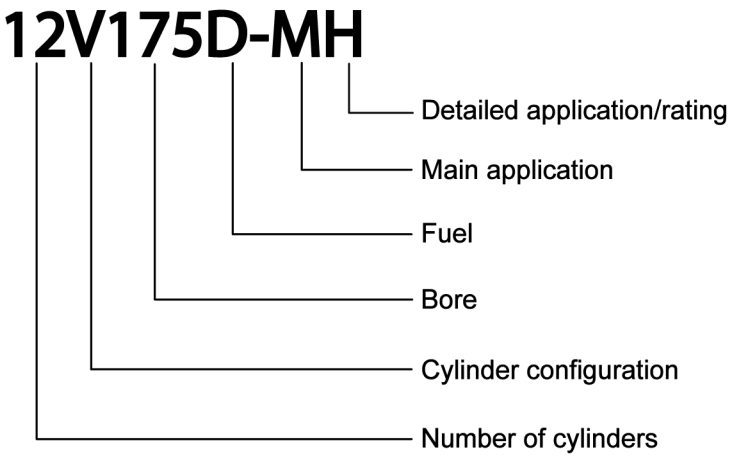



Figure 23: Type designation

| | |
|---|---|
| Number of cylinders | 12, 16, 20 |
| Cylinder configuration | "V"-shaped |
| Bore | Cylinder bore diameter (in millimetre) |
| Fuel | Abbreviation for:<br>▪ Diesel (D) |
| Main application | Abbreviation for:<br>▪ Marine (M) |
| Detailed application/rating | Abbreviation for:<br>▪ Auxiliary (A)<br>▪ Electric propulsion light duty (EL)<br>▪ Electric propulsion medium duty (EM)<br>▪ Electric propulsion variable speed (EV)<br>▪ Mechanical propulsion heavy duty (H)<br>▪ Mechanical propulsion medium duty (M)<br>▪ Mechanical propulsion light duty (L) |

Table 2: Type designation



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### 2.4.2 Turbocharger assignments

| Variant Tier II/Tier III | Power [kW] | Speed [rpm] | TC assignment | | |
|---|---|---|---|---|---|
| | | | 12V175D | 16V175D | 20V175D |
| ML (only 20V) | 220 | 2,000 | - | - | 4 x TCR12-43069 |
| ML (only 12V) | 215 | 2,000 | 2 x TCR12-43070 | - | - |
| ML | 200 | 2,000 | 2 x TCR12-43063 | 4 x TCR10-43032 | 4 x TCR12-43064 |
| MM (only 12V) | 200 | 1,800 | 2 x TCR12-43052 | - | - |
| MM | 185 | 1,900 | 2 x TCR12-43052 | 4 x TCR10-43024 | 4 x TCR12-43061 |
| MM | 185 | 1,800 | 2 x TCR12-43052 | 4 x TCR10-43024 | 4 x TCR12-43061 |
| MM | 170 | 1,800 | 2 x TCR12-43052 | 4 x TCR10-43024 | 4 x TCR12-43061 |
| MM (only 12V, 16V) | 160 | 1,800 | 2 x TCR12-43052 | 4 x TCR10-43024 | - |
| MM (only 12V) | 155 | 1,800 | 2 x TCR12-43052 | - | - |
| MH (only 12V) | 145 | 1,800 | 2 x TCR12-43052 | - | - |
| MEL (only 12V, 20V) | 190 | 1,800 | 2 x TCR12-43052 | - | 4 x TCR12-43061 |
| MEL (only 16V) | 185 | 1,800 | - | 4 x TCR10-43024 | - |
| MEL | 175 | 1,800 | 2 x TCR12-43052 | 4 x TCR10-43024 | 4 x TCR12-43061 |
| MEL | 165 | 1,500 | 2 x TCR12-43052 | 4 x TCR10-43024 | 4 x TCR12-43061 |
| MEL | 150 | 1,500 | 2 x TCR12-43052 | 4 x TCR10-43024 | 4 x TCR12-43061 |
| MEM | 160 | 1,800 | 2 x TCR12-43052 | 4 x TCR10-43024 | 4 x TCR12-43061 |
| MEM | 150 | 1,800 | 2 x TCR12-43052 | 4 x TCR10-43024 | 4 x TCR12-43061 |
| MEM | 135 | 1,500 | 2 x TCR12-43052 | 4 x TCR10-43024 | 4 x TCR12-43061 |
| MEM (only 12V) | 120 | 1,500 | 2 x TCR12-43052 | - | - |
| MEV (only 12V, 20V) | 190 | 1,800 | 2 x TCR12-43052 | - | 4 x TCR12-43061 |
| MEV (only 16V) | 185 | 1,800 | - | 4 x TCR10-43024 | - |
| MEV | 170 | 1,800 | 2 x TCR12-43052 | 4 x TCR10-43024 | 4 x TCR12-43061 |
| MEV | 155 | 1,800 | 2 x TCR12-43052 | 4 x TCR10-43024 | 4 x TCR12-43061 |
| MA (only 12V) | 190 | 1,800 | 2 x TCR12-43052 | - | - |
| MA (only 12V) | 175 | 1,800 | 2 x TCR12-43052 | - | - |
| MA (only 12V) | 165 | 1,500 | 2 x TCR12-43052 | - | - |
| MA (only 12V) | 160 | 1,800 | 2 x TCR12-43052 | - | - |
| MA (only 12V) | 150 | 1,500 | 2 x TCR12-43052 | - | - |
| MA (only 16V) | 150 | 1,800 | - | 4 x TCR10-43024 | - |
| MA (only 12V) | 135 | 1,500 | 2 x TCR12-43052 | - | - |

Table 3: Turbocharger assignments



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### 2.4.3 Detailed applications/ratings – Rating philosophy

The 175D can be applied to a wide range of applications. In order to select an appropriate engine rating, vessel type and operating profile are of great importance.

#### Example

For the following case study, subsequent points are assumed:

- Vessel to be equipped with mechanical propulsion package.
- For the intended use, the customer has defined the expected load profile:

| Engine operating time [%] | Engine load [%] |
|---|---|
| 20 | 15 |
| 20 | 60 |
| 50 | 80 |
| 10 | 100 |

Table 4: Exemplary operating profile

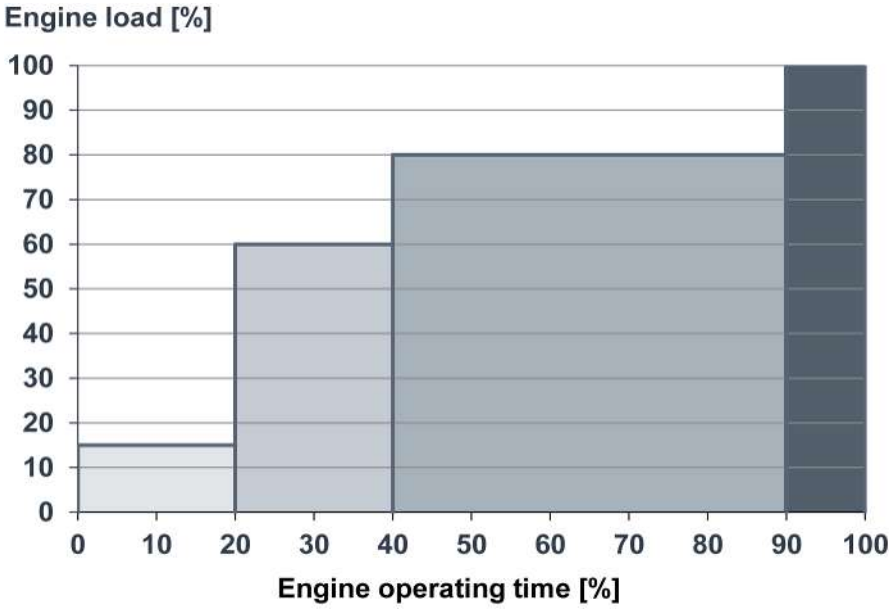



Figure 24: Exemplary operating profile diagram

Resulting average load:
(20% * 15% + 20% * 60% + 50% * 80% + 10% * 100%) / 100%
= 65% average load

#### Rating philosophy

The 175D rating philosophy offers solutions for highest power density but also lower power solutions for high load factors and longest TBO (time between overhauls).



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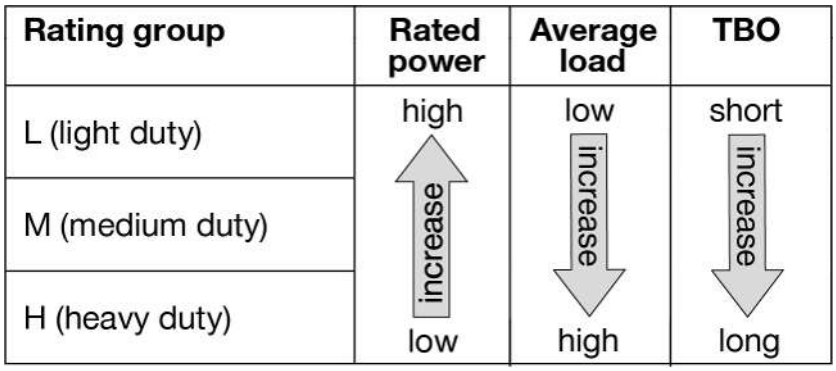



Figure 25: Interdependence between rating group and power, average load and TBO

### Exemplary load profiles and vessel types for the rating groups

Be aware that the overview indicates typical load profiles and applications that the ratings have been designed and optimized for. Nevertheless, customers are free to choose the best appropriate rating to their vessel. If a specific customer operation profile is not available, the typical standard load profile is applicable.

Stated TBO values are target values without warranty. Some parts may have shorter TBOs, see accordingly the respective maintenance schedule. The TBO is not only influenced by the engine rating, but also by media treatment and ambient conditions. Significant deviations from the standard load profile may result in shorter TBOs.



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ML (light duty)

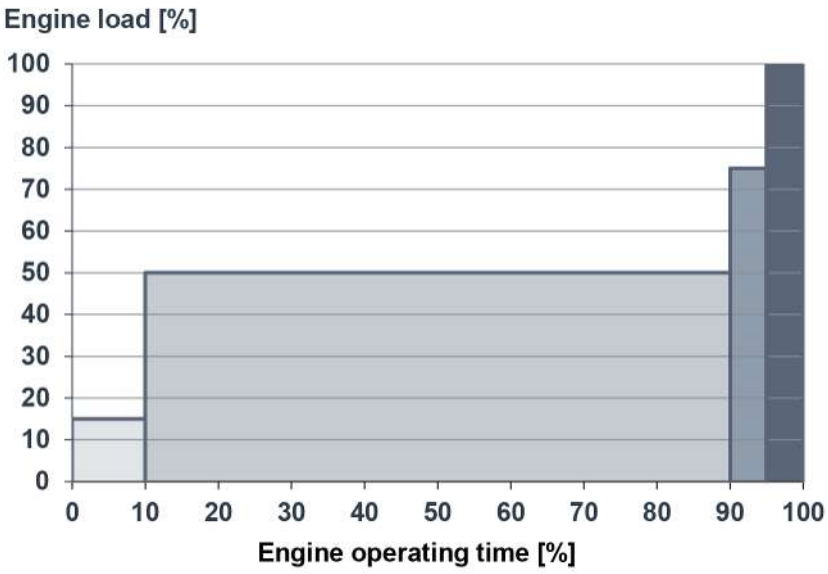



Figure 26: ML (light duty) - exemplary load profile

| Average load of example | Typical operation time | Typical applications |
|---|---|---|
| 50% | < 2,000 h/a | Fast patrol boat, fast yacht |

Table 5: Legend diagram ML (light duty)

### Mechanical propulsion applications/ratings

Marine mechanical propulsion light duty (ML)

| Type designation | Output[1] | | Speed [rpm] | Average load [%] | TBO[2] [Operating hours] |
|---|---|---|---|---|---|
| | [kW] | [bhp] | | | |
| ML, 220 kW/cyl., 2,000 rpm[3] | 20V: 4,400 | 20V: 5,900 | 2,000 | 60 | 16,000 |
| ML, 215 kW/cyl., 2,000 rpm[3] | 12V: 2,580 | 12V: 3,459 | 2,000 | 60 | 16,000 |
| ML, 200 kW/cyl., 2,000 rpm[3] | 12V: 2,400<br>16V: 3,200<br>20V: 4,000 | 12V: 3,218<br>16V: 4,291<br>20V: 5,364 | 2,000 | 60 | 18,000 |

[1] $P_{ISO, standard}$: ISO standard output (as specified in DIN ISO 3046-1).

[2] TBO values are target values without warranty. Some parts may have shorter TBOs, see accordingly the respective maintenance schedule. The TBO is not only influenced by the engine rating and load profile but also by, for example, media treatment and ambient conditions.

Typical applications are, amongst others:

[3] Fast patrol boat, fast yacht.

Table 6: Marine mechanical propulsion light duty (ML)



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MM (medium duty)

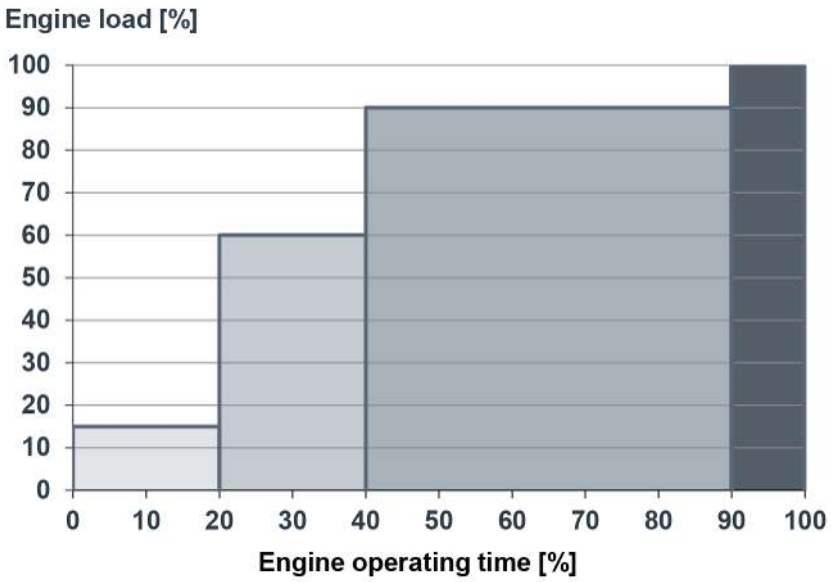



Figure 27: MM (medium duty) - exemplary load profile

| Average load of example | Typical operation time | Typical applications |
|---|---|---|
| 70% | < 3,000 h/a | OSV, ferry, patrol boat, yacht |

Table 7: Legend diagram MM (medium duty)

MM (medium duty) – tug operation

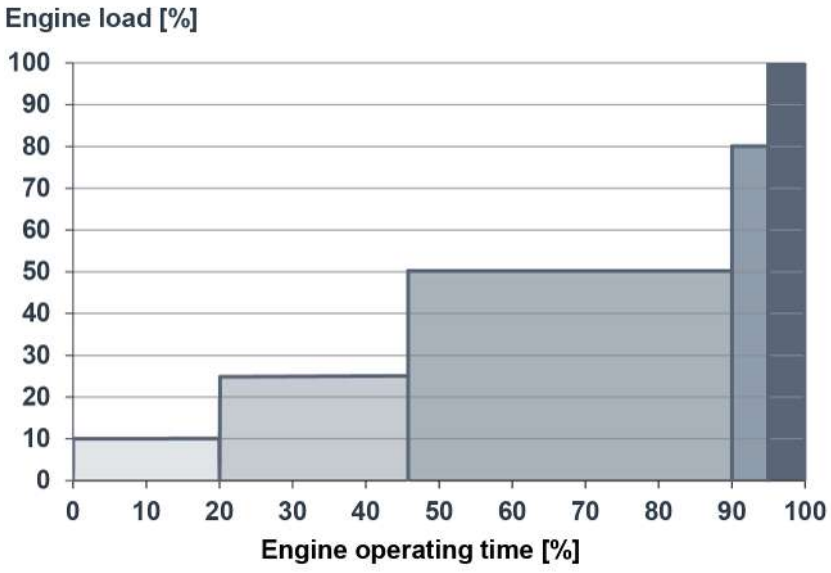



Figure 28: MM (medium duty) – tug operation - exemplary load profile

| Average load of example | Typical operation time | Typical applications |
|---|---|---|
| 40% | < 3,000 h/a | Tug boats |

Table 8: Legend diagram MM (medium duty) – tug operation



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Marine mechanical propulsion medium duty (MM)

| Type designation | Output[1] | | Speed [rpm] | Average load [%] | TBO[2] [Operating hours] |
|---|---|---|---|---|---|
| | [kW] | [bhp] | | | |
| MM, 200 kW/cyl., 1,800 rpm[4] | 12V: 2,400 | 12V: 3,218 | 1,800 | 40 | 25,000 |
| MM, 185 kW/cyl., 1,900 rpm[3] | 12V: 2,220<br>16V: 2,960<br>20V: 3,700 | 12V: 2,977<br>16V: 3,969<br>20V: 4,961 | 1,900 | 65 | 25,000 |
| MM, 185 kW/cyl., 1,800 rpm[4] | 12V: 2,220<br>16V: 2,960<br>20V: 3,700 | 12V: 2,977<br>16V: 3,969<br>20V: 4,961 | 1,800 | 40 | 25,000 |
| MM, 170 kW/cyl., 1,800 rpm[5] | 12V: 2,040<br>16V: 2,720<br>20V: 3,400 | 12V: 2,736<br>16V: 3,647<br>20V: 4,559 | 1,800 | 70 | 30,000 |
| MM, 160 kW/cyl., 1,800 rpm[6] | 12V: 1,920<br>16V: 2,560 | 12V: 2,574<br>16V: 3,433 | 1,800 | 80 | 30,000 |
| MM, 155 kW/cyl., 1,800 rpm[6] | 12V: 1,860 | 12V: 2,494 | 1,800 | 80 | 30,000 |

[1] $P_{ISO, standard}$: ISO standard output (as specified in DIN ISO 3046-1).

[2] TBO values are target values without warranty. Some parts may have shorter TBOs, see accordingly the respective maintenance schedule. The TBO is not only influenced by the engine rating and load profile but also by, for example, media treatment and ambient conditions.

Typical applications are, amongst others:

[3] Patrol boat, yacht (ferry).

[4] Tug/thruster operation only.

[5] Patrol boat, yacht, ferry.

[6] Offshore vessels, tug, ferry (also applicable for patrol boat and yacht).

Table 9: Marine mechanical propulsion medium duty (MM)



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MH (heavy duty)

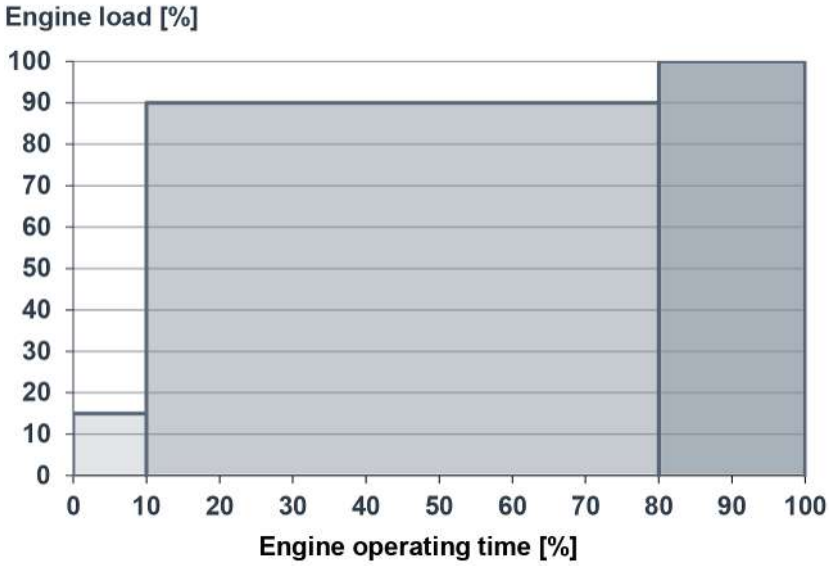



Figure 29: MH (heavy duty) - exemplary load profile

| Average load of example | Typical operation time | Typical applications |
|---|---|---|
| 84.5% | < 5,000 h/a | OSV, ferry |

Table 10: Legend diagram MH (heavy duty)

### Marine mechanical propulsion heavy duty (MH)

| Type designation | Output[1] | | Speed [rpm] | Average load [%] | TBO[2] [Operating hours] |
|---|---|---|---|---|---|
| | [kW] | [bhp] | | | |
| MH, 145 kW/cyl., 1,800 rpm | 12V: 1,740 | 12V: 2,333 | 1,800 | 85 | 30,000 |

[1] $P_{ISO, standard}$: ISO standard output (as specified in DIN ISO 3046-1).

[2] TBO values are target values without warranty. Some parts may have shorter TBOs, see accordingly the respective maintenance schedule. The TBO is not only influenced by the engine rating and load profile but also by, for example, media treatment and ambient conditions.

Typical applications are, amongst others:

Offshore vessels, tug, ferry (also applicable for patrol boat and yacht).

Table 11: Marine mechanical propulsion heavy duty (MH)



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MEL (light duty)

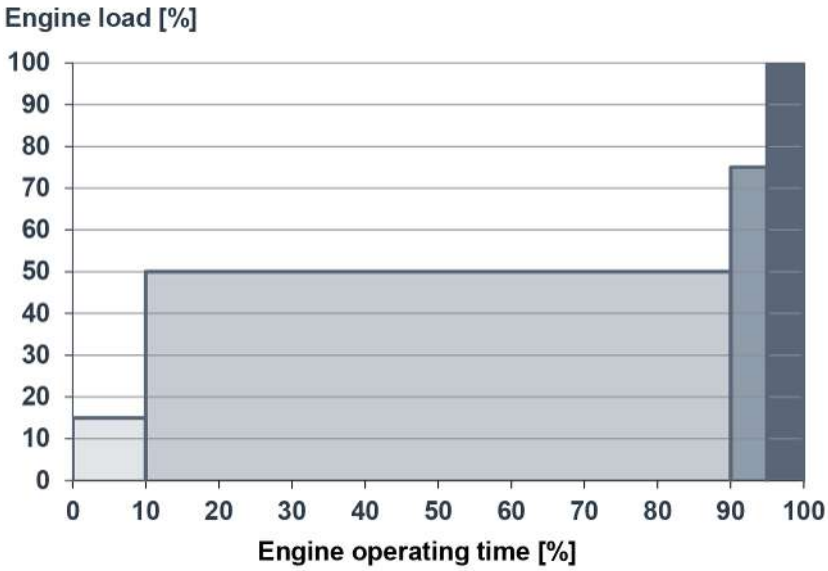



Figure 30: MEL (light duty) - exemplary load profile

| Average load of example | Typical operation time | Typical applications |
|---|---|---|
| 50% | < 5,000 h/a | OSV, Navy, other DE |

Table 12: Legend diagram MEL (light duty)



2025-10-30 - 12.0

**Electric propulsion applications/ratings**

Marine electric propulsion light duty (MEL)

| Type designation | Output[1] | | Speed [rpm] | Average load [%] | TBO[2] [Operating hours] |
|---|---|---|---|---|---|
| | [kW] | [bhp] | | | |
| MEL, 190 kW/cyl., 1,800 rpm | 12V: 2,280<br>20V: 3,800 | 12V: 3,057<br>20V: 5,095 | 1,800<br>(60 Hz) | 50 | 25,000 |
| MEL, 185 kW/cyl., 1,800 rpm | 16V: 2,960 | 16V: 3,969 | 1,800<br>(60 Hz) | 50 | 25,000 |
| MEL, 175 kW/cyl., 1,800 rpm | 12V: 2,100<br>16V: 2,800<br>20V: 3,500 | 12V: 2,816<br>16V: 3,755<br>20V: 4,693 | 1,800<br>(60 Hz) | 50 | 25,000 |
| MEL, 165 kW/cyl., 1,500 rpm | 12V: 1,980<br>16V: 2,640<br>20V: 3,300 | 12V: 2,655<br>16V: 3,540<br>20V: 4,425 | 1,500<br>(50 Hz) | 50 | 25,000 |
| MEL, 150 kW/cyl., 1,500 rpm | 12V: 1,800<br>16V: 2,400<br>20V: 3,000 | 12V: 2,413<br>16V: 3,218<br>20V: 4,023 | 1,500<br>(50 Hz) | 50 | 25,000 |

[1] $P_{ISO, standard}$: ISO standard output (as specified in DIN ISO 3046-1).

[2] TBO values are target values without warranty. Some parts may have shorter TBOs, see accordingly the respective maintenance schedule. The TBO is not only influenced by the engine rating and load profile but also by, for example, media treatment and ambient conditions.

Typical applications are, amongst others:

Offshore vessels, navy, ferry, and other electric propulsion vessels.

Table 13: Marine electric propulsion light duty (MEL)



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MEM/MA/MEV (medium duty)

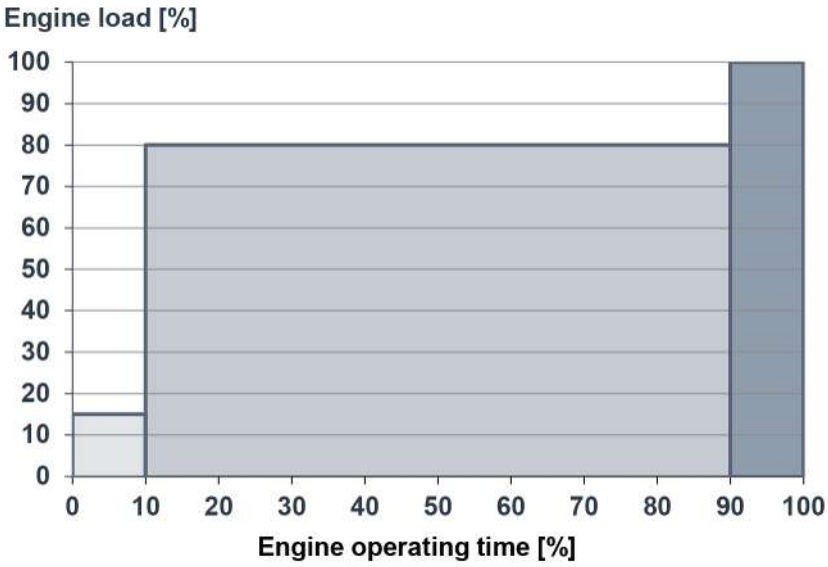



Figure 31: MEM/MA/MEV (medium duty) - exemplary load profile

| Average load of example | Typical operation time | Typical applications |
|---|---|---|
| 75% | < 5,000 h/a | OSV, Navy, other DE |

Table 14: Legend diagram MEM/MA/MEV (medium duty)

### Marine electric propulsion medium duty (MEM)

| Type designation | Output[1] | | Speed [rpm] | Average load [%] | TBO[2] [Operating hours] |
|---|---|---|---|---|---|
| | [kW] | [bhp] | | | |
| MEM, 160 kW/cyl., 1,800 rpm | 12V: 1,920<br>16V: 2,560<br>20V: 3,200 | 12V: 2,574<br>16V: 3,433<br>20V: 4,291 | 1,800<br>(60 Hz) | 50 | 30,000 |
| MEM, 150 kW/cyl., 1,800 rpm | 12V: 1,800<br>16V: 2,400<br>20V: 3,000 | 12V: 2,413<br>16V: 3,218<br>20V: 4,023 | 1,800<br>(60 Hz) | 75 | 30,000 |
| MEM, 135 kW/cyl., 1,500 rpm | 12V: 1,620<br>16V: 2,160<br>20V: 2,700 | 12V: 2,172<br>16V: 2,896<br>20V: 3,620 | 1,500<br>(50 Hz) | 50 | 30,000 |
| MEM, 120 kW/cyl., 1,500 rpm | 12V: 1,440 | 12V: 1,931 | 1,500<br>(50 Hz) | 75 | 30,000 |

[1] $P_{ISO, standard}$: ISO standard output (as specified in DIN ISO 3046-1).

[2] TBO values are target values without warranty. Some parts may have shorter TBOs, see accordingly the respective maintenance schedule. The TBO is not only influenced by the engine rating and load profile but also by, for example, media treatment and ambient conditions.

Typical applications are, amongst others:

Offshore vessels, navy, ferry, and other electric propulsion vessels.

Table 15: Marine electric propulsion medium duty (MEM)



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**Electric propulsion with variable speed applications/ratings**

Marine electric propulsion with variable speed, medium duty (MEV)

| Type designation | Output[1] | | Speed [rpm] | Average load [%] | TBO[2] [Operating hours] |
|---|---|---|---|---|---|
| | [kW] | [bhp] | | | |
| MEV, 190 kW/cyl., 1,800 rpm | 12V: 2,280<br>20V: 3,800 | 12V: 3,057<br>20V: 5,095 | 1,080–1,800 | 50 | 25,000 |
| MEV, 185 kW/cyl., 1,800 rpm | 16V: 2,960 | 16V: 3,969 | 1,080–1,800 | 50 | 25,000 |
| MEV, 170 kW/cyl., 1,800 rpm | 12V: 2,040<br>16V: 2,720<br>20V: 3,400 | 12V: 2,735<br>16V: 3,647<br>20V: 4,559 | 1,080–1,800 | 50 | 30,000 |
| MEV, 155 kW/cyl., 1,800 rpm | 12V: 1,860<br>16V: 2,480<br>20V: 3,100 | 12V: 2,494<br>16V: 3,325<br>20V: 4,157 | 1,080–1,800 | 75 | 30,000 |

[1] $P_{ISO, standard}$: ISO standard output (as specified in DIN ISO 3046-1).

[2] TBO values are target values without warranty. Some parts may have shorter TBOs, see accordingly the respective maintenance schedule. The TBO is not only influenced by the engine rating and load profile but also by, for example, media treatment and ambient conditions.

Typical applications are, amongst others:

Offshore vessels, navy, ferry, and other electric propulsion vessels.

Table 16: Marine electric propulsion with variable speed, medium duty (MEV)



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### Auxiliary applications/ratings

Marine auxiliary (MA)

| Type designation | Output[1] | | Speed [rpm] | Average load [%] | TBO[2] [Operating hours] |
|---|---|---|---|---|---|
| | [kW] | [bhp] | | | |
| MA, 190 kW/cyl., 1,800 rpm | 12V: 2,280 | 12V: 3,057 | 1,800 (60 Hz) | 50 | 25,000 |
| MA, 175 kW/cyl., 1,800 rpm | 12V: 2,100 | 12V: 2,816 | 1,800 (60 Hz) | 50 | 25,000 |
| MA, 160 kW/cyl., 1,800 rpm | 12V: 1,920 | 12V: 2,574 | 1,800 (60 Hz) | 50 | 30,000 |
| MA, 150 kW/cyl., 1,800 rpm | 16V: 2,400 | 16V: 3,218 | 1,800 (60 Hz) | 75 | 30,000 |
| MA, 165 kW/cyl., 1,500 rpm | 12V: 1,980 | 12V: 2,655 | 1,500 (50 Hz) | 50 | 25,000 |
| MA, 150 kW/cyl., 1,500 rpm | 12V: 1,800 | 12V: 2,413 | 1,500 (50 Hz) | 50 | 25,000 |
| MA, 135 kW/cyl., 1,500 rpm | 12V: 1,620 | 12V: 2,172 | 1,500 (50 Hz) | 50 | 30,000 |

[1] $P_{ISO, standard}$: ISO standard output (as specified in DIN ISO 3046-1).

[2] TBO values are target values without warranty. Some parts may have shorter TBOs, see accordingly the respective maintenance schedule. The TBO is not only influenced by the engine rating and load profile but also by, for example, media treatment and ambient conditions.

Typical applications are, amongst others:

For continuous power generation for auxiliary purposes.

Table 17: Marine auxiliary (MA)

### Further applications/ratings

If you have significant deviations from above stated applications or uncertainties for selecting the right engine, consult Everllence.
Further, any application for offshore platforms or rigs should be approved by Everllence.



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### 2.4.4 Speed adjusting range

The following specification represents the standard settings. For special applications, deviating settings may be necessary.

| | Drive | Speed droop | Minimum speed at full load | Maximum speed at idle running | Minimum speed |
|---|---|---|---|---|---|
| Electronic speed control | Every main engine each with controllable pitch propeller and without PTO | 0% | 100% (+0.5%) | 100% (+0.5%) | 600 rpm |
| | Every main engine each with controllable pitch propeller and with PTO | 0% | 100% (+0.5%) | 100% (+0.5%) | 600 rpm |
| | Parallel operation of 2 engines driving 1 shaft with/without PTO: | | | | |
| | Load sharing via speed droop | 3-5% | 95% (+0.5%) | 100% (+0.5%) | 600 rpm |
| | or | | | | |
| | master/slave operation | 0% | 100% (+0.5%) | 100% (+0.5%) | 600 rpm |
| | GenSets/electric propulsion plants: | | | | |
| | With load sharing via speed droop | 3-6.5% | 97.5% (+0.5%) | 104% (+0.5%) | 100%[1)] |
| | or | | | | |
| | isochronous operation | 0% | 100% (+0.5%) | 100% (+0.5%) | 100%[1)] |
| | Fixed pitch propeller plants | 0% | 100% (+0.5%) | - | 600 rpm |

[1)] Speed after start of the engine, before synchronisation.

Table 18: Electronic speed control

Note:
For single-engine plants with fixed pitch propeller, the speed droop is of no significance.
Only if several engines drive one shaft with fixed pitch propeller, the speed droop is relevant for the load distribution. In the case of electronic speed control, a speed droop of 0% is also possible during parallel operation.



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## 2.5 Standard versus optional equipment

| Device/measure | Auxiliary | Electric propulsion | Mechanical propulsion |
|---|---|---|---|
| Engine prepared for external intake air supply system | In case of engine operation under arctic conditions (see section Engine operation under arctic conditions, Page 101) | | |
| Temperature after turbine control by continuously adjustable waste gate | X (for Tier III application) | X (for Tier III application) | X (for Tier III application) |
| SCR system | X (for Tier III application) | X (for Tier III application) | X (for Tier III application) |
| Charge air pressure control by continuously adjustable waste gate | In case of Tier II application only applied for variants with > 150 kW/cyl. nominal output. | | |
| One-stage charge air cooler (LT circuit) | X | X | X |
| Splash oil monitoring | X | X | X |
| Main bearing temperature monitoring[1)] | O | O | O |
| Starting system – Electric starter | X | X | X |
| Starting system – Compressed air starter | O | O | O |
| Redundant starting system (electric starter + pneumatic starter) | O | O | O |
| Attached HT cooling water pump | X | X | X |
| Attached LT cooling water pump | X | X | X |
| Attached lube oil pump | X | X | X |
| Attached fuel supply pump | X | X | X |
| Attached seawater pump | O | O | O |
| Attached auxiliary cooling water pump | O | O | O |
| Attached prelubrication pump (electric driven) | O[2)] | O[2)] | O[2)] |
| Attached lube oil centrifuge | O | O | O |
| HT cooling water temperature control thermostat | X | X | X |
| Lube oil temperature control thermostat | X | X | X |
| Lube oil cooler | X | X | X |
| Lube oil filter | X | X | X |
| Lube oil level monitoring | X | X | X |
| PTO ccs (crankshaft extension) | O | O | O |
| Attached seawater cooler | O | O | O |
| Fresh water adapter | O | O | O |
| Attached alternator | O[3)] | O[3)] | O[3)] |
| Exhaust gas temperature monitoring per cylinder | O | O | O |



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| Device/measure | Auxiliary | Electric propulsion | Mechanical propulsion |
|---|---|---|---|
| Deep oil sump | O[4)] | O[4)] | O[4)] |
| Shock mount | O | O | O |

X = required, O = optional, – = not designed

[1)] Specific monitoring for each main bearing and early detection of possible main bearing damages.

[2)] Prelubrication pump is mandatory for engine. If not attached, then prelubrication pump in plant equipment required.

[3)] With belt drive or direct drive.

[4)] Only for 20V.

Note:
Everllence recommends an engine room temperature of +5°C to avoid freezing wetness on intake air silencer filter mat and electronic equipment.

Table 19: Standard versus optional equipment

**Standard equipment (attached at the engine):**

- Duplex fuel filter, complete with change-over cock enabling one filter element to be exchanged while engine is running
- Integrated lube oil cooler and filter
- Integrated cooling system, consisting of lube oil cooler, charge air cooler and cylinder cooling
- Lube oil paper cartridge filter

Optional attached equipment at the engine

- Additional attached centrifugal filter for extended lube oil change intervals
- Other equipment see table above

Optional equipment as loose supply

- Electric preheating unit for HT engine cooling water
- External lube oil pump interface
- Optional engine driven auxiliary water pump

As an option an engine driven auxiliary water pump is available for cooling of external consumers, e.g. hydraulic oil cooling or thruster cooling. The cooling circuit is intended for fresh water, seawater is not allowed. The pump should not be integrated in the closed LT cooling water circuit. If this is required contact Everllence.

| Max. suction lift [m] | Max. back pressure plant [bar] | Nominal flow rate [l/min] | At engine speed [rpm] | Media temperature [°C] |
|---|---|---|---|---|
| 3 (NPSHa: 100% water)<br>5 (NPSHa: 40% glycol) | 1 | 600 | 1,800 | -10%/+40° |

Table 20: Max. suction lift



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## 2.6 Mechanical propulsion application

### 2.6.1 Operating ranges – General remarks

The propeller design depends on type and application of the vessel. Therefore the determination of the installed propulsive power in the ship is always the exclusive responsibility of the yard. A typical design power margin of approx. 6–10% shall be used without project-specific requirements.

Determining the engine power:
The energy demand or the energy losses from all at the engine also attached aggregates has to be considered (for example, shaft alternators, gearboxes). That means, after deduction of their energy demand from the engine power the remaining engine power must be sufficient for the required propulsion power.

Max. fuel admission (blocking):
In accordance to classification rules, engines for mechanical propulsion must be blocked at 100–102% fuel admission, so that 100% output cannot be exceeded.

Note:
In next section Operating ranges – Mechanical propulsion variants, Page 56 stated operating ranges are fixed and will not be changed with two exceptions stated below.

#### Adaption of torque limiter curve – Only on special demand

As a standard during Factory Acceptance Test (FAT) the engine will be limited to the variant-specific operating range by parameterisation of the engine torque limiter curve.

If project-specific, a further limitation of this range is required, for example, due to layout of propulsion train for maximum torque at MCR, this needs to be agreed on at early stage and prior to FAT.



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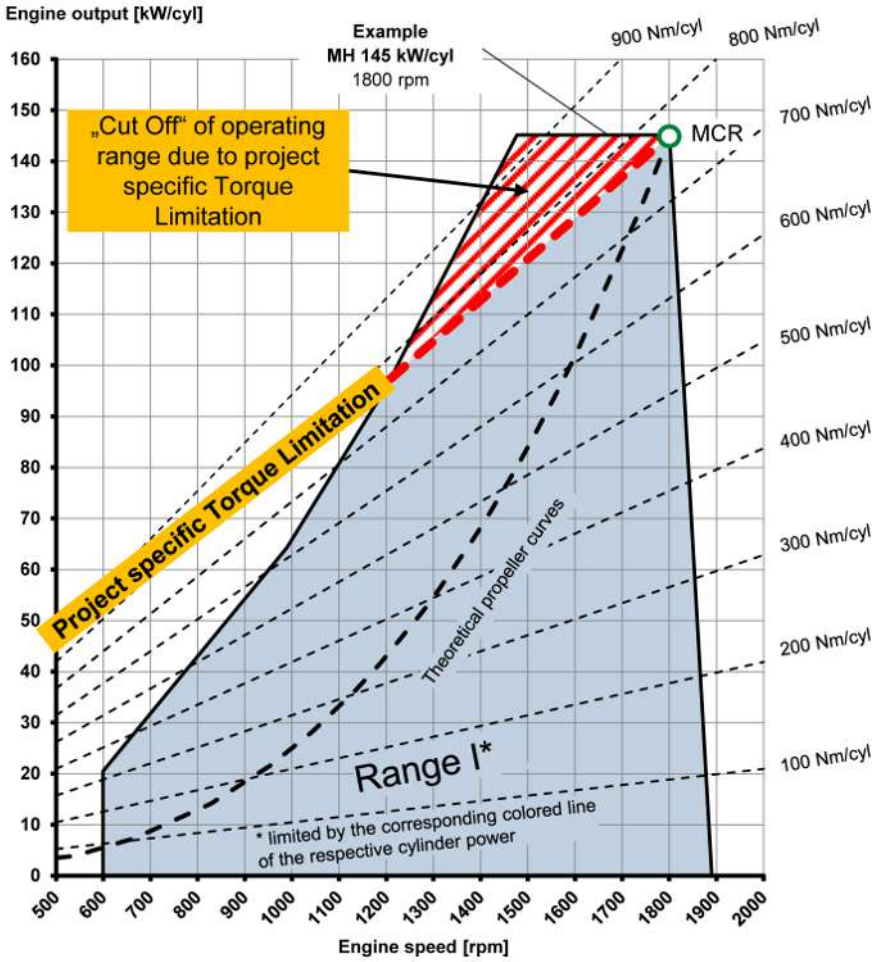



Figure 32: Operating range – Example for adaption of torque limiter curve

### "Battle Override" – Only on special demand

On special demand, the optional "Battle Override" function is available.
In special manoeuvres or applications (for example, combat situations in the navy), an additional engine power beyond the regularly released engine power may be required. This service can be provided via the optional "Battle Override" function (not available for: ML variant with 215 kW/cyl., 220 kW/cyl., at 2,000 rpm and MM variant with 200 kW/cyl. at 1,800 rpm).

This function is activated by switching a digital input of the SaCoS system of the engine (for circuit diagram see customer documentation). The activation of this digital input has to be implemented in the ship control system (for example, switch).
By activating the "Battle Override" function, the engine operating map expands by an additional 10% engine output.

Important note: In operation of the engine in the extended engine map area, any warranty claim for the engine is void.
After operation in the extended map area, maintenance work by service is necessary.



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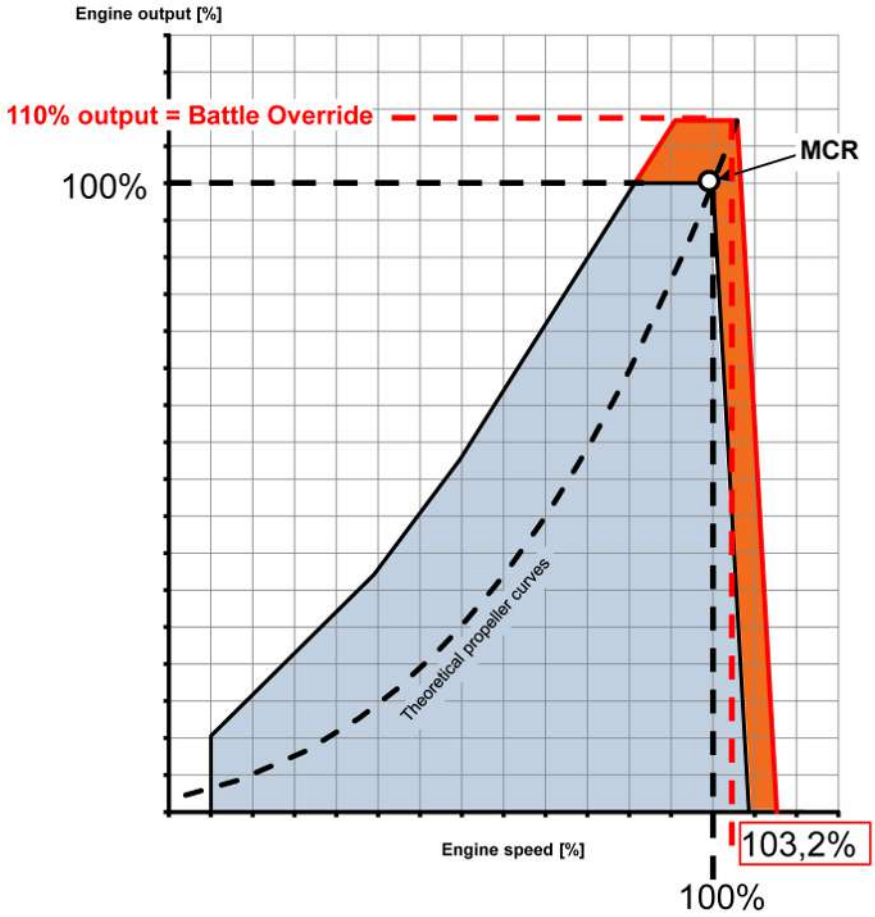



Figure 33: Operating range – Example for function "Battle Override"



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### 2.6.2 Operating ranges – Mechanical propulsion variants

When according the load profile and detailed application the engine variant has been chosen, the associated operating range can be found below.

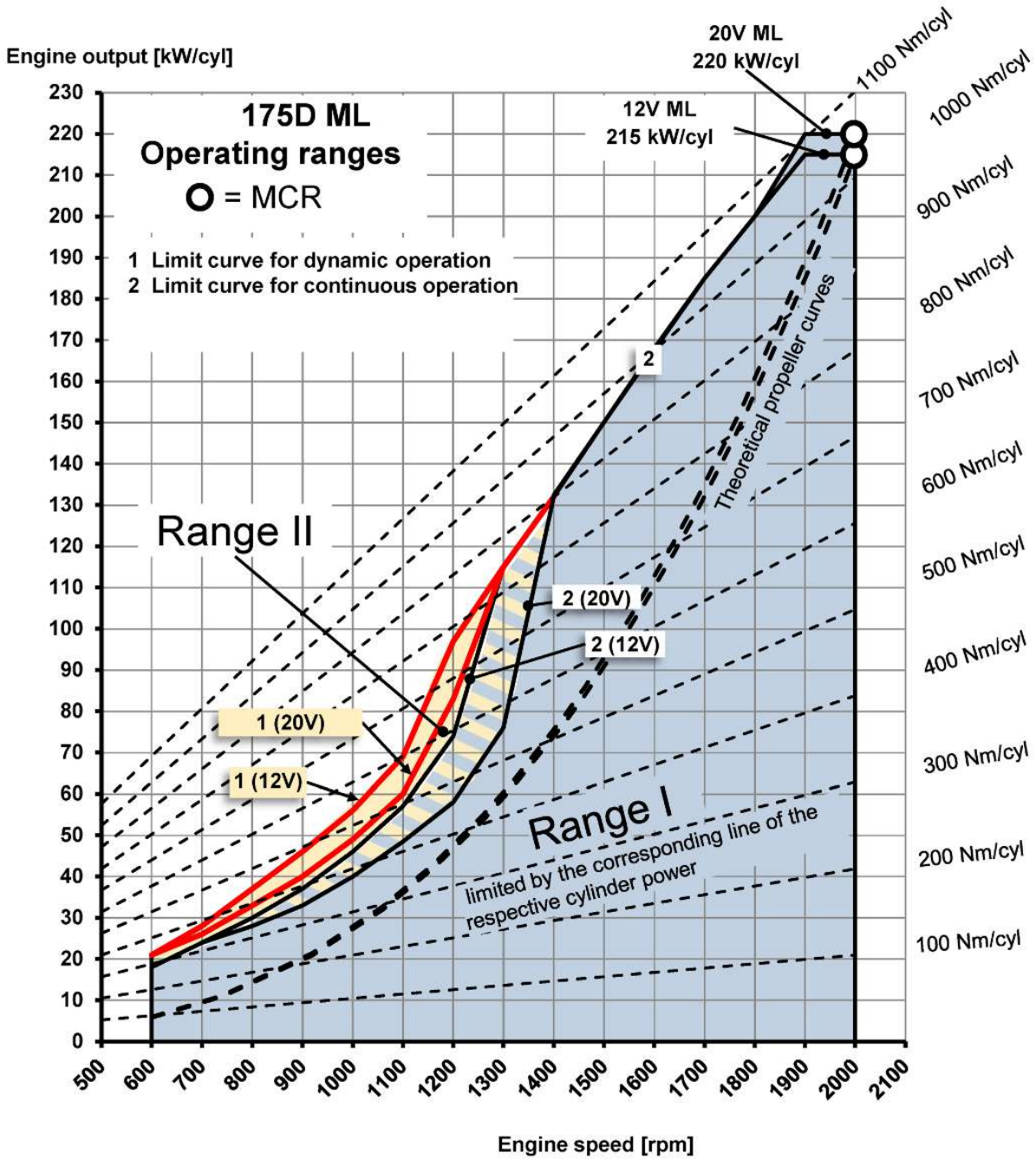



Figure 34: Operating ranges of the ML variants, 215 kW/cyl. and 220 kW/cyl.

- MCR
  Maximum continuous rating.
- Range I
  Operating range for continuous operation.

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- Range II

  Operating range which is temporarily (< 2 min.) admissible e.g. during acceleration and manoeuvring.

| Limit curves 175D ML, 215 and 220 kW/cyl. | | | | |
|---|---|---|---|---|
| Engine speed [rpm] | 12V, 215 kW/cyl. | | 20V, 220 kW/cyl. | |
| | 12V Continuos operation | 12V Dynamic operation | 20V Continuos operation | 20V Dynamic operation |
| | Engine output [kW/cyl.] | | | |
| 600 | 18 | 21 | 18 | 21 |
| 700 | 24 | 28 | 24 | 26 |
| 800 | 30 | 37 | 28 | 33 |
| 900 | 37 | 46 | 33 | 40 |
| 1,000 | 46 | 56 | 40 | 49 |
| 1,100 | 57 | 69 | 48.5 | 60 |
| 1,200 | 74 | 97 | 58 | 83 |
| 1,300 | 115 | 115 | 76 | 115 |
| 1,400 | 132 | 132 | 132 | 132 |
| 1,500 | 150 | 150 | 150 | 150 |
| 1,600 | 168 | 168 | 168 | 168 |
| 1,700 | 185 | 185 | 185 | 185 |
| 1,800 | 200 | 200 | 200 | 200 |
| 1,900 | 215 | 215 | 220 | 220 |
| 2,000 | 215 | 215 | 220 | 220 |

Table 21: Limit curve values of the ML variants, 215 kW/cyl. and 220 kW/cyl.

Note:
The propeller design depends on type and application of the vessel. Therefore the determination of the installed propulsive power in the ship is always the exclusive responsibility of the yard. A typical design power margin of approx. 6 to 10% shall be used without project specific requirements. Determining the engine power: The energy demand or the energy losses from all at the engine additionally attached aggregates has to be considered (e.g. shaft alternators, gearboxes). That means, after deduction of their energy demand from the engine power the remaining engine power must be sufficient for the required propulsion power.



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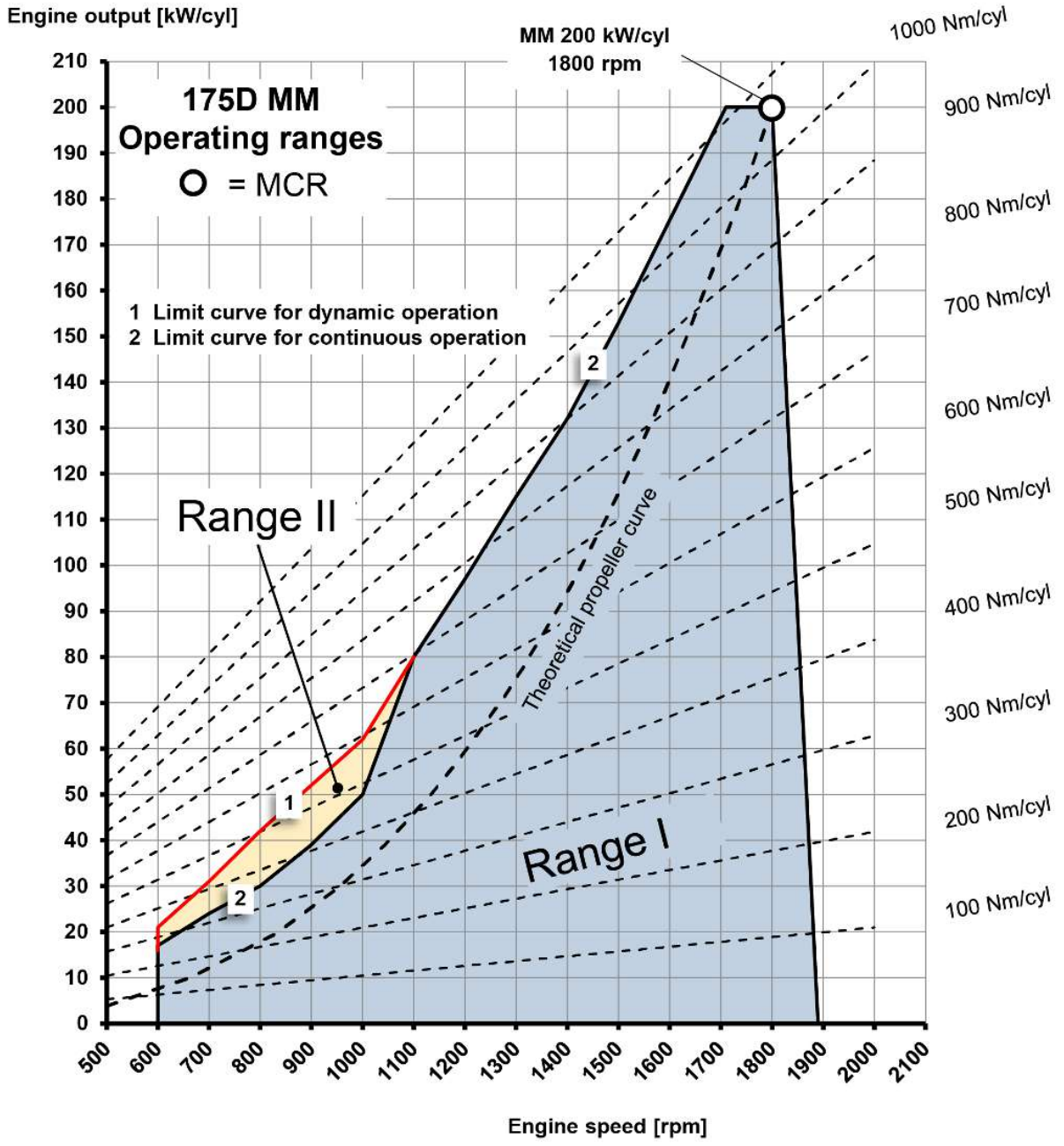



Figure 35: Operating range 12V, MM, 200 kW/cyl., 1,800 rpm for Tug Application



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- MCR

  Maximum continuous rating.
- Range I

  Operating range for continuous operation.
- Range II

  Operating range which is temporarily (< 2 min.) admissible e.g. during acceleration and manoeuvring.

*) For 12V/16V/20V - Tier III operation only - engine operation to be designed to the right of this line.

| **Limit curves 175D MM, 200 kW/cyl. for Tug Application** | | |
|---|---|---|
| **Engine speed [rpm]** | **12V, 200 kW/cyl.** | |
| | **12V Continuos operation** | **12V Dynamic operation** |
| | **Engine output [kW/cyl.]** | |
| 600 | 17 | 21 |
| 700 | 24 | 31 |
| 800 | 30 | 42 |
| 900 | 39 | 52 |
| 1,000 | 50 | 62 |
| 1,100 | 80 | 80 |
| 1,200 | 97 | 97 |
| 1,300 | 115 | 115 |
| 1,400 | 132 | 132 |
| 1,500 | 152.9 | 152.9 |
| 1,600 | 175.3 | 175.3 |
| 1,700 | 197.8 | 197.8 |
| 1,710 | 200 | 200 |
| 1,800 | 200 | 200 |

Table 22: Limit curve values of the 12V, MM variant, 200 kW/cyl. for Tug Application



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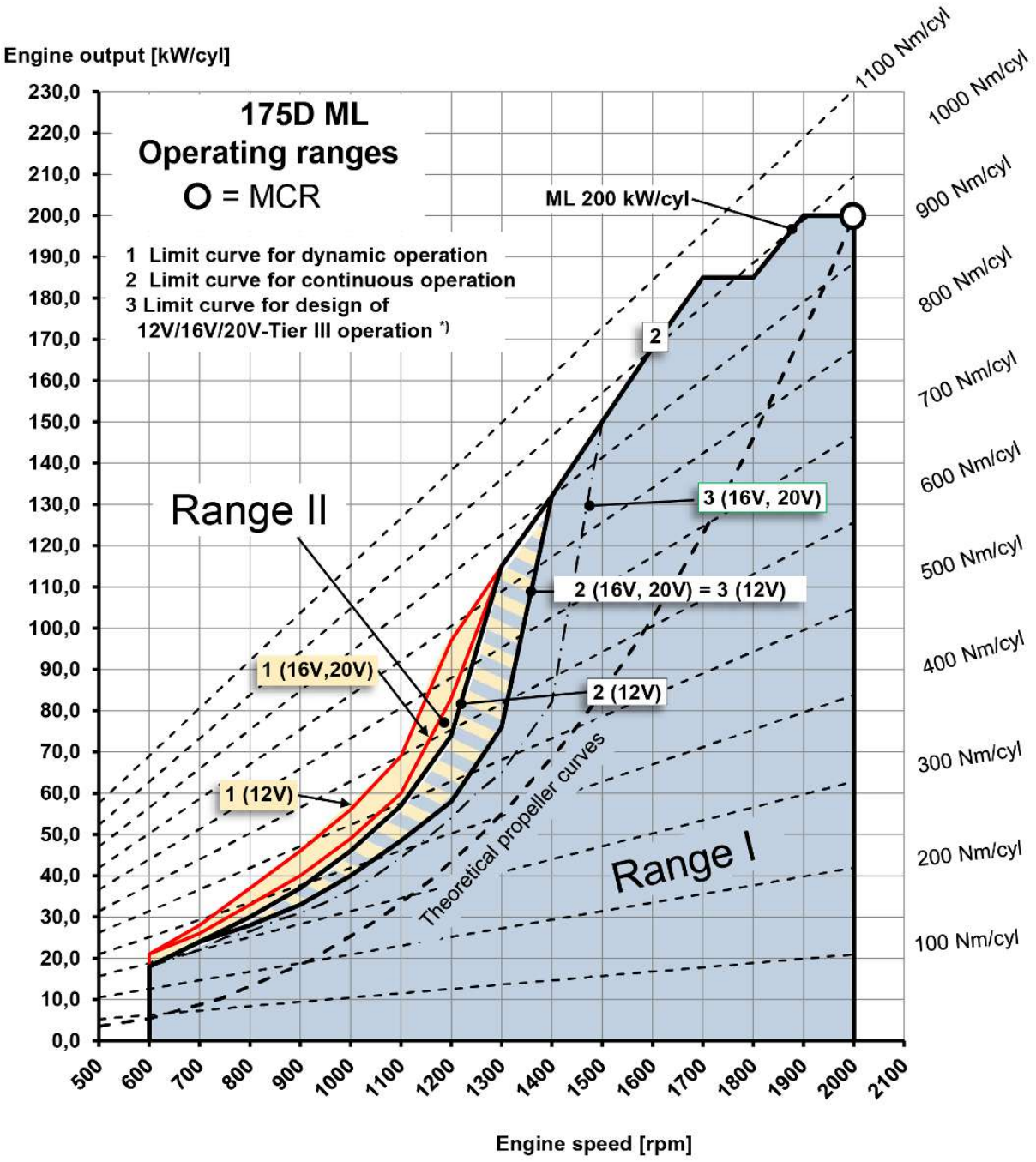



Figure 36: Operating range of the ML variant, 200 kW/cyl

- MCR

  Maximum continuous rating.
- Range I

  Operating range for continuous operation.
- Range II

  Operating range which is temporarily (< 2 min.) admissible e.g. during acceleration and manoeuvring.

*) For 12V/16V/20V - Tier III operation only - engine operation to be designed to the right of this line.

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| Limit curves 175D ML, 200 kW/cyl. | | | | |
|---|---|---|---|---|
| Engine speed [rpm] | 12V | | 16V, 20V | |
| | 12V Continuos operation | 12V Dynamic operation | 16V, 20V Continuos operation | 16V, 20V Dynamic operation |
| | Engine output [kW/cyl.] | | | |
| 600 | 18 | 21 | 18 | 21 |
| 700 | 24 | 28 | 24 | 26 |
| 800 | 30 | 37 | 28 | 33 |
| 900 | 37 | 46 | 33 | 40 |
| 1,000 | 46 | 56 | 40 | 49 |
| 1,100 | 57 | 69 | 48.5 | 60 |
| 1,200 | 74 | 97 | 58 | 83 |
| 1,300 | 115 | 115 | 76 | 115 |
| 1,400 | 132 | 132 | 132 | 132 |
| 1,500 | 150 | 150 | 150 | 150 |
| 1,600 | 168 | 168 | 168 | 168 |
| 1,700 | 185 | 185 | 185 | 185 |
| 1,800 | 185 | 185 | 185 | 185 |
| 1,900 | 200 | 200 | 200 | 200 |
| 2,000 | 200 | 200 | 200 | 200 |

Table 23: Limit curve values of the ML variant, 200 kW/cyl.

| Limit curves for design Tier III operating points ML variants | | |
|---|---|---|
| Engine speed [rpm] | 12V | 16V, 20V |
| | Engine output [kW/cyl.] | |
| 600 | 18 | 18 |
| 650 | 20 | 20 |
| 700 | 24 | 22 |
| 750 | 26 | 25 |
| 800 | 28 | 26.5 |
| 850 | 30.5 | 29 |
| 900 | 33 | 31 |
| 950 | 36.5 | 33.5 |
| 1,000 | 40 | 36.5 |
| 1,050 | 44.5 | 40 |
| 1,100 | 48.5 | 44.5 |
| 1,150 | 53 | 49 |
| 1,200 | 58 | 54 |



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| Limit curves for design Tier III operating points ML variants | | |
|---|---|---|
| Engine speed | 12V | 16V, 20V |
| [rpm] | Engine output [kW/cyl.] | |
| 1,250 | 66.5 | 60 |
| 1,300 | 76 | 65 |
| 1,400 | 132 | 82 |
| 1,500 | - | 150 |

Table 24: Limit curve values of the ML variants, 200 kW/cyl., 215 kW/cyl. and 220 kW/cyl. for desgin Tier III operating points

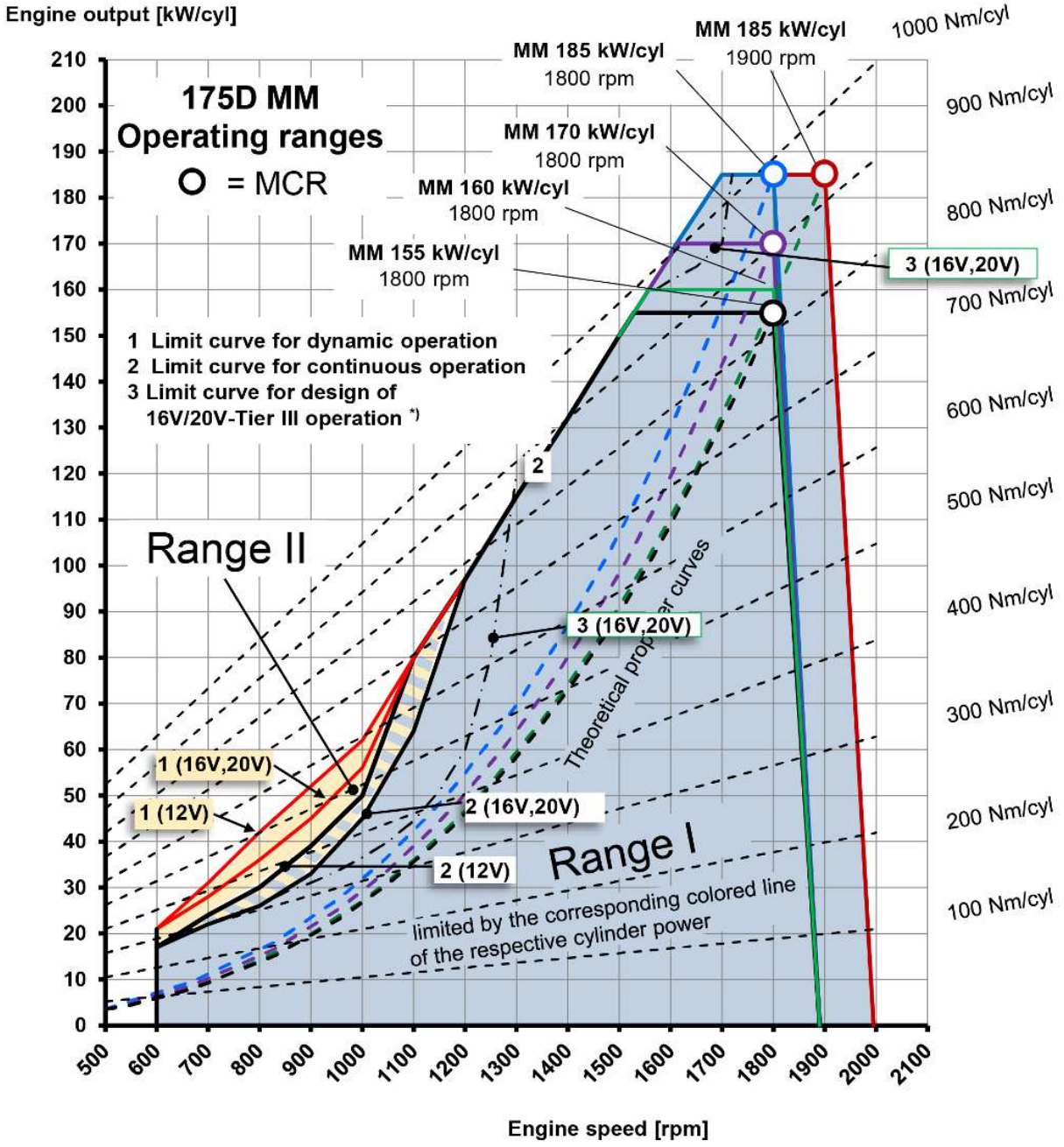



Figure 37: Operating ranges of the MM variants

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- MCR

  Maximum continuous rating.
- Range I

  Operating range for continuous operation.
- Range II

  Operating range which is temporarily (< 2 min.) admissible e.g. during acceleration and manoeuvring.

*) For 16V/20V - Tier III operation only - engine operation to be designed to the right of this line.

| Limit curves 175D MM, 185 kW/cyl., 1,900 rpm | | | | |
|---|---|---|---|---|
| Engine speed [rpm] | 12V | | 16V, 20V | |
| | 12V Continuos operation | 12V Dynamic operation | 16V, 20V Continuos operation | 16V, 20V Dynamic operation |
| | Engine output [kW/cyl.] | | | |
| 600 | 17 | 21 | 17 | 21 |
| 700 | 24 | 31 | 22 | 28 |
| 800 | 30 | 42 | 26 | 36 |
| 900 | 39 | 52 | 33 | 45 |
| 1,000 | 50 | 62 | 45 | 56 |
| 1,100 | 80 | 80 | 64 | 80 |
| 1,200 | 97 | 97 | 97 | 97 |
| 1,300 | 115 | 115 | 115 | 115 |
| 1,400 | 132 | 132 | 132 | 132 |
| 1,500 | 150 | 150 | 150 | 150 |
| 1,600 | 168 | 168 | 168 | 168 |
| 1,700 | 185 | 185 | 185 | 185 |
| 1,800 | 185 | 185 | 185 | 185 |
| 1,900 | 185 | 185 | 185 | 185 |

Table 25: Limit curve values of the MM variant, 185 kW/cyl., 1,900 rpm

| Limit curves 175D MM, 185 kW/cyl., 1,800 rpm | | | | |
|---|---|---|---|---|
| Engine speed [rpm] | 12V | | 16V, 20V | |
| | 12V Continuos operation | 12V Dynamic operation | 16V, 20V Continuos operation | 16V, 20V Dynamic operation |
| | Engine output [kW/cyl.] | | | |
| 600 | 17 | 21 | 17 | 21 |
| 700 | 24 | 31 | 22 | 28 |
| 800 | 30 | 42 | 26 | 36 |
| 900 | 39 | 52 | 33 | 45 |
| 1,000 | 50 | 62 | 45 | 56 |



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| Limit curves 175D MM, 185 kW/cyl., 1,800 rpm | | | | |
|---|---|---|---|---|
| Engine speed [rpm] | 12V | | 16V, 20V | |
| | 12V Continuos operation | 12V Dynamic operation | 16V, 20V Continuos operation | 16V, 20V Dynamic operation |
| | Engine output [kW/cyl.] | | | |
| 1,100 | 80 | 80 | 64 | 80 |
| 1,200 | 97 | 97 | 97 | 97 |
| 1,300 | 115 | 115 | 115 | 115 |
| 1,400 | 132 | 132 | 132 | 132 |
| 1,500 | 150 | 150 | 150 | 150 |
| 1,600 | 168 | 168 | 168 | 168 |
| 1,700 | 185 | 185 | 185 | 185 |
| 1,800 | 185 | 185 | 185 | 185 |

Table 26: Limit curve values of the MM variant, 185 kW/cyl., 1,800 rpm

| Limit curves 175D MM, 170 kW/cyl., 1,800 rpm | | | | |
|---|---|---|---|---|
| Engine speed [rpm] | 12V | | 16V, 20V | |
| | 12V Continuos operation | 12V Dynamic operation | 16V, 20V Continuos operation | 16V, 20V Dynamic operation |
| | Engine output [kW/cyl.] | | | |
| 600 | 17 | 21 | 17 | 21 |
| 700 | 24 | 31 | 22 | 28 |
| 800 | 30 | 42 | 26 | 36 |
| 900 | 39 | 52 | 33 | 45 |
| 1,000 | 50 | 62 | 45 | 56 |
| 1,100 | 80 | 80 | 64 | 80 |
| 1,200 | 97 | 97 | 97 | 97 |
| 1,300 | 115 | 115 | 115 | 115 |
| 1,400 | 132 | 132 | 132 | 132 |
| 1,500 | 150 | 150 | 150 | 150 |
| 1,615 | 170 | 170 | 170 | 170 |
| 1,700 | 170 | 170 | 170 | 170 |
| 1,800 | 170 | 170 | 170 | 170 |

Table 27: Limit curve values of the MM variant, 170 kW/cyl., 1,800 rpm

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| Limit curves 175DD MM, 160 kW/cyl., 1,800 rpm | | | | |
|---|---|---|---|---|
| Engine speed [rpm] | 12V | | 16V | |
| | 12V Continuos operation | 12V Dynamic operation | 16V Continuos operation | 16V Dynamic operation |
| | Engine output [kW/cyl.] | | | |
| 600 | 17 | 21 | 17 | 21 |
| 700 | 24 | 31 | 22 | 28 |
| 800 | 30 | 42 | 26 | 36 |
| 900 | 39 | 52 | 33 | 45 |
| 1,000 | 50 | 62 | 45 | 56 |
| 1,100 | 80 | 80 | 64 | 80 |
| 1,200 | 97 | 97 | 97 | 97 |
| 1,300 | 115 | 115 | 115 | 115 |
| 1,400 | 132 | 132 | 132 | 132 |
| 1,500 | 150 | 150 | 150 | 150 |
| 1,557 | 160 | 160 | 160 | 160 |
| 1,700 | 160 | 160 | 160 | 160 |
| 1,800 | 160 | 160 | 160 | 160 |

Table 28: Limit curve values of the MM variant, 160 kW/cyl., 1,800 rpm

| Limit curves 175D MM, 155 kW/cyl., 1,800 rpm | | |
|---|---|---|
| Engine speed [rpm] | 12V | |
| | 12V Continuos operation | 12V Dynamic operation |
| | Engine output [kW/cyl.] | |
| 600 | 17 | 21 |
| 700 | 24 | 31 |
| 800 | 30 | 42 |
| 900 | 39 | 52 |
| 1,000 | 50 | 62 |
| 1,100 | 80 | 80 |
| 1,200 | 97 | 97 |
| 1,300 | 115 | 115 |
| 1,400 | 132 | 132 |
| 1,500 | 150 | 150 |
| 1,528.7 | 155 | 155 |
| 1,700 | 155 | 155 |
| 1,800 | 155 | 155 |

Table 29: Limit curve values of the MM variant, 155 kW/cyl., 1,800 rpm

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| Limit curves for design Tier III operating points MM variants - lower load range | |
|---|---|
| **Engine speed** | **16V, 20V** |
| **[rpm]** | **Engine output [kW/cyl.]** |
| 600 | 17 |
| 700 | 22 |
| 750 | 24.5 |
| 800 | 26 |
| 850 | 29 |
| 900 | 31 |
| 950 | 33.5 |
| 1,000 | 36.5 |
| 1,050 | 40 |
| 1,100 | 44.5 |
| 1,150 | 51 |
| 1,200 | 60 |
| 1,250 | 80 |
| 1,290 | 113.5 |

Table 30: Limit curve values of the MM variants, 185 kW/cyl., 170 kW/cyl., 160 kW/cyl. and 155 kW/cyl. for desgin Tier III operating points - lower load range

| Limit curves for design Tier III operating points MM variants - upper load range | |
|---|---|
| **Engine speed** | **16V, 20V** |
| **[rpm]** | **Engine output [kW/cyl.]** |
| 1,570 | 160 |
| 1,600 | 162 |
| 1,650 | 165 |
| 1,700 | 170 |
| 1,720 | 185 |

Table 31: Limit curve values of the MM variants, 185 kW/cyl., 170 kW/cyl. for desgin Tier III operating points - upper load range



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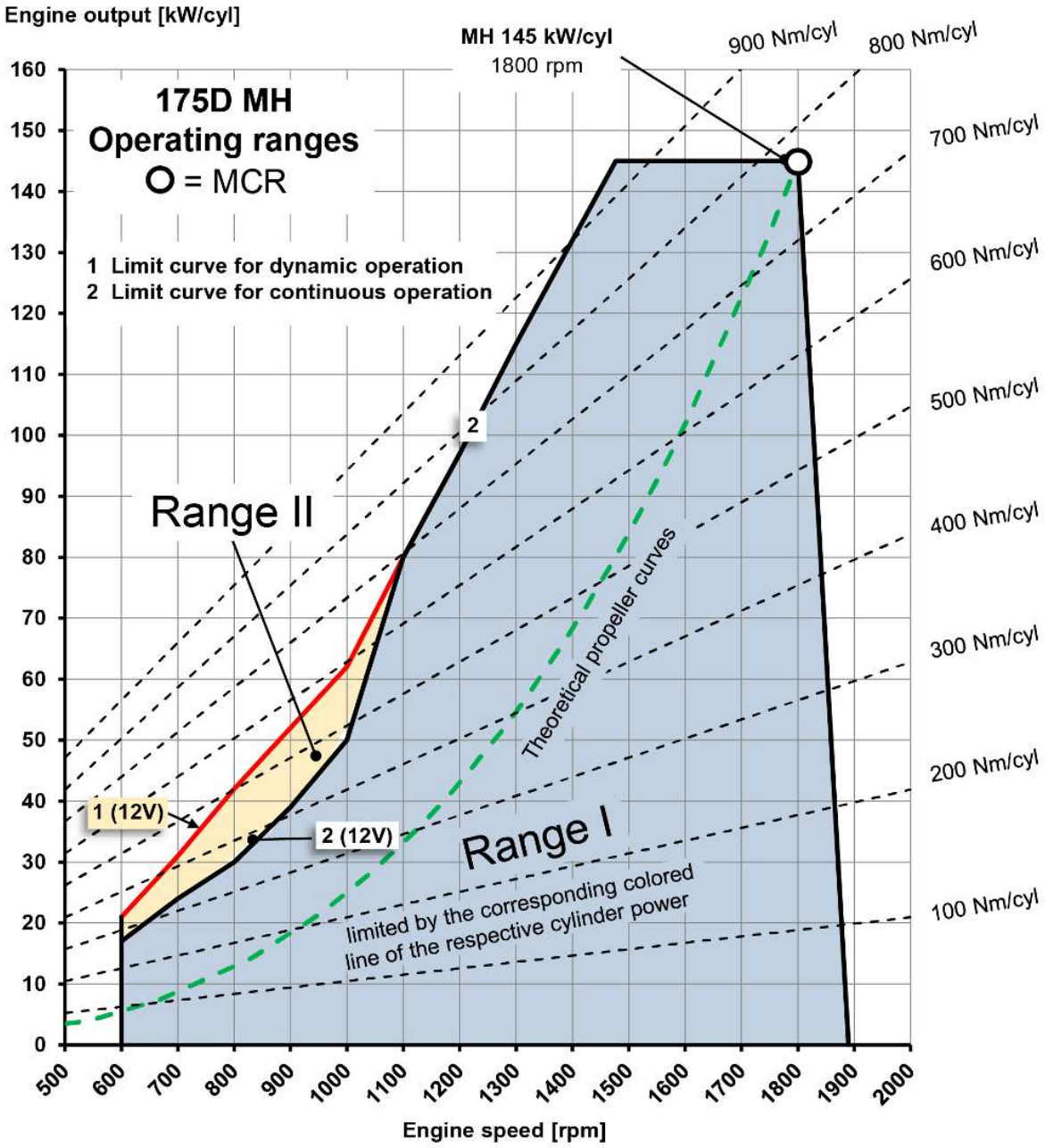



Figure 38: Operating ranges of the MH variants

- MCR

  Maximum continuous rating.
- Range I

  Operating range for continuous operation.
- Range II

  Operating range which is temporarily (< 2 min.) admissible e.g. during acceleration and manoeuvring.



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| Limit curves 175D MH, 145 kW/cyl., 1,800 rpm | | |
|---|---|---|
| Engine speed [rpm] | 12V | |
| | 12V Continuos operation | 12V Dynamic operation |
| | Engine output [kW/cyl.] | |
| 600 | 17 | 21 |
| 700 | 24 | 31 |
| 800 | 30 | 42 |
| 900 | 39 | 52 |
| 1,000 | 50 | 62 |
| 1,100 | 80 | 80 |
| 1,200 | 97 | 97 |
| 1,300 | 115 | 115 |
| 1,400 | 132 | 132 |
| 1,476.9 | 145 | 145 |
| 1,500 | 145 | 145 |
| 1,600 | 145 | 145 |
| 1,700 | 145 | 145 |
| 1,800 | 145 | 145 |

Table 32: Limit curve values of the MH variant, 145 kW/cyl., 1,800 rpm

### 2.6.3 Low-load operation

#### Definition

Basically, the following load conditions are distinguished:

- Overload: > 100% of the full load power
- Full load: 100% of the full load power
- Part load: < 100% of the full load power
- Low load: < 17 kW/cyl.

Note:

- Overload is not permitted.

#### Minimum load

- There are no limitations at speeds > 1,000 rpm regarding low-load operation.
- Low-load operation at a speed below 1,000 rpm is limited to maximum 1 day (for continuous) operation.



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**Tier III only**

- For applications applied with SCR system, it is recommended to operate the engine at > 17 kW/cyl. After > 6 hours continuous low-load operation (< 17 kW/cyl.) Everllence recommends to run the engine for a minimum of 1 – 2 hours, with a load > 50 kW/cyl., to remove possible pollution of the after treatment system.

### 2.6.4 General requirements for the CPP propulsion control

**Pitch control of the propeller plant**

General

A distinction between constant-speed operation and combinator-curve operation has to be ensured.

Failure of propeller pitch control:

To avoid overloading of the engine upon failure of the propeller pitch control, the propeller pitch must be adjusted to a value, so that the resulting FPP-curve is covered by the allowed area for continuous operation within the operating diagram.

4– 20-mA load indication from engine control

As a load indication a 4–20 mA signal from the engine control is supplied to the propeller control.

Combinator-curve operation:

Use the 4–20 mA signal for the assignment of the propeller pitch to the respective engine speed. The operation curve of engine speed and propeller pitch has to be observed also during acceleration/load increase and unloading.

**Acceleration/load increase**

Increase the engine speed prior to increasing the propeller pitch (see figure Example to illustrate the change from one load step to another, Page 70).

When increasing propeller pitch and engine speed synchronously, the speed has to be increased faster than the propeller pitch.

Automatic limitation of the rate of load increase must be implemented in the propulsion control.

**Deceleration/unloading the engine**

Increase the engine speed later than the propeller pitch (see figure Example to illustrate the change from one load step to another, Page 70).

When decreasing propeller pitch and engine speed synchronously, the propeller pitch has to be decreased faster than the speed.



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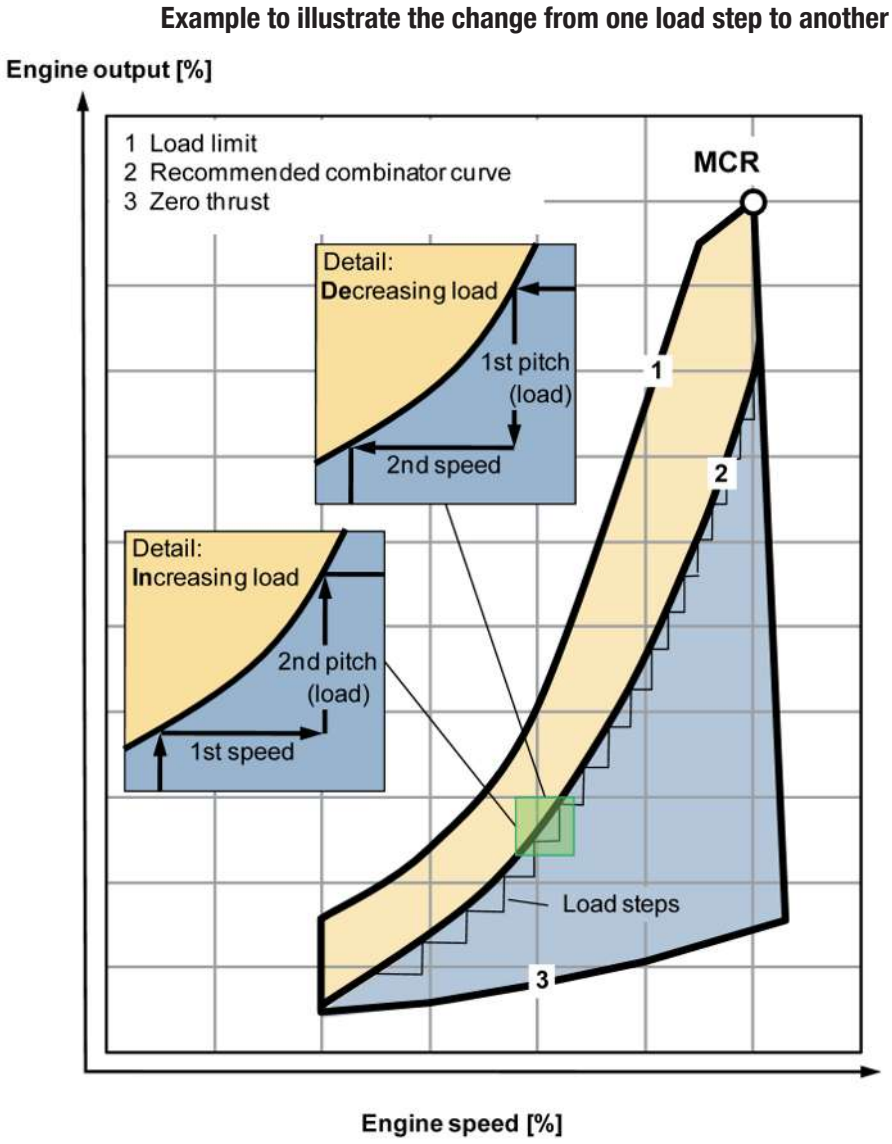



Figure 39: Example to illustrate the change from one load step to another

### Windmilling protection

If a stopped engine (fuel admission at zero) is being turned by the propeller, this is called “windmilling”. The permissible period for windmilling is short, because it can cause excessive wear of the engine bearings, due to poor lubrication at low propeller speed.

Single-screw ship

The propeller control has to ensure that the windmilling time is less than 40 seconds.

Multiple-screw ship

The propeller control has to ensure that the windmilling time is less than 40 seconds. In plants without shifting clutch, it has to be ensured that a stopped engine cannot be turned by the propeller.

For maintenance work, a shaft interlock has to be provided for each propeller shaft.

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**Binary signals from engine control**

Overload contact

The overload contact will be activated when the engine's fuel admission reaches the maximum position. At this position, the control system has to reduce the propeller pitch until the activation of the overload signal disappears.

Contact "operation close to the limit curve"

This contact is activated when the engine is operated close to a limit curve (torque limiter, charge air pressure limiter, and so on). When the contact is activated, the control system has to stop the increase of the propeller pitch. If this signal remains longer than the predetermined time limit, the propeller pitch has to be decreased.

Propeller pitch reduction contact

This contact is activated when disturbances in engine operation occur, for example too high exhaust-gas mean-value deviation. When the contact is activated, the propeller control system has to reduce the propeller pitch to 60% of the rated engine output, without change in engine speed.

In section Engine load reduction as a protective safety measure, Page 101, the requirements for the response time are stated.

**Additional signals from the Propulsion Optimisation Interface are available**

In addition, binary and analogue signals from the Propulsion Optimisation Interface are available that allow an optimsed data exchange between the engine and a smooth and look ahead control of the CPP propulsion system. Clarify details at an early stage of the project.

**Distinction between normal manoeuvre and emergency manoeuvre**

The propeller control system has to be able to distinguish between normal manoeuvre and emergency manoeuvre (that is, two different acceleration curves are necessary).

### 2.6.5 General requirements for the FPP propulsion control

In accordance to IACS “Requirements concerning MACHINERY INSTALLATIONS”, M43, a single control device for each independent propeller has to be provided, with automatic performance preventing overload and prolonged running in critical speed ranges of the propelling machinery.

Operation of the engine according to the stated FPP operating range has to be ensured.

**Load control of the propeller plant**

As a load indication a 4–20 mA signal from the engines safety and control system is supplied to the propeller control system.

**Windmilling protection**

If a stopped engine (fuel admission at zero) is being turned by the propeller, this is called “windmilling”. The permissible period for windmilling is short, because it can cause, due to poor lubrication at low propeller speed, excessive wear of the engine bearings.

In risk that windmilling can appear for a longer period than 40 sec, the engine has to be protected by opening the clutch of the gearbox or/and a shaft breaking system activation at the propeller shaft by the propulsion control system.

For maintenance work, a shaft interlock has to be provided for each propeller shaft.



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**Binary signals from engine control (SaCoS)**

| | |
|---|---|
| Overload contact | The overload contact will be activated when the fuel admission reaches the maximum position.<br>The propeller control has to reduce the rpm setpoint until contact will be de-activated again. |
| Reduction contact | This contact is activated when disturbances in engine operation occur, for example too high exhaust gas mean-value deviation. When the contact is activated, the propeller control system has to reduce the output demand to below 60% of the nominal output of the engine by adjusting the speed setpoint to the engine control to a value corresponding to maximum 60% engine load. |
| Operation close to the limit curves | This contact is activated when the engine is operated close to a limit curve (torque limiter, charge air pressure limiter, ...). When the contact is activated, the propeller control system has to pause with an increase of a load demand. In case the signal remains longer than the predetermined time limit, the output demand must be reduced.<br>The output demand is including the propulsion power itself but also additional power from equipment like PTO-alternator or pumps connected to the drive train. The engine control is not able to influence to a suitable output demand by itself, this can only be handled by a super-ordinate control, which has connection to signals for the complete drive train and can maintain the total power consumption. |

**Binary signals to engine control (SaCoS) from ECR or bridge**

| | |
|---|---|
| Override (Binary signal by switch) | In case “Override” has been activated, “Stop” or “Reduce” demands of engine safety system will not be executed, but printed at the alarm printer. |

**Binary signals to engine control (SaCoS) from coupling control**

| | |
|---|---|
| Activation of clutch | To enable engine control (SaCoS), to act at the beginning of the clutch-in procedure, a binary signal has to be provided. |



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### 2.6.6 Propulsion packages – Single source

**We offer single source solutions**

Our state-of-the-art high-speed propulsion package:
+ Everllence Alpha controllable pitch or fixed pitch propellers tailored with stern tubes, seals, tail shafts, intermediate shafts, couplings and the Alphatronic 3000 control system
=> optimised and fine-tuned for geared 175D engines.

Benefits at a glance:

- High efficiency and low noise
- Low operational costs
- Low installation costs
- Superior package value

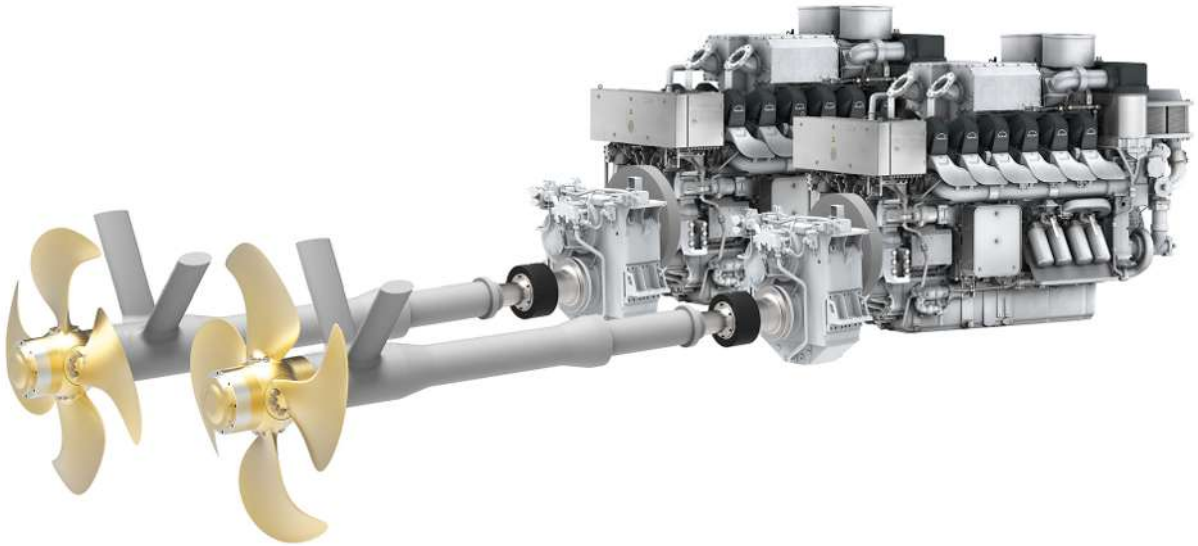


Figure 40: Propulsion packages – Controllable pitch propellers (CPP)



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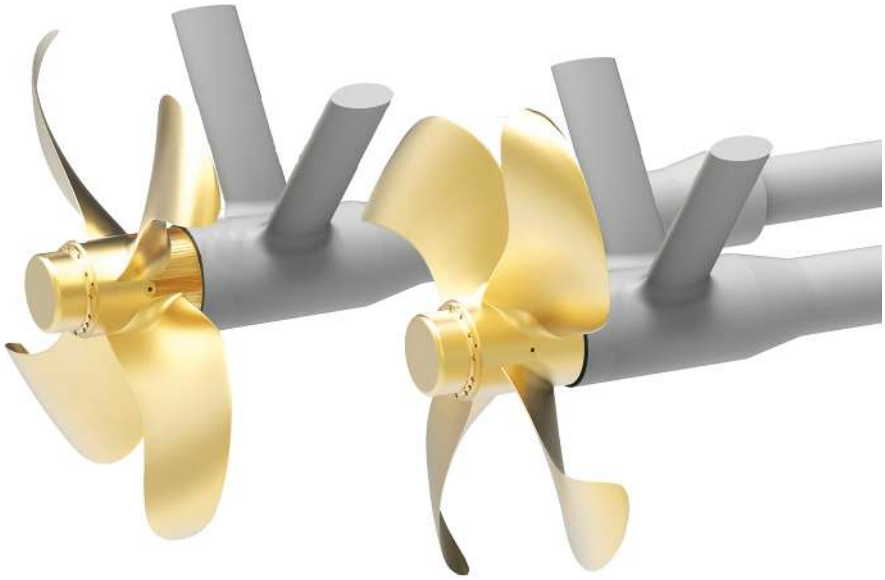


Figure 41: Propulsion packages – Fixed pitch propellers (FPP)

Our state-of-the-art propulsion control system:
The Alphatronic 3000 controls both Everllence Alpha controllable pitch and fixed pitch propeller packages
=> for geared 175D engines.




Figure 42: Alphatronic 3000 control station for 175D propulsion package – CPP or FPP

## 2.7 GenSet application

### 2.7.1 Description

The Everllence high-speed marine generator set (GenSet) incorporates the 175D engine. With its robust and compact design, this high-speed power plant package provides a standardised power supply platform that is perfectly suited to meet the requirements of all marine power applications within its output range.
This includes electric propulsion applications and auxiliary power supplies.



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The standard GenSet package can be configured with a selection of different 175D engine variants.
By utilising a pre-selected alternator and baseframe mounted cooling options to satisfy most requirements the package footprint can be kept the same.
It is also compliant with all of the most common classification society requirements and meets with all the relevant and necessary ISO GenSet standards.

### 2.7.2 Design philosophy

The design philosophy for the Everllence high-speed marine GenSet is for a package with a consistent, standardised base specification, but which is also able to offer enough options to give flexibility for adaption to the various on-board power generation applications. This marries together the benefits of standardised serial production methods and the use of materials with enough design customisation to install the package into the endlessly different vessel layouts.
The Everllence high-speed GenSet design layout is such that the engine flywheel casing and alternator casing are rigidly fixed together. The engine flywheel and alternator rotor are connected via a flexible torsional coupling. This complete mass is then resiliently mounted to the GenSet baseframe using suitably selected anti-vibration mountings.
In addition, 175D high-speed GenSets can be incorporated into vessel designs with special requirements, such as reduced vibration and/or low acoustic noise levels. For such applications, contact your nearest Everllence equipment sales point for more information.

### 2.7.3 Applications

#### Electric propulsion

The vessel propels and manoeuvres by electrically driven thrusters.
The installed GenSets provide the primary power supply for the variable speed electric thruster motors.
In addition, they also support the power requirements for the vessels' electrical systems.
Because of this, the load levels seen on the GenSets are almost continuously fluctuating, especially when the vessel is manoeuvring.
Depending on the vessel size, a typical arrangement would be, to have a two or four GenSet system on board.
This allows a smoothing out of the load variations across each piece of equipment and also provides flexibility to match power generation capacity with power demand.
With an analysis of the electrical load levels, over a pre-determined cycle time, it is possible to determine what the average load level would be.
Based on this it can be determined, if the application requires an MEM specification GenSet (< 75% average load profile) or an MEL specification GenSet (< 50% average load profile).

#### Auxiliary power

On larger vessels where, for example, the propulsion is provided mechanically by large medium-speed engines, there is a requirement for auxiliary GenSets to provide power system support on board.



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### 2.7.4 Alternator

The pre-selected range of brushless, A.C. synchronous marine alternators utilised within 175D high-speed GenSets are of a robust, contemporary design supplied from a major marine equipment OEM and are available with the following features and options:

- Double bearing design with easy maintenance rolling element bearings.
- Positive build-up self-excitation system.
- Integrated digital voltage control unit with external access.
- Class H insulation system, with marine class F temperature rise.
- Continuously rated, with an S1 duty.
- Wide range of nominal voltage outputs available at 50 and 60 Hz.
- IP23, IC01 air-cooled, or IP54, IC81W, freshwater-cooled options.
- Compliant with all the relevant electrical machine standards, incl. IEEE45, IEC60034 and IEC60092.
- Class type approved with all the main classification societies.

### 2.7.5 GenSet auxiliary equipment

The 175D standard GenSet comes complete with a certain amount of auxiliary equipment mounted directly on the engine, or on the GenSet baseframe. This equipment is shown and described below:

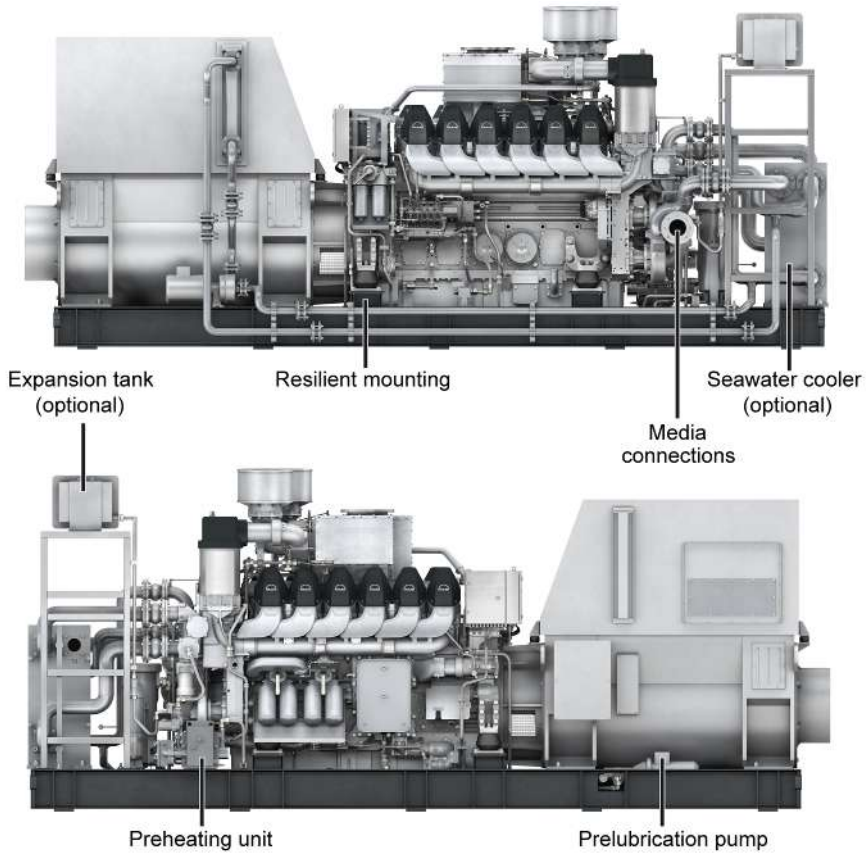



Figure 43: 175D GenSet with standard and optional auxiliary equipment

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**Standard equipment**

Connecting elements

- Flexible coupling – Highly flexible coupling, type confirmed by torsional vibration calculation, class approval is included.
- Flexible mountings – Engine and alternator resiliently mounted by means of conical mountings, type confirmed by vibration calculation, class approved.
- Exhaust pipe expansion joint – Metal exhaust pipe expansion joints for each turbocharger outlet are included.
- Media connections – Hose lines and compensators for each media connection included.

Lube oil system – For the engine lube oil system refer to section Lube oil system, Page 433.
The GenSet has, in addition, the following components:

- Prelubrication pump – Electrically driven, baseframe mounted, including lube oil draining and refilling capability by means of three-way switchover valve.

Fuel oil system – The 175D is equipped with a mechanical driven fuel oil supply pump. Refer to details in section Fuel oil system, Page 454.
The GenSet has, in addition, the following components:

- Fuel oil cooler – Plate type, baseframe mounted, internally cooled method by freshwater supply.
- Filtration system – The 175D GenSet consists of the following filtration units, all are baseframe mounted:
  – Pump protection filter
  – Fuel duplex filter
  – Coalescer
- A second duplex filter (2nd stage) is mounted on the engine.

Cooling water system

- Cooling water pump for alternator – In the case of a freshwater cooled alternator, an additional cooling water pump for alternator cooling is required.
- Pre-heating unit – Electrical preheating unit, consisting of heater, circulating pump, safety valve, all baseframe mounted.

GenSet local operating panel

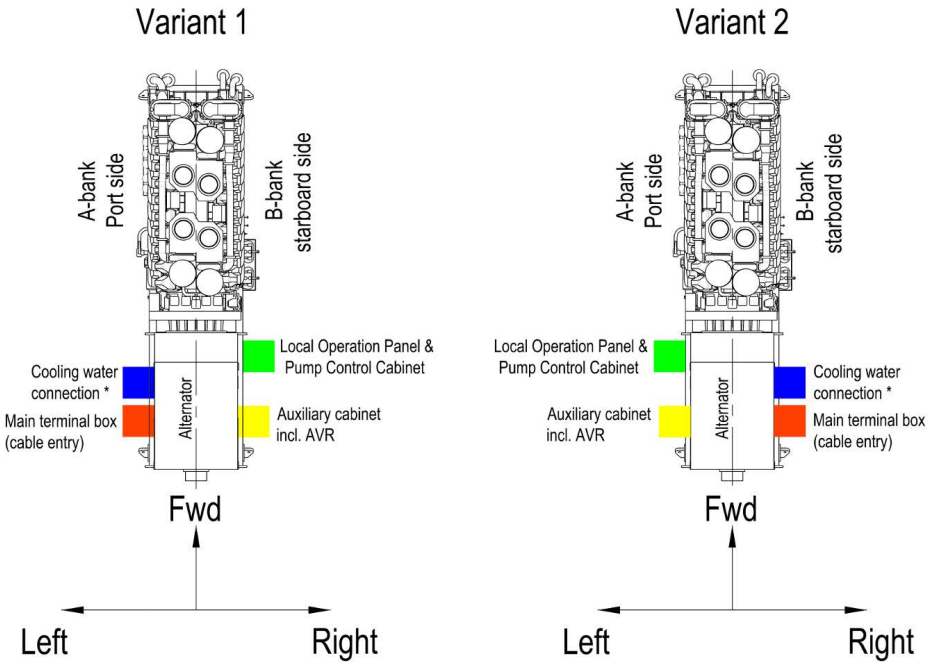
Local operating panel of the GenSet are mounted on a base frame. The following positioning is possible: Left and right. See figure Positioning of the local operating panel of the GenSet, Page 78.



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## Location of standard connections
## Antifriction bearing




## Location of standard connections
## Sleeve bearing

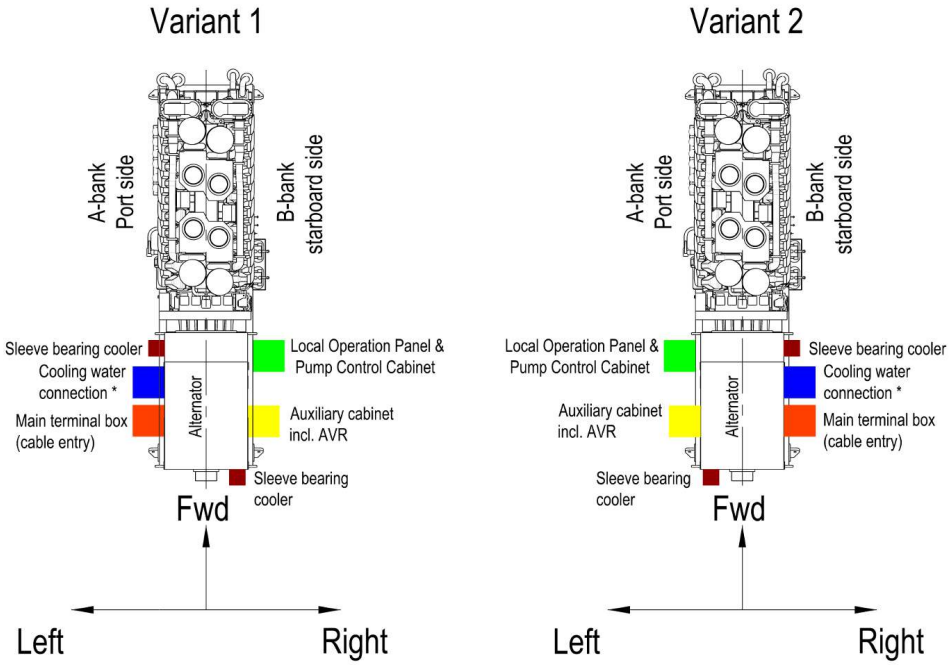


Figure 44: View of direction, location of standard connections and position of the local operation panel

#### Optional equipment

Some optional equipment is available, based on customer requirements. Additional equipment will have an influence on the size and weight of the 175D GenSet.

Seawater cooling system

- Seawater cooler – Optional plate type seawater cooler (combined HT-/LT-/SW), including mechanical driven seawater pump (on engine) and piping, can be selected.
- Expansion tank – In case the seawater cooler is selected an expansion tank is also mounted on the GenSet baseframe.

### 2.7.6 GenSet installation drawings

GenSet installation drawings will be supplied project specific. Note also section 3D Viewer – A support programme to configure the engine room, Page 413.

### 2.7.7 Operating ranges – General remarks

Max. fuel admission (blocking):

In accordance to classification rules and to DIN ISO 3046-1, GenSets must be blocked at 110% fuel admission.

Following is specified:

- The power management system of the plant must observe the maximum output (100% = MCR)
- The range of 100% up to 110% fuel admission, may only be used for a short time for governing purposes (for example, transient load conditions and suddenly applied load).



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### 2.7.8 Operating range for GenSet/electric propulsion (constant speed)

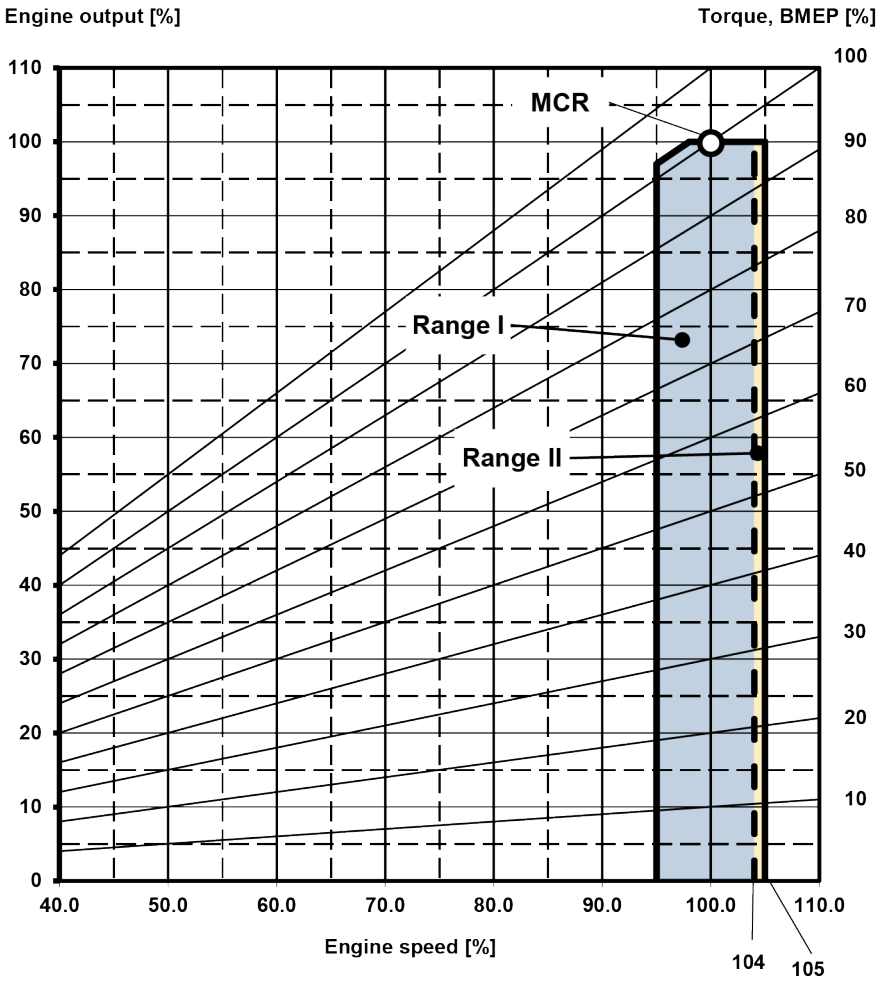



Figure 45: Operating range for GenSet/electric propulsion (constant speed)

- MCR[1)]

  Maximum continuous rating.
- Range I

  Operating range for continuous operation.
- Range II

  No continuous operation permissible.

  Maximum operating time less than 2 minutes.

[1)] In accordance with DIN ISO 3046-1 and for further clarification of relevant sections within DIN ISO 8528-1, the following is specified:

- The maximum output (MCR) has to be observed by the power management system of the plant.
- The range of 100% up to 110% fuel admission may only be used for a short time for governing purposes (for example, transient load conditions and suddenly applied load).

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**IMO certification for engines with operating range for electric propulsion**

Test cycle type E2 will be applied for the engine´s certification for compliance with the $NO_x$ limits, according to $NO_x$ technical code.

**IMO certification for engines with operating range for auxiliary GenSet**

Test cycle type D2 will be applied for the engine´s certification for compliance with the $NO_x$ limits, according to $NO_x$ technical code.

### 2.7.9 Operating range for EPROX-DC

EPROX-DC is an electric-propulsion system based on a DC net and generators with variable speed.



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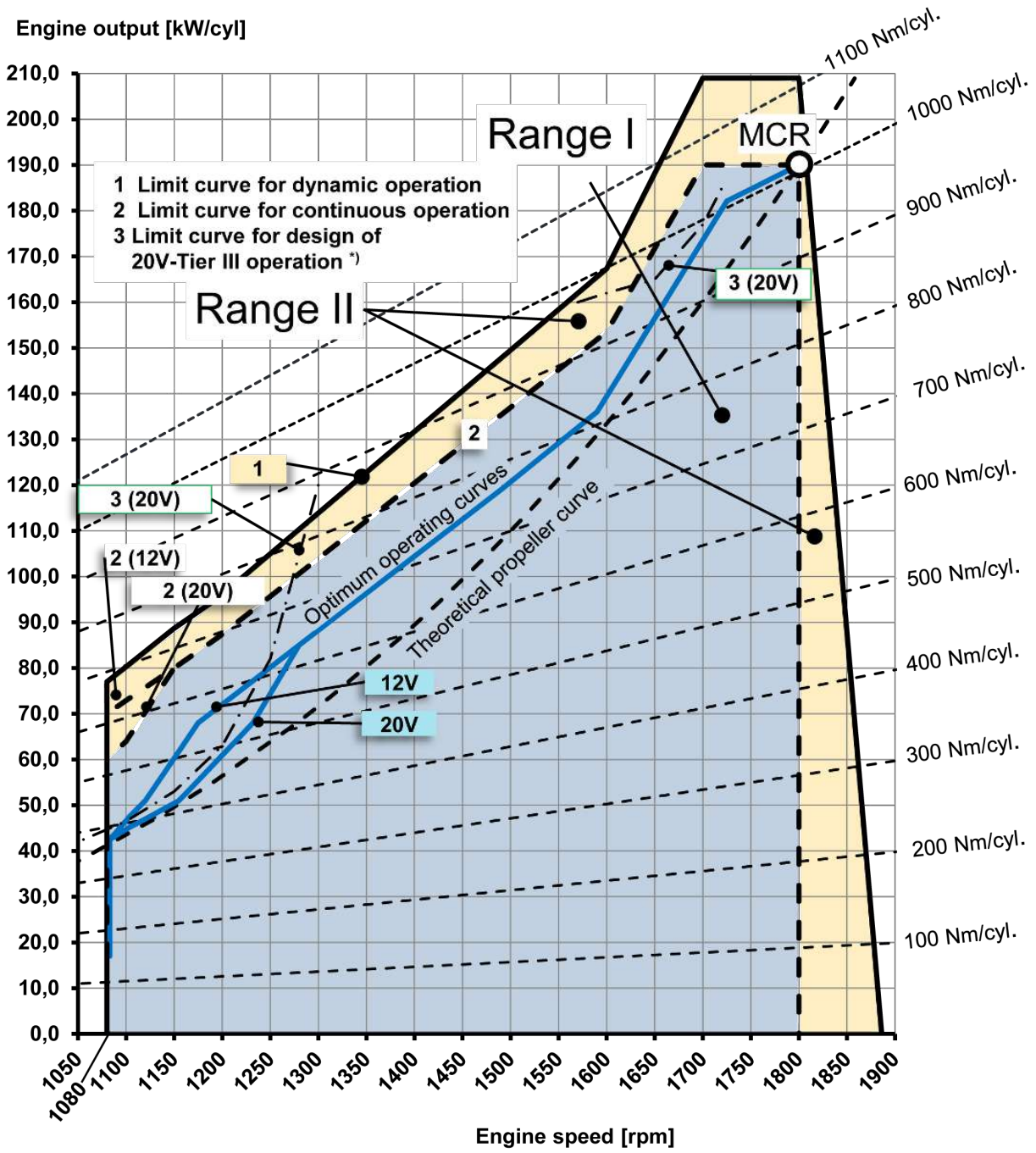



Figure 46: Operating range for 175D MEV, 190 kW/cyl., 1,800 rpm

- MCR[1)]
  Maximum continuous rating.
- Range I
  Operating range for continuous operation.
- Range II
  No continuous operation permissible.
  Maximum operating time less than 2 minutes.

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*) For 16V/20V - Tier III operation only - engine operation to be designed to the right of this line.

[1)] In accordance with DIN ISO 3046-1 and for further clarification of relevant sections within DIN ISO 8528-1, the following is specified:

- The maximum output (MCR) has to be observed by the power management system of the plant.
- The range of 100% up to 110% fuel admission, may only be used for a short time for governing purposes (for example, transient load conditions and suddenly applied load).

| Limit curves 175D MEV, 190 kW/cyl., 1,800 rpm | | | | |
|---|---|---|---|---|
| **Engine speed [rpm]** | **12V Continuous operation** | **12V Dynamic operation** | **20V Continuous operation** | **20V Dynamic operation** |
| | **Engine output [kW/cyl.]** | | | |
| 1,080 | 70 | 77 | 60 | 77 |
| 1,100 | 72.9 | 80.3 | 64 | 80.3 |
| 1,150 | 80 | 88.7 | 80 | 88.7 |
| 1,195.6 | 86.7 | 95.3 | 86.7 | 95.3 |
| 1,700 | 190 | 209 | 190 | 209 |
| 1,800 | 190 | 209 | 190 | 209 |
| 1,800 | 0 | 209 | 0 | 209 |
| 1,886 | - | 0 | - | 0 |

Table 33: Limit curves 175D MEV, 190 kW/cyl., 1,800 rpm

| Optimum operating curves 175D MEV, 190 kW/cyl., 1,800 rpm | | |
|---|---|---|
| **Engine speed [rpm]** | **12V** | **20V** |
| | **Engine output [kW/cyl.]** | |
| 1,080 | 42.5 | 42.5 |
| 1,120 | 51 | 47 |
| 1,155 | 61.8 | 51 |
| 1,175 | 68 | 55.4 |
| 1,232 | 77.2 | 68 |
| 1,280 | 85 | 85 |
| 1,385 | 102 | 102 |
| 1,490 | 119 | 119 |
| 1,590 | 136 | 136 |
| 1,635 | 151.4 | 151.4 |
| 1,690 | 170.1 | 170.1 |
| 1,725 | 182.1 | 182.1 |
| 1,800 | 190 | 190 |

Table 34: Optimum operating curves 175D MEV, 190 kW/cyl., 1,800 rpm



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| Limit curves for design Tier III operating points MEV variant | |
|---|---|
| **Engine speed [rpm]** | **20V** |
| | **Engine output [kW/cyl.]** |
| 1,080 | 44.5 |
| 1,100 | 46.5 |
| 1,150 | 53 |
| 1,200 | 63 |
| 1,250 | 82 |
| 1,300 | 120 |

Table 35: Limit curve values of the MEV variant, 190 kW/cyl., for design Tier III operating points



2025-10-30 - 12.0

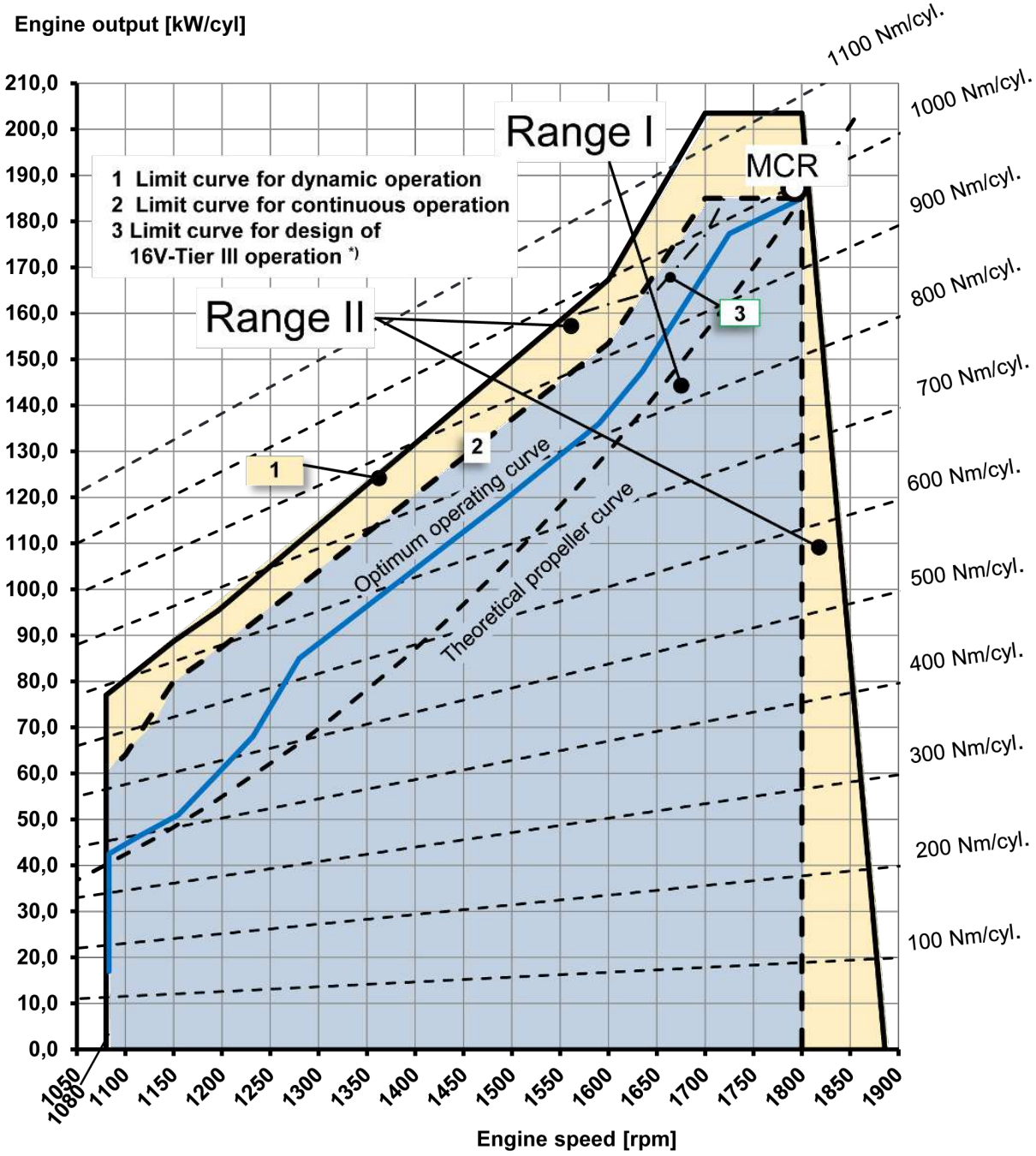



Figure 47: Operating range for 175D MEV, 185 kW/cyl., 1,800 rpm

- MCR[1)]
  Maximum continuous rating.
- Range I
  Operating range for continuous operation.
- Range II
  No continuous operation permissible.
  Maximum operating time less than two minutes.



2025-10-30 - 12.0

*) For 16V/20V - Tier III operation only - engine operation to be designed to the right of this line.

[1)] In accordance with DIN ISO 3046-1 and for further clarification of relevant sections within DIN ISO 8528-1, the following is specified:

- The maximum output (MCR) has to be observed by the power management system of the plant.
- The range of 100% up to 110% fuel admission may only be used for a short time for governing purposes (for example, transient load conditions and suddenly applied load).

| Limit curves 175D MEV, 185 kW/cyl., 1,800 rpm | | |
|---|---|---|
| **Engine speed [rpm]** | **16V Continuous operation** | **16V Dynamic operation** |
| | **Engine output [kW/cyl.]** | |
| 1,080 | 60 | 77 |
| 1,100 | 64 | 80.3 |
| 1,150 | 80 | 88.7 |
| 1,195.6 | 86.7 | 95.3 |
| 1,700 | 185 | 203.5 |
| 1,800 | 185 | 203.5 |
| 1,800 | 0 | 203.5 |
| 1,886 | - | 0 |

Table 36: Limit curves 175D MEV, 185 kW/cyl., 1,800 rpm

| Optimum operating curves 175D MEV, 185 kW/cyl., 1,800 rpm | |
|---|---|
| **Engine speed [rpm]** | **16V** |
| | **Engine output [kW/cyl.]** |
| 1,080 | 42.5 |
| 1,120 | 47 |
| 1,155 | 51 |
| 1,175 | 55.4 |
| 1,232 | 68 |
| 1,280 | 85 |
| 1,385 | 102 |
| 1,490 | 119 |
| 1,590 | 136 |
| 1,635 | 157.3 |
| 1,690 | 165.7 |
| 1,725 | 177.3 |
| 1,800 | 185 |

Table 37: Optimum operating curves 175D MEV, 185 kW/cyl., 1,800 rpm



2025-10-30 - 12.0

| Limit curves for design Tier III operating points MEV variant | |
|---|---|
| **Engine speed [rpm]** | **16V** |
| | **Engine output [kW/cyl.]** |
| 1,080 | 44.5 |
| 1,100 | 46.5 |
| 1,150 | 53 |
| 1,200 | 63 |
| 1,250 | 82 |
| 1,300 | 120 |

Table 38: Limit curve values of the MEV variant, 185 kW/cyl., for design Tier III operating points





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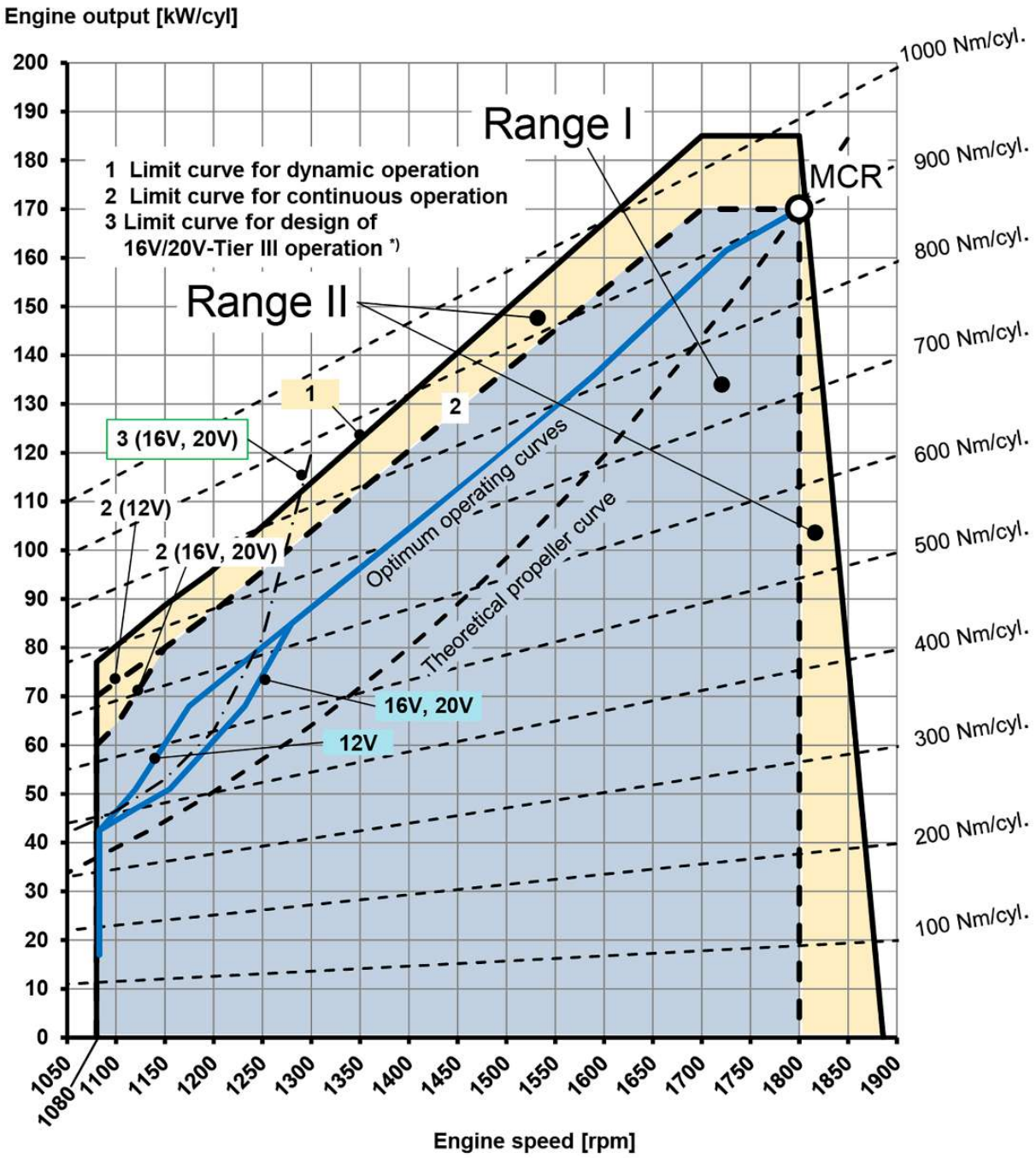



Figure 48: Operating range for 175D MEV, 170 kW/cyl., 1,800 rpm

- MCR[1)]
  Maximum continuous rating.
- Range I
  Operating range for continuous operation.
- Range II
  No continuous operation permissible.
  Maximum operating time less than two minutes.

2025-10-30 - 12.0

*) For 16V/20V - Tier III operation only - engine operation to be designed to the right of this line.

[1)] In accordance with DIN ISO 3046-1 and for further clarification of relevant sections within DIN ISO 8528-1, the following is specified:

- The maximum output (MCR) has to be observed by the power management system of the plant.
- The range of 100% up to 110% fuel admission may only be used for a short time for governing purposes (for example, transient load conditions and suddenly applied load).

| Limit curves 175D MEV, 170 kW/cyl., 1,800 rpm | | | | |
|---|---|---|---|---|
| **Engine speed [rpm]** | **12V Continuous operation** | **12V Dynamic operation** | **16V, 20V Continuous operation** | **16V, 20V Dynamic operation** |
| | **Engine output [kW/cyl.]** | | | |
| 1,080 | 70 | 77 | 60 | 77 |
| 1,100 | 72.9 | 80.3 | 64 | 80.3 |
| 1,150 | 80 | 88.7 | 80 | 88.7 |
| 1,195.6 | 86.7 | 95.3 | 86.7 | 95.3 |
| 1,700 | 170 | 185 | 170 | 185 |
| 1,800 | 170 | 185 | 170 | 185 |
| 1,800 | 0 | 185 | 0 | 185 |
| 1,886 | - | 0 | - | 0 |

Table 39: Limit curves 175D MEV, 170 kW/cyl., 1,800 rpm

| Optimum operating curves 175D MEV, 170 kW/cyl., 1,800 rpm | | |
|---|---|---|
| **Engine speed [rpm]** | **12V** | **16V, 20V** |
| | **Engine output [kW/cyl.]** | |
| 1,080 | 42.5 | 42.5 |
| 1,120 | 51 | 47 |
| 1,155 | 61.8 | 51 |
| 1,175 | 68 | 55.4 |
| 1,232 | 77.2 | 68 |
| 1,280 | 85 | 85 |
| 1,385 | 102 | 102 |
| 1,490 | 119 | 119 |
| 1,590 | 136 | 136 |
| 1,635 | 144.5 | 144.5 |
| 1,690 | 154.9 | 154.9 |
| 1,725 | 161.5 | 161.5 |
| 1,800 | 170 | 170 |

Table 40: Optimum operating curves 175D MEV, 170 kW/cyl., 1,800 rpm



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| Limit curves for design Tier III operating points MEV variant | |
|---|---|
| **Engine speed [rpm]** | **16V, 20V** |
| | **Engine output [kW/cyl.]** |
| 1,080 | 44.5 |
| 1,100 | 46.5 |
| 1,150 | 53 |
| 1,200 | 63 |
| 1,250 | 82 |
| 1,290 | 112 |

Table 41: Limit curve values of the MEV variant, 170 kW/cyl., for design Tier III operating points



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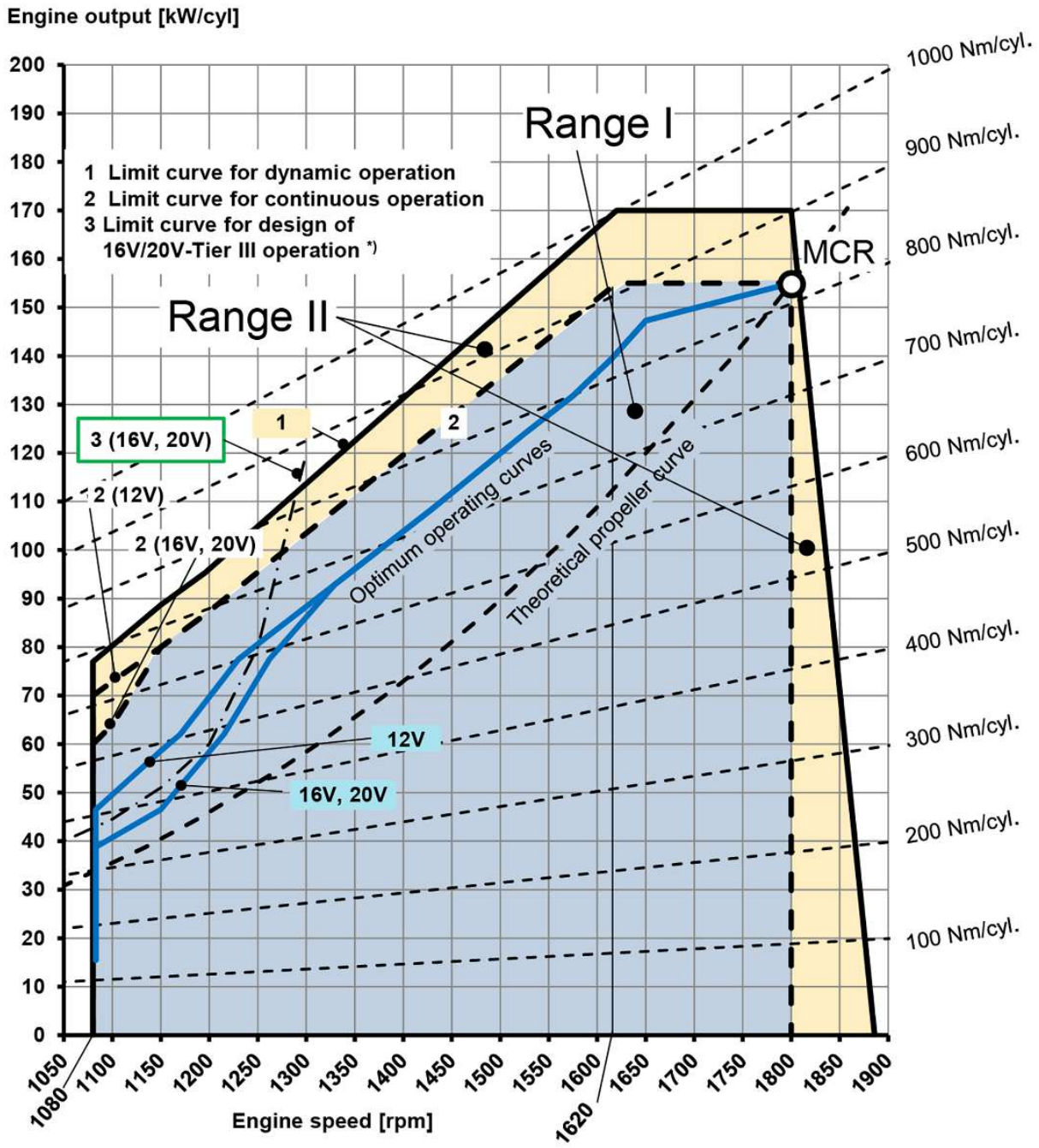



Figure 49: Operating range for 175D MEV, 155 kW/cyl., 1,800 rpm

- MCR[1)]
  Maximum continuous rating.
- Range I
  Operating range for continuous operation.
- Range II
  No continuous operation permissible.
  Maximum operating time less than two minutes.



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*) For 16V/20V - Tier III operation only - engine operation to be designed to the right of this line.

[1)] In accordance with DIN ISO 3046-1 and for further clarification of relevant sections within DIN ISO 8528-1, the following is specified:

- The maximum output (MCR) has to be observed by the power management system of the plant.
- The range of 100% up to 110% fuel admission may only be used for a short time for governing purposes (for example, transient load conditions and suddenly applied load).

| Limit curves 175D MEV, 155 kW/cyl., 1,800 rpm | | | | |
|---|---|---|---|---|
| **Engine speed [rpm]** | **12V Continuous operation** | **12V Dynamic operation** | **16V, 20V Continuous operation** | **16V, 20V Dynamic operation** |
| | **Engine output [kW/cyl.]** | | | |
| 1,080 | 70 | 77 | 60 | 77 |
| 1,100 | 72.9 | 80.3 | 64 | 80.3 |
| 1,150 | 80 | 88.7 | 80 | 88.7 |
| 1,195.6 | 86.7 | 95.3 | 86.7 | 95.3 |
| 1,620 | 155 | 170 | 155 | 170 |
| 1,800 | 155 | 170 | 155 | 170 |
| 1,800 | 0 | 170 | 0 | 170 |
| 1,886 | - | 0 | - | 0 |

Table 42: Limit curves 175D MEV, 155 kW/cyl., 1,800 rpm

| Optimum operating curves 175D MEV, 155 kW/cyl., 1,800 rpm | | |
|---|---|---|
| **Engine speed [rpm]** | **12V** | **16V, 20V** |
| | **Engine output [kW/cyl.]** | |
| 1,080 | 46.5 | 38.8 |
| 1,150 | 58.6 | 46.5 |
| 1,170 | 62 | 51.3 |
| 1,215 | 73.6 | 62 |
| 1,230 | 77.5 | 66.9 |
| 1,262 | 82.5 | 77.5 |
| 1,330 | 93 | 93 |
| 1,430 | 108.5 | 108.5 |
| 1,525 | 124 | 124 |
| 1,575 | 131.8 | 131.8 |
| 1,615 | 139.5 | 139.5 |
| 1,650 | 147.3 | 147.3 |
| 1,800 | 155 | 155 |

Table 43: Optimum operating curves 175D MEV, 155 kW/cyl., 1,800 rpm



2025-10-30 - 12.0

| Limit curves for design Tier III operating points MEV variant | |
|---|---|
| Engine speed [rpm] | 16V, 20V |
| | Engine output [kW/cyl.] |
| 1,080 | 43 |
| 1,100 | 44.5 |
| 1,150 | 51 |
| 1,200 | 60 |
| 1,250 | 80 |
| 1,290 | 112 |

Table 44: Limit curve values of the MEV variant, 155 kW/cyl., for design Tier III operating points

### 2.7.10 Generator operation/electric propulsion – Power management

Operation of vessels with electric propulsion is defined as parallel operation of main engines with generators forming a closed system.

The power supply of the plant as a standard is done by auxiliary GenSets also forming a closed system.

In the design/layout of the plant, a possible failure of one engine has to be considered to avoid overloading and under-frequency of the remaining engines with the risk of an electrical blackout.

Therefore we recommend installing a power management system. This ensures uninterrupted operation in the maximum output range. In case one engine fails, the power management system reduces the propulsive output or switches off less important energy consumers, to avoid under-frequency.

According to the operating conditions, it is the responsibility of the ship's operator to set priorities and to decide which energy consumer has to be switched off.

The base load should be chosen as high as possible to achieve an optimum engine operation and lowest soot emissions.

Note:
As stated within the section "Control Unit" an alternator electric power (active power) signal must be provided. See accordingly also "Interfaces between plant and Control Unit" stated signal "Generator Load".

#### Load application in case one engine fails

In case one engine fails, its output has to be made up for by the remaining engines in the system and/or the load has to be decreased by reducing the propulsive output and/or by switching off electrical consumers.

The immediate load transfer to one engine does not always correspond with the load reserve that the particular engine has available at the respective moment. That depends on the engine's base load.



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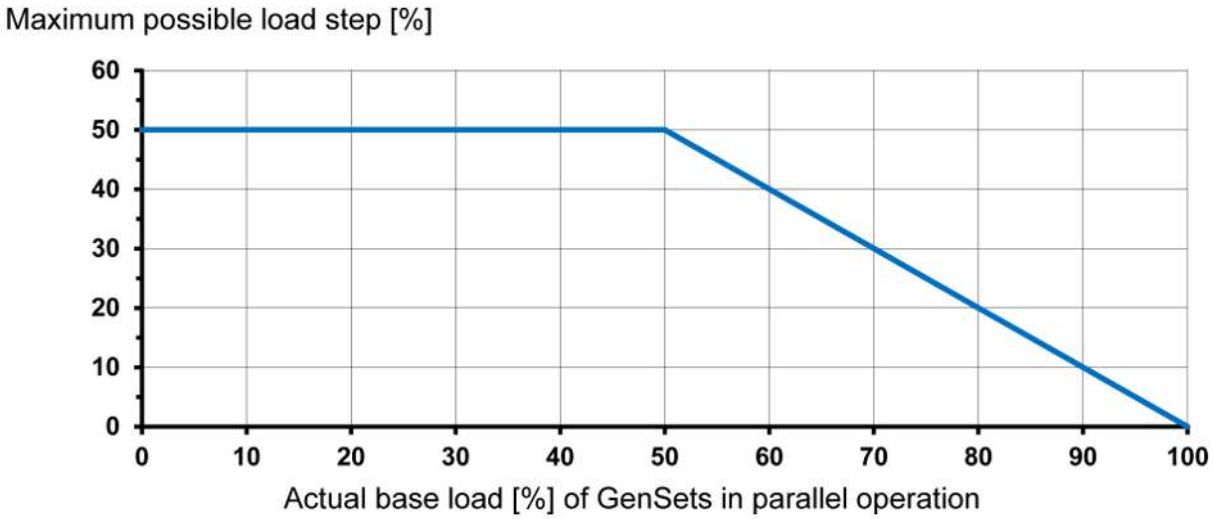



Figure 50: Maximum load step depending on base load

Based on the above stated figure and on the total number of engines in operation the recommended maximum load of these engines can be derived. Observing this limiting maximum load ensures that the load from one failed engine can be transferred to the remaining engines in operation without power reduction.

| Number of engines in parallel operation | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|
| Recommended maximum load in (%) of $P_{max}$ | 50 | 66 | 75 | 80 | 83 | 85.5 | 87.5 |

Table 45: Recommended maximum load in (%) of $P_{max}$ dependent on number of engines in parallel operation

Note:
Before an additional load step will be applied, at least 20 sec waiting time after initiation of the previous load step must be considered.

### 2.7.11 Alternator – Reverse power protection

#### Definition of reverse power

If an alternator, coupled to a combustion engine, is no longer driven by this engine, but is supplied with propulsive power by the connected electric grid and operates as an electric motor instead of working as an alternator, this is called reverse power. The speed of a reverse power-driven engine is accordingly to the grid frequency and the rated engine speed.

#### Demand for reverse power protection

For each alternator (arranged for parallel operation), a reverse power protection device has to be provided. Because if a stopped combustion engine (fuel admission at zero) is being turned, it can cause, due to poor lubrication, excessive wear on the engine´s bearings. This is also a classifications' requirement.

#### Examples for possible reverse power occurrences

- Due to lack of fuel the combustion engine no longer drives the alternator, which is still connected to the mains.



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- Stopping of the combustion engine while the driven alternator is still connected to the electric grid.
- On ships with electric drive the propeller can also drive the electric traction motor and this in turn drives the alternator and the alternator drives the connected combustion engine.
- Sudden frequency increase, for example, because of a load decrease in an isolated electrical system -> if the combustion engine is operated at low load (for example, just after synchronising).

#### Adjusting the reverse power protection relay

The necessary power to drive an unfired diesel or gas engine at nominal speed cannot exceed the power which is necessary to overcome the internal friction of the engine. This power is called motoring power. The setting of the reverse-power relay should be, as stated in the classification rules, 50% of the motoring power. To avoid false tripping of the alternator circuit breaker, a time delay has to be implemented. A reverse power > 6% mostly indicates serious disturbances in the generator operation.

The following table provides a summary:

| Admissible reverse power $P_{el}$ [%] | Time delay for tripping the alternator circuit breaker [sec] |
|---|---|
| $P_{el} < 3$ | 30 |
| $3 \leq P_{el} < 8$ | 3–10 |
| $P_{el} \geq 8$ | No delay |

Table 46: Adjusting the reverse power relay

## 2.8 Start-up and load application

### 2.8.1 General 175D

#### Starting conditions

Engine must be prelubricated before engine start.

The engine can be started with ambient temperature ≥ 0°C. For the optimal starting sequence, an engine room temperature and media temperatures ≥ 5°C is recommended.

Starting at lower intake air temperature is possible if, in addition to engine prelubrication and preheating, a proper fuel oil type (winter fuel) is selected.

Consult Everllence for additional information regarding engine operation in cold climate conditions. See also section Engine operation under arctic conditions, Page 101.

### 2.8.2 Additional general remarks

To limit the effort regarding regulating the media circuits, also to ensure an uniform heat input, it always should be aimed for longer load application times by considering the realistic requirements of the specific plant.

All questions regarding the dynamic behaviour should be clarified in close cooperation between the customer and Everllence at an early project stage.

Requirements for plant design:



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- The load application behaviour must be considered in the electrical system design of the plant.
- The system operation must be safe in case of graduated load application.
- The load application conditions (E-balance) must be approved during the planning and examination phase.
- The possible failure of one engine must be considered, see section Generator operation/electric propulsion – Power management, Page 93.

### 2.8.3 Definitions and requirements

**General remark**

Prior to the start-up of the engine it must be ensured that the emergency stop of the engine is working properly. Also all required supply systems must be in operation or in stand-by operation. Engine must be prelubricated before engine start.

**Start-up - cold engine**

For the start-up of the engine, following must be fulfilled:

- Lube oil temperature ≥ 5°C
- Cooling water temperature ≥ 5°C

Before further use of the engine, a warming-up phase is required to reach at least the level of the regular preheating temperatures. The duration of the warming-up phase depends on the system layout and the media volumes in the system and is therefore project-specific. See diagrams in section Load application – Continuous loading, Page 97.

**Start-up - Preheated engine**

For the start-up of a preheated engine, following must be fulfilled:

- Lube oil temperature ≥ 25°C
- Cooling water temperature 40°C, ±5 K

Note:
A HT cooling water temperature level above 45°C during engine stand still should generally be prevented to avoid removing the oil film from the cylinder liner walls (especially during long heating periods).

**Speed ramp-up**

The standard speed ramp-up serves for all engine conditions and ensures a low opacity level of the exhaust gas.

**Load ramp-up**

The time required for load ramp-up is in high extent dependent on the engine conditions:

- Cold
  - Lube oil temperature ≥ 5°C
  - Cooling water temperature ≥ 5°C
- Warm (= preheated)
  - Lube oil temperature ≥ 25°C
  - Cooling water temperature 40°C, ±5 K
- Hot (= previously been in operation)
  - Lube oil temperature ≥ 40°C
  - Cooling water temperature ≥ 60°C
  - Exhaust gas pipe engine and turbocharger > 320°C [within 1 h after engine stop]



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Note:
Load application handled within plant automation:
The compliance of the load application with the specifications of Everllence has to be handled within the plant automation.
The SaCoS engine control will not interfere in the load ramp-up or load ramp-down initiated by the plant control.

### 2.8.4 Load application – Continuous loading

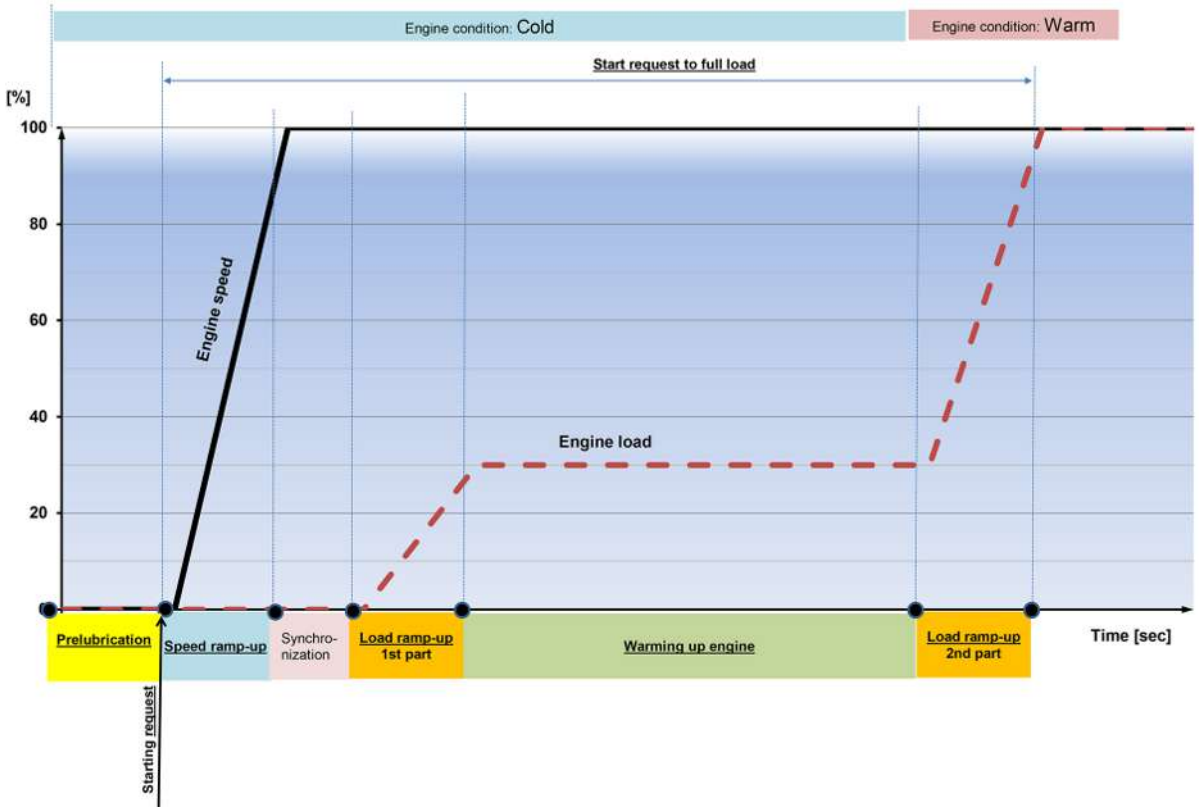



Figure 51: Start-up and load ramp-up for cold engine condition



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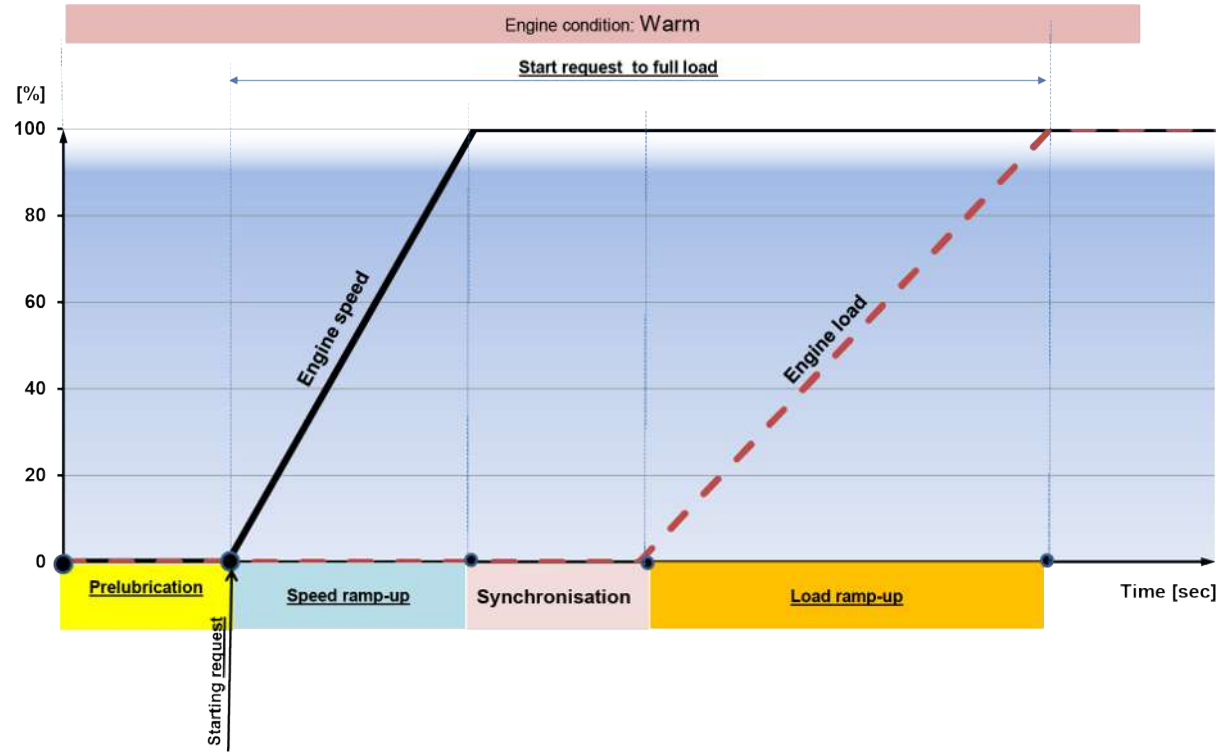



Figure 52: Start-up and load ramp-up for warm/hot engine condition

Find in the table below the relevant durations for the phases in above given diagram.

| 175D - Duration of start procedure | | | | | |
|---|---|---|---|---|---|
| Engine condition | Prelubrication [sec] () exceptional | Speed ramp-up [sec] | Synchronisation [sec] | Load ramp-up [sec] () exceptional | Total |
| Cold | 20 | 15 | 5 | 0 - 30%: 20<br>at 30%: 300[1)]<br>30% - 100%: 40<br>∑ 360 | 6 min 40 sec |
| Warm/Hot Recommended times | 20 | 15 | 5 | 12 | 52 sec |
| Warm/Hot Fastest times | 20 (0)[2)] | 5 | 5 | 6 (5)[3)] | 36 (15)[2) 3)] |

Figure 53: Duration of the load application – Continuous loading 175D MEL, MEM, MEV, MA

[1)] Estimated duration may differ depending on media system design. The engine must be operated at 30% load until regular preheating temperatures are reached.

[2)] Without prelubrication (exceptional) due to activated overwrite button.

[3)] Load ramp-up (exceptional) with visible smoke.



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## 2.9 Load application – Load steps for GenSet

**Performance class G2 for Everllence GenSets as a standard will be fulfilled**

As a standard, Everllence GenSets fulfill the requirements of the performance class G2 of the ISO rule 8528-5. Clarify any higher project-specific requirements at an early project stage with Everllence. They must be part of the contract. Below stated table describes exemplary in excerpts, the differences between the performance classes G1, G2 and G3.

| | IACS M3 Rev.6 | Performance class in accordance to ISO 8528-5 for GenSets | | |
|---|---|---|---|---|
| | | G1 | G2 | G3 |
| Auto shutdown overspeed | at 115% of nominal speed | | | |
| Alarm overspeed | at 110% of nominal speed | | | |
| Frequency droop (Max. remaining speed deviation in the whole load range) | ≤ 5% of nominal frequency | ≤ 8% of nominal frequency | ≤ 5% of nominal frequency | ≤ 3% of nominal frequency |
| Steady-state frequency band (Deviation at recent frequency at constant load) | ≤ 1.0% of recent frequency | ≤ 2.5% of recent frequency | ≤ 1.5% of recent frequency | ≤ 0.5% of recent frequency |
| In case of power increase | | | | |
| Transient frequency deviation related to rated frequency (Dynamic speed drop) | ≤ -10% of nominal frequency | ≤ -15% of nominal frequency | ≤ -10% of nominal frequency | ≤ -7% of nominal frequency |
| Only for gas engines | - | ≤ -25% of nominal frequency | ≤ -20% of nominal frequency | ≤ -15% of nominal frequency |
| Frequency recovery time (till frequency is within steady-state frequency band of new frequency) | ≤ 5 sec | ≤ 10 sec | ≤ 5 sec | ≤ 3 sec |
| In case of 100% load drop | | | | |
| Transient frequency deviation related to rated frequency (Dynamic speed increase) | ≤ +10% of nominal frequency | ≤ +18% of nominal frequency | ≤ +12% of nominal frequency | ≤ +10% of nominal frequency |
| Frequency recovery time (till frequency is within steady-state frequency band of new frequency) | ≤ 5 sec | ≤ 10 sec | ≤ 5 sec | ≤ 3 sec |

Table 47: Excerpt of the differences between the performance classes G1, G2 and G3 according ISO 8528-5 and requirements according IACS M3 Rev.6

Below stated diagrams "Load application dependent on base load" accordingly state the possible load steps of the Genset.



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**Engine specific load steps – Maximum load step dependent on base load**

Boundary conditions:

- Engine and media systems faultless in operation
- Engine condition hot
- Engine in steady state for minimum 5 min

If above stated boundary conditions are fulfilled, the maximum load step which can be applied as a function of the currently driven base load can be derived out of the below stated diagram(s).

Before an additional load step will be applied, at least 20 seconds waiting time after initiation of the previous load step needs to be considered.

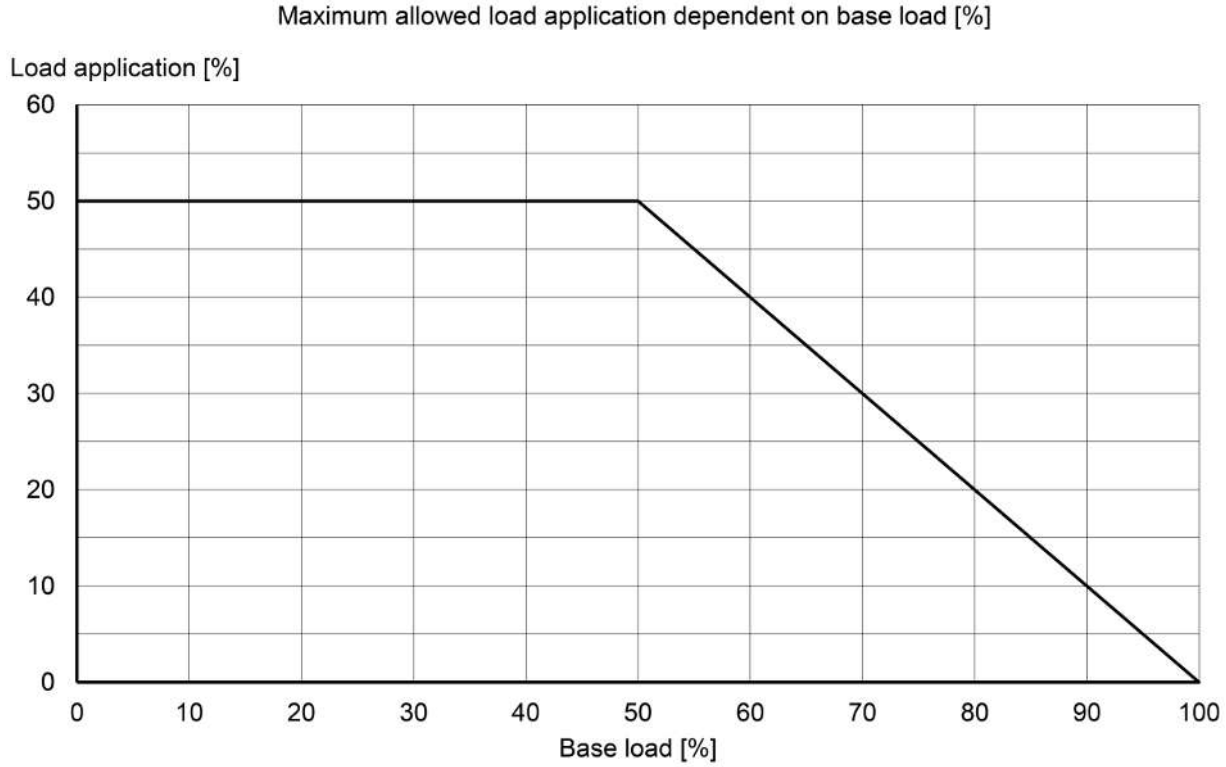



Figure 54: Load application dependent on base load (engine condition hot) - 175D MEL, MEM, MEV, MA, performance class G2

## 2.10 Engine load reduction and engine stop

**Recommended load reduction/stopping the engine**

To limit the effort regarding regulating the media circuits and also to ensure an uniform heat dissipation it always should be aimed for a smooth ramping down of the engine.

Before final engine stop, the engine has to be operated for a minimum of 1 minute at idling speed.



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## 2.11 Engine load reduction as a protective safety measure

### Requirements for the power management system/propeller control

In case of a load reduction request due to predefined abnormal engine parameter (for example, high exhaust gas temperature, high turbine speed, high lube oil temperature) the power output (load) must be ramped down as fast as possible to ≤ 60% load.

Therefore the power management system/propeller control has to meet the following requirements:

- After a maximum of 5 sec after occurrence of the load reduction signal, the engine load must be reduced by at least 5%.
- Then, within the next time period of maximum 30 sec an additional reduction of engine load by at least 35% must be applied.
- The “prohibited range” shown in figure Engine load reduction as a protective safety measure, Page 101 has to be avoided.

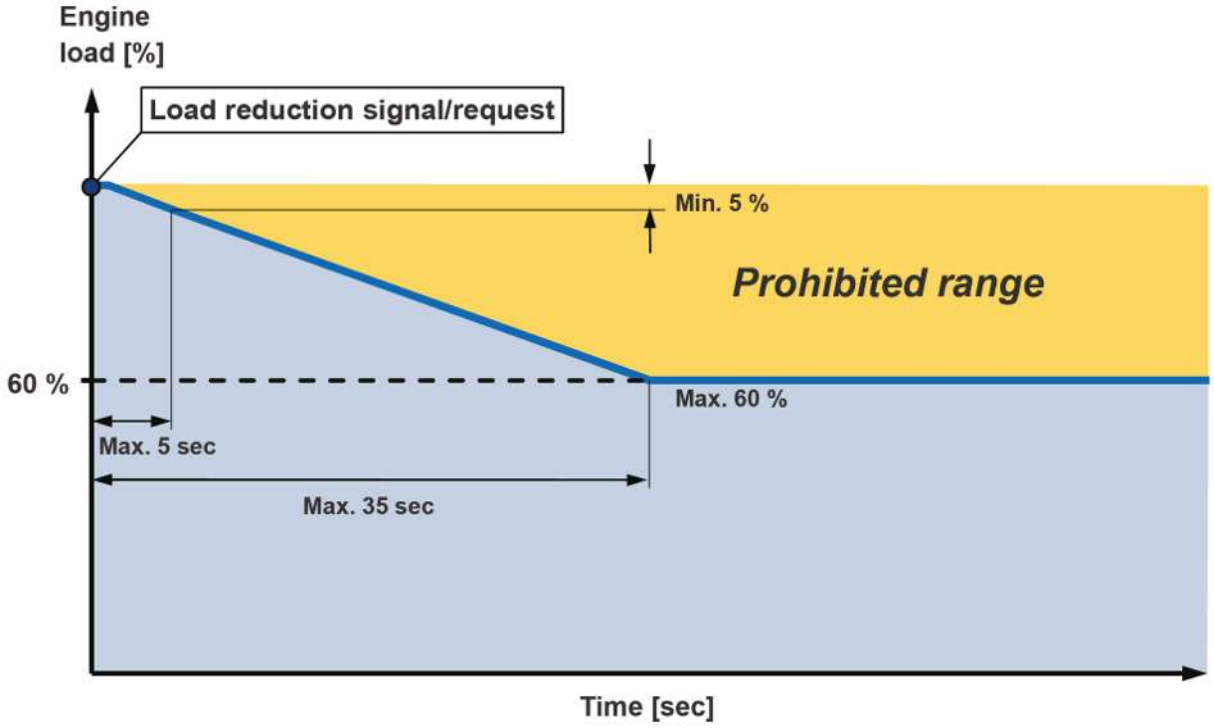



Figure 55: Engine load reduction as a protective safety measure

## 2.12 Engine operation under arctic conditions

As a standard, the 175D is equipped with a silencer at the compressor of the turbocharger and is taking its air direct out of the engine room.
And it is assumed that the engine room will have constantly a temperature of ≥ 5°C (minimum 0°C).

Accordingly arctic condition is defined as:

Air intake temperatures of the engine below 0°C.



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If engines operate under arctic conditions (intermittently or permanently), the engine equipment and plant installation have to hold certain design features, and have to meet special requirements. These depend on the possible minimum air intake temperature of the engine and the specification of the fuel used.

Minimum ambient air temperature, $t_a$ and minimum intake air temperature of the engine, $t_d$:

For all 175D variants, except 175D ML, 215 or 220 kW/cyl.:

- Category 1
  0°C > $t_a$ > −25°C and accordingly 0°C > $t_d$ > −25°C
- Category 2
  −25°C ≥ $t_a$ > −50°C and $t_d$ > −25°C by preheating

For 175D ML, 215 or 220 kW/cyl.:

- Category 1
  0°C > $t_a$ > −10°C and accordingly 0°C > $t_d$ > −10°C
- Category 2
  −10°C ≥ $t_a$ > −50°C and $t_d$ > −10°C by preheating

### Special engine design requirements

Special engine equipment required for arctic conditions category 1 and category 2, see section Standard versus optional equipment, Page 51.

### Engine equipment

SaCoS 5000

- SaCoS 5000 equipment is suitable to be stored at minimum ambient temperatures of −15°C.
- In case these conditions cannot be met, protective measures against climatic influences have to be taken for the following electronic components:
  - EDS Data box
  - TFT-touchscreen
  - Emergency switch module

  These components have to be stored at places, where the temperature is above −15°C.
- A minimum operating temperature of ≥ 0°C has to be ensured. The use of an optional electric heating is recommended.

See section Environmental conditions, Page 631.

### Alternators

Alternator operation is possible according to suppliers specification.

### Plant installation

Engine intake air conditioning

- Cooling down of engine room due to cold ambient air can be avoided by supplying the engine directly from outside with combustion air. For this the combustion air must be filtered (see quality requirements in section Specification for intake air (combustion air), Page 411). Moreover a droplet separator and air intake silencer become necessary, see section Engine room ventilation and combustion air, Page 479. According to classification rules it may be required to install two air inlets from the exterior, one at starboard and one at portside.



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- It is necessary to ensure that the charge air cooler cannot freeze when the engine is out of operation (and the cold air is at the air inlet side). Additionally it is recommended to prepare the combustion air duct upstream of the engine for the installation of a blanking plate.

Needed installation space above engine

- Everllence to be informed
  - Option "Engine prepared for external intake air supply system" to be triggered.
  - Needed installation space above engine to be clarified.

**Category 1**

- Intake air duct to be applied, see section External intake air supply system, Page 480.

Minimum engine room temperature

- Ventilation of engine room.

  The air of the engine room ventilation must not be too cold (preheating is necessary) to avoid the freezing of the liquids in the engine room systems.
- Minimum engine room temperature for design ≥ +5°C, thus preheating necessary.
- As a result, no preheating of the media systems within the engine room is necessary.

Instruction for minimum admissible fuel temperature

- In general, the minimum viscosity before engine of 1.5 cSt must not be undershoot.
- The fuel specific characteristic values “pour point” and “cold filter plugging point” have to be observed to ensure pumpability respectively filterability of the fuel oil.
- Fuel temperatures of ≤ –10°C are to be avoided, due to temporarily embrittlement of seals used in the engines fuel oil system. As a result they may suffer a loss of function.

Coolant and lube oil systems

- Media temperatures ≥ +5°C.
- Even with media temperatures of ≥ +5°C before engine, due to the cold intake air in the charge air cooler, the LT cooling water will be cooled down and following measures are needed.
- Maximum permissible antifreeze concentration (ethylene glycol) in the engine cooling water.

  An increasing proportion of antifreeze decreases the specific heat capacity of the engine cooling water, which worsens the heat dissipation from the engine and will lead to higher component temperatures. As a standard the antifreeze concentration of the engine cooling systems (HT and LT) within the engine room, respectively power house, should be 35% glycol.
- For information regarding engine cooling water, see section Specification of engine coolant, Page 404.
- Avoid heat extraction within LT CW system.

  After start of the engine and operation with ≤ +5°C intake air temperature, a heat extraction out of the LT cooling water system will start.

Required countermeasures to be taken:

- Preheating of LT cooling water temperature to ≥ +5°C – for required size of the preheater see accordingly diagram(s) below.

or alternatively

- after start of the engine, load up to ≥ 20–30% output [see accordingly diagram(s) below] to avoid heat extraction from LT system and keep engine operation constantly above this minimum load.



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Insulation

The design of the insulation of the piping systems and other plant parts (tanks, heat exchanger, external intake air duct, and so on) has to be modified and designed for the special requirements of arctic conditions.

Note:
For plants taken out of operation and cooled down below temperatures of +5°C additional special measures are required – in this case contact Everllence.

**Category 2**

Information and measures as stated in "category 1" plus

- Installation of a preheater in the intake air duct to achieve always intake air temperatures $t_d$ of the engine (at the inlet of the compressor of the turbocharger) of ≥ –25°C respectively for ML, 215 kW/cyl. or 220 kW/cyl. $t_d$ ≥ –10°C, see section External intake air supply system, Page 480.

**Heat extraction LT system and preheater sizes**

Start-up of an engine at arctic conditions (Air intake temperatures of the engine below +0°C) has to be done with a preheated engine (Normal start). (See section Start-up and load application).

Engine operation under arctic conditions and at low load carries the risk of heat loss in the cooling water systems and resulting risk of engine operation problems or even damage.

Therefore 3 cases are given:

Case1) Preheating of the intake air of the engine to a minimum of 0°C

Case 2) Installation of adequate HT preheater, that operates in parallel to engine operation to compensate HT energy losses

If operation within Range I is required,

a) Intake air needs to be preheated to > -25°C / > -10°C (for ML).

b) the preheater size within the plant must be capable to compensate any Heat losses within the cooling water system and to keep these on the required temperature level.

c) All preheaters need to be operated in parallel to engine operation until minimum engine load is reached.



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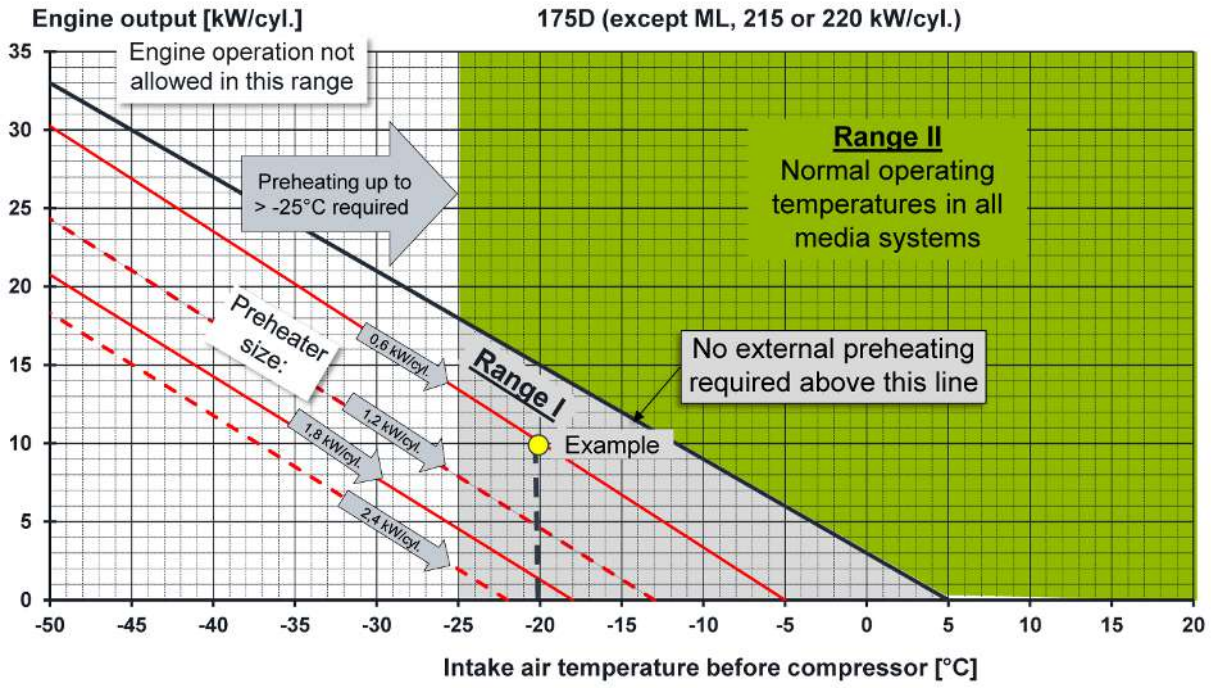



Figure 56: Required preheater size to avoid heat extraction from LT system – 175D (except ML, 215 or 220 kW/cyl.)

Example:

- Operation at 10kW/cyl. engine load and -20°C intake air temperature wanted.
- Preheating of intake air from -20°C up to minimum -11.5°C required.

> According diagram preheater size of 0.6 kW/cyl. required.

- Ensure that this preheater size is installed, otherwise this operation point is not permissible.



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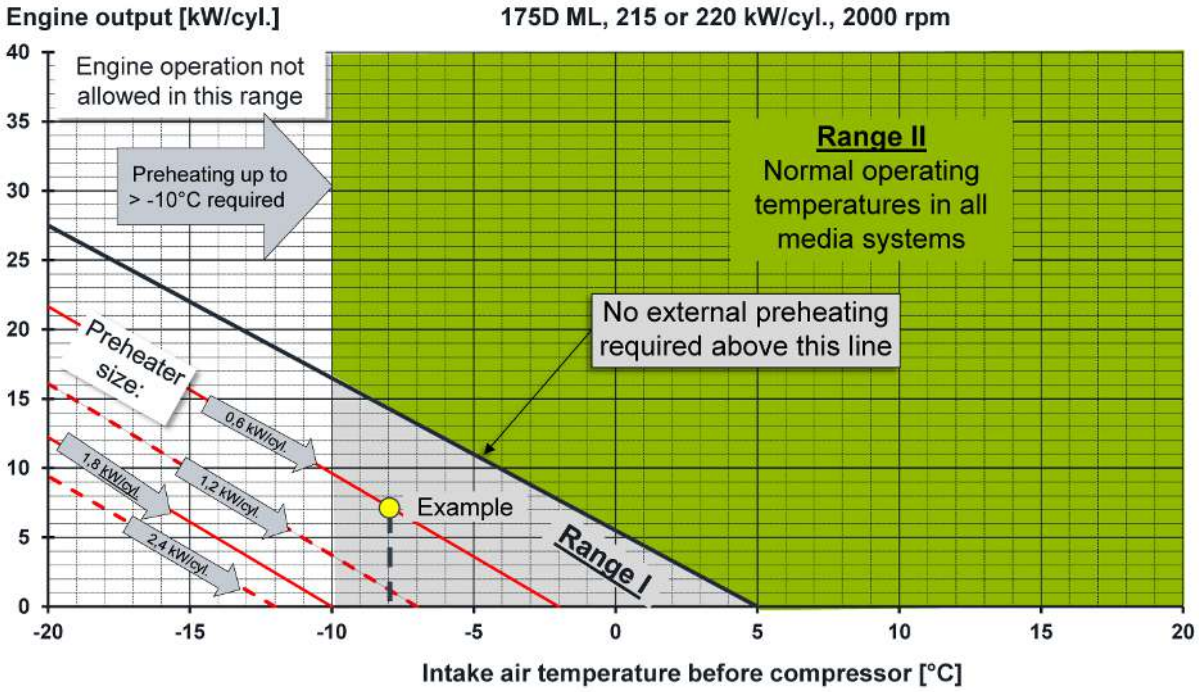



Figure 57: Required preheater size to avoid heat extraction from LT system – 175D ML, 215 or 220 kW/cyl.

Example for ML-variant:

- Operation at 6 kW/cyl engine load and -8°C intake air temperature wanted.
- Preheating of intake air from -8°C up to minimum -1°C required.

> According diagram preheater size of 0.6 kW/cyl. required.

- Ensure that this preheater size is installed, otherwise this operation point is not permissible.

Case 3)

Start up and fast passage through the area with HT energy loss.

In case operation within Range I **is not required** and the needed additional preheater capacity will not be applied, than following needs to be noticed:

- For any start up of the engine with <0°C.
  - Engine must be preheated.
  - Start up and load up to a minimum of the stated engine load, where no external preheating is not longer required, must be done within ≤ 5 min. Within this 5 min the stored heat of the preheated media systems can overcome the possible heat loss, without the risk of operation problems of the engine.
- Operation in Range I must be avoided.
- For operation within Range I without the needed additional preheater capacity, no guarantee can be given for a stable, trouble free engine operation.

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# 3 Technical data and engine performance

## 3.1 Performance data – Mechanical propulsion applications, IMO Tier II

### 3.1.1 20V175D-ML, 220 kW/cyl., 2,000 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 4,400 | 3,740 | 3,300 | 2,200 | 1,100 | 440 |
| Engine speed (FPP-curve) | rpm | 2,000 | 1,895 | 1,817 IMO: 1,820 | 1,587 IMO: 1,600 | 1,260 | 928 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 199 | 199 | 205 | 204 | 203 | 225 |
| Total fuel oil consumption[3)] | l/h | 1,047 | 890 | 809 | 537 | 267 | 119 |
| Lube oil consumption[4)] | g/kWh | 0.11 | - | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 48: Marine mechanical propulsion light duty, 220 kW/cyl., 2,000 rpm, IMO Tier II

Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 49: Reference conditions – 175D IMO Tier II



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### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 99%[1)] | 96%[1)] | 93%[1)] |
| 35 | 41 | 100%[1)] | 96%[1)] | 94%[1)] |
| 32 | 38 | 100% (Tropic) | 99%[1)] | 94%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 50: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 20V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 42.5 | 48.4 |
| LT CW flow from and to cooling system | $m^3/h$ | 55.3 | 62.2 |
| HT heat quantity | kW | 1,313 | 1,547 |
| LT heat quantity | kW | 1,291 | 1,551 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,900 | |

Table 51: Data for off-engine cooling system – Marine mechanical propulsion light duty

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 20V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 195 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 180 | |
| Seawater heat quantity | kW | 2,586 | 3,098 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 15 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 5 | |
| Max. seawater outlet temperature | °C | 30.5 | 47.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 52: Data for seawater system – Marine mechanical propulsion light duty

### Fuel supply system

| | | 20V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 53: Fuel supply system – Marine mechanical propulsion light duty

### Combustion air system

| | | 20V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 18,845 | 19,260 |

Table 54: Combustion air system – Marine mechanical propulsion light duty

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### Heat radiation

| | | 20V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 140 | 109 |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 55: Heat radiation – Marine mechanical propulsion light duty

### Exhaust system

| | | 20V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 51,562 | 51,965 |
| Exhaust gas temperature after turbocharger[2] | °C | 510 | 549 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 50 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 56: Exhaust system – Marine mechanical propulsion light duty

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### 3.1.2 12V175D-ML, 215 kW/cyl., 2,000 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 2,580 | 2,193 | 1,935 | 1,290 | 645 | 258 |
| Engine speed (FPP-curve) | rpm | 2,000 | 1,895 | 1,817<br>IMO:<br>1,820 | 1,587<br>IMO:<br>1,600 | 1,260 | 928 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 202 | 202 | 207 | 209 | 205 | 225 |
| Total fuel oil consumption[3)] | l/h | 623 | 530 | 479 | 323 | 158 | 70 |
| Lube oil consumption[4)] | g/kWh | 0.11 | - | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 57: Marine mechanical propulsion light duty, 215 kW/cyl., 2,000 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 58: Reference conditions – 175D IMO Tier II



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Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 97%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 97%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 98%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 59: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 24.0 | 27.2 |
| LT CW flow from and to cooling system | $m^3/h$ | 32.2 | 37.3 |
| HT heat quantity | kW | 733 | 856 |
| LT heat quantity | kW | 731 | 934 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 4,000 | |

Table 60: Data for off-engine cooling system – Marine mechanical propulsion light duty

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 130 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 105 | |
| Seawater heat quantity | kW | 1,464 | 1,790 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 25 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.8 | |
| Max. seawater outlet temperature | °C | 30 | 47 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 61: Data for seawater system – Marine mechanical propulsion light duty

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 62: Fuel supply system – Marine mechanical propulsion light duty

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 10,878 | 11,037 |

Table 63: Combustion air system – Marine mechanical propulsion light duty

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### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 83 | 65 |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 64: Heat radiation – Marine mechanical propulsion light duty

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 29,668 | 29,978 |
| Exhaust gas temperature after turbocharger[2] | °C | 507 | 553 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 50 | - |
| [1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine. | | | |
| [2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant). | | | |
| [3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances. | | | |

Table 65: Exhaust system – Marine mechanical propulsion light duty

2025-10-30 - 12.0

### 3.1.3 12V/16V/20V175D-ML, 200 kW/cyl., 2,000 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,400<br>16V: 3,200<br>20V: 4,000 | 12V: 2,040<br>16V: 2,720<br>20V: 3,400 | 12V: 1,800<br>16V: 2,400<br>20V: 3,000 | 12V: 1,200<br>16V: 1,600<br>20V: 2,000 | 12V: 600<br>16V: 800<br>20V: 1,000 | 12V: 240<br>16V: 320<br>20V: 400 |
| Engine speed (FPP-curve) | rpm | 2,000 | 1,895 | 1,817<br>IMO:<br>1,820 | 1,587<br>IMO:<br>1,600 | 1,260 | 928 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 197.5<br>16V: 197.5<br>20V: 197.5 | 12V: 194.5<br>16V: 194.5<br>20V: 194.5 | 12V: 194<br>16V: 194<br>20V: 194 | 12V: 187<br>16V: 187<br>20V: 188.5 | 12V: 199<br>16V: 199<br>20V: 199 | 12V: 300<br>16V: 300<br>20V: 300 |
| Total fuel oil consumption[3)] | l/h | 12V: 567<br>16V: 756<br>20V: 944 | 12V: 475<br>16V: 633<br>20V: 791 | 12V: 418<br>16V: 557<br>20V: 696 | 12V: 269<br>16V: 358<br>20V: 451 | 12V: 143<br>16V: 191<br>20V: 238 | 12V: 87<br>16V: 115<br>20V:144 |
| Lube oil consumption[4)] | g/kWh | 0.11 | - | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 66: Marine mechanical propulsion light duty, 200 kW/cyl., 2,000 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 67: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 97%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 98%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 98%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 68: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 23.8 | 26.8 | 33.1 | 37.2 | 41.5 | 47 |
| LT CW flow from and to cooling system | $m^3/h$ | 31.2 | 37.3 | 39.9 | 50.7 | 50.2 | 62.2 |
| HT heat quantity | kW | 725 | 841 | 1,012 | 1,175 | 1,275 | 1,492 |
| LT heat quantity | kW | 709 | 907 | 886 | 1,095 | 1,127 | 1,366 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 4,000 | | 2,800 | | 2,900 | |

Table 69: Data for off-engine cooling system – Marine mechanical propulsion light duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 130 | | 175 | | 195 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 105 | | 130 | | 150 | |
| Seawater heat quantity | kW | 1,434 | 1,748 | 1,898 | 2,270 | 2,402 | 2,858 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 25 | | 45 | | 45 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.7 | | 3.5 | | 4.2 | |
| Max. seawater outlet temperature | °C | 30 | 46.5 | 31 | 47 | 32 | 49 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 70: Data for seawater system – Marine mechanical propulsion light duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 71: Fuel supply system – Marine mechanical propulsion light duty

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### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 10,574 | 10,807 | 13,654 | 13,964 | 17,382 | 17,717 |

Table 72: Combustion air system – Marine mechanical propulsion light duty

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 81 | 63 | 108 | 84 | 136 | 105 |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | | | | | |

Table 73: Heat radiation – Marine mechanical propulsion light duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 27,282 | 27,658 | 36,552 | 36,659 | 45,826 | 15,976 |
| Exhaust gas temperature after turbocharger[2)] | °C | 472 | 508 | 493 | 527 | 482 | 518 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 74: Exhaust system – Marine mechanical propulsion light duty

2025-10-30 - 12.0

### 3.1.4 12V175D-MM, 200 kW/cyl., 1,800 rpm, IMO Tier II for tug application

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 2,400 | 2,040 | 1,800 | 1,200 | 600 | 240 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1,705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 193 | 195 | 196 | 186 | 194 | 295 |
| Total fuel oil consumption[3)] | l/h | 535.5 | 476 | 421.5 | 267 | 139.5 | 85 |
| Lube oil consumption[4)] | g/kWh | 0.12 | - | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 75: Marine mechanical propulsion medium duty, 200 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 76: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 99%[1)] | 94%[1)] |
| 35 | 41 | 100%[1)] | 99%[1)] | 94%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 95%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 77: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 23.7 | 27.1 |
| LT CW flow from and to cooling system | $m^3/h$ | 29.1 | 33.3 |
| HT heat quantity | kW | 747 | 884 |
| LT heat quantity | kW | 674 | 830 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 78: Data for off-engine cooling system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 120 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 95 | |
| Seawater heat quantity | kW | 1,421 | 1,715 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 25 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 31 | 48 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 79: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 80: Fuel supply system – Marine mechanical propulsion medium duty

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,905 | 10,072 |

Table 81: Combustion air system – Marine mechanical propulsion medium duty

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### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 81 | 63 |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 82: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 25,820 | 25,950 |
| Exhaust gas temperature after turbocharger[2] | °C | 473 | 512 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 83: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.1.5 12V/16V/20V175D-MM, 185 kW/cyl., 1,900 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,220<br>16V: 2,960<br>20V: 3,700 | 12V: 1,887<br>16V: 2,516<br>20V: 3,145 | 12V: 1,665<br>16V: 2,220<br>20V: 2,775 | 12V: 1,110<br>16V: 1,480<br>20V: 1,850 | 12V: 555<br>16V: 740<br>20V: 925 | 12V: 222<br>16V: 296<br>20V: 370 |
| Engine speed (FPP-curve) | rpm | 1,900 | 1,800 | 1,726<br>IMO:<br>1,729 | 1,508<br>IMO:<br>1,520 | 1,197 | 882 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 195<br>16V: 196<br>20V: 194 | 12V: 194<br>16V: 194<br>20V: 193 | 12V: 194.5<br>16V: 194.5<br>20V: 194.5 | 12V: 187<br>16V: 187<br>20V: 190 | 12V: 198<br>16V: 198<br>20V: 198 | 12V: 240<br>16V: 240<br>20V: 240 |
| Total fuel oil consumption[3)] | l/h | 12V: 518<br>16V: 694<br>20V: 858 | 12V: 438<br>16V: 584<br>20V: 726 | 12V: 387<br>16V: 516<br>20V: 645 | 12V: 248<br>16V: 331<br>20V: 420 | 12V: 132<br>16V: 176<br>20V: 219 | 12V: 64<br>16V: 85<br>20V: 107 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 84: Marine mechanical propulsion medium duty, 185 kW/cyl., 1,900 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 85: Reference conditions – 175D IMO Tier II



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### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 97%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 98%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 98%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 86: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 23.1 | 26.1 | 32 | 35.9 | 39 | 44.4 |
| LT CW flow from and to cooling system | $m^3/h$ | 29.7 | 35.3 | 38.4 | 47.7 | 49 | 59.2 |
| HT heat quantity | kW | 715 | 834 | 998 | 1,151 | 1,209 | 1,421 |
| LT heat quantity | kW | 678 | 861 | 861 | 1,064 | 1,112 | 1,345 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,600 | | 2,800 | | 2,800 | |

Table 87: Data for off-engine cooling system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 115 | | 160 | | 195 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 88 | | 119 | | 150 | |
| Seawater heat quantity | kW | 1,393 | 1,695 | 1,859 | 2,215 | 2,321 | 2,766 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 27 | | 41 | | 45 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 4 | | 4.4 | | 4 | |
| Max. seawater outlet temperature | °C | 32 | 49 | 31.5 | 48 | 31.5 | 48.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 88: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 89: Fuel supply system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 10,098 | 10,317 | 12,901 | 13,188 | 16,631 | 16,952 |

Table 90: Combustion air system – Marine mechanical propulsion medium duty

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 79 | 61 | 105 | 82 | 132 | 102 |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | | | | | |

Table 91: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 25,118 | 25,192 | 33,042 | 33,032 | 41,269 | 41,431 |
| Exhaust gas temperature after turbocharger[2)] | °C | 441 | 473 | 461 | 491 | 439 | 474 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 92: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.1.6 12V/16V/20V175D-MM, 185 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,220<br>16V: 2,960<br>20V: 3,700 | 12V: 1,887<br>16V: 2,516<br>20V: 3,145 | 12V: 1,665<br>16V: 2,220<br>20V: 2,775 | 12V: 1,110<br>16V: 1,480<br>20V: 1,850 | 12V: 555<br>16V: 740<br>20V: 925 | 12V: 222<br>16V: 296<br>20V: 370 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1,705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 191.5<br>16V: 192.5<br>20V: 191.5 | 12V: 192<br>16V: 192<br>20V: 192 | 12V: 192.5<br>16V: 192.5<br>20V: 192.5 | 12V: 188<br>16V: 188<br>20V: 188 | 12V: 197<br>16V: 197<br>20V: 197 | 12V: 230<br>16V: 230<br>20V: 230 |
| Total fuel oil consumption[3)] | l/h | 12V: 508<br>16V: 681<br>20V: 847 | 12V: 433<br>16V: 578<br>20V: 722 | 12V: 383<br>16V: 510.5<br>20V: 638.5 | 12V: 250<br>16V: 333<br>20V: 416 | 12V: 131<br>16V: 175<br>20V: 218 | 12V: 62<br>16V: 82<br>20V: 102 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 93: Marine mechanical propulsion medium duty, 185 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 94: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 95: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 22.9 | 26.1 | 31.5 | 35.2 | 38.8 | 43.9 |
| LT CW flow from and to cooling system | $m^3/h$ | 28.4 | 33.3 | 36.9 | 44.7 | 46.8 | 56.2 |
| HT heat quantity | kW | 713 | 844 | 993 | 1,142 | 1,216 | 1,425 |
| LT heat quantity | kW | 652 | 805 | 836 | 1,038 | 1,064 | 1,292 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 96: Data for off-engine cooling system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,365 | 1,649 | 1,829 | 2,180 | 2,280 | 2,717 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 33 | 50.5 | 33 | 50 | 33 | 50.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 97: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 98: Fuel supply system – Marine mechanical propulsion medium duty

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### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,837 | 10,011 | 12,642 | 12,954 | 16,133 | 16,448 |

Table 99: Combustion air system – Marine mechanical propulsion medium duty

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 79 | 61 | 105 | 82 | 131 | 102 |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 100: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 24,420 | 24,543 | 31,719 | 31,750 | 40,484 | 40,620 |
| Exhaust gas temperature after turbocharger[2)] | °C | 439 | 476 | 446 | 475 | 447 | 481 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 101: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.1.7 12V/16V/20V175D-MM, 170 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,040<br>16V: 2,720<br>20V: 3,400 | 12V: 1,734<br>16V: 2,312<br>20V: 2,890 | 12V: 1,530<br>16V: 2,040<br>20V: 2,550 | 12V: 1,020<br>16V: 1,360<br>20V: 1,700 | 12V: 510<br>16V: 680<br>20V: 850 | 12V: 204<br>16V: 272<br>20V: 340 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1,705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 191<br>16V: 191<br>20V: 191 | 12V: 192<br>16V: 192<br>20V: 192 | 12V: 194<br>16V: 194<br>20V: 194 | 12V: 188.5<br>16V: 188.5<br>20V: 192 | 12V: 199<br>16V: 199<br>20V: 199 | 12V: 230<br>16V: 230<br>20V: 230 |
| Total fuel oil consumption[3)] | l/h | 12V: 466<br>16V: 621<br>20V: 776 | 12V: 398<br>16V: 531<br>20V: 663 | 12V: 355<br>16V: 473<br>20V: 592 | 12V: 230<br>16V: 307<br>20V: 390 | 12V: 122<br>16V: 162<br>20V: 203 | 12V: 57<br>16V: 75<br>20V: 94 |
| Lube oil consumption[4)] | g/kWh | 0.14 | - | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 102: Marine mechanical propulsion medium duty, 170 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 103: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 104: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 21.9 | 25 | 30.1 | 33.7 | 36.4 | 41.6 |
| LT CW flow from and to cooling system | $m^3/h$ | 27.2 | 33.3 | 36.6 | 44.7 | 47.4 | 56.2 |
| HT heat quantity | kW | 677 | 800 | 938 | 1,080 | 1,124 | 1,327 |
| LT heat quantity | kW | 614 | 762 | 825 | 1,022 | 1,080 | 1,303 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 105: Data for off-engine cooling system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,391 | 1,562 | 1,763 | 2,102 | 2,204 | 2,630 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 33.5 | 49.5 | 32.5 | 49.5 | 32.5 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 106: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 107: Fuel supply system – Marine mechanical propulsion medium duty

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### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,667 | 9,850 | 12,469 | 12,778 | 16,411 | 16,742 |

Table 108: Combustion air system – Marine mechanical propulsion medium duty

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 76 | 59 | 101 | 79 | 126 | 98 |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 109: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 22,947 | 23,069 | 29,762 | 29,791 | 37,748 | 38,022 |
| Exhaust gas temperature after turbocharger[2)] | °C | 410 | 444 | 413 | 440 | 389 | 423 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 110: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.1.8 12V/16V175D-MM, 160 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,920<br>16V: 2,560 | 12V: 1,632<br>16V: 2,176 | 12V: 1,440<br>16V: 1,920 | 12V: 960<br>16V: 1,280 | 12V: 480<br>16V: 640 | 12V: 192<br>16V: 256 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1.705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 193<br>16V: 193 | 12V: 194<br>16V: 194 | 12V: 194<br>16V: 194 | 12V: 194<br>16V: 194 | 12V: 201<br>16V: 201 | 12V: 300<br>16V: 300 |
| Total fuel oil consumption[3)] | l/h | 12V: 443<br>16V: 591 | 12V: 379<br>16V: 505 | 12V: 334<br>16V: 446 | 12V: 223<br>16V: 297 | 12V: 116<br>16V: 154 | 12V: 69<br>16V: 92 |
| Lube oil consumption[4)] | g/kWh | 0.15 | - | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 111: Marine mechanical propulsion medium duty, 160 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 112: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 113: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 21 | 24.1 | 29.2 | 32.7 |
| LT CW flow from and to cooling system | $m^3/h$ | 27.3 | 33.3 | 36.1 | 44.7 |
| HT heat quantity | kW | 642 | 762 | 900 | 1,037 |
| LT heat quantity | kW | 617 | 761 | 811 | 1,005 |
| HT inlet temperature | °C | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | |

Table 114: Data for off-engine cooling system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | |
| Seawater heat quantity | kW | 1,259 | 1,523 | 1,611 | 2,042 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.8 | |
| Max. seawater outlet temperature | °C | 32 | 49 | 32 | 49 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 115: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 116: Fuel supply system – Marine mechanical propulsion medium duty

### Combustion air system

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,703 | 9,878 | 12,467 | 12,777 |

Table 117: Combustion air system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 74 | 58 | 99 | 77 |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | | | |

Table 118: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 21,775 | 21,955 | 28,557 | 28,590 |
| Exhaust gas temperature after turbocharger[2)] | °C | 374 | 409 | 386 | 413 |
| Exhaust gas back pressure | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 119: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.1.9 12V175D-MM, 155 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 1,860 | 1,581 | 1,395 | 930 | 465 | 186 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1.705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 191 | 192 | 193.5 | 190 | 201 | 300 |
| Total fuel oil consumption[3)] | l/h | 425 | 363 | 323 | 212 | 112 | 67 |
| Lube oil consumption[4)] | g/kWh | 0.16 | - | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 120: Marine mechanical propulsion medium duty, 155 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 121: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 122: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20.7 | 23.8 |
| LT CW flow from and to cooling system | $m^3/h$ | 26.9 | 33.3 |
| HT heat quantity | kW | 631 | 749 |
| LT heat quantity | kW | 603 | 741 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 123: Data for off-engine cooling system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,234 | 1,490 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 32 | 48.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 124: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 125: Fuel supply system – Marine mechanical propulsion medium duty

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,608 | 9,765 |

Table 126: Combustion air system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 73 | 57 |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 127: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 21,316 | 21,510 |
| Exhaust gas temperature after turbocharger[2] | °C | 367 | 404 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 128: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.1.10 12V175D-MH, 145 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 1,740 | 1,479 | 1,305 | 870 | 435 | 174 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1,705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 192.5 | 193 | 195 | 193.5 | 203 | 215 |
| Total fuel oil consumption[3)] | l/h | 401 | 342 | 305 | 222 | 106 | 45 |
| Lube oil consumption[4)] | g/kWh | 0.17 | - | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 129: Marine mechanical propulsion heavy duty, 145 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 130: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 131: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20.2 | 23.1 |
| LT CW flow from and to cooling system | $m^3/h$ | 25.3 | 33.3 |
| HT heat quantity | kW | 611 | 723 |
| LT heat quantity | kW | 555 | 684 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 132: Data for off-engine cooling system – Marine mechanical propulsion heavy duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,166 | 1,407 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 31 | 48 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 133: Data for seawater system – Marine mechanical propulsion heavy duty

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 134: Fuel supply system – Marine mechanical propulsion heavy duty

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,286 | 9,439 |

Table 135: Combustion air system – Marine mechanical propulsion heavy duty



2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 71 | 56 |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 136: Heat radiation – Marine mechanical propulsion heavy duty

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 20,368 | 20,543 |
| Exhaust gas temperature after turbocharger[2)] | °C | 360 | 369 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |
| [1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine. | | | |
| [2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant). | | | |
| [2)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances. | | | |

Table 137: Exhaust system – Marine mechanical propulsion heavy duty

2025-10-30 - 12.0

## 3.2 Performance data – Mechanical propulsion applications, IMO Tier III

### 3.2.1 12V/16V/20V175D-ML, 200 kW/cyl., 2,000 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,400<br>16V: 3,200<br>20V: 4,000 | 12V: 2,040<br>16V: 2,720<br>20V: 3,400 | 12V: 1,800<br>16V: 2,400<br>20V: 3,000 | 12V: 1,200<br>16V: 1,600<br>20V: 2,000 | 12V: 600<br>16V: 800<br>20V: 1,000 | 12V: 240<br>16V: 320<br>20V: 400 |
| Engine speed (FPP-curve) | rpm | 2,000 | 1,895 | 1,817<br>IMO:<br>1,820 | 1,587<br>IMO:<br>1,600 | 1,260 | 928 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 198<br>16V: 198<br>20V: 198 | 12V: 195<br>16V: 195<br>20V: 196 | 12V: 195.5<br>16V: 195.5<br>20V: 195.5 | 12V: 189.5<br>16V: 189.5<br>20V: 189.5 | 12V: 200<br>16V: 200<br>20V: 200 | 12V: 300<br>16V: 300<br>20V: 300 |
| Total fuel oil consumption[3)] | l/h | 12V: 568<br>16V: 757<br>20V: 947 | 12V: 476<br>16V: 634<br>20V: 797 | 12V: 421<br>16V: 561<br>20V: 701 | 12V: 272<br>16V: 363<br>20V: 453 | 12V: 144<br>16V: 192<br>20V: 239 | 12V: 87<br>16V: 115<br>20V: 144 |
| Lube oil consumption[4)] | g/kWh | 0.12 | - | | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 138: Marine mechanical propulsion light duty, 200 kW/cyl., 2,000 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 139: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 98%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 98%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 99%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 140: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 23.7 | 26.8 | 32.8 | 37 | 40.6 | 46.2 |
| LT CW flow from and to cooling system | $m^3/h$ | 29.1 | 37.3 | 39.5 | 50.7 | 50.4 | 62.2 |
| HT heat quantity | kW | 722 | 839 | 1,003 | 1,166 | 1,241 | 1,459 |
| LT heat quantity | kW | 673 | 855 | 871 | 1,080 | 1,133 | 1,370 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 4,000 | | 2,800 | | 2,900 | |

Table 141: Data for off-engine cooling system – Marine mechanical propulsion light duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 130 | | 175 | | 195 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 105 | | 130 | | 150 | |
| Seawater heat quantity | kW | 1,395 | 1,694 | 1,874 | 2,246 | 2,374 | 2,829 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 25 | | 45 | | 45 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.7 | | 3.5 | | 4.2 | |
| Max. seawater outlet temperature | °C | 29.5 | 46 | 30.5 | 47 | 32 | 49 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 142: Data for seawater system – Marine mechanical propulsion light duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 143: Fuel supply system – Marine mechanical propulsion light duty

2025-10-30 - 12.0

### Combustion air system

| Values at 100% output | Unit | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Combustion air flow rate | $m^3/h$ | 10,378 | 10,556 | 13,575 | 13,892 | 17,422 | 17,781 |

Table 144: Combustion air system – Marine mechanical propulsion light duty

### Heat radiation

| Values at 100% output | Unit | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Heat radiation (engine)[1] | kW | 81 | 63 | 108 | 84 | 136 | 105 |
| Heat radiation SCR | kW | 18 | | 36 | | | |

[1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 145: Heat radiation – Marine mechanical propulsion light duty

### Exhaust system

| Values at 100% output | Units | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Exhaust gas flow rate[1] | $m^3/h$ | 27,675 | 27,872 | 35,916 | 36,085 | 43,376 | 46,280 |
| Exhaust gas temperature after turbocharger[2] | °C | 491 | 532 | 484 | 518 | 482 | 519 |
| Exhaust gas back pressure composition | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 160 | - | 90 | - | 124 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 210 | - | 140 | - | 174 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 4-line | | 4-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 146: Exhaust system – Marine mechanical propulsion light duty

2025-10-30 - 12.0

### 3.2.2 12V175D-MM, 200 kW/cyl., 1,800 rpm, IMO Tier III for tug application

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 2,400 | 2,040 | 1,800 | 1,200 | 600 | 240 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1,705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 193 | 195 | 196 | 187 | 195 | 296 |
| Total fuel oil consumption[3)] | l/h | 553.5 | 475.5 | 421.5 | 268.5 | 140 | 85 |
| Lube oil consumption[4)] | g/kWh | 0.12 | - | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 147: Marine mechanical propulsion medium duty, 200 kW/cyl., 1,800 rpm, IMO Tier III for tug application

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 148: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 99%[1)] | 94%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 94%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 96%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 149: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 23.4 | 26.7 |
| LT CW flow from and to cooling system | $m^3/h$ | 29 | 33.3 |
| HT heat quantity | kW | 733 | 870 |
| LT heat quantity | kW | 671 | 827 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 150: Data for off-engine cooling system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 120 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 95 | |
| Seawater heat quantity | kW | 1,404 | 1,697 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 25 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 31 | 47.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 151: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 152: Fuel supply system – Marine mechanical propulsion medium duty

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,867 | 10,043 |

Table 153: Combustion air system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 81 | 63 |
| Heat radiation SCR | kW | 18 | 18 |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 154: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 25,789 | 25,979 |
| Exhaust gas temperature after turbocharger[2] | °C | 475 | 515 |
| Exhaust gas back pressure composition | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 150 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 200 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |
| SCR system layout | - | 2-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 155: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.2.3 12V/16V/20V175D-MM, 185 kW/cyl., 1,900 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,220<br>16V: 2,960<br>20V: 3,700 | 12V: 1,887<br>16V: 2,516<br>20V: 3,145 | 12V: 1,665<br>16V: 2,220<br>20V: 2,775 | 12V: 1,110<br>16V: 1,480<br>20V: 1,850 | 12V: 555<br>16V: 740<br>20V: 925 | 12V: 222<br>16V: 296<br>20V: 370 |
| Engine speed (FPP-curve) | rpm | 1,900 | 1,800 | 1,726<br>IMO:<br>1,729 | 1,508<br>IMO:<br>1,520 | 1,197 | 882 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 196<br>16V: 197<br>20V: 195 | 12V: 195.5<br>16V: 195.5<br>20V: 194 | 12V: 196<br>16V: 196<br>20V: 196 | 12V: 188.5<br>16V: 188.5<br>20V: 191 | 12V: 198<br>16V: 198<br>20V: 198 | 12V: 240<br>16V: 240<br>20V: 240 |
| Total fuel oil consumption[3)] | l/h | 12V: 520<br>16V: 697<br>20V: 863 | 12V: 441<br>16V: 588<br>20V: 729 | 12V: 390<br>16V: 520<br>20V: 650 | 12V: 250<br>16V: 334<br>20V: 423 | 12V: 132<br>16V: 176<br>20V: 219 | 12V: 64<br>16V: 85<br>20V: 107 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 156: Marine mechanical propulsion medium duty, 185 kW/cyl., 1,900 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 157: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 98%[1)] | 96%[1)] |
| 35 | 41 | 100%[1)] | 98%[1)] | 97%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 97%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 158: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 22.5 | 25.8 | 31.9 | 35.8 | 38.4 | 43.8 |
| LT CW flow from and to cooling system | $m^3/h$ | 29.6 | 35.3 | 37.9 | 47.7 | 48.7 | 59.2 |
| HT heat quantity | kW | 700 | 818 | 1,094 | 1,134 | 1,185 | 1,397 |
| LT heat quantity | kW | 675 | 856 | 843 | 1,047 | 1,104 | 1,336 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,600 | | 2,800 | | 2,800 | |

Table 159: Data for off-engine cooling system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 115 | | 160 | | 195 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 88 | | 119 | | 150 | |
| Seawater heat quantity | kW | 1,375 | 1,674 | 1,937 | 2,162 | 2,289 | 2,733 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 27 | | 41 | | 45 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 4.0 | | 4.4 | | 4.0 | |
| Max. seawater outlet temperature | °C | 31.5 | 48.5 | 32 | 47.5 | 31.5 | 48 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 160: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 161: Fuel supply system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Combustion air system

| Values at 100% output | Unit | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Combustion air flow rate | $m^3/h$ | 10,093 | 10,319 | 12,636 | 12,922 | 16,550 | 16,888 |

Table 162: Combustion air system – Marine mechanical propulsion medium duty

### Heat radiation

| Values at 100% output | Unit | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Heat radiation (engine)[1] | kW | 79 | 61 | 105 | 82 | 131 | 102 |
| Heat radiation SCR | kW | 18 | | 36 | | | |

[1] Based on engine room temperature 35°C (ISO)/55 °C (tropic conditions).

Table 163: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| Values at 100% output | Units | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Exhaust gas flow rate[1] | $m^3/h$ | 25,130 | 25,277 | 33,714 | 32,933 | 42,143 | 41,684 |
| Exhaust gas temperature after turbocharger[2] | °C | 442 | 476 | 472 | 503 | 445 | 481 |
| Exhaust gas back pressure composition | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 141 | - | 76 | - | 108 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 191 | - | 126 | - | 158 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 4-line | | 4-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 164: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.2.4 12V/16V/20V175D-MM, 185 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,220<br>16V: 2,960<br>20V: 3,700 | 12V: 1,887<br>16V: 2,516<br>20V: 3,145 | 12V: 1,665<br>16V: 2,220<br>20V: 2,775 | 12V: 1,110<br>16V: 1,480<br>20V: 1,850 | 12V: 555<br>16V: 740<br>20V: 925 | 12V: 222<br>16V: 296<br>20V: 370 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1,705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 193<br>16V: 194<br>20V: 193 | 12V: 193<br>16V: 193<br>20V: 193 | 12V: 193.5<br>16V: 193.5<br>20V: 193.5 | 12V: 188<br>16V: 188<br>20V: 188 | 12V: 197<br>16V: 198<br>20V: 197 | 12V: 230<br>16V: 230<br>20V: 230 |
| Total fuel oil consumption[3)] | l/h | 12V: 512<br>16V: 687<br>20V: 854 | 12V: 436<br>16V: 581<br>20V: 726 | 12V: 385<br>16V: 513.5<br>20V: 641.5 | 12V: 250<br>16V: 333<br>20V: 416 | 12V: 131<br>16V: 176<br>20V: 218 | 12V: 62<br>16V: 82<br>20V: 102 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 165: Marine mechanical propulsion medium duty, 185 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 166: Reference conditions – 175D IMO Tier III

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### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 97%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 97%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 98%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 167: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 22.4 | 25.7 | 31.7 | 35.3 | 38.1 | 43.3 |
| LT CW flow from and to cooling system | $m^3/h$ | 28.4 | 33.3 | 36.3 | 44.7 | 46.7 | 56.2 |
| HT heat quantity | kW | 697 | 828 | 998 | 1,146 | 1,175 | 1,397 |
| LT heat quantity | kW | 650 | 802 | 816 | 1,016 | 1,061 | 1,287 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 168: Data for off-engine cooling system – Marine mechanical propulsion medium duty

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,347 | 1,630 | 1,814 | 2,162 | 2,236 | 2,684 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 33 | 50 | 33 | 50 | 33 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 169: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 170: Fuel supply system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Combustion air system

| Values at 100% output | Unit | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Combustion air flow rate | $m^3/h$ | 9,795 | 9,976 | 12,344 | 12,647 | 16,099 | 16,435 |

Table 171: Combustion air system – Marine mechanical propulsion medium duty

### Heat radiation

| Values at 100% output | Unit | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Heat radiation (engine)[1] | kW | 79 | 61 | 105 | 82 | 132 | 102 |
| Heat radiation SCR | kW | 18 | | 36 | | | |

[1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 172: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| Values at 100% output | Units | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Exhaust gas flow rate[1] | $m^3/h$ | 24,477 | 24,674 | 31,988 | 32,004 | 40,616 | 40,881 |
| Exhaust gas temperature after turbocharger[2] | °C | 444 | 482 | 468 | 498 | 450 | 486 |
| Exhaust gas back pressure composition | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 137 | - | 73 | - | 105 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 187 | - | 123 | - | 155 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 4-line | | 4-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 173: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.2.5 12V/16V/20V175D-MM, 170 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,040<br>16V: 2,720<br>20V: 3,400 | 12V: 1,734<br>16V: 2,312<br>20V: 2,890 | 12V: 1,530<br>16V: 2,040<br>20V: 2,550 | 12V: 1,020<br>16V: 1,360<br>20V: 1,700 | 12V: 510<br>16V: 680<br>20V: 850 | 12V: 204<br>16V: 272<br>20V: 340 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1,705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 191.5<br>16V: 192.5<br>20V: 191.5 | 12V: 193.5<br>16V: 194.5<br>20V: 193.5 | 12V: 195<br>16V: 196<br>20V: 195 | 12V: 190<br>16V: 194<br>20V: 194 | 12V: 199<br>16V: 200<br>20V: 199 | 12V: 230<br>16V: 230<br>20V: 230 |
| Total fuel oil consumption[3)] | l/h | 12V: 467<br>16V: 626<br>20V: 778 | 12V: 401<br>16V: 538<br>20V: 669 | 12V: 357<br>16V: 478<br>20V: 595 | 12V: 232<br>16V: 316<br>20V: 395 | 12V: 122<br>16V: 163<br>20V: 203 | 12V: 57<br>16V: 75<br>20V: 94 |
| Lube oil consumption[4)] | g/kWh | 0.14 | - | | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 174: Marine mechanical propulsion medium duty, 170 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 175: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 176: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 21.5 | 24.7 | 30.6 | 33.9 | 36.3 | 41.4 |
| LT CW flow from and to cooling system | $m^3/h$ | 27.1 | 33.3 | 30.4 | 44.7 | 45.2 | 56.2 |
| HT heat quantity | kW | 660 | 785 | 957 | 1,088 | 1,119 | 1,319 |
| LT heat quantity | kW | 612 | 650 | 639 | 1,022 | 1,012 | 1,222 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 177: Data for off-engine cooling system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,272 | 1,435 | 1,596 | 2,110 | 2,131 | 2,514 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 32 | 48 | 31 | 49.5 | 32.5 | 49 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 178: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 179: Fuel supply system – Marine mechanical propulsion medium duty

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### Combustion air system

| Values at 100% output | Unit | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Combustion air flow rate | $m^3/h$ | 9,576 | 9,731 | 11,207 | 11,503 | 15,919 | 16,183 |

Table 180: Combustion air system – Marine mechanical propulsion medium duty

### Heat radiation

| Values at 100% output | Unit | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Heat radiation (engine)[1] | kW | 76 | 59 | 101 | 79 | 126 | 98 |
| Heat radiation SCR | kW | 18 | | | | 36 | |

[1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 181: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| Values at 100% output | Units | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| | | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions | ISO conditions | Tropic conditions |
| Exhaust gas flow rate[1] | $m^3/h$ | 22,798 | 23,012 | 29,490 | 29,445 | 37,835 | 38,157 |
| Exhaust gas temperature after turbocharger[2] | °C | 412 | 451 | 480 | 507 | 410 | 449 |
| Exhaust gas back pressure composition | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 122 | - | 173 | - | 93 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 172 | - | 223 | - | 143 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 2-line | | 4-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 182: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.2.6 12V/16V175D-MM, 160 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,920<br>16V: 2,560 | 12V: 1,632<br>16V: 2,176 | 12V: 1,440<br>16V: 1,920 | 12V: 960<br>16V: 1,280 | 12V: 480<br>16V: 640 | 12V: 192<br>16V: 256 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1,705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 194<br>16V: 194 | 12V: 195<br>16V: 195 | 12V: 195<br>16V: 195 | 12V: 195<br>16V: 197 | 12V: 201<br>16V: 206 | 12V: 300<br>16V: 305 |
| Total fuel oil consumption[3)] | l/h | 12V: 446<br>16V: 594 | 12V: 381<br>16V: 507 | 12V: 336<br>16V: 448 | 12V: 224<br>16V: 302 | 12V: 116<br>16V: 158 | 12V: 69<br>16V: 94 |
| Lube oil consumption[4)] | g/kWh | 0.15 | - | | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 183: Marine mechanical propulsion medium duty, 160 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 184: Reference conditions – 175D IMO Tier III



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Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 185: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

Cooling system without integrated seawater cooler

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 21 | 24 | 29.4 | 32.6 |
| LT CW flow from and to cooling system | $m^3/h$ | 26.3 | 33.3 | 30.6 | 44.7 |
| HT heat quantity | kW | 641 | 760 | 909 | 1,037 |
| LT heat quantity | kW | 584 | 720 | 645 | 826 |
| HT inlet temperature | °C | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | |

Table 186: Data for off-engine cooling system – Marine mechanical propulsion medium duty

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | |
| Seawater heat quantity | kW | 1,225 | 1,480 | 1,554 | 1,863 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.8 | |
| Max. seawater outlet temperature | °C | 31.5 | 48.5 | 31 | 47.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 187: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 188: Fuel supply system – Marine mechanical propulsion medium duty

### Combustion air system

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,457 | 9,611 | 11,330 | 11,631 |

Table 189: Combustion air system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 74 | 58 | 99 | 77 |
| Heat radiation SCR | kW | 18 | | | |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | | | |

Table 190: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| | | 12V | | 16V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 23,816 | 22,366 | 28,161 | 28,149 |
| Exhaust gas temperature after turbocharger[2] | °C | 402 | 440 | 440 | 466 |
| Exhaust gas back pressure composition | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3] | mbar | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 116 | - | 155 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 166 | - | 205 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 2-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 191: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.2.7 12V175D-MM, 155 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 1,860 | 1,581 | 1,395 | 930 | 465 | 186 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1,705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 192 | 193.5 | 195 | 192 | 201 | 360 |
| Total fuel oil consumption[3)] | l/h | 427 | 366 | 325 | 214 | 112 | 80 |
| Lube oil consumption[4)] | g/kWh | 0.16 | - | | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 192: Marine mechanical propulsion medium duty, 155 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 193: Reference conditions – 175D IMO Tier III



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### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 98%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 98%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 99%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 194: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20.7 | 23.7 |
| LT CW flow from and to cooling system | $m^3/h$ | 25.2 | 33.3 |
| HT heat quantity | kW | 632 | 747 |
| LT heat quantity | kW | 551 | 681 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 195: Data for off-engine cooling system – Marine mechanical propulsion medium duty

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,183 | 1,428 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 31 | 48 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 196: Data for seawater system – Marine mechanical propulsion medium duty

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 197: Fuel supply system – Marine mechanical propulsion medium duty

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,225 | 9,376 |

Table 198: Combustion air system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 73 | 57 |
| Heat radiation SCR | kW | 18 | |

[1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 199: Heat radiation – Marine mechanical propulsion medium duty

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 21,232 | 21,416 |
| Exhaust gas temperature after turbocharger[2] | °C | 390 | 428 |
| Exhaust gas back pressure composition | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 111 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 161 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |
| SCR system layout | - | 2-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 200: Exhaust system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### 3.2.8 12V175D-MH, 145 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% | 10% |
|---|---|---|---|---|---|---|---|
| Engine output | kW | 1,740 | 1,479 | 1,305 | 870 | 435 | 174 |
| Engine speed (FPP-curve) | rpm | 1,800 | 1,705 | 1,635<br>IMO:<br>1,638 | 1,429<br>IMO:<br>1,440 | 1,134 | 835 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 193 | 194 | 196 | 195 | 203 | 215 |
| Total fuel oil consumption[3)] | l/h | 402 | 343 | 306 | 203 | 106 | 45 |
| Lube oil consumption[4)] | g/kWh | 0.17 | - | | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 201: Marine mechanical propulsion heavy duty, 145 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 202: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 203: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20.2 | 23 |
| LT CW flow from and to cooling system | $m^3/h$ | 23.7 | 33.3 |
| HT heat quantity | kW | 612 | 718 |
| LT heat quantity | kW | 507 | 633 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 204: Data for off-engine cooling system – Marine mechanical propulsion heavy duty

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,119 | 1,351 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 30.5 | 47 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 205: Data for seawater system – Marine mechanical propulsion heavy duty

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 206: Fuel supply system – Marine mechanical propulsion heavy duty

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 8,897 | 17,839 |

Table 207: Combustion air system – Marine mechanical propulsion heavy duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 71 | 56 |
| Heat radiation SCR | kW | 18 | |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 208: Heat radiation – Marine mechanical propulsion heavy duty

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 20,284 | 20,442 |
| Exhaust gas temperature after turbocharger[2] | °C | 384 | 421 |
| Exhaust gas back pressure composition | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 102 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 152 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |
| SCR system layout | - | 2-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[2] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 209: Exhaust system – Marine mechanical propulsion heavy duty

2025-10-30 - 12.0

## 3.3 Performance data – Electric propulsion applications, IMO Tier II

### 3.3.1 12V/20V175D-MEL, 190 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,280<br>20V: 3,800 | 12V: 1,938<br>20V: 3,230 | 12V: 1,710<br>20V: 2,850 | 12V: 1,140<br>20V: 1,900 | 12V: 570<br>20V: 950 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 192<br>20V: 192 | 12V: 193.5<br>20V: 193.5 | 12V: 197<br>20V: 197 | 12V: 203<br>20V: 203 | 12V: 231<br>20V: 231 |
| Total fuel oil consumption[3)] | l/h | 12V: 523<br>20V: 872 | 12V: 448<br>20V: 747 | 12V: 403<br>20V: 671 | 12V: 277<br>20V: 461 | 12V: 158<br>20V: 263 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 210: Marine electric propulsion light duty, 190 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 211: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 212: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 22.9 | 26.1 | 38.1 | 43.5 |
| LT CW flow from and to cooling system | $m^3/h$ | 28.2 | 33.3 | 48.2 | 56.2 |
| HT heat quantity | kW | 714 | 846 | 1,187 | 1,407 |
| LT heat quantity | kW | 644 | 796 | 1,106 | 1,321 |
| HT inlet temperature | °C | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | |

Table 213: Data for off-engine cooling system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 130 | |
| Seawater heat quantity | kW | 1,358 | 1,642 | 2,293 | 2,728 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.3 | |
| Max. seawater outlet temperature | °C | 33 | 50 | 33.5 | 50.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 214: Data for seawater system – Marine electric propulsion light duty

### Fuel supply system

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 215: Fuel supply system – Marine electric propulsion light duty

### Combustion air system

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,738 | 9,918 | 16,520 | 16,790 |

Table 216: Combustion air system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 79 | 62 | 132 | 103 |

[1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 217: Heat radiation – Marine electric propulsion light duty

### Exhaust system

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 24,765 | 24,930 | 41,340 | 41,728 |
| Exhaust gas temperature after turbocharger[2] | °C | 456 | 494 | 444 | 485 |
| Exhaust gas back pressure | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 218: Exhaust system – Marine electric propulsion light duty

2025-10-30 - 12.0

### 3.3.2 16V175D-MEL, 185 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 2,960 | 2,516 | 2,220 | 1,480 | 740 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 194 | 195 | 198 | 202 | 230 |
| Total fuel oil consumption[3)] | l/h | 687 | 587 | 526 | 358 | 204 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 219: Marine electric propulsion light duty, 185 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 220: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 97%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 98%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 98%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 221: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 31.6 | 35.2 |
| LT CW flow from and to cooling system | $m^3/h$ | 36.3 | 44.7 |
| HT heat quantity | kW | 997 | 1,142 |
| LT heat quantity | kW | 818 | 1,019 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,800 | |

Table 222: Data for off-engine cooling system – Marine electric propulsion light duty

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 140 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 105 | |
| Seawater heat quantity | kW | 1,815 | 2,161 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 35 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.8 | |
| Max. seawater outlet temperature | °C | 33 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 223: Data for seawater system – Marine electric propulsion light duty

### Fuel supply system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 14 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 4,020 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 23 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 224: Fuel supply system – Marine electric propulsion light duty

### Combustion air system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 12,464 | 12,765 |

Table 225: Combustion air system – Marine electric propulsion light duty

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### Heat radiation

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 103 | 80 |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 226: Heat radiation – Marine electric propulsion light duty

### Exhaust system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 32,499 | 32,479 |
| Exhaust gas temperature after turbocharger[2] | °C | 473 | 503 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 227: Exhaust system – Marine electric propulsion light duty

2025-10-30 - 12.0

### 3.3.3 12V/16V/20V175D-MEL, 175 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,100<br>16V: 2,800<br>20V: 3,500 | 12V: 1,785<br>16V: 2,380<br>20V: 2,975 | 12V: 1,575<br>16V: 2,100<br>20V: 2,625 | 12V: 1,050<br>16V: 1,400<br>20V: 1,750 | 12V: 525<br>16V: 700<br>20V: 875 |
| Engine speed (FPP-curve) | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 191<br>16V: 191<br>20V: 191 | 12V: 194<br>16V: 194<br>20V: 194 | 12V: 198<br>16V: 198<br>20V: 198 | 12V: 206<br>16V: 206<br>20V: 206 | 12V: 233<br>16V: 233<br>20V: 233 |
| Total fuel oil consumption[3)] | l/h | 12V: 480<br>16V: 639<br>20V: 799 | 12V: 414<br>16V: 552<br>20V: 690 | 12V: 373<br>16V: 497<br>20V: 621 | 12V: 259<br>16V: 345<br>20V: 431 | 12V: 147<br>16V: 195<br>20V: 244 |
| Lube oil consumption[4)] | g/kWh | 0.14 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 228: Marine electric propulsion light duty, 175 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 229: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 230: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 22.4 | 25.5 | 30.8 | 34.4 | 37.3 | 42.5 |
| LT CW flow from and to cooling system | $m^3/h$ | 24.7 | 33.3 | 36.5 | 44.7 | 47.8 | 56.2 |
| HT heat quantity | kW | 694 | 818 | 963 | 1,107 | 1,158 | 1,364 |
| LT heat quantity | kW | 620 | 769 | 824 | 1,022 | 1,095 | 1,321 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | | | | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | | | | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | | |

Table 231: Data for off-engine cooling system – Marine electric propulsion light duty

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,314 | 1,587 | 1,787 | 2,129 | 2,253 | 2,685 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 30 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 33 | 50 | 33 | 50 | 33 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 232: Data for seawater system – Marine electric propulsion light duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 233: Fuel supply system – Marine electric propulsion light duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,676 | 9,854 | 12,467 | 12,772 | 16,483 | 16,815 |

Table 234: Combustion air system – Marine electric propulsion light duty

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### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 77 | 60 | 103 | 80 | 128 | 100 |

[1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 235: Heat radiation – Marine electric propulsion light duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 23,443 | 23,542 | 30,424 | 30,427 | 39,253 | 39,480 |
| Exhaust gas temperature after turbocharger[2] | °C | 423 | 458 | 427 | 455 | 412 | 446 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 236: Exhaust system – Marine electric propulsion light duty

2025-10-30 - 12.0

### 3.3.4 12V/16V/20V175D-MEL, 165 kW/cyl., 1,500 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,980<br>16V: 2,640<br>20V: 3,300 | 12V: 1,683<br>16V: 2,244<br>20V: 2,805 | 12V: 1,485<br>16V: 1,980<br>20V: 2,475 | 12V: 990<br>16V: 1,320<br>20V: 1,650 | 12V: 495<br>16V: 660<br>20V: 825 |
| Engine speed (FPP-curve) | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 186<br>16V: 186.5<br>20V: 186.5 | 12V: 184.5<br>16V: 187.5<br>20V: 187.5 | 12V: 188.5<br>16V: 188.5<br>20V: 190.5 | 12V: 193<br>16V: 193<br>20V: 195 | 12V: 218<br>16V: 218<br>20V: 218 |
| Total fuel oil consumption[3)] | l/h | 12V: 440<br>16V: 589<br>20V: 736 | 12V: 371<br>16V: 503<br>20V: 629 | 12V: 335<br>16V: 446<br>20V: 564 | 12V: 229<br>16V: 305<br>20V: 385 | 12V: 129<br>16V: 172<br>20V: 215 |
| Lube oil consumption[4)] | g/kWh | 0.15 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 237: Marine electric propulsion light duty, 165 kW/cyl., 1,500 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 238: Reference conditions – 175D IMO Tier II

2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 239: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20.4 | 23.6 | 28.8 | 32 | 34.5 | 39.1 |
| LT CW flow from and to cooling system | $m^3/h$ | 25.2 | 30.3 | 30.6 | 39.7 | 39.8 | 50.2 |
| HT heat quantity | kW | 646 | 787 | 928 | 1,063 | 1,102 | 1,293 |
| LT heat quantity | kW | 573 | 696 | 675 | 852 | 886 | 1,081 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | | | | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | | | | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | | 2,100 | | 2,100 | |

Table 240: Data for off-engine cooling system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 92 | | 115 | | 154 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 100 | | 130 | |
| Seawater heat quantity | kW | 1,219 | 1,483 | 1,603 | 1,915 | 1,988 | 2,374 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 13 | | 15 | | 24 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 2.5 | | 2.5 | | 2.1 | |
| Max. seawater outlet temperature | °C | 31.5 | 48.5 | 32 | 49 | 31.5 | 48 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 241: Data for seawater system – Marine electric propulsion light duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 242: Fuel supply system – Marine electric propulsion light duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 8,922 | 9,062 | 11,020 | 11,320 | 14,093 | 14,329 |

Table 243: Combustion air system – Marine electric propulsion light duty

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### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 75 | 58 | 100 | 78 | 125 | 97 |

[1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 244: Heat radiation – Marine electric propulsion light duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 21,234 | 21,463 | 27,704 | 27,749 | 34,845 | 35,125 |
| Exhaust gas temperature after turbocharger[2] | °C | 411 | 452 | 447 | 475 | 436 | 476 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 245: Exhaust system – Marine electric propulsion light duty

2025-10-30 - 12.0

### 3.3.5 12V/16V/20V175D-MEL, 150 kW/cyl., 1,500 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,800<br>16V: 2,400<br>20V: 3,000 | 12V: 1,530<br>16V: 2,040<br>20V: 2,550 | 12V: 1,350<br>16V: 1,800<br>20V: 2,250 | 12V: 900<br>16V: 1,200<br>20V: 1,500 | 12V: 450<br>16V: 600<br>20V: 750 |
| Engine speed (FPP-curve) | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 186<br>16V: 186<br>20V: 186 | 12V: 188<br>16V: 188<br>20V: 188 | 12V: 190<br>16V: 190<br>20V: 190 | 12V: 197<br>16V: 197<br>20V: 197 | 12V: 222.0<br>16V: 222<br>20V: 222 |
| Total fuel oil consumption[3)] | l/h | 12V: 400<br>16V: 534<br>20V: 667 | 12V: 344<br>16V: 459<br>20V: 573 | 12V: 307<br>16V: 409<br>20V: 511 | 12V: 212<br>16V: 283<br>20V: 354 | 12V: 120<br>16V: 160<br>20V: 199 |
| Lube oil consumption[4)] | g/kWh | 0.16 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 246: Marine electric propulsion light duty, 150 kW/cyl., 1,500 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 247: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 248: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 19.7 | 22.5 | 27 | 30.2 | 33.2 | 37.4 |
| LT CW flow from and to cooling system | $m^3/h$ | 23.1 | 30.3 | 29.8 | 39.7 | 35.7 | 50.2 |
| HT heat quantity | kW | 619 | 635 | 855 | 987 | 1,048 | 1,219 |
| LT heat quantity | kW | 506 | 627 | 649 | 801 | 764 | 949 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | | 2,100 | | 2,100 | |

Table 249: Data for off-engine cooling system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 83 | | 110 | | 139 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 70 | | 95 | | 115 | |
| Seawater heat quantity | kW | 1,125 | 1,262 | 1,504 | 1,788 | 1,812 | 2,168 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 13 | | 15 | | 24 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 2.5 | | 2.5 | | 2.1 | |
| Max. seawater outlet temperature | °C | 32 | 48 | 32 | 48.5 | 32 | 48.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 250: Data for seawater system – Marine electric propulsion light duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 251: Fuel supply system – Marine electric propulsion light duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 8,455 | 8,603 | 10,776 | 10,964 | 13,198 | 13,426 |

Table 252: Combustion air system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 72 | 56 | 96 | 75 | 120 | 94 |

[1)] Based on engine room temperature 35°C (ISO)/55 °C (tropic conditions).

Table 253: Heat radiation – Marine electric propulsion light duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 19,749 | 19,928 | 25,245 | 25,401 | 32,222 | 32,442 |
| Exhaust gas temperature after turbocharger[2)] | °C | 399 | 437 | 400 | 436 | 428 | 466 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 254: Exhaust system – Marine electric propulsion light duty

2025-10-30 - 12.0

### 3.3.6 12V/16V/20V175D-MEM, 160 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,920<br>16V: 2,560<br>20V: 3,200 | 12V: 1,632<br>16V: 2,176<br>20V: 2,720 | 12V: 1,440<br>16V: 1,920<br>20V: 2,400 | 12V: 960<br>16V: 1,280<br>20V: 1,600 | 12V: 480<br>16V: 640<br>20V: 800 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 190.5<br>16V: 190.5<br>20V: 190.5 | 12V: 194<br>16V: 194<br>20V: 194 | 12V: 198<br>16V: 198<br>20V: 198 | 12V: 210<br>16V: 210<br>20V: 210 | 12V: 238<br>16V: 238<br>20V: 238 |
| Total fuel oil consumption[3)] | l/h | 12V: 437<br>16V: 583<br>20V: 729 | 12V: 379<br>16V: 505<br>20V: 631 | 12V: 341<br>16V: 455<br>20V: 568 | 12V: 241<br>16V: 322<br>20V: 402 | 12V: 137<br>16V: 182<br>20V: 228 |
| Lube oil consumption[4)] | g/kWh | 0.15 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 255: Marine electric propulsion medium duty, 160 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 256: Reference conditions – 175D IMO Tier II

2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 257: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 21.4 | 24.4 | 29.1 | 32.6 | 35.4 | 40.4 |
| LT CW flow from and to cooling system | $m^3/h$ | 25.4 | 33.3 | 35.4 | 44.7 | 44.9 | 56.2 |
| HT heat quantity | kW | 658 | 774 | 897 | 1,034 | 1,087 | 1,280 |
| LT heat quantity | kW | 557 | 697 | 788 | 981 | 1,005 | 1,214 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 258: Data for off-engine cooling system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,215 | 1,471 | 1,685 | 2,015 | 2,092 | 2,494 |
| Max. allowed seawater flow rate in off-engine coolant system[1] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$ [2] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 31.5 | 48.5 | 32 | 49 | 32 | 49 |

[1] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2] NPSH: Net positive suction height.

Table 259: Data for seawater system – Marine electric propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 260: Fuel supply system – Marine electric propulsion medium duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,316 | 9,501 | 12,301 | 12,611 | 15,998 | 16,263 |

Table 261: Combustion air system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 74 | 58 | 99 | 77 | 124 | 96 |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 262: Heat radiation – Marine electric propulsion medium duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 21,712 | 21,797 | 28,028 | 28,068 | 35,835 | 36,133 |
| Exhaust gas temperature after turbocharger[2)] | °C | 398 | 430 | 383 | 409 | 373 | 409 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 263: Exhaust system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### 3.3.7 12V/16V/20V175D-MEM, 150 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,800<br>16V: 2,400<br>20V: 3,000 | 12V: 1,530<br>16V: 2,040<br>20V: 2,550 | 12V: 1,350<br>16V: 1,800<br>20V: 2,250 | 12V: 900<br>16V: 1,200<br>20V: 1,500 | 12V: 450<br>16V: 600<br>20V: 750 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 190<br>16V: 190<br>20V: 190 | 12V: 195<br>16V: 195<br>20V: 195 | 12V: 199.5<br>16V: 199.5<br>20V: 199.5 | 12V: 212<br>16V: 212<br>20V: 212 | 12V: 242<br>16V: 242<br>20V: 242 |
| Total fuel oil consumption[3)] | l/h | 12V: 409<br>16V: 545<br>20V: 682 | 12V: 357<br>16V: 476<br>20V: 595 | 12V: 322<br>16V: 430<br>20V: 537 | 12V: 228<br>16V: 304<br>20V: 380 | 12V: 131<br>16V: 174<br>20V: 212 |
| Lube oil consumption[4)] | g/kWh | 0.16 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 264: Marine electric propulsion medium duty, 150 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 265: Reference conditions – 175D IMO Tier II

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 266: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20.5 | 23.4 | 28.8 | 31.9 | 34.9 | 39.3 |
| LT CW flow from and to cooling system | $m^3/h$ | 25.6 | 33.3 | 31.6 | 44.7 | 40.8 | 56.2 |
| HT heat quantity | kW | 622 | 736 | 884 | 1,008 | 1,095 | 1,236 |
| LT heat quantity | kW | 564 | 696 | 672 | 855 | 878 | 1,097 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 267: Data for off-engine cooling system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,186 | 1,432 | 1,556 | 1,863 | 1,973 | 2,333 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 31 | 48 | 31 | 47.5 | 31 | 48 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 268: Data for seawater system – Marine electric propulsion medium duty

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 269: Fuel supply system – Marine electric propulsion medium duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,344 | 9,497 | 11,607 | 11,901 | 15,161 | 15,511 |

Table 270: Combustion air system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 72 | 56 | 96 | 75 | 120 | 94 |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 271: Heat radiation – Marine electric propulsion medium duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 20,599 | 20,779 | 26,941 | 26,865 | 34,233 | 34,324 |
| Exhaust gas temperature after turbocharger[2)] | °C | 363 | 399 | 395 | 419 | 378 | 407 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 272: Exhaust system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### 3.3.8 12V/16V/20V175D-MEM, 135 kW/cyl., 1,500 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,620<br>16V: 2,160<br>20V: 2,700 | 12V: 1,377<br>16V: 1,836<br>20V: 2,295 | 12V: 1,215<br>16V: 1,620<br>20V: 2,025 | 12V: 810<br>16V: 1,080<br>20V: 1,350 | 12V: 405<br>16V: 540<br>20V: 675 |
| Engine speed | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 183<br>16V: 183<br>20V: 183 | 12V: 187.5<br>16V: 187.5<br>20V: 188 | 12V: 192<br>16V: 192<br>20V: 193 | 12V: 200<br>16V: 200<br>20V: 200 | 12V: 225<br>16V: 225<br>20V: 225 |
| Total fuel oil consumption[3)] | l/h | 12V: 355<br>16V: 473<br>20V: 591 | 12V: 309<br>16V: 412<br>20V: 516 | 12V: 279<br>16V: 372<br>20V: 467 | 12V: 194<br>16V: 259<br>20V: 323 | 12V: 109<br>16V: 146<br>20V: 182 |
| Lube oil consumption[4)] | g/kWh | 0.18 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 273: Marine electric propulsion medium duty, 135 kW/cyl., 1,500 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 274: Reference conditions – 175D IMO Tier II

2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 275: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 18.9 | 21.3 | 25.8 | 28.7 | 31.9 | 35.5 |
| LT CW flow from and to cooling system | $m^3/h$ | 19.6 | 30.3 | 26.4 | 39.7 | 30.4 | 50.2 |
| HT heat quantity | kW | 590 | 684 | 807 | 925 | 995 | 1,140 |
| LT heat quantity | kW | 405 | 521 | 552 | 690 | 613 | 784 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | | 2,100 | | 2,100 | |

Table 276: Data for off-engine cooling system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 75 | | 100 | | 130 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 56 | | 79 | | 95 | |
| Seawater heat quantity | kW | 995 | 1,205 | 1,359 | 1,615 | 1,608 | 1,924 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 19 | | 21 | | 35 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 2.5 | | 2.5 | | 2.1 | |
| Max. seawater outlet temperature | °C | 33.5 | 51 | 33 | 50 | 33 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 277: Data for seawater system – Marine electric propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 278: Fuel supply system – Marine electric propulsion medium duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 7,631 | 7,763 | 9,905 | 10,081 | 11,901 | 12,114 |

Table 279: Combustion air system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 69 | 54 | 92 | 72 | 115 | 90 |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 280: Heat radiation – Marine electric propulsion medium duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 17,491 | 17,603 | 22,741 | 22,861 | 28,791 | 29,938 |
| Exhaust gas temperature after turbocharger[2)] | °C | 553 | 627 | 388 | 422 | 422 | 458 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 281: Exhaust system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### 3.3.9 12V175D-MEM, 120 kW/cyl., 1,500 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 1,440 | 1,224 | 1,080 | 720 | 360 |
| Engine speed | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 184 | 188.5 | 193.5 | 204.5 | 231 |
| Total fuel oil consumption[3)] | l/h | 317 | 276 | 250 | 176 | 100 |
| Lube oil consumption[4)] | g/kWh | 0.20 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 282: Marine electric propulsion medium duty, 120 kW/cyl., 1,500 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 283: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 284: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 18.1 | 20.1 |
| LT CW flow from and to cooling system | $m^3/h$ | 17.1 | 30.3 |
| HT heat quantity | kW | 558 | 637 |
| LT heat quantity | kW | 338 | 445 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | |

Table 285: Data for off-engine cooling system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 75 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 56 | |
| Seawater heat quantity | kW | 896 | 1,082 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 19 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 2.5 | |
| Max. seawater outlet temperature | °C | 32 | 49 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 286: Data for seawater system – Marine electric propulsion medium duty

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 287: Fuel supply system – Marine electric propulsion medium duty

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 7,016 | 7,143 |

Table 288: Combustion air system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 66 | 51 |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 289: Heat radiation – Marine electric propulsion medium duty

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 15,910 | 15,981 |
| Exhaust gas temperature after turbocharger[2] | °C | 381 | 414 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 290: Exhaust system – Marine electric propulsion medium duty

2025-10-30 - 12.0

## 3.4 Performance data – Electric propulsion applications, IMO Tier III

### 3.4.1 12V/20V175D-MEL, 190 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,280<br>20V: 3,800 | 12V: 1,938<br>20V: 3,230 | 12V: 1,710<br>20V: 2,850 | 12V: 1,140<br>20V: 1,900 | 12V: 570<br>20V: 950 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 193<br>20V: 193 | 12V: 194.5<br>20V: 194.5 | 12V: 197<br>20V: 197 | 12V: 203<br>20V: 203 | 12V: 231<br>20V: 231 |
| Total fuel oil consumption[3)] | l/h | 12V: 526<br>20V: 877 | 12V: 451<br>20V: 751 | 12V: 403<br>20V: 671 | 12V: 277<br>20V: 461 | 12V: 158<br>20V: 263 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | |
| Urea consumption | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 291: Marine electric propulsion light duty, 190 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 292: Reference conditions – 175D IMO Tier III

2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 293: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 22.9 | 26.1 | 38.1 | 43.5 |
| LT CW flow from and to cooling system | $m^3/h$ | 28.3 | 33.3 | 48.2 | 56.2 |
| HT heat quantity | kW | 714 | 846 | 1,187 | 1,407 |
| LT heat quantity | kW | 644 | 796 | 1,107 | 1,321 |
| HT inlet temperature | °C | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | |

Table 294: Data for off-engine cooling system – Marine mechanical propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 130 | |
| Seawater heat quantity | kW | 1,358 | 1,642 | 2,294 | 2,728 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.3 | |
| Max. seawater outlet temperature | °C | 33 | 50 | 33.5 | 50.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 295: Data for seawater system – Marine electric propulsion light duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 296: Fuel supply system – Marine electric propulsion light duty

### Combustion air system

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,738 | 9,918 | 16,520 | 16,790 |

Table 297: Combustion air system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 79 | 62 | 132 | 103 |
| Heat radiation SCR | kW | 18 | | 36 | |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | | | |

Table 298: Heat radiation – Marine electric propulsion light duty

### Exhaust system

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 24,765 | 24,930 | 41,340 | 41,728 |
| Exhaust gas temperature after turbocharger[2] | °C | 456 | 494 | 444 | 485 |
| Exhaust gas back pressure | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 141 | - | 105 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 191 | - | 155 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 4-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 299: Exhaust system – Marine electric propulsion light duty

2025-10-30 - 12.0

### 3.4.2 16V175D-MEL, 185 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 2,960 | 2,516 | 2,220 | 1,480 | 740 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 195 | 196 | 198.5 | 202 | 230 |
| Total fuel oil consumption[3)] | l/h | 653 | 558 | 499 | 338 | 193 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 300: Marine electric propulsion light duty, 185kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 301: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 98%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 98%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 302: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

Cooling system without integrated seawater cooler

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 31.3 | 34.9 |
| LT CW flow from and to cooling system | $m^3/h$ | 36.4 | 44.7 |
| HT heat quantity | kW | 984 | 1,120 |
| LT heat quantity | kW | 819 | 1,019 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,800 | |

Table 303: Data for off-engine cooling system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 140 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 105 | |
| Seawater heat quantity | kW | 1,803 | 2,139 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 35 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.8 | |
| Max. seawater outlet temperature | °C | 33 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 304: Data for seawater system – Marine electric propulsion light duty

### Fuel supply system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 14 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 4,020 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 23 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60 °C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50 %.

Table 305: Fuel supply system – Marine electric propulsion light duty

### Combustion air system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 12,456 | 12,763 |

Table 306: Combustion air system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Heat radiation

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 103 | 80 |
| Heat radiation SCR | kW | 36 | 36 |
| [1)] Based on engine room temperature 35 °C (ISO)/55 °C (tropic condition). | | | |

Table 307: Heat radiation – Marine electric propulsion light duty

### Exhaust system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 32,491 | 32,526 |
| Exhaust gas temperature after turbocharger[2)] | °C | 473 | 504 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 77 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 127 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |
| SCR system layout | - | 4-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h with respect to the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 308: Exhaust system – Marine electric propulsion light duty

2025-10-30 - 12.0

### 3.4.3 12V/16V/20V175D-MEL, 175 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 2,100<br>16V: 2,800<br>20V: 3,500 | 12V: 1,785<br>16V: 2,380<br>20V: 2,975 | 12V: 1,575<br>16V: 2,100<br>20V: 2,625 | 12V: 1,050<br>16V: 1,400<br>20V: 1,750 | 12V: 525<br>16V: 700<br>20V: 875 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 192<br>16V: 192<br>20V: 192 | 12V: 195<br>16V: 195<br>20V: 195 | 12V: 199<br>16V: 199<br>20V: 199 | 12V: 207<br>16V: 207<br>20V: 207 | 12V: 233<br>16V: 233<br>20V: 233 |
| Total fuel oil consumption[3)] | l/h | 12V: 482<br>16V: 643<br>20V: 803 | 12V: 416<br>16V: 555<br>20V: 694 | 12V: 375<br>16V: 500<br>20V: 625 | 12V: 260<br>16V: 347<br>20V: 433 | 12V: 147<br>16V: 195<br>20V: 244 |
| Lube oil consumption[4)] | g/kWh | 0.14 | - | | | |
| Urea consumption | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 309: Marine electric propulsion light duty, 175 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 310: Reference conditions – 175D IMO Tier III

2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 98%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 98%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 99%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 311: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 22.6 | 25.6 | 30.6 | 34.7 | 37.5 | 42.3 |
| LT CW flow from and to cooling system | $m^3/h$ | 27.4 | 33.3 | 37.6 | 44.7 | 48.4 | 56.2 |
| HT heat quantity | kW | 680 | 804 | 952 | 1,097 | 1,138 | 1,346 |
| LT heat quantity | kW | 610 | 757 | 819 | 1,017 | 1,072 | 1,286 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 312: Data for off-engine cooling system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,290 | 1,561 | 1,771 | 2,114 | 2,210 | 2,632 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 32.5 | 49.5 | 32.5 | 49.5 | 33 | 49.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 313: Data for seawater system – Marine electric propulsion light duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 314: Fuel supply system – Marine electric propulsion light duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,595 | 9,780 | 12,383 | 12,693 | 16,267 | 16,534 |

Table 315: Combustion air system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 77 | 60 | 103 | 80 | 128 | 100 |
| Heat radiation SCR | kW | 18 | | | | 36 | |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 316: Heat radiation – Marine electric propulsion light duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 23,412 | 23,573 | 30,407 | 30,459 | 39,298 | 39,650 |
| Exhaust gas temperature after turbocharger[2)] | °C | 428 | 464 | 431 | 460 | 421 | 461 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 127 | - | 67 | - | 98 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 177 | - | 117 | - | 148 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 4-line | | 4-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 317: Exhaust system – Marine electric propulsion light duty

2025-10-30 - 12.0

### 3.4.4 12V/16V/20V175D-MEL, 165 kW/cyl., 1,500 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,980<br>16V: 2,640<br>20V: 3,300 | 12V: 1,683<br>16V: 2,244<br>20V: 2,805 | 12V: 1,485<br>16V: 1,980<br>20V: 2,475 | 12V: 990<br>16V: 1,320<br>20V: 1,650 | 12V: 495<br>16V: 660<br>20V: 825 |
| Engine speed | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 187<br>16V: 187.5<br>20V: 187.5 | 12V: 185.5<br>16V: 188.5<br>20V: 188.5 | 12V: 190<br>16V: 192<br>20V: 192 | 12V: 194<br>16V: 196<br>20V: 196 | 12V: 218<br>16V: 218<br>20V: 218 |
| Total fuel oil consumption[3)] | l/h | 12V: 443<br>16V: 592<br>20V: 740 | 12V: 373<br>16V: 506<br>20V: 632 | 12V: 338<br>16V: 455<br>20V: 568 | 12V: 230<br>16V: 310<br>20V: 387 | 12V: 129<br>16V: 172<br>20V: 215 |
| Lube oil consumption[4)] | g/kWh | 0.15 | - | | | |
| Urea consumption | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 318: Marine electric propulsion light duty, 165 kW/cyl., 1,500 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 319: Reference conditions – 175D IMO Tier III

2025-10-30 - 12.0

Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 320: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20.4 | 23.4 | 28 | 31.3 | 34.5 | 38.9 |
| LT CW flow from and to cooling system | $m^3/h$ | 23.6 | 30.3 | 29.3 | 39.7 | 36.9 | 50.2 |
| HT heat quantity | kW | 648 | 772 | 896 | 1,034 | 1,100 | 1,282 |
| LT heat quantity | kW | 522 | 644 | 610 | 785 | 798 | 987 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | | 2,100 | | 2,100 | |

Table 321: Data for off-engine cooling system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 92 | | 115 | | 154 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 100 | | 130 | |
| Seawater heat quantity | kW | 1,170 | 1,416 | 1,506 | 1,819 | 1,898 | 2,269 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 13 | | 15 | | 24 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 2.5 | | 2.5 | | 2.1 | |
| Max. seawater outlet temperature | °C | 31 | 47.5 | 31 | 48 | 31 | 47.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 322: Data for seawater system – Marine electric propulsion light duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 323: Fuel supply system – Marine electric propulsion light duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 8,530 | 8,668 | 10,543 | 10,727 | 13,386 | 13,615 |

Table 324: Combustion air system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 75 | 58 | 100 | 78 | 125 | 97 |
| Heat radiation SCR | kW | 18 | | | | 36 | |

[1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 325: Heat radiation – Marine electric propulsion light duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 21,319 | 21,527 | 27,564 | 27,743 | 34,651 | 34,909 |
| Exhaust gas temperature after turbocharger[2] | °C | 444 | 485 | 475 | 514 | 468 | 508 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 116 | - | 165 | - | 76 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 166 | - | 215 | - | 126 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 2-line | | 4-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 326: Exhaust system – Marine electric propulsion light duty

2025-10-30 - 12.0

### 3.4.5 12V/16V/20V175D-MEL, 150 kW/cyl., 1,500 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,800<br>16V: 2,400<br>20V: 3,000 | 12V: 1,530<br>16V: 2,040<br>20V: 2,550 | 12V: 1,350<br>16V: 1,800<br>20V: 2,250 | 12V: 900<br>16V: 1,200<br>20V: 1,500 | 12V: 450<br>16V: 600<br>20V: 750 |
| Engine speed | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 187<br>16V: 187<br>20V: 187 | 12V: 189<br>16V: 189<br>20V: 189 | 12V: 192.5<br>16V: 192.5<br>20V: 192.5 | 12V: 198<br>16V: 198<br>20V: 198 | 12V: 222<br>16V: 222<br>20V: 222 |
| Total fuel oil consumption[3)] | l/h | 12V: 403<br>16V: 537<br>20V: 671 | 12V: 346<br>16V: 461<br>20V: 576 | 12V: 311<br>16V: 414<br>20V: 518 | 12V: 213<br>16V: 284<br>20V: 355 | 12V: 120<br>16V: 160<br>20V: 199 |
| Lube oil consumption[4)] | g/kWh | 0.16 | - | | | |
| Urea consumption | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on a urea solution concentration of 40%.

Table 327: Marine electric propulsion light duty, 150 kW/cyl., 1,500 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 328: Reference conditions – 175D IMO Tier III

2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 329: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 19.7 | 22.3 | 26.9 | 29.9 | 33.2 | 37.1 |
| LT CW flow from and to cooling system | $m^3/h$ | 21.2 | 30.3 | 26.5 | 39.7 | 32.3 | 50.2 |
| HT heat quantity | kW | 321 | 728 | 850 | 976 | 1,048 | 1,200 |
| LT heat quantity | kW | 450 | 568 | 554 | 695 | 666 | 842 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | | 2,100 | | 2,100 | |

Table 330: Data for off-engine cooling system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 83 | | 110 | | 139 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 70 | | 95 | | 115 | |
| Seawater heat quantity | kW | 771 | 1,296 | 1,404 | 1,671 | 1,714 | 2,042 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 13 | | 15 | | 24 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 2.5 | | 2.5 | | 2.1 | |
| Max. seawater outlet temperature | °C | 35.5 | 58 | 34.5 | 52 | 34.5 | 51.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 331: Data for seawater system – Marine electric propulsion light duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 332: Fuel supply system – Marine electric propulsion light duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 7,970 | 8,104 | 9,874 | 10,049 | 12,272 | 12,489 |

Table 333: Combustion air system – Marine electric propulsion light duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 72 | 56 | 96 | 75 | 120 | 94 |
| Heat radiation SCR | kW | 18 | | | | 36 | |

[1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 334: Heat radiation – Marine electric propulsion light duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 19,443 | 19,594 | 25,251 | 25,396 | 31,582 | 31,770 |
| Exhaust gas temperature after turbocharger[2] | °C | 428 | 466 | 459 | 498 | 464 | 502 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 96 | - | 140 | - | 70 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 146 | - | 190 | - | 120 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 2-line | | 4-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 335: Exhaust system – Marine electric propulsion light duty

2025-10-30 - 12.0

### 3.4.6 12V/16V/20V175D-MEM, 160 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,920<br>16V: 2,560<br>20V: 3,200 | 12V: 1,632<br>16V: 2,176<br>20V: 2,720 | 12V: 1,440<br>16V: 1,920<br>20V: 2,400 | 12V: 960<br>16V: 1,280<br>20V: 1,600 | 12V: 480<br>16V: 640<br>20V: 800 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 190.5<br>16V: 191.5<br>20V: 190.5 | 12V: 194<br>16V: 195<br>20V: 194 | 12V: 199.5<br>16V: 200.5<br>20V: 199.5 | 12V: 210<br>16V: 214<br>20V: 210 | 12V: 238<br>16V: 239<br>20V: 238 |
| Total fuel oil consumption[3)] | l/h | 12V: 437<br>16V: 586<br>20V: 729 | 12V: 379<br>16V: 507<br>20V: 631 | 12V: 344<br>16V: 460<br>20V: 573 | 12V: 241<br>16V: 328<br>20V: 402 | 12V: 137<br>16V: 183<br>20V: 228 |
| Lube oil consumption[4)] | g/kWh | 0.15 | - | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 336: Marine electric propulsion medium duty, 160 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 337: Reference conditions – 175D IMO Tier III

2025-10-30 - 12.0

Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 338: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 21 | 24 | 29.9 | 33 | 35.4 | 40.2 |
| LT CW flow from and to cooling system | $m^3/h$ | 25.4 | 33.3 | 28.5 | 44.7 | 42.7 | 56.2 |
| HT heat quantity | kW | 641 | 759 | 927 | 1,049 | 1,085 | 1,274 |
| LT heat quantity | kW | 557 | 688 | 588 | 764 | 935 | 1,140 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 339: Data for off-engine cooling system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,198 | 1,447 | 1,515 | 1,813 | 2,020 | 2,414 |
| Max. allowed seawater flow rate in off-engine coolant system[1] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$ [2] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 31 | 48 | 32 | 48.5 | 31.5 | 48.5 |

[1] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2] NPSH: Net positive suction height.

Table 340: Data for seawater system – Marine electric propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 341: Fuel supply system – Marine electric propulsion medium duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,226 | 9,377 | 10,899 | 11,182 | 15,422 | 15,681 |

Table 342: Combustion air system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 74 | 58 | 99 | 77 | 124 | 96 |
| Heat radiation SCR | kW | 18 | | | | 36 | |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 343: Heat radiation – Marine electric propulsion medium duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 21,473 | 21,662 | 28,146 | 28.070 | 35,915 | 36,195 |
| Exhaust gas temperature after turbocharger[2)] | °C | 397 | 435 | 468 | 493 | 397 | 434 |
| Exhaust gas back pressure composition | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 115 | - | 159 | . | 86 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 165 | - | 209 | - | 136 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 2-line | | 4-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 344: Exhaust system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### 3.4.7 12V/16V/20V175D-MEM, 150 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,800<br>16V: 2,400<br>20V: 3,000 | 12V: 1,530<br>16V: 2,040<br>20V: 2,550 | 12V: 1,350<br>16V: 1,800<br>20V: 2,250 | 12V: 900<br>16V: 1,200<br>20V: 1,500 | 12V: 450<br>16V: 600<br>20V: 750 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 191<br>16V: 192<br>20V: 191 | 12V: 196<br>16V: 197<br>20V: 196 | 12V: 201<br>16V: 202.5<br>20V: 201 | 12V: 212.5<br>16V: 215.5<br>20V: 212.5 | 12V: 242<br>16V: 243<br>20V: 242 |
| Total fuel oil consumption[3)] | l/h | 12V: 411<br>16V: 551<br>20V: 685 | 12V: 359<br>16V: 481<br>20V: 598 | 12V: 325<br>16V: 436<br>20V: 541 | 12V: 229<br>16V: 309<br>20V: 381 | 12V: 131<br>16V: 175<br>20V: 217 |
| Lube oil consumption[4)] | g/kWh | 0.16 | - | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 345: Marine electric propulsion medium duty, 150 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 346: Reference conditions – 175D IMO Tier III

2025-10-30 - 12.0

Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 347: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20.5 | 23.3 | 28.6 | 31.6 | 34.6 | 39 |
| LT CW flow from and to cooling system | $m^3/h$ | 24.1 | 33.3 | 28.6 | 44.7 | 39.5 | 56.2 |
| HT heat quantity | kW | 622 | 733 | 877 | 996 | 1,053 | 1,222 |
| LT heat quantity | kW | 518 | 645 | 589 | 765 | 840 | 1,050 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 348: Data for off-engine cooling system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,140 | 1,378 | 1,466 | 1,761 | 1,893 | 2,272 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 30.5 | 47.5 | 30.5 | 47 | 30.5 | 47.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 349: Data for seawater system – Marine electric propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 350: Fuel supply system – Marine electric propulsion medium duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 8,973 | 9,123 | 10,911 | 11,206 | 14,785 | 15,098 |

Table 351: Combustion air system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 72 | 56 | 96 | 75 | 120 | 94 |
| Heat radiation SCR | kW | 18 | | | | 36 | |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 352: Heat radiation – Marine electric propulsion medium duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 20,557 | 20,722 | 26,811 | 26,772 | 34,197 | 34,369 |
| Exhaust gas temperature after turbocharger[2)] | °C | 387 | 424 | 433 | 458 | 393 | 425 |
| Exhaust gas back pressure composition | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 107 | - | 147 | - | 80 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 157 | - | 197 | - | 130 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 2-line | | 4-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 353: Exhaust system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### 3.4.8 12V/16V/20V175D-MEM, 135 kW/cyl., 1,500 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 12V: 1,620<br>16V: 2,160<br>20V: 2,700 | 12V: 1,377<br>16V: 1,836<br>20V: 2,295 | 12V: 1,215<br>16V: 1,620<br>20V: 2,025 | 12V: 810<br>16V: 1,080<br>20V: 1,350 | 12V: 405<br>16V: 540<br>20V: 675 |
| Engine speed | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 184<br>16V: 185<br>20V: 184.5 | 12V: 189<br>16V: 190<br>20V: 189.5 | 12V: 193<br>16V: 194<br>20V: 194.5 | 12V: 201<br>16V: 202<br>20V: 201 | 12V: 225<br>16V: 226<br>20V: 225 |
| Total fuel oil consumption[3)] | l/h | 12V: 357<br>16V: 478<br>20V: 596 | 12V: 311<br>16V: 417<br>20V: 520 | 12V: 281<br>16V: 376<br>20V: 471 | 12V: 195<br>16V: 261<br>20V: 325 | 12V: 109<br>16V: 146<br>20V: 182 |
| Lube oil consumption[4)] | g/kWh | 0.18 | - | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 354: Marine electric propulsion medium duty, 135 kW/cyl., 1,500 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 355: Reference conditions – 175D IMO Tier III

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### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 356: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 19 | 21.2 | 25.7 | 28.6 | 31.9 | 35.4 |
| LT CW flow from and to cooling system | $m^3/h$ | 18.2 | 30.3 | 24.2 | 39.7 | 28.5 | 50.2 |
| HT heat quantity | kW | 592 | 680 | 805 | 920 | 995 | 1,134 |
| LT heat quantity | kW | 365 | 479 | 490 | 622 | 565 | 732 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | | 2,100 | | 2,100 | |

Table 357: Data for off-engine cooling system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 75 | | 100 | | 130 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 56 | | 79 | | 95 | |
| Seawater heat quantity | kW | 957 | 1,159 | 1.295 | 1,542 | 1,560 | 1,866 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 19 | | 21 | | 35 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 2.5 | | 2.5 | | 2.1 | |
| Max. seawater outlet temperature | °C | 33 | 50 | 32 | 49.5 | 32.5 | 49 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 358: Data for seawater system – Marine electric propulsion medium duty

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 359: Fuel supply system – Marine electric propulsion medium duty

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 7,255 | 7,383 | 9,442 | 9,612 | 28,894 | 28,828 |

Table 360: Combustion air system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 69 | 54 | 92 | 72 | 115 | 90 |
| Heat radiation SCR | kW | 18 | | | | 36 | |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 361: Heat radiation – Marine electric propulsion medium duty

### Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 17,420 | 17,514 | 23,063 | 23,062 | 28,894 | 29,027 |
| Exhaust gas temperature after turbocharger[2)] | °C | 417 | 453 | 428 | 464 | 453 | 490 |
| Exhaust gas back pressure composition | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 84 | - | 136 | - | 62 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 134 | - | 186 | - | 112 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 2-line | | 4-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 362: Exhaust system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### 3.4.9 12V175D-MEM, 120 kW/cyl., 1,500 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 1,440 | 1,224 | 1,080 | 720 | 360 |
| Engine speed | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 185 | 190 | 195 | 205 | 231.5 |
| Total fuel oil consumption[3)] | l/h | 319 | 278 | 252 | 177 | 100 |
| Lube oil consumption[4)] | g/kWh | 0.20 | - | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 363: Marine electric propulsion medium duty, 120 kW/cyl., 1,500 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 364: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 365: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 18.2 | 20 |
| LT CW flow from and to cooling system | $m^3/h$ | 15.8 | 30.3 |
| HT heat quantity | kW | 560 | 633 |
| LT heat quantity | kW | 305 | 411 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | |

Table 366: Data for off-engine cooling system – Marine electric propulsion medium duty

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 75 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 56 | |
| Seawater heat quantity | kW | 865 | 1,044 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 19 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 2.5 | |
| Max. seawater outlet temperature | °C | 31.5 | 48.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 367: Data for seawater system – Marine electric propulsion medium duty

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 368: Fuel supply system – Marine electric propulsion medium duty

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 6,682 | 6,805 |

Table 369: Combustion air system – Marine electric propulsion medium duty

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 66 | 52 |
| Heat radiation SCR | kW | 18 | |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 370: Heat radiation – Marine electric propulsion medium duty

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 15,854 | 15,912 |
| Exhaust gas temperature after turbocharger[2] | °C | 410 | 444 |
| Exhaust gas back pressure composition | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 73 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 123 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |
| SCR system layout | - | 2-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 371: Exhaust system – Marine electric propulsion medium duty

2025-10-30 - 12.0

## 3.5 Performance data – MEV applications, IMO Tier II

MEV application is designed for EPROX-DC operation, see accordingly section High-efficient electric propulsion plants with variable speed GenSets (EPROX-DC), Page 665.

### 3.5.1 12V/20V175D-MEV, 190 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| **Engine output** | **kW** | **12V: 2,280<br>20V: 3,800** | **12V: 1,938<br>20V: 3,230** | **12V: 1,710<br>20V: 2,850** | **12V: 1,140<br>20V: 1,900** | **12V: 570<br>20V: 950** |
| **Engine speed** | **rpm** | **1,800** | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 192<br>20V: 192 | 12V: 193.5<br>20V: 193.5 | 12V: 198<br>20V: 198 | 12V: 199<br>20V: 199 | 12V: 225<br>20V: 225 |
| Total fuel oil consumption[3)] | l/h | 12V: 523<br>20V: 872 | 12V: 448<br>20V: 747 | 12V: 404.5<br>20V: 674.5 | 12V: 271<br>20V: 452 | 12V: 153.5<br>20V: 255.5 |
| **Engine speed according propeller curve** | **rpm** | **1,800** | **1,705** | **1,635<br>IMO: 1,638** | **1,429<br>IMO: 1,440** | **1,134** |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 192<br>20V: 192 | 12V: 190<br>20V: 190 | 12V: 188<br>20V: 188 | 12V: 185<br>20V: 185 | 12V: 196<br>20V: 196 |
| Total fuel oil consumption[3)] | l/h | 12V: 523<br>20V: 872 | 12V: 440<br>20V: 733.5 | 12V: 385<br>20V: 513 | 12V: 252<br>20V: 420 | 12V: 133.5<br>20V: 222.5 |
| **Optimum performance curve** | **rpm** | **1,800** | **1,665** | **1,609** | **1,342** | **12V: 1,103<br>20V: 1,124** |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 192<br>20V: 192 | 12V: 187<br>20V: 187 | 12V: 184.5<br>20V: 184.5 | 12V: 184<br>20V: 184 | 12V: 197<br>20V: 197 |
| Total fuel oil consumption[3)] | l/h | 12V: 523<br>20V: 872 | 12V: 433<br>20V: 722 | 12V: 377<br>20V: 629 | 12V: 251<br>20V: 418 | 12V: 135<br>20V: 224 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 372: Marine electric propulsion with variable speed, medium duty (MEV), 190 kW/cyl., 1,800 rpm, IMO Tier II



2025-10-30 - 12.0

## Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 373: Reference conditions – 175D IMO Tier II

## Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 374: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

2025-10-30 - 12.0

### Cooling system without integrated seawater cooler

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 23.2 | 26.4 | 13.3 | 43.9 |
| LT CW flow from and to cooling system | $m^3/h$ | 28.5 | 33.3 | 28.1 | 56.2 |
| HT heat quantity | kW | 727 | 859 | 1,209 | 1,425 |
| LT heat quantity | kW | 654 | 807 | 1,109 | 1,336 |
| HT inlet temperature | °C | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | |

Table 375: Data for off-engine cooling system – Marine electric propulsion with variable speed, medium duty (MEV)

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 130 | |
| Seawater heat quantity | kW | 1,384 | 1,666 | 2,318 | 2,761 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 45 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | | 3.3 | |
| Max. seawater outlet temperature | °C | 33 | 50.5 | 33.5 | 51 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 376: Data for seawater system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### Fuel supply system

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | |
| [1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%. | | | | | |

Table 377: Fuel supply system – Marine electric propulsion with variable speed, medium duty (MEV)

### Combustion air system

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,776 | 9,946 | 16,591 | 16,926 |

Table 378: Combustion air system – Marine electric propulsion with variable speed, medium duty (MEV)

### Heat radiation

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 79 | 62 | 132 | 103 |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | | | |

Table 379: Heat radiation – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

Exhaust system

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 24,646 | 25,754 | 41,128 | 41,403 |
| Exhaust gas temperature after turbocharger[2)] | °C | 449 | 486 | 438 | 474 |
| Exhaust gas back pressure | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 380: Exhaust system – Marine electric propulsion with variable speed, medium duty (MEV)



2025-10-30 - 12.0

### 3.5.2 16V175D-MEV, 185 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| **Engine output** | **kW** | **2,960** | **2,516** | **2,220** | **1,480** | **740** |
| **Engine speed** | **rpm** | | | **1,800** | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 194.5 | 195.5 | 198 | 200 | 227 |
| Total fuel oil consumption[3)] | l/h | 688 | 588 | 526 | 354 | 201 |
| **Engine speed according propeller curve** | **rpm** | **1,800** | **1,705** | **1,635 IMO: 1,638** | **1,429 IMO: 1,440** | **1,134** |
| Specific fuel oil consumption[1) 2)] | g/kWh | 194.5 | 191 | 188 | 186 | 198 |
| Total fuel oil consumption[3)] | l/h | 688 | 575 | 499 | 329 | 176 |
| **Optimum performance curve** | **rpm** | **1,800** | **1,665** | **1,601** | **1,326** | **1,113** |
| Specific fuel oil consumption[1) 2)] | g/kWh | 194.5 | 189 | 186 | 185 | 198 |
| Total fuel oil consumption[3)] | l/h | 688 | 569 | 494 | 328 | 176 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 381: Marine electric propulsion with variable speed, medium duty (MEV), 185kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 382: Reference conditions – 175D IMO Tier II

2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project specific request.

Table 383: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 16V | |
|---|---|---|---|
| **Values at 100 % output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 31.7 | 35.2 |
| LT CW flow from and to cooling system | $m^3/h$ | 36.6 | 44.7 |
| HT heat quantity | kW | 999 | 1,145 |
| LT heat quantity | kW | 825 | 1,026 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,800 | |

Table 384: Data for off-engine cooling system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 140 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 105 | |
| Seawater heat quantity | kW | 1,824 | 2,171 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.8 | |
| Max. seawater outlet temperature | °C | 33 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 385: Data for seawater system – Marine electric propulsion with variable speed, medium duty (MEV)

### Fuel supply system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 14 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 4,020 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 23 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 386: Fuel supply system – Marine electric propulsion with variable speed, medium duty (MEV)

### Combustion air system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 12,659 | 12,964 |

Table 387: Combustion air system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### Heat radiation

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 103 | 80 |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic condition). | | | |

Table 388: Heat radiation – Marine electric propulsion with variable speed, medium duty (MEV)

### Exhaust system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 32,534 | 32,501 |
| Exhaust gas temperature after turbocharger[2)] | °C | 463 | 492 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h with respect to the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 389: Exhaust system – Marine electric propulsion with variable speed, medium duty (MEV)



2025-10-30 - 12.0

### 3.5.3 12V/16V/20V175D-MEV, 170 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| **Engine output** | kW | 12V: 2,040<br>16V: 2,720<br>20V: 3,400 | 12V: 1,734<br>16V: 2,312<br>20V: 2,890 | 12V: 1,530<br>16V: 2,040<br>20V: 2,550 | 12V: 1,020<br>16V: 1,360<br>20V: 1,700 | 12V: 510<br>16V: 680<br>20V: 850 |
| **Engine speed (constant speed)** | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 190<br>16V: 191<br>20V: 190 | 12V: 193.5<br>16V: 193.5<br>20V: 193.5 | 12V: 197<br>16V: 197<br>20V: 197 | 12V: 204<br>16V: 204<br>20V: 204 | 12V: 232<br>16V: 232<br>20V: 232 |
| Total fuel oil consumption[3)] | l/h | 12V: 464<br>16V: 621<br>20V: 772 | 12V: 401<br>16V: 535<br>20V: 669 | 12V: 361<br>16V: 481<br>20V: 601 | 12V: 249<br>16V: 332<br>20V: 415 | 12V: 142<br>16V: 189<br>20V: 236 |
| **Engine speed according propeller curve** | rpm | 1,800 | 1,705 | 1,635<br>IMO: 1,638 | 1,429<br>IMO: 1,440 | 1,134 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 190<br>16V: 191<br>20V: 190 | 12V: 190<br>16V: 190<br>20V: 189 | 12V: 188<br>16V: 188<br>20V: 188 | 12V: 186<br>16V: 186<br>20V: 187 | 12V: 200<br>16V: 200<br>20V: 200 |
| Total fuel oil consumption[3)] | l/h | 12V: 464<br>16V: 621<br>20V: 772 | 12V: 394<br>16V: 525<br>20V: 653 | 12V: 344<br>16V: 459<br>20V: 573 | 12V: 227<br>16V: 303<br>20V: 380 | 12V: 122<br>16V: 163<br>20V: 204 |
| **Optimum performance curve** | rpm | 1,800 | 1,635 | 1,540 | 1,280 | 1,080 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 190<br>16V: 191<br>20V: 190 | 12V: 186<br>16V: 186<br>20V: 186 | 12V: 183<br>16V: 183<br>20V: 183 | 12V: 184<br>16V: 184<br>20V: 185 | 12V: 200<br>16V: 200<br>20V: 200 |
| Total fuel oil consumption[3)] | l/h | 12V: 464<br>16V: 621<br>20V: 772 | 12V: 386<br>16V: 514<br>20V: 643 | 12V: 335<br>16V: 447<br>20V: 558 | 12V: 225<br>16V: 299<br>20V: 376 | 12V: 122<br>16V: 163<br>20V: 204 |
| **Lube oil consumption**[4)] | g/kWh | 0.14 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 390: Marine electric propulsion with variable speed, medium duty (MEV), 170 kW/cyl., 1,800 rpm, IMO Tier II

2025-10-30 - 12.0

### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 391: Reference conditions – 175D IMO Tier II

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 392: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 21.4 | 24.8 | 29.8 | 33.3 | 36 | 41.1 |
| LT CW flow from and to cooling system | $m^3/h$ | 28 | 33.3 | 36.6 | 44.7 | 47.4 | 56.2 |
| HT heat quantity | kW | 656 | 791 | 924 | 1,064 | 1,108 | 1,308 |
| LT heat quantity | kW | 638 | 785 | 827 | 1,024 | 1,080 | 1,303 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 393: Data for off-engine cooling system – Marine electric propulsion with variable speed, medium duty (MEV)

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,294 | 1,576 | 1,751 | 2,088 | 2,188 | 2,611 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 32 | 50 | 32.5 | 49.5 | 32.5 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 394: Data for seawater system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |
| [1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%. | | | | | | | |

Table 395: Fuel supply system – Marine electric propulsion with variable speed, medium duty (MEV)

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,809 | 9,959 | 12,469 | 12,777 | 16,411 | 16,742 |

Table 396: Combustion air system – Marine electric propulsion with variable speed, medium duty (MEV)

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 76 | 59 | 101 | 79 | 126 | 98 |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | | | | | |

Table 397: Heat radiation – Marine electric propulsion with variable speed, medium duty (MEV)

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Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 22,770 | 22,858 | 29,762 | 29,791 | 37,741 | 38,015 |
| Exhaust gas temperature after turbocharger[2)] | °C | 395 | 431 | 413 | 440 | 389 | 423 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 398: Exhaust system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### 3.5.4 12V/16V/20V175D-MEV, 155 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| **Engine output** | kW | 12V: 1,860<br>16V: 2,480<br>20V: 3,100 | 12V: 1,581<br>16V: 2,108<br>20V: 2,635 | 12V: 1,395<br>16V: 1,860<br>20V: 2,325 | 12V: 930<br>16V: 1,240<br>20V: 1,550 | 12V: 465<br>16V: 620<br>20V: 775 |
| **Engine speed (constant speed)** | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 191<br>16V: 191<br>20V: 191 | 12V: 194<br>16V: 195.5<br>20V: 194 | 12V: 198<br>16V: 199.5<br>20V: 198 | 12V: 204<br>16V: 204<br>20V: 204 | 12V: 240<br>16V: 240<br>20V: 240 |
| Total fuel oil consumption[3)] | l/h | 12V: 425<br>16V: 566<br>20V: 708 | 12V: 367<br>16V: 493<br>20V: 611 | 12V: 330<br>16V: 444<br>20V: 550 | 12V: 227<br>16V: 303<br>20V: 378 | 12V: 134<br>16V: 178<br>20V: 223 |
| **Engine speed according propeller curve** | rpm | 1,800 | 1,705 | 1,635<br>IMO: 1,638 | 1,429<br>IMO: 1,440 | 1,134 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 191<br>16V: 191<br>20V: 191 | 12V: 191<br>16V: 191<br>20V: 191 | 12V: 189<br>16V: 189<br>20V: 189 | 12V: 189<br>16V: 189<br>20V: 189 | 12V: 205<br>16V: 205<br>20V: 205 |
| Total fuel oil consumption[3)] | l/h | 12V: 425<br>16V: 566<br>20V: 708 | 12V: 361<br>16V: 482<br>20V: 602 | 12V: 315<br>16V: 420<br>20V: 525 | 12V: 210<br>16V: 280<br>20V: 350 | 12V: 114<br>16V: 152<br>20V: 190 |
| **Optimum performance curve** | rpm | 1,800 | 1,575 | 1,478 | 12V: 1,230<br>16V/20V: 1,262 | 1,080 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 191<br>16V: 191<br>20V: 191 | 12V: 184<br>16V: 184<br>20V: 184 | 12V: 183<br>16V: 183<br>20V: 183 | 12V: 186<br>16V: 186<br>20V: 187 | 12V: 205<br>16V: 205<br>20V: 205 |
| Total fuel oil consumption[3)] | l/h | 12V: 425<br>16V: 566<br>20V: 708 | 12V: 348<br>16V: 464<br>20V: 580 | 12V: 305<br>16V: 407<br>20V: 509 | 12V: 207<br>16V: 276<br>20V: 347 | 12V: 114<br>16V: 152<br>20V: 190 |
| **Lube oil consumption[4)]** | g/kWh | 0.16 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 399: Marine electric propulsion with variable speed, medium duty (MEV), 155 kW/cyl., 1,800 rpm, IMO Tier II



2025-10-30 - 12.0

## Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 400: Reference conditions – 175D IMO Tier II

## Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 401: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

2025-10-30 - 12.0

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20.8 | 23.6 | 27.9 | 31.3 | 34.1 | 38.9 |
| LT CW flow from and to cooling system | $m^3/h$ | 24.7 | 33.3 | 35.6 | 44.7 | 44.8 | 56.2 |
| HT heat quantity | kW | 636 | 743 | 852 | 982 | 1,035 | 1,220 |
| LT heat quantity | kW | 536 | 675 | 792 | 985 | 999 | 1,207 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 402: Data for off-engine cooling system – Marine electric propulsion with variable speed, medium duty (MEV)

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,172 | 1,418 | 1,644 | 1,967 | 2,035 | 2,427 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 31 | 48 | 31.5 | 48.5 | 31.5 | 49 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 403: Data for seawater system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |
| [1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%. | | | | | | | |

Table 404: Fuel supply system – Marine electric propulsion with variable speed, medium duty (MEV)

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,209 | 9,392 | 12,340 | 12,650 | 15,976 | 16,242 |

Table 405: Combustion air system – Marine electric propulsion with variable speed, medium duty (MEV)

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 73 | 57 | 98 | 76 | 122 | 95 |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | | | | | |

Table 406: Heat radiation – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 21,766 | 21,812 | 27,794 | 27,838 | 35,645 | 35,937 |
| Exhaust gas temperature after turbocharger[2)] | °C | 408 | 440 | 376 | 402 | 371 | 407 |
| Exhaust gas back pressure | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 407: Exhaust system – Marine electric propulsion with variable speed, medium duty (MEV)



2025-10-30 - 12.0

## 3.6 Performance data – MEV applications, IMO Tier III

MEV application is designed for EPROX-DC operation, see accordingly section High-efficient electric propulsion plants with variable speed GenSets (EPROX-DC), Page 665.

### 3.6.1 12V/20V175D-MEV, 190 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| **Engine output** | **kW** | **12V: 2,280<br>20V: 3,800** | **12V: 1,938<br>20V: 3,230** | **12V: 1,710<br>20V: 2,850** | **12V: 1,140<br>20V: 1,900** | **12V: 570<br>20V: 950** |
| **Engine speed** | **rpm** | **1,800** | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 193<br>20V: 193 | 12V: 194.5<br>20V: 194.5 | 12V: 199<br>20V: 199 | 12V: 200<br>20V: 200 | 12V: 225<br>20V: 225 |
| Total fuel oil consumption[3)] | l/h | 12V: 526<br>20V: 877 | 12V: 450<br>20V: 750.5 | 12V: 406.5<br>20V: 677.5 | 12V: 272.5<br>20V: 454 | 12V: 153.5<br>20V: 255.5 |
| **Engine speed according propeller curve** | **rpm** | **1,800** | **1,705** | **1,635<br>IMO: 1,638** | **1,429<br>IMO: 1,440** | **1,134** |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 193<br>20V: 193 | 12V: 191<br>20V: 191 | 12V: 189<br>20V: 189 | 12V: 186<br>20V: 186 | 12V: 197<br>20V: 197 |
| Total fuel oil consumption[3)] | l/h | 12V: 526<br>20V: 877 | 12V: 442.5<br>20V: 737 | 12V: 387<br>20V: 644 | 12V: 253.5<br>20V: 422.5 | 12V: 133.5<br>20V: 222.5 |
| **Optimum performance curve** | **rpm** | **1,800** | **1,665** | **1,609** | **1,342** | **12V: 1,103<br>20V: 1,124** |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 193<br>20V: 193 | 12V: 188<br>20V: 188 | 12V: 185.5<br>20V: 185.5 | 12V: 185<br>20V: 185 | 12V: 197<br>20V: 197 |
| Total fuel oil consumption[3)] | l/h | 12V: 526<br>20V: 877 | 12V: 435.5<br>20V: 725.5 | 12V: 379<br>20V: 632 | 12V: 252<br>20V: 420 | 12V: 135<br>20V: 224 |
| Operation left side of "Optimum performance curve" to be avoided in Tier III operation" | | | | | | |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 408: Marine electric propulsion with variable speed, medium duty (MEV), 190 kW/cyl., 1,800 rpm, IMO Tier III

2025-10-30 - 12.0

### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 409: Reference conditions – 175D IMO Tier III

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 410: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III



2025-10-30 - 12.0

### Cooling system without integrated seawater cooler

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 22.9 | 26.1 | 38.1 | 43.5 |
| LT CW flow from and to cooling system | $m^3/h$ | 28.2 | 33.3 | 48.2 | 56.2 |
| HT heat quantity | kW | 714 | 846 | 1,187 | 1,407 |
| LT heat quantity | kW | 644 | 796 | 1,107 | 1,320 |
| HT inlet temperature | °C | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | |

Table 411: Data for off-engine cooling system – Marine electric propulsion with variable speed, medium duty (MEV)

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 130 | |
| Seawater heat quantity | kW | 1,358 | 1,642 | 2,294 | 2,727 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.3 | |
| Max. seawater outlet temperature | °C | 33 | 50 | 33.5 | 50.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 412: Data for seawater system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### Fuel supply system

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | |
| [1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%. | | | | | |

Table 413: Fuel supply system – Marine electric propulsion with variable speed, medium duty (MEV)

### Combustion air system

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,738 | 9,918 | 16,520 | 16,790 |

Table 414: Combustion air system – Marine electric propulsion with variable speed, medium duty (MEV)

### Heat radiation

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 79 | 62 | 132 | 103 |
| Heat radiation SCR | kW | 18 | | 36 | |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | | | |

Table 415: Heat radiation – Marine electric propulsion with variable speed, medium duty (MEV)



2025-10-30 - 12.0

Exhaust system

| | | 12V | | 20V | |
|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 24,765 | 24,930 | 41,340 | 41,728 |
| Exhaust gas temperature after turbocharger[2] | °C | 456 | 494 | 444 | 485 |
| Exhaust gas back pressure | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 141 | - | 105 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 191 | - | 155 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 4-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 416: Exhaust system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### 3.6.2 16V175D-MEV, 185 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| **Engine output** | kW | 2,960 | 2,516 | 2,220 | 1,480 | 740 |
| **Engine speed** | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 195 | 196 | 198 | 200 | 227 |
| Total fuel oil consumption[3)] | l/h | 690 | 590 | 526 | 354 | 201 |
| **Engine speed according propeller curve** | rpm | 1,800 | 1,705 | 1,635<br>IMO: 1,638 | 1,429<br>IMO: 1,440 | 1,134 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 195 | 191.5 | 188 | 186 | 198 |
| Total fuel oil consumption[3)] | l/h | 690 | 576 | 499 | 329 | 176 |
| **Optimum performance curve** | rpm | 1,800 | 1,665 | 1,601 | 1,326 | 1,113 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 195 | 189.5 | 186 | 185 | 198 |
| Total fuel oil consumption[3)] | l/h | 690 | 570 | 494 | 328 | 176 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 417: Marine electric propulsion with variable speed, medium duty (MEV), 185kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 418: Reference conditions – 175D IMO Tier III

2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 98%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 98%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project specific request.

Table 419: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 31.3 | 34.9 |
| LT CW flow from and to cooling system | $m^3/h$ | 36.3 | 44.7 |
| HT heat quantity | kW | 985 | 1,131 |
| LT heat quantity | kW | 816 | 1,016 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,800 | |

Table 420: Data for off-engine cooling system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 140 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 105 | |
| Seawater heat quantity | kW | 1,801 | 2,147 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 35 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.8 | |
| Max. seawater outlet temperature | °C | 33 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 421: Data for seawater system – Marine electric propulsion with variable speed, medium duty (MEV)

### Fuel supply system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 14 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 4,020 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 23 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 422: Fuel supply system – Marine electric propulsion with variable speed, medium duty (MEV)

### Combustion air system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 12,553 | 12,864 |

Table 423: Combustion air system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### Heat radiation

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 103 | 80 |
| Heat radiation SCR | kW | 36 | |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic condition).

Table 424: Heat radiation – Marine electric propulsion with variable speed, medium duty (MEV)

### Exhaust system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 32,575 | 32,603 |
| Exhaust gas temperature after turbocharger[2)] | °C | 470 | 500 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 74 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 124 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |
| SCR system layout | - | 4-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h with respect to the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 425: Exhaust system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### 3.6.3 12V/16V/20V175D-MEV, 170 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| **Engine output** | kW | 12V: 2,040<br>16V: 2,720<br>20V: 3,400 | 12V: 1,734<br>16V: 2,312<br>20V: 2,890 | 12V: 1,530<br>16V: 2,040<br>20V: 2,550 | 12V: 1,020<br>16V: 1,360<br>20V: 1,700 | 12V: 510<br>16V: 680<br>20V: 850 |
| **Engine speed (constant speed)** | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 191<br>16V: 193<br>20V: 191 | 12V: 195<br>16V: 196<br>20V: 195 | 12V: 199<br>16V: 200<br>20V: 199 | 12V: 206<br>16V: 210<br>20V: 206 | 12V: 232<br>16V: 233<br>20V: 232 |
| Total fuel oil consumption[3)] | l/h | 12V: 466<br>16V: 628<br>20V: 776 | 12V: 404<br>16V: 542<br>20V: 674 | 12V: 364<br>16V: 488<br>20V: 607 | 12V: 252<br>16V: 342<br>20V: 419 | 12V: 142<br>16V: 190<br>20V: 236 |
| **Engine speed according propeller curve** | rpm | 1,800 | 1,705 | 1,635<br>IMO: 1,638 | 1,429<br>IMO: 1,440 | 1,134 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 191<br>16V: 193<br>20V: 191 | 12V: 191<br>16V: 192<br>20V: 190 | 12V: 189<br>16V: 190<br>20V: 189 | 12V: 187<br>16V: 188<br>20V: 188 | 12V: 200<br>16V: 201<br>20V: 200 |
| Total fuel oil consumption[3)] | l/h | 12V: 466<br>16V: 628<br>20V: 776 | 12V: 396<br>16V: 531<br>20V: 657 | 12V: 346<br>16V: 464<br>20V: 576 | 12V: 228<br>16V: 306<br>20V: 382 | 12V: 122<br>16V: 164<br>20V: 204 |
| **Optimum performance curve** | rpm | 1,800 | 1,635 | 1,540 | 1,280 | 1,080 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 191<br>16V: 193<br>20V: 191 | 12V: 187<br>16V: 188<br>20V: 187 | 12V: 184<br>16V: 185<br>20V: 184 | 12V: 185<br>16V: 186<br>20V: 186 | 12V: 200<br>16V: 201<br>20V: 200 |
| Total fuel oil consumption[3)] | l/h | 12V: 466<br>16V: 628<br>20V: 776 | 12V: 388<br>16V: 520<br>20V: 646 | 12V: 337<br>16V: 451<br>20V: 561 | 12V: 226<br>16V: 303<br>20V: 378 | 12V: 122<br>16V: 164<br>20V: 204 |
| Operation left side of "Optimum performance curve" to be avoided in Tier III operation" | | | | | | |
| **Lube oil consumption[4)]** | g/kWh | 0.14 | - | | | |
| **Urea consumption[5)]** | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 426: Marine electric propulsion with variable speed, medium duty (MEV), 170 kW/cyl., 1,800 rpm, IMO Tier III



2025-10-30 - 12.0

### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 427: Reference conditions – 175D IMO Tier III

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 428: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

2025-10-30 - 12.0

### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 21.2 | 24.3 | 30 | 33.2 | 35.9 | 40.9 |
| LT CW flow from and to cooling system | $m^3/h$ | 26.9 | 33.3 | 30.4 | 44.7 | 45.2 | 56.2 |
| HT heat quantity | kW | 650 | 772 | 935 | 1,060 | 1,102 | 1,300 |
| LT heat quantity | kW | 604 | 743 | 639 | 822 | 1,012 | 1,222 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 429: Data for off-engine cooling system – Marine electric propulsion with variable speed, medium duty (MEV)

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,254 | 1,515 | 1,574 | 1,882 | 2,114 | 2,522 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 32 | 49 | 31 | 48 | 32.5 | 49.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 430: Data for seawater system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |
| [1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%. | | | | | | | |

Table 431: Fuel supply system – Marine electric propulsion with variable speed, medium duty (MEV)

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,523 | 9,678 | 11,207 | 11,503 | 15,919 | 16,183 |

Table 432: Combustion air system – Marine electric propulsion with variable speed, medium duty (MEV)

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 76 | 59 | 101 | 79 | 126 | 98 |
| Heat radiation SCR | kW | 18 | | | | 36 | |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | | | | | |

Table 433: Heat radiation – Marine electric propulsion with variable speed, medium duty (MEV)

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Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 22,610 | 22,821 | 29,493 | 29,448 | 37,831 | 38,153 |
| Exhaust gas temperature after turbocharger[2)] | °C | 410 | 449 | 480 | 507 | 410 | 449 |
| Exhaust gas back pressure composition | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3)] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 122 | - | 173 | - | 93 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 172 | - | 223 | - | 143 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 2-line | | 4-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 434: Exhaust system – Marine electric propulsion with variable speed, medium duty (MEV)



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### 3.6.4 12V/16V/20V175D-MEV, 155 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| **Engine output** | kW | 12V: 1.860<br>16V: 2,480<br>20V: 3,100 | 12V: 1.581<br>16V: 2,108<br>20V: 2,635 | 12V: 1,395<br>16V: 1,860<br>20V: 2,325 | 12V: 930<br>16V: 1,240<br>20V: 1,550 | 12V: 465<br>16V: 620<br>20V: 775 |
| **Engine speed (constant speed)** | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 192<br>16V: 193<br>20V: 192 | 12V: 195.5<br>16V: 196.5<br>20V: 195.5 | 12V: 200<br>16V: 201<br>20V: 200 | 12V: 204<br>16V: 209<br>20V: 204 | 12V: 240<br>16V: 241<br>20V: 240 |
| Total fuel oil consumption[3)] | l/h | 12V: 427<br>16V: 572<br>20V: 712 | 12V: 370<br>16V: 495<br>20V: 616 | 12V: 334<br>16V: 447<br>20V: 556 | 12V: 227<br>16V: 310<br>20V: 378 | 12V: 134<br>16V: 179<br>20V: 223 |
| **Engine speed according propeller curve** | rpm | 1,800 | 1,705 | 1,635<br>IMO: 1,638 | 1,429<br>IMO: 1,440 | 1,134 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 192<br>16V: 193<br>20V: 192 | 12V: 192<br>16V: 193<br>20V: 192 | 12V: 190<br>16V: 191<br>20V: 190 | 12V: 190<br>16V: 191<br>20V: 190 | 12V: 205<br>16V: 206<br>20V: 205 |
| Total fuel oil consumption[3)] | l/h | 12V: 427<br>16V: 572<br>20V: 712 | 12V: 363<br>16V: 487<br>20V: 605 | 12V: 317<br>16V: 425<br>20V: 528 | 12V: 212<br>16V: 283<br>20V: 352 | 12V: 114<br>16V: 153<br>20V: 190 |
| **Optimum performance curve** | rpm | 1,800 | 1,575 | 1,478 | 12V:1,230<br>16/20V:<br>1,262 | 1,080 |
| Specific fuel oil consumption[1) 2)] | g/kWh | 12V: 192<br>16V: 193<br>20V: 192 | 12V: 185<br>16V: 186<br>20V: 185 | 12V: 184<br>16V: 185<br>20V: 184 | 12V: 187<br>16V: 188<br>20V: 188 | 12V: 205<br>16V: 206<br>20V: 205 |
| Total fuel oil consumption[3)] | l/h | 12V: 427<br>16V: 572<br>20V: 712 | 12V: 350<br>16V: 469<br>20V: 583 | 12V: 307<br>16V: 412<br>20V: 512 | 12V: 208<br>16V: 279<br>20V: 349 | 12V: 114<br>16V: 153<br>20V: 190 |
| Operation left side of "Optimum performance curve" to be avoided in Tier III operation" | | | | | | |
| **Lube oil consumption**[4)] | g/kWh | 0.16 | - | | | |
| **Urea consumption**[5)] | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 435: Marine electric propulsion with variable speed, medium duty (MEV), 155 kW/cyl., 1,800 rpm, IMO Tier III

2025-10-30 - 12.0

### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 436: Reference conditions – 175D IMO Tier III

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 437: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III



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### Cooling system without integrated seawater cooler

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20 | 24.2 | 28.1 | 32.7 | 33.4 | 40.4 |
| LT CW flow from and to cooling system | $m^3/h$ | 24.6 | 33.3 | 28.5 | 44.7 | 42.5 | 56.2 |
| HT heat quantity | kW | 604 | 768 | 860 | 1,039 | 1,009 | 1,278 |
| LT heat quantity | kW | 535 | 672 | 586 | 763 | 929 | 1,133 |
| HT inlet temperature | °C | - | 65 | - | 65 | - | 65 |
| LT inlet temperature | °C | 25 | 38 | 25 | 38 | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | | 500 | | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | | 2,800 | | 2,800 | |

Table 438: Data for off-engine cooling system – Marine electric propulsion with variable speed, medium duty (MEV)

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | | 140 | | 175 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | | 105 | | 130 | |
| Seawater heat quantity | kW | 1,139 | 1,440 | 1,446 | 1,802 | 1,938 | 2,411 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | | 35 | | 45 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | | 3.8 | | 3.3 | |
| Max. seawater outlet temperature | °C | 30.5 | 48 | 30 | 47 | 31 | 48.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 439: Data for seawater system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

### Fuel supply system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | | 14 | | 17 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | | | | | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | | 4,020 | | 4,440 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | | 23 | | 31 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | | | | | |
| [1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%. | | | | | | | |

Table 440: Fuel supply system – Marine electric propulsion with variable speed, medium duty (MEV)

### Combustion air system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,100 | 9,291 | 10,908 | 11,201 | 15,419 | 15,678 |

Table 441: Combustion air system – Marine electric propulsion with variable speed, medium duty (MEV)

### Heat radiation

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 73 | 57 | 98 | 76 | 122 | 95 |
| Heat radiation SCR | kW | 18 | | | | 36 | |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | | | | | |

Table 442: Heat radiation – Marine electric propulsion with variable speed, medium duty (MEV)

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Exhaust system

| | | 12V | | 16V | | 20V | |
|---|---|---|---|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 21,503 | 21,621 | 27,567 | 27,490 | 35,772 | 36,048 |
| Exhaust gas temperature after turbocharger[2] | °C | 407 | 441 | 452 | 477 | 395 | 432 |
| Exhaust gas back pressure composition | | | | | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3] | mbar | 50 | - | 50 | - | 50 | - |
| Difference pressure, SCR system | mbar | 111 | - | 144 | - | 85 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 161 | - | 194 | - | 135 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - | 300 | - | 300 | - |
| SCR system layout | - | 2-line | | 2-line | | 4-line | |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 443: Exhaust system – Marine electric propulsion with variable speed, medium duty (MEV)

2025-10-30 - 12.0

## 3.7 Performance data – Auxiliary power applications, IMO Tier II

### 3.7.1 12V175D-MA, 190 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 2,280 | 1,938 | 1,710 | 1,140 | 570 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 192 | 193.5 | 197 | 203 | 231 |
| Total fuel oil consumption[3)] | l/h | 524 | 449 | 403 | 277 | 158 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | |

1) Tolerance +5%.

2) Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

3) Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

4) See accordingly section Lube oil consumption, Page 347.

Table 444: Marine Auxiliary, 190 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

1) Contact Everllence if project specific, the tropic conditions might be exceeded.

2) Intake air depression up to 30 mbar allowed.

3) Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 445: Reference conditions – 175D IMO Tier II



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### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 446: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 23.2 | 26.4 |
| LT CW flow from and to cooling system | $m^3/h$ | 28.5 | 33.3 |
| HT heat quantity | kW | 727 | 859 |
| LT heat quantity | kW | 654 | 807 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 447: Data for off-engine cooling system – Marine Auxiliary

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,381 | 1,666 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 33 | 50.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 448: Data for seawater system – Marine Auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 449: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,776 | 9,946 |

Table 450: Combustion air system – Marine Auxiliary

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 79 | 62 |

[1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 451: Heat radiation – Marine Auxiliary

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 24,646 | 24,754 |
| Exhaust gas temperature after turbocharger[2] | °C | 449 | 486 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 452: Exhaust system – Marine Auxiliary

2025-10-30 - 12.0

### 3.7.2 12V175D-MA, 175 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 2,100 | 1,785 | 1,575 | 1,050 | 525 |
| Engine speed (FFP-curve) | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 191 | 194 | 198 | 206 | 233 |
| Total fuel oil consumption[3)] | l/h | 480 | 414 | 373 | 259 | 147 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 453: Marine Auxiliary, 175 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 454: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 455: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 22.4 | 25.5 |
| LT CW flow from and to cooling system | $m^3/h$ | 27.4 | 33.3 |
| HT heat quantity | kW | 620 | 769 |
| LT heat quantity | kW | 657 | 817 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 456: Data for off-engine cooling system – Marine Auxiliary

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,314 | 1,587 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 33 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 457: Data for seawater system – Marine Auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 458: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,676 | 9,854 |

Table 459: Combustion air system – Marine Auxiliary

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 77 | 60 |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 460: Heat radiation – Marine Auxiliary

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 23,443 | 23,542 |
| Exhaust gas temperature after turbocharger[2] | °C | 423 | 458 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 461: Exhaust system – Marine Auxiliary

2025-10-30 - 12.0

### 3.7.3 12V175D-MA, 160 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 1,920 | 1,632 | 1,440 | 960 | 480 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 190.5 | 194 | 198 | 210 | 238 |
| Total fuel oil consumption[3)] | l/h | 437 | 379 | 341 | 241 | 137 |
| Lube oil consumption[4)] | g/kWh | 0.15 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according D2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 462: Marine auxiliary, 160 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 463: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 464: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 21.4 | 24.4 |
| LT CW flow from and to cooling system | $m^3/h$ | 25.4 | 33.3 |
| HT heat quantity | kW | 658 | 774 |
| LT heat quantity | kW | 557 | 697 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 465: Data for off-engine cooling system – Marine auxiliary

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,215 | 1,471 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 31.5 | 48.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 466: Data for seawater system – Marine auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 467: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,316 | 9,501 |

Table 468: Combustion air system

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 74 | 58 |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 469: Heat radiation – Marine auxiliary

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 21,712 | 21,797 |
| Exhaust gas temperature after turbocharger[2)] | °C | 398 | 430 |
| Exhaust gas back pressure composition | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[2)] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |
| [1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.<br>[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).<br>[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances. | | | |

Table 470: Exhaust system – Marine auxiliary

2025-10-30 - 12.0

### 3.7.4 16V175D-MA, 150 kW/cyl., 1,800 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 2,400 | 2,040 | 1,800 | 1,200 | 600 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 190 | 195 | 199.5 | 212 | 242 |
| Total fuel oil consumption[3)] | l/h | 545 | 476 | 430 | 304 | 174 |
| Lube oil consumption[4)] | g/kWh | 0.16 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_X$ limits according D2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 471: Marine auxiliary, 150 kW/cyl., 1,800 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 472: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 473: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 28.8 | 31.9 |
| LT CW flow from and to cooling system | $m^3/h$ | 31.6 | 44.7 |
| HT heat quantity | kW | 884 | 1,008 |
| LT heat quantity | kW | 672 | 855 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,800 | |

Table 474: Data for off-engine cooling system – Marine auxiliary

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 140 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 105 | |
| Seawater heat quantity | kW | 1,556 | 1,863 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 35 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.8 | |
| Max. seawater outlet temperature | °C | 31 | 47.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 475: Data for seawater system – Marine auxiliary

### Fuel supply system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 14 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 4,020 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 23 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 476: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 11,607 | 11,901 |

Table 477: Combustion air system – Marine auxiliary

2025-10-30 - 12.0

### Heat radiation

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 97 | 75 |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 478: Heat radiation – Marine auxiliary

### Exhaust system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 26,941 | 26,865 |
| Exhaust gas temperature after turbocharger[2] | °C | 395 | 419 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[2] | mbar | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 479: Exhaust system – Marine auxiliary

2025-10-30 - 12.0

### 3.7.5 12V175D-MA, 165 kW/cyl., 1,500 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 1,980 | 1,683 | 1,485 | 990 | 495 |
| Engine speed (FFP-curve) | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 186 | 184.5 | 188.5 | 193 | 215 |
| Total fuel oil consumption[3)] | l/h | 440 | 371 | 335 | 229 | 128 |
| Lube oil consumption[4)] | g/kWh | 0.15 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 480: Marine Auxiliary, 165 kW/cyl., 1,500 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 481: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 482: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20.4 | 23.6 |
| LT CW flow from and to cooling system | $m^3/h$ | 25.2 | 30.3 |
| HT heat quantity | kW | 646 | 787 |
| LT heat quantity | kW | 573 | 696 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 483: Data for off-engine cooling system – Marine Auxiliary

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 92 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,219 | 1,483 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 13 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 2.5 | |
| Max. seawater outlet temperature | °C | 31.5 | 48.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 484: Data for seawater system – Marine Auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 485: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 8,922 | 9,062 |

Table 486: Combustion air system – Marine Auxiliary

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 75 | 58 |

[1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 487: Heat radiation – Marine Auxiliary

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 21,234 | 21,463 |
| Exhaust gas temperature after turbocharger[2] | °C | 411 | 452 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 488: Exhaust system – Marine Auxiliary

2025-10-30 - 12.0

### 3.7.6 12V175D-MA, 150 kW/cyl., 1,500 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 1,800 | 1,530 | 1,350 | 900 | 450 |
| Engine speed (FFP-curve) | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 185.5 | 188 | 190 | 195 | 222 |
| Total fuel oil consumption[3)] | l/h | 399 | 344 | 307 | 210 | 120 |
| Lube oil consumption[4)] | g/kWh | 0.15 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 489: Marine Auxiliary, 150 kW/cyl., 1,500 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 490: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 491: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 19.7 | 22.5 |
| LT CW flow from and to cooling system | $m^3/h$ | 23.1 | 30.3 |
| HT heat quantity | kW | 619 | 635 |
| LT heat quantity | kW | 506 | 627 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | |

Table 492: Data for off-engine cooling system – Marine Auxiliary

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 83 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 70 | |
| Seawater heat quantity | kW | 1,125 | 1,262 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 13 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 2.5 | |
| Max. seawater outlet temperature | °C | 32 | 48 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 493: Data for seawater system – Marine Auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 494: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 8,455 | 8,603 |

Table 495: Combustion air system – Marine Auxiliary

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 72 | 56 |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 496: Heat radiation – Marine Auxiliary

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 19,749 | 19,928 |
| Exhaust gas temperature after turbocharger[2] | °C | 399 | 437 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 497: Exhaust system – Marine Auxiliary

2025-10-30 - 12.0

### 3.7.7 12V175D-MA, 135 kW/cyl., 1,500 rpm, IMO Tier II

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 1,620 | 1,377 | 1,215 | 810 | 405 |
| Engine speed | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 183 | 187.5 | 192 | 200 | 225 |
| Total fuel oil consumption[3)] | l/h | 355 | 309 | 279 | 194 | 109 |
| Lube oil consumption[4)] | g/kWh | 0.18 | - | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according D2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m³.

[4)] See accordingly section Lube oil consumption, Page 347.

Table 498: Marine auxiliary, 135 kW/cyl., 1,500 rpm, IMO Tier II

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Intake air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific, the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of exhaust gas line (plant) at MCR for IMO Tier II variant.

Table 499: Reference conditions – 175D IMO Tier II



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] Higher ambient conditions than tropic only on project-specific request.

Table 500: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier II

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 18.9 | 21.3 |
| LT CW flow from and to cooling system | $m^3/h$ | 19.6 | 30.3 |
| HT heat quantity | kW | 590 | 684 |
| LT heat quantity | kW | 405 | 521 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | |

Table 501: Data for off-engine cooling system – Marine auxiliary

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 75 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 56 | |
| Seawater heat quantity | kW | 995 | 1,205 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 19 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 2.5 | |
| Max. seawater outlet temperature | °C | 33.5 | 51 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 502: Data for seawater system – Marine auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 503: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 7,631 | 7,763 |

Table 504: Combustion air system – Marine auxiliary

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1] | kW | 69 | 54 |
| [1] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 505: Heat radiation – Marine auxiliary

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1] | $m^3/h$ | 17,491 | 17,603 |
| Exhaust gas temperature after turbocharger[2] | °C | 553 | 627 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3] | mbar | 50 | - |
| Exhaust gas back pressure, after engine (limit)[3] | mbar | 300 | - |

[1] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 506: Exhaust system – Marine auxiliary

2025-10-30 - 12.0

## 3.8 Performance data – Auxiliary power applications, IMO Tier III

### 3.8.1 12V175D-MA, 190 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 2,280 | 1,938 | 1,710 | 1,140 | 570 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 193 | 194.5 | 197 | 203 | 231 |
| Total fuel oil consumption[3)] | l/h | 526 | 451 | 403 | 277 | 158 |
| Lube oil consumption[4)] | g/kWh | 0.13 | - | | | |
| Urea consumption | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 507: Marine auxiliary, 190 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 508: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 509: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 22.9 | 26.1 |
| LT CW flow from and to cooling system | $m^3/h$ | 28.3 | 33.3 |
| HT heat quantity | kW | 714 | 846 |
| LT heat quantity | kW | 644 | 796 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 510: Data for off-engine cooling system – Marine auxiliary

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,358 | 1,642 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | |
| $NPSH_{req.}$[2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 33 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 511: Data for seawater system – Marine auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 512: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,738 | 9,918 |

Table 513: Combustion air system – Marine auxiliary

2025-10-30 - 12.0

## Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 79 | 62 |
| Heat radiation SCR | kW | 18 | |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 514: Heat radiation – Marine auxiliary

## Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 24,765 | 24,930 |
| Exhaust gas temperature after turbocharger[2)] | °C | 456 | 494 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 140 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 190 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |
| SCR system layout | - | 2-line | |
| [1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine. | | | |
| [2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant). | | | |
| [3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances. | | | |

Table 515: Exhaust system – Marine auxiliary

2025-10-30 - 12.0

### 3.8.2 12V175D-MA, 175 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 2,100 | 1,785 | 1,575 | 1,050 | 525 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 192 | 195 | 199 | 207 | 233 |
| Total fuel oil consumption[3)] | l/h | 482 | 416 | 375 | 260 | 147 |
| Lube oil consumption[4)] | g/kWh | 0.14 | - | | | |
| Urea consumption | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 516: Marine auxiliary, 175 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 517: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 518: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 22 | 25.2 |
| LT CW flow from and to cooling system | $m^3/h$ | 27.1 | 33.3 |
| HT heat quantity | kW | 680 | 804 |
| LT heat quantity | kW | 610 | 757 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 519: Data for off-engine cooling system – Marine auxiliary

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,290 | 1,561 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 32.5 | 49.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 520: Data for seawater system – Marine auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 521: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,595 | 9,780 |

Table 522: Combustion air system – Marine auxiliary

2025-10-30 - 12.0

## Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 77 | 60 |
| Heat radiation SCR | kW | 18 | |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 523: Heat radiation – Marine auxiliary

## Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 23,412 | 23,573 |
| Exhaust gas temperature after turbocharger[2)] | °C | 428 | 464 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 127 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 177 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |
| SCR system layout | - | 2-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 524: Exhaust system – Marine auxiliary

2025-10-30 - 12.0

### 3.8.3 12V175D-MA, 160 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 1,920 | 1,632 | 1,440 | 960 | 480 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 190.5 | 194 | 199.5 | 210 | 238 |
| Total fuel oil consumption[3)] | l/h | 437 | 379 | 344 | 241 | 137 |
| Lube oil consumption[4)] | g/kWh | 0.15 | - | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according D2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 525: Marine auxiliary, 160 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 526: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 527: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 21 | 24 |
| LT CW flow from and to cooling system | $m^3/h$ | 25.4 | 33.3 |
| HT heat quantity | kW | 641 | 759 |
| LT heat quantity | kW | 557 | 688 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 3,400 | |

Table 528: Data for off-engine cooling system – Marine auxiliary

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 100 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,198 | 1,447 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 21 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.5 | |
| Max. seawater outlet temperature | °C | 31 | 48 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 529: Data for seawater system – Marine auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 530: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 9,226 | 9,377 |

Table 531: Combustion air system – Marine auxiliary

2025-10-30 - 12.0

## Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 74 | 58 |
| Heat radiation SCR | kW | 18 | |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 532: Heat radiation – Marine auxiliary

## Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 21,473 | 21,662 |
| Exhaust gas temperature after turbocharger[2)] | °C | 397 | 435 |
| Exhaust gas back pressure composition | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3)] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 115 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 165 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |
| SCR system layout | - | 2-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 533: Exhaust system – Marine auxiliary

2025-10-30 - 12.0

### 3.8.4 16V175D-MA, 150 kW/cyl., 1,800 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 2,400 | 2,040 | 1,800 | 1,200 | 600 |
| Engine speed | rpm | 1,800 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 192 | 197 | 202.5 | 215.5 | 243 |
| Total fuel oil consumption[3)] | l/h | 551 | 481 | 436 | 309 | 175 |
| Lube oil consumption[4)] | g/kWh | 0.16 | - | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according D2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 534: Marine auxiliary, 150 kW/cyl., 1,800 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 535: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 536: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 28.6 | 31.6 |
| LT CW flow from and to cooling system | $m^3/h$ | 28.6 | 44.7 |
| HT heat quantity | kW | 877 | 998 |
| LT heat quantity | kW | 589 | 765 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,800 | |

Table 537: Data for off-engine cooling system – Marine auxiliary

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 140 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 105 | |
| Seawater heat quantity | kW | 1,466 | 1,763 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 35 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 3.8 | |
| Max. seawater outlet temperature | °C | 30.5 | 47.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 538: Data for seawater system – Marine auxiliary

### Fuel supply system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 14 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 4,020 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 23 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 539: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 10,911 | 11,206 |

Table 540: Combustion air system – Marine auxiliary

## Heat radiation

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 96 | 75 |
| Heat radiation SCR | kW | 18 | |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 541: Heat radiation – Marine auxiliary

## Exhaust system

| | | 16V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 26,811 | 26,772 |
| Exhaust gas temperature after turbocharger[2)] | °C | 433 | 458 |
| Exhaust gas back pressure composition | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3)] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 147 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 197 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |
| SCR system layout | - | 2-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 542: Exhaust system – Marine auxiliary

2025-10-30 - 12.0

### 3.8.5 12V175D-MA, 165 kW/cyl., 1,500 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 1,980 | 1,683 | 1,485 | 990 | 495 |
| Engine speed | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 187.5 | 186 | 190 | 195 | 215 |
| Total fuel oil consumption[3)] | l/h | 444 | 374 | 338 | 231 | 128 |
| Lube oil consumption[4)] | g/kWh | 0.15 | - | | | |
| Urea consumption | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 543: Marine auxiliary, 165 kW/cyl., 1,500 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 544: Reference conditions – 175D IMO Tier III



2025-10-30 - 12.0

### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 545: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 20.4 | 23.4 |
| LT CW flow from and to cooling system | $m^3/h$ | 23.6 | 30.3 |
| HT heat quantity | kW | 648 | 772 |
| LT heat quantity | kW | 522 | 644 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | |

Table 546: Data for off-engine cooling system – Marine auxiliary

2025-10-30 - 12.0

### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 92 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 79 | |
| Seawater heat quantity | kW | 1,170 | 1,416 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 13 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 2.5 | |
| Max. seawater outlet temperature | °C | 31 | 47.5 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 547: Data for seawater system – Marine auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 548: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 8,530 | 8,668 |

Table 549: Combustion air system – Marine auxiliary

2025-10-30 - 12.0

### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 75 | 58 |
| Heat radiation SCR | kW | 18 | |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 550: Heat radiation – Marine auxiliary

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 21,319 | 21,527 |
| Exhaust gas temperature after turbocharger[2)] | °C | 444 | 485 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 116 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 166 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |
| SCR system layout | - | 2-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 551: Exhaust system – Marine auxiliary

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### 3.8.6 12V175D-MA, 150 kW/cyl., 1,500 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 1,800 | 1,530 | 1,350 | 900 | 450 |
| Engine speed | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 186 | 188.5 | 192 | 198 | 222 |
| Total fuel oil consumption[3)] | l/h | 400 | 345 | 310 | 213 | 120 |
| Lube oil consumption[4)] | g/kWh | 0.16 | - | | | |
| Urea consumption | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT- and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on a urea solution concentration of 40%.

Table 552: Marine auxiliary, 150 kW/cyl., 1,500 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 553: Reference conditions – 175D IMO Tier III



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### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 554: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 19.7 | 22.3 |
| LT CW flow from and to cooling system | $m^3/h$ | 21.2 | 30.3 |
| HT heat quantity | kW | 321 | 728 |
| LT heat quantity | kW | 450 | 568 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | |

Table 555: Data for off-engine cooling system – Marine auxiliary

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 75 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 56 | |
| Seawater heat quantity | kW | 771 | 1,296 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 19 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 2.5 | |
| Max. seawater outlet temperature | °C | 35.5 | 58 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 556: Data for seawater system – Marine auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 557: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 7,970 | 8,104 |

Table 558: Combustion air system – Marine auxiliary

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## Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 72 | 56 |
| Heat radiation SCR | kW | 18 | |
| [1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions). | | | |

Table 559: Heat radiation – Marine auxiliary

## Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 19,443 | 19,594 |
| Exhaust gas temperature after turbocharger[2)] | °C | 428 | 466 |
| Exhaust gas back pressure | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR[3)] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 96 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 146 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |
| SCR system layout | - | 2-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project-specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 560: Exhaust system – Marine auxiliary

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### 3.8.7 12V175D-MA, 135 kW/cyl., 1,500 rpm, IMO Tier III

| | Units | 100% | 85% | 75% | 50% | 25% |
|---|---|---|---|---|---|---|
| Engine output | kW | 1,620 | 1,377 | 1,215 | 810 | 405 |
| Engine speed | rpm | 1,500 | | | | |
| Specific fuel oil consumption[1) 2)] | g/kWh | 184 | 189 | 193 | 201 | 225 |
| Total fuel oil consumption[3)] | l/h | 357 | 311 | 281 | 195 | 109 |
| Lube oil consumption[4)] | g/kWh | 0.18 | - | | | |
| Urea consumption[5)] | g/kWh | Approx. 6% of fuel consumption | | | | |

[1)] Tolerance +5%.

[2)] Based on ISO reference conditions [according to ISO 15550:2002; ISO 3046:2002] and a lower calorific value of 42,700 kJ/kg and engine equipped with attached lube oil pump(s), fuel oil pump(s), HT-, and LT cooling water pump(s). Relevant for engine´s certification for compliance with the $NO_x$ limits according D2 Test cycle.

[3)] Total fuel oil consumption [l/h] calculated based on above stated specific fuel oil consumption [g/kWh] and a density of 837 kg/m$^3$.

[4)] See accordingly section Lube oil consumption, Page 347.

[5)] Based on an urea solution concentration of 40%.

Table 561: Marine auxiliary, 135 kW/cyl., 1,500 rpm, IMO Tier III

#### Reference conditions

| | Units | ISO conditions | Tropic conditions[1)] |
|---|---|---|---|
| Air temperature | °C | 25 | 45 |
| Seawater inlet temperature | °C | 18 | 32 |
| Air pressure[2)] | mbar | 1,000 | |
| Exhaust back pressure[3)] | mbar | 50 | |
| Relative humidity | % | 30 | 60 |

[1)] Contact Everllence if project specific the tropic conditions might be exceeded.

[2)] Intake air depression up to 30 mbar allowed.

[3)] Reference value for the difference pressure of the exhaust gas line (plant) at MCR, without consideration of the additional difference pressure of the Everllence SCR system.

Table 562: Reference conditions – 175D IMO Tier III



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### Available engine output in case of higher demands than tropic conditions

| | | Intake air temperature (Relative humidity) | | |
|---|---|---|---|---|
| **Seawater inlet temperature [°C]** | **LT inlet temperature [°C]** | **45°C (60%)** | **50°C (45%)** | **55°C (30%)** |
| 37 | 43 | 100%[1)] | 100%[1)] | 100%[1)] |
| 35 | 41 | 100%[1)] | 100%[1)] | 100%[1)] |
| 32 | 38 | 100% (Tropic) | 100%[1)] | 100%[1)] |

[1)] At ambient conditions ≥ tropic, a degraded performance of SCR may occur. For further information consult Everllence.

Table 563: Available engine output in case of higher demands than tropic conditions – 175D IMO Tier III

### Cooling system without integrated seawater cooler

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| HT CW flow from and to cooling system | $m^3/h$ | 19 | 21.2 |
| LT CW flow from and to cooling system | $m^3/h$ | 18.2 | 30.3 |
| HT heat quantity | kW | 592 | 680 |
| LT heat quantity | kW | 365 | 479 |
| HT inlet temperature | °C | - | 65 |
| LT inlet temperature | °C | 25 | 38 |
| Max. allowed HT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed LT pressure loss in off-engine coolant system | mbar | 500 | |
| Max. allowed seawater pressure loss in off-engine coolant system (in case of optional attached seawater pump) | mbar | 2,400 | |

Table 564: Data for off-engine cooling system – Marine auxiliary

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### Cooling system with integrated seawater cooler and attached seawater pump

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Seawater pump flow rate | $m^3/h$ | 75 | |
| Seawater flow rate through seawater cooler | $m^3/h$ | 56 | |
| Seawater heat quantity | kW | 957 | 1,159 |
| Max. allowed seawater flow rate in off-engine coolant system[1)] | $m^3/h$ | 19 | |
| $NPSH_{req.}$ [2)] for seawater pump | m | 2.5 | |
| Max. seawater outlet temperature | °C | 33 | 50 |

[1)] Max. allowed seawater flow rate in off-engine coolant system has to be regulated, for example by orifices or flow control valves. Consider a safety margin of 15% for the auxiliary consumer. In any case, the specified flow rate for the engine seawater cooler has to be ensured.

[2)] NPSH: Net positive suction height.

Table 565: Data for seawater system – Marine auxiliary

### Fuel supply system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Cooling requirement of fuel return | kW | 10 | |
| Permissible pressure range at fuel supply pump inlet | bar | –0.5 to +0.5 | |
| Max. flow rate of attached fuel supply pump (for equipment design after supply pump) | l/h | 2,220 | |
| Max. leakage fuel flow rate/temperature at open pressure limiting valve[1)] | l/min | 19 | |
| | °C | Temperatures depending on fuel inlet temperatures, temperatures increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres to be foreseen for temperatures above flashpoint (> 60°C). | |

[1)] Max. achievable engine output during open pressure limiting valve event: approx. 50%.

Table 566: Fuel supply system – Marine auxiliary

### Combustion air system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Combustion air flow rate | $m^3/h$ | 7,255 | 7,383 |

Table 567: Combustion air system – Marine auxiliary

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### Heat radiation

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Unit** | **ISO conditions** | **Tropic conditions** |
| Heat radiation (engine)[1)] | kW | 69 | 54 |
| Heat radiation SCR | kW | 18 | |

[1)] Based on engine room temperature 35°C (ISO)/55°C (tropic conditions).

Table 568: Heat radiation – Marine auxiliary

### Exhaust system

| | | 12V | |
|---|---|---|---|
| **Values at 100% output** | **Units** | **ISO conditions** | **Tropic conditions** |
| Exhaust gas flow rate[1)] | $m^3/h$ | 17,420 | 17,514 |
| Exhaust gas temperature after turbocharger[2)] | °C | 417 | 453 |
| Exhaust gas back pressure composition | | | |
| Reference value for the difference pressure of exhaust gas line (plant) at MCR without SCR system[3)] | mbar | 50 | - |
| Difference pressure, SCR system | mbar | 84 | - |
| Exhaust gas back pressure, after engine (reference conditions) | mbar | 134 | - |
| Exhaust gas back pressure, after engine (limit)[3)] | mbar | 300 | - |
| SCR system layout | - | 2-line | |

[1)] Exhaust gas flow rate calculated as $m^3/h$ from kg/h regarding the actual exhaust gas temperature after turbine.

[2)] Consider section Engine operating/service temperature and pressure values, Page 351 and within Exhaust gas, the recommended minimum design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant).

[3)] Any higher value than the reference value for the difference pressure of the exhaust gas line (plant) will lead to an increase of the SFOC figures and a change of the operating figures of the engine. Accordingly a project specific calculation and release is needed. The limit of the exhaust gas back pressure after engine must not be exceeded under any circumstances.

Table 569: Exhaust system – Marine auxiliary

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## 3.9 Recalculation of fuel consumption

### 3.9.1 Additions to fuel consumption

**1. Engine driven pumps increase the fuel consumption by:**

$$be_{ISO\ with\ pumps} = be_{ISO\ without\ pumps} \times (1 + f_{SWpumps})$$

**For seawater pumps (attached)**

$$f_{SW\ pumps} = i_{SW\ pumps} \times C_{SW\ pumps} \times \frac{100\%}{load\%} \times \left(\frac{n_x}{n_n}\right)^3$$

| Variant | Power [kW/cyl] | Speed [rpm] | $C_{SW\ pumps}$ |
|---|---|---|---|
| MEL | 1,500 | 150 | 0.0062 |
| | 1,500 | 165 | 0.0056 |
| | 1,800 | 175 | 0.0078 |
| | 1,800 | 185 | 0.0073 |
| | 1,800 | 190 | 0.0072 |
| MEM | 1,500 | 120 | 0.0063 |
| | 1,500 | 135 | 0.0056 |
| | 1,800 | 150 | 0.0089 |
| | 1,800 | 160 | 0.0084 |
| MEV | 1,800 | 155 | 0.0087 |
| | 1,800 | 170 | 0.0079 |
| | 1,800 | 185 | 0.0073 |
| | 1,800 | 190 | 0.0072 |
| MA | 1,500 | 135 | 0.0056 |
| | 1,500 | 150 | 0.0062 |
| | 1,500 | 165 | 0.0056 |
| | 1,500 | 150 | 0.0089 |
| | 1,500 | 160 | 0.0084 |
| | 1,500 | 175 | 0.0078 |
| | 1,500 | 190 | 0.0072 |
| MM | 1,500 | 155 | 0.0087 |
| | 1,800 | 160 | 0.0084 |
| | 1,800 | 170 | 0.0079 |
| | 1,800 | 185 | 0.0073 |
| | 1,800 | 200 | 0.0084 |



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| Variant | Power [kW/cyl] | Speed [rpm] | $C_{SW\ pumps}$ |
|---|---|---|---|
| | 1,800 | 185 | 0.0091 |
| MH | 1,800 | 145 | 0.0092 |
| ML | 2,000 | 200 | 0.0100 |
| | 2,000 | 215 | 0.0094 |
| | 2,000 | 220 | 0.0094 |

Table 570: Values $C_{SW\ pumps}$

| | | |
|---|---|---|
| $f_{SW\ pumps}$ | Actual factor for impact of attached pumps | [-] |
| $i_{SW\ pumps}$ | Number of attached seawater pumps | [-] |
| $n_x$ | Actual engine speed | [rpm] |
| $n_n$ | Nominal engine speed | [rpm] |
| load% | Actual engine load | [%] |

**2. For exhaust gas back pressure after turbine > 50 mbar**

Every additional 1 mbar (0.1 kPa) back pressure addition of 0.01 g/kWh to be calculated.

### 3.9.2 Recalculation of fuel consumption dependent on ambient conditions

In accordance to ISO standard ISO 3046-1:2002 "*Reciprocating internal combustion engines – Performance, Part 1: Declarations of power, fuel and lube oil consumptions, and test methods – Additional requirements for engines for general use*" Everllence has specified the method for recalculation of fuel consumption for liquid fuel dependent on ambient conditions for single-stage turbocharged engines as follows:

$$\beta = 1 + 0.00045 \times (t_x - t_r) + 0.0002 \times (t_{bax} - t_{bar}) + 0.07 \times (p_r - p_x)$$

| **The formula is valid within the following limits:** | |
|---|---|
| Ambient air temperature | 0°C–45°C |
| Charge air temperature before cylinder | 35°C–60°C |
| Ambient air pressure | 0.900 bar–1.030 bar |

Table 571: Limit values for recalculation of liquid fuel consumption

$$b_x = b_r \times \beta \qquad b_r = \frac{b_x}{\beta}$$

| | |
|---|---|
| $\beta$ | Fuel consumption factor |
| $t_{bar}$ | Engine type specific reference charge air temperature before cylinder 40°C. |

| | Unit | Reference | At test run or at site |
|---|---|---|---|
| Specific fuel consumption | [g/kWh] | $b_r$ | $b_x$ |
| Ambient air temperature | [°C] | $t_r$ | $t_x$ |

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| | Unit | Reference | At test run or at site |
|---|---|---|---|
| Charge air temperature before cylinder | [°C] | $t_{bar}$ | $t_{bax}$ |
| Ambient air pressure | [bar] | $p_r$ | $p_x$ |

Table 572: Recalculation of liquid fuel consumption – Units and references

**Example**

Reference values:

$b_r$ = 200 g/kWh, $t_r$ = 25°C, $t_{bar}$ = 40°C, $p_r$ = 1.0 bar

At site:

$t_x$ = 45°C, $t_{bax}$ = 50°C, $p_x$ = 0.9 bar

ß = 1+ 0.00045 (45 – 25) + 0.0002 (50 – 40) + 0.07 (1.0 – 0.9) = 1.018

$b_x$ = ß x $b_r$ = 1.018 x 200 = 203.6 g/kWh

## 3.10 Fuel oil consumption at idle running

| Fuel oil consumption at idle running | | | |
|---|---|---|---|
| No. of cylinders, config. | 12V | 16V | 20V |
| Speed 600 rpm | 8–10 kg/h | | |

Table 573: Fuel oil consumption at idle running (for guidance only)

## 3.11 Lube oil consumption

Specific lube oil consumption:

$$0.15\ \text{g/kWh}^{1)} \times \frac{100\%}{\text{load\%}} \times \frac{160\ \text{kW/cyl.}}{\text{nominal output per cyl.}}$$

| | | |
|---|---|---|
| load% | Actual engine load | [%] |
| nominal output per cyl. | Insert the nominal output per cyl. | [kW/cyl.] |

[1)] The value stated above is without any losses due to cleaning of filter and centrifuge or lube oil charge replacement. Tolerance for warranty +20%.

Example:

For nominal output 160 kW/cyl. and 100% actual engine load: 0.150 g/kWh

For nominal output 185 kW/cyl. and 85% actual engine load: 0.153 g/kWh

## 3.12 Starting system – Energy consumption

### 3.12.1 General

**Starting layout**

The 175D engine can be equipped with electrical starter/s or an air starter or a redundant starting system consisting of electrical starter and an air starter.



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**Starting system types**

| No. of cylinders, config. | No redundancy only electric starter | No redundancy only pneumatic starter | With redundancy electric plus pneumatic starter |
|---|---|---|---|
| 12V | 2 x Prestolite M128 | - | 1 x Prestolite S152 |
| 16V | | | |
| 20V | | | |

Table 574: Starting system types and type of electric starter

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### 3.12.2 Electrical starting system (standard)

Electrical starters require a dedicated power supply line (24V DC). A two-pole cable is required for connection to the starter positive and negative terminals. Proper cable should be selected accordingly to the maximum starting current, as defined for the relevant engine variant.

| **No. of cylinders, config.** | | **12V** | **16V** | **20V** |
|---|---|---|---|---|
| Power supply | V DC | 24 | | |
| Maximum starting current | Ampere | 3,026 | 3,619 | 4,212 |
| Cranking current | | 882 | 1,086 | 1,290 |
| Approx. starting duration | sec | 1.8 | 2.9 | 4.0 |
| Energy consumption per start | kWh | 0.015 | 0.026 | 0.043 |
| Everllence recommendation with safety factor for cold condition/20% | | | | |
| Cold case cranking/CCA | Ampere | 3,630 | 4,340 | 5,050 |
| Energy consumption per start | kWh | 0.019 | 0.032 | 0.052 |

Table 575: Electrical starting system

| **Cable layout for electrical starter:** | |
|---|---|
| **No. of cylinders, config.** | **Minimum cross-sectional area A** |
| 12V | 185 $mm^2$ |
| 16V | 240 $mm^2$ |
| 20V | 300 $mm^2$ |

Prerequisites:

- Ambient air temperature max. 55°C
- Maximum cable length 6.5 m
- Conductor material copper with at least permissible operating temperature of 100°C
- Thermal conductivity of the insulation material not worse then that of PVC
- Isolation thickness: 2 mm up to 7 mm
- Cable laying separated with cooling by natural convection

Table 576: Cable layout for electrical starter

The further requirements of the classification societies such as:

- Number of start attempts
- Duration of each starting
- Sufficient capacity of start attempts
- Number of starts within 30 minutes without recharging must be observed and are the responsibility of the customer

### 3.12.3 Compressed air starting system (optional)

A pneumatic motor (gear type), operating with a pressure up to 30 bar, is available as an optional starting system. The starter has a single connection for compressed air inlet.

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| No. of cylinders, config. | | 12V | 16V | 20V |
|---|---|---|---|---|
| **Air consumption at minimum moment of inertia**[1] | | | | |
| Air consumption per start $V_{Start}$ | $Nm^3$ [2] | 0.6 | 0.9 | 0.8 |
| Reference moment of inertia for stated air consumption figures $J_{Ref}$ | $kgm^2$ | 28.18 | 35.43 | 52.1 |
| **Air consumption at high moment of inertia**[1] | | | | |
| Air consumption per start $V_{Start}$ | $Nm^3$ [2] | 1.9 | 2.7 | 2 |
| Reference moment of inertia for stated air consumption figures $J_{Ref}$ | $kgm^2$ | 200 | 250 | 300 |
| Min. pressure | bar | 12 | 16 | 19 |
| Max. pressure | bar | 30 | | |
| Starting system active[3] | sec | 0.8 | | |
| Operating temperature | °C | min. 5°C, max. 65°C | | |

[1] The air consumption per starting manoeuvre/slow turn of the unit (e.g. engine plus alternator) increases in relation to its total moment of inertia. Linear interpolation must be carried out between the stated figures to gain the relevant air consumption figures for the unit within the plant based on its total moment of inertia at start. Consider also the "Required minimum total moments of inertia" as stated within tables Moments of inertia for marine main engines – Crankshaft, damper, flywheel.

[2] $Nm^3$ corresponds to 1 cubic metre of gas at 20°C and 100.0 kPa.

[2] Stated time duration for activated starting system only relevant for layout of starting air system. For layout of the starting air system, note:

- Starting air pressure stated within section Engine operating/service temperature and pressure values, Page 351.
- Maximum velocity (m/s) see section External pipe dimensioning, Page 414 - consider multiple start of engines, if needed.

Table 577: Starting air consumption

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## 3.13 Engine operating/service temperature and pressure values

### Ambient air

| | Min. | Max. |
|---|---|---|
| Ambient air temperature (outside vessel) | 0°C[1)] | 45°C[2)] |

[1)] Conditions below this temperature are defined as "arctic conditions" – see section Engine operation under arctic conditions.

[2)] In accordance with power definition. A reduction in power is required at higher temperatures.

Table 578: Ambient air

### Engine room air

| | Min. | Max. |
|---|---|---|
| Engine room air temperature | 0°C<br>recommended: 5°C[1)] | 55°C[2)] |

[1)] Recommendation given to avoid any possibility for ice formation. In general it can be assumed that the air temperature in the area of the engine and attached components will be 5–10 K above the ambient air temperature outside the engine room.

[2)] Air temperatures at the engine > 55°C are not permissible.

Table 579: Engine room air

### Intake air (conditions before compressor of turbocharger)

| | Min. | Max. |
|---|---|---|
| Intake air temperature compressor inlet | 0°C[1)] | 45°C[2)] |
| Intake air pressure compressor inlet | –30 mbar[3)] | - |

[1)] Conditions below this temperature are defined as "arctic conditions" – see related section. External intake air supply to be applied in this case.

[2)] In accordance with power definition. A reduction in power is required at higher temperatures.

[3)] -50 mbar possible with performance deterioration.

Table 580: Intake air (conditions before compressor of turbocharger)

### Charge air (conditions within charge air pipe before cylinder)

| | Min. | Max. |
|---|---|---|
| Charge air temperature cylinder inlet | 29°C | 55°C |

Table 581: Charge air (conditions within charge air pipe before cylinder)



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### HT cooling water

Engine

| | Min. | Max. |
|---|---|---|
| HT cooling water temperature at jacket cooling outlet[1] | 82°C[2] | 94°C[3] |
| HT cooling water pressure engine inlet at nominal speed:[4]:<br>1,500 rpm<br>1,800 rpm<br>1,900 rpm<br>2,000 rpm | <br>0.78 bar[3]<br>1.12 bar[3]<br>1.24 bar[3]<br>1.37 bar | 2.0 bar |
| Pressure loss (total, for nominal flow rate) for orifice, attached lube oil cooler, engine, and HT seawater cooler | - | 2.3 bar |
| Pressure loss (total, for nominal flow rate) for orifice, attached lube oil cooler, engine without HT seawater cooler | - | 1.8 bar |
| Pressure rise attached HT cooling water pump | - | 3.4 bar |

[1] SaCoS measuring point is jacket cooling outlet of the engine.

[2] Regulated temperature by thermostatic cartridges.

[3] Operation at alarm level.

[4] SaCoS measuring point is jacket cooling inlet of the engine.

Table 582: HT cooling water – Engine

Plant

| | Min. | Max. |
|---|---|---|
| Permitted pressure loss of external HT system (plant) | - | 0.5 bar |

Table 583: HT cooling water – Plant

### LT cooling water

Engine

| | Min. | Max. |
|---|---|---|
| LT cooling water temperature charge air cooler inlet (LT stage) | 32°C[1] | 38°C[2] |
| LT cooling water pressure charge air cooler inlet (LT stage) at nominal speed:<br>1,500 rpm<br>1,800 rpm<br>1,900 rpm<br>2,000 rpm | <br>0.72 bar[3]<br>1.09 bar[3]<br>1.24 bar[3]<br>1.4 bar | 2.0 bar |
| Pressure loss (total, for nominal flow rate) for orifice, attached lube oil cooler, engine, and HT seawater cooler | - | 2.0 bar |
| Pressure loss (total, for nominal flow rate) for orifice, attached lube oil cooler, engine without HT seawater cooler | - | 1.5 bar |
| Pressure rise attached LT cooling water pump | - | 2.9 bar |

[1] Regulated temperature by thermostatic cartridges.

[2] In accordance with power definition. A reduction in power is required at higher temperature.

[3] Operation at alarm level.

Table 584: LT cooling water – Engine

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Plant

| | Min. | Max. |
|---|---|---|
| Permitted pressure loss of external LT system (plant) | - | 0.5 bar |

Table 585: LT cooling water – Plant

### Seawater

| | Min. | Max. |
|---|---|---|
| Seawater temperature – Attached seawater cooler inlet | - | 32°C[1)] |
| Pressure loss of attached seawater cooler | - | 3.0 bar |
| Pressure rise attached seawater pump | - | 4.0 bar[2)] |

[1)] In accordance with power definition. A reduction in power is required at higher temperature.

[2)] For applications 20V MEL, 150 and 165 kW/cyl @ 1,500 rpm max. pressure drop in SW system 2.0 bar including plantside SW cooler.

Table 586: Seawater

### Lube oil

| | Min. | Max. |
|---|---|---|
| Lube oil temperature engine inlet | 85°C | 103°C[1)] |
| Lube oil pressure engine inlet at nominal speed:<br>1,500 rpm<br>1,800 rpm<br>1,900 rpm<br>2,000 rpm | <br>3.5 bar[3)]<br>4 bar[3)]<br>4 bar[3)]<br>4 bar | 5.0 bar |

[1)] Operation at alarm level.

Table 587: Lube oil

### Fuel

| | Min. | Max. |
|---|---|---|
| Fuel temperature engine inlet – DMA, DFA according ISO 8217 | –10°C[1)] | 50°C[2)] |
| Fuel viscosity engine inlet – DMA, DFA according ISO 8217 | 1.3 cSt | 6.0 cSt |
| Fuel pressure at fuel supply pump inlet | –0.5 bar | +0.5 bar |
| Fuel pressure engine inlet (before high-pressure pumps) | 7.0 bar | 9.0 bar<br>(10.0 bar)[3)] |
| Maximum pressure variation at engine inlet | - | ±0.5 bar |
| Maximum allowed pressure resistance engine fuel oil outlet connection "5243 leakage fuel drain 1", see figure(s) Fuel oil supply system, Page 469 | - | 0.8 bar |

[1)] Maximum viscosity not to be exceeded. “Pour point” and “cold filter plugging point” have to be observed.

[2)] Not permissible to fall below minimum viscosity.

[3)] With mechanical pre-feeder pump 10.0 bar.

Table 588: Fuel

### Exhaust gas

Plant



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| Recommended design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant) | Min. | Max. |
|---|---|---|
| 12V MA [135 kW/cyl., 1,500 rpm, Tier II]<br>12V MA [150 kW/cyl., 1,500 rpm, Tier II]<br>16V MA [150 kW/cyl., 1,800 rpm, Tier II]<br>12V MA [160 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>12V/16V MEL [150 kW/cyl., 1,500 rpm, Tier II]<br>20V MEL [175 kW/cyl., 1,800 rpm, Tier II]<br>12V MEM [120 kW/cyl., 1,500 rpm, Tier II/Tier III]<br>12V/16V MEM [135 kW/cyl., 1,500 rpm, Tier II]<br>12V/16V/20V MEM [150 kW/cyl., 1,800 rpm, Tier II]<br>12V/20V MEM [150 kW/cyl., 1,800 rpm, Tier III]<br>12V/16V/20V MEM [160 kW/cyl., 1,800 rpm, Tier II]<br>12V/20V MEM [160 kW/cyl., 1,800 rpm, Tier III]<br>12V MH [145 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>12V MM [155 kW/cyl., 1,800 rpm, Tier II]<br>16V MM [160 kW/cyl., 1,800 rpm, Tier II] | 450°C[1)] | - |
| 12V MA [135 kW/cyl., 1,500 rpm, Tier III]<br>16V MA [150 kW/cyl., 1,800 rpm, Tier III]<br>12V MA [165 kW/cyl., 1,500 rpm, Tier II]<br>12V MEL [165 kW/cyl., 1,500 rpm, Tier II]<br>20V MEM [135 kW/cyl., 1,500 rpm, Tier II]<br>12V MEM [135 kW/cyl., 1,500 rpm, Tier III]<br>16V MEM [150 kW/cyl., 1,800 rpm, Tier III]<br>12V MM [155 kW/cyl., 1,800 rpm, Tier III]<br>12V MM [160 kW/cyl., 1,800 rpm, Tier II]<br>12V MM [170 kW/cyl., 1,800 rpm, Tier II] | 460°C[1)] | - |
| 12V MA [150 kW/cyl., 1,500 rpm, Tier III]<br>12V MA [175 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>12V MEL [150 kW/cyl., 1,500 rpm, Tier III]<br>12V/16V MEL [175 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>20V MEL [175 kW/cyl., 1,800 rpm, Tier III]<br>16V MEM [135 kW/cyl., 1,500 rpm, Tier III]<br>12V MM [160 kW/cyl., 1,800 rpm, Tier III]<br>12V MM [170 kW/cyl., 1,800 rpm, Tier III] | 470°C[1)] | - |
| 12V MA [165 kW/cyl., 1,500 rpm, Tier III]<br>20V MEL [150 kW/cyl., 1,500 rpm, Tier II]<br>12V MEL [165 kW/cyl., 1,500 rpm, Tier III]<br>16V MEL [165 kW/cyl., 1,500 rpm, Tier II]<br>20V MEL [190 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>16V ML [200 kW/cyl., 2,000 rpm, Tier II/Tier III]<br>16V MM [160 kW/cyl., 1,800 rpm, Tier II]<br>12V MM [185 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>12V MM [185 kW/cyl., 1,900 rpm, Tier II /Tier III] | 490°C[1)] | - |

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| Recommended design exhaust gas temperature turbine outlet for layout of exhaust gas line (plant) | Min. | Max. |
|---|---|---|
| 12V MA [190 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>16V/20V MEL [150 kW/cyl., 1,500 rpm, Tier III]<br>20V MEL [165 kW/cyl., 1,500 rpm, Tier II]<br>16V MEL [185 kW/cyl., 1,800 rpm, Tier II]<br>12V MEL [190 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>20V MEM [135 kW/cyl., 1,500 rpm, Tier III]<br>16V MEM [160 kW/cyl., 1,800 rpm, Tier III]<br>12V MEV [170 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>16V MEV [185 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>12V MEV [190 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>16V/20V MM [170 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>20V MM [185 kW/cyl., 1,900 rpm, Tier II/Tier III] | 510°C[1)] | - |
| 16V/20V MEL [165 kW/cyl., 1,500 rpm, Tier III]<br>16V MEL [185 kW/cyl., 1,800 rpm, Tier III]<br>16V MEV [170 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>20V MEV [190 kW/cyl., 1,800 rpm, Tier II]<br>12V ML [200 kW/cyl., 2,000 rpm, Tier II]<br>16V/20V MM [185 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>16V MM [185 kW/cyl., 1,900 rpm, Tier II/Tier III]<br>12V MM [200 kW/cyl., 1,800 rpm, Tier II/Tier III] | 530°C[1)] | - |
| 12V/16V/20V ML [200 kW/cyl., 2,000 rpm, Tier II/Tier III]<br>12V MEV [155 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>20V MEV [190 kW/cyl., 1,800 rpm, Tier III]<br>12V ML [200 kW/cyl., 2,000 rpm, Tier III]<br>20 ML [200 kW/cyl., 2,000 rpm, Tier II/Tier III] | 540°C[1)] | - |
| 16V MEV [155 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>20V MEV [170 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>12V ML [215 kW/cyl., 2,000 rpm, Tier II] | 570°C[1)] | - |
| 20V MEV [155 kW/cyl., 1,800 rpm, Tier II/Tier III]<br>20V ML [220 kW/cyl., 2,000 rpm, Tier II] | 590°C[1)] | - |
| Maximum allowable difference pressure of exhaust gas line (plant) at MCR | | |
| 175D without SCR | - | 50 mbar[2)] |
| 175D with SCR | - | 50 mbar[2)] |

[1)] Project-specific evaluation required, figure given as minimum value for guidance only.

[2)] If the stated value will be exceeded, the available engine performance must be recalculated.

Table 589: Exhaust gas – Plant

## 3.14 Filling volumes (oil and coolant capacities)

| | 12V | 16V | 20V |
|---|---|---|---|
| Engine lube oil | 300 l | 400 l | 500 l |
| HT coolant | Approx. 200 l | Approx. 290 l | Approx. 340 l |
| LT coolant | Approx. 100 l | Approx. 130 l | Approx. 150 l |



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| | 12V | 16V | 20V |
|---|---|---|---|
| Expansion tank (plant equipment) | Approx. 60 l | Approx. 80 l | Approx. 100 l |

Table 590: Oil and coolant capacities 175D

### Expansion tank

The expansion tank has to be supplied as a plant equipment.

A static pressure of 0.5 bar at suction side is sufficient.

For expansion tank installation height see section External cooling water system, Page 445.

## 3.15 Emission values

### $NO_x$ emission values

Marine engines are guaranteed to meet the applicable limits of MARPOL Annex VI (Regulations for the Prevention of Air Pollution from Ships), Regulation 13 as adopted by the International Maritime Organization (IMO).

**If required the engine's certification for compliance with the $NO_x$ limits will be carried out during factory acceptance test (FAT) as a single or a group certification.**

| Rated speed | $NO_x$ [1) 2) 3)] IMO Tier II cycle D2/E2/E3 | $NO_x$ [1) 2) 3)] IMO Tier III cycle D2/E2/E3 |
|---|---|---|
| 1,500 rpm | 8.2 g/kWh[4)] | 2.1 g/kWh[5)] |
| 1,600 rpm | 8.1 g/kWh[4)] | 2.1 g/kWh[5)] |
| 1,800 rpm | 7.9 g/kWh[4)] | 2.0 g/kWh[5)] |
| 1,900 rpm | 7.8 g/kWh[4)] | 2.0 g/kWh[5)] |
| 2,000 rpm | 7.7 g/kWh[4)] | 2.0 g/kWh[5)] |

[1)] Cycle values, operation on DM grade fuel (marine distillate fuel: DMA) according ISO 8217.

[2)] Calculated as $NO_2$.

D2: Test cycle for "constant-speed auxiliary engine application".

E2: Test cycle for "constant-speed main propulsion application" including electric propulsion and all controllable-pitch propeller installations).

E3: Test cycle for "propeller-law operated main and propeller-law operated auxiliary engine" application.

[3)] Contingent to a charge air cooling water temperature of. max. 32°C at 25°C seawater temperature.

[4)] Maximum allowable $NO_X$ emissions for marine diesel engines according to IMO Tier II:
$130 \le n \le 2{,}000 \rightarrow 44 * n^{-0,23}$ g/kWh (n = rated engine speed in rpm).

[5)] Maximum allowable $NO_X$ emissions for marine diesel engines according to IMO Tier III:
$130 \le n \le 2{,}000 \rightarrow 9 * n^{-0.2}$ g/kWh (n = rated engine speed in rpm).

Table 591: Maximum permissible $NO_X$ emission limit value

### Smoke emission

Smoke index FSN for engine loads ≥ 10% load well below limit of visibility.

Valid for normal engine operation.

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## 3.16 Exhaust gas – possible components and visibility

The exhaust gas of reciprocating internal combustion engines is composed of numerous constituents. These are derived from either the combustion air and fuel and lube oil used, or they are reaction products, formed during the combustion process. Only some of these are to be considered as harmful substances.

The following listed exhaust gas components need to be seen as a general overview – the presence and amount of the singular component depends in large extends on the engine type, combustion process and fuel type.

### Nitrogen $N_2$

Nitrogen ($N_2$) is with approximately 73–75 vol-% the main constituent of the exhaust gas.

### Oxygen $O_2$

Approximately 21 vol-% of the ambient air is Oxygen ($O_2$).

### Carbon dioxide $CO_2$

Carbon dioxide ($CO_2$) is a product of combustion.

### Water vapour $H_2O$

The water in the exhaust comes from the combustion of the fuel and, to a lesser extent, from the moisture in the intake air. In diesel operation, the water vapour content is approximately 6 vol-%, in gas operation approximately 10 vol-%.

### Inert gases Ar, Ne, He, etc.

Inert gases, such as Ar, Ne, He, etc., are constituents of the ambient air with a volume fraction of approximately 0.9 vol-%.

### Sulphur oxides $SO_x$

Sulphur oxides ($SO_x$) are formed by the combustion of the sulphur contained in the fuel. The sulphur content in the fuel determines the $SO_2$ content in the exhaust gas.

### Nitrogen oxides $NO_x$ ($NO + NO_2$)

The high temperatures prevailing in the combustion chamber of an internal combustion engine cause the chemical reaction of nitrogen (contained in the combustion air as well as in some types of fuel) and oxygen (contained in the combustion air) to form nitrogen oxides ($NO_x$).

### Carbon monoxide CO

Carbon monoxide (CO) is formed during incomplete combustion.

### Hydrocarbons HC

The hydrocarbons (HC) contained in the exhaust gas are composed of a multitude of various organic compounds as a result of incomplete combustion.



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### Particulate matter PM

Particulate matter (PM) consists of soot (elemental carbon) and ash.

### Methanol $CH_3OH$

Methanol only might occur in methanol operation as result of incomplete combustion.

### Formaldehyde $CH_2O$

Formaldehyde ($CH_2O$) is a gas known by its pungent smell. Its proportion in the exhaust gas depends on the fuel and the degree of combustion. If the proportion of formaldehyde ($CH_2O$) is high, it can be removed by an oxidation catalyst – this is only necessary for gas or methanol operation.

### Nitrous oxide $N_2O$

Nitrous oxide ($N_2O$) is a gas that only might occur in relevant quantity in ammonia ($NH_3$) operation.

### Visibility of the exhaust gas

The visibility of exhaust gas highly depends on ambient conditions and the observer's line of sight to the exhaust gas, background and the sun. The exhaust gas can either be seen or not depending on the ambient temperature, wind velocity, diameter and height of the chimney and the colouring of the background. It can be black, blue, brown, yellow or white depending on the components present in the exhaust gas. Black or gray exhaust gas is mainly due to the presence of carbon particles. A blue appearance is usually due to droplets resulting from the incomplete combustion of fuel or lubricating oil. A yellow or brown appearance can be caused by the presence of $NO_2$ in the exhaust gas. White exhaust gas may be caused by condensed water and/or liquid fuel.

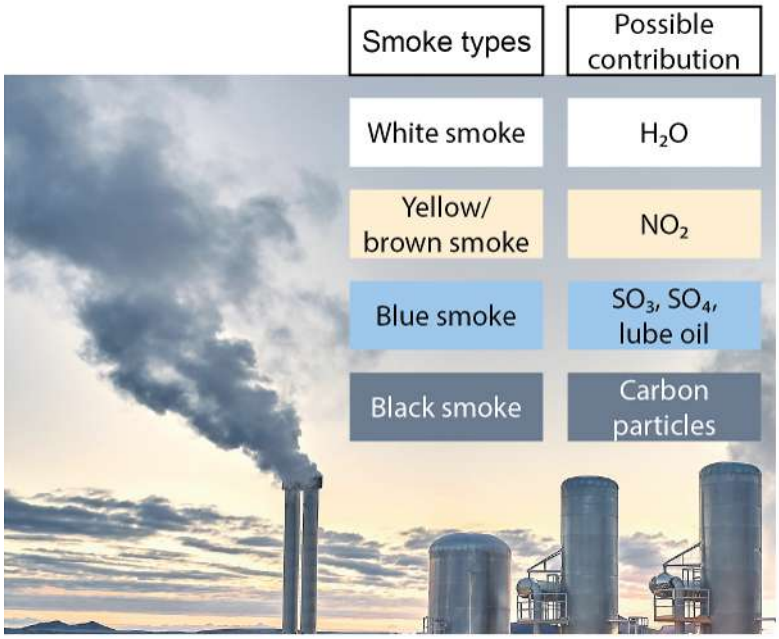



Figure 58: Possible components of the exhaust gas – Visibility

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## 3.17 Emission-related installation instruction for engines

### Position of the exhaust gas sampling points

The sampling position shall be fitted:

- At least 10 times the diameter of the exhaust pipe after the outlet of the engine, turbocharger or last after-treatment device
- In a straight pipe segment:
  - With an inlet path length before sampling position of at least 5 times the diameter of the exhaust pipe after last bending/obstruction/diameter deviation
  - With a path length after sampling position of at least 2 times the diameter of the exhaust pipe
- At least 5 times the diameter of the exhaust pipe before end of exhaust pipe
- Sufficiently close to the engine to ensure that the exhaust gas temperature at the sampling position will be minimum 180°C

If this is not attainable, a deviation of these requirements is acceptable if:

- justified by good engineering practice
- an incorrect measurement is not expected

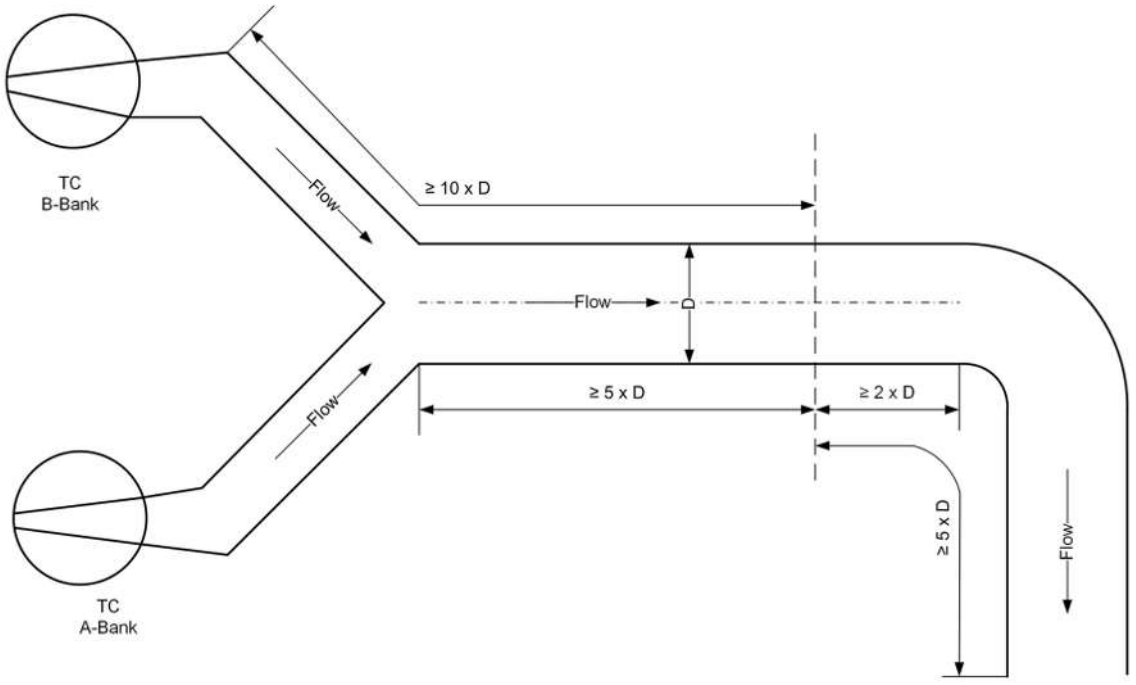



Figure 59: Position of sampling points (exemplary)

In the case an engine has distinct groups of manifolds, it is permissible to acquire a sample from each group individually and calculate an average exhaust emission. In this case, each sampling point must be designed as mentioned above.

The exhaust gas upstream the sampling point shall be free of any dilution from surrounding air or contamination from other exhaust gas systems.



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### Accessibility and working area at sampling point

The sampling point shall be accessible in a save way also during engine operation. In case the sampling point is covered by an insulation, the position shall be clearly visible marked on the insulation. The Insulation shall be designed in a way that it is easy to remove and to install again.

If necessary, a step has to be established.

There shall be enough space to place and operate the measurement equipment.

Requirements regarding the working area:

- Minimum space requirements: about 2-m width, 2-m depth, 2-m height
- Sufficient floor load capacity (at least 200 kg per $m^2$)
- Temperature at this working area should be within +5°C to + 40°C and well ventilated
- Not subjected to excessive vibrations
- If needed weather protection for personnel and equipment against sun, wind and rain

Depending on the measurement equipment it should be considered that during the measurements following items are available at the working area:

- Adequate lighting and ventilation
- Power supply
- Pressurised air (instrument quality, oil free)
- Lifting devices for raising and lowering the equipment, if necessary

### Exhaust pipe connection

- 1 piece of pipe thread inner diameter G 3” (use for particulate measurements)
- 2 pieces of pipe thread inner diameter G ½" (use for gaseous emission measurements or for smoke number measurement)

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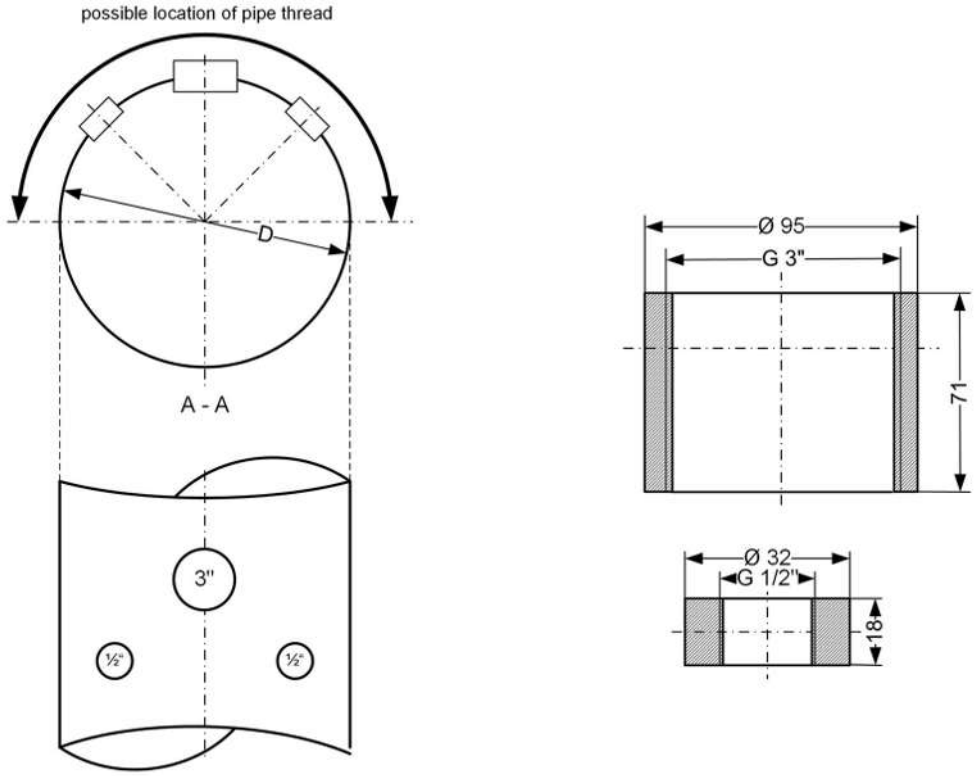



Figure 60: Sampling point, details

**Installation of pipe thread G 3" and G ½"**

To establish an airtight connection, the pipe threads shall be welded at the exhaust gas pipe. In case of a horizontal orientated exhaust gas pipe the position shall be in the upper half of the exhaust gas pipe in radial direction to the centre line and easy to access.

When the sampling points are not in use, a pipe plug shall close the pipe threads.

## 3.18 Noise

### 3.18.1 Airborne noise

Sound pressure level Lp

#### Measurements

Approximately 20 measuring points at 1-metre distance from the engine surface are distributed evenly around the engine according to ISO 6798. The noise at the exhaust outlet is not included, but provided separately in the following sections.

#### Octave level diagram

The expected sound pressure level Lp is below 110 dB(A) at 100% MCR.

The octave level diagram below depicts a typical airborne noise spectrum, measured at a 12V175D at 1,800 rpm and 1,920 kW power. No room correction is performed. Measured sound pressure levels may vary, dependent on the environment and operating point of the engine.



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Blow-off noise

Blow-off noise is not considered in the measurements, see below.

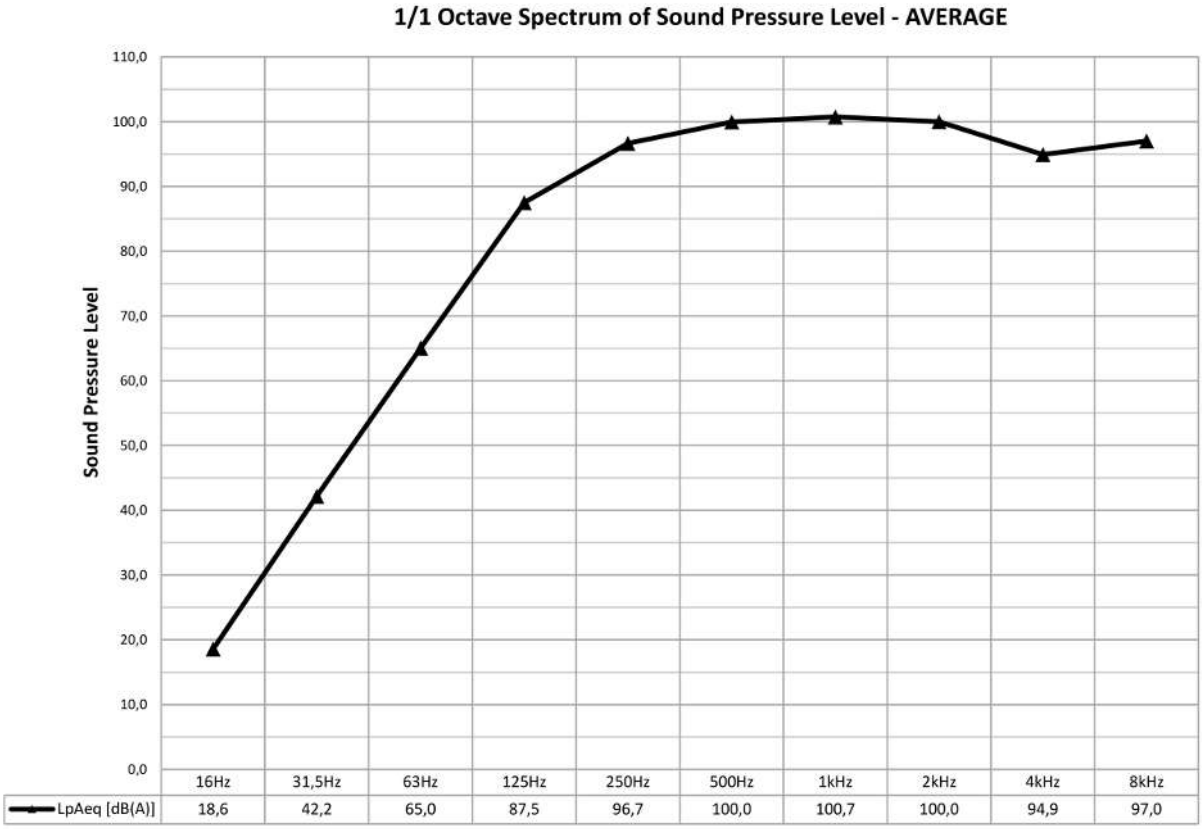



Figure 61: Airborne noise - Sound pressure level Lp - Typical octave level diagram of a 12V175D at 1.800 rpm and 1,920 kW

## 3.18.2 Exhaust gas noise

Sound power level Lw at 100% MCR

Measurements

The (unsilenced) exhaust gas noise is measured according to internal Everllence guidelines at several positions in the exhaust duct.

Third-octave level diagram

The sound power level Lw of the unsilenced exhaust gas noise in the exhaust pipe is shown for various applications in the graphs below.

The data may differ depending on the engine variant and the acoustical properties of the environment.

In case of an attached Everllence SCR system a sound attenuation of 5 dB < 100 Hz and 10 dB >100 Hz can be considered.

Acoustic design

To ensure an appropriate acoustic design of the exhaust gas system, the vessel/plant designers, Everllence, supplier of silencer and where necessary acoustic consultant have to cooperate.

Waste gate blow-off noise

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Waste gate blow-off noise is not considered in the measurements, see below.

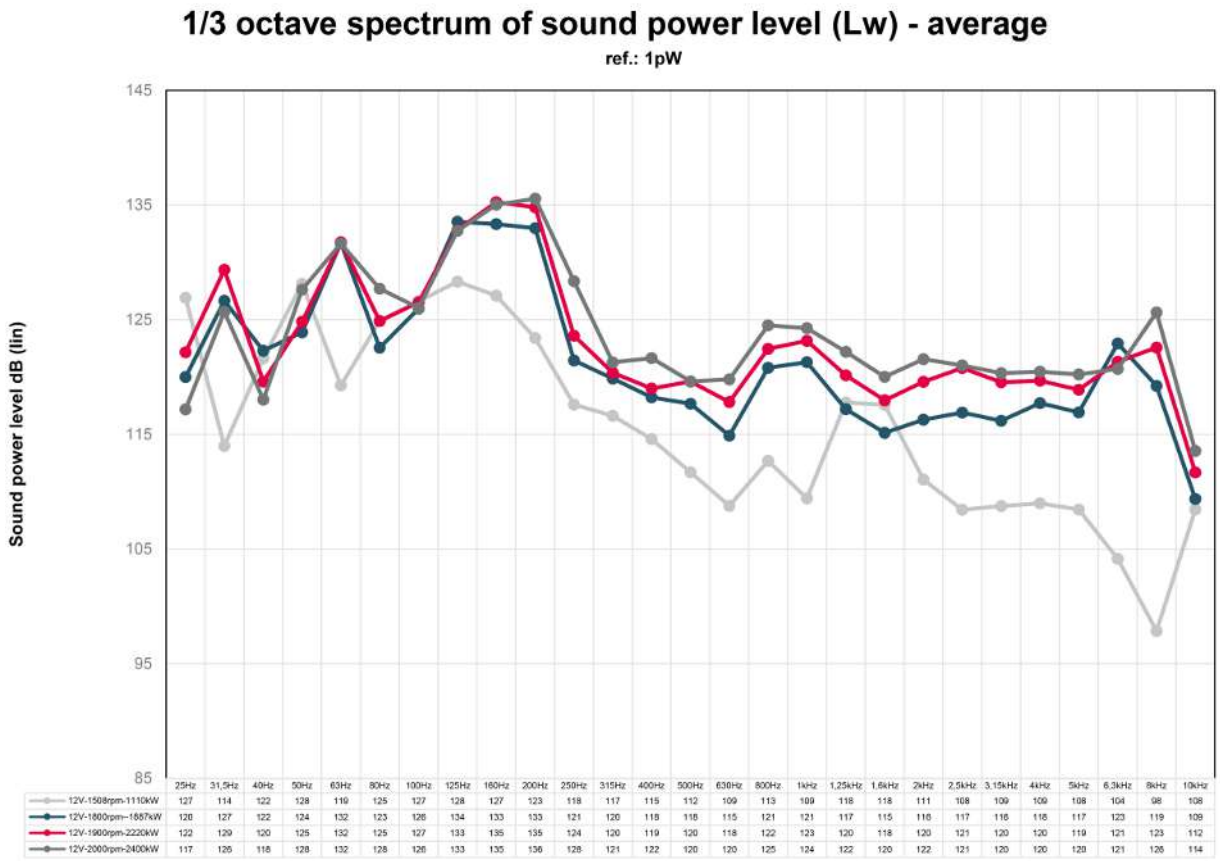



Figure 62: Typical unsilenced exhaust gas noise spectra of 12V175D - Sound power level Lw - Octave level diagram



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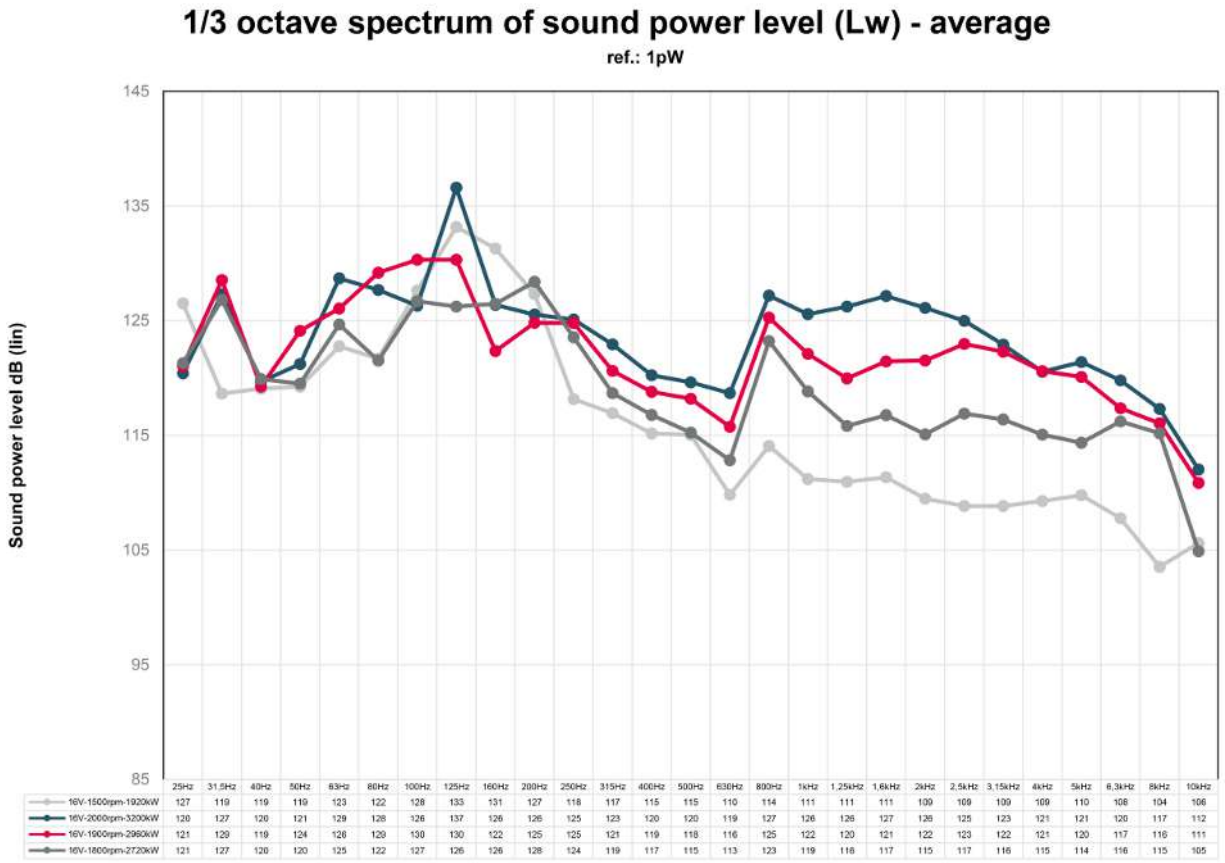



Figure 63: Typical unsilenced exhaust gas noise spectra of 16V175D - Sound power level Lw - Octave level diagram



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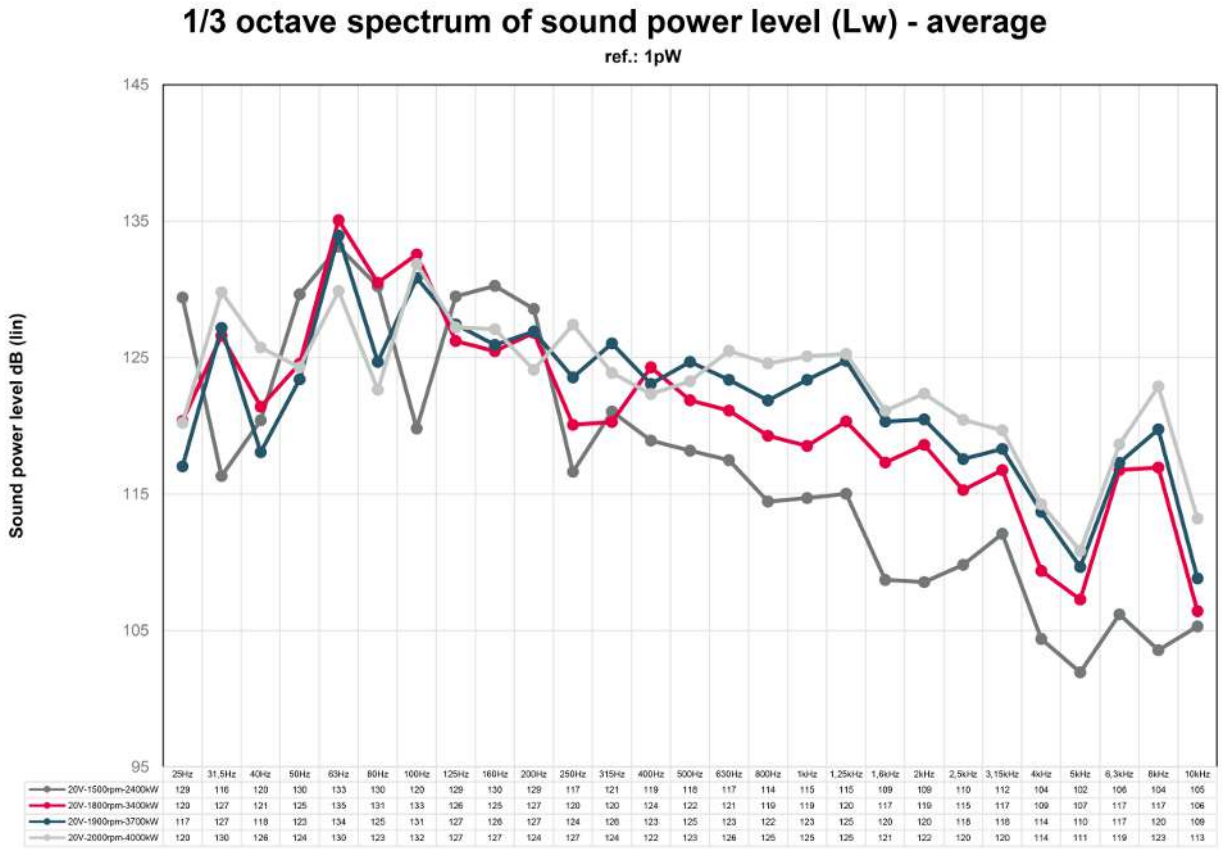



Figure 64: Typical unsilenced exhaust gas noise spectra of 20V175D - Sound power level Lw - Octave level diagram

### 3.18.3 Noise and vibration – Impact on foundation

Noise and vibration is emitted by the engine to the surrounding (see figure below). The engine impact transferred through the engine mounting to the foundation is focused subsequently.



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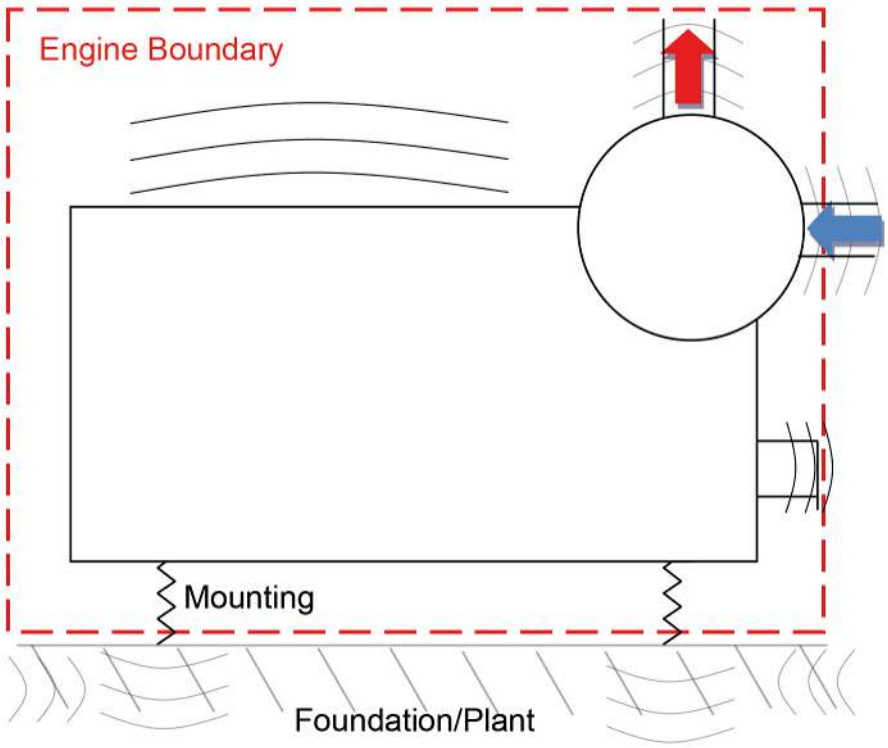



Figure 65: Noise and vibration – Impact on foundation

The foundation is excited to vibrations in a wide frequency range by the engine and by auxiliary equipment (from engine or plant). The engine is vibrating as a rigid body. Additionally, elastic engine vibrations are superimposed. Elastic vibrations are either of global (for example, complete engine bending) or local (for example, bending engine foot) character. If the higher frequency range is involved, the term "structure borne noise" is used instead of "vibrations".

Mechanical engine vibrations are mainly caused by mass forces of moved drive train components and by gas forces of the combustion process. For structure borne noise, further excitations are relevant as well, for example, impacts from piston stroke and valve seating, impulsive gas force components, alternating gear train meshing forces and excitations from pumps.

For the analysis of the engine noise- and vibration-impact on the surrounding, the complete system with engine, engine mounting, foundation and plant has to be considered.

Engine related noise and vibration reduction measures cover for example, counterbalance weights, balancing, crankshaft design with firing sequence, component design etc. The remaining, inevitable engine excitation is transmitted to the surrounding of the engine – but not completely in case of a resilient engine mounting, which is chosen according to the application-specific requirements. The resilient mounting isolates engine noise and vibration from its surrounding to a large extend. Hence, the transmitted forces are considerably reduced compared with a rigid mounting. Nevertheless, the engine itself is vibrating stronger in the low frequency range in general – especially when driving through mounting resonances.

In order to avoid resonances, it must be ensured that eigenfrequencies of foundation and coupled plant structures have a sufficient safety margin in relation to the engine excitations. Moreover, the foundation has to be designed as

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stiff as possible in all directions at the connections to the engine. Thus, the foundation mobility (measured according to ISO 7262) has to be as low as possible to ensure low structure borne noise levels. For low frequencies, the global connection of the foundation with the plant is focused for that matter. The dynamic vibration behaviour of the foundation is mostly essential for the mid frequency range. In the high frequency range, the foundation elasticity is mainly influenced by the local design at the engine mounts. For example, for steel foundations, sufficient wall thicknesses and stiffening ribs at the connection positions shall be provided. The dimensioning of the engine foundation also has to be adjusted to other parts of the plant. For instance, it has to be avoided that engine vibrations are amplified by alternator foundation vibrations. Due to the scope of supply, the foundation design and its connection with the plant is mostly within the responsibility of the costumer. Therefore, the customer is responsible to involve Everllence for consultancy in case of system-related questions with interaction of engine, foundation and plant. The following information is available for Everllence customers, some on special request:

- Residual external forces and couples (Project Guide)

  Resulting from the summation of all mass forces from the moving drive train components. All engine components are considered rigidly in the calculation. The residual external forces and couples are only transferred completely to the foundation in case of a rigid mounting, see above.
- Static torque fluctuation (Project Guide)

  Static torque fluctuations result from the summation of gas and mass forces acting on the crank drive. All components are considered rigidly in the calculation. These couples are acting on the foundation dependent on the applied engine mounting, see above.
- Mounting forces (project-specific)

  The mounting dimensioning calculation is specific to a project and defines details of the engine mounting. Mounting forces acting on the foundation are part of the calculation results. Gas and mass forces are considered for the excitation. The engine is considered as one rigid body with elastic mounts. Thus, elastic engine vibrations are not implemented.
- Reference measurements for engine crankcase vibrations according to ISO 10816-6 (project-specific)
- Reference testbed measurements for structure borne noise (project-specific)

  Measuring points are positioned according to ISO 13332 on the engine feet above and below the mounting elements. Structure borne noise levels above elastic mounts mainly depend on the engine itself. Whereas structure borne noise levels below elastic mounts strongly depend on the foundation design. A direct transfer of the results from the testbed foundation to the plant foundation is not easily possible – even with the consideration of testbed mobilities. The results of testbed foundation mobility measurements according to ISO 7626 are available as a reference on request as well.
- Dynamic transfer stiffness properties of resilient mounts (supplier information, project-specific)

Beside the described interaction of engine, foundation and plant with transfer through the engine mounting to the foundation, additional transfer paths need to be considered. For instance with focus on the elastic coupling of the drive train, the exhaust pipe, other pipes and supports etc. Besides the engine, other sources of noise and vibration need to be considered as well (for example, auxiliary equipment, propeller, thruster).



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## 3.19 Torsional vibrations

### Data required for torsional vibration calculation

Everllence calculates the torsional vibrations behaviour for each individual engine plant of their supply to determine the location and severity of resonance points. If necessary, appropriate measures will be taken to avoid excessive stresses due to torsional vibration. These investigations cover the ideal normal operation of the engine (all cylinders are firing equally) as well as the simulated emergency operation (misfiring of the cylinder exerting the greatest influence on vibrations, acting against compression). Besides the natural frequencies and the modes also the dynamic response will be calculated, normally under consideration of the 1$^{st}$ to 24$^{th}$ harmonic of the gas and mass forces of the engine.

Beyond that also further exciting sources such as propeller, pumps etc. can be considered if the respective manufacturer is able to make the corresponding data available to Everllence.

If necessary, a torsional vibration calculation will be worked out which can be submitted for approval to a classification society or a legal authority.

To carry out the torsional vibration calculation following particulars and/or documents are required.

#### General

- Type of application (GenSet, mechanical propulsion, electric propulsion)
- Arrangement of the whole system including all engine-driven equipment
- Definition of the operating modes
- Maximum power consumption of the individual working machines

#### Engine

- Rated output, rated speed
- Kind of engine operation (fixed pitch propeller or controllable propeller and associated combinator curve)
- Kind of mounting of the engine (can influence the determination of the flexible coupling)
- Operational speed range

#### Flexible coupling

- Make, size and type
- Rated torque (Nm)
- Possible application factor
- Maximum speed (rpm)
- Permissible maximum torque for passing through resonance (Nm)
- Permissible shock torque for short-term loads (Nm)
- Permanently permissible alternating torque (Nm) including influencing factors (frequency, temperature, mean torque)
- Permanently permissible power loss (W) including influencing factors (frequency, temperature)

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- Dynamic torsional stiffness (Nm/rad) including influencing factors (load, frequency, temperature), if applicable
- Relative damping (ψ) including influencing factors (load, frequency, temperature), if applicable
- Moment of inertia (kgm$^2$) for all parts of the coupling
- Dynamic stiffness in radial, axial and angular direction
- Permissible relative motions in radial, axial and angular direction, permanent and maximum
- Maximum permissible torque which can be transferred through a get-you-home-device/torque limiter if foreseen

**Clutch coupling**

- Make, size and type
- Rated torque (Nm)
- Permissible maximum torque (Nm)
- Permanently permissible alternating torque (Nm) including influencing factors (frequency, temperature, mean torque)
- Dynamic torsional stiffness (Nm/rad)
- Damping factor
- Moments of inertia for the operation conditions, clutched and declutched
- Course of torque versus time during clutching in
- Permissible slip time (s)
- Slip torque (Nm)
- Maximum permissible engagement speed (rpm)

**Gearbox**

- Make and type
- Torsional multi mass system including the moments of inertia and the torsional stiffness, preferably related to the individual speed; in case of related figures, specification of the relation speed is required
- Gear ratios (number of teeth, speeds)
- Possible operating conditions (different gear ratios, clutch couplings)
- Permissible alternating torques in the gear meshes

**Shaft line**

- Drawing including all information about length and diameter of the shaft sections as well as the material
- Alternatively torsional stiffness (Nm/rad)

**Propeller**

- Kind of propeller (fixed pitch or controllable pitch propeller or water jet)
- Moment of inertia in air (kgm$^2$)
- Moment of inertia in water (kgm$^2$); for controllable pitch propellers also in dependence on pitch; for twin-engine plants separately for single- and twin-engine operation
- Relation between load and pitch
- Number of blades
- Diameter (mm)



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- Possible torsional excitation in % of the rated torque for the 1st and the 2nd blade-pass frequency

**Alternator for electric propulsion plants**

- Drawing of the alternator shaft with all lengths and diameters
- Alternatively, torsional stiffness (Nm/rad)
- Moment of inertia of the parts mounted to the shaft (kgm$^2$)
- Electrical output (kVA) including power factor cos φ and efficiency
- Or mechanical output (kW)
- Complex synchronizing coefficients for idling and full load in dependence on frequency, reference torque
- Island or parallel mode
- Load profile (e.g. load steps)
- Frequency fluctuation of the net

**Alternator for mechanical propulsion plants**

- Drawing of the alternator shaft with all lengths and diameters
- Torsional stiffness, if available
- Moment of inertia of the parts mounted to the shaft (kgm$^2$)
- Electrical output (kVA) including power factor cos φ and efficiency
- Or mechanical output (kW)
- Complex synchronizing coefficients for idling and full load in dependence on frequency, reference torque

**Secondary power take-off**

- Kind of working machine
- Kind of drive
- Operational mode, operation speed range
- Power consumption
- Drawing of the shafts with all lengths and diameters
- Alternatively, torsional stiffness (Nm/rad)
- Moments of inertia (kgm$^2$)
- Possible torsional excitation in size and frequency in dependence on load and speed

**Water jet**

- Kind of water jet
- Moment of inertia in air (kgm$^2$)
- Moment of inertia in water (kgm$^2$); for twin-engine plants separately for single- and twin-engine operation
- Number of blades
- Diameter (mm)
- Possible torsional excitation in % of the rated torque for the first and the second blade-pass frequency

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## 3.20 Requirements for power drive connection (static)

Evaluation of permissible theoretical bearing loads

**Limit values of masses to be coupled after the engine**

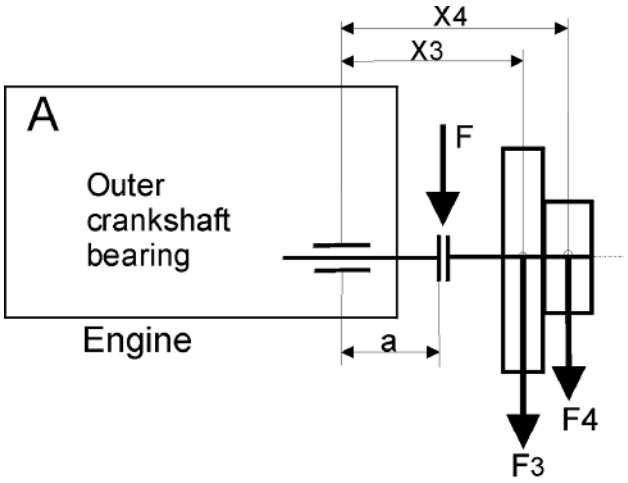



Figure 66: Case A: Overhung arrangement

$M_{max} = F * a = F_3 * x_3 + F_4 * x_4$

### 1. Main power drive connection at coupling side

| | |
|---|---|
| $F_3$ | Flywheel weight |
| $F_4$ | Coupling weight acting on the engine, including reset forces |
| a | Distance between end of coupling flange and centre of outer crankshaft bearing |

| Engine | Distance a | Case A |
|---|---|---|
| | | $M_{max} = F * a$ |
| | mm | kNm |
| V engine | 93.7 | 1.75 |

Table 592: Distance a and max. bending moment $M_{max}$ at coupling side

### 2. Optional: Power take off with PTO-shaft at counter coupling side

| | |
|---|---|
| $F_3$ | Weight of PTO assembly |
| $F_4$ | Coupling weight acting on the engine, including reset forces |
| a | Distance between crankshaft flange and centre of outer crankshaft bearing |

| Engine | Distance a | $F_3$ 80 mm PTO shaft | $F_3$ 130 mm PTO shaft | $M_{max} = F * a$ |
|---|---|---|---|---|
| | mm | kg | kg | kNm |
| V engine | 192 | 19.6 | 32.6 | 1,044 |

Table 593: Distance a and max. bending moment $M_{max}$ at coupling side

Distance between engine seating surface and crankshaft centre line:

- V engine: Contact Everllence for details.



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Note:
Changes may be necessary as a result of the torsional vibration calculation or special service conditions.

Note:
Masses which are connected downstream of the engine in the case of an overhung or rigidly coupled, arrangement result in additional crankshaft bending stress, which is mirrored in a measured web deflection during engine installation.
Provided the limit values for the masses to be coupled downstream of the engine (permissible values for $M_{max}$ and $F_{1max}$) are complied with, the permitted web deflections will not be exceeded during assembly.
Observing these values ensures a sufficiently long operating time before a realignment of the crankshaft has to be carried out.

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## 3.21 Requirements for power drive connection (dynamic)

### 3.21.1 Moments of inertia – Crankshaft, damper, flywheel

**Propeller operation (CPP)**

| Marine main engines (MM application) | | | | | | |
|---|---|---|---|---|---|---|
| Engine | | | | | | Plant |
| No. of cylinders, config. | Maximum continuous rating | Moment of inertia crank-shaft + damper $J_1$ | Moment of inertia flywheel $J_2$ | Mass of flywheel | Required minimum total moment of inertia[1] $J_{Total\ min}$ | Required minimum additional moment of inertia after flywheel[2] |
| | [kW] | [kgm²] | [kgm²] | [kg] | [kgm²] | [kgm²] |
| n = 1,900 rpm | | | | | | |
| 12V | 2,220 | 17.5 | 10.7 | 169.1 | 70.1 | 41.9 |
| 16V | 2,960 | 29.0 | 10.7 | 169.1 | 93.5 | 53.8 |
| 20V | 3,700 | 41.4 | 10.7 | 169.1 | 116.8 | 64.7 |
| n = 1,800 rpm | | | | | | |
| 12V | 2,400 | 17.5 | 10.7 | 169.1 | 84.4 | 56.3 |
| 12V | 2,220 | 17.5 | 10.7 | 169.1 | 78.1 | 49.9 |
| 12V | 2,040 | 17.5 | 10.7 | 169.1 | 71.8 | 43.6 |
| 12V | 1,920 | 17.5 | 10.7 | 169.1 | 67.6 | 39.4 |
| 12V | 1,860 | 17.5 | 10.7 | 169.1 | 65.4 | 37.3 |
| 16V | 2,960 | 29.0 | 10.7 | 169.1 | 104.1 | 64.5 |
| 16V | 2,720 | 29.0 | 10.7 | 169.1 | 95.7 | 56.1 |
| 16V | 2,560 | 29.0 | 10.7 | 169.1 | 90.1 | 50.4 |
| 20V | 3,700 | 41.4 | 10.7 | 169.1 | 130.2 | 78.1 |
| 20V | 3,400 | 41.4 | 10.7 | 169.1 | 119.6 | 67.5 |

[1] Needed minimum moment of inertia of engine, flywheel and arrangement after flywheel in total.

[2] Required additional moment of inertia after flywheel to achieve the required minimum total moment of inertia.

Table 594: Moments of inertia for marine main engines (MM application) – Crankshaft, damper, flywheel



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| Marine main engines (MH application) | | | | | | |
|---|---|---|---|---|---|---|
| Engine | | | | | | Plant |
| No. of cylinders, config. | Maximum continuous rating | Moment of inertia crankshaft + damper $J_1$ | Moment of inertia flywheel $J_2$ | Mass of flywheel | Required minimum total moment of inertia[1] $J_{Total\ min}$ | Required minimum additional moment of inertia after flywheel[2] |
| | [kW] | [kgm²] | [kgm²] | [kg] | [kgm²] | [kgm²] |
| n = 1,800 rpm | | | | | | |
| 12V | 1,740 | 17.5 | 10.7 | 169.1 | 61.2 | 33.0 |

[1] Needed minimum moment of inertia of engine, flywheel and arrangement after flywheel in total.

[2] Required additional moment of inertia after flywheel to achieve the required minimum total moment of inertia.

Table 595: Moments of inertia for marine main engines (MH application) – Crankshaft, damper, flywheel

| Marine main engines (ML application) | | | | | | |
|---|---|---|---|---|---|---|
| Engine | | | | | | Plant |
| No. of cylinders, config. | Maximum continuous rating | Moment of inertia crankshaft + damper $J_1$ | Moment of inertia flywheel $J_2$ | Mass of flywheel | Required minimum total moment of inertia[1] $J_{Total\ min}$ | Required minimum additional moment of inertia after flywheel[2] |
| | [kW] | [kgm²] | [kgm²] | [kg] | [kgm²] | [kgm²] |
| n = 2,000 rpm | | | | | | |
| 12V | 2,580 | 17.5 | 10.7 | 169.1 | 73.5 | 45.4 |
| 12V | 2,400 | 17.5 | 10.7 | 169.1 | 68.4 | 40.2 |
| 16V | 3,200 | 29.0 | 10.7 | 169.1 | 91.2 | 51.6 |
| 20V | 4,400 | 41.4 | 10.7 | 169.1 | 125.4 | 73.3 |
| 20V | 4,000 | 41.4 | 10.7 | 169.1 | 114.0 | 61.9 |

[1] Needed minimum moment of inertia of engine, flywheel and arrangement after flywheel in total.

[2] Required additional moment of inertia after flywheel to achieve the required minimum total moment of inertia.

Table 596: Moments of inertia for marine main engines (ML application) – Crankshaft, damper, flywheel

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### Constant speed

| Marine main engines (MEL, MA only 12V, 50 Hz application) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Engine | | | | | | | Plant |
| No. of cylinders, config. | Maximum continuous rating | Moment of inertia crankshaft + damper $J_1$ | Moment of inertia flywheel $J_2$ | Mass of flywheel | Cyclic irregularity | Required minimum total moment of inertia[1] $J_{Total\ min}$ | Required minimum additional moment of inertia after flywheel[2] |
| | [kW] | [kgm²] | [kgm²] | [kg] | | [kgm²] | [kgm²] |
| n = 1,500 rpm | | | | | | | |
| 12V | 1,980 | 17.5 | 10.7 | 169.1 | tbd. | 160.5 | 132.3 |
| 12V | 1,800 | 17.5 | 10.7 | 169.1 | tbd. | 145.9 | 117.7 |
| 16V | 2,640 | 29.0 | 10.7 | 169.1 | tbd. | 214.0 | 174.4 |
| 16V | 2,400 | 29.0 | 10.7 | 169.1 | tbd. | 194.6 | 154.9 |
| 20V | 3,300 | 41.4 | 10.7 | 169.1 | tbd. | 267.5 | 215.4 |
| 20V | 3,000 | 41.4 | 10.7 | 169.1 | tbd. | 243.2 | 191.1 |

[1] Required minimum moment of inertia of engine, flywheel and arrangement after flywheel in total.

[2] Required additional moment of inertia after flywheel to achieve the required minimum total moment of inertia.

Table 597: Moments of inertia for marine main engines (MEL 50 Hz application) – Crankshaft, damper, flywheel

| Marine main engines (MEL, MA only 12V, 60 Hz application) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Engine | | | | | | | Plant |
| No. of cylinders, config. | Maximum continuous rating | Moment of inertia crankshaft + damper $J_1$ | Moment of inertia flywheel $J_2$ | Mass of flywheel | Cyclic irregularity | Required minimum total moment of inertia[1] $J_{Total\ min}$ | Required minimum additional moment of inertia after flywheel[2] |
| | [kW] | [kgm²] | [kgm²] | [kg] | | [kgm²] | [kgm²] |
| n = 1,800 rpm | | | | | | | |
| 12V | 2,280 | 17.5 | 10.7 | 169.1 | tbd. | 128.4 | 100.2 |
| 12V | 2,100 | 17.5 | 10.7 | 169.1 | tbd. | 118.2 | 90.0 |
| 16V | 2,960 | 29.0 | 10.7 | 169.1 | tbd. | 166.6 | 127.0 |
| 16V | 2,800 | 29.0 | 10.7 | 169.1 | tbd. | 157.6 | 118.0 |
| 20V | 3,800 | 41.4 | 10.7 | 169.1 | tbd. | 213.9 | 161.8 |
| 20V | 3,500 | 41.4 | 10.7 | 169.1 | tbd. | 197.0 | 144.9 |

[1] Required minimum moment of inertia of engine, flywheel and arrangement after flywheel in total.

[2] Required additional moment of inertia after flywheel to achieve the required minimum total moment of inertia.

Table 598: Moments of inertia for marine main engines (MEL 60 Hz application) – Crankshaft, damper, flywheel

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| Marine main engines (MEM, MA only 12V, 50 Hz application) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Engine | | | | | | | Plant |
| No. of cylinders, config. | Maximum continuous rating | Moment of inertia crankshaft + damper $J_1$ | Moment of inertia flywheel $J_2$ | Mass of flywheel | Cyclic irregularity | Required minimum total moment of inertia[1] $J_{Total\ min}$ | Required minimum additional moment of inertia after flywheel[2] |
| | [kW] | [kgm²] | [kgm²] | [kg] | | [kgm²] | [kgm²] |
| n = 1,500 rpm | | | | | | | |
| 12V | 1,620 | 17.5 | 10.7 | 169.1 | 1/73 | 131.3 | 103.2 |
| 12V | 1,440 | 17.5 | 10.7 | 169.1 | 1/80 | 116.7 | 88.6 |
| 16V | 2,160 | 29.0 | 10.7 | 169.1 | 1/53 | 175.1 | 135.5 |
| 20V | 2,700 | 41.4 | 10.7 | 169.1 | 1/44 | 218.9 | 166.8 |
| [1] Required minimum moment of inertia of engine, flywheel and arrangement after flywheel in total. | | | | | | | |
| [2] Required additional moment of inertia after flywheel to achieve the required minimum total moment of inertia. | | | | | | | |

Table 599: Moments of inertia for marine main engines (MEM 50 Hz application) – Crankshaft, damper, flywheel

| Marine main engines (MEM, MA only 12V or 16V, 60 Hz application) | | | | | | | |
|---|---|---|---|---|---|---|---|
| Engine | | | | | | | Plant |
| No. of cylinders, config. | Maximum continuous rating | Moment of inertia crankshaft + damper $J_1$ | Moment of inertia flywheel $J_2$ | Mass of flywheel | Cyclic irregularity | Required minimum total moment of inertia[1] $J_{Total\ min}$ | Required minimum additional moment of inertia after flywheel[2] |
| | [kW] | [kgm²] | [kgm²] | [kg] | | [kgm²] | [kgm²] |
| n = 1,800 rpm | | | | | | | |
| 12V | 1,920 | 17.5 | 10.7 | 169.1 | 1/60 | 108.1 | 79.9 |
| 12V | 1,800 | 17.5 | 10.7 | 169.1 | 1/62 | 101.3 | 73.2 |
| 16V | 2,560 | 29.0 | 10.7 | 169.1 | 1/63 | 144.1 | 104.5 |
| 16V | 2,400 | 29.0 | 10.7 | 169.1 | 1/65 | 135.1 | 95.5 |
| 20V | 3,200 | 41.4 | 10.7 | 169.1 | 1/52 | 180.1 | 128.0 |
| 20V | 3,000 | 41.4 | 10.7 | 169.1 | 1/54 | 168.9 | 116.8 |
| [1] Required minimum moment of inertia of engine, flywheel and arrangement after flywheel in total. | | | | | | | |
| [2] Required additional moment of inertia after flywheel to achieve the required minimum total moment of inertia. | | | | | | | |

Table 600: Moments of inertia for marine main engines (MEM 60 Hz application) – Crankshaft, damper, flywheel

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**Variable speed**

| Marine main engines (MEV application) | | | | | | |
|---|---|---|---|---|---|---|
| Engine | | | | | | Plant |
| No. of cylinders, config. | Maximum continuous rating | Moment of inertia crankshaft + damper | Moment of inertia flywheel | Mass of flywheel | Needed minimum total moment of inertia[1] | Required minimum additional moment of inertia after flywheel[2] |
| | [kW] | [kgm²] | [kgm²] | [kg] | [kgm²] | [kgm²] |
| n = 1,800 rpm | | | | | | |
| 12V | 2,280 | 17.5 | 10.7 | 169.1 | 128.4 | 100.2 |
| 12V | 2,040 | 17.5 | 10.7 | 169.1 | 114.8 | 86.7 |
| 12V | 1,860 | 17.5 | 10.7 | 169.1 | 104.7 | 76.5 |
| 16V | 2,960 | 29.0 | 10.7 | 169.1 | 166.6 | 127.0 |
| 16V | 2,720 | 29.0 | 10.7 | 169.1 | 153.1 | 113.5 |
| 16V | 2,480 | 29.0 | 10.7 | 169.1 | 139.6 | 100.0 |
| 20V | 3,800 | 41.4 | 10.7 | 169.1 | 213.9 | 161.8 |
| 20V | 3,400 | 41.4 | 10.7 | 169.1 | 191.4 | 139.3 |
| 20V | 3,100 | 41.4 | 10.7 | 169.1 | 174.5 | 122.4 |

[1] Required minimum moment of inertia of engine, flywheel and arrangement after flywheel in total.

[2] Required additional moment of inertia after flywheel to achieve the required minimum total moment of inertia.

Table 601: Moments of inertia for marine main engines (MEV application) – Crankshaft, damper, flywheel



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### 3.21.2 Balancing of masses – Firing order

**V engine**

Rotating crank balance: 100%

Certain cylinder numbers have unbalanced forces and couples due to the crank diagram. These forces and couples cause dynamic effects on the foundation. Due to a balancing of masses the forces and couples are reduced. In the following tables, the remaining forces and couples are displayed.

| No. of cylinders, config. | Firing order | Residual external couples | | | |
|---|---|---|---|---|---|
| | | $M_{rot}$ (kNm) + $M_{osc\ 1st\ order}$ (kNm) | | $M_{osc\ 2nd\ order}$ (kNm) | |
| Engine speed (rpm) | | 1,500, 1,800, 1,900 | | | |
| Direction | | vertical | horizontal | vertical | horizontal |
| 12V | See table below | 0 | | 0 | |
| 16V | | 0 | | 0 | |
| 20V | | 0 | | 0 | |

Table 602: Residual external couples – 1,500 rpm, 1,800 rpm, 1,900 rpm

Firing order: Counted from coupling side

| No. of cylinders, config. | Firing order | Clockwise rotation | Counter clockwise rotation |
|---|---|---|---|
| 12V | A | - | A1-B2-A2-B4-A4-B6-A6-B5-A5-B3-A3-B1 |
| 16V | A | - | A1-B2-A2-B4-A4-B6-A6-B8-A8-B7-A7-B5-A5-B3-A3-B1 |
| 20V | - | - | A1-B8-A3-B7-A4-B9-A9-B5-A5-B10-A10-B3-A8-B4-A7-B2-A2-B6-A6-B1 |

Table 603: Firing order

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### 3.21.3 Static torque fluctuation

V engine – Example to declare abbreviations

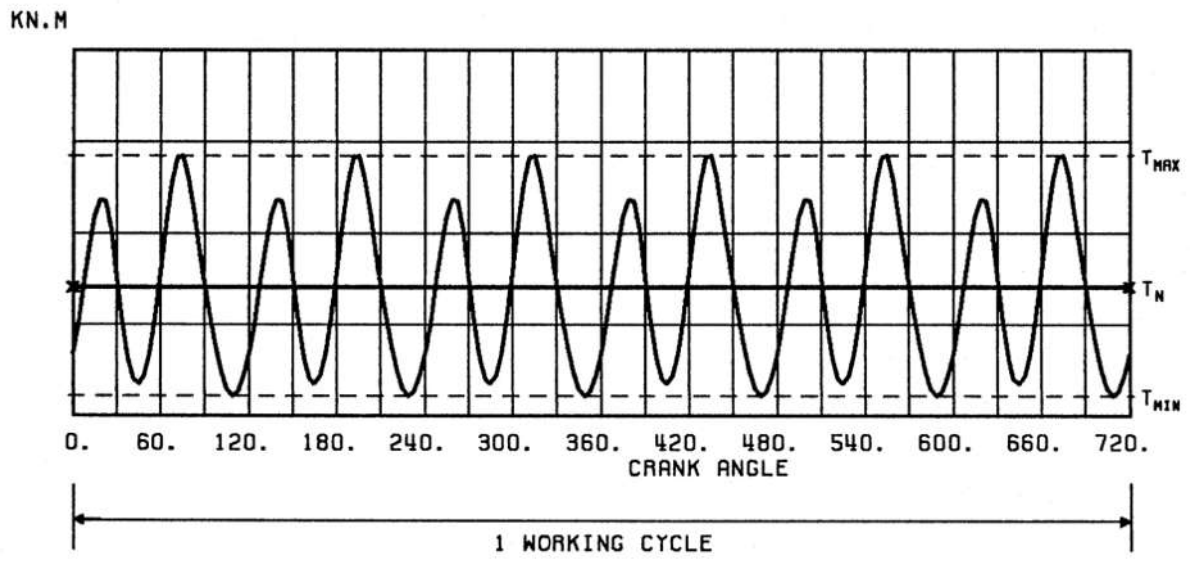



Figure 67: Example to declare abbreviation – V engine

| MM – 1,900 rpm | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **No. of cylinders, config.** | **Output** | **Speed** | **$T_n$** | **$T_{max}$** | **$T_{min}$** | **Main exciting components[1)]** | | |
| | | | | | | **Order** | **Frequency[1)]** | **±T** |
| | **kW** | **rpm** | **kNm** | **kNm** | **kNm** | | **Hz** | **kNm** |
| 12V | 2,220 | 1,900 | 11.2 | 18.6 | 3.5 | 3.0<br>6.0 | 95<br>190 | 0.0<br>7.6 |
| 16V | 2,960 | 1,900 | 14.9 | 26.3 | 3.4 | 4.0<br>8.0 | 127<br>253 | 10.5<br>1.9 |
| 20V | 3,700 | 1,900 | 18.6 | 36.0 | 1.1 | 5.0<br>10.0 | 158<br>317 | 17.3<br>0.9 |
| [1)] Exciting frequency of the main harmonic components. | | | | | | | | |

Table 604: Static torque fluctuation and exciting frequencies – MM – 1,900 rpm

| MH – 1,800 rpm | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **No. of cylinders, config.** | **Output** | **Speed** | **$T_n$** | **$T_{max}$** | **$T_{min}$** | **Main exciting components[1)]** | | |
| | | | | | | **Order** | **Frequency[1)]** | **±T** |
| | **kW** | **rpm** | **kNm** | **kNm** | **kNm** | | **Hz** | **kNm** |
| 12V | 1,740 | 1,800 | 9.2 | 16.7 | 1.4 | 3.0<br>6.0 | 90<br>180 | 0.0<br>7.7 |
| 16V | 2,320 | 1,800 | 12.3 | 23.8 | 0.9 | 4.0<br>8.0 | 120<br>240 | 10.7<br>1.9 |
| 20V | 2,900 | 1,800 | 15.4 | 32.9 | –2.2 | 5.0<br>10.0 | 150<br>300 | 17.5<br>0.8 |

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| MH – 1,800 rpm | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No. of cylinders, config. | Output | Speed | $T_n$ | $T_{max}$ | $T_{min}$ | Main exciting components[1] | | |
| | | | | | | Order | Frequency[1] | ±T |
| | kW | rpm | kNm | kNm | kNm | | Hz | kNm |
| [1] Exciting frequency of the main harmonic components. | | | | | | | | |

Table 605: Static torque fluctuation and exciting frequencies – MH – 1,800 rpm

| MEL 50 Hz | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No. of cylinders, config. | Output | Speed | $T_n$ | $T_{max}$ | $T_{min}$ | Main exciting components[1] | | |
| | | | | | | Order | Frequency[1] | ±T |
| | kW | rpm | kNm | kNm | kNm | | Hz | kNm |
| 12V | 1,620 | 1,500 | 10.3 | 17.7 | 2.8 | 3.0<br>6.0 | 75<br>150 | 0.0<br>7.5 |
| 16V | 2,160 | 1,500 | 13.8 | 25.3 | 2.1 | 4.0<br>8.0 | 100<br>200 | 10.9<br>1.8 |
| 20V | 2,700 | 1,500 | 17.2 | 34.2 | 0.2 | 5.0<br>10.0 | 125<br>250 | 17.0<br>0.7 |
| [1] Exciting frequency of the main harmonic components. | | | | | | | | |

Table 606: Static torque fluctuation and exciting frequencies – MEL 50 Hz

| MEL 60 Hz | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No. of cylinders, config. | Output | Speed | $T_n$ | $T_{max}$ | $T_{min}$ | Main exciting components[1] | | |
| | | | | | | Order | Frequency[1] | ±T |
| | kW | rpm | kNm | kNm | kNm | | Hz | kNm |
| 12V | 1,920 | 1,800 | 10.2 | 17.2 | 2.7 | 3.0<br>6.0 | 90<br>180 | 0.0<br>7.2 |
| 16V | 2,560 | 1,800 | 13.6 | 24.8 | 2.3 | 4.0<br>8.0 | 120<br>240 | 10.8<br>1.6 |
| 20V | 3,200 | 1,800 | 17.0 | 33.9 | –0.3 | 5.0<br>10.0 | 150<br>300 | 17.1<br>0.5 |
| [1] Exciting frequency of the main harmonic components. | | | | | | | | |

Table 607: Static torque fluctuation and exciting frequencies – MEL 60 Hz

| MEM 50 Hz | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No. of cylinders, config. | Output | Speed | $T_n$ | $T_{max}$ | $T_{min}$ | Main exciting components[1] | | |
| | | | | | | Order | Frequency[1] | ±T |
| | kW | rpm | kNm | kNm | kNm | | Hz | kNm |
| 12V | 1,440 | 1,500 | 9.2 | 15.8 | 2.3 | 3.0<br>6.0 | 75<br>150 | 0.0<br>6.8 |
| 16V | 1,920 | 1,500 | 12.2 | 22.6 | 1.8 | 4.0<br>8.0 | 100<br>200 | 9.9<br>1.6 |
| 20V | 2,400 | 1,500 | 15.3 | 30.7 | –0.2 | 5.0<br>10.0 | 125<br>250 | 15.4<br>0.6 |
| [1] Exciting frequency of the main harmonic components. | | | | | | | | |

Table 608: Static torque fluctuation and exciting frequencies – MEM 50 Hz

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| MEM 60 Hz | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| No. of cylinders, config. | Output | Speed | $T_n$ | $T_{max}$ | $T_{min}$ | Main exciting components[1)] | | |
| | | | | | | Order | Frequency[1)] | ±T |
| | kW | rpm | kNm | kNm | kNm | | Hz | kNm |
| 12V | 1,800 | 1,800 | 9.5 | 16.2 | 2.3 | 3.0<br>6.0 | 90<br>180 | 0.0<br>7.0 |
| 16V | 2,400 | 1,800 | 12.7 | 23.5 | 1.9 | 4.0<br>8.0 | 120<br>240 | 10.5<br>1.5 |
| 20V | 3,000 | 1,800 | 15.9 | 32.3 | –0.9 | 5.0<br>10.0 | 150<br>300 | 16.6<br>0.5 |

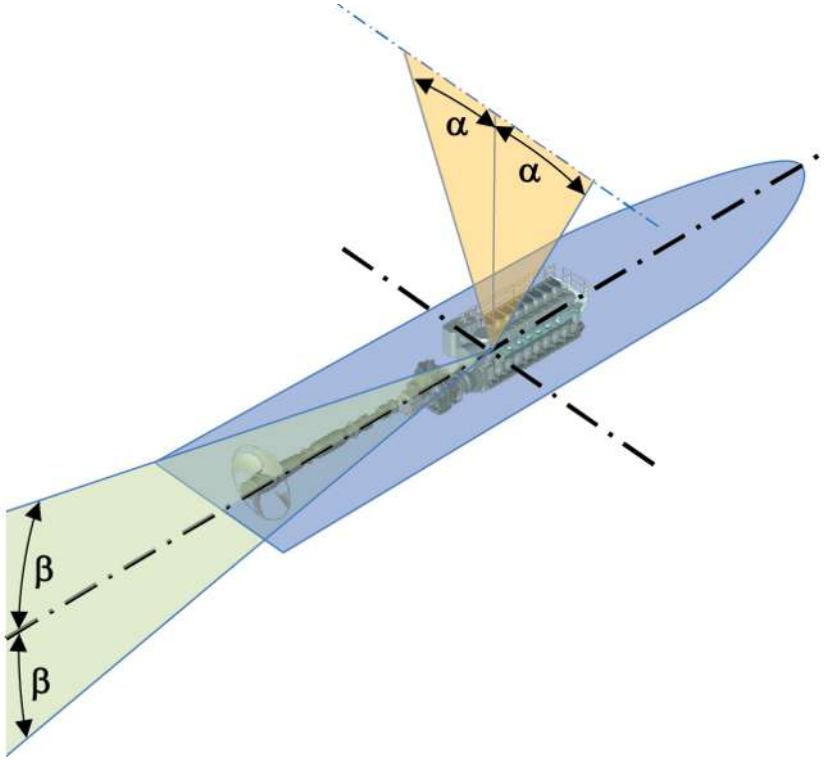
[1)] Exciting frequency of the main harmonic components.

Table 609: Static torque fluctuation and exciting frequencies – MEM 60 Hz

For other applications contact Everllence.

## 3.22 Foundation and inclination

### 3.22.1 Engine inclination




α Athwartships

β Fore and aft

Figure 68: Engine inclination



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| Application | Angle of inclination in (°) | | | | |
|---|---|---|---|---|---|
| | Athwartship α | | Fore and aft β | | |
| | Static (Heel to each side) | Dynamic (Rolling to each side) | Trim (static) | | Dynamic (Pitching) |
| | | | L<100 m | L>100 m | |
| Main & auxiliary engines (standard)[1] | 15 | 22.5 | ±5[2] | 500/L | 7.5 |
| Main & auxiliary engines (extended dynamic)[4] | 15[1] | 30[3] | ±5[1][2] | | 10[3] |
| Main & auxiliary engines (extended static)[1] [4] | 22.5 | 22.5 | ±10 | | 10 |

[1] Athwartship and fore and aft inclinations may occur simultaneously.

[2] While engine may be installed tilted in vessels longitudinal direction, the max. allowed engine installation angle depends on the inclinations due to ship motion, cylinder configuration and the direction of power output. For further information contact Everllence.

[3] Not simultaneously.

[4] 20V requires a deeper oil pan for extended inclinations.

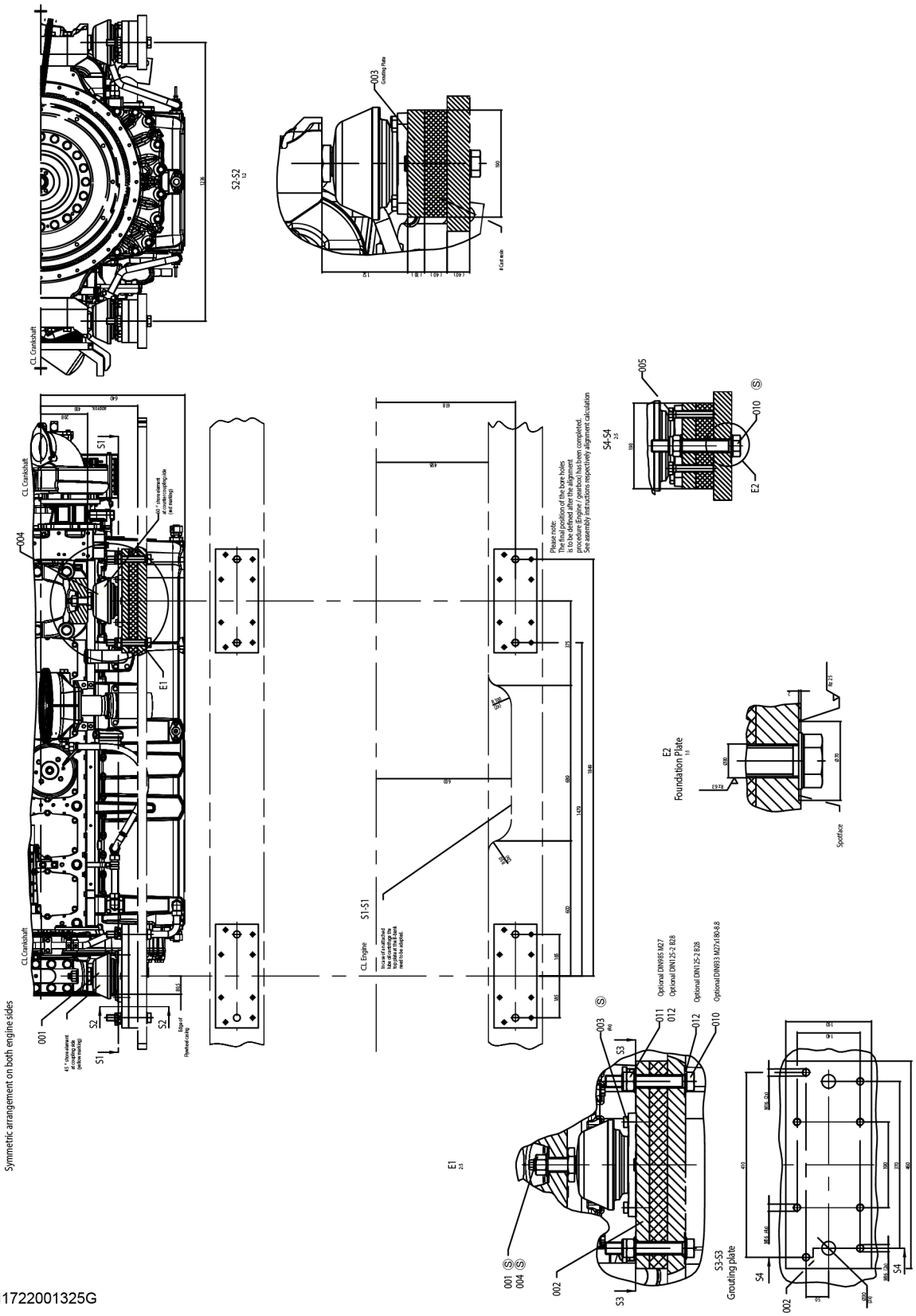
Table 610: Inclinations

Note:
For higher requirements contact Everllence. Arrange engines always lengthwise of the ship.



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### 3.22.2 Resilient mounting - Standard




11722001325G

Figure 69: Resilient mounting 12V - Standard

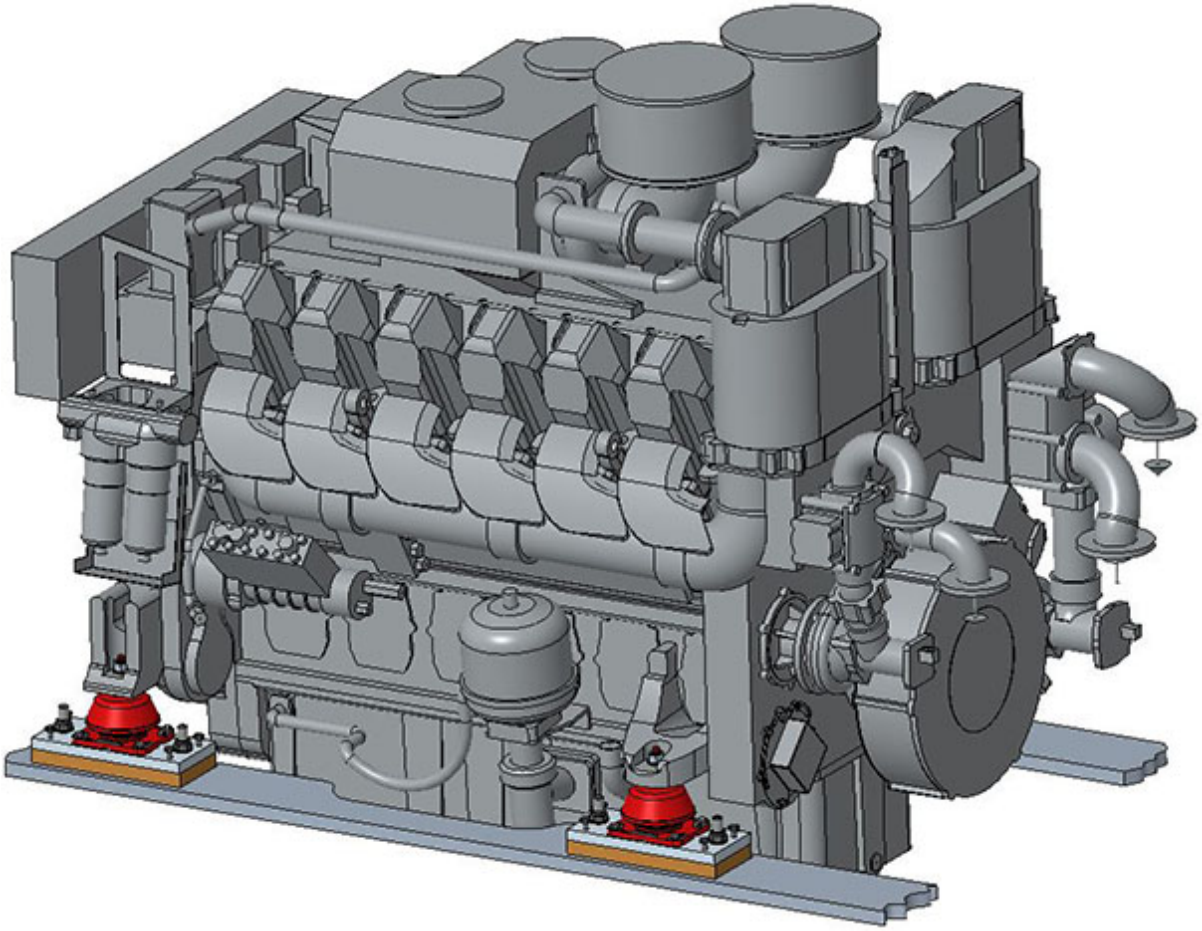


Figure 70: Resilient mounting 12V - Standard, 3D view



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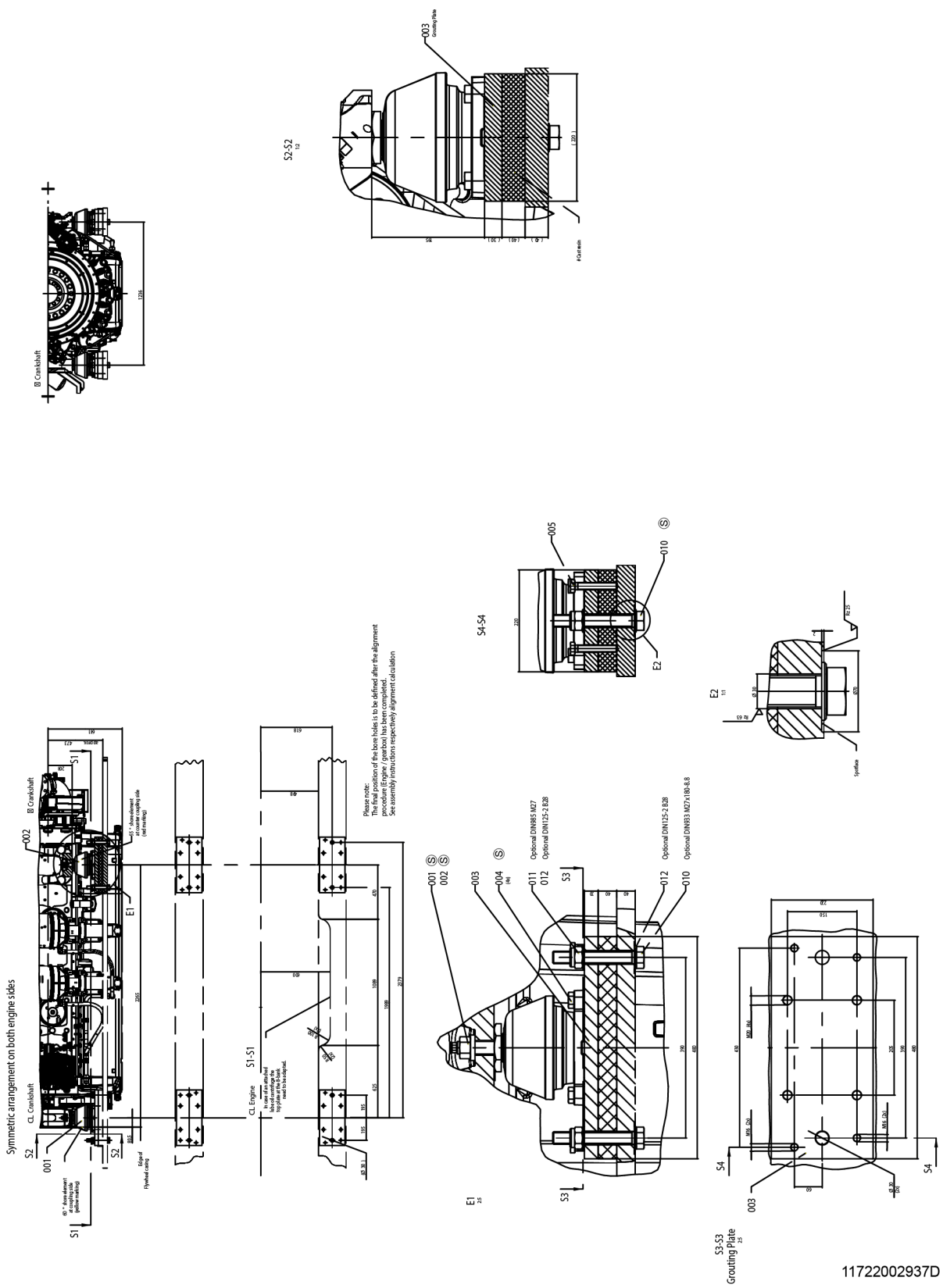



Figure 71: Resilient mounting 16V - Standard

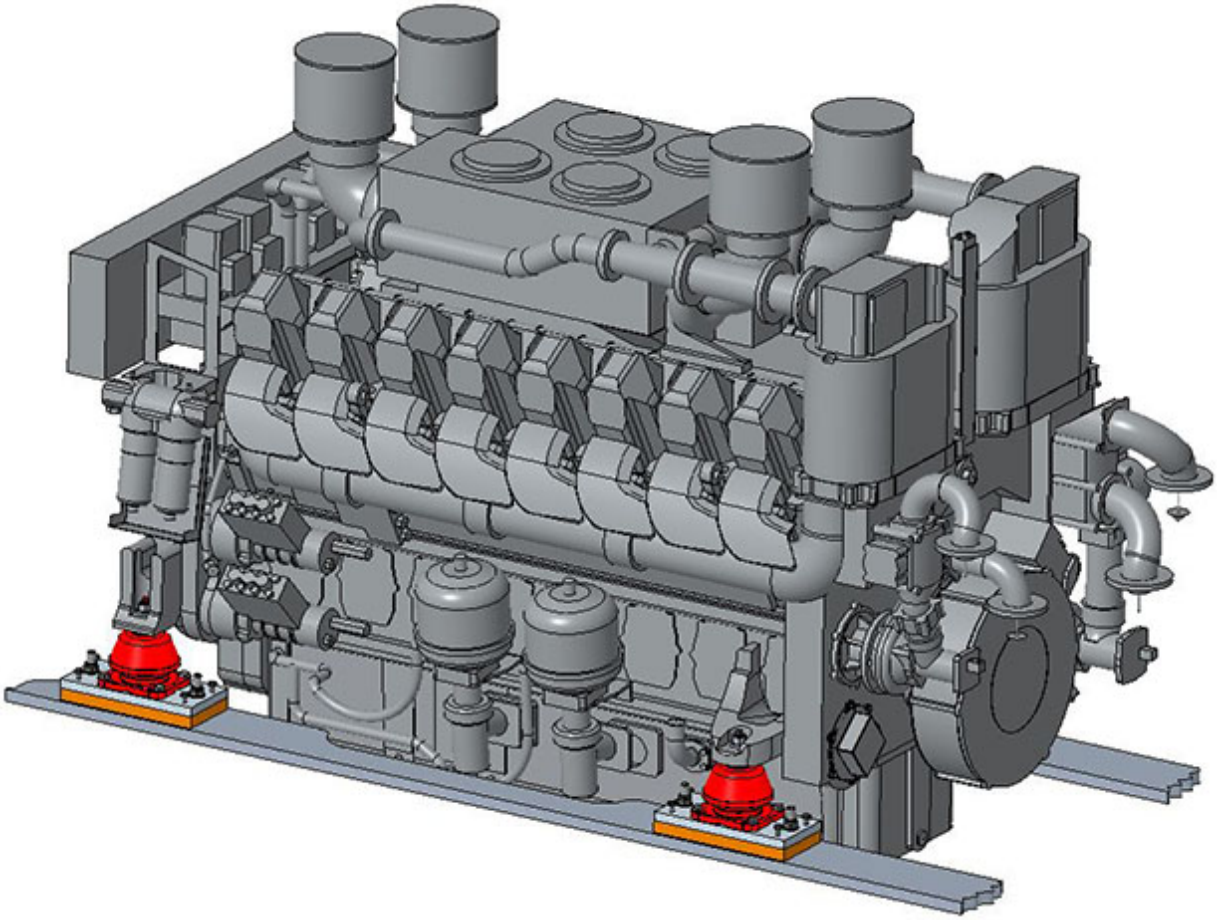


Figure 72: Resilient mounting 16V - Standard, 3D view



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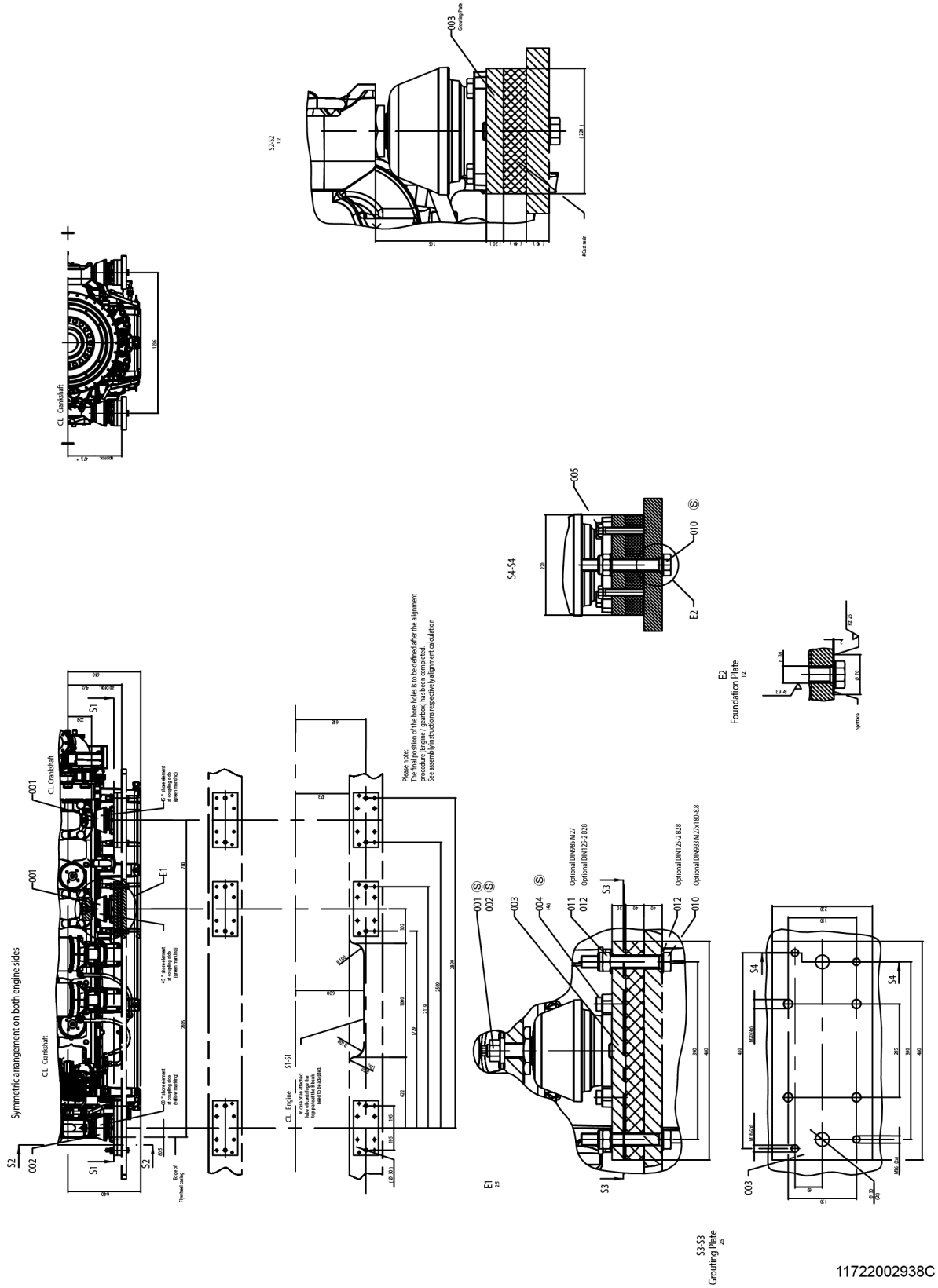



Figure 73: Resilient mounting 20V - Standard

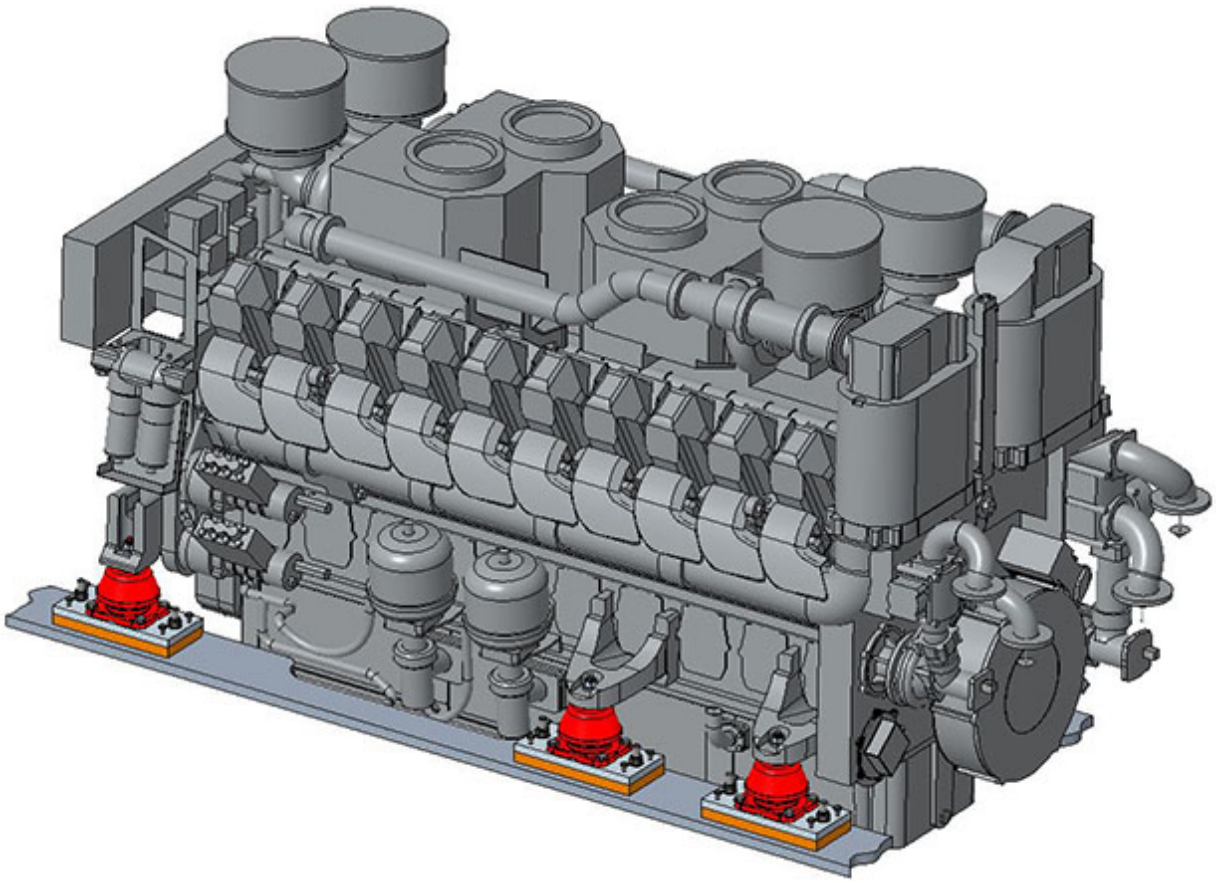


Figure 74: Resilient mounting 20V - Standard, 3D view

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### 3.22.3 Resilient mounting - Shock mount (optional)



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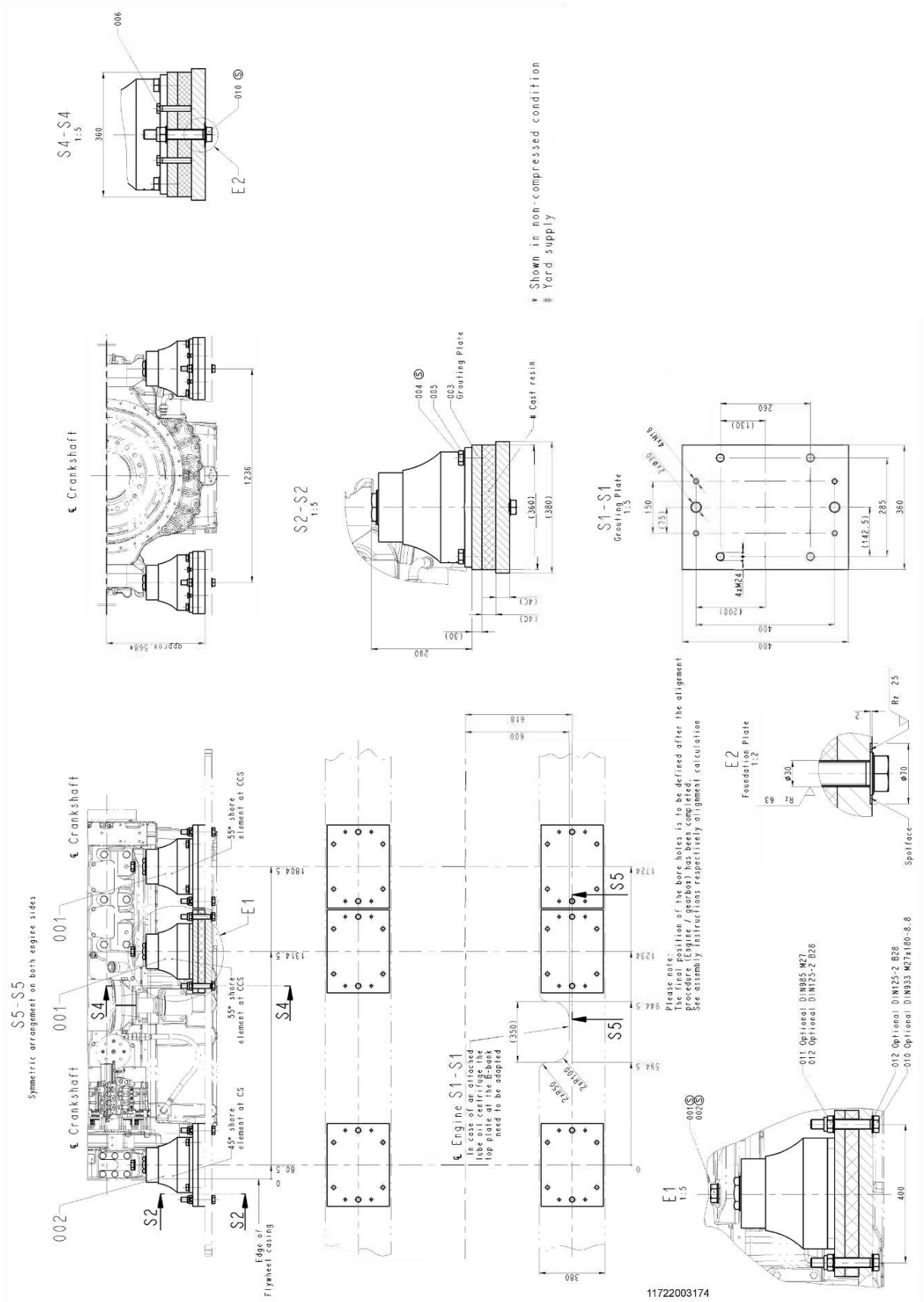



Figure 75: Resilient mounting 12V - Shock mount (optional)

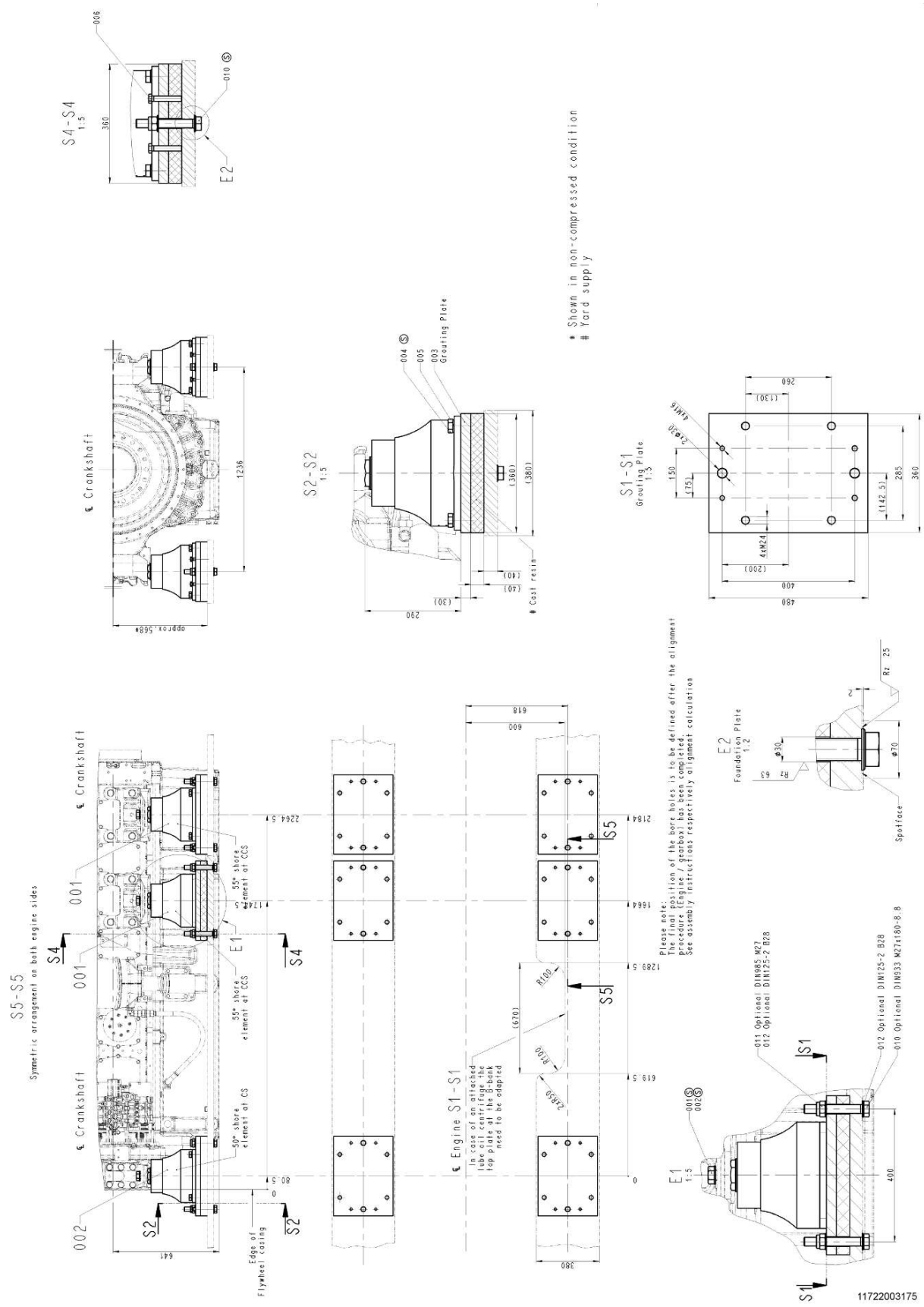



Figure 76: Resilient mounting 16V - Shock mount (optional)



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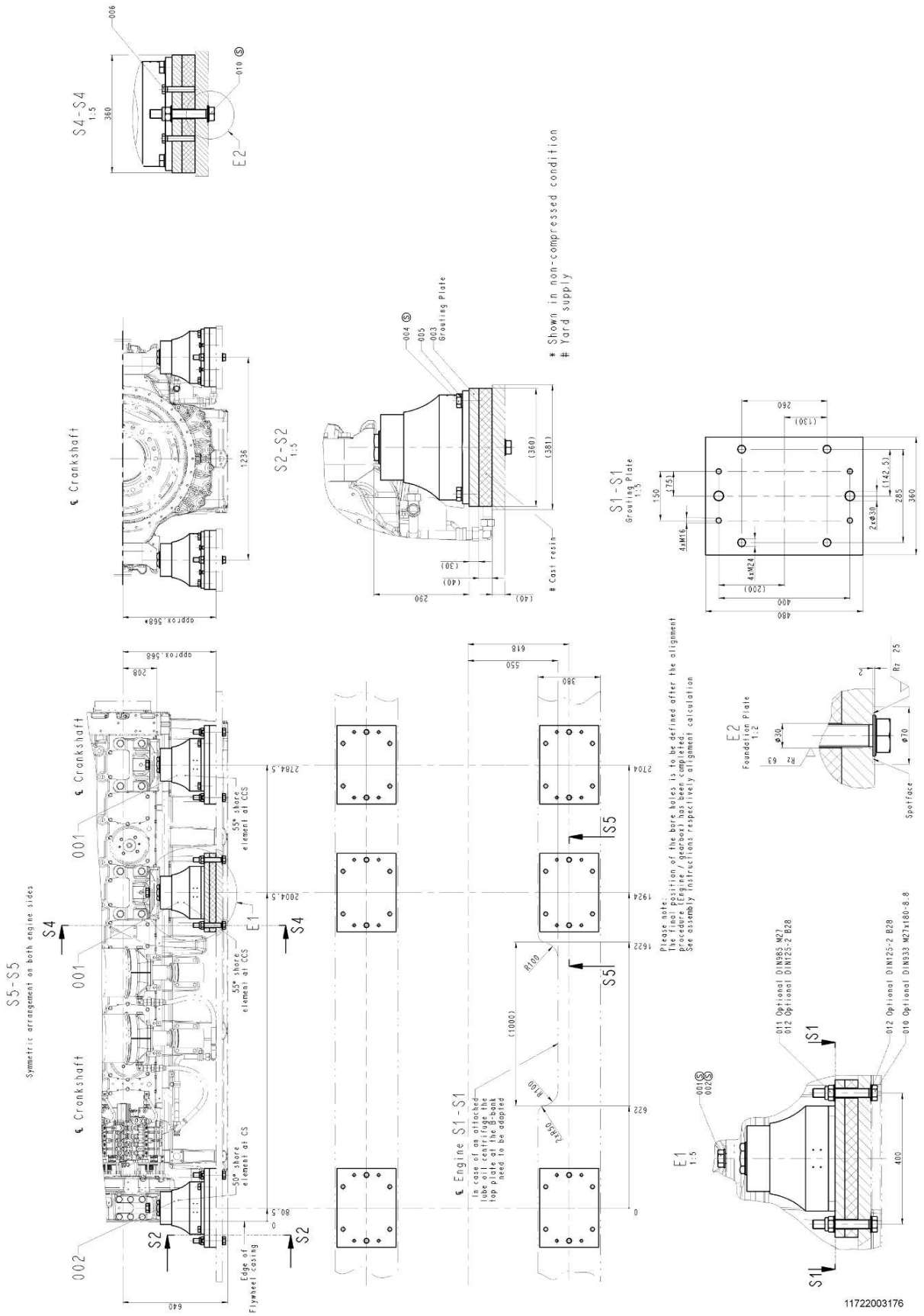



Figure 77: Resilient mounting 20V - Shock mount (optional)

### 3.22.4 Engine seating

The vibration of the engine causes dynamic effects on the foundation. These effects are attributed to the pulsating reaction forces due to the fluctuating torque. Also, for engines with certain cylinder numbers these effects are increased by unbalanced forces and couples caused by rotating or reciprocating masses which – considering their vector sum – do not equate to zero.

The direct resilient support makes it possible to reduce the dynamic forces acting on the foundation, which are generated by every reciprocating engine and may – under adverse conditions – have harmful effects on the environment of the engine.

The supporting elements will be connected directly to the engine feet by special brackets. The size and rubber hardness of the supporting elements depend on:

- The weight of the engine
- The centre of gravity of the engine
- The desired natural frequencies
- The inclination of the engine
- The weight of the attached components

The following has to be considered when designing a propulsion plant:

- Resilient mountings always feature several resonances resulting from the natural mounting frequencies. Despite the endeavour to keep resonances as far as possible from nominal speed the lower bound of the speed range free from resonances will be rarely lower than 85% for mountings using conical mounts.
  However, these percentages are only guide values. The speed interval being free from resonances may be larger or smaller.
- Between the resiliently mounted engine and the rigidly mounted gearbox or alternator, a flexible coupling with minimum axial and radial elastic forces and large axial and radial displacement capacities has to be provided.
- The media connections (compensators) to and from the engine must be highly flexible, whereas the fixations of the compensators with the engine and with the environment must be realised as stiff as possible.
- To achieve a good vibration isolation, the lower brackets used to connect the supporting elements with the ship's foundation are to be fitted at sufficiently rigid points of the foundation. Influences of the foundation's stiffness on the natural frequencies of the resilient support of the engine will not be considered in the mounting design calculation.
- The yard must specify with which inclination related to the plane keel the engine will be installed in the ship. The inclination must be defined and communicated before entering the dimensioning process.

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### 3.22.5 Earthing measures of diesel engines and bearing insulation on alternators

#### General

The use of electrical equipment on diesel engines requires precautions to be taken for protection against shock current and for equipotential bonding. These measures not only serve as shock protection but also for functional protection of electric and electronic devices (EMC protection, device protection in case of welding, and so on).

### Earthing connections on the engine

Threaded bores M12, 20 mm deep, marked with the earthing symbol are provided on the engine´s B-side, see figure Earthing 12V175D, Page 394.

It has to be ensured that earthing is carried out immediately after engine set-up. If this cannot be accomplished any other way, at least provisional earthing is to be affected right after engine set-up.

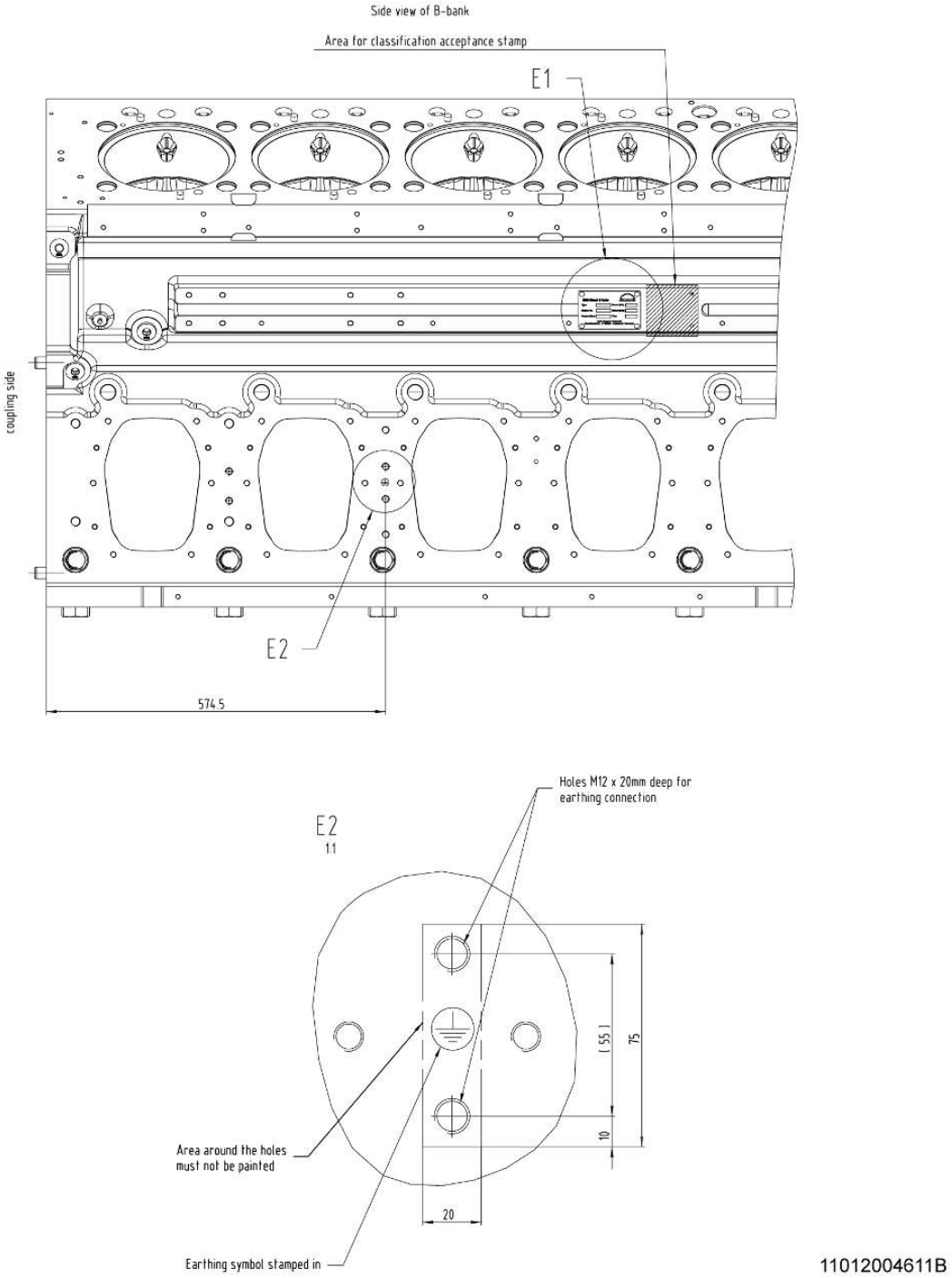



Figure 78: Earthing 12V175D

### Measures to be taken on the alternator

Shaft voltages, that are, voltages between the two shaft ends, are generated in electrical machines because of slight magnetic unbalances and ring excitations. In the case of considerable shaft voltages (for example, > 0.3 V), there is the risk that bearing damage occurs due to current transfers. For this reason, at least the bearing that is not located on the drive end is insulated (valid for alternators > 1-MW output). For verification, the voltage available at the shaft (shaft voltage) is measured while the alternator is running and excited. With proper insulation, a voltage can be measured. To protect the prime mover and to divert electrostatic charging, an earthing brush is often fitted on the coupling side.

Observation of the required measures is the alternator manufacturer's responsibility.

### Consequences of inadequate bearing insulation on the alternator and insulation check

In case the bearing insulation is inadequate, for example, if the bearing insulation was short-circuited by a measuring lead (PT100, vibration sensor), leakage currents may occur, which result in the destruction of the bearings. One possibility to check the insulation with the alternator at standstill (prior to coupling the alternator to the engine; this, however, is only possible in the case of single-bearing alternators) would be:

- Raise the alternator rotor (insulated, in the crane) on the coupling side.
- Measure the insulation by the megger test against earth.

Note:
Hereby the max. voltage permitted by the alternator manufacturer is to be observed.

If the shaft voltage of the alternator at rated speed and rated voltage is known (for example, from the test record of the alternator acceptance test), it is also possible to carry out a comparative measurement.

If the measured shaft voltage is lower than the result of the "earlier measurement" (test record), the alternator manufacturer should be consulted.

### Earthing conductor

The nominal cross section of the earthing conductor (equipotential bonding conductor) has to be selected in accordance with DIN VDE 0100, part 540 (up to 1 kV) or DIN VDE 0141 (more than 1 kV).

Generally, the following applies:

The protective conductor to be assigned to the largest main conductor is to be taken as a basis for sizing the cross sections of the equipotential bonding conductors.

Flexible conductors have to be used for the connection of resiliently mounted engines.

### Execution of earthing

The earthing must be executed by the shipyard, since generally it is not scope of supply of Everllence.

Earthing strips are also not included in the Everllence scope of supply.



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**Additional information regarding the use of welding equipment**

To prevent damage on electrical components, it is imperative to earth welding equipment close to the welding area, that is, the distance between the welding electrode and the earthing connection should not exceed 10 m.

### 3.22.6 Alignment

The alignment of the engine to the attached power train is crucial for trouble-free operation. Depending on the plant installation influencing factors on the alignment might be:

- Thermal expansion of the foundations
- Thermal expansion of the engine, alternator, or the gearbox
- Thermal expansion of the rubber elements in case of resilient mounting
- The settling behaviour of the resilient mounting
- Shaft misalignment under pressure
- Necessary axial pretensioning of the flexible coupling

Therefore take care that a special alignment calculation, resulting in alignment tolerance limits will be carried out. Follow the relevant working instructions of this specific engine type. Alignment tolerance limits must not be exceeded.

### 3.22.7 Gearbox seating

You find the required information in section Mounting concept, Page 661.



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# 4 Specification for engine supplies

## 4.1 Diesel fuel specification

### General information

Diesel fuel is a middle distillate refined from crude oil. It is also referred to as: gas oil, marine gas oil (MGO) and diesel oil. It must not contain any residue from crude oil refining.

### Selection of suitable diesel fuel

Unsuitable or adulterated fuel generally results in a shortening of the service life of engine parts/components, damage to these and to catastrophic engine failure. It is therefore important to select the fuel with care in terms of its suitability for the engine and the intended application. Through its combustion, the fuel influences the emissions behaviour of the engine.

### Specifications and approvals

The fuel quality varies regionally and is dependent on climatic conditions.

The following values must be complied with at the engine inlet:



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| Characteristic | Unit | | Limit value | Standard[1)] |
|---|---|---|---|---|
| Appearance | | Clear, bright and free from visible contamination | | |
| Kinematic viscosity at 40°C[2)] | $mm^2/s$ | Max. | 6.0 | ISO 3104, ASTM D7042, ASTM D445, DIN EN 16896 |
| | | Min. | 2.0 | |
| Density at 15°C | $kg/m^3$ | Max. | 890.0 | ISO 3675, ISO 12185 |
| | | Min. | 820.0 | |
| Water content | % (m/m) | Max. | 0.02 | DIN 51777, DIN EN 12937, ASTM D6304 |
| Cetane number | | Min. | 40 | EN ISO 5165, IP541, EN 15195, EN 16715, EN 17155 |
| Sulphur content[3)] | % (m/m) | Max. | 1.0 | ISO 8754, ISO 14596, ASTM D4294, DIN 51400-10 |
| Flashpoint[4)] | °C | Min. | 60.0 | ISO 2719 |
| Acid number | mg KOH/g | Max. | 0.5 | ASTM D664 |
| FAME[5)] content DMA | % (V/V) | Max. | 0.5 | ASTM D7963, IP 579, DIN EN 14078 |
| Oxidation stability DMA | $g/m^3$ | Min. | 25 | EN ISO 12205 |
| Sediment content[6)] | % (m/m) | Max. | 0.01 | ISO 10307-1 |
| Carbon residue[7)] | % (m/m) | Max. | 0.30 | ISO 10370 |
| Ash content | % (m/m) | Max. | 0.010 | ISO 6245 |
| CFPP | °C | 10°C below the lowest temperature in the fuel system | | DIN EN 116, IP 309, IP 612) |
| Pour Point[8)] winter quality | °C | Max. | -6 | ISO 3016 |
| Pour Point[8)] summer quality | °C | Max. | 0 | ISO 3016 |
| Lubricity (WSD) | µm | Max. | 520 | ISO 12156-1, ASTM D6079 |
| Corrosion effect on copper | Class | Max. | 1 | EN ISO 2160 |
| Hydrogen sulphide | mg/kg | Max. | 2.0 | IP 570 |
| Na, K, Ca, P, Cu, Zn, Si | mg/kg | Max. | free from | DIN EN 16476 |
| Particles [9)] | Classes | Max. | 18/17/12 | ISO 4406 |

Table 611: Requirements for diesel fuel

Remarks:

[1)] Always in relation to the currently applicable edition

[2)] Specific requirements of the injection system must be taken into account

[3)] Independent of the maximum permissible sulphur content, local laws and regulations must be adhered to

[4)] Additional requirements (e.g. SOLAS) must be observed. Applicable laws must be adhered to.

[5)] The FAME must either be in accordance with EN 14214 or with ASTM D6751 as well as with increased oxidation stability of at least 8 hours (EN 15751)

[6)] If the sample is not clear and bright, complete sedimentation through hot filtration and the determination of water content are required

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[7] Determined at 10% distillation residue

[8] 10°C below the lowest temperature in the fuel system

[9] Particle distribution in the last tank before engine inlet

This means the following fuels are approved for use:

- Classes ISO F-DMA & DMZ as per ISO 8217:2024 with additional requirement regarding cetane number.

In addition, the following fuels can be used:

- Diesel fuel as per EN 590:2022 with additional requirement regarding flashpoint ≥ 60 °C in SOLAS regulated areas
- Diesel fuel no. 2-D as per ASTM D975-21 with additional requirement regarding flashpoint ≥60 °C in SOLAS regulated areas
- Synthetic diesel fuel as per EN 15940:2023 in the current edition with additional requirement regarding flashpoint ≥ 60 °C in SOLAS regulated areas.

### Viscosity

In order to ensure sufficient lubrication, a minimum level of viscosity must be ensured at the fuel injection pump. The permissible maximum temperature of the fuel required to maintain minimum viscosity upstream of the injection pump of 1.3 $mm^2/s$ thus depends on the basic viscosity of the fuel. The fuel temperature must be set in such a way that the viscosity is no less than 1.3 $mm^2/s$. The temperature of the fuel upstream of the injection pump must under no circumstances be above 50 °C, even if the basic viscosity of the fuel would ensure a viscosity of ≥1.3 $mm^2/s$ at the injection pump at 50 °C. The lubricity requirement of the fuel upstream of the engine is a maximum of 520 µm WSD in each case according to ISO 12156-1.

### Military fuel specification

The fuels of type F-75 or F-76 as per NATO STANAG 1385 can be used if they fully comply with the standards or limit values listed in the table Requirements of the diesel fuel, Page 398 or DMA pursuant to ISO 8217:2024 and the minimum permissible viscosity upstream of the injection pump with the corresponding temperature is adhered to.

### Synthetic fuels (DIN EN 15940)

Synthetic fuels such as HVO, BTL, CTL, GTL according to DIN EN 15940, can be produced from renewable electrical energy and $CO_2$ or from the same basic material such as FAME fuels (vegetable oil, cooking oil, animal fat) but in a completely different procedure. Synthetic fuels are produced by means of hydrogen treatment, with a fuel being generated which has a very similar chemical structure to high-performance diesel fuel and consists of paraffinic hydrocarbons. In contrast to fossil diesel fuel, synthetic fuel barely contains any aromatic components, which causes very good combustion properties.

Although the energy content (per mass unit) is higher in comparison with fossil diesel fuel, the volumetric energy content is lower due to the lower density (typically approx. 780 $kg/m^3$ at 15 °C). This may lead to deviations in the specified engine output, operating behaviour, load application and emissions as well as deviations in the specific fuel consumption.

The lubricity of synthetic fuels is relatively low. In order to meet fuel specifications (requirements on diesel fuel, Page 398) and guarantee sufficient lubricity of the fuel, the fuel supplier needs to add a lubricity additive or FAME.



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The lower flashpoint limit is too low at a minimum of 55°C. Additional requirement regarding flashpoint min. 60°C in SOLAS regulated areas.

**FAME (Fatty acid methyl ester) additives of 0.5 to 100%**

The following values must be maintained at the engine inlet:

| Characteristic | Unit | | Limit value | Standard[1)] |
|---|---|---|---|---|
| Appearance | | Clear, bright and free from visible contamination | | |
| Kinematic viscosity at 40°C[2)] | $mm^2/s$ | Max. | 6.0 | ISO 3104, ASTM D7042, ASTM D445, DIN EN 16896 |
| | | Min. | 2.0 | |
| Density at 15°C | $kg/m^3$ | Max. | 900.0 | ISO 3675, ISO 12185 |
| | | Min. | 820.0 | |
| Cetane number | | Min. | 40 | EN ISO 5165, IP541, EN 15195, EN 16715, EN 17155 |
| Sulphur content[3)] | % (m/m) | Max. | 1.0 | ISO 8754, ISO 14596, ASTM D4294, DIN 51400-10 |
| Flashpoint[4)] | °C | Min. | 60.0 | ISO 2719 |
| Hydrogen sulphide | mg/kg | Max. | 2.0 | IP 570 |
| Acid number | mg KOH/g | Max. | 0.5 | ASTM D664, DIN EN 14104 |
| Corrosion effect on copper | Class | Max. | 1 | EN ISO 2160 |
| Oxidation stability | h | Min. | 8 | EN 15751 |
| Fatty acid methyl ester content (FAME)[5)] | % (V/V) | Max. | 0.5-100 | ASTM D7963, IP 579, DIN EN 14078, DIN EN 14103 |
| Carbon residue[6)] | % (m/m) | Max. | 0.40 | ISO 10370 |
| Water content | % (m/m) | Max. | 0.05 | DIN 51777, DIN EN 12937, ASTM D6304 |
| Ash content | % (m/m) | Max. | 0.010 | ISO 6245 |
| Total contamination | mg/kg | Max. | 24 | DIN EN 12662 |
| CFPP | °C | 10°C below the lowest temperature in the fuel system | | DIN EN 116, IP 309, IP 612) |
| Methanol | % (m/m) | Max. | 0.20 | EN 14110 |
| Monoglyceride | % (m/m) | Max. | 0.70 | DIN EN 14105 |
| Diglyceride | % (m/m) | Max. | 0.20 | DIN EN 14105 |
| Triglyceride | % (m/m) | Max. | 0.20 | DIN EN 14105 |
| Free glycerol | % (m/m) | Max. | 0.02 | DIN EN 14105 |
| Total glycerol | % (m/m) | Max. | 0.25 | DIN EN 14105 |
| Iodine value | g $I_2$/100 g | Max. | 120 | EN 16300, DIN EN 14111 |
| Linolenic acid methyl ester | % (m/m) | Max. | 12.0 | DIN EN 14103 |
| Polyunsaturated fatty acid methyl ester with ≥4 double bonds | % (m/m) | Max. | 1.00 | DIN EN 15779 |

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| Characteristic | Unit | | Limit value | Standard[1)] |
|---|---|---|---|---|
| Alkali metals (Na+K) | mg/kg | Max. | 5.0 | DIN EN 14538, DIN EN 14108 |
| Alkaline earth metals (Ca+Mg) | mg/kg | Max. | 5.0 | DIN EN 14538 |
| Phosphorus | mg/kg | Max. | 4.0 | DIN EN 14107 |
| Copper, zinc | mg/kg | Max. | Free from | DIN EN 16476 |
| Lubricity (WSD) | µm | Max. | 520 | DIN EN ISO 12156-1, ASTM D6079 |
| Lower calorific value at 15°C | MJ/l | Min. | 32.1 | DIN 51900-3 |
| Particles[7)] | Classes | Max. | 18/17/12 | ISO 4406 |

Table 612: Requirements for fuel with FAME additives of 0.5 to 100%

Remarks:

[1)] Always in relation to the currently applicable edition

[2)] Specific requirements of the injection system must be taken into account

[3)] Independent of the maximum permissible sulphur content, local laws and regulations must be adhered to

[4)] Additional requirements (e.g. SOLAS) must be observed. Applicable laws must be adhered to.

[5)] The FAME must either be in accordance with EN 14214 or with ASTM D6751 as well as with increased oxidation stability of at least 8 hours (EN 15751)

[6)] Determined at 10% distillation residue

[7)] Particle distribution in the last tank before engine inlet

Prior to using specific FAME fuels according to EN 14214, ASTM D6751* or Everllence specifications and their mixtures with DMA for Everllence four-stroke high and medium-speed rotors, the following is to be observed:

- Due to the typically lower calorific value or energy content of FAME fuels and their mixtures with DMA, it may result in deviations to the specified engine output, operating behaviour, load application, specific fuel consumption and emissions. By providing an external load signal to the SaCoS system, engine output can be corrected. In the aged state of the injector, deviations may occur. This fuel is therefore to be specified for envisaged use when placing the order.
- The sealants used must be suitable for FAME fuels and their mixtures with DMA. NBR seals are not suitable and must not be used.
- FAME fuels and their mixtures with DMA tend to attract water. The risk of microbial growth is therefore increased. For this reason, the water content needs to be kept as low as possible. The maximum water content must not be exceeded. Everllence recommends draining the water from the fuel tank daily.
- Long standstill periods (e.g. emergency power units) must be avoided due to microbial growth. To prevent damage, it is recommendable to only operate applications with fuel which is free of biodiesel.
- The fuel reacts to air and may thus lead to microbial growth. Ensure that the atmospheric oxygen ventilation is kept to a minimum. A nitrogen buffer is ideally installed in the fuel tank.
- The entire fuel system must be purged with fuel which is free of biodiesel (DMA) prior to longer standstill periods.
- If FAME fuels and their mixtures with DMA are to be used with other fuels, and mixing cannot be avoided, please contact your fuel supplier to ensure the compatibility of these fuels.



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- It is recommended that wherever possible a heat tracing system is installed in the fuel supply system, in order to prevent deposits or blockage of the lines.
- As FAME fuels and their mixtures with DMA have a higher evaporation temperature than standard DMA qualities, these are enriched in lubricating oil. Regular analysis of all the lubricating oil is highly recommended. The lubricating oil needs to be replaced if a FAME content of 12% is reached.
- FAME fuels and their mixtures with DMA may cause a layer to form, such a phenomenon leads to increased consumption of lubricating oil. If such an increase in lubricating oil consumption values is detected, please contact your Everllence PrimeServ department.
- Fuels may cause harmful reactions with metals such as zinc or copper. We highly recommend getting in contact with your tank and heating oil system supplier.
- After converting to FAME fuels and their mixtures with DMA, keep an eye on the Delta pressure indicators/filter alarms as these can be blocked by residue dissolved in non-standard fuel.
- In any case, it is the responsibility of the operating company to adhere to the legal requirements (e.g. SOLAS) and agree on these with the relevant authorities for this non-standard fuel.
- Since the volumetric fuel value of FAME fuel oil is generally lower than that of pure petroleum-based fuels, the design of the equipment in the fuel supply and delivery circuit must be checked with regard to the increased flow (pumps, filters, coolers, etc.) and adjusted if necessary.

* as well as with increased oxidation stability of at least 8 hours (EN 15751)

#### Cold suitability

The cold suitability of the fuel is determined by the climatic requirements at the place of installation. It is the responsibility of the operating company to choose a fuel with sufficient cold suitability.

The cold suitability of a fuel may be determined and assessed using the following standards:

- Limit of filterability (CFPP) as per EN 116
- Pour point as per ISO 3016
- Cloud point as per EN 23015

To be able to draw a reliable conclusion, it is recommended to perform all three stated procedures.

#### Analyses

The examination of fuel samples is essential for safe engine operation. Examinations can be carried out in the Everllence PrimeServLab laboratory for our customers.

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## 4.2 Specification of urea solution

#### General

Use of good quality urea solution is essential for the operation of a SCR catalyst.

Note:

**The overall SCR system is designed for one of the two possible urea solution qualities (32.5% AdBlue® or 40% concentration) as listed in the tables below. This must be taken into account when ordering. The mixture of the both different solutions is not permissible.**

Everllence recommends urea according to the specification below. Urea 40 % must meet the standard of ISO 18611.

| | **Urea solution concentration [%] 31.8 – 33.2** | **ISO 22241-2 Annex C** |
|---|---|---|
| Density at 20 °C [g/cm$^3$] | 1.087 – 1.093 | DIN EN ISO 12185 |
| Refractive index at 20 °C | 1.3814 – 1.3843 | ISO 22241-2 Annex C |
| Biuret [%] | max. 0.3 | ISO 22241-2 Annex E |
| Alkality as $NH_3$ [%] | max. 0.2 | ISO 22241-2 Annex D |
| Aldehyde [mg/kg] | max. 5 | ISO 22241-2 Annex F |
| Insolubles [mg/kg] | max. 20 | ISO 22241-2 Annex G |
| Phosphorus (as $PO_4$) [mg/kg] | max. 0.5 | ISO 22241-2 Annex H |
| Calcium [mg/kg] | max. 0.5 | ISO 22241-2 Annex I |
| Iron [mg/kg] | max. 0.5 | ISO 22241-2 Annex I |
| Magnesium [mg/kg] | max. 0.5 | ISO 22241-2 Annex I |
| Sodium [mg/kg] | max. 0.5 | ISO 22241-2 Annex I |
| Potassium [mg/kg] | max. 0.5 | ISO 22241-2 Annex I |
| Copper [mg/kg] | max. 0.2 | ISO 22241-2 Annex I |
| Zinc [mg/kg] | max. 0.2 | ISO 22241-2 Annex I |
| Chromium [mg/kg] | max. 0.2 | ISO 22241-2 Annex I |

Table 613: Urea 32.5 % solution specification

| | **Urea solution concentration 39 – 41 [%]** | **Test method** |
|---|---|---|
| Density at 20 °C [g/cm$^3$] | 1.105 – 1.115 | DIN EN ISO 12185 |
| Refractive index at 20 °C | 1.3930 – 1.3962 | ISO 18611-2 Annex C |
| Biuret [%] | max. 0.5 | ISO 18611-2 Annex E |
| Alkality as $NH_3$ [%] | max. 0.5 | ISO 18611-2 Annex D |
| Aldehyde [mg/kg] | max. 10 | ISO 18611-2 Annex F |
| Insolubles [mg/kg] | max. 20 | ISO 18611-2 Annex G |
| Phosphorus (as $PO_4$) [mg/kg] | max. 0.5 | ISO 18611-2 Annex H |
| Calcium [mg/kg] | max. 0.5 | ISO 18611-2 Annex I |
| Iron [mg/kg] | max. 0.5 | ISO 18611-2 Annex I |
| Magnesium [mg/kg] | max. 0.5 | ISO 18611-2 Annex I |
| Sodium [mg/kg] | max. 0.5 | ISO 18611-2 Annex I |

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| | Urea solution concentration 39 – 41 [%] | Test method |
|---|---|---|
| Potassium [mg/kg] | max. 0.5 | ISO 18611-2 Annex I |
| Aluminium [mg/kg] | max. 0.5 | ISO 22241-2 Annex I |
| Nickel [mg/kg] | max. 0.2 | ISO 22241-2 Annex I |
| Copper [mg/kg] | max. 0.2 | ISO 22241-2 Annex I |
| Zinc [mg/kg] | max. 0.2 | ISO 22241-2 Annex I |
| Chromium [mg/kg] | max. 0.2 | ISO 22241-2 Annex I |

Table 614: Urea 40 % solution specification

## 4.3 Specification of engine coolant

### Preliminary remarks

The engine coolant is of the following composition: water for heat removal and coolant additive for corrosion protection and optionally as an antifreeze agent.

As is also the case with the fuel and lubricating oil, the engine coolant must be carefully selected, handled and checked. Otherwise, corrosion, erosion and cavitation may occur at the walls of the cooling system in contact with water, and deposits may form. Deposits obstruct the transfer of heat and can cause thermal overloading of the cooled parts. The plant must be treated with an anti-corrosion agent before bringing it into operation for the first time. The concentrations prescribed by the engine manufacturer must always be observed during subsequent operation.

### Tropical applications

A minimum concentration of coolant additives is necessary for adequate corrosion protection. At high ambient temperatures, optimum engine output can only be guaranteed for additives without antifreeze.

### Standard and Arctic applications

A minimum concentration of coolant additives is necessary for adequate corrosion protection. A high antifreeze content requires a corresponding cooling capacity.

### Requirements

Limit values

The properties of untreated coolant (mixed water) must correspond to the following limit values:

| Properties/Characteristic | Properties | Unit |
|---|---|---|
| Water type | Distillate or fresh water, free of foreign matter | – |
| Total hardness | max. 15 | dGH[1)] |
| pH value | 6.5 – 8 | – |
| Chloride ion content | max. 100 | mg/l[2)] |

Table 615: Properties of coolant that must be complied with

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[1] 1 dGH (German hardness) ≙ 10 mg CaO in 1 litre of water ≙ 17.8 mg $CaCO_3$/l

≙ 0.357 mval/l ≙ 0.178 mmol/l

[2] 1 mg/l ≙ 1 ppm

Testing equipment

The manufacturers of anticorrosive agents supply user-friendly testing equipment.

Analyses

Regular analysis of coolant is very important for safe engine operation. We can analyse samples for customers at Everllence PrimeServLab.

**Additional information**

Distilate

If distilled water (from a fresh water generator, for example) or fully desalinated water (from ion exchange or reverse osmosis) is available, this should ideally be used as mixing water for the engine coolant. These waters are free of lime and salts, which means that deposits that could interfere with the transfer of heat to the coolant, and therefore also reduce the cooling effect, cannot form. However, these waters are more corrosive than normal hard water. This is why distilled water must be handled particularly carefully and the concentration of the additive must be regularly checked.

Hardness

The total hardness of water is the combined effect of temporary and permanent hardness. The proportion of calcium and magnesium salts is of overriding importance. Temporary hardness is determined by the carbonate content of the calcium and magnesium salts. Permanent hardness is determined by the amount of remaining calcium and magnesium salts (sulphates). Temporary (carbonate) hardness is a critical factor that determines the extent of limescale deposit in the cooling system.

Water with a total hardness of > 15°dGH must be mixed with distilled water, or softened.

**Damage to the coolant system**

Corrosion

Corrosion is an electrochemical process that can widely be avoided by selecting the correct water quality and by carefully handling the water in the engine cooling system.

Flow cavitation

Flow cavitation can occur in areas in which high flow velocities and high turbulence is present. If the steam pressure is reached, steam bubbles form and subsequently collapse in high pressure zones which causes the destruction of materials in constricted areas.

Erosion

Erosion is a mechanical process accompanied by material abrasion and the destruction of protective films by solids that have been drawn in, particularly in areas with high flow velocities or strong turbulence.

Stress corrosion cracking

Stress corrosion cracking is a failure mechanism that occurs as a result of simultaneous dynamic and corrosive stress. This may lead to cracking and rapid crack propagation in water-cooled, mechanically-loaded components if the coolant has not been treated correctly.

**Treatment of engine coolant**

Formation of a protective film

The purpose of treating the engine coolant using anticorrosive agents is to produce a continuous protective film on the walls of cooling surfaces and therefore prevent the damage referred to above. In order for the anticorrosive agent to be 100 % effective, it is extremely important that untreated water satisfies the requirements in paragraph Requirements, Page 404.



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Protective films can be formed by treating the coolant with chemical slushing oil.

Treatment prior to initial commissioning of engine

Treatment with a anticorrosive agent should be carried out before the engine is brought into operation for the first time to prevent irreparable initial damage.

Note:

The engine must not be brought into operation without treating the cooling water first.

**Additives for coolants**

Required approval

A coolant additive may only be permitted for use if tested and approved as per the latest directives of the ICE Research Association (FVV) "Suitability test of internal combustion engine cooling fluid additives." The test report must be obtainable on request. The relevant tests can be carried out on request in Germany at the staatliche Materialprüfanstalt (Federal Institute for Materials Research and Testing), Abteilung Oberflächentechnik (Surface Technology Division), Grafenstraße 2 in D-64283 Darmstadt.

Once the coolant additive has been tested by the FVV, the engine must be tested in the second step as specified by Everllence before the final approval is granted.

**Prerequisite for effective use of an anti-corrosive agent**

Clean cooling system

As contamination significantly reduces the effectiveness of the additive, the tanks, pipes, coolers and other parts outside the engine must be free of rust and other deposits before the engine is started up for the first time and after repairs of the pipe system. For this reason, the entire system must be cleaned with a suitable cleaning agent while the engine is off.

Loose solid matter in particular must be removed by flushing the system thoroughly as otherwise erosion may occur in locations where the flow velocity is high.

The cleaning agents must not corrode the seals and materials of the cooling system. In most cases, the supplier of the cooling water additive will be able to carry out this work and, if this is not possible, will at least be able to provide suitable products to do this. If this work is carried out by the engine operator, he should use the services of a specialist supplier of cleaning agents. The cooling system must be flushed thoroughly after cleaning. Once this has been done, the engine coolant must be immediately treated with anticorrosive agent. Once the engine has been brought back into operation, the cleaned system must be checked for leaks.

The complete cooling system must be free of zinc. The use of copper and its alloys must be limited to a minimum.

**Approved coolant additives**

A list of currently approved coolant additives and their concentration can be found at Lubrication.

Regular checks of the coolant condition and coolant system

Treated coolant may become contaminated when the engine is in operation, which causes the additive to loose some of its effectiveness. It is therefore advisable to regularly check the cooling system and the coolant condition. To determine leakages in the lube oil system, it is advisable to carry out regular checks of water in the expansion tank. Indications of oil content in water are, e.g. discolouration or a visible oil film on the surface of the water sample.

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Excessively low concentrations can promote corrosion and must be avoided. Concentrations that are higher than the permissible maximum cause problems with heat removal due to reduced heat capacity of the coolant.

Every 2 to 6 months, a coolant sample must be sent to an independent laboratory or to the engine manufacturer for an integrated analysis.

The coolant and additive concentration must be checked regularly. The results must be documented.

The coolant used must comply with the requirements stated in the table entitled "Limit values for coolants", Page 407. In addition, the requirements for mixed water apply (Table "Coolant properties to be complied with", Page 404).

| | Limit value | Procedure |
|---|---|---|
| Reserve alkalinity at pH 7 and pH 5.5 | At least 50 % of initial value | ASTM D1121 |
| pH value | > 7.0 | ASTM D1287 |
| Silicate content[1)] | Min. 50 ppm | EN ISO 11885-E22 |
| [1)] Only for silicate-containing coolant additives | | |

Table 616: Limit values for coolants

In case of non-observance the complete coolant must be replaced.

Irrespective of this the coolant must be completely changed after 3 years or 9000 operating hours at the latest.

Note:

**The concentrations of the chemical additives must not fall below the minimum concentrations listed in table** Antifreeze agents.

If there is a high concentration of solids (rust) in the system, the water must be completely replaced and entire system carefully cleaned.

Deposits in the cooling system may be caused by fluids that enter the coolant or by emulsion break-up, corrosion in the system, and lime scale deposits if the water is very hard. If the concentration of chloride ions has increased, this generally indicates that seawater has entered the system. The maximum specified concentration of 100 mg chloride ions per kg must not be exceeded as otherwise the risk of corrosion is too high. If exhaust gas enters the coolant, this can lead to a sudden drop in the pH value or to an increase in the sulphate content.

Water losses must be compensated for by filling with untreated water that meets the quality requirements specified in the paragraph Requirements, Page 404. The concentration of anticorrosive agent must subsequently be checked and adjusted if necessary.

Subsequent checks of the coolant are especially required if the coolant had to be drained off in order to carry out repairs or maintenance.

### Protective measures

Anticorrosive agents contain chemical compounds that can pose a risk to health or the environment if incorrectly used. Comply with the directions in the manufacturer's material safety data sheets.

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Avoid prolonged direct contact with the skin. Wash hands thoroughly after use. If larger quantities spray and/or soak into clothing, remove and wash clothing before wearing it again.

If chemicals come into contact with your eyes, rinse them immediately with plenty of water and seek medical advice.

Anticorrosive agents are generally harmful to the water cycle. Observe the relevant statutory requirements for disposal.

## 4.4 Specification of lubricating oil for operation with DMA/DFA

### General

The specific output achieved by modern diesel engines combined with the use of fuels that satisfy the quality requirements more and more frequently increase the demands on the performance of the lubricating oil which must therefore be carefully selected.

Doped lubricating oils (HD oils) have a proven track record as lubricants for the drive, cylinder, turbocharger, and for cooling the piston. Doped lubricating oils contain additives that among other things ensure dirt absorption capability, engine cleaning, and neutralisation of acidic combustion products.

Only lubricating oils approved by Everllence may be used.

### Specifications

**Base oil**

The base oil (doped lubricating oil = base oil + additives) must have a narrow distillation range and be refined using modern methods. If it contains paraffins, they must not impair the thermal stability or oxidation stability.

**Compounded lubricating oils (HD oils)**

The compounded lubricating oil must have the following properties:

The additives must be dissolved in the oil, and their composition must ensure that as little ash as possible remains after combustion.

**Additives**

The ash must be soft. If this prerequisite is not met, it is likely the rate of deposition in the combustion chamber will be higher, particularly at the outlet valves and at the turbocharger inlet housing. Hard additive ash promotes pitting of the valve seats, and causes valve burn-out, it also increases mechanical wear of the cylinder liners.

Additives must not increase the rate, at which the filter elements in the active or used condition are blocked.

**Washing ability**

The washing ability must be high enough to prevent the accumulation of tar and coke residue as a result of fuel combustion.

**Neutralization capacity**

The neutralization capacity (DIN ISO 3771) must be so high that the acidic products produced during combustion are neutralized. The reaction time of the additives must be matched to the process in the combustion chamber.

The base number (BN) should be at least 8.5 mg KOH/g with a fuel sulphur content of 0.5 % or less. The base number (BN) should be at least 12 mg KOH/g with a fuel sulphur content of between 0.5 % and 1.5 %, the base number 16 is recommended.

When using low-SAPS oils, the fuel may contain at most 1,000 mg/kg sulphur.

**Evaporation tendency**

The evaporation tendency must be as low as possible as otherwise the oil consumption will be adversely affected.

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**Additional requirements**

The lube oil may contain viscosity index improver. Fresh oil must not contain water or other contaminants.

The ACEA classes E4, E6 or E7 must be observed.

**Lubricating oil additives**

The use of other additives in conjunction with the lubricating oil or the mixing of different brands (oils from different manufacturers and different brands from the same manufacturer) is not permitted, as this can affect the performance of existing additives, which have been carefully matched to each other and have also been specially adapted to the base oil.

**Military specification**

Lube oils according to the NATO Code O-278 require a special approval.

**Selection of lubricating oils/ warranty**

Most oil manufacturers have close and constant contacts with engine manufacturers and can therefore specify which oil from their own product line is approved by the engine manufacturer for the application. Regardless of this information, lubricating oil manufacturers are always liable for the quality and properties of their products. If you have any questions, we will be happy to provide you with further information.

The current releases are available at Lubrication.

Everllence will not accept liability for problems that occur as a result of using these oils.

**Oil during operation**

The engine oil change intervals are dictated by the maintenance schedule. The intervals between lubricating oil changes are determined by the ageing rate of the oil. This parameter depends on the method of lubricating oil preparation/cleaning on the engine, as well as on the engine operation. Shortly, the following will effect among others:

- High start/stop frequency of the engine
- High sulphur content in fuel
- More frequent idling or low load operation (“loaf-around operation“)
- Operation in extreme climactic conditions
- Operation with fuel containing biodiesel

The lubricating oil used must comply with the requirements stated in the table entitled “Limit values for engine oil to be used”, Page 409.

| Property | Unit | Limit value | Procedure |
|---|---|---|---|
| Viscosity at 40 °C | $mm^2/s$ | 100–190 (SAE 40)<br>80–190 (SAE 10W-40) | ISO 3104, ASTM D445, ASTM D 7042, DIN EN 16896 |
| Viscosity at 100 °C | | 10.5–19.0 (SAE 40)<br>10.5–19.0 (SAE10W-40) | |
| Base number (BN) | % | At least 50 % of fresh oil - BN | ISO 3771 |
| Flash point (PM) | °C | At least 170 | ISO 2719 |
| Water content | vol. % | Max. 0.20 | DIN 51777, ASTM D6304 |
| Soot content | % (m/m) | Max. 3.5 (SAE 10W-40)<br>Max. 3.0 (SAE 40) | DIN 51452 |
| Oxidation[1)] | A/cm | Max. 30 | DIN 51453 |
| Fuel dilution | % (m/m) | Max. 3.0 | DIN 51454 |
| Coolant additive | mg/kg | Free from | DIN 51399-1 |
| TAN | mg KOH/g | +3.5 for fresh oil and BN > TAN | ASTM D664 |

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| Property | Unit | Limit value | Procedure |
|---|---|---|---|
| Metal content (reference values)<br>Iron,<br>chrome, tin,<br>copper,<br>aluminium, lead | ppm | <br>max. 100<br>max. 10<br>max. 15<br>max. 20 | ASTM D5185, DIN 51399-1 |
| [1] Only possible if there are no ester compounds and no ingress of biofuel. | | | |

Table 617: Limit values for engine oil to be used

A monthly analysis of lube oil samples is mandatory for safe engine operation. We can analyse samples for customers in the Everllence PrimeServLab.

Everllence recommends to take the samples at the sampling point of the lubrication oil cooler (Minimess® Adapter). The lubrication oil cooler is attached to the engine.

## 4.5 Specification of compressed air

### General

For compressed air quality observe the ISO 8573-1. Compressed air must be free of solid particles and oil (acc. to the specification).

### Requirements

Compressed air quality of starting air system

The starting air must fulfil at least the following quality requirements according to ISO 8573-1.

| | |
|---|---|
| Purity regarding solid particles | Quality class 6 |
| Particle size > 40µm | max. concentration < 5 mg/m$^3$ |
| Purity regarding moisture | Quality class 7 |
| Residual water content | < 0.5 g/m$^3$ |
| Purity regarding oil | Quality class X |

Additional requirements are:

- The air must not contain organic or inorganic silicon compounds.
- The layout of the starting air system must ensure that no corrosion may occur.
- The starting air system and the starting air receiver must be equipped with condensate drain devices.
- By means of devices provided in the starting air system and via maintenance of the system components, it must be ensured that any hazardous formation of an explosive compressed air/lube oil mixture is prevented in a safe manner.

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## 4.6 Specification for intake air (combustion air)

### General

The quality and condition of intake air (combustion air) have a significant effect on the engine output, wear and emissions of the engine. In this regard, not only are the atmospheric conditions extremely important, but also contamination by solid and gaseous foreign matter.

Mineral dust in the intake air increases wear. Chemicals and gases promote corrosion.

This is why effective cleaning of intake air (combustion air) and regular maintenance of the air filter are required.

When designing the intake air system, the maximum permissible overall pressure drop (filter, silencer, pipe line) of 30 mbar must be taken into consideration.

Exhaust turbochargers for marine engines are equipped with silencers and air filters as a standard.

### Requirements

Liquid fuel engines: As minimum, inlet air (combustion air) must be cleaned by an ISO Coarse 45% class filter as per DIN EN ISO 16890, if the combustion air is drawn in from inside (e.g. from the machine room/engine room). If the combustion air is drawn in from outside, in the environment with a risk of higher inlet air contamination (e.g. due to sand storms, due to loading and unloading grain cargo vessels or in the surroundings of cement plants), additional measures must be taken. This includes the use of pre-separators, pulse filter systems and a higher grade of filter efficiency class at least up to ISO ePM10 50% according to DIN EN ISO 16890.

In general, the following applies:

The inlet air path from air filter to engine shall be designed and implemented airtight so that no false air may be drawn in from the outdoor.

The concentration downstream of the air filter and/or upstream of the turbocharger inlet must not exceed the following limit values.

The air must not contain organic or inorganic silicon compounds.

| Properties | Limit | Unit [1] |
|---|---|---|
| Dust (sand, cement, CaO, $Al_2O_3$ etc.) | max. 5 | mg/Nm$^3$ |
| Chlorine | max. 1.5 | |
| Sulphur dioxide ($SO_2$) | max. 1.25 | |
| Hydrogen sulphide ($H_2S$) | max. 5 | |
| Salt (NaCl) | max. 1 | |
| [1] One Nm$^3$ corresponds to one cubic meter of gas at 0 °C and 101.32 kPa. | | |

Table 618: Typical values for intake air (combustion air) that must be complied with

Note:

Intake air shall not contain any flammable gases. Make sure that the combustion air is not explosive and is not drawn in from the ATEX Zone.



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# 5 Engine room and application planning

## 5.1 3D Viewer – A support programme to configure the engine room

Everllence offers a free-of-charge online programme for the configuration and provision of installation data required for installation examinations and engine room planning: The 3D Engine Viewer and the GenSet Viewer.

Easy-to-handle selection and navigation masks permit configuration of the required engine type, as necessary for virtual installation in your engine room.

In order to be able to use the 3D Engine, respectively GenSet Viewer, register on our website.

Everllence Extranet

After successful registration, the 3D Engine Viewer and GenSet Viewer are available under:

3D Engine Viewer

3D GenSet Viewer

by clicking onto the requested application.

In only three steps, you will obtain professional engine room data for your further planning:

- Selection

  Select the requested output, respectively the requested type.
- Configuration

  Drop-down menus permit individual design of your engine according to your requirements. Each of your configurations will be presented on the basis of isometric models.
- View

  The models of the 3D Engine Viewer and the GenSet Viewer include all essential geometric and planning-relevant attributes (e.g. connection points, interfering edges, exhaust gas outlets, etc.) required for the integration of the model into your project.

The configuration with the selected engines can now be easily downloaded. For 2D representation as .pdf or .dxf, for 3D as .dgn, .sat, .igs or 3D-dxf.



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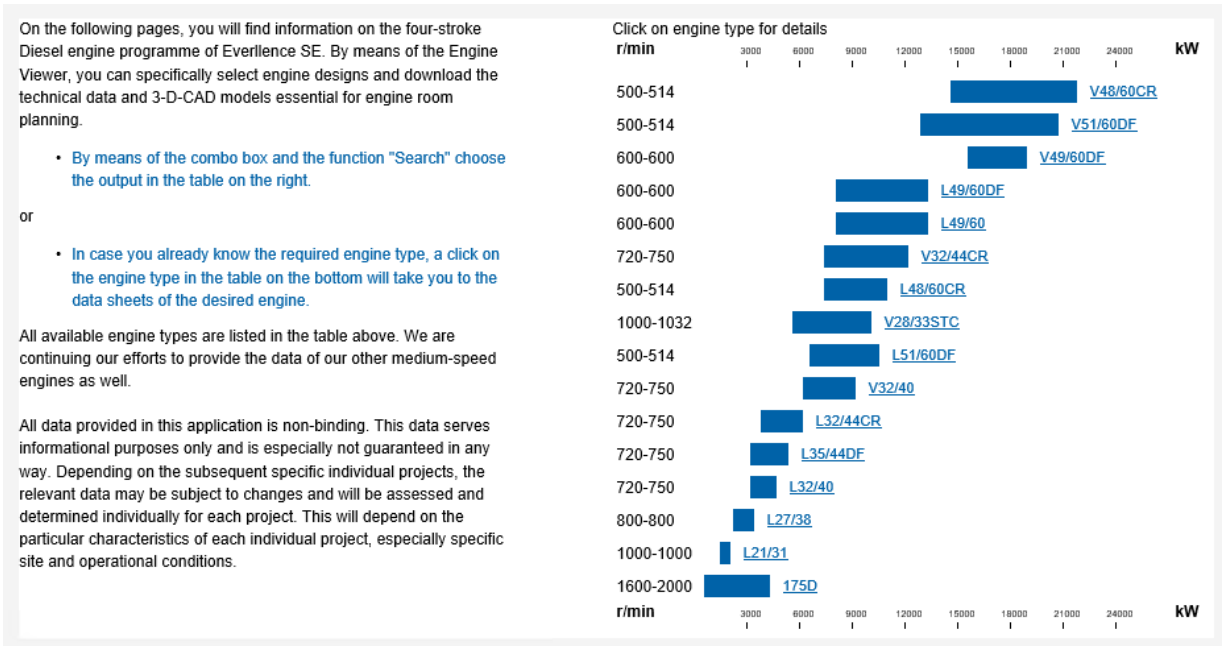



Figure 79: Selection of engine

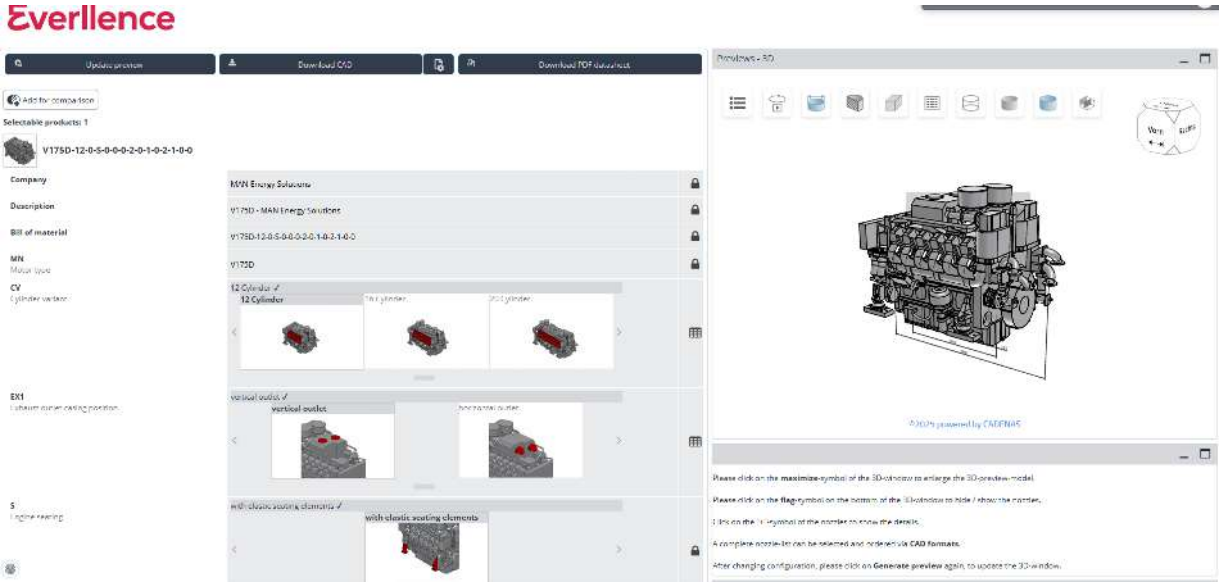



Figure 80: Preselected standard configuration

## 5.2 Basic principles for pipe selection

### 5.2.1 External pipe dimensioning

The external piping systems are to be dimensioned, designed, installed, and connected to the engine by the shipyard. The pipe systems should be designed in such a way that the pressure losses are kept within reasonable limits. To achieve this at justifiable cost, it is recommended to maintain the flow rates as indicated below. Nevertheless, depending on specific conditions of piping systems, it may be necessary sometimes to adopt even lower flow rates. Generally, it is not recommended to use higher flow rates.

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| | Recommended flow rates (m/s) | |
|---|---|---|
| | Suction side | Delivery side |
| Fresh water (cooling water) | 1.0–2.0 | 1.5–3.0 |
| Lube oil | 0.5–1.0 | 1.5–2.5 |
| Seawater | 1.0–1.5 | 1.5–2.5 |
| Diesel fuel | 0.5–1.0 | 1.5–2.0 |
| Compressed air for control air system | - | 2–10 |
| Compressed air for starting air system | - | 25–30 |
| Intake air | 20–25 | |
| Exhaust gas | 40 | |

Table 619: Recommended flow rates

In addition to obtaining certain flow rates, it is recommended to achieve an uniform inflow towards pumps. If disturbances in front of the pump cannot be avoided on the system side, the inflow must be made uniform to a permissible level. This can be achieved, amongst other things, by a sufficiently long straight pipe section (approx. 5 to 8 times the nominal diameter DN between the pump and the point of interference), bends with a large radius of curvature, and other measures.

Bends have to be carried out using radius 1.5 x DN or higher. Sharp angles or other installations that may cause cavitation are to be avoided.

### 5.2.2 Specification of materials for piping

**General**

- The properties of the piping shall conform to international standards, for example, DIN EN 10208, DIN EN 10216, DIN EN 10217 or DIN EN 10305, DIN EN 13480-3.
- For piping, black steel pipe should be used; stainless steel shall be used where necessary.
- Outer surface of black steel pipes must be primed and painted according to shipyard´s specification.
- The pipes are to be sound, clean, and free from all imperfections. The internal surfaces must be thoroughly cleaned and all scale, grit, dirt, and sand used in casting or bending has to be removed. No sand is to be used as packing during bending operations.
- In case of pipes with forged bends, care must be taken to ensure that inner surfaces are smooth and that no stray weld metal remains after joining.
- Advice in Everllence work instruction 010.000.001-03 pipelines cleaning, pickling, and preservation. Carry out the pressure test for cleaning of steel pipes before fitting them together should be observed.
- Certain material combinations are sensitive to electro-chemical corrosion, therefore special attention must be paid to the arrangement within a pipe system including all connected components.
- All information given is to be regarded as indication only; the sole responsibility for the functionality and durability of the external piping system lies with the shipyard.



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**Cooling water pipes**

For piping of fresh cooling water, black steel or stainless steel pipes are recommended.
Pure copper is not permissible for fresh water pipes, fittings, and other parts like seal rings.
Sealants or other substances containing copper must not be used, as parts of the engine are made of aluminum and may be corroded by copper particles.
Brass and other alloys containing copper should be avoided as far as possible.
Galvanised material must not be used, since zinc particles may cause damages at the engine.
For seawater pipes CuNiFe material or fiber reinforced plastic is recommended.
In case black steel has to be used, the pipes need dedicated coating with rubber or other seawater proof materials.

**Fuel oil pipes, lube oil pipes**

Galvanised steel pipe must not be used for the piping of the system as acid components of the fuel may attack zinc.

Proposed material (EN)

E235, P235GH, X6CrNiMoTi17-12-2

**Urea pipes (for SCR only)**

Galvanised steel pipe, brass, and copper components must not be used for the piping of the system.

Proposed material (EN)

X6CrNiMoTi17-12-2

**Compressed air pipes**

Galvanised steel pipe must not be used for the piping of the system.

Proposed material (EN)

E235, P235GH, X6CrNiMoTi17-12-2

**Seawater pipes**

Material depending on required flow speed and mechanical stress.

Proposed material

CuNiFe, glass fiber reinforced plastic, rubber lined steel

### 5.2.3 Installation of flexible pipe connections

**Arrangement of hoses on engine**

Flexible pipe connections are necessary to connect resiliently mounted engines with external piping systems. They are used to compensate the dynamic movements of the engine in relation to the external piping system.

The engine´s movement on its foundation is caused by the engine´s rotation and torque itself as well as by rolling and pitching of the ship. Based on roll angles of +/- 22.5° and pitching of +/- 7.5° (according to prescriptive rules of classification societies) the excursions at the exhaust gas outlet can be up to

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5 mm in X-, 25 mm in Y- and 6 mm in Z-direction. As the exhaust gas outlet is at the highest point of the engine the excursions at lower positions are smaller respectively.

To obtain exact data on excursions at certain points, a project-specific calculation of the elastic engine mount is required.

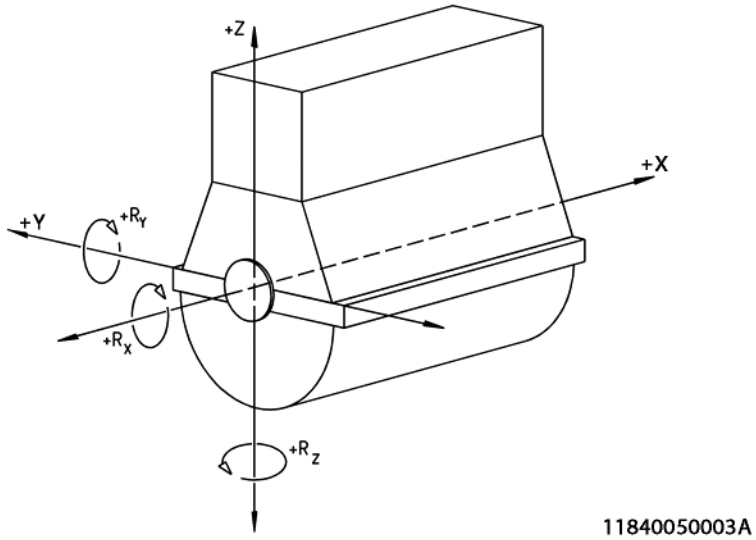



Figure 81: Coordinate system

Generally flexible pipes (rubber hoses with steel inlet, metal hoses, PTFE-corrugated hose-lines, rubber bellows with steel inlet, steel bellows, steel compensators) are nearly unable to compensate twisting movements. Therefore the installation direction of flexible pipes must be vertically (in Z-direction) if ever possible. Torsion on flexible pipe connections must be avoided. Flexible pipe connections which are installed in X-direction are particularly at risk. Therefore the installation of flexible pipe connections in this direction should be avoided. Where the installation of flexible pipe connections in X-direction is nevertheless unavoidable, the continuing pipeline on the plant side must be designed in such a way that the torsional forces can be safely absorbed. An installation in horizontal-lateral (Y-direction) is not recommended.

The media connections (compensators) to and from the engine must be highly flexible whereas the fixations of the compensators on the one hand with the engine and on the other hand with the environment must be realised as stiff as possible.

### Flange and screw connections

Flexible pipes delivered loose by Everllence are fitted with flange connections from DN32 upwards. Smaller sizes are fitted with screw connections. Each flexible pipe is delivered complete with counter flanges or, those smaller than DN32, with weld-on sockets.

### Arrangement of the external piping system

Shipyard's pipe system must be exactly arranged so that the flanges or screw connections do fit without lateral or angular offset. Therefore it is recommended to adjust the final position of the pipe connections after engine alignment is completed.



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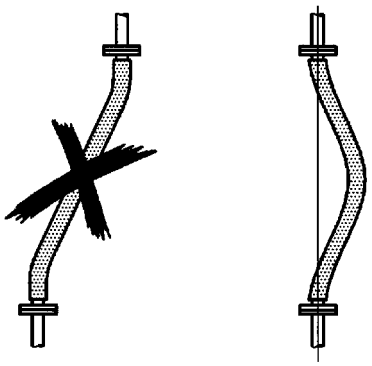


Figure 82: Arrangement of pipes in system

### Installation of hoses

In the case of straight-line-vertical installation, a suitable distance between the hose connections has to be chosen, so that the hose is installed with a sag. To satisfy a correct sag in a straight-line-vertically installed hose, the distance between the hose connections (hose installed, engine stopped) has to be approximately 5 % shorter than the same distance of the unconnected hose (without sag). Flexible hoses must not be installed with tensile stress, compression, or torsional tension.

In case it is unavoidable (this is not recommended) to connect the hose in lateral-horizontal direction (Y-direction) the hose must preferably be installed with a 90° arc. The minimum bending radii, specified in provided drawings, are to be observed.

Hoses must not be twisted during installation. Turnable lapped flanges on the hoses avoid this.

Where bolted connections are used, hold the hexagon on the hose with a wrench while fitting the nut.

All installation instructions of the hose manufacturer have to be complied with.

Depending on the required application rubber hoses with steel inlet, metal hoses or PTFE-corrugated hose lines are used.

### Installation of steel compensators

Steel compensators are used for hot media, for example, exhaust gas. They can compensate movements in line and transversal to their centre line, but they are unable to compensate twisting movements. Compensators are stiff against torsion. For this reason, all kind of steel compensators installed on resilient mounted engines are to be installed in vertical direction.

Note:
Exhaust gas compensators are also used to compensate for thermal expansion. Exhaust gas compensators are therefore required for all type of engine mountings, also for semi-resilient, or rigid mounted engines. But in these cases the compensators can be shorter, as they are designed only to compensate the thermal expansions and vibrations, but not other dynamic engine movements.

### Supports of pipes

Flexible pipes must be installed as close as possible to the engine connection.

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On the shipside, directly after the flexible pipe, the pipe is to be fixed with a sturdy pipe anchor of higher than normal quality. This anchor must be capable to absorb the reaction forces of the flexible pipe, the hydraulic force of the fluid and the dynamic force.

Example of the axial force of a compensator to be absorbed by the pipe anchor:

- Hydraulic force
  = (cross section area of the compensator) x (pressure of the fluid inside)
- Reaction force
  = (spring rate of the compensator) x (displacement of the comp.)
- Axial force
  = (hydraulic force) + (reaction force)

Additionally a sufficient margin has to be included to account for pressure peaks and vibrations.



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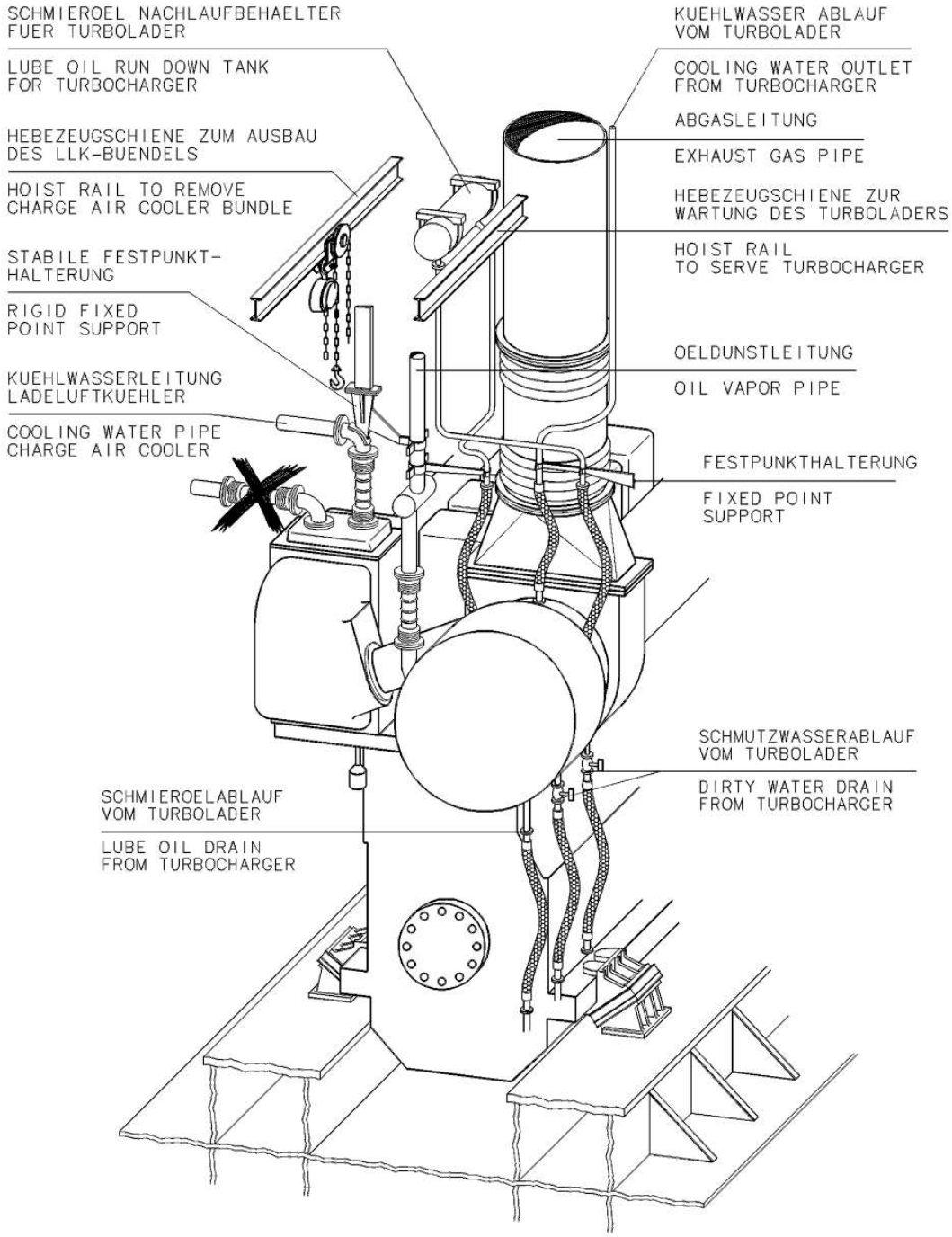



Figure 83: Installation of hoses

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### 5.2.4 Condensate amount in charge air pipes and air vessels

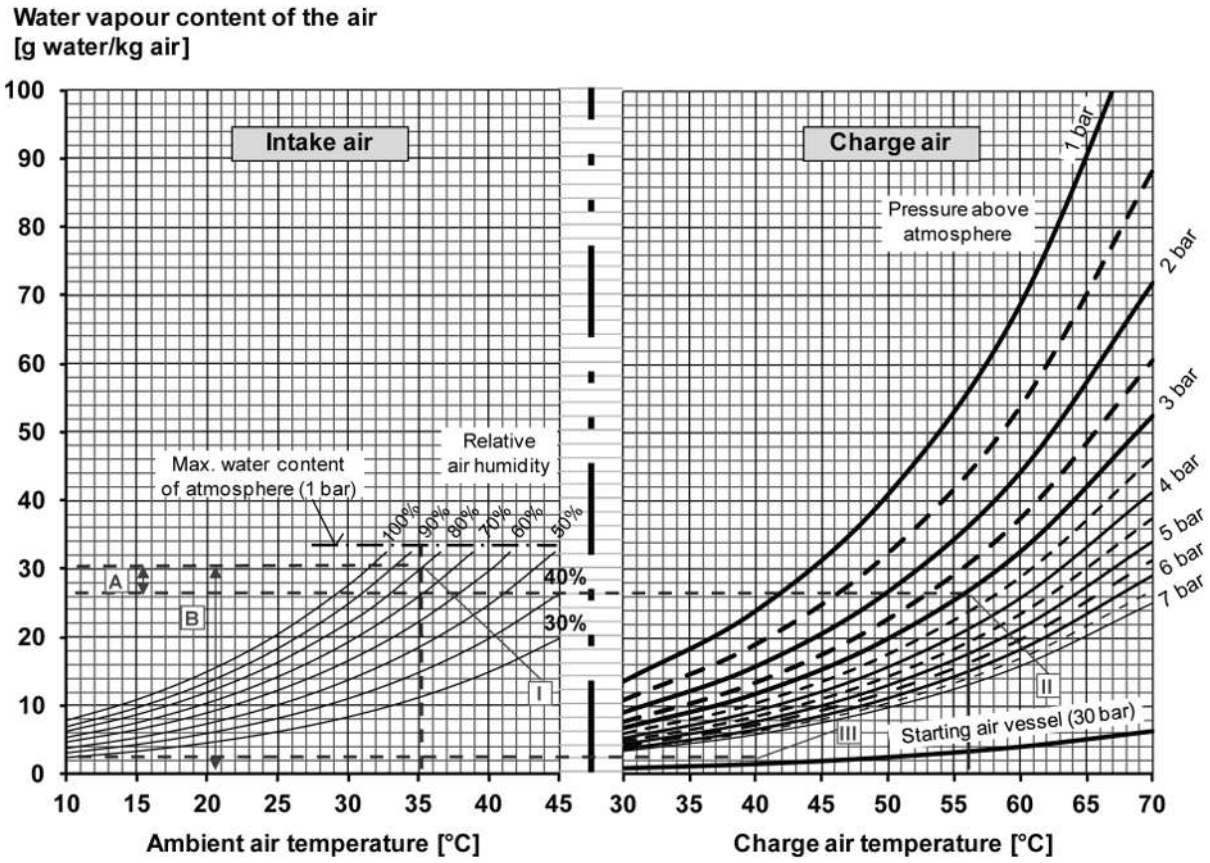



Figure 84: Diagram condensate amount

The amount of condensate precipitated from the air can be considerablly high, particularly in the tropics. It depends on the condition of the intake air (temperature, relative air humidity) in comparison to the charge air after charge air cooler (pressure, temperature).

It is important, that no condensed water of the intake air/charge air will be led to the compressor of the turbocharger, as this may cause damages.

In addition the condensed water quantity in the engine needs to be minimised. This is achieved by controlling the charge air temperature.

How to determine the amount of condensate:

First determine the point I of intersection in the left side of the diagram (intake air), see figure Diagram condensate amount, Page 421 between the corresponding relative air humidity curve and the ambient air temperature.

Secondly determine the point II of intersection in the right side of the diagram (charge air) between the corresponding charge air pressure curve and the charge air temperature. Note that charge air pressure as mentioned in section Technical data and engine performance, Page 107 is shown in absolute pressure.

At both points of intersection read out the values [g water/kg air] on the vertically axis.



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The intake air water content I minus the charge air water content II is the condensate amount A which will precipitate. If the calculations result is negative no condensate will occur.

For an example see figure Diagram condensate amount, Page 421. Intake air water content 30 g/kg minus 26 g/kg = 4 g of water/kg of air will precipitate.

To calculate the condensate amount during filling of the starting air receiver just use the 30 bar curve (see figure Diagram condensate amount, Page 421) in a similar procedure.

**Example how to determine the amount of water accumulating in the charge air pipe**

| Parameter | Unit | Value |
|---|---|---|
| Engine output (P) | kW | 9,000 |
| Specific air flow (le) | kg/kWh | 6.9 |
| Ambient air condition (I): | | |
| Ambient air temperature | °C | 35 |
| Relative air humidity | % | 80 |
| Charge air condition (II): | | |
| Charge air temperature after cooler | °C | 56 |
| Charge air pressure (over pressure) | bar | 3.0 |
| Solution according to above diagram | | |
| Water content of air according to point of intersection (I) | kg of water/kg of air | 0.030 |
| Maximum water content of air according to point of intersection (II) | kg of water/kg of air | 0.026 |
| The difference between (I) and (II) is the condensed water amount (A)<br>A = I – II = 0.03-0.026 = 0.004 kg of water/kg of air | | |
| Total amount of condensate $Q_A$:<br>$Q_A$ = A x le x P<br>$Q_A$ = 0.004 x 6.9 x 9,000 = 248 kg/h | | |

Table 620: Example how to determine the amount of water accumulating in the charge air pipe

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**Example how to determine the condensate amount in the starting air receiver**

| Parameter | Unit | Value |
|---|---|---|
| Volumetric capacity of tank (V) | litre<br>$m^3$ | 3,500<br>3.5 |
| Temperature of air in starting air receiver (T) | °C<br>K | 40<br>313 |
| Air pressure in starting air receiver ($p_{above\ atmosphere}$)<br>Air pressure in starting air receiver ($p_{absolute}$) | bar<br>bar abs<br>$\frac{N}{m^2}$ | 30<br>31<br>$31 \times 10^5$ |
| Gas constant for air (R) | $\frac{Nm}{kg \times K}$ | 287 |
| Ambient air temperature | °C | 35 |
| Relative air humidity | % | 80 |
| Weight of air in the starting air receiver is calculated as follows:<br>$m = \frac{p \times V}{R \times T} = \frac{31 \times 10^5 \times 3.5}{287 \times 313} = 121\,kg$ | | |
| Solution according to above diagram | | |
| Water content of air according to point of intersection (I) | kg of water/kg of air | 0.030 |
| Maximum water content of air according to point of intersection (III) | kg of water/kg of air | 0.002 |
| The difference between (I) and (III) is the condensed water amount (B)<br>B = I – III<br>B = 0.030 – 0.002 = 0.028 kg of water/kg of air | | |
| Total amount of condensate in the vessel ($Q_B$)<br>$Q_B$ = m x B<br>$Q_B$ = 121 x 0.028 = 3.39 kg | | |

Table 621: Example how to determine the condensate amount in the starting air receiver

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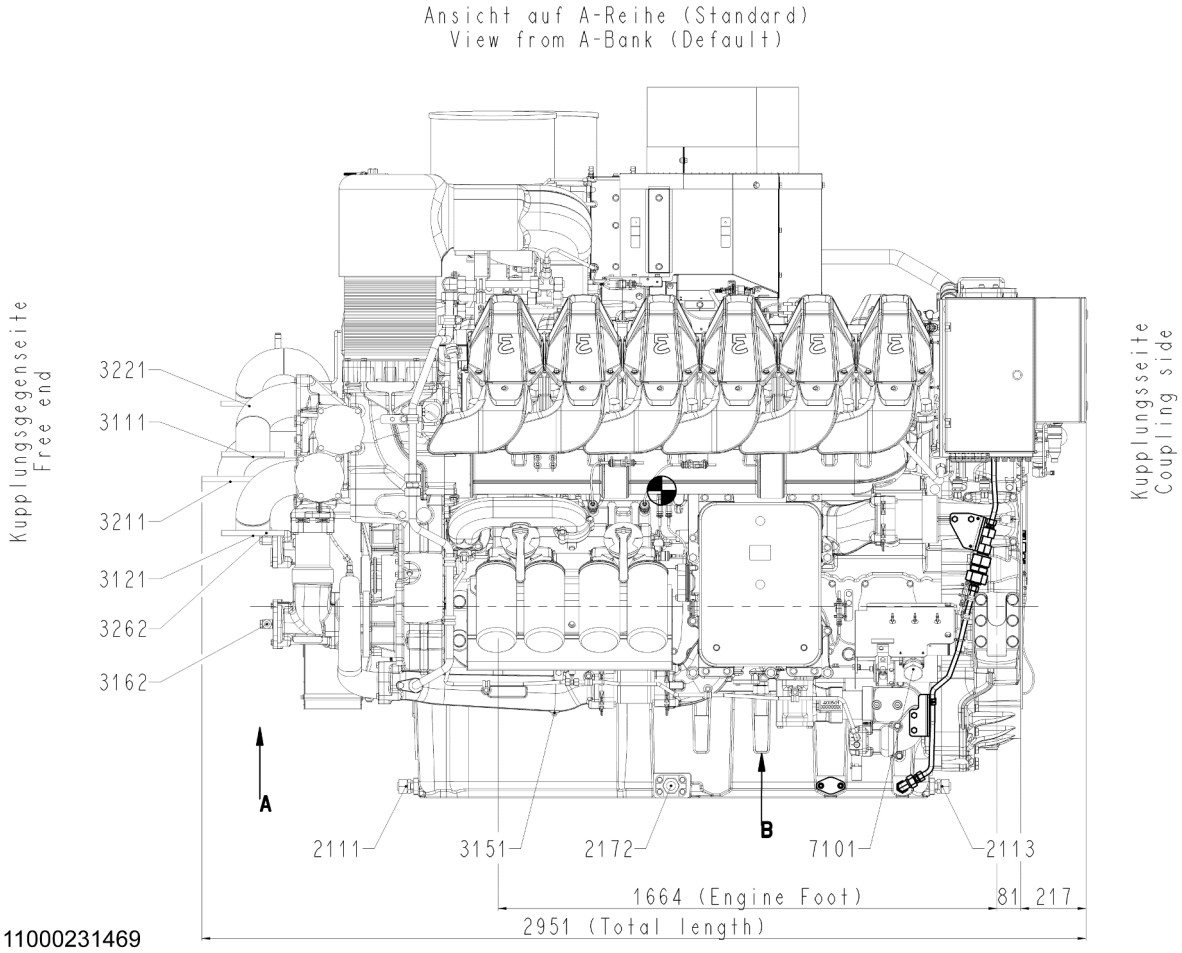
## 5.3 Media interfaces

The following presentation of the media connection numbers is for orientation only.

Final drawings will follow as part of the project-specific execution.

Be aware that distinct media connection numbers are linked to optional engine features only.

**Engine/GenSet**

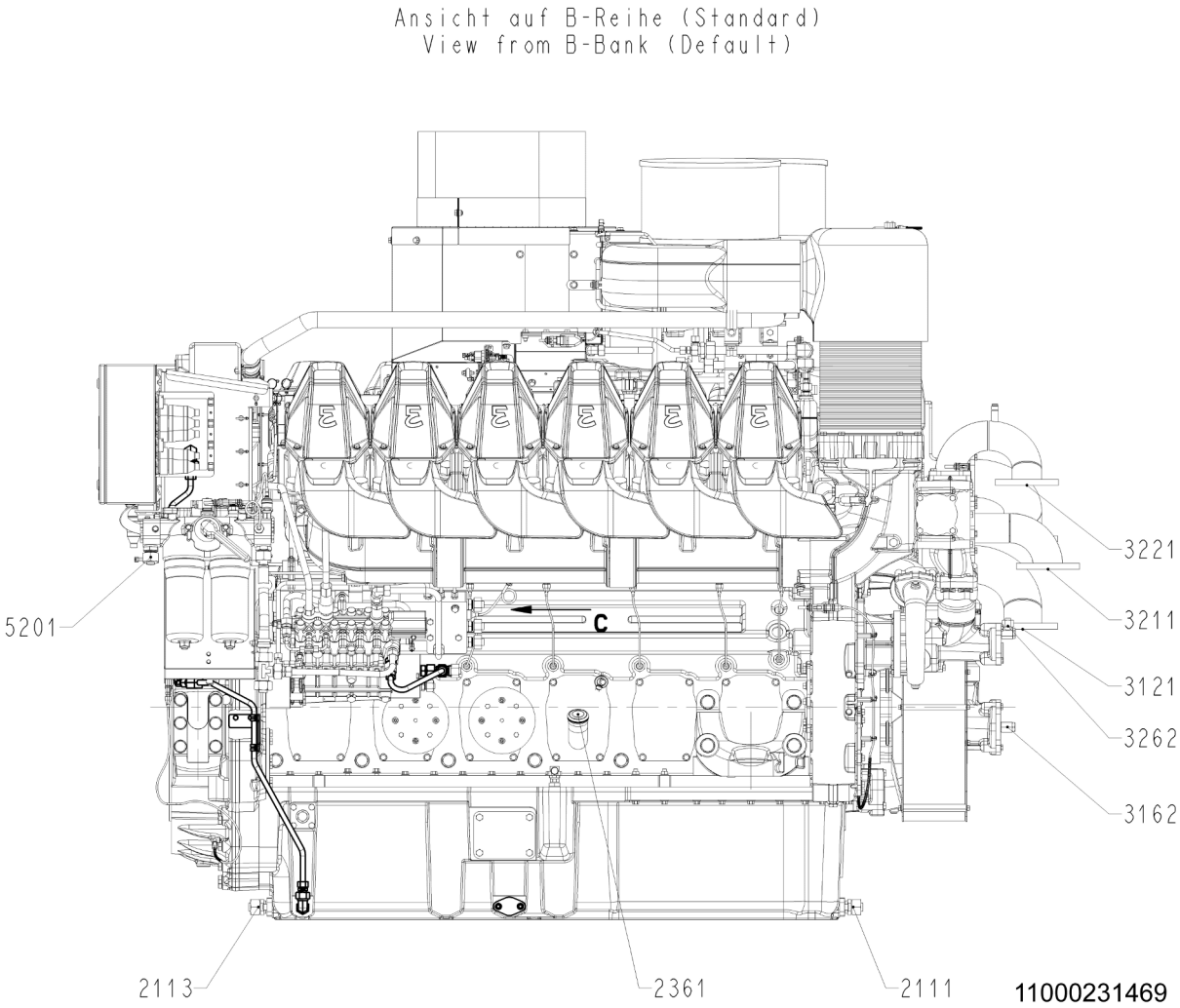



11000231469

2111 Lube oil drain from oil pan, counter coupling side 1
2113 Lube oil drain from oil pan, coupling side 1
2172 Lube oil outlet from base frame tank to prelubrication pump
3111 HT cooling water outlet on engine
3121 HT cooling water inlet to cooling water pump 1
3151 Drain of HT cooling water pipe 1
3162 HT cooling water inlet from expansion tank
3165 HT cooling water inlet from preheater 2
3211 LT cooling water outlet from engine 1
3262 LT cooling water inlet from expansion tank
7101 Starting air inlet to engine

Figure 85: Media interfaces, engine/GenSet – Side view on A-bank (default)

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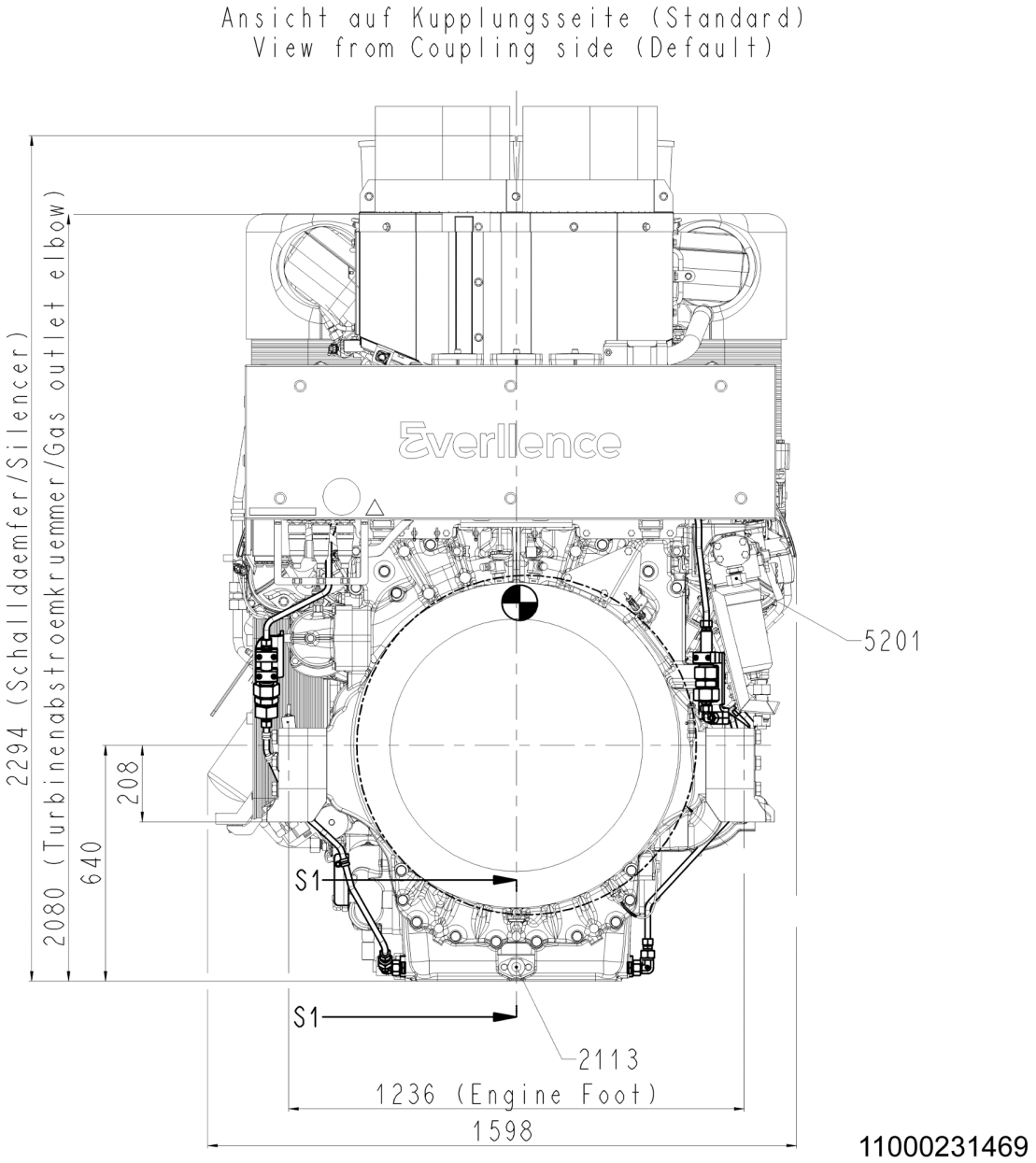



2111 Lube oil drain from oil pan, counter coupling side 1
2113 Lube oil drain from oil pan, coupling side 1
2361 Lube oil filling connection on base frame tank
3121 HT cooling water inlet to cooling water pump 1
3162 HT cooling water inlet from expansion tank
3211 LT cooling water outlet from engine 1
3221 LT cooling water inlet to cooling water pump
3262 LT cooling water inlet from expansion tank
5201 Fuel oil inlet to engine

Figure 86: Media interfaces, engine/GenSet - Side views on B-bank (default)



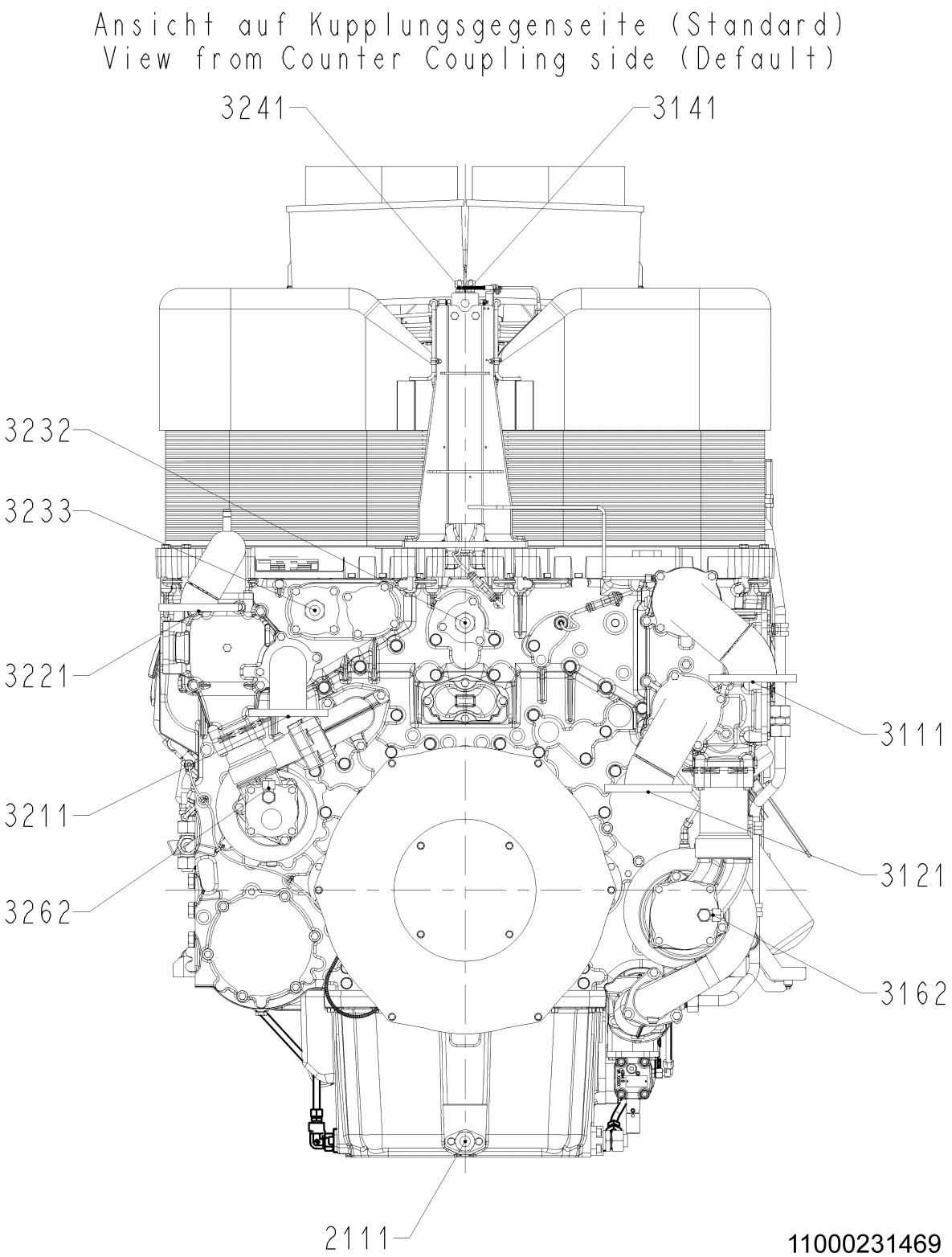
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5201 Fuel oil inlet to engine

Figure 87: Media interfaces, engine/GenSet – View on coupling side (default)

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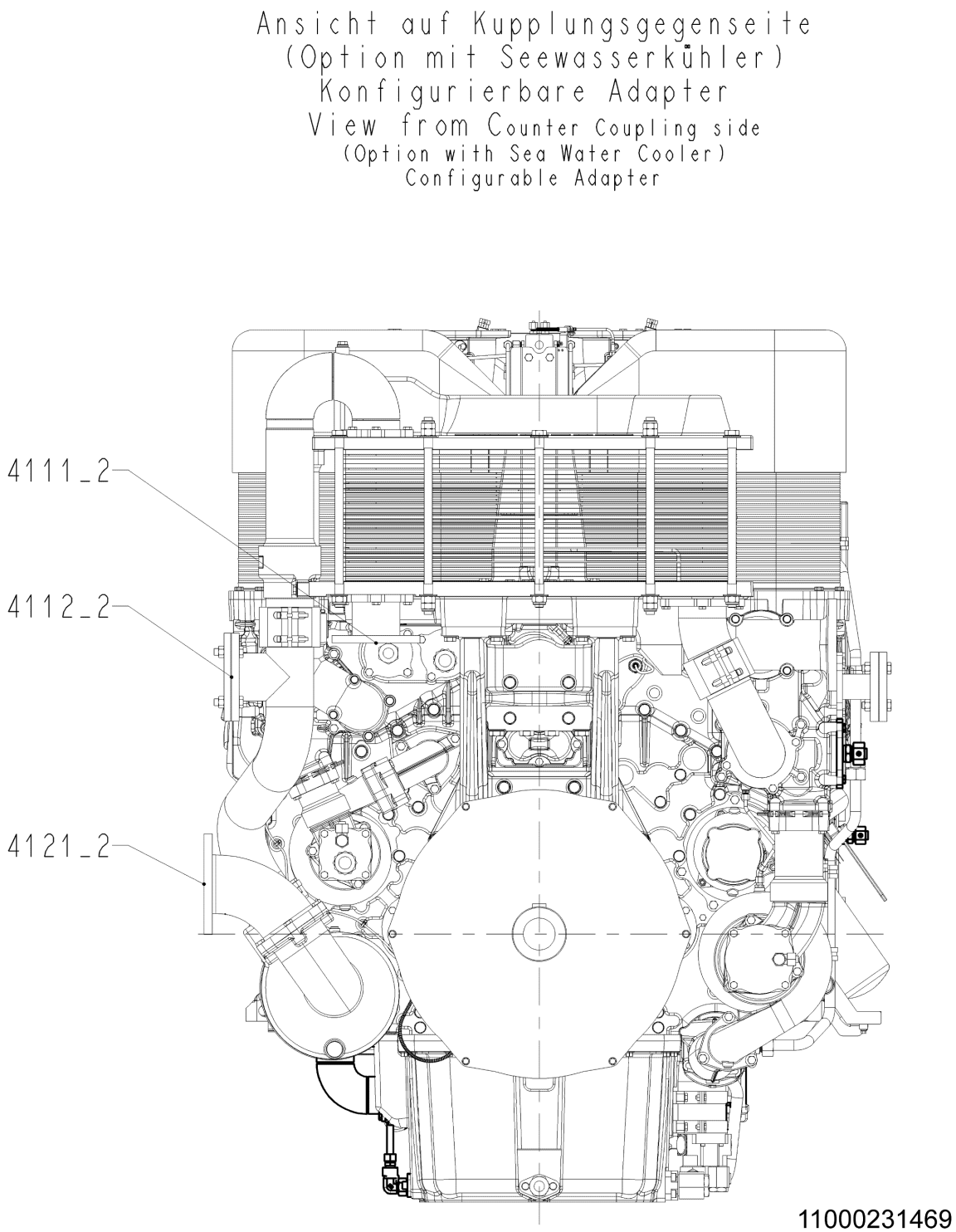



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2111 Lube oil drain from oil pan, counter coupling side 1
3111 HT cooling water outlet on engine
3121 HT cooling water inlet to cooling water pump 1
3141 Venting of HT cooling water pipe 1
3162 HT cooling water inlet from expansion tank
3211 LT cooling water outlet from engine 1
3221 LT cooling water inlet to cooling water pump
3232 LT cooling water outlet to fuel oil cooler
3233 LT cooling water inlet from fuel oil cooler
3241 Venting of LT cooling water pipe 1
3262 LT cooling water inlet from expansion tank

Figure 88: Media interfaces, engine/GenSet - View on counter coupling side (default)

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4111_2 Sea water outlet from sea water cooler

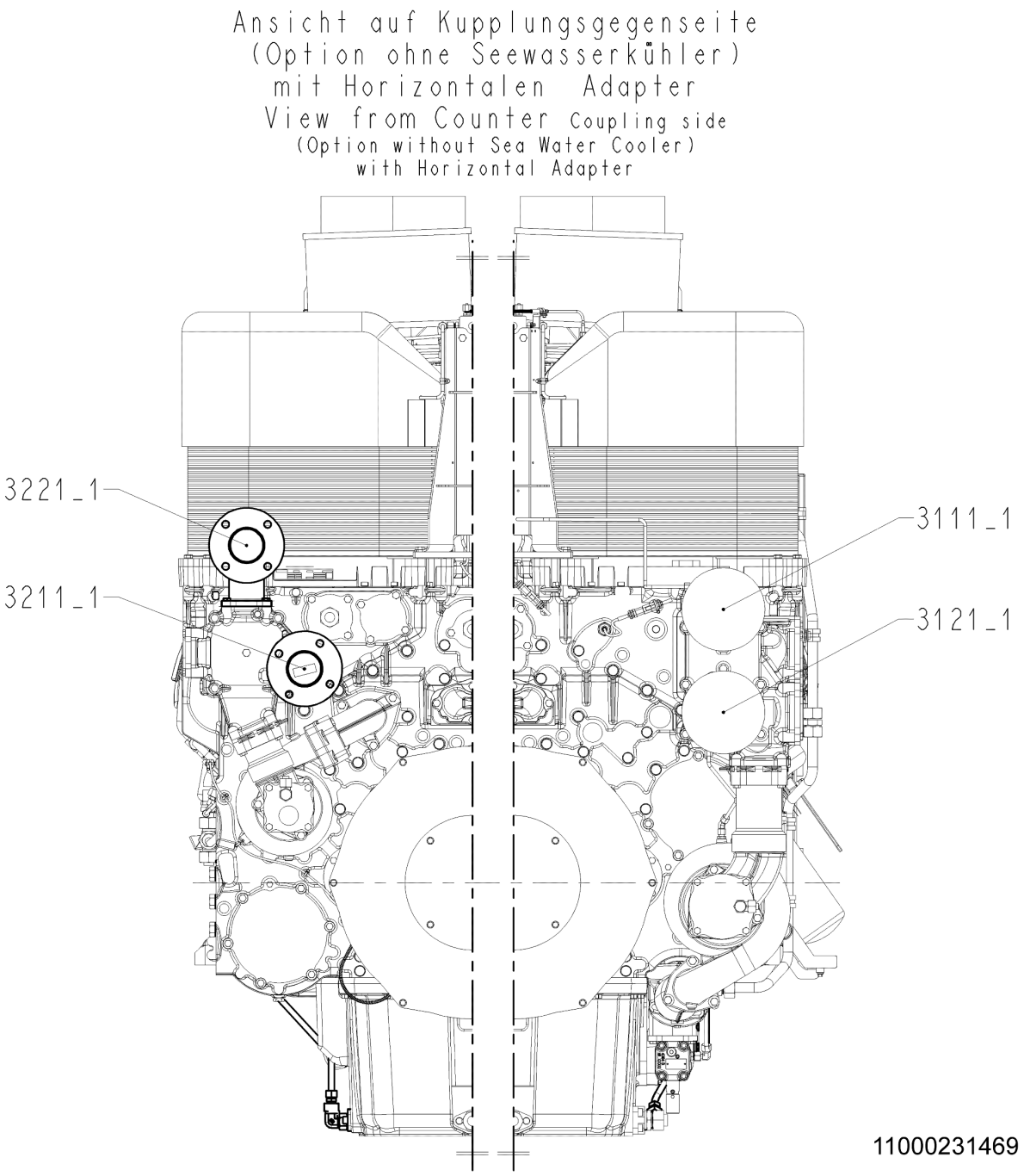
4112_2 Sea water outlet to auxiliary consumer

4121_2 Sea water inlet to sea water pump

Figure 89: Media interfaces, engine/GenSet - View on counter coupling side (with seawater cooler)



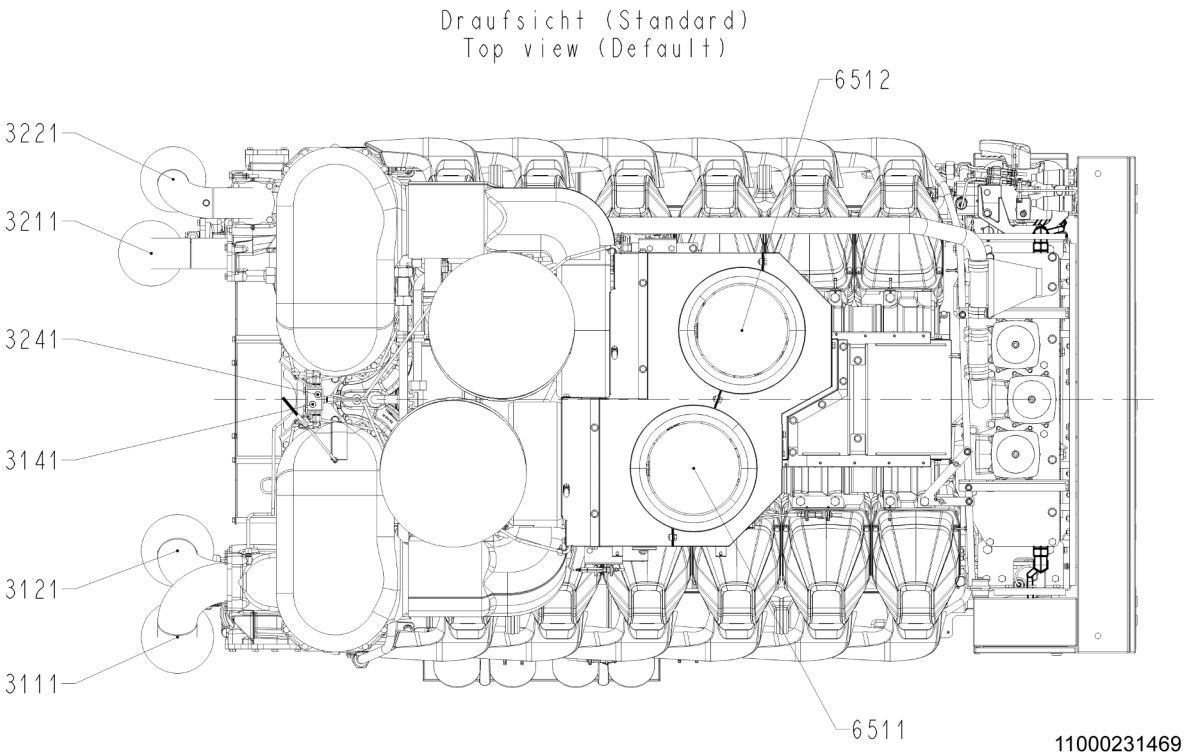
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| | | | |
|---|---|---|---|
| 3111_1 | HT cooling water outlet from engine | 3211_1 | LT cooling water outlet from engine 1 |
| 3121_1 | HT cooling water inlet to cooling water pump 1 | 3221_1 | LT cooling water inlet to cooling water pump |

Figure 90: Media interfaces, engine/GenSet - View on counter coupling side (without seawater cooler)

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3111 HT cooling water outlet from engine
3121 HT cooling water inlet to cooling water pump 1
3141 Venting of HT cooling water pipe 1
3211 LT cooling water outlet 1 on engine
3221 LT cooling water pump inlet
3241 Venting of LT cooling water pipe
6511 Exhaust gas outlet from turbocharger 1
6512 Exhaust gas outlet from turbocharger 2

Figure 91: Media interfaces, engine/GenSet - Top view (default)



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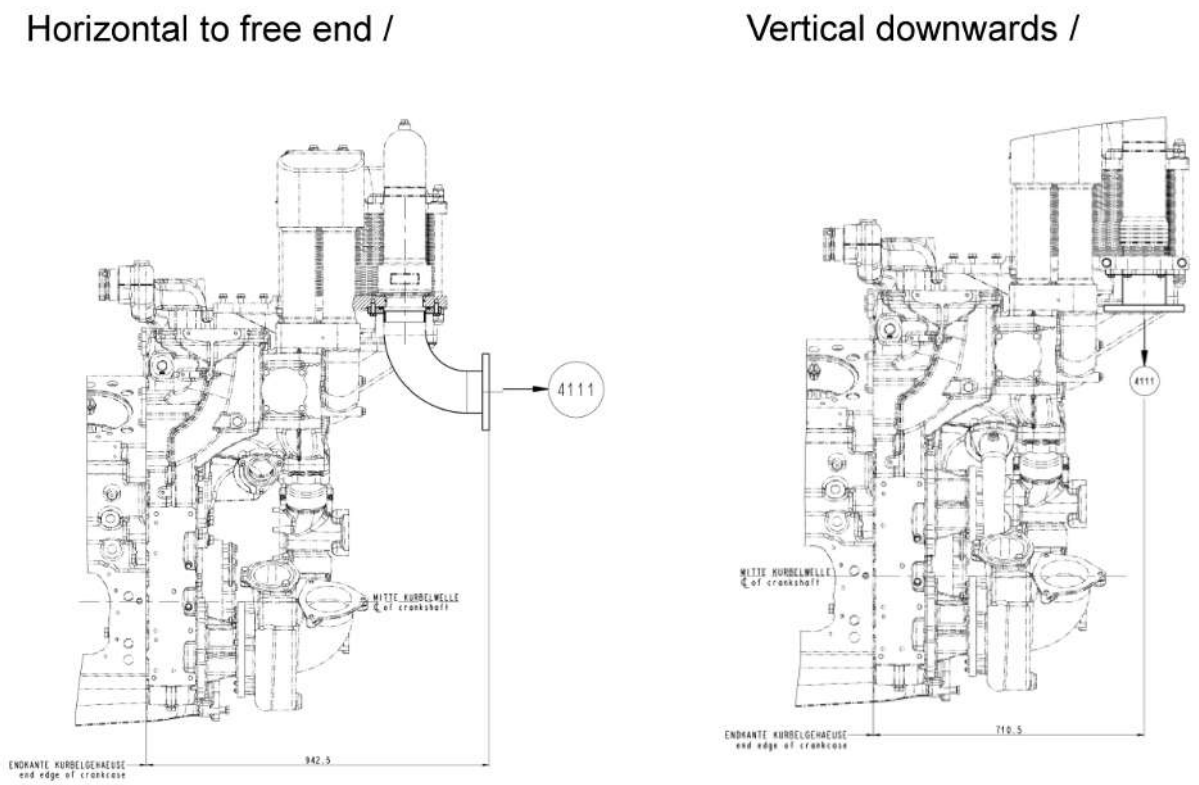



Figure 92: Media interfaces, engine/GenSet - Sea water outlet

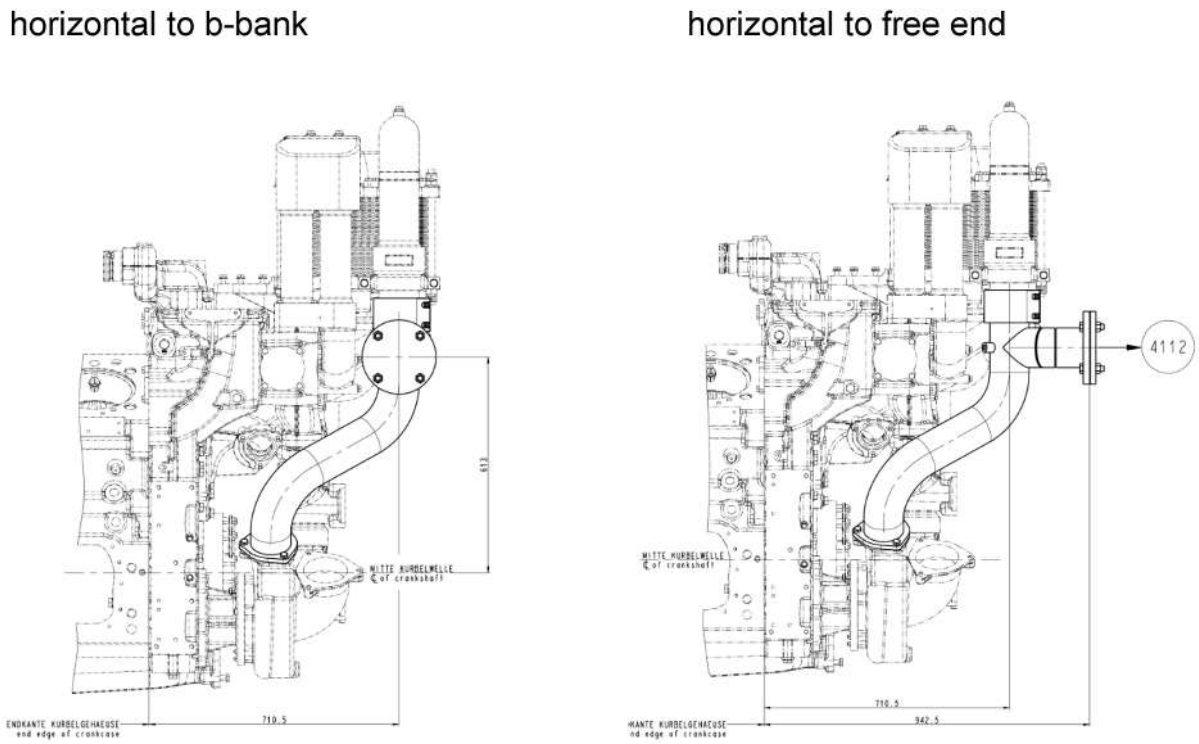



Figure 93: Media interfaces, engine/GenSet - Sea water outlet to auxiliary consumer

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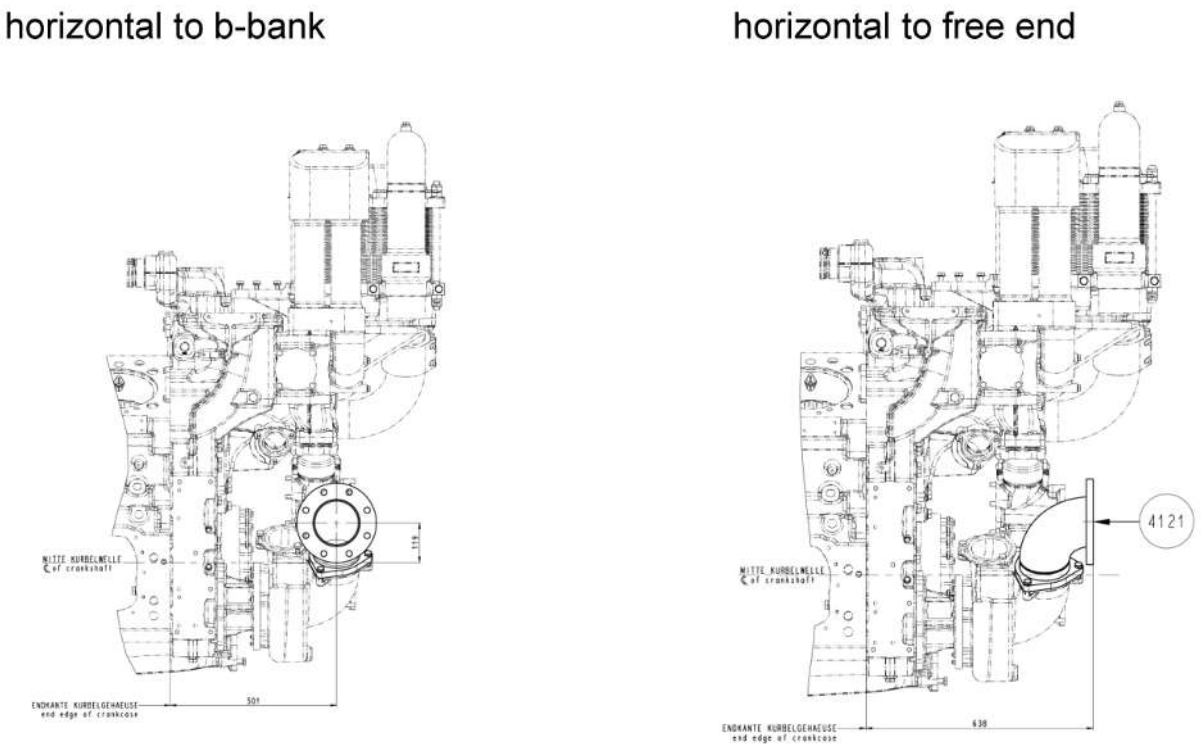



Figure 94: Media interfaces, engine/GenSet - Sea water pump inlet

## 5.4 Lube oil system

### 5.4.1 Internal lube oil system

To easen the installation of the 175D all core components of the lube oil system are already integrated in the engine design. The lube oil system is typically independent from the plant.
The only interface is the refilling pipe which serves both as the main refilling and draining point in standard engine operation.
The engine is supplied as a standard with full-flow spin-on lube oil filters, replaceable during engine operation and suitable for most applications.

In the event of failure of the attached lubricating oil pump, the regulations of some classification societies require redundancy through a stand-by pump on the plant side.
The required engine connection adapters are available as options (for interfaces see section Media interfaces, Page 423). In this case, the engine mounted lubricating oil centrifuge must be dismantled. For more details concerning stand-by pump design data contact Everllence.

As a standard:

- Engine equipment with attached lube oil pump, lube oil cooler, filter and optional available attached prelubrication pump (electric driven).

Below stated internal media schemata state the principal layout.



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### Prelubrication

The purpose of a prelubrication pump is supplying the engine with lubricating oil before starting the engine. The pump should initially fill and bleed the lubricating oil system and transport oil to all positions of the engine in the lubricating oil circuit that are lubricated during normal operation (main-, connecting rod-, camshaft bearings, rocker arms, and so on). A vented lubricating oil system ensures that the oil pressure builds up quickly after the engine has been started and thus minimises wear on the mechanical parts during the starting process. The oil on the engine bearings due to the prelubrication ensures immediate lubrication during the first engine revolutions until the engine oil pump (gear driven) can build up oil pressure and takes over the general lubrication of the engine. Since a sufficient supply of lubricating oil, particularly to the fuel injection pump, must be ensured when the engine is started, prelubrication is fundamentally mandatory for all applications.

Note:
To avoid over-lubrication (for example, oil entering the cylinder), permanent prelubrication is not permitted.

The control logic of the prelubrication pump is integrated into engine automation and is part of the starting sequence.

The SaCoS automation system from Everllence fulfils the following functions regarding prelubrication:

- Activation of the prelubrication sequence after the engine start command. The engine is started after a specified lubricating oil pressure has been reached, measured at the engine inlet.
- The prelubrication pump can also be controlled independently of the engine start using a manual button on the display for maintenance, emptying, and so on. The pump is released by SaCoS (only possible when the motor is at a standstill).
- If the engine is stopped during an active prelubrication sequence ("engine stop" or "emergency stop"), the prelubrication sequence is aborted prematurely.
- In case of an emergency, the engine can be started directly by activating the "Deactivation of Pre-Lubrication at start" function during or without a prelubrication sequence.

Prelubrication pump (electric driven)

An engine-mounted prelubrication pump is optionally available.

Performance data engine-mounted 24-V pump

21°C: 7–9 $m^3$/h @ 100–130 A 5°C: 4.5–7 $m^3$/h @ 140–170 A
Maximum duty cycle: 5 min ON & 30 min OFF @ < 125 A
Ambient temperature: –40°C to 125°C

| Wire size | Total length (24-V system) |
|---|---|
| 25 $mm^2$ | 11 m |
| 35 $mm^2$ | 16 m |

Longer lengths are possible with larger cables.
Maximum electrical resistance of all cabling is: 24-V system – 0.010 ohm.

Alternatively, a plant-side prelubrication pump can be used.

The control must executed in the same way as the engine-mounted pump via SaCoS.
-> SaCoS supplies digital output signal ON/OFF

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Required performance data for the system-side pump (flow rate and pressure): 9 $m^3$/h at 2.5 bar.

If the prelubrication pump is installed on the system side, the required engine connection adapters are part of the scope of supply (see section Media interfaces, Page 423).

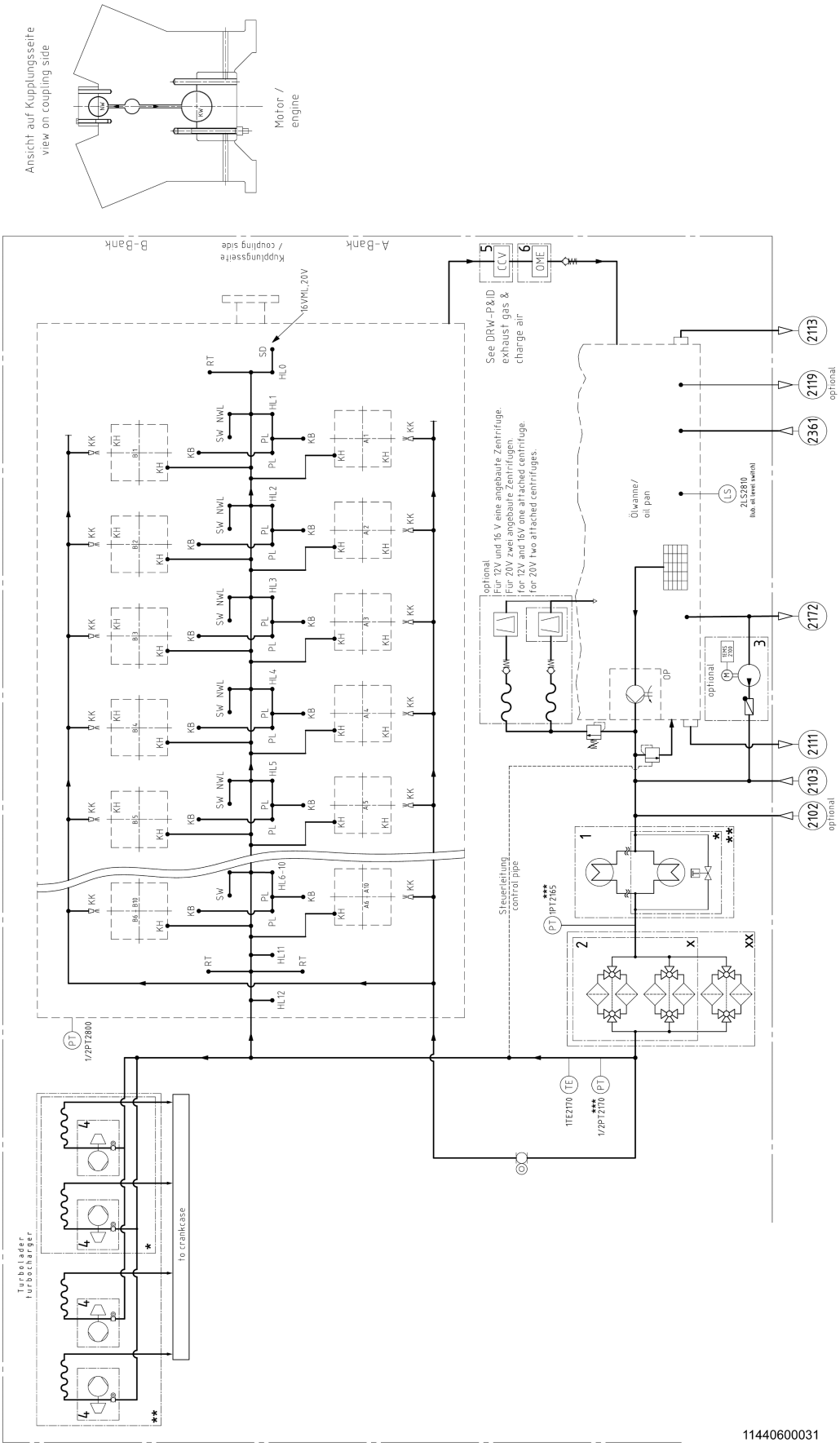
### Lube oil centrifuge

The optional lube oil centrifuge filters out finest particles from the engine lube oil. Via centrifugal force the dirt particles are pressed together and form a "thick cake". This helps to reduce engine wear and increase lube oil lifetime.



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## 5.4 Lube oil system






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1 Oil cooler
2 Oil filter
3 Prelubrication (optional)

Connection numbers

2102 Lube oil inlet to engine (reserve connection)
2103 Lube oil inlet to engine (from prelubrication pump)
2111 Lube oil drain from oil pan, CCS 1
2113 Lube oil drain from oil pan, CS 1
4 Turbocharger lubricating oil
5 Closed crankcase ventilation
6 Oil mist eliminator
2119 Lube oil outlet from engine (reserve connection)
2172 Lube oil outlet to prelubrication pump
2361 Lube oil filling connection on oil pan

Figure 95: Internal lube oil system 12V engine – Exemplary

### 5.4.2 External lube oil system

#### P-012/Lube oil transfer pump

The lube oil transfer pump supplies fresh oil from the oil storage tank to the filling tube with sealing cap.

The connections 2111 and 2113 are oil drains for dumping the lube oil out of the oil pan. Standard closed with oil drain screws.

#### Lube oil preheating

Only necessary when engine room temperature less than 5°C. A lube oil preheater can be supplied by Everllence. Contact Everllence for technical drawings of auxiliary equipment.

#### FIL-004/Lube oil suction strainer

The lube oil suction strainer protects the lube oil pumps against larger dirt particles that may have accumulated in the oil pan of the engine. It is recommended to use a cone type strainer with a mesh size of 1.5 mm. Two manometers installed before and after the strainer indicate when manual cleaning of filter becomes necessary, which should preferably be done in port.

#### P-007/P-074/Lube oil pumps

For prelubrication two variants are selectable:

- Prelubrication pump P-007 mounted on engine (24V, direct current power supply necessary)
- Prelubrication pump P-007 free-standing as auxiliary equipment

For the free-standing prelubrication pump P-007, an orifice on the discharge side could be necessary, to comply with the required differential pressure over the pump given by the pump manufacturer. The request for prelubrication is given by engine control system.

According to some class rules a stand-by pump (free-standing) P-074 can be necessary as a redundancy. The request for activation of stand-by pump must be done manually.

Pump shall be activated in case of "lube oil pressure low" alarms during engine operation, which are caused by a wear of the main lube oil pump. Other reasons for lube oil pressure low alarms, like blocked filters or low oil levels must be excluded in advance to avoid damages at the pump.



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Both lube oil pumps (P-007, P-074) must be equipped with non-return valves on the discharge side to prohibit an oil flow against the discharge direction back into the oil pan of the engine.

The lube oil pumps (P-007, P-074) must be located as low as possible and close to the engine to prevent cavitation. The pressure drop in the piping must not exceed the suction capability of the pump. With adequate diameter straight line and short length the pressure drop can be kept low.

### FIL-027/Lube oil fine filter

The lube oil fine filter is an option for offline treatment of engine lubricating oil. It is not of self-cleaning type, therefore the filter elements need to be replaced.

Based on the engine, the number of filter elements of the fine filter has to be selected according to the evaluation table of the maker. The table per maker is based on a fixed filter life time stated in the table (filter lifetime in engine operating hours). This has to be considered carefully. For a longer filter exchange interval, the number of filter elements has to be increased.

The information regarding released manufacturers and filter types for lube oil fine filters can be found here.

### Fine filter equipment

The fine filter connects to the engine lube oil pan via drain connections (2111, 2113), as well as to the fresh and dirty oil tank. Unlike with a built on lube oil centrifuge, the lube oil fine filter can be used in combination with the standby pump P-074. The module supports filling the engine oil pan with filtered oil. It also enables draining of the engine lube oil. When used for draining, precautions must be taken to prevent dry running of the lube oil pump; operation must follow the specifications provided in the pump manufacturer's documentation.

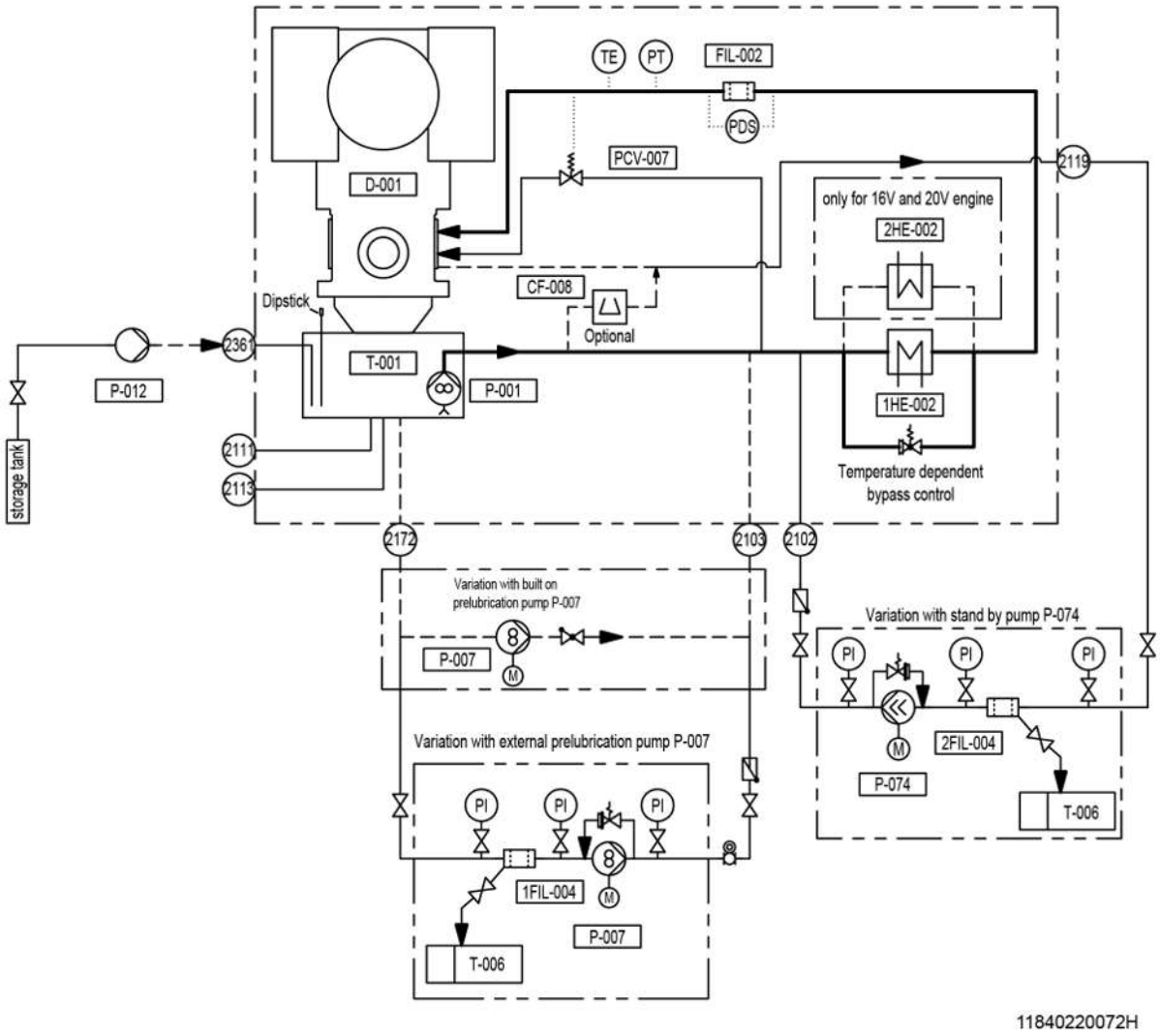
The filter incorporates an optional preheater to condition the lube oil prior to engine startup. The preheater is also available as a retrofit for existing fine filters.

A designated sampling point is available on the module to support routine oil condition monitoring, recommended once per month.

Depending of the size of the fine filter, a lifting possibility above the filter housing can be necessary.

The supply pump is mounted on the same frame as the fine filter. Therefore, the module is to be installed in the immediate vicinity of the lube oil pan. This arrangement has the advantage of suction of lube oil without causing cavitation.

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**Components**

| | |
|---|---|
| CF-008 | Lube oil centrifugal filter |
| D-001 | Diesel engine |
| FIL-002 | Lube oil filter |
| 1.2 FIL-004 | Lube oil suction strainer |
| 1.2 HE-002 | Lube oil cooler |
| P-001 | Lube oil service pump (engine driven) |
| P-007 | Prelubrication pump (built on) |
| P-012 | Lube oil transfer pump, hand operated |
| P-074 | Lube oil stand-by pump, free-standing |
| PCV-007 | Pressure control valve |
| T-001 | Wet lube oil sump |
| T-006 | Leakage oil collecting tank |

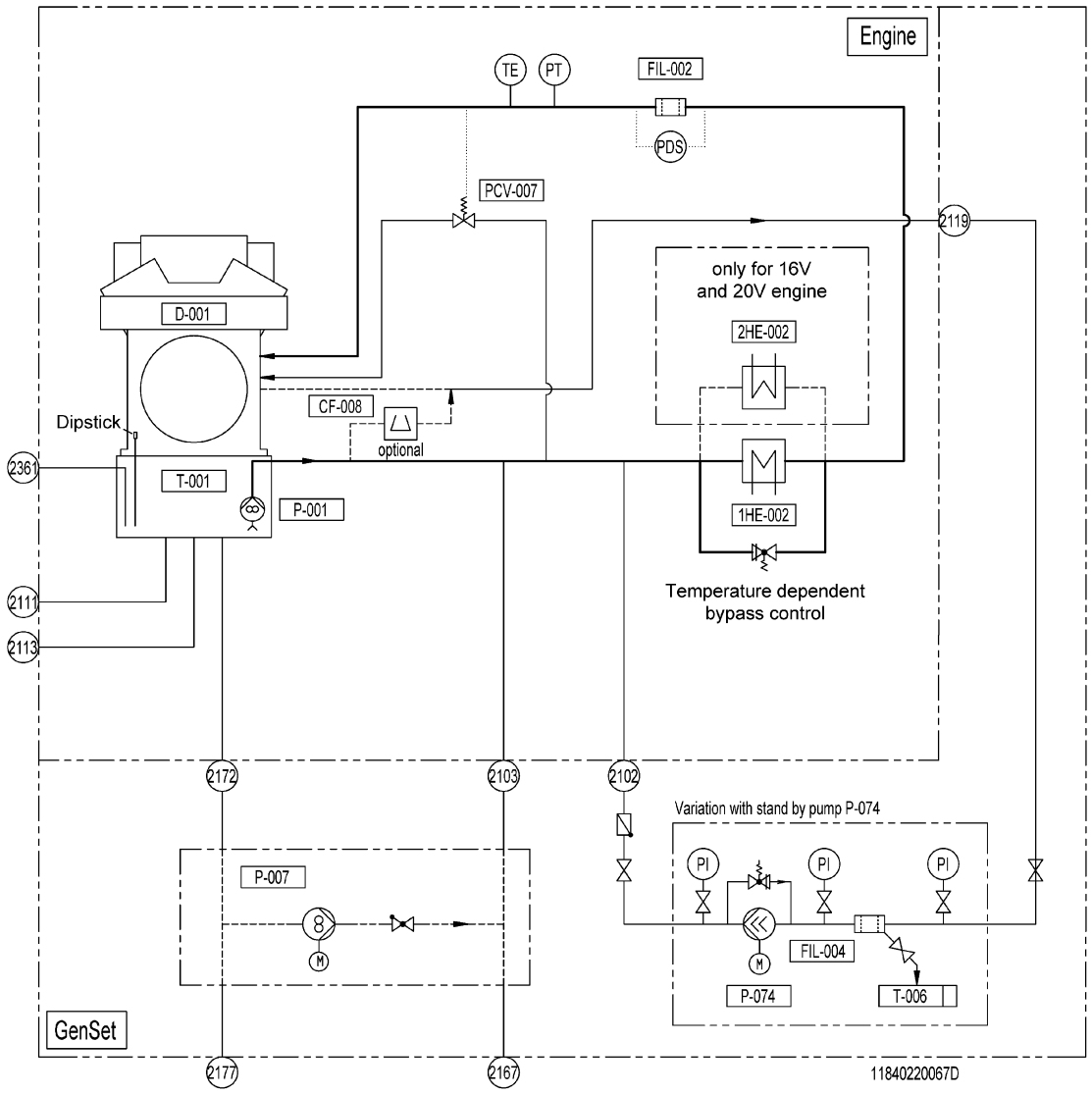
**Connection numbers**

| | |
|---|---|
| 2102 | Lube oil inlet to engine (reserve connection) |
| 2103 | Lube oil inlet to engine (from prelubrication pump) |
| 2111 | Oil drain (counter coupling side) |
| 2113 | Oil drain (coupling side) |
| 2119 | Lube oil outlet from engine (reserve connection) |
| 2172 | Lube oil outlet to prelubrication pump |
| 2361 | Oil tank fill connection (can also be used for drain the lube oil sump) |

Figure 96: External lube oil system



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**Components**

| | |
|---|---|
| CF-008 | Lube oil centrifugal filter |
| D-001 | Diesel engine |
| FIL-002 | Lube oil filter |
| FIL-004 | Lube oil suction strainer |
| 1.2 HE-002 | Lube oil cooler |
| P-001 | Lube oil service pump (engine driven) |
| P-007 | Prelubrication pump (built on) |
| P-074 | Lube oil stand-by pump, free-standing |
| PCV-007 | Pressure control valve |
| T-001 | Wet lube oil sump |
| T-006 | Leakage oil collecting tank |

**Connection numbers**

| | |
|---|---|
| 2102 | Lube oil inlet to engine (reserve connection) |
| 2103 | Lube oil inlet to engine (from prelubrication pump) |
| 2111 | Oil drain (counter coupling side) |
| 2113 | Oil drain (coupling side) |
| 2119 | Lube oil outlet from engine (reserve connection) |
| 2167 | Prelubrication pump connection pressure side (for lube oil exchange) |
| 2172 | Lube oil outlet to prelubrication pump |
| 2361 | Oil tank fill connection (can also be used for drain the lube oil sump) |

Figure 97: External lube oil system - GenSet

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## 5.5 Crankcase ventilation system

A closed crankcase ventilation system is installed on the 175D engine by default. Crankcase air flows through oil separators into the air inlet of the turbocharger compressors. The collected oil drains back to the oil pan via dedicated pipes.

## 5.6 Cooling water system

### 5.6.1 Internal cooling water system

To easen the installation of the 175D several components and functions are already integrated into the engine design and distinct further options can be offered.

As a standard:

- Engine has a split cooling water system with a high temperature (HT) circuit and a low temperature (LT) circuit.
- For each circuit an engine-driven pump and built-in temperature control valve are installed.

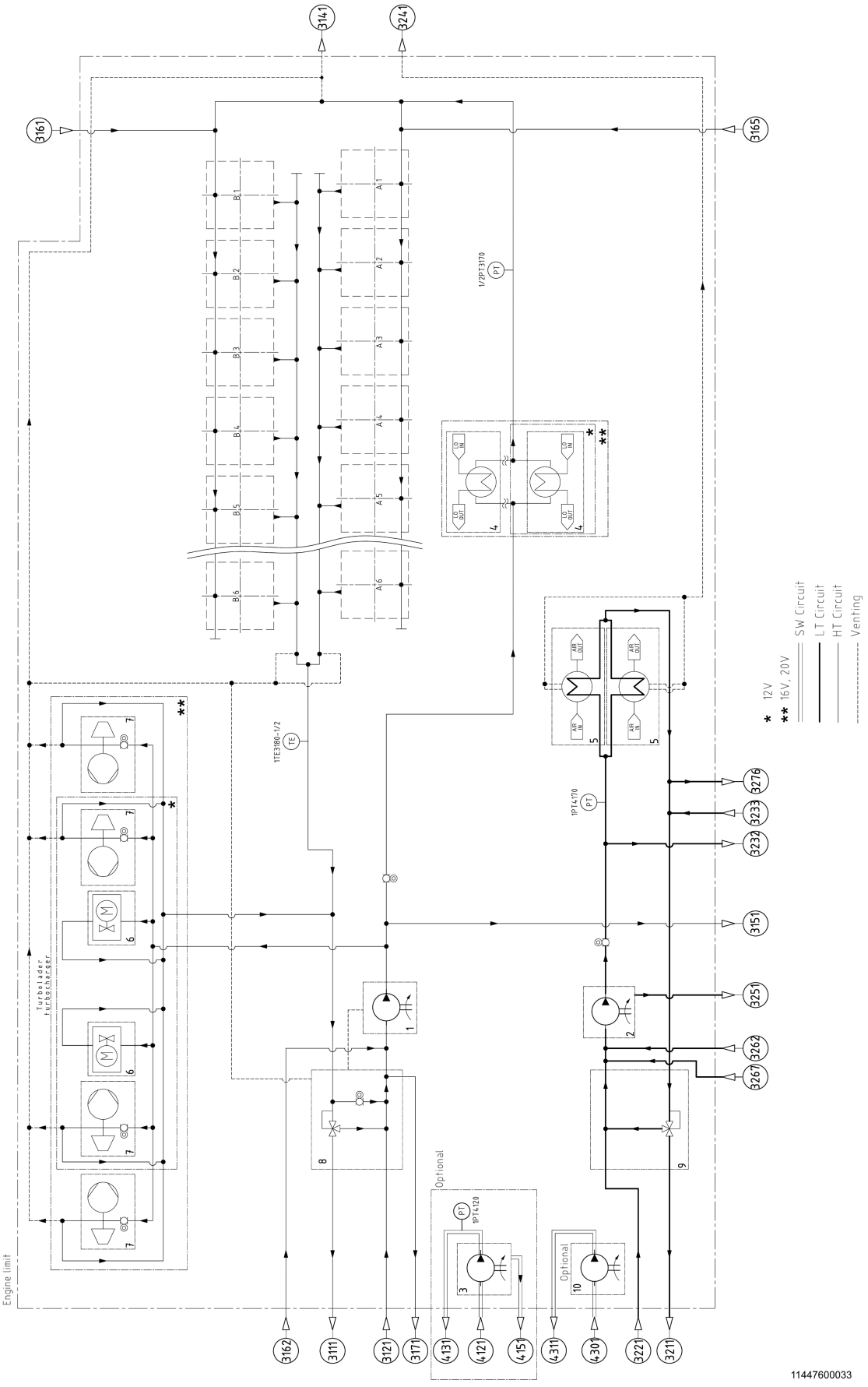
As an option can be supplied:

- Seawater cooler plus seawater pump
- Seawater pump
- Fresh cooling water auxiliary pump

Below stated internal media schemata state the principal layout.



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3141
3241
3161
3165
1/2PT3170
PT
1TE3380-1/2
TE
1PT4170
PT
3276
3233
3232
3151
3251
3262
3267
Turbolader
Turbocharger
Engine limit
Optional
1PT4120
Optional
3162
3111
3121
3171
4133
4121
4151
4311
4301
3221
3211
* 12V
** 16V, 20V
SW Circuit
LT Circuit
HT Circuit
Venting
11447600033

1 HT pump
2 LT pump
3 SW pump (optional)
4 Oil cooler
5 Charge air cooler
6 Waste gate
7 Turbocharger
8 Thermostate housing HT
9 Thermostate housing LT
10 Treated water pump

Connection numbers

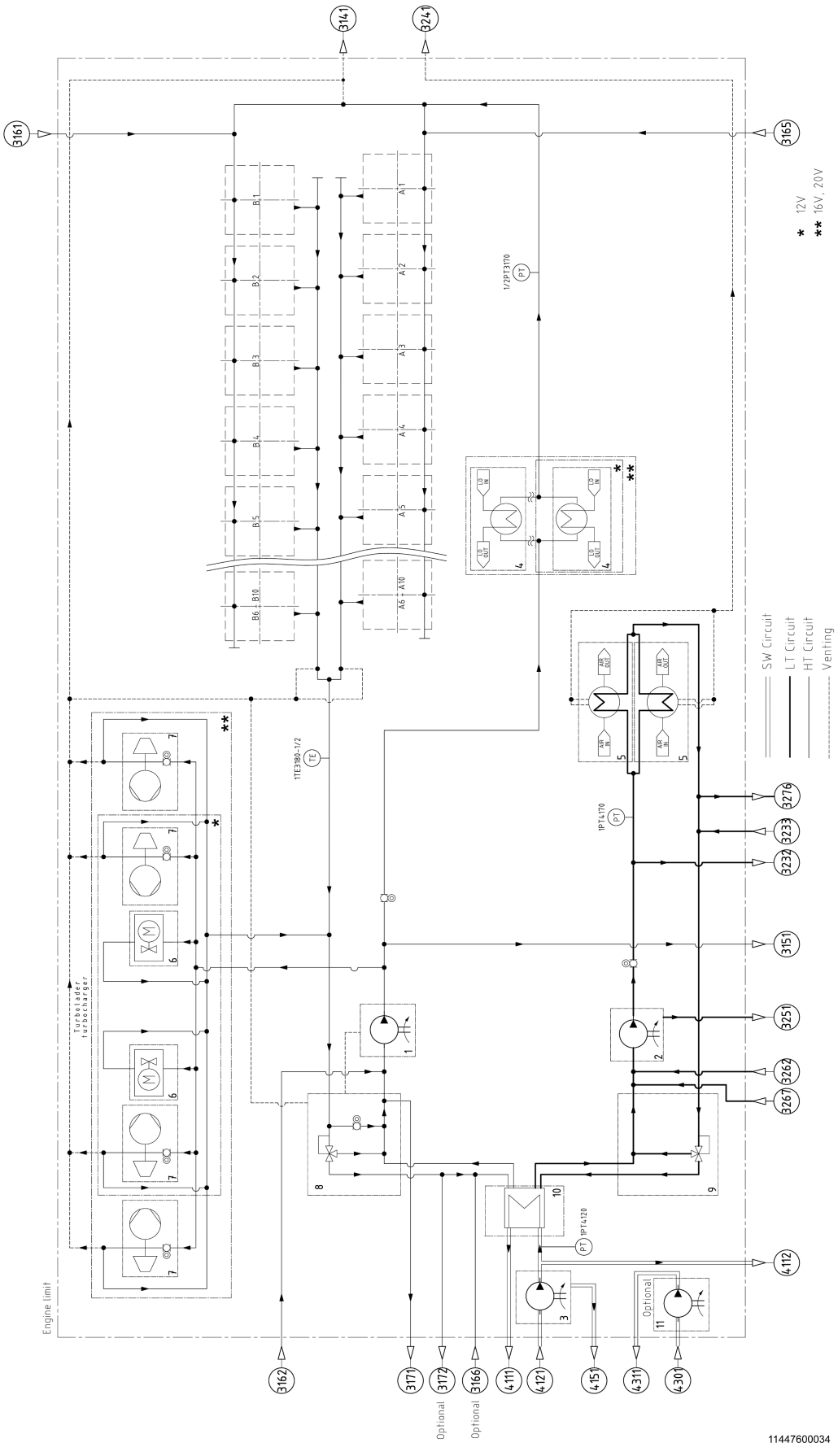
3111 HT cooling water outlet from engine
3121 HT cooling water inlet to cooling water pump
3141 Venting of HT cooling water pipe
3151 Drain of HT cooling water pipe
3161 HT cooling water inlet from preheater 1
3162 HT cooling water inlet from expansion tank
3165 HT cooling water inlet from preheater 2
3171 HT cooling water outlet to preheater
3211 LT cooling water outlet from engine
3221 LT cooling water inlet to cooling water pump
3232 LT cooling water outlet to fuel oil cooler
3233 LT cooling water inlet from fuel oil cooler
3241 Venting of LT cooling water pipe
3251 Drain of LT cooling water pipe
3262 LT cooling water inlet from expansion tank
3267 LT cooling water inlet from LT preheater (optional)
3276 LT cooling water outlet to LT preheater (optional)
4121 Sea water inlet to sea water pump
4131 Sea water outlet from sea water pump
4151 Drain of sea water pump (optional)
4301 Treated fresh water engine inlet (optional)
4311 Treated fresh water engine outlet (optional)

Figure 98: Internal cooling water system – With option for attached seawater pump 12V engine – Exemplary

Note:
The drawing shows the basic internal media flow of the engine in general.
Project-specific drawings thereof don´t exist.



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3141
3241
3161
3165
* 12V
** 16V, 20V
1/2PT3170
1TE3180-1/2
1PT4170
1PT4120
SW Circuit
LT Circuit
HT Circuit
Venting
Engine limit
Turbolader
turbocharger
Optional
3162
3171
3172
3166
4111
4121
4151
4311
4301
3276
3233
3232
3151
3251
3262
3261
4112
11447600034

1 HT pump
2 LT pump
3 SW pump
4 Oil cooler
5 Charge air cooler
6 Waste gate
7 Turbocharger
8 Thermostate housing HT
9 Thermostate housing LT
10 Sea water cooler
11 Treated water pump

Connection numbers

3141 Venting of HT cooling water pipe
3151 Drain of HT cooling water pipe
3161 HT cooling water inlet from preheater 1
3162 HT cooling water inlet from expansion tank
3165 HT cooling water inlet from preheater 2
3166 HT cooling water inlet from heat recovery (optional)
3171 HT cooling water outlet to preheater
3172 HT cooling water outlet to heat recovery (optional)
3232 LT cooling water outlet to fuel oil cooler
3233 LT cooling water inlet from fuel oil cooler
3241 Venting of LT cooling water pipe
3251 Drain of LT cooling water pipe
3262 LT cooling water inlet from expansion tank
3267 LT cooling water inlet from LT preheater (optional)
3276 LT cooling water outlet to LT preheater (optional)
4111 Sea water outlet from sea water cooler
4112 Sea water outlet to auxiliary consumer
4121 Sea water inlet to seawater pump
4151 Drain of sea water pump
4301 Treated fresh water engine inlet (optional)
4311 Treated fresh water engine outlet (optional)

Figure 99: Internal cooling water system – With attached seawater cooler and attached seawater pump 12V engine – Exemplary

Note:
The drawing shows the basic internal media flow of the engine in general. Project-specific drawings thereof don´t exist.

### 5.6.2 External cooling water system

At plant side following components need to be applied:

- Expansion tank
- Preheating module (recommended)
- Fuel oil cooler
- Cooling water collecting tank
- Seawater filter
- Strainer in the HT-system (Y-type with magnetic insert)
- Strainer in the LT-system (Y-type with magnetic insert)

Additionally required components depend on the chosen cooling water system layout.



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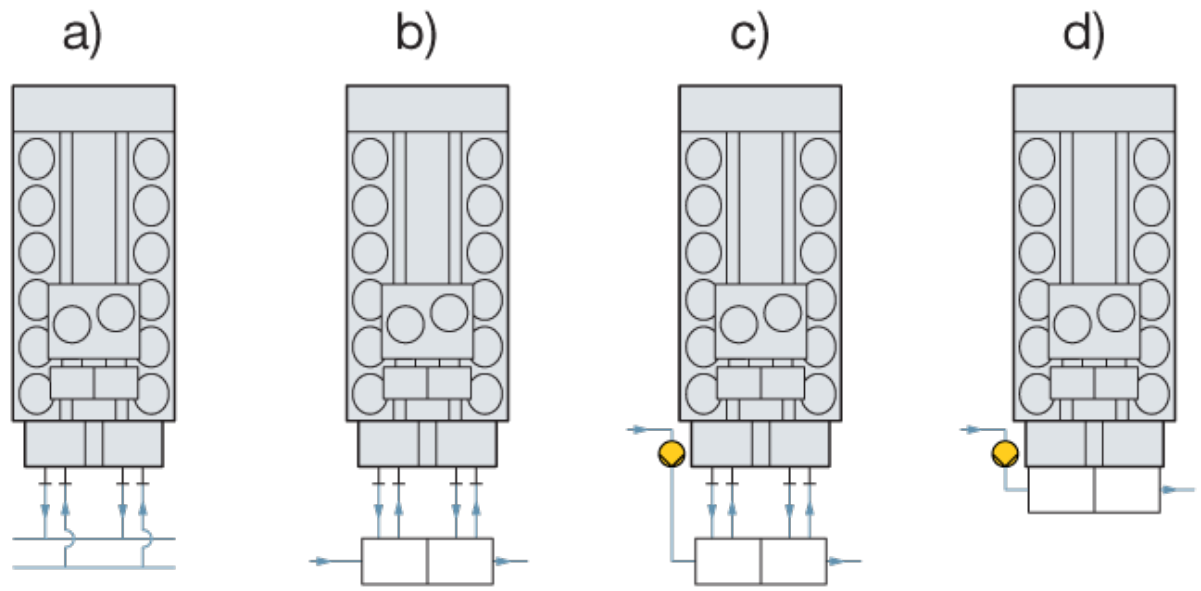



Figure 100: Typical plant arrangements

**Freshwater supply with external cooler (option a)**

The figure above shows the typical arrangement for vessels providing a centralised freshwater cooling system serving several users. Usually all engines in the same machinery compartment are connected to the same cooling system.

This layout does not require individual expansion tanks to be installed on each engine and simplifies the overall engine room piping. The required cooling water flow rates and engine heat loads are listed in the technical specifications. See section Performance data, Page 107.

Take care to use cooling water additives suitable for all engine types, integrated in the cooling water circuits.

**Local HT and LT coolers with centralised seawater cooling system (option b)**

The arrangement of local HT and LT coolers with centralised seawater cooling system is chosen when a centralised seawater cooling system is available in the engine room to serve several users.

Suitable coolers for each engine type can be delivered by Everllence.

**Local HT and LT coolers with engine-driven seawater pump (option c)**

If no electrically operated seawater pump is available, an optional engine-driven seawater pump should be selected. The pump is capable of delivering an excess of flow and therefore can be used to cool additional equipment (for example, gearbox or alternator) according to the planning data.

The engine must be placed below the seawater level to ensure that the seawater suction pipe upstream of the engine driven pump is always filled with water. If a position above seawater level is required, an electrical driven pump may be used to fill the seawater suction line before engine start. A second option to get air out of the seawater suction line is to use an ejector driven by pressurised air.

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In any case, the maximum suction capacity of the engine driven pump has to be observed. The NPSH values for the different pumps are shown in section Performance data, Page 107.

Suitable coolers for each engine type can be delivered by Everllence.

### Integrated cooling module (option d)

For applications requiring extremely compact solutions, the engine is available with an integrated cooling module, providing both – an attached seawater pump and a combined plate type cooler for the HT and LT water.

With this layout, the interfaces to the plant are brought to a minimum as only a seawater connection is required.

### Other options

For operation under arctic conditions with very cold combustion air temperatures, the cooling water system has to be adapted to ensure stable temperatures and proper combustion. Contact Everllence for order specific solutions.

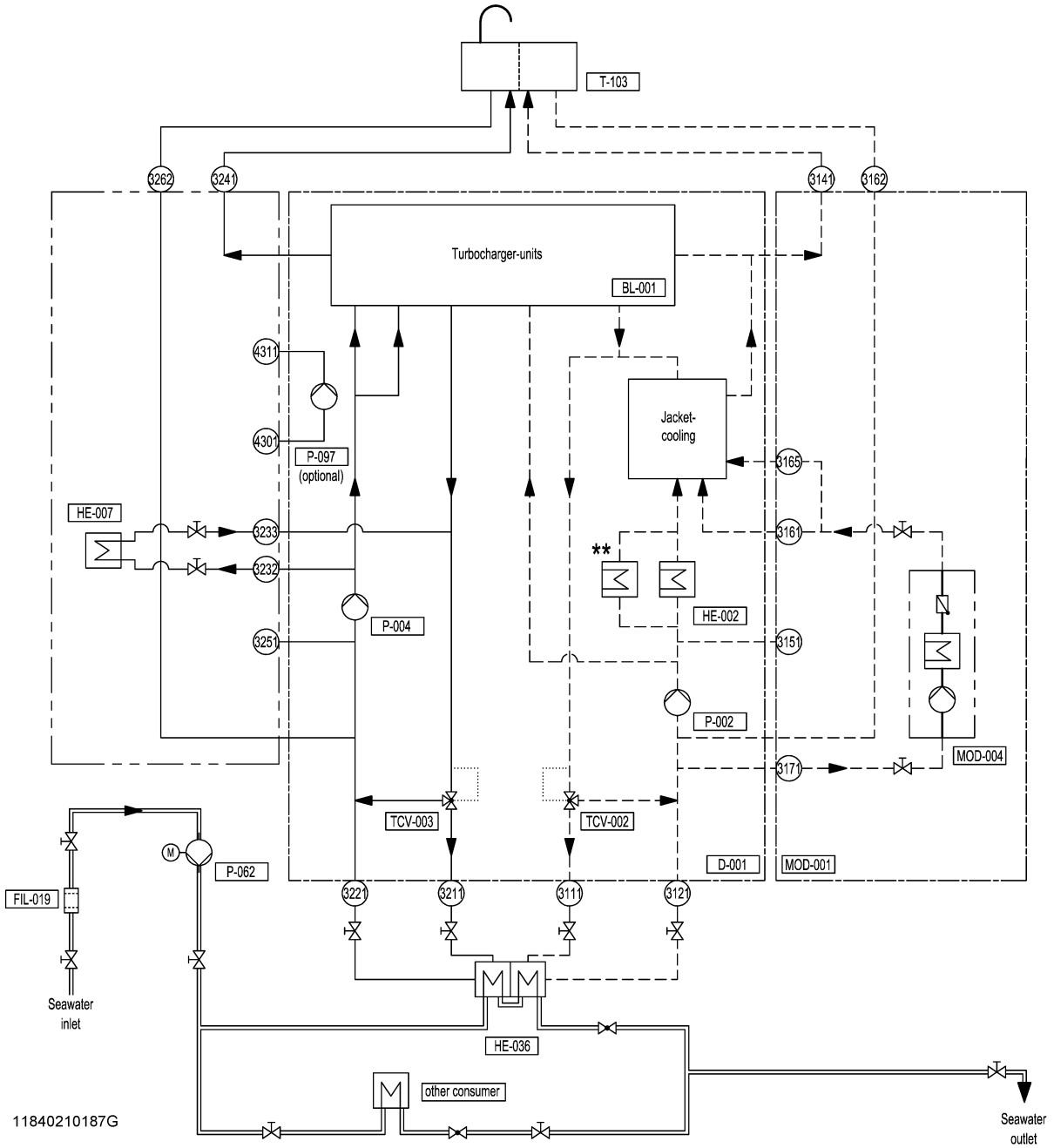
The engine provides hot cooling water that can be used for waste heat recovery systems or fresh water generation. Contact Everllence for order specific solutions.

As an option, Everllence can provide an additional engine driven fresh water pump that may be used for alternator cooling or other purposes.



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**Cooling water system for option a) and b)**




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Components

| | |
|---|---|
| BL-001 | Turbocharger |
| D-001 | Diesel engine |
| FIL-019 | Seawater filter |
| 1,2 HE-002 | Lube oil cooler |
| HE-007 | Fuel oil cooler |
| HE-036 | Combined cooler for HT/LT cooling water |
| MOD-001 | GenSet |
| MOD-004 | HT cooling water preheating module |
| P-002 | HT cooling water pump (attached) |
| P-004 | LT cooling water pump (attached) |
| P-062 | Seawater pump |
| P-097 | Fresh cooling water auxiliary pump (attached) |
| T-103 | HT/LT cooling water expansion tank |
| TCV-002 | HT temperature control valve |
| TCV-003 | LT cooling water temperature control valve |

Major engine connections

| | |
|---|---|
| 3111 | HT cooling water outlet on engine |
| 3121 | HT cooling water pump inlet |
| 3141 | Venting of HT cooling water |
| 3151 | Drain HT cooling water pipe |
| 3161 | HT cooling water inlet from preheater |
| 3162 | HT cooling water inlet from expansion tank |
| 3165 | HT cooling water inlet from preheater |
| 3171 | HT cooling water outlet to preheater |
| 3211 | LT cooling water outlet on engine |
| 3221 | LT cooling water pump inlet |
| 3232 | LT outlet to fuel heat exchanger |
| 3233 | LT inlet from fuel heat exchanger |
| 3241 | Venting of LT cooling water pipe |
| 3251 | Drain LT cooling water pipe |
| 3262 | LT cooling water inlet from expansion tank |
| 4301 | Fresh cooling water inlet (optional) |
| 4311 | Fresh cooling water outlet (optional) |

Figure 101: P&ID cooling water system – Without seawater pump

**Cooling water system for option c)**

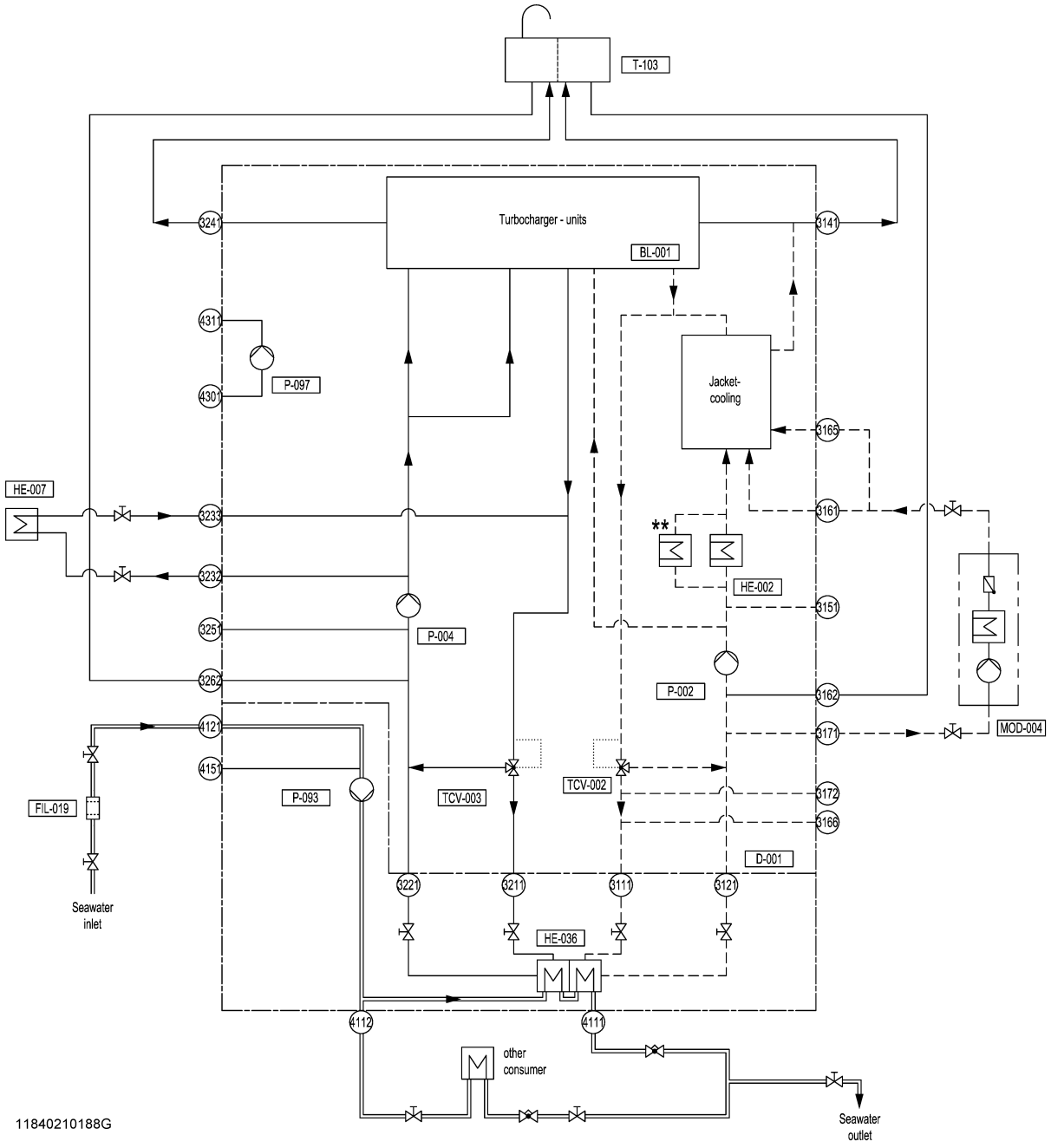
Cooling water system is identical see figure P&ID cooling water system – Without seawater pump, except for:

- P-062 external seawater pump replaced by engine attached seawater pump.
- Plant system connected to engine connections 4121, 4131 and 4151.



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**Cooling water system for option d)**




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| | Components |
|---|---|
| BL-001 | Turbocharger |
| D-001 | Diesel engine |
| **FIL-019 | Seawater filter |
| 1,2 HE-002 | Lube oil cooler |
| HE-007 | Fuel oil cooler |
| HE-036 | Combined cooler for HT/LT cooling water |
| MOD-004 | HT cooling water preheating module |
| P-002 | HT cooling water pump (attached) |
| P-004 | LT cooling water pump (attached) |
| P-093 | Seawater pump (attached) |
| P-097 | Fresh cooling water auxiliary pump (optional) |
| T-103 | HT/LT cooling water expansion tank |
| TCV-002 | HT temperature control valve |
| TCV-003 | LT cooling water temperature control valve |

| | Connection numbers |
|---|---|
| 3141 | Venting of HT cooling water |
| 3151 | Drain HT cooling water pipe |
| 3161 | HT cooling water inlet from preheater |
| 3162 | HT cooling water inlet from expansion tank |
| 3165 | HT cooling water inlet from preheater |
| 3166 | HT cooling water inlet from heat recovery (optional) |
| 3171 | HT cooling water outlet to preheater |
| 3172 | HT cooling water outlet to heat recovery (optional) |
| 3232 | LT outlet to fuel heat exchanger |
| 3233 | LT inlet from fuel heat exchanger |
| 3241 | Venting of LT cooling water pipe |
| 3251 | Drain LT cooling water pipe |
| 3262 | LT cooling water inlet from expansion tank |
| 4111 | Seawater outlet |
| 4112 | Seawater outlet to auxiliaries |
| 4121 | Seawater pump inlet |
| 4151 | Drain seawater pipe |
| 4301 | Fresh cooling water inlet (optional) |
| 4311 | Fresh cooling water outlet (optional) |

Figure 102: P&ID cooling water system – With attached seawater cooler

### T-103/Expansion tank

If the engine is not connected to a pressurised common LT cooling water system, a single closed compression expansion tank is required for each engine. The tank has to be equipped with a safety valve opening at 1.5 bar and a vacuum relief valve, opening at –0.1 bar. Everllence can provide a suitable tank with level indication and safety valves included.

We recommend installing a manometer 0–4 bar to monitor the tank overpressure during engine operation.

The expansion tank has to be installed above the engine, with a height not less than 1.5 m and not exceeding 5 m above the crankshaft line. In case the tank has to be installed at a lower position, the tank has to be pre-pressurised at 0.25 bar over pressure. If an open tank (vent to free atmosphere) will be used, the tank has to be placed at 5 – 10 m above the crankshaft centre line.

For the size of the tank refer to the technical data given in the table Oil and coolant capacities, Page 355.

The tank has to be equipped with a low-level alarm switch and a level indicator.

To check the water quality visually from outside, a sight glass or other devices in the piping system are recommended.

For standard applications, the system is operated with a common expansion tank for HT- and LT-systems. If the systems have to be strictly separated, two expansion tanks are necessary.

A suitable tank can be delivered by Everllence.



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### MOD-004/Preheating module

A preheating module for HT water, including a circulation pump, and an electrical heater is available as an option. The engine may be started in normal ambient temperature conditions (see paragraph Starting conditions, Page 95) but the use of a preheating module is strongly recommended for the following applications:

- Fast load rise after engine start (no warm up operation).
- When long periods without engine operation are foreseen (e.g. yacht propulsion engines).
- For applications that require cold starting capabilities (arctic conditions, see section Engine operating/service temperature and pressure values, Page 351).

Everllence recommends permanent preheating to prevent possible corrosion due to condensate caused by humid air and to reduce thermal stress on the engine in case of fast load step up after engine start.

The preheating module may also be used for postcooling of the engine after engine shut down.

For standard applications we recommend a heating capacity of 0.3–0.75 kW per cylinder and a flow rate of 2–3 $m^3$/h. For operation under arctic conditions, a higher heating capacity is required (see section Engine operation under arctic conditions, Page 101). Everllence can provide a suitable preheating module.

Preheater shall be installed as low as possible (in best case below crankshaft level) to facilitate venting of the system. The maximum height of the pipework between the engine and the preheater module should not exceed the cylinder head level. In case this cannot be fulfilled, proper venting devices shall be available at suction and discharge line.

### HE-007/Fuel oil cooler

This cooler is required to dissipate the heat of the fuel injection pumps during DMA operation. For the description of the principal design criteria for coolers see data given in section Fuel oil system, Page 454. We recommend a nominal temperature difference of 6–10 K and a maximum pressure drop of 0.15 bar on the LT cooling water side.

Everllence can provide suitable fuel oil coolers for all engine types.

In case the cooler ist operated by seawater, we recommend to use a double wall plate type cooler. This design will prevent oil leakage to seawater in case of damage at sealings or plates.

### T-074/Cooling water collecting tank

We recommend to install a cooling water collecting tank to store the cooling water in case the engine has to be drained. Depending on the installation, we recommend to install drain valves in the plant piping. In case this is not possible, the drain plugs at the engine driven pumps may be used to connect a drain hose. The drain connections have to be routed to a cooling water collecting tank or water hoses may be used to lead the water to the tank. The tank has to be dimensioned and arranged in such a way that the cooling water content of the circuits of the cooling water systems can be drained into it for maintenance purposes.

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### FIL-019/Seawater filter

To protect the seawater system against erosion or blocking, a suitable seawater filter has to be installed. We recommend a mesh size of 0.5 – 2 mm.

### Draining

At the lowest point of the cooling system a drain has to be provided. Additional points for draining to be provided in the cooling system according to layout and necessity, e.g. for components in the system that will be removed for maintenance.

### Venting

Insufficient venting of the cooling water system prevents air from escaping which can lead to thermal overloading of the engine. The cooling water system needs to be vented at the highest point in the cooling system. Additional points with venting lines have to be installed in the cooling system according to layout and necessity. In case LT system and HT system have to be separated, make sure that the venting lines are always routed only to the associated expansion tank. The venting pipe must be connected to the expansion tank below the minimum water level, this prevents oxidation of the cooling water caused by "splashing" from the venting pipe.

Venting pipes of the same system (LT or HT) may be connected for one engine. Make sure to expand the venting pipe to double the pipe cross section area before the pipe connection point.

Additional notes regarding venting pipe routing:

- The ventilation pipe should be continuously inclined (min. 5 degrees).
- At the interface to the system (engine connection terminal), the line must be continued directly with an elastic pipe connection (e.g. hose line).
- No additional masses such as shut-off valves, reducers, extensions, etc. may be attached to the engine-side connection terminal, since they represent an additional oscillating mass that can cause the line to break during operation.
- Venting pipes from several engine circuits may only be connected together if there are no longer any pressure differences between the individual pipes.
- It is to be avoided to merge venting pipes from low-temperature (LT) and high-temperature (HT) circuits, as a separate fault detection (e.g. lubricating oil or fuel in the cooling water) is no longer possible.
- No restrictions, no kinks in the ventilation pipes.
- Merging of ventilation pipes only permitted with appropriate cross-sectional enlargement.

### Sampling

To check the cooling water quality regularly, at least one sampling point has to be provided at each cooling water circuit. We recommend ball valves with locks or sealing caps to avoid injuries by scalding in case of opening by mistake.

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### Corrosion protection

The fresh cooling water has to be treated with anti-corrosion agents (see section Specification of engine coolant, Page 404). Use only coolant additives that are released by Everllence. Other additives may cause serious damage at some engine parts.

### Oil in water detection

Depending on rules by classification societies or customer requirements, an oil in water detection device may be required. If one or more cooling water circuits have to be monitored continuously, contact Everllence. In any case, regular checks of the cooling water have to be carried out (see section Specification for engine supplies, Page 397).

## 5.7 Fuel oil system

### 5.7.1 External – Fuel oil treatment system

A prerequisite for safe and reliable engine operation with a minimum of servicing is a properly designed and well-functioning fuel oil treatment system. The schematic diagram shows the system components required for fuel treatment for marine gas oil (DMA). See description in section Diesel fuel specification, Page 397.

#### T-015/Diesel fuel oil storage tank

The minimum effective capacity of the diesel fuel oil storage tank should be sufficient for the operation of the propulsion plant, as well as for the operation of the auxiliary diesels for the maximum duration of voyage including the resulting sediments and water. Regarding the tank design, the requirements of the respective classification society are to be observed.

Tank heating

The tank heater must be designed to keep the temperature of DMA is at least 10°C minimum above the pour point. The supply of the heating medium must be automatically controlled as a function of the DMA temperature.

#### T-021/Sludge tank

If disposal by an incinerator plant is not planned, the tank has to be dimensioned so that it is capable to absorb all residues which accumulate during the operation in the course of a maximum duration of voyage. In order to render emptying of the tank possible, it has to be heated.

The heating is to be dimensioned so that the content of the tank can be heated to approximately 40°C.

#### P-073/Diesel fuel oil separator feed pump

The diesel fuel oil separator feed pump should always be electrically driven, i.e. not mounted on the separator, as the delivery volume can be matched better to the required throughput.

#### H-019/Fuel oil preheater

In order to achieve the separating temperature, a separator adapted to suit the fuel viscosity should be fitted.

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### CF-003/Diesel fuel oil separator

A self-cleaning separator must be provided. The separator is dimensioned in accordance with the separator manufacturers' guidelines.

The required flow rate (Q) can be roughly determined by the following equation:

$$Q = \frac{P \times b_e}{p}$$

| | |
|---|---|
| Q [l/h] | Separator flow rate |
| P [kW] | Total engine output |
| $b_e$ [g/kWh] | Fuel consumption |
| p | Density at separating temperature – Approx. 830 kg/m$^3$ = g/dm$^3$ |

With the evaluated flow rate, the size of the diesel fuel oil separator has to be selected according to the evaluation table of the manufacturer. The separator rating stated by the manufacturer should be higher than the flow rate (Q) calculated according to the above formula.

By the separator flow rate, which was determined in this way, the separator type, depending on the fuel viscosity, is selected from the lists of the separator manufacturers.

For the first estimation of the maximum fuel consumption ($b_e$), increase the specific table value by 15%.

For specific values contact Everllence.

This increase takes into consideration:

- Tropical conditions
- The engine-mounted pumps
- Fluctuations of the calorific value
- The consumption tolerance

The freshwater supplied has to be treated as specified by the separator supplier.

### Withdrawal points for samples

Points for drawing fuel oil samples are to be provided upstream and downstream of each separator, to verify the effectiveness of these system components.

### FIL-039/DMA fuel oil filter treatment module

Instead of a diesel fuel oil separator CF-003 an adequate filtration system (FIL-039) can be used for fuel oil treatment. This is only valid for engines which operate with marine gas oil (DMA).

The fuel oil is intensively cleaned by fine filtration in the by-pass thus relieving the main filters and allowing an economical design The fuel oil fine filter is not of self-cleaning type, therefore the filter elements need to be replaced regularly.

The formula for determining the fine filter flow rate (Q) is:

$$Q = \frac{P \times b_e}{p}$$



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| | |
|---|---|
| Q [l/h] | Separator flow rate |
| P [kW] | Total engine output |
| $b_e$ [g/kWh] | Fuel consumption |
| p | Density at separating temperature – Approx. 830 kg/m$^3$ = g/dm$^3$ |

With the evaluated flow rate the size of the fine filter module has to be selected according to the evaluation table of the maker.

The information regarding released manufacturers and filter types for fuel oil fine filters can be found here: Fuel oil fine filter selection for Everllence marine engines.

### T-003/Diesel fuel oil service tank

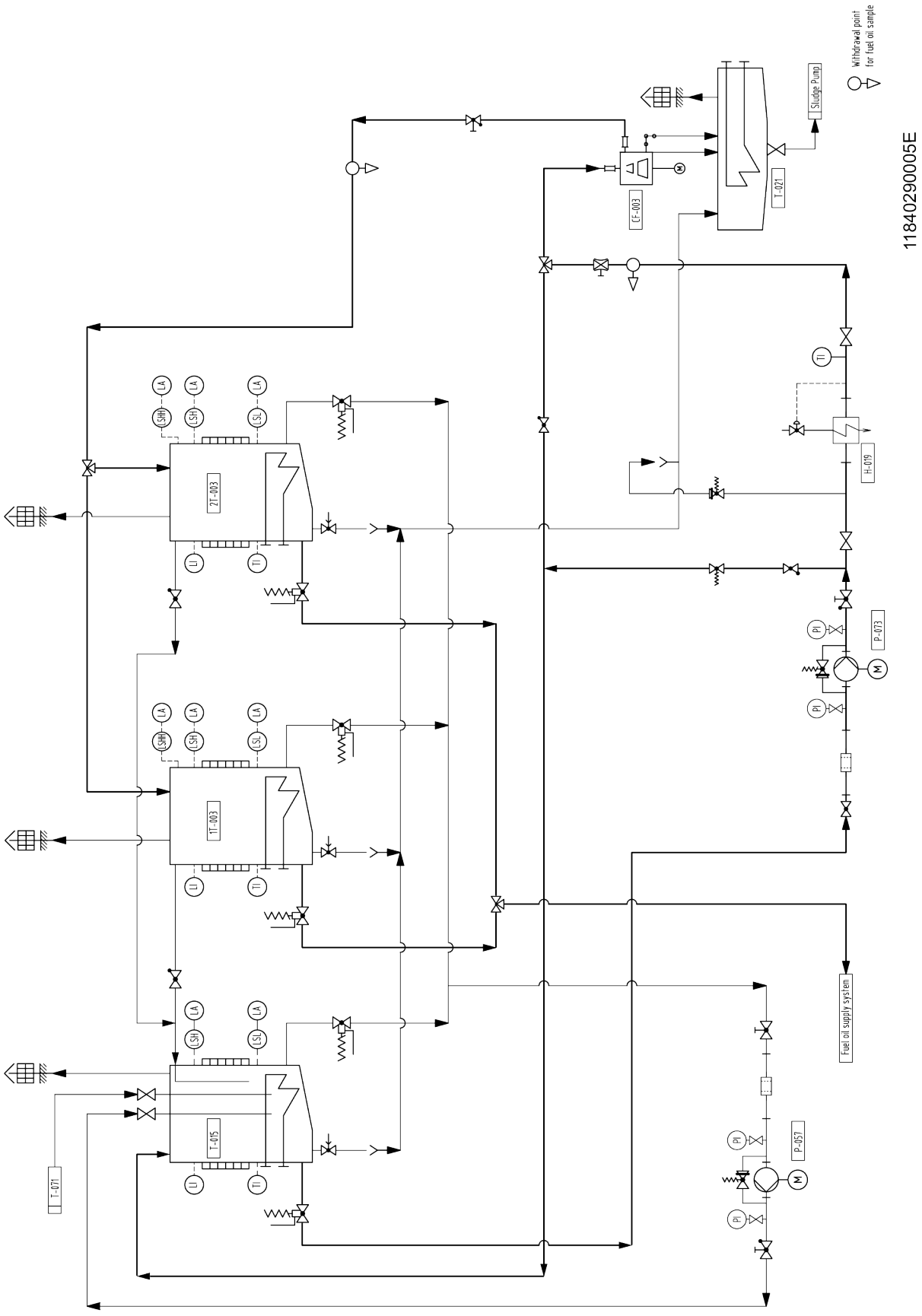
After separating the fuel oil has to be provided to achieve cleanliness level ≤ 18/≤ 17/≤ 12 according to ISO 4406:1999.

### T-071/Clean leakage fuel oil tank

See description in paragraph T-071/Clean leakage fuel oil tank, Page 467.

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**Fuel oil treatment system with separator CF-003**




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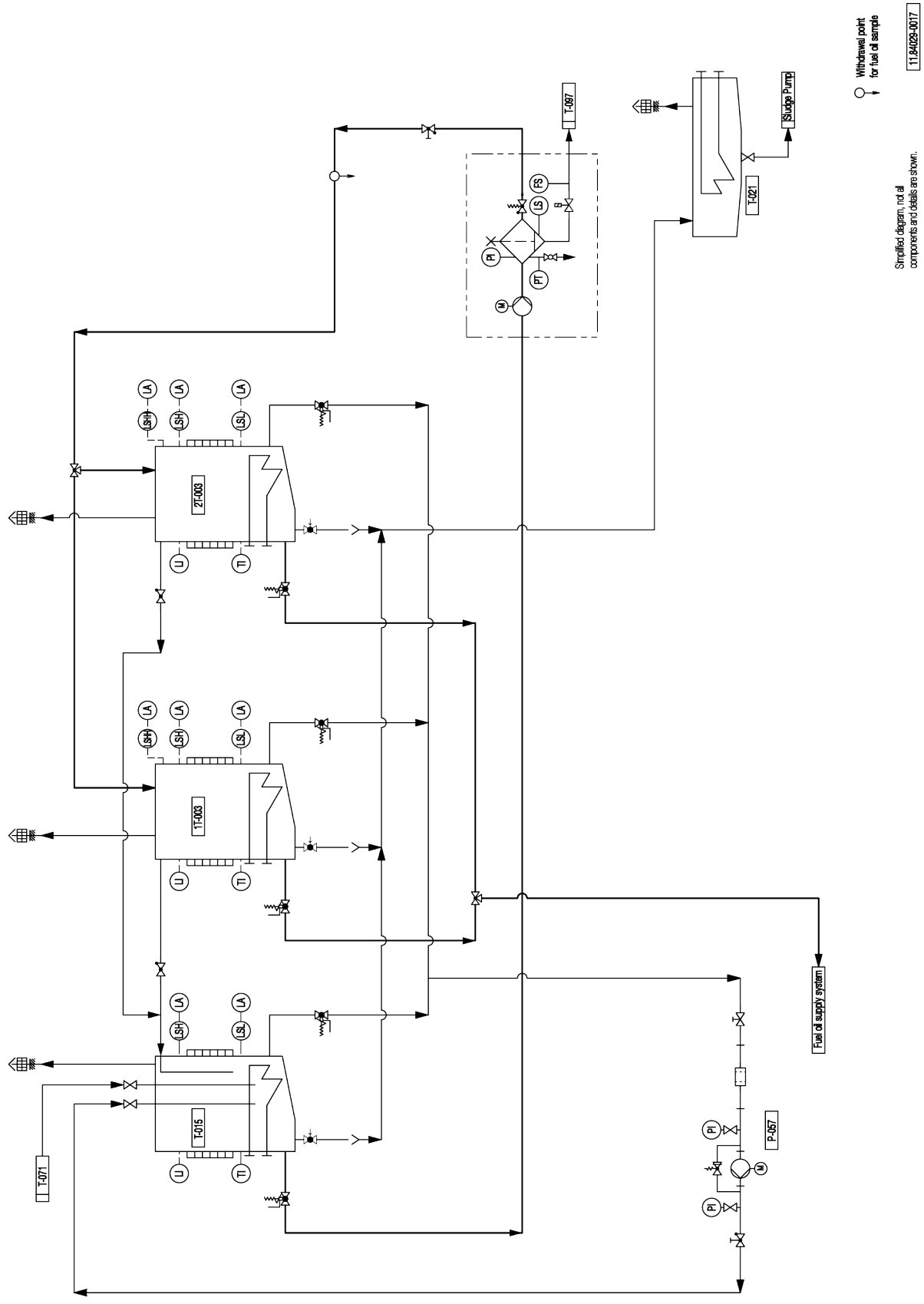
Components

| | |
|---|---|
| CF-003 | Diesel fuel oil separator |
| H-019 | Fuel oil preheater |
| T-021 | Sludge tank |
| P-057 | Diesel fuel oil transfer pump |
| P-073 | Diesel fuel oil separator feed pump |
| T-015 | Diesel fuel oil storage tank |
| 1,2 T-003 | Diesel fuel oil service tank |
| T-071 | Clean leakage fuel oil tank |

Figure 103: Fuel oil treatment system

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## Fuel oil treatment with DMA fuel oil filter treatment module FIL-039






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Components

| | |
|---|---|
| CF-003 | Diesel fuel oil separator |
| H-019 | Fuel oil preheater |
| T-021 | Sludge tank |
| P-057 | Diesel fuel oil transfer pump |
| P-073 | Diesel fuel oil separator feed pump |
| T-015 | Diesel fuel oil storage tank |
| 1,2 T-003 | Diesel fuel oil service tank |
| T-071 | Clean leakage fuel oil tank |
| T-097 | Oily water or bilge water tank |

Figure 104: Fuel oil treatment with DMA fuel oil filter treatment module FIL-039

### 5.7.2 Internal fuel oil system

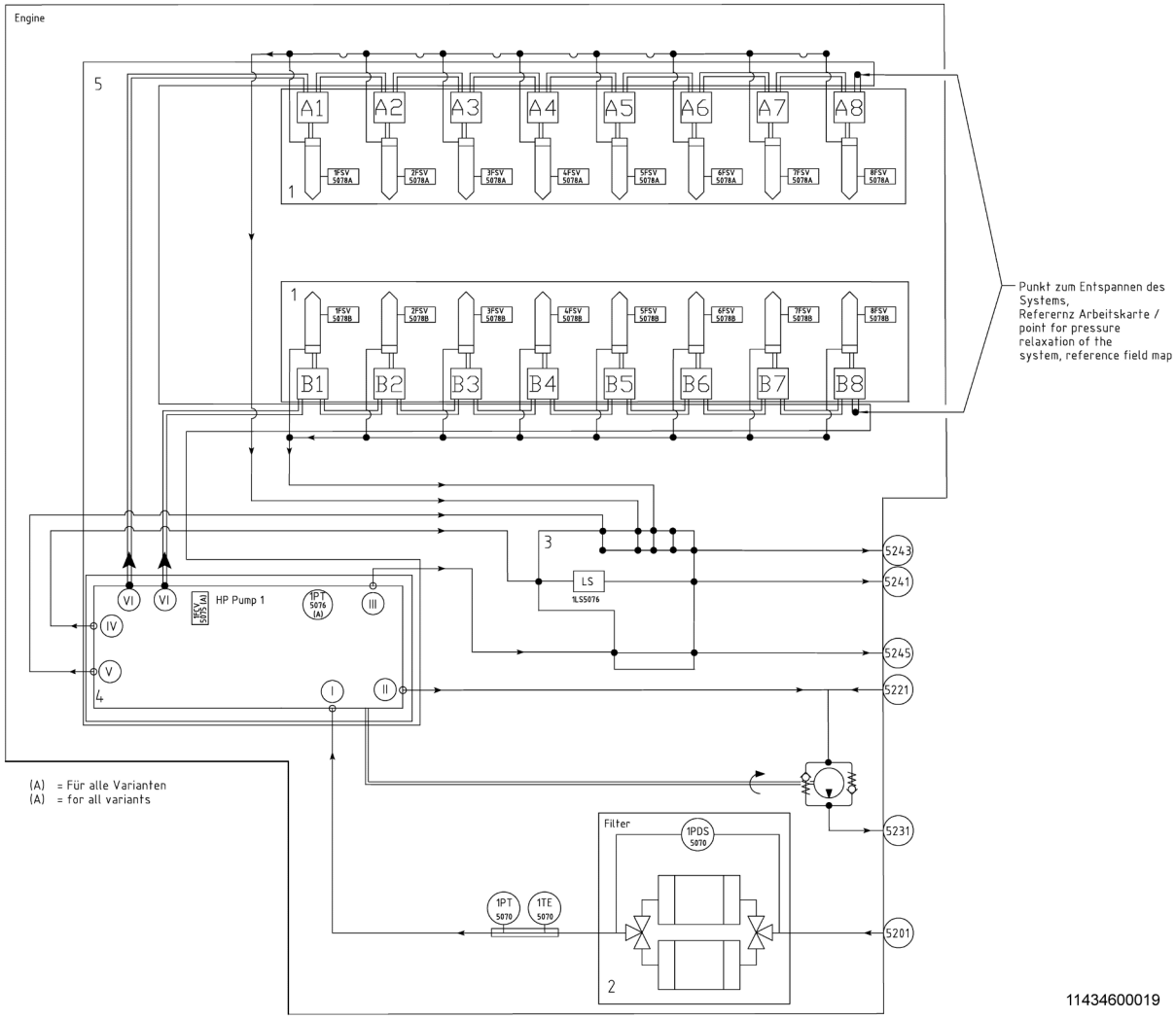
To ease the installation of the 175D several components and functions are already integrated into the engine design and distinct further options can be offered.

Standard equipment (attached at the engine):

- Duplex fuel filter, complete with change-over cock enabling one filter element to be exchanged while engine is running.
- Engine mounted mechanical fuel feed pump.

Below stated internal media schemata state the principal layout.

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**Engine**

1 Cylinder
2 Fuel filter
3 Fuel connection block
4 High pressure pump
5 High pressure circuit

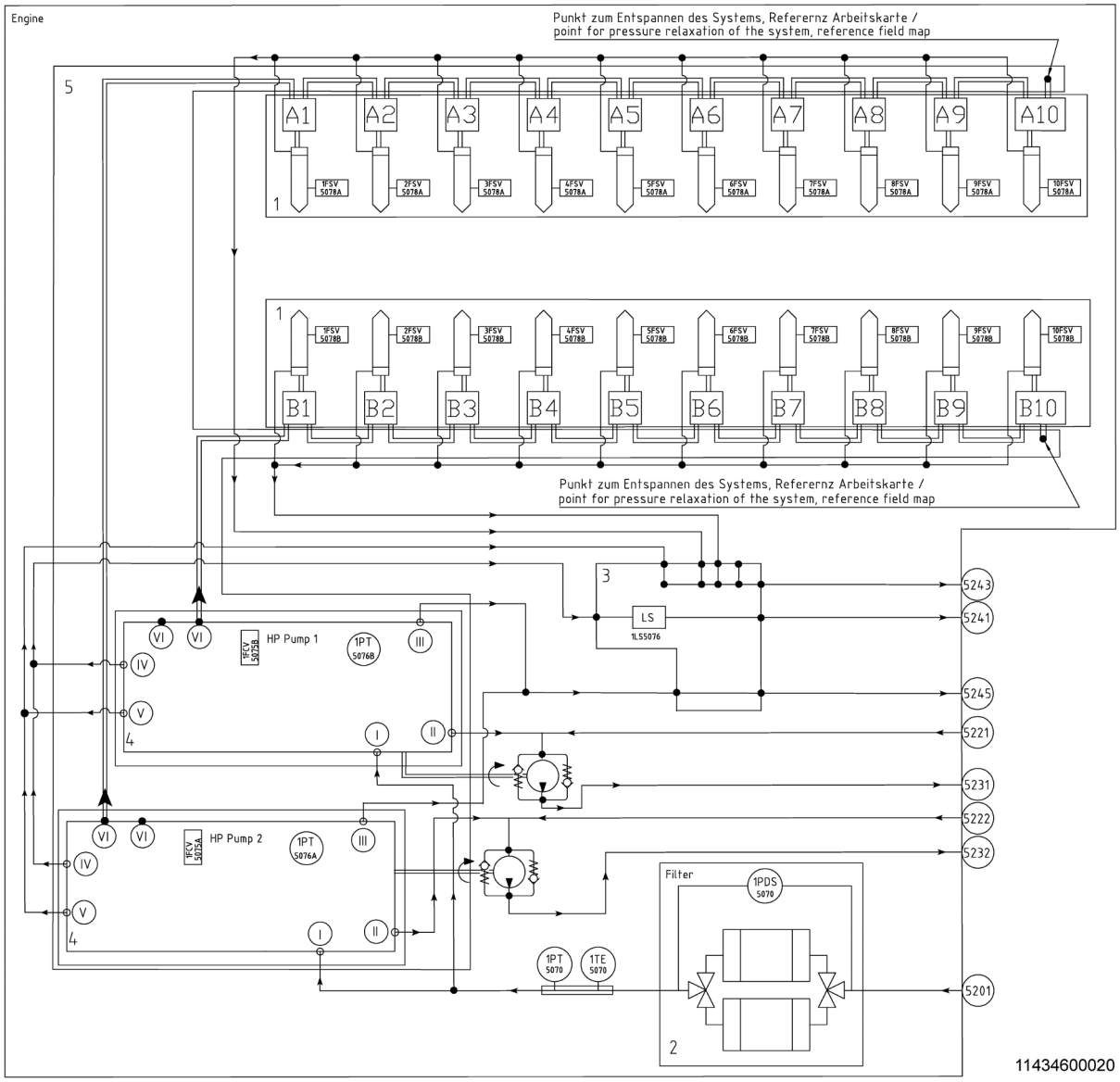
**High pressure pump**

I Fuel inlet
II Leakage pipe suction throttle
III Pressure limiting valve exit
IV High pressure pipe leakage
V Pump element leakage
VI HP circuit – Fuel to injectors

**Connection numbers**

5201 Fuel oil inlet to engine
5221 Fuel oil inlet to fuel oil supply pump
5231 Fuel oil outlet from fuel oil supply pump
5241 Fuel oil break leakage drain
5243 Fuel oil leakage drain (reusable)
5245 Fuel oil drain from pressure limiting valve

Figure 105: Internal fuel oil system 12V, 16V engine with 1 HP pump – Exemplary




**Engine**

1 Cylinder
2 Fuel filter
3 Fuel connection block
4 High-pressure pump
5 High-pressure circuit

**High-pressure pump**

I Fuel inlet
II Leakage pipe suction throttle
III Pressure limiting valve exit
IV High-pressure pipe leakage
V Pump element leakage
VI HP circuit – Fuel to injectors

**Connection numbers**

5201 Fuel oil inlet to engine
5221 Fuel oil inlet to fuel oil supply pump 1
5231 Fuel oil outlet from fuel oil supply pump 1
5241 Fuel oil break leakage drain
5243 Fuel oil leakage drain (reusable)
5245 Fuel oil drain from pressure limiting valve

Figure 106: Internal fuel oil system 16V, 20V engine with 2 HP pumps – Exemplary

**Note:**
**The drawing shows the basic internal media flow of the engine in general. Project-specific drawings thereof don´t exist.**

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The design of other cylinder variants and performance variants is similar (16V with 1 high-pressure pump and 1 fuel oil supply pump, 16V with 2 high-pressure pumps and 2 fuel oil supply pumps, 20V with 2 high-pressure pumps and 2 fuel oil supply pumps).

### Leakage rates

For layout of

- T-071 and
- transfer pump to T-015

following leakage rates have to be considered:

| | Max. leakage rate in case of open pressure limiting valve |
|---|---|
| 12V | 19 l/min |
| 16V | 23 l/min |
| 20V | 31 l/min |

Table 622: Leakage rates

Stated leakage occurs at connection number 5245. The temperature of the leakage depends on the fuel inlet temperatures, temperature increase approximately 45 K. Accordingly safety precautions regarding explosive atmospheres have to be foreseen for temperatures above flashpoint (> 60°C / > 55°C for synthetic fuels).

### Engine mounted mechanical fuel feed pump

The fuel oil supply pump is a positive displacement gear type pump. Independent of the engine type or application, the fuel oil supply pump is mounted and driven by the engine high pressure pump. The supply pump has an integrated pressure relief safety valve.

The day tank and mechanically driven pump arrangement ensures that the engine will remain running or available to start in "black ship" condition. This is assuming 24 V DC is available for the electronic fuel injection and control systems.

The pump increases fuel pressure up to 14 bar.

### Duplex fuel filter, complete with change-over cock

This filter is always attached on the engine.

The filter unit is a 1 micron (absolute) element depth type of duplex construction. It has a manual change-over valve to allow filter cartridge change during engine operation, and to meet classification society requirements. The filter housing is equipped with a differential pressure transmitter. Whenever the maximum dp-level is exceeded, an alarm will be triggered. If the differential pressure is reached, the filter cartridge must be replaced. For that the filter chamber must be emptied before changing the filter element. This prevents dirt particles remaining in the filter casing from migrating to the clean oil side of the filter.

After changing the filter cartridge, the reconditioned filter chamber must be vented manually. The relevant design criterion is the filter area load as specified by the filter manufacturer.



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| Fuel oil duplex filter FIL-013 | |
|---|---|
| Filter mesh width (mm) | 0.001 |
| Design pressure | PN16 |

Table 623: Required filter mesh width (sphere passing mesh)

**Note – Required installation at plant side:**

The emptying port of each filter chamber must be fitted with a valve and a pipe to the sludge tank. The relevant design criterion is the filter area load as specified by the filter manufacturer.

### 5.7.3 External – Fuel oil supply system

#### Introduction

The 175D engine runs on distillate diesel fuel oil (light fuel oil) only. The following is a description of a typical 175D fuel oil system and is designed to suit the majority of installations (refer to figure Fuel oil treatment system, Page 457). Tailored systems are possible for individual vessel requirements as well. To specify those contact Everllence for assistance.

#### Distillate fuel oil specification and requirements

ISO 8217 class DMA (with approval of Everllence see section Diesel fuel specification, Page 397) or equivalent. If the proposed fuel oil differs from this specification, however slightly, consult Everllence for advice supplying a full specification showing the list of limiting properties of the fuel oil. Note that an analysis of existing fuel oil is not enough as it is only indicative of the batch sampled and does not give any indication of each property limit. Therefore a full specification is required.

| Required fuel oil | Cleanliness ≤ 11/≤ 8/≤ 7 (ISO4406:1999) |
|---|---|
| Water separation efficiency | Water separation efficiency always ≥ 93%:<br>▪ Within whole project-specific flow rate (min. to max.)<br>▪ With fuel oil having<br>▪ IFT = 8 – 15 mN/m (interfacial tension)<br>▪ DSEP < 50 (diesel micro separometer according to ASTM D7261-08)<br>▪ Everything else according to<br>▪ SAE J1488 Revised AUG 1997<br>▪ ISO/TS 16332 (2006), but with droplet size (DSD) D50 = 10 µm +/- 1 µm |

Table 624: Fuel oil requirements

#### General

For the fuel oil piping system it is recommended to maintain a fuel oil flow velocity between 0.5 and 1.0 m/s in suction pipes and between 1.5 and 2.0 m/s in delivery pipes. The recommended pressure class for the fuel oil pipes is PN16.

The installed components in the fuel oil supply system are designed to fulfil the fuel oil quantity and quality requirements (refer to table Fuel oil requirements, Page 464). The fuel oil supply system is operated as a closed loop system. Each engine has its own fuel oil supply system. Usually one or two



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engines are connected to one fuel oil service tank. If required, auxiliary engines can be connected to the same fuel oil tank as well (not shown in the diagram).

### T-003/Diesel fuel oil service tank

After separating the fuel oil has to be provided to achieve cleanliness level ≤ 18/≤ 17/≤ 12 according to ISO 4406:1999.

The classification societies specify that at least two service tanks are to be installed on board. The minimum tank capacity of each tank should, in addition to the fuel oil consumption of other consumers, enable a full load operation of at least 8 operating hours for all engines under all conditions.

The tank should be provided with a sludge space with a tank bottom inclination of preferably 10°. Sludge drain valves at the lowest point, an overflow pipe from the diesel fuel oil service tank T-003 to the diesel fuel oil storage tank T-015, with heating coils and insulation.

If DMA fuel oil with 6 cSt (at 40°C) is used, the tank heating is to be designed to keep the tank temperature at least 40°C.

For lighter types of DMA it is recommended to heat the tank in order to reach a fuel oil viscosity of 6 cSt or less, see table Fuel, Page 353. Rules and regulations for tanks, issued by the classification societies, must be observed.

The tank is normally a 'standard' header tank design, with float level control valve and fitted with vent and drain pipework. The base of the tank must be installed either max. 4 metres beneath or max. 6 metres above the engine crankshaft centreline (pressure loss of supply systems and piping not considered). In addition, the pipe diameters of the lines from the tank to the engine have to be dimensioned sufficiently to minimise pressure losses. This ensures the required pressure range at the inlet of the engine driven fuel oil supply pump (engine connection 5221 and 5222 or 5261, depending on engine type and application) of min. –0.5 bar up to max. +0.5 bar. In order to improve the engine's commissioning and starting behaviour in case of fuel oil tank being beneath crankshaft centreline, it is recommended to install a fuel oil hand pump (P-006) in the supply line close to the tank.

The required minimum DMA capacity of each service tank is:

| $V_{FO\ Service\ tank} = (p \times b_e)/(\varrho_{FO} \times 1{,}000) \times t_0 \times 1.05\ [m^3]$ | | |
|---|---|---|
| Required min. volume of one fuel oil service tank | $V_{FO\ service\ tank}$ | $m^3$ |
| Total engine output at 100% load | P | kW |
| Fuel consumption at 100% load | $b_e$ | g/kWh |
| Density at separating temperature approx.<br>830 kg/m³ = g/dm³ | $\varrho_{FO}$ | $g/dm^3$ |
| Operating time<br>$t_0$ = 8 h | $t_0$ | h |
| Margin for sludge (5%)<br>$M_s$ = 1.05 | $M_s$ | - |

Table 625: Required minimum DMA capacity

In case of more than one engine, or if different engine types are connected to the same fuel oil system, the service tank capacity has to be increased accordingly.



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### P-006/Fuel oil hand pump

The fuel oil hand pump P-006 is required to fill up the system for commissioning, after maintenance of the fuel oil supply system and to improve the engine's starting behavior if the fuel oil tank is beneath crankshaft centerline.

It is recommended to install the fuel oil hand pump in the supply line close to the tank. The fuel oil hand pump delivers fuel oil directly in front of fuel oil supply pump P-008.

Note:
The fuel oil pressure during filling up the system must not exceed a value of +0.5 bar in front of the engine interface 5221/5222.

Before engine start and engine operation, shut-off valves from and to pump must be closed and pump must be drained! Otherwise, air can enter the fuel oil suction line via the sealing of the pump.

### FQ-003/Fuel oil flow meter

Each flowmeter requires a by-pass to ensure a continuous fuel oil flow in case of maintenance or malfunction. A coriolis type flowmeter is recommended for fuel oil flow measuring. The by-pass of the coriolis type flowmeter needs a shut-off valve. If a positive displacement type flowmeter is used the by-pass needs to be equipped with a spring loaded overflow valve which opens automatically in case of blocking. The pressure resistance of the fuel oil flowmeter should be as low as possible and considered during the system design stage.

### STR-010/Suction strainer and TR-009/Coalescer

To fulfill the water content requirements in the fuel oil (see table Fuel oil requirements, Page 464) a coalescer (water separator) should be installed. The coalescer consists of a pre-filter STR-010 with a mesh width of 7 micron (absolute) and a coalescer element. The pre-filter acts as a suction strainer to protect the fuel oil supply pump P-008.

For safety reason the filter housing is equipped with a negative pressure transmitter at the outlet of the filter elements. A certain negative pressure at the outlet of the coalescer/filter element indicates a clogged filter cartridge and triggers an alarm.

In case the negative pressure at the outlet of the filter reaches the maximum, the filter cartridge must be replaced. To allow the replacement of the filter during engine operation it can be switched over to a redundant coalescer/filter element with a manual change over valve. In the coalescer housing a water sensor is installed. The sensor triggers an alarm if a certain water level inside the coalescer is reached. Following the water has to be drained manually.

| STR-010/Suction strainer and TR-009/Coalescer | |
|---|---|
| Filter mesh width (mm) | 0.007 |
| Design pressure | PN5 |

Table 626: Required filter mesh width (sphere passing mesh)

### FIL-005/Fuel oil duplex filter

The filter unit is a 1 micron (absolute) element depth type of duplex construction. It has a manual change-over valve to allow filter cartridge change during engine operation to meet classification society requirements.

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The filter housing is equipped with a differential pressure transmitter. Whenever the maximum dp-level is exceeded, an alarm will be triggered. If the differential pressure is reached, the filter cartridge must be replaced. For that, the filter chamber must be emptied before changing the filter element. This prevents dirt particles remaining in the filter casing from migrating to the clean oil side of the filter.

After changing the filter cartridge, the reconditioned filter chamber must be vented manually. The relevant design criterion is the filter area load as specified by the filter manufacturer.

| **Fuel oil duplex filter FIL-005** | |
|---|---|
| Filter mesh width (mm) | 0.001 |
| Design pressure | PN16 |

Table 627: Required filter mesh width (sphere passing mesh)

### HE-007/Fuel oil cooler

The fuel oil cooler uses fresh water from the engine's LT water system to achieve fuel oil cooling.

The fuel oil cooler is designed for a fuel oil outlet temperature of 45°C.

The thermal design of the cooler is based on the following data:

| **Cooler capacity** | | | |
|---|---|---|---|
| Engine type | 12V175D | 16V175D | 20V175D |
| Fuel flow (l/h) | 300 | 400 | 500 |
| Design pressure | PN16 | | |
| Pressure drop, fuel side (bar) | 0.2 | | |

Table 628: Dimensioning of the fuel oil cooler

### T-071/Clean leakage fuel oil tank

The break leakage of the double-walled high pressure pipes and the drain from the safety valve of the high pressure pump can be connected to the clean leakage fuel oil tank T-071. From there it can be emptied into the fuel oil storage tank. It must be ensured that the leakage fuel oil is well diluted with fresh fuel oil before entering the engine again. Clean leakage fuel oil form T-071 can be used again after passing the separator.

Leakage fuel oil flows pressure-less (by gravity only) from the engine into this tank (to be installed below the engine connections). Pressure resistance must be avoided by a sufficient downward slope and an appropriate pipe dimensioning.

A high flow of leakage fuel oil will occur in case of a pipe break for short time only. Engine will run down immediately after a pipe break alarm.

In case the described clean leakage fuel oil tank T-071 is installed, leakages from the following engine connections are to be conducted into this tank:

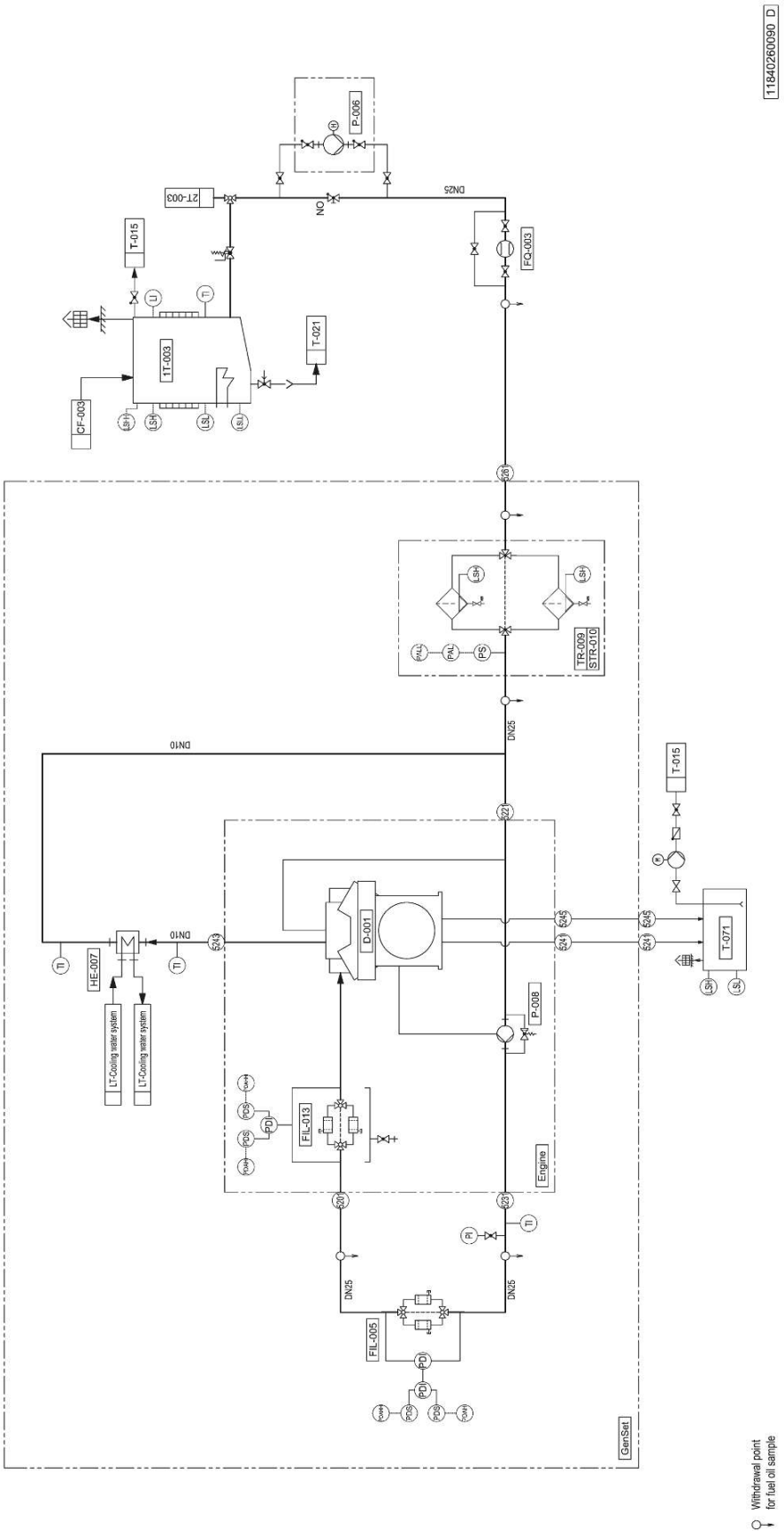
| **Application** | **Connection** |
|---|---|
| Propulsion engine | 5241, 5245 |
| GenSet operation | 5272, 5273 |

Table 629: Connections clean leakage fuel oil tank



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## Fuel oil supply system – GenSet



**Components**

| | |
|---|---|
| CF-003 | Fuel oil separator |
| D-001 | Diesel engine |
| FIL-005 | Fuel oil duplex filter |
| FIL-013 | Fuel oil duplex filter |
| FQ-003 | Fuel oil flow meter |
| HE-007 | Fuel oil cooler |
| P-006 | Fuel oil hand pump |
| P-008 | Fuel oil supply pump, attached |
| STR-010 | Strainer |
| TR-009 | Coalescer |
| T-003 | Fuel oil service tank |
| T-015 | Fuel oil storage tank |
| T-021 | Sludge tank |
| T-071 | Clean leakage fuel tank |

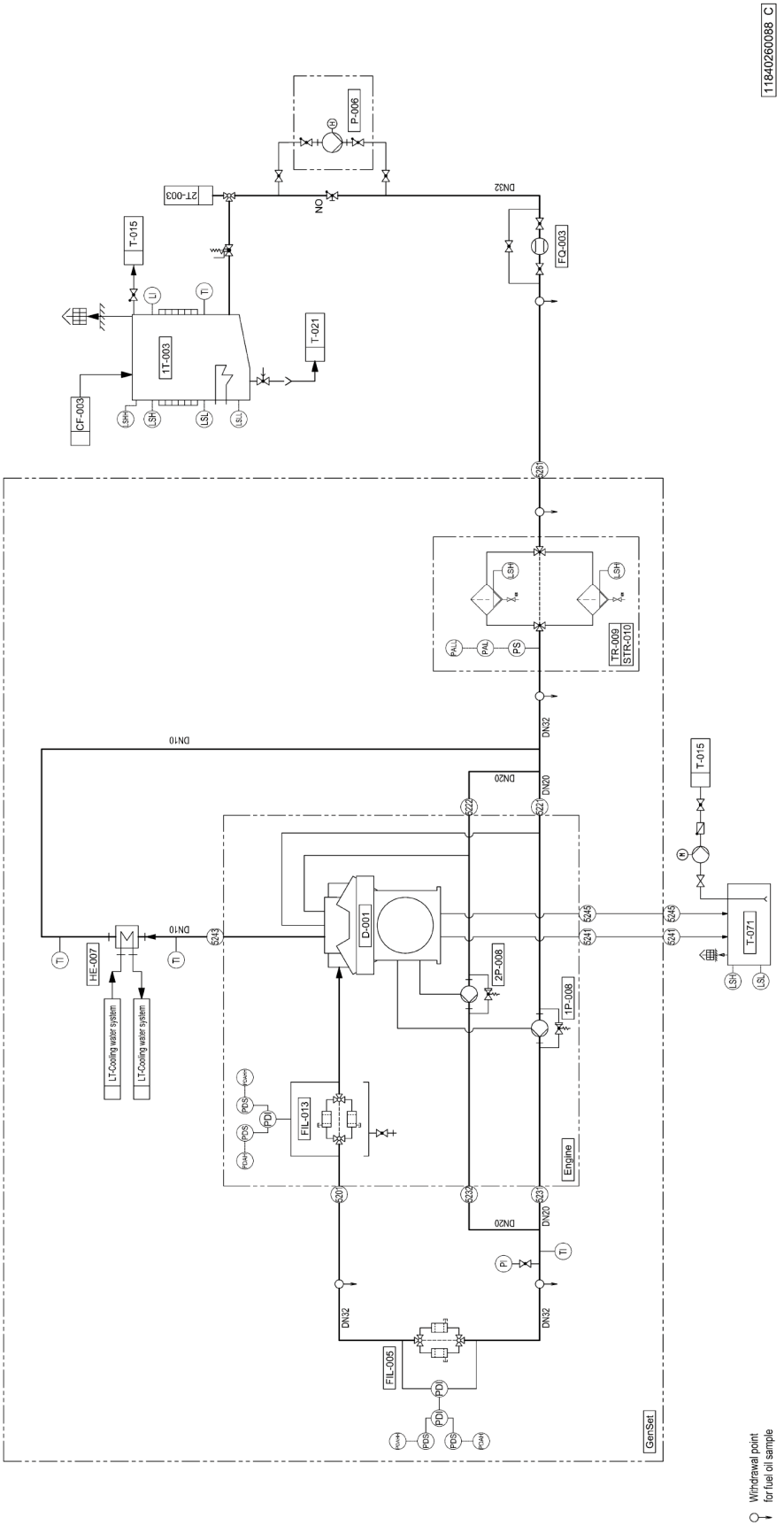
**Major engine connections**

| | |
|---|---|
| 5201 | Fuel oil inlet on engine |
| 5221 | Fuel oil supply pump inlet |
| 5231 | Fuel oil supply pump outlet |
| 5241 | Leakage fuel drain 1, monitored (from pressure pipe jacket) |
| 5243 | Leakage fuel drain 1 (not monitored) |
| 5245 | Fuel oil drain from safety valve |
| 5261 | Fuel oil inlet on GenSet |
| 5272 | Leakage fuel drain 1 on GenSet, monitored |
| 5273 | Fuel oil drain from safety valve on GenSet |

Figure 107: Fuel oil supply system – GenSet application 12V175D or 16V175D



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11840260088 C
P-006
2T-003
NO
DN32
T-015
FQ-003
1T-003
T-021
OF-003
TR-009
STR-010
DN10
DN20
D-001
HE-007
LT-Cooling water system
LT-Cooling water system
2P-008
1P-008
T-071
FIL-013
Engine
FIL-005
GenSet
Withdrawal point for fuel oil sample

**Components**

| | |
|---|---|
| CF-003 | Fuel oil separator |
| D-001 | Diesel engine |
| FIL-005 | Fuel oil duplex filter |
| FIL-013 | Fuel oil duplex filter |
| FQ-003 | Fuel oil flow meter |
| HE-007 | Fuel oil cooler |
| P-006 | Fuel oil hand pump |
| 1,2 P-008 | Fuel oil supply pump, attached |
| STR-010 | Strainer |
| TR-009 | Coalescer |
| 1,2 T-003 | Fuel oil service tank |
| T-015 | Fuel oil storage tank |
| T-021 | Sludge tank |
| T-071 | Clean leakage fuel tank |

**Major engine connections**

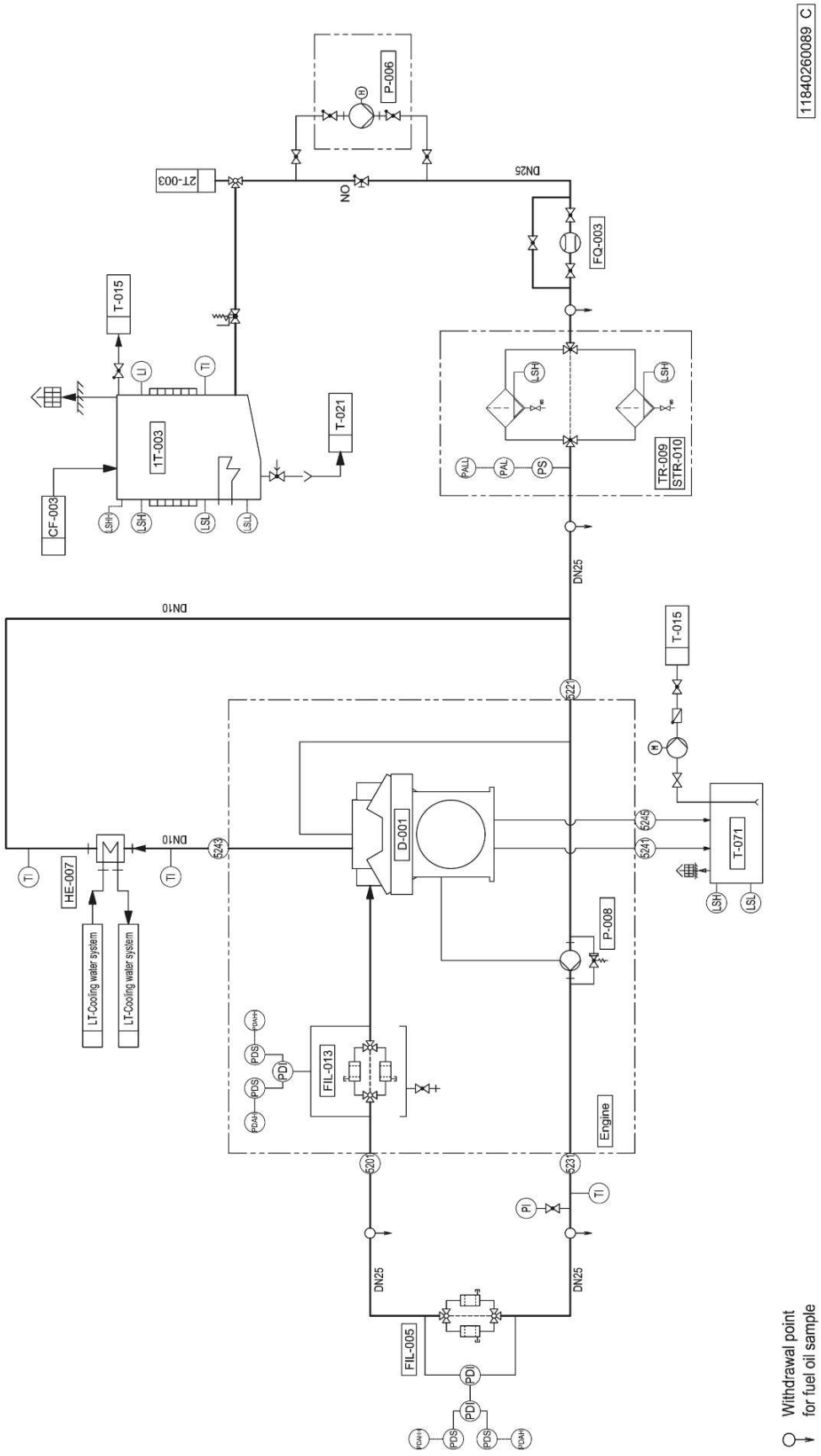
| | |
|---|---|
| 5201 | Fuel oil inlet on engine |
| 5221 | Fuel oil supply pump inlet |
| 5222 | Fuel oil supply pump inlet |
| 5231 | Fuel oil supply pump outlet |
| 5232 | Fuel oil supply pump outlet |
| 5241 | Leakage fuel drain 1, monitored (from pressure pipe jacket) |
| 5243 | Leakage fuel drain 1 (not monitored) |
| 5245 | Fuel oil drain from safety valve |
| 5261 | Fuel oil inlet on GenSet |
| 5272 | Leakage fuel drain 1 on GenSet, monitored |
| 5273 | Fuel oil drain from safety valve on GenSet |

Figure 108: Fuel oil supply system – GenSet application 20V175D



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## Fuel oil supply system – Propulsion engine



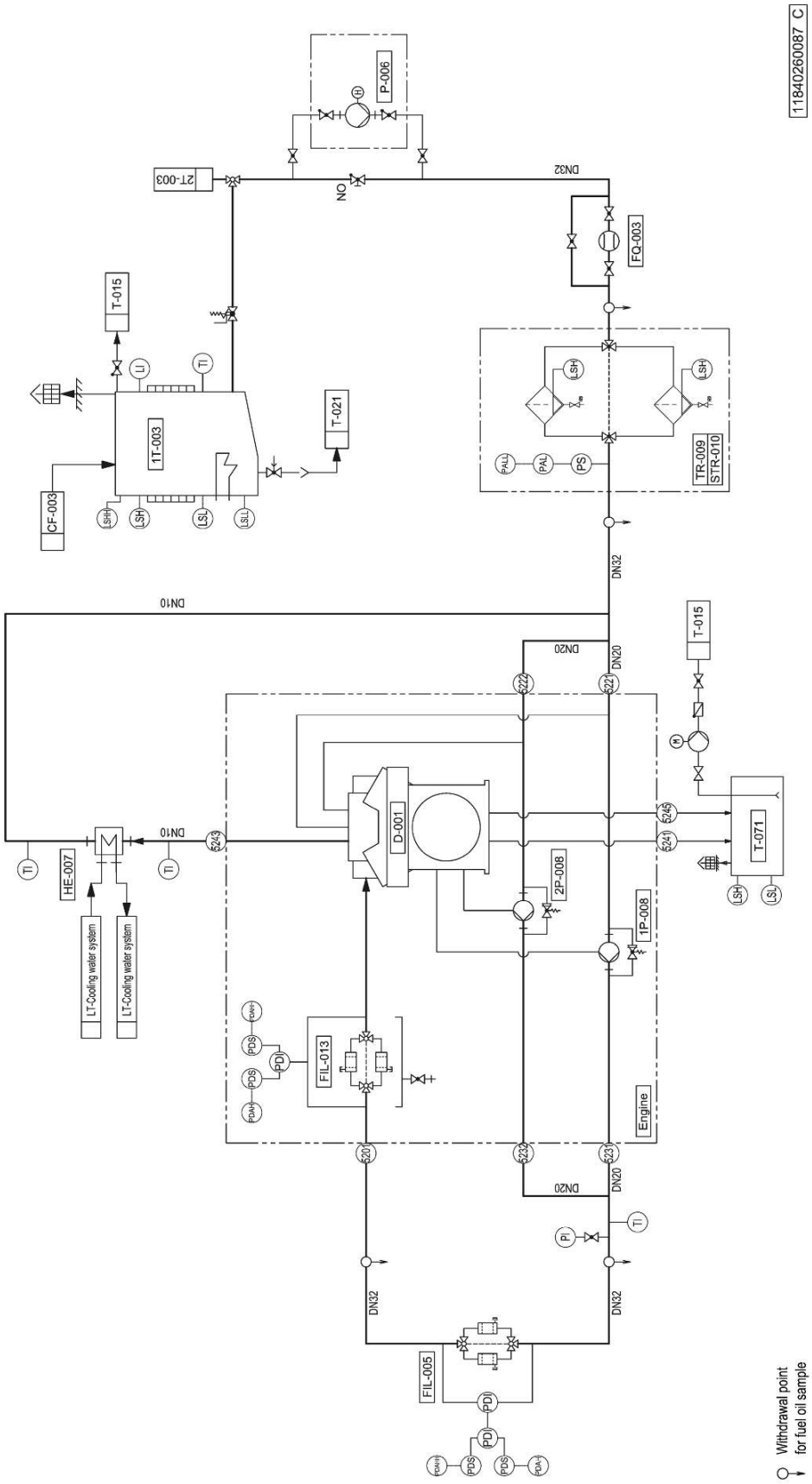

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| | |
|---|---|
| | **Components** |
| CF-003 | Fuel oil separator |
| D-001 | Diesel engine |
| FIL-005 | Fuel oil duplex filter |
| FIL-013 | Fuel oil duplex filter |
| FQ-003 | Fuel oil flow meter |
| HE-007 | Fuel oil cooler |
| P-006 | Fuel oil hand pump |
| | **Major engine connections** |
| 5201 | Fuel oil inlet on engine |
| 5221 | Fuel oil supply pump inlet |
| 5231 | Fuel oil supply pump outlet |
| P-008 | Fuel oil supply pump, attached |
| STR-010 | Strainer |
| TR-009 | Coalescer |
| T-003 | Fuel oil service tank |
| T-015 | Fuel oil storage tank |
| T-021 | Sludge tank |
| T-071 | Clean leakage fuel tank |
| 5241 | Leakage fuel drain 1, monitored (from pressure pipe jacket) |
| 5243 | Leakage fuel drain 1 (not monitored) |
| 5245 | Fuel oil drain from safety valve |

Figure 109: Fuel oil supply system – Propulsion engine 12V175D or 16V175D (w/o ML+, ML, MM)



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| | Components | | |
|---|---|---|---|
| CF-003 | Fuel oil separator | 1,2 P-008 | Fuel oil supply pump, attached |
| D-001 | Diesel engine | STR-010 | Strainer |
| FIL-005 | Fuel oil duplex filter | TR-009 | Coalescer |
| FIL-013 | Fuel oil duplex filter | 1,2 T-003 | Fuel oil service tank |
| FQ-003 | Fuel oil flow meter | T-015 | Fuel oil storage tank |
| HE-007 | Fuel oil cooler | T-021 | Sludge tank |
| P-006 | Fuel oil hand pump | T-071 | Clean leakage fuel tank |
| | Major engine connections | | |
| 5201 | Fuel oil inlet on engine | 5232 | Fuel oil supply pump outlet |
| 5221 | Fuel oil supply pump inlet | 5241 | Leakage fuel drain 1, monitored (from pressure pipe jacket) |
| 5222 | Fuel oil supply pump inlet | 5243 | Leakage fuel drain 1 (not monitored) |
| 5231 | Fuel oil supply pump outlet | 5245 | Fuel oil drain from safety valve |

Figure 110: Fuel oil supply system – Propulsion engine 16V175D ML+, ML and MM and 20V175D

## 5.8 Compressed air system (for optional air starter)

### General

The engine requires compressed air only for starting, if the standard pneumatic starter is supplied.

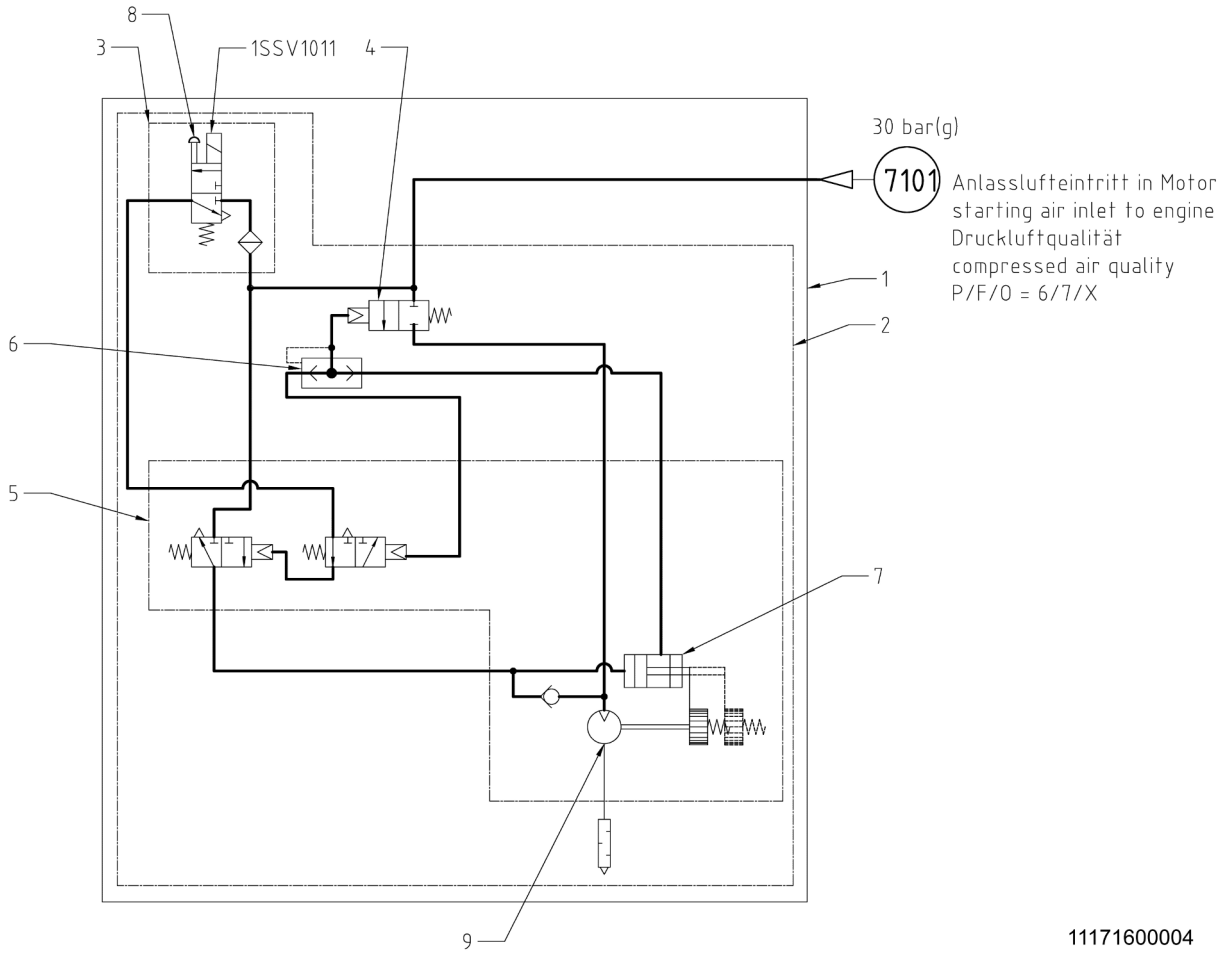
### Starting air quality

The compressed air, supplied to the engine, must meet the requirements given in sections Compressed air starting system (optional), Page 349, Specification of compressed air, Page 410 and External compressed air system, Page 476.



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### 5.8.1 Internal compressed air system




1 Engine
2 Compressed air starter
3 Engine start valve
4 Starter main valve
5 Servo unit

Connection numbers

7101 Starting air inlet on starting valve or air starter

6 Membrane valve
7 Pusher
8 Manual emergency start button
9 Pneumatic motor

Figure 111: Internal compressed air system

### 5.8.2 External compressed air system

#### Air filter and water trap

In order to protect the starter, it is necessary that an air filter and a water trap are installed on the compressed air supply line.

A suitable component for most applications is available as an option.

Consult Everllence if you have specific requirements or plan to use third party hardware.

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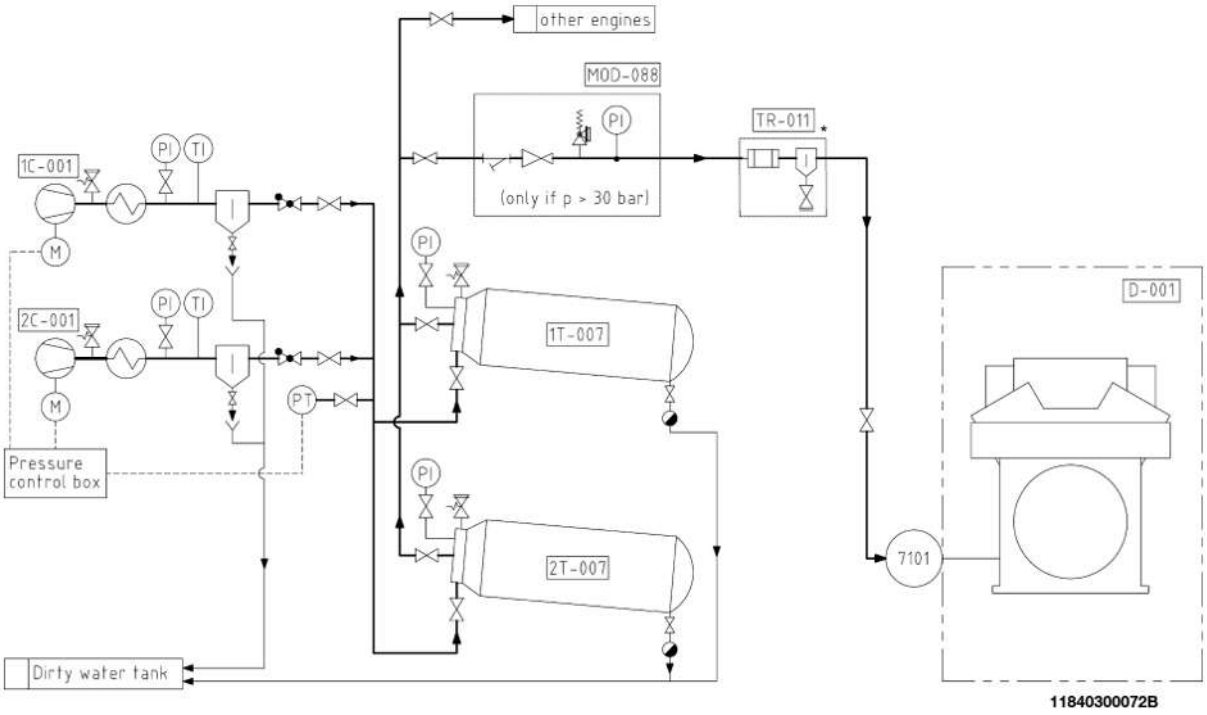
### Air receivers

Air receivers should be selected according to the air consumption, as defined for the relevant engine variant. Compressed air temperature at the pneumatic motor inlet flange should not be lower than 0°C because of the plant components.

If compressed air pressure above 30 bar is used, a suitable pressure reducing station is required.

Consult Everllence for specific information.

### Compressed air system




Components

| | |
|---|---|
| 1.2 C-001 | Starting air compressor |
| D-001 | Diesel engine |
| TR-011 | Water separator with filter |
| MOD-088 | Pressure reducing unit |
| 1.2 T-007 | Air receiver |

Major engine connection

| | |
|---|---|
| 7101 | Starting air connection |

Figure 112: P&ID compressed air system

### Starting air receivers

The starting air supply is to be split up into not less than two starting air receivers of nominally the same size, which can be used independently of each another.

The engine requires compressed air for starting, if the standard pneumatic starter is supplied. The design of the pressure air receiver directly depends on the air consumption and the requirements of the classification societies.

In case of mechanical-propulsion drive without shifting clutch but with shaft driven alternator, consult Everllence.



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For air consumption see section Starting system – Energy consumption, Page 347.

Within the table Starting air consumption, Page 349 two different values for starting air and slow turn air consumption are stated, one at minimum and one at high moment of inertia. Accordingly the valid starting air consumption $V_{Start}$ for the unit need to be interpolated between the two figures stated in the table based on the relevant total moment of inertia $J_{Total}$ for the unit.

Hereby relevant is the moment of inertia, that needs to be accelerated by the engine's starting air system and can not be separated from the engine by a clutch during starting-up.

First the moment of inertia of the plant $J_{Total}$ needs to be calculated:

$J_{Total} = J_1+J_2+J_{Plant\ attached\ to\ flywheel}$

For moment of inertia $\Theta_1$ and $\Theta_2$ of the engine see section Moments of inertia – Crankshaft, damper, flywheel, Page 373.

**Calculation for starting air receiver of engines without jet assist and Slow Turn:**

$$V = \frac{\left(V_{start} * \left(z_{St} + z_{safe}\right)\right) * p_{amb}}{\left(p_{max} - p_{min}\right)}$$

| | |
|---|---|
| V [litre] | Required receiver capacity |
| $V_{Start}$ [litre] | Interpolated air consumption per start and valid for the unit, to be recalculated from $Nm^3$ to litre |
| $J_1$ | Moment of inertia of crankshaft and damper of the engine[2)] |
| $J_2$ | Moment of inertia of flywheel of the engine[2)] |
| $J_{Plant\ attached\ to\ the\ flywheel}$ | Plant specific moment of inertia attached to the flywheel, that needs to be accelerated by the engine's starting air system and can not be separated from the engine by a clutch during starting-up |
| $J_{Total}$ | Total moment of inertia of engine and plant, that needs to be accelerated by the engine's starting air system |
| $z_{St}$ | Number of starts required by the classification society |
| $z_{Safe}$ | Number of starts as safety margin |
| $z_{sl}$ | Number of Slow Turn manoeuvres |
| $p_{amb}$ | Ambient pressure |
| $p_{max}$ [bar] | Maximum starting air pressure (normally 30 bar) |
| $p_{min}$ [bar] | Minimum starting air pressure (15 bar) |

[1)] Tabulated values see section Starting system – Energy consumption, Page 347.

[2)] Tabulated values see section Moments of inertia – Crankshaft, damper, flywheel, Page 373.

If other consumers (i.e. auxiliary engines, ship air etc.) which are not listed in the formula are connected to the starting air receiver, the capacity of starting air receiver must be increased accordingly, or an additional separate air receiver has to be installed.

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## 5.9 Engine room ventilation and combustion air

### 5.9.1 General information

Engine room ventilation system

The engine room ventilation system has the following purpose:

- Supplying the engines and auxiliary boilers with combustion air.
- Carrying off the radiant heat from all installed engines and auxiliaries.

Combustion air

The combustion air must be free from spray water, snow, dust, and oil mist.

This is achieved by:

- Louvres, protected against the head wind, with baffles in the back and optimally dimensioned suction space to reduce the air flow velocity to 1 – 1.5 m/s.
- Self-cleaning air filter in the suction space (required for dust-laden air, e. g. cement, ore or grain carrier).
- Sufficient space between the intake point and the openings of exhaust air ducts from the engine and separator room as well as vent pipes from lube oil and fuel oil tanks and the air intake louvres (the influence of winds must be taken into consideration).
- Positioning of engine room doors on the ship's deck so that no oil-laden air and warm engine room air will be drawn in when the doors are open.
- Arranging the separator station at a sufficiently large distance from the turbochargers.

As a standard, the engines are equipped with turbochargers with air intake silencers and the intake air is normally drawn in from the engine room.

In tropical service a sufficient volume of air must be supplied to the turbocharger(s) at outside air temperature. For this purpose there must be an air duct installed for each turbocharger, with the outlet of the duct facing the respective intake air silencer, separated from the latter by a space of 1.5 m. No water of condensation from the air duct must be permissible to be drawn in by the turbocharger. The air stream must not be directed onto the exhaust manifold.

For the required combustion air quality, see section Specification for intake air (combustion air), Page 411.

Cross sections of air supply ducts are to be designed to obtain the following air flow velocities:

- Main ducts 8 – 12 m/s
- Secondary ducts max. 8 m/s

Air fans are to be designed to maintain a positive air pressure of 50 Pa (5 mm WC) in the engine room.

Radiant heat

The heat radiated from the main and auxiliary engines, from the exhaust manifolds, waste heat boilers, silencers, alternators, compressors, electrical equipment, steam and condensate pipes, heated tanks and other auxiliaries is absorbed by the engine room air.

The amount of air V required to carry off this radiant heat can be calculated as follows:

$$V = \frac{Q}{\Delta t \times cp \times \rho t}$$



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| | |
|---|---|
| V [$m^3$/h] | Air required |
| Q [kJ/h] | Heat to be dissipated |
| Δt [°C] | Air temperature rise in engine room (10 – 12.5) |
| cp [kJ/kg*k] | Specific heat capacity of air (1.01) |
| ρt [$kg/m^3$] | Air density at 35°C (1.15) |

Ventilator capacity

The capacity of the air ventilators (without separator room) must be large enough to cover at least the sum of the following tasks:

- The combustion air requirements of all consumers.
- The air required for carrying off the radiant heat.

A rule-of-thumb applicable to plants operating on heavy fuel oil is 20 – 24 $m^3$/kWh.

Moreover it is recommended to apply variable ventilator speed to regulate the air flow. This prevents excessive energy consumption and cooling down of engines in stand-by.

Maximum engine room temperature

The engine room ventilation must ensure a maximum engine room temperature, with following boundary conditions:

- Maximum air temperature in the area of the engine and its components ≤ 45°C.
- Maximum air temperature at least 5 K below the flash point of any liquids, that is present within the engine room.

## 5.9.2 External intake air supply system

**General recommendations for external intake air system of vessels operating in arctic conditions**

The design of the intake air system ducting is crucial for reliable operation of the engine. The following points must be considered:

- Every single engine must be provided with a dedicated intake air system. It is not allowed to combine air intake systems of different engines.
- According to classification rules it may be required to install two air inlets from the exterior, one at starboard and one at portside.
- It must be prevented that exhaust gas and oil dust is sucked into the intake air duct as fast filter blocking might occur.
- Suitable corrosion and low temperature resistant materials should be applied. Stainless steel S316 L might be suitable.
- Inside the duct, there must not be any parts (for example, bolts, nuts, stiffening, and so on) that could fall off and move towards the engine. Installations, that are absolutely necessary (for example, light behind filter wall) must be specially secured (self-locking nuts, screwed covers instead of clamped covers and so on).
- Due to the air flow, load changes and other external forces, (especially during ice breaking, if applicable) the intake air pipe is subject to heavy vibrations. Additionally engine and propeller exciting frequencies have to be taken into account. This has to be considered within the overall layout and the intake air duct must be reinforced sufficiently.
- Thermal expansion has to be considered for the layout and foundation of the duct (for example, flexible mounting, additional compensators).

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- Suitable drainage arrangements to remove any water from the intake air ducting should be provided. Backflow of air through drains has to be avoided (for example, by syphons) and regularly checked for proper functioning. Adequate heating is required to prevent icing of drains.
- The air duct and its components must be insulated properly. Especially a vapour barrier has to be applied to prevent atmospheric moisture freezing in the insulation material.
- An (automatic) shut-off flap should be installed to prevent a chimney effect and cooling down of engine during stand-still (maintenance or stand-by of engine). This flap is to be monitored and engine start should only be allowed in fully-open position. As an alternative, the intake system can be closed by a roller shutter or tarpaulin in front of the filter.
- The overall pressure drop of the intake air system ducting and its components is to be limited to 30 mbar. Moreover the differential pressure of the intake air filter must be monitored to keep this requirement. For additional safety, other components as the droplet separator and the weather hood can be monitored by differential pressure devices.
  During commissioning and maintenance work, checking of the air intake system back pressure by means of a temporarily connected measuring device may become necessary. For this purpose, a measuring socket is to be provided approximately 1 to 2 metres before the turbocharger, in a straight length of pipe at an easily accessible position. Standard pressure measuring devices usually require a measuring socket size of 1/2".
- The turbocharger as a flow machine is dependent on a uniform inflow. Therefore, the ducting must enable an air flow without disturbances or constrictions. For this, multiple deflections with an angle > 45° within the ducting must be avoided.
- The intake air must not flow against the direction of the compressor rotation, otherwise stalling could occur.
- It is recommended to verify the layout of the intake air piping by CFD calculations up to the entry of the compressor of the turbocharger.
- The maximum specified air flow speed of 20 m/s should not be exceeded at any location of the pipe.
- A silencer is recommended to reduce the noise emissions from engine inlet and charge air blow-off. Sound power levels can be found in the relevant section of the Project Guide. Care must be taken, that no insulation material can escape from the silencer, which can fuse into glass spheres in the combustion chamber.

### Components of intake air ducting

The whole system and its components must be designed suitably robust to withstand pressure peaks occurring from turbocharger surge. This will not happen during normal operation, but it could occur at fast load changes of the engine. This can happen 2 – 3 times consecutively, until the turbocharger comes back to its normal working range.

The table below shows values at engine inlet connection with a suitable intake air ducting. An unfavourable intake air duct design can also lead to higher values.

| Type | Variation | Frequency | Comment |
|---|---|---|---|
| Pressure oscillation | ± 40 mbar, 5 – 10 Hz | Permanent | Normal operation/ constant load |
| Peak pressure (shock wave) | ± 300 mbar | Sporadically | Engine emergency stop/ turbocharger surge |



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The ambient air, which is led to engine by the intake air duct, must be conditioned by several components. This could be done by the following components:

- Section for cleaning of intake air (1 – 4)

  A weather hood (1) in combination with a snow trap (2) removes coarse dirt, snow and rain. A heated droplet separator (3) subsequently separates remaining water droplets or snow from the air. An appropriate filter cleans the intake air from particles (4). As a minimum, inlet air must be cleaned by an ISO coarse 45% class filter as per DIN EN ISO 16890. If there is a risk of high inlet air contamination, filter efficiency should be at least ISO ePM10 50 % according to DIN EN ISO 16890.

- Combustion air silencer (5)

  Noise emissions of engine inlet and charge air blow-off can be reduced by a silencer in the intake air duct. It is recommended to apply a mesh (5a) at the outlet of the silencer to protect the turbocharger against any loose parts (for example, insulation material of silencer, rust and so on) from the intake air duct. This mesh is to be applied even if the silencer will not be supplied. A drain close to the turbocharger is required to separate condensate water.

- Overpressure flap (6) (optional)

  Depending on the system volume and chosen components it might be necessary to install an overpressure flap between silencer and engine. Peak pressure pulses (for example, during emergency stop) are conducted into the engine room via this flap, preventing possible damage to the filter and silencer.

- Shut-off flap/blind plate (7)

  It is recommended to install a shut-off flap to prevent cooling down of the engine during longer standstills under arctic conditions. This flap should be monitored by the engine automation system to prevent engine start with closed flap.
  As an alternative, the intake system can be closed by a roller shutter or tarpaulin in front of the filter.

- Compensator (8) and transition piece (9)

  A steel compensator (rubber might also be considered) has to be installed direct vertically upstream of the 90° transition piece behind turbocharger. A rigid support must be provided as close as possible upstream of the compensator. It has to be noted, that this compensator is solely foreseen to compensate engine-borne movements. Additional compensators might be necessary to cope for thermal expansion.

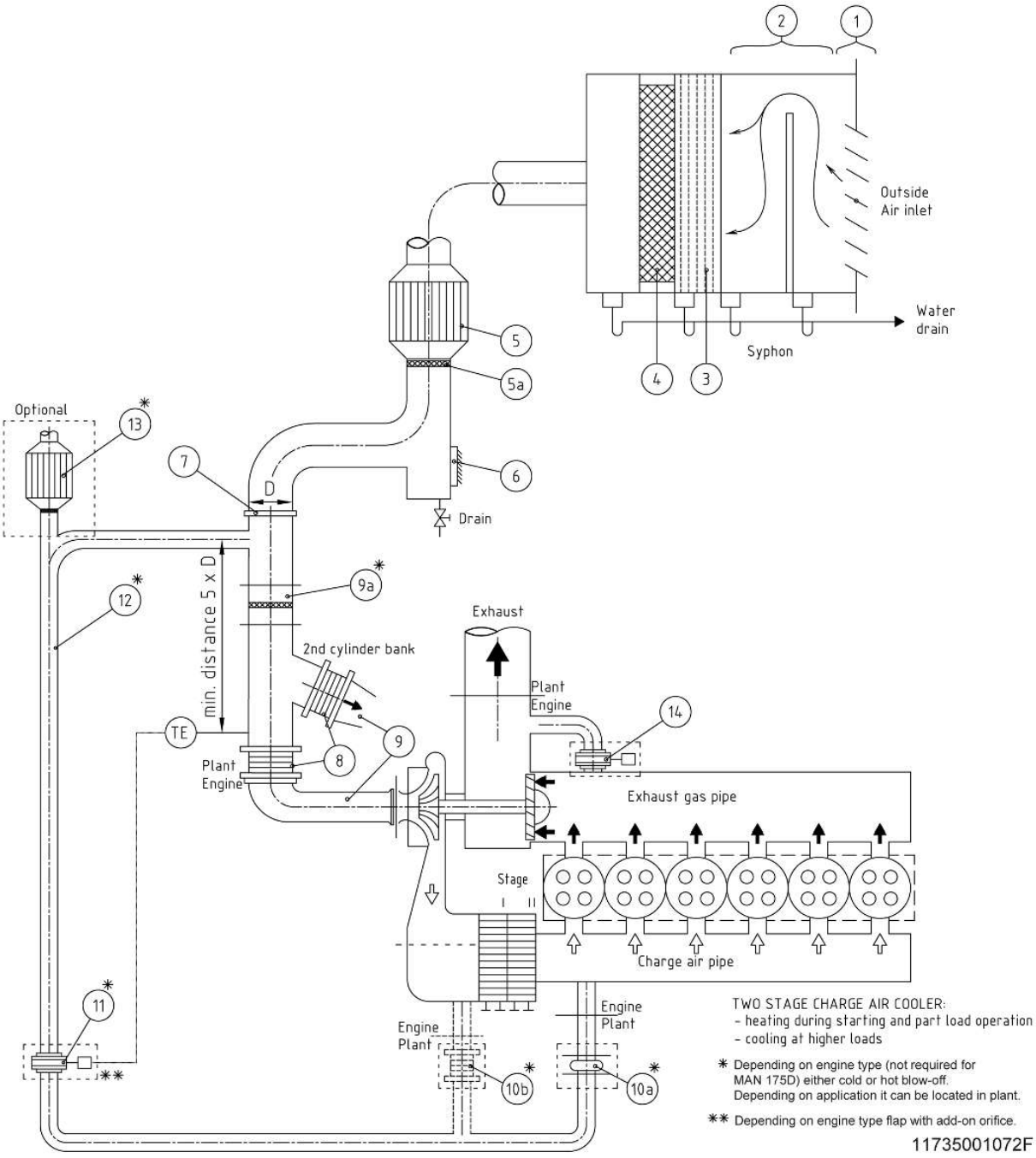
- Strainer for commissioning phase (9a)

  To prevent residues from installation phase entering the engine during commissioning, it is recommended to install a strainer or protective mesh as close as possible to the turbocharger. After running-in is finished, the strainer must be removed and exchanged by an intermediate pipe.

- Charge air blow-off or recirculation

  For arctic conditions an increased firing pressure, which is caused by higher density of cold air, is prevented by an additional valve, which blows off charge air (11). A compensator (10) connects the engine with the charge air blow-off piping. The blown-off air is taken after (cold blow-off) the charge air cooler or before the charge air cooler (hot blow-off) and is circulated (12) back in the intake air duct or blown out via an additional silencer. A homogenous temperature profile and a correct measurement of intake air temperature in front of compressor has to be achieved. For this a minimum distance of five times the diameter of the intake air duct between inlet of blown-off air and the measuring point must be kept.

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1 Weather hood
2 Snow trap
3 Heated droplet separator
4 Air intake filter 030.120.010
5 Combustion air silencer 030.130.040
5a Protective mesh
6 Overpressure flap (optional)
7 Blind plate/shut-off flap (for maintenance case)
8 Metal below expansion joint combustion air (rubber might be considered)
9 Transition piece
9a (Optional) intermediate pipe with protective grid for running-in phase (to be removed afterwards)
10a Rubber below expansion joint – Cold blow-off
10b Metal below expansion joint – Hot blow-off
11 Charge air blow-off valve
12 Charge air blow-off pipe
13 Charge air blow-off silencer
14 Waste gate (if required for relevant engine type)

Figure 113: External intake air supply system for arctic conditions

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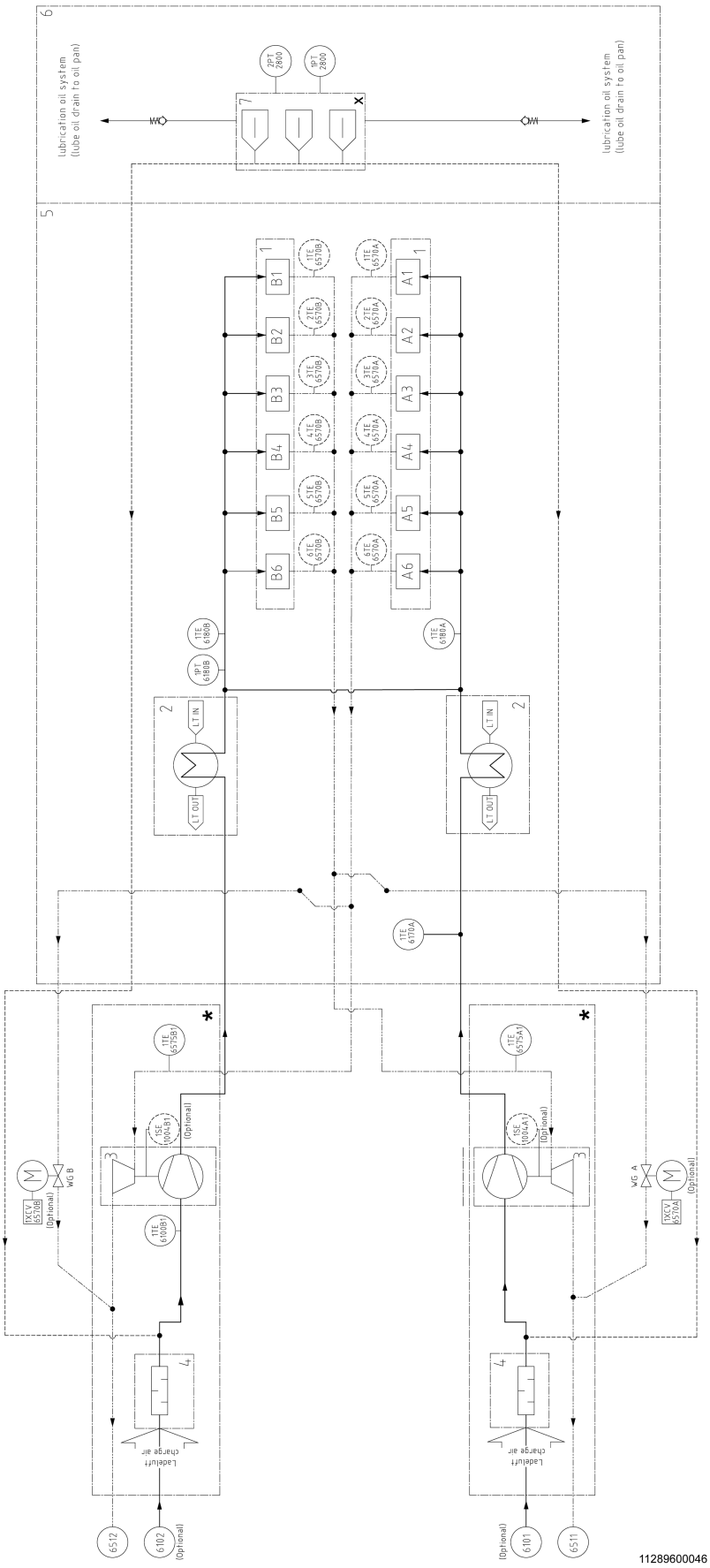
## 5.10 Exhaust gas system

### 5.10.1 Internal engine exhaust gas system



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## 5.10 Exhaust gas system



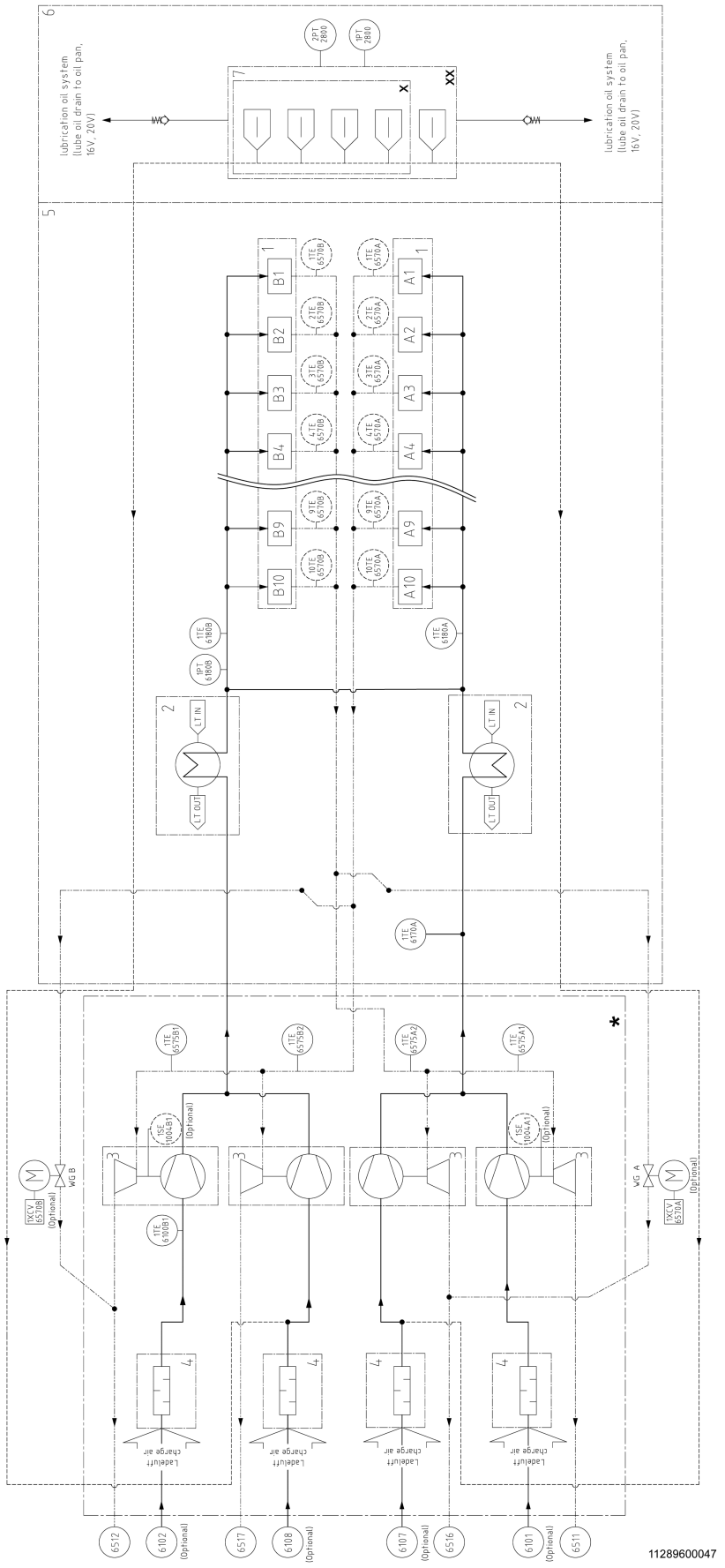
6101 Intake air inlet to turbocharger 1 (optional)
6102 Intake air inlet to turbocharger 2 (optional)
x 12V
6511 Exhaust gas outlet from turbocharger A1
6512 Exhaust gas outlet from turbocharger B2
* 12V (2 x TCR12)

Figure 114: Charge air and exhaust gas diagram 12V exemplary



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## 5.10 Exhaust gas system



6101 Intake air inlet to turbocharger 1 (optional)
6102 Intake air inlet to turbocharger 2 (optional)
6107 Intake air inlet to turbocharger 3 (optional)
6108 Intake air inlet to turbocharger 4 (optional)
x 16V
xx 20V

6511 Exhaust gas outlet from turbocharger A1
6512 Exhaust gas outlet from turbocharger B2
6516 Exhaust gas outlet from turbocharger A3
6517 Exhaust gas outlet from turbocharger B4
* 16V (4 x TCR10 & 20V (4 x TCR12)

Figure 115: Charge air and exhaust gas diagram 16V/20V exemplary

### 5.10.2 Exhaust gas system description

Layout

As the flow resistance in the exhaust system has a very large influence on the fuel consumption and the thermal load of the engine, the total resistance of the exhaust gas system must not exceed 50 mbar.

Contact Everllence for permissible values for special cases.

The pipe diameter selection depends on the engine output, the exhaust gas volume, and the system back pressure, including silencer and SCR (if fitted). The backpressure also depending on the length and arrangement of the piping and the number of bends. Sharp bends result in high flow resistance and should therefore be avoided. If necessary, pipe bends must be provided with guide vanes.

It is recommended not to exceed a maximum exhaust gas velocity of approx. 40 m/s.

Installation

When installing the exhaust system, the following points must be observed:

- The exhaust pipes of two or more engines must not be joined.
- Because of the high temperatures involved, the exhaust pipes must be able to expand. The expansion joints to be provided for this purpose are to be mounted between fixed-point pipe supports installed in suitable positions. One sturdy fixed-point support must be provided for the expansion joint directly after the turbocharger. It should be positioned, if possible, immediately above the expansion joint to prevent the transmission of forces to the turbocharger itself. These forces include those resulting from the weight, thermal expansion, or lateral displacement of the exhaust piping.
- The exhaust piping should be elastically hung or supported by dampers in order to prevent the transmission of sound to other parts of the vessel.
- Underwater exhaust is possible, see section Underwater exhaust, Page 491.
- The exhaust piping is to be provided with water drains, which are to be regularly checked to drain any condensation water or possible leak water from exhaust gas boilers if fitted.
- During commissioning and maintenance work, checking of the exhaust gas system back pressure by means of a temporarily connected measuring device may become necessary. For this purpose, a measuring socket is to be provided approximately 1 to 2 metres after the exhaust gas outlet of the turbocharger, in a straight length of pipe at an easily accessible position. Standard pressure measuring devices usually require a measuring socket size of 1/2". This measuring socket is to be provided to ensure back pressure can be measured without any damage to the exhaust gas pipe insulation.



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### 5.10.3 Exhaust components and thermal insulation

#### Exhaust gas silencer

Mode of operation

The silencer operates on the absorption and resonance principle so it is effective in a wide frequency band.

A vertical installation situation is to be preferred to avoid formations of gas fuel pockets in the silencer. The cleaning ports of the spark arrestor are to be easily accessible.

Everllence can supply standard silencers with noise attenuation values of 35 dB and 45 dB over the whole frequency range of 31.5 – 8,000 Hz and back pressure of 20 – 40 mbar, depending on the application. Higher attenuation values are available on request. Contact Everllence for further information.

#### Thermal insulation

The exhaust gas system (from outlet of turbocharger to the outlet stack) must be insulated to reduce the external surface temperature to the required level. The relevant provisions concerning accident prevention and provisions of the classification societies must be observed.

The thermal insulation is also required to avoid temperatures below the dew point in the interior. In case of insufficient insulation, intensified corrosion occurs and soot deposits on the interior surface.

Insulation and covering of the compensator must not restrict its free movement.

#### Compensator

Compensators are used for hot media, for example, exhaust gas. They compensate movements in line and transversely to their centre line, but they are unable to compensate twisting movements. Compensators are very stiff against torsion. Therefore, all kinds of steel compensators installed on resiliently mounted engines must be installed in vertical direction.

Exhaust gas compensators are also used to compensate thermal expansion. Therefore exhaust gas compensators are required for all type of engine mountings, also for semi-resilient, or rigid mounted engines. These compensators are shorter, since they are designed only to compensate the thermal expansions and vibrations, but not other dynamic engine movements.

### 5.10.4 Exhaust gas piping material

- The properties of the piping shall conform to international standards, e.g. DIN EN 10208, DIN EN 10216, DIN EN 10217 or DIN EN 10305, DIN EN 13480-3.
- For piping, black steel pipe should be used; stainless steel shall be used where necessary.
- Outer surface of pipes need to be primed and painted according to the specification.
- The pipes are to be sound, clean and free from all imperfections. The internal surfaces must be thoroughly cleaned and all scale, grit, dirt and sand used in casting or bending removed. No sand is to be used as packing during bending operations.

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### 5.10.5 Underwater exhaust

Standard is a top exhaust gas outlet.

For special applications underwater exhaust gas outlet may be applied, in case of:

- No space for top exhaust gas outlet
- Avoiding visible exhaust gas
- Using underwater outlet as indirect silencer
- Reduced heat signature for patrol boats

If a underwater exhaust needs to be applied, contact Everllence for additional information.

Following items mentioned for consideration and project specific coordination:

- Order of the installations has to be kept. Just after exhaust gas outlet of the engine the SCR system and as next the silencer to be placed.
- Underwater exhaust system design must prevent water to enter the exhaust gas system. Worst conditions are when running astern or with the ship rolling and pitching at low speed. Typically at this time main underwater outlet will be closed and sufficient tightness against water penetration must be given.
- Above water line outlet with flap as installation required.
  For engine starting, during low speed conditions or when manoeuvring astern the exhaust gas will be led to an above water exhaust outlet (flap open). At a certain ship speed ahead the exhaust gas outlet will be switched from the above water line to underwater outlet.
  The speed at which the flap is to be closed is an experience value of shipyards and depends on the curve of remaining backpressure at different loads and speeds. Shipyard shall follow the engine´s backpressure limits.
  Flap in "Open position" to above water line outlet in case of:
  - Engine not running
  - Ship speed < defined limit
  - Gear in reverse
  - Signal failure
- Remote control, monitoring and safety functions required:
  - Control of flap to above water line.
  - Monitoring of back pressure after engine (before SCR/silencer).
  - In case of failure of flap start to be locked and alarm to be triggered.
  - In case of exceeding the exhaust gas back pressure limit flap will switch to above water line.

Required signals, instruments and system for integration to be agreed on.

## 5.11 SCR system

### 5.11.1 SCR system layout and number of main components

SCR system layout



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| Variant Tier III | Power [kW/cyl.] | Speed [rpm] | 12V175D | 16V175D | 20V175D |
|---|---|---|---|---|---|
| ML | 200 | 2,000 | 2-line | 4-line | 4-line |
| MM | 200 | 1,800 | 2-line | - | - |
| MM | 185 | 1,900 | 2-line | 4-line | 4-line |
| MM | 185 | 1,800 | 2-line | 4-line | 4-line |
| MM | 170 | 1,800 | 2-line | 2-line | 4-line |
| MM | 160 | 1,800 | 2-line | 2-line | - |
| MM | 155 | 1,800 | 2-line | - | - |
| MH | 145 | 1,800 | 2-line | - | - |
| MEL | 190 | 1,800 | 2-line | - | 4-line |
| MEL | 185 | 1,800 | - | 4-line | - |
| MEL | 175 | 1,800 | 2-line | 4-line | 4-line |
| MEL | 165 | 1,500 | 2-line | 2-line | 4-line |
| MEL | 150 | 1,500 | 2-line | 2-line | 4-line |
| MEM | 160 | 1,800 | 2-line | 2-line | 4-line |
| MEM | 150 | 1,800 | 2-line | 2-line | 4-line |
| MEM | 135 | 1,500 | 2-line | 2-line | 4-line |
| MEM | 120 | 1,500 | 2-line | - | - |
| MEV | 190 | 1,800 | 2-line | - | 4-line |
| MEV | 185 | 1,800 | - | 4-line | - |
| MEV | 170 | 1,800 | 2-line | 2-line | 4-line |
| MEV | 155 | 1,800 | 2-line | 2-line | 4-line |
| MA | 190 | 1,800 | 2-line | - | - |
| MA | 175 | 1,800 | 2-line | - | - |
| MA | 160 | 1,800 | 2-line | - | - |
| MA | 150 | 1,800 | - | 2-line | - |
| MA | 165 | 1,500 | 2-line | - | - |
| MA | 150 | 1,500 | 2-line | - | - |
| MA | 135 | 1,500 | 2-line | - | - |

Table 630: SCR system layout

### Number of main components

The general description is given within section SCR system description for 175D IMO Tier III variants, Page 22.

| Main components | | |
|---|---|---|
| | 2-line | 4-line |
| Urea mixing unit | 2 | 4 |
| Urea pump module | 1 | 1 |
| Reactor | 2 | 4 |

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| Main components | | |
|---|---|---|
| | 2-line | 4-line |
| SCR control unit | 1 | 1 |

Table 631: Main components

### 5.11.2 SCR system components – Dimensions and weight

**Urea mixing unit (including thermal insulation)**

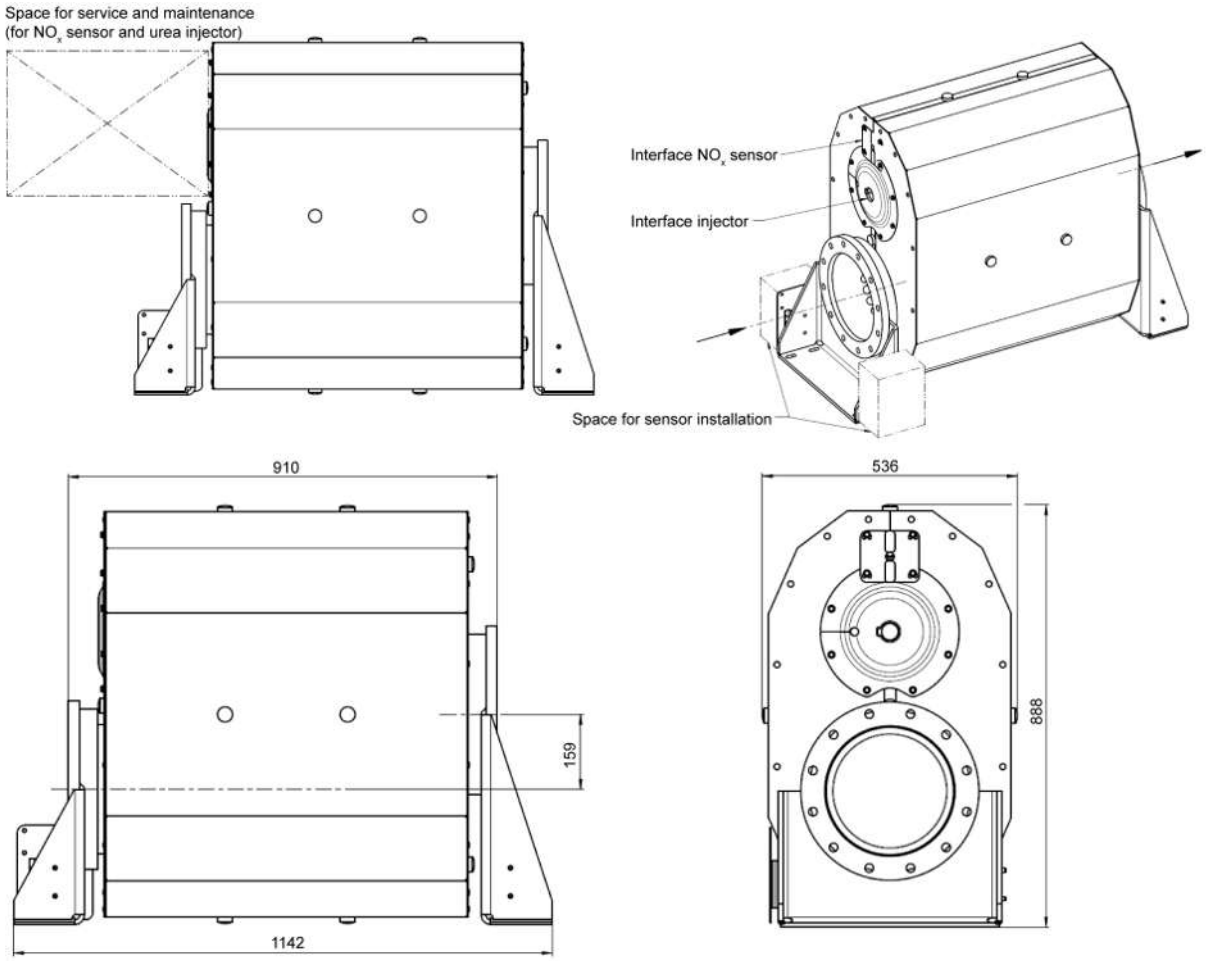



Figure 116: Urea mixing unit (including thermal insulation) [final dimensions project specific]

| Mixing chamber | |
|---|---|
| Flange connection inlet/outlet | DN250 PN6 (acc. to DIN EN 1092) |
| Weight | Approx. 150 kg |

Table 632: Connecting flange and weight



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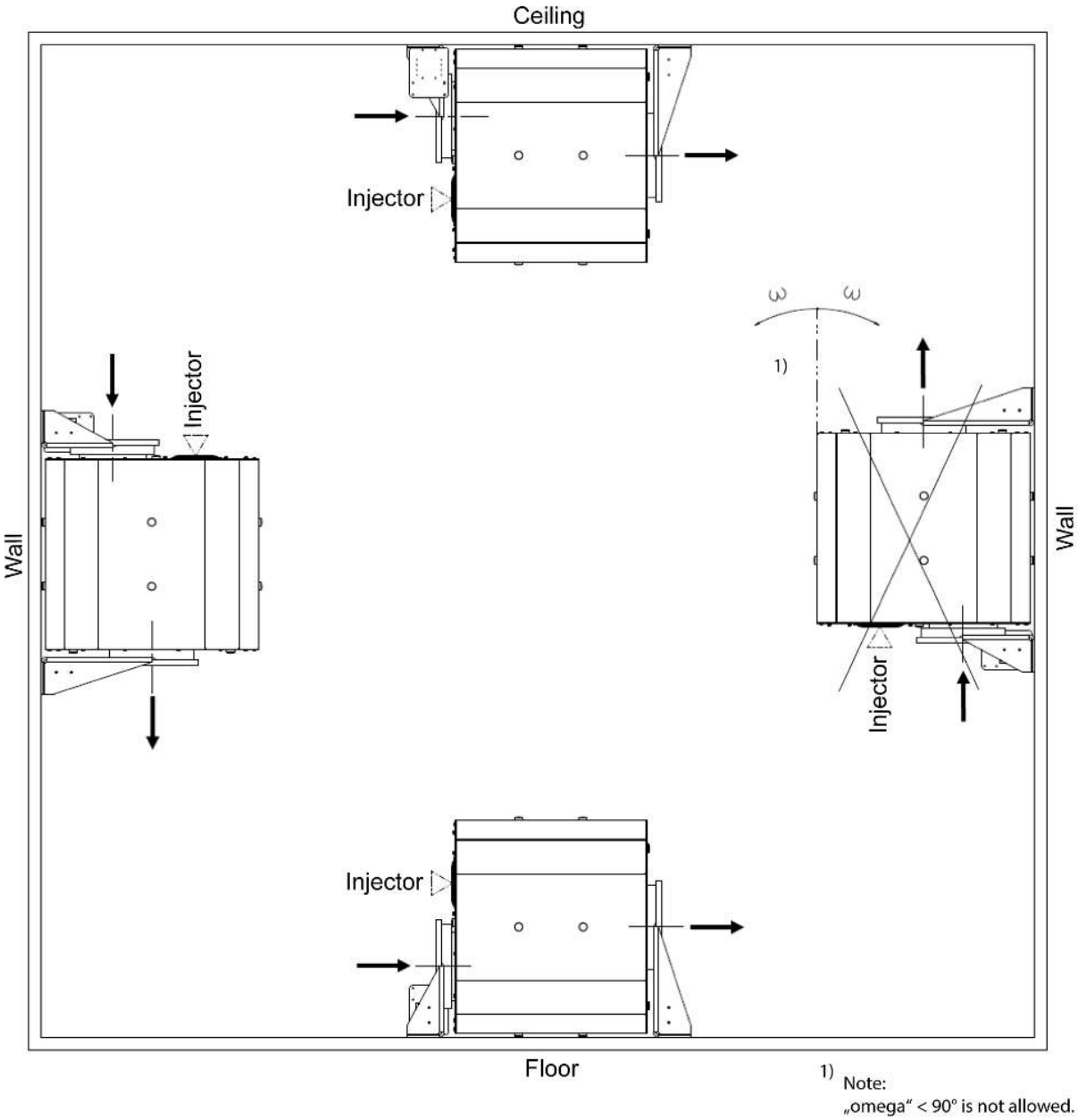



Figure 117: Possible positions for installation of the urea mixing unit

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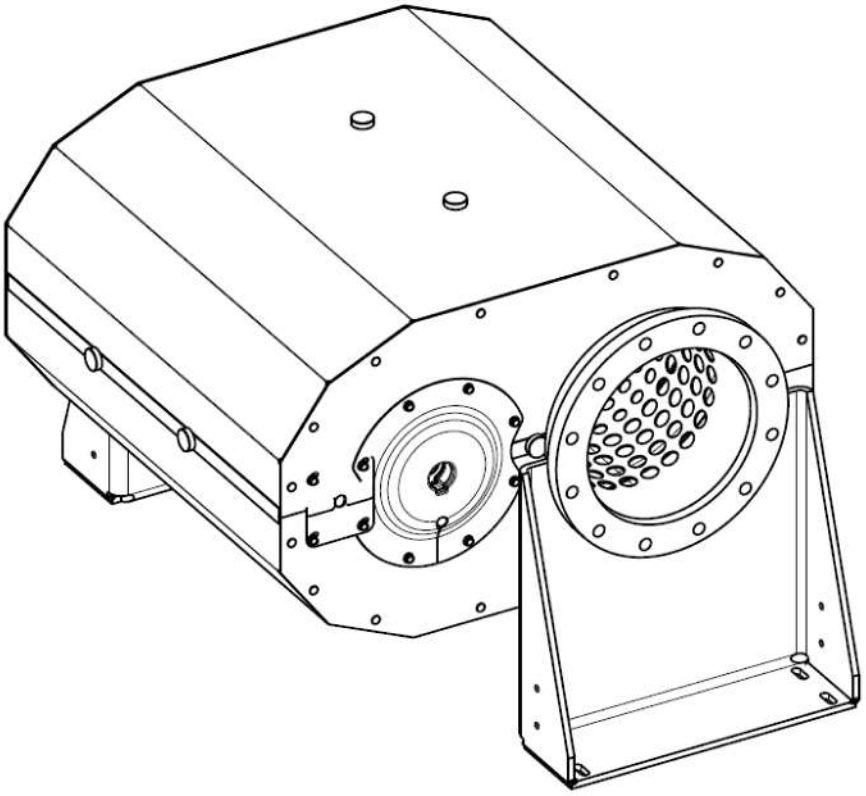


Figure 118: Urea mixing unit – Lying position, instead of upright



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**Urea pump module with dosing cabinet**

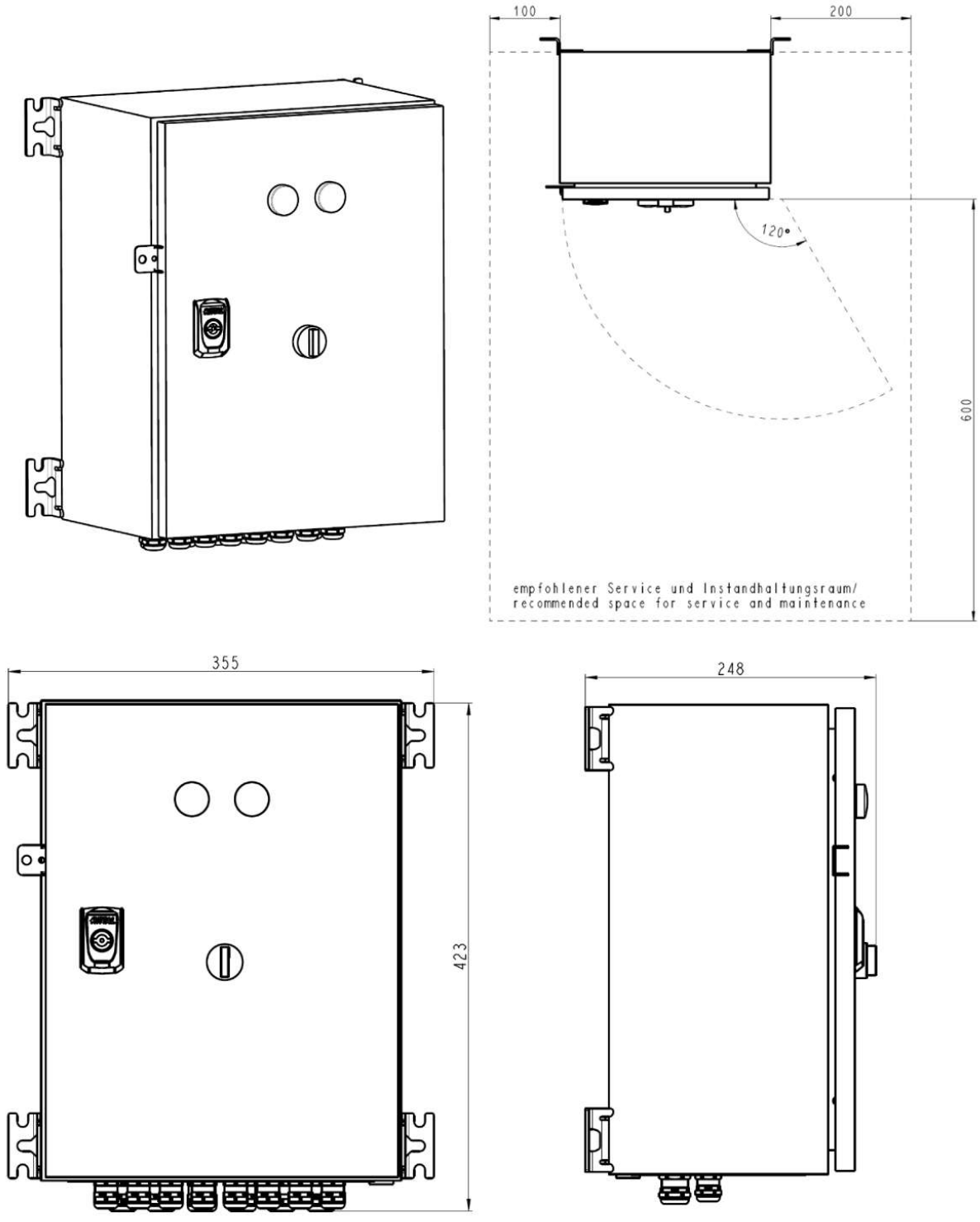



Figure 119: Urea pump module 2-line (final dimensions project specific)

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**Urea pump module with dosing cabinet**

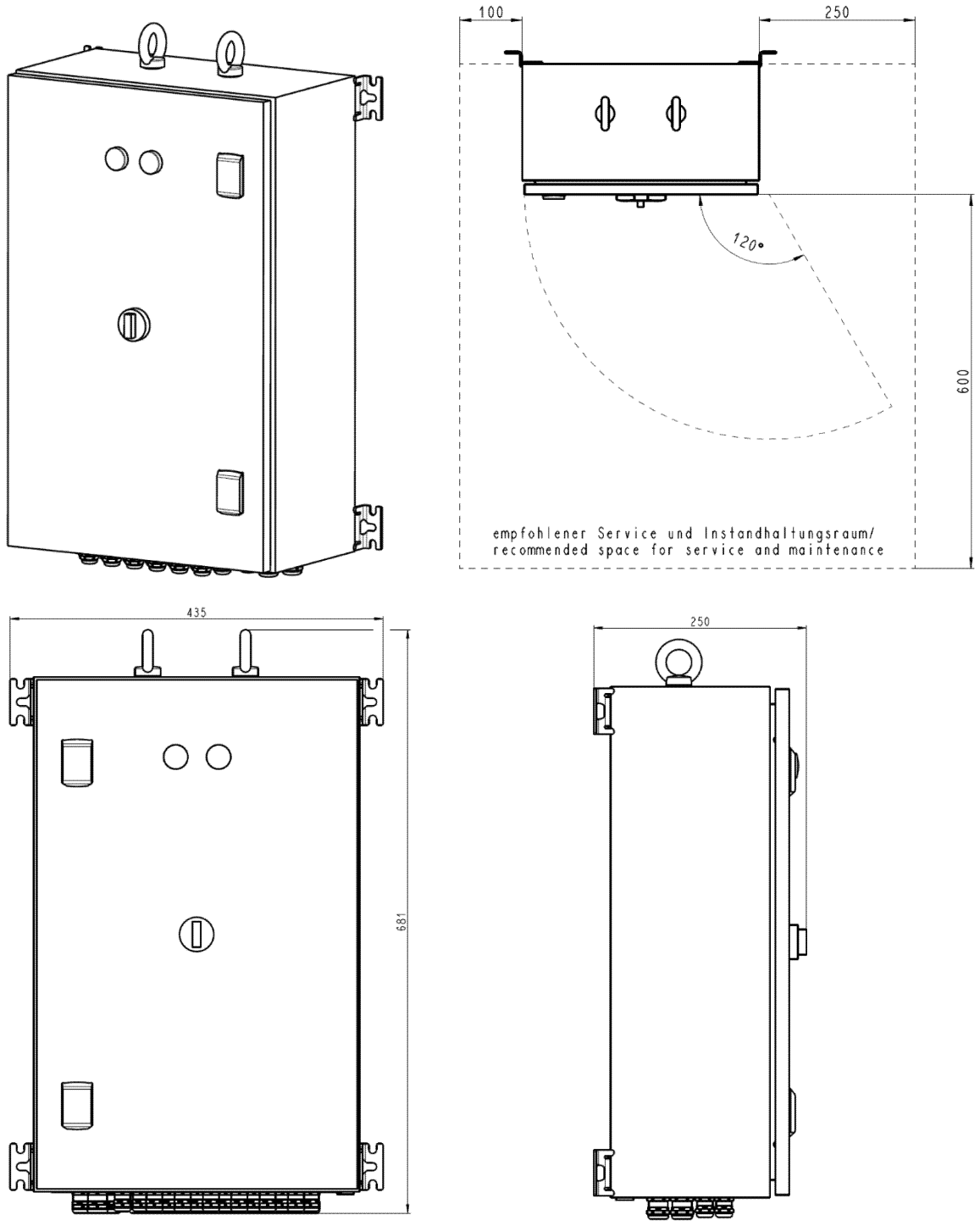



Figure 120: Urea pump module 4-line (final dimensions project specific)

| Urea pump module | |
|---|---|
| Weight | Approx. 35 kg |
| Power supply | 24 V DC, 300 W |



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| Urea pump module | |
|---|---|
| Emitted vibrations | < DNV class A |

Table 633: Main data urea pump module

Note:
The urea pump module generates during operation a maximum vibration velocity (RMS) < 3 mm/sec, which will be transferred to the supporting structure or has to be compensated.

**SCR reactor (including thermal insulation)**

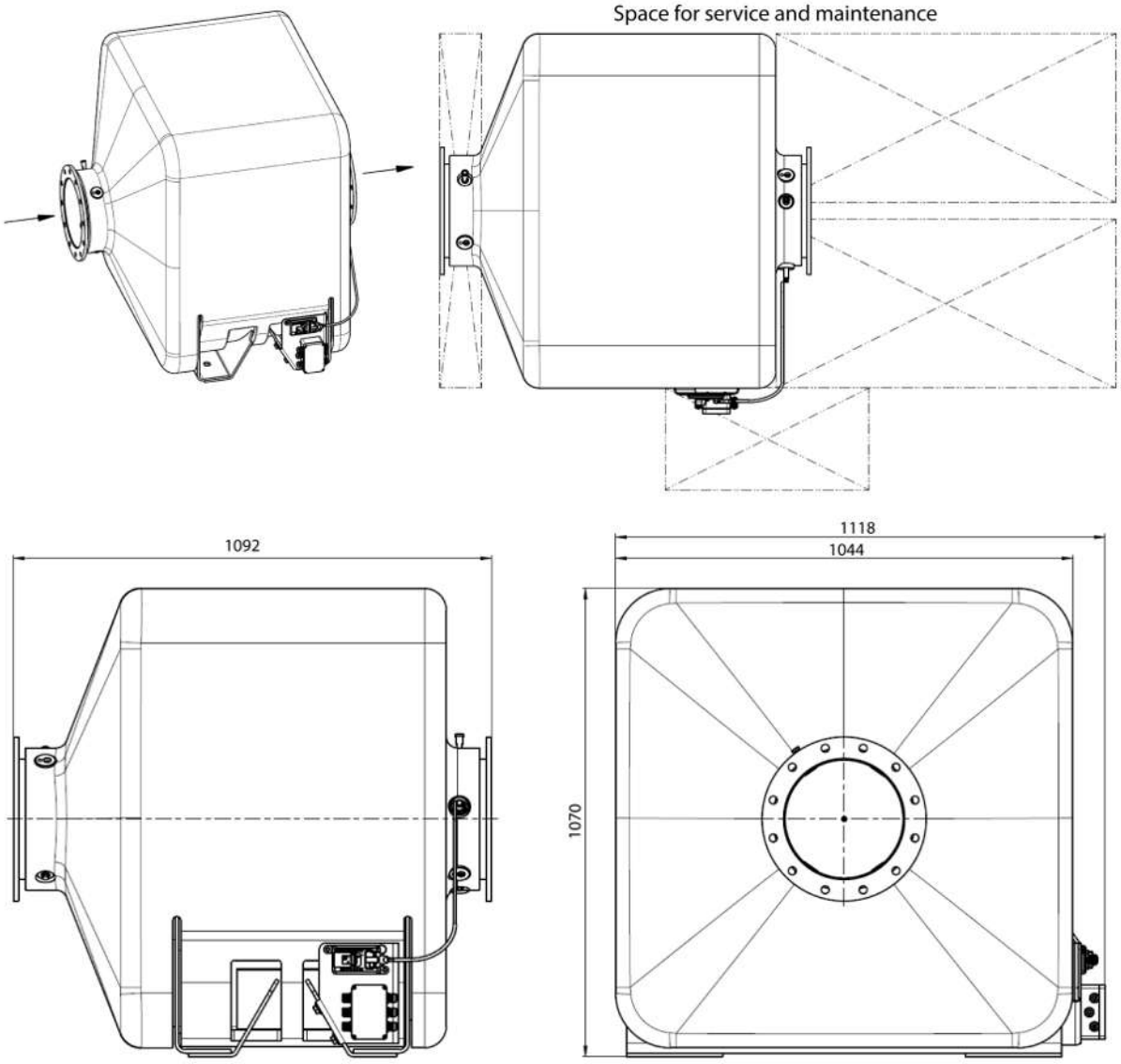



Figure 121: SCR reactor (final dimensions project specific)

| SCR catalyst | |
|---|---|
| Flange connection inlet/outlet | DN250 PN6 (acc. to DIN EN 1092) |
| Weight | Approx. 440 kg |

Table 634: Connecting flange and weight



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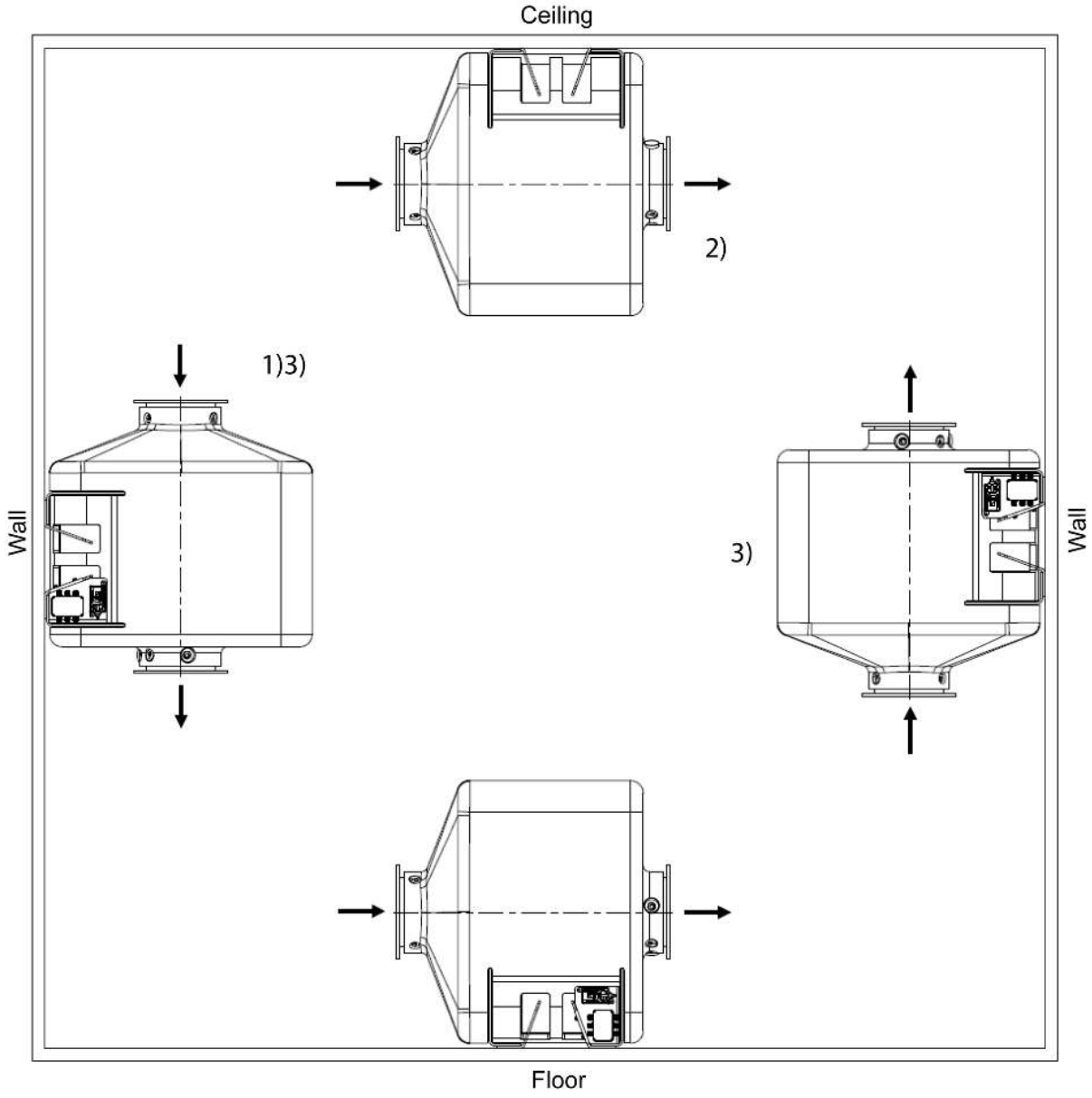



Figure 122: Possible positions for installation of the SCR reactor

1) Consider that the reactor in downstream position has to be dismounted for service and maintenance of the catalyst modules.

2) For shock requirements not possible.

3) For shock requirements additional shock frame for mounting needed.

For shock requirements: For special shock requirements, the reactor can be mounted on the floor. An additional shock frame must be used for mounting on the side wall. Mounting on the ceiling is not possible.



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**SCR control unit with ambient condition sensor**

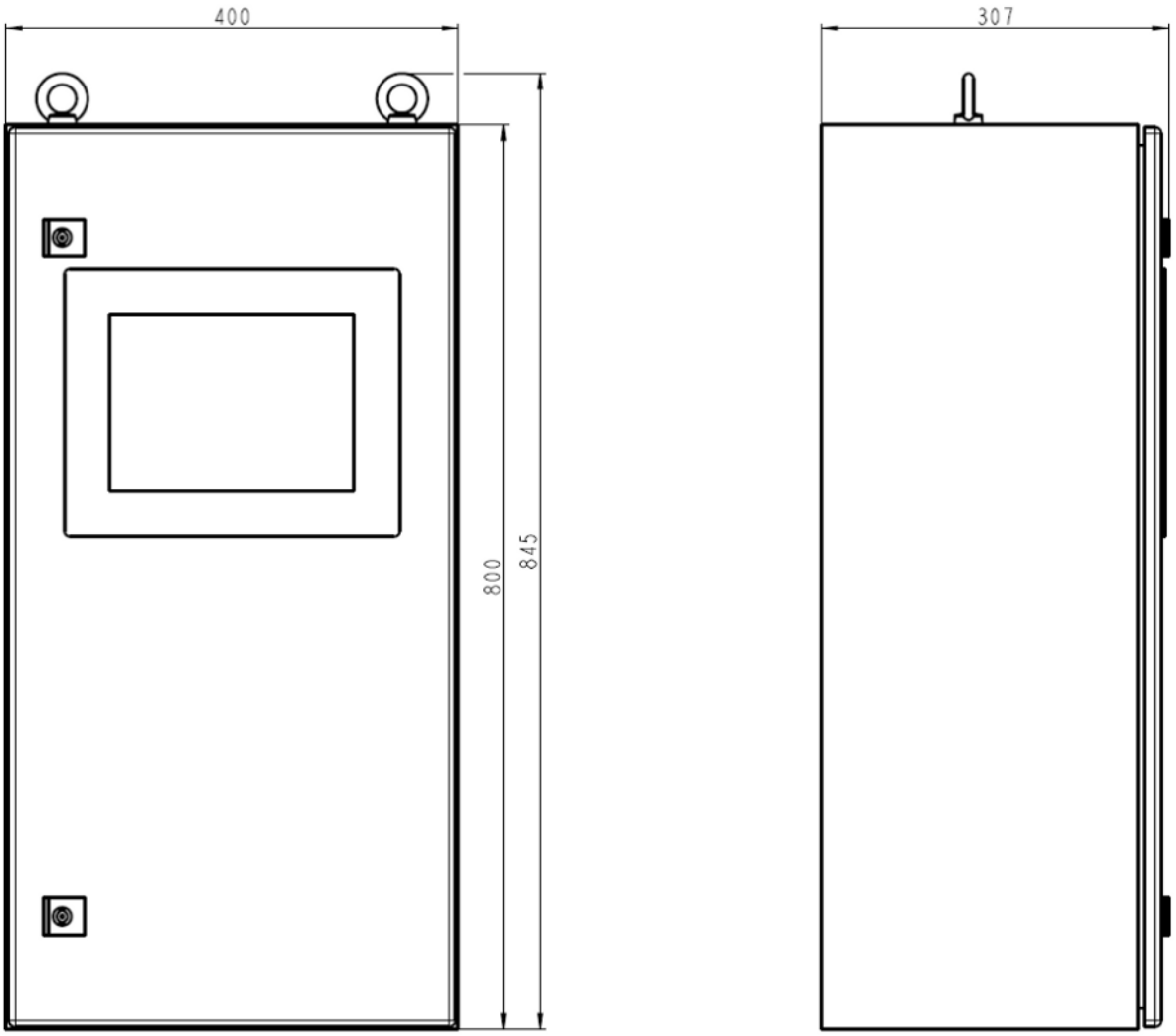



Figure 123: SCR control unit (final dimensions project specific)

| SCR control unit | |
|---|---|
| Weight | Approx. 30 kg |
| Power supply | 24 V DC, 400 W |

Table 635: Main data SCR control unit

## 5.11.3 SCR system installation

**Remarks on the installation of the urea mixing unit and SCR reactor**

- Decoupling of vibration project specific may be required.
- Urea mixing unit and SCR reactor must be integrated into the thermal expansion concept of the exhaust gas piping to ensure a load and torque free connection.
- Service space and access for dismounting and for service at the components is required.

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- For installation of urea mixing unit, note that angle ω has to be ≥ 90° (see figure Forbidden position of the urea mixing unit, Page 501). Spray upwards of urea injection is forbidden.

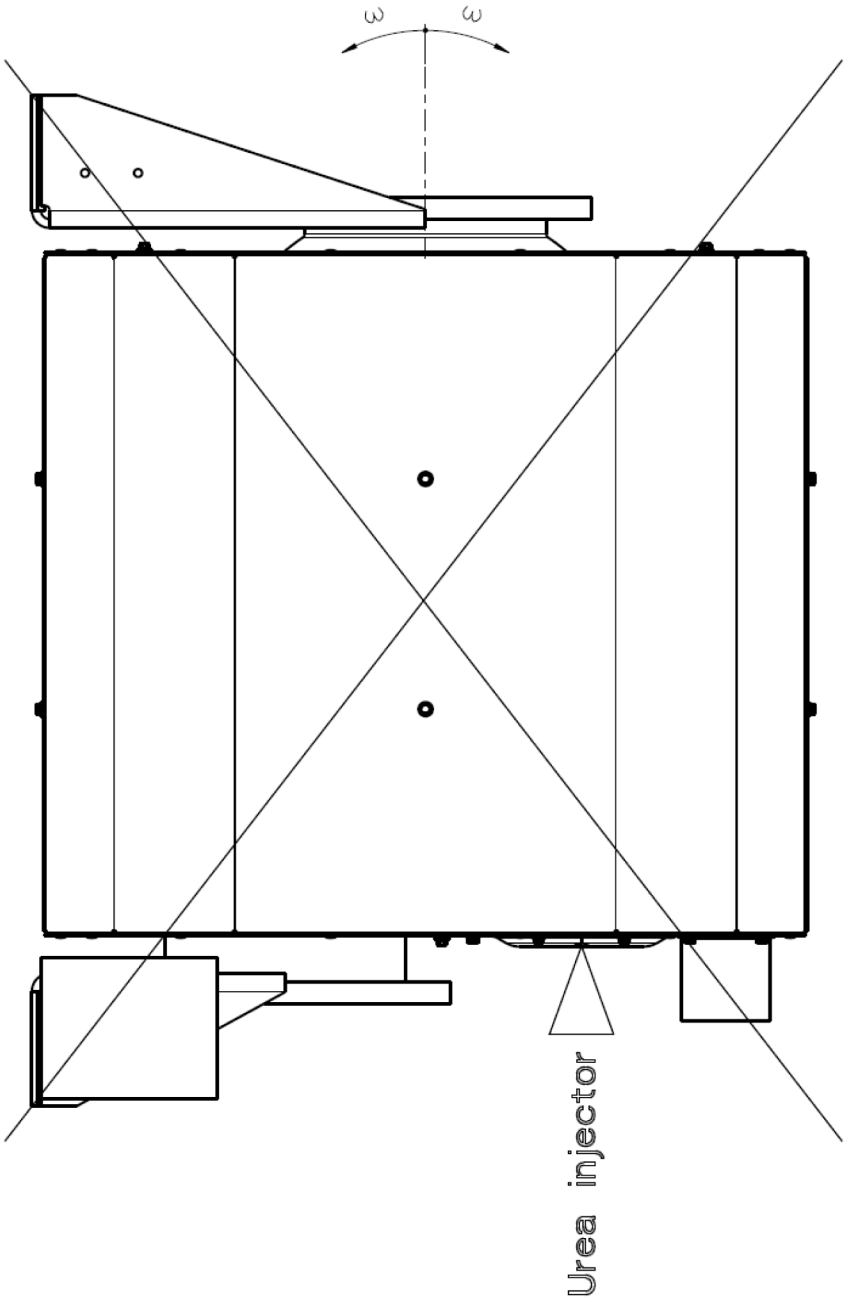



Figure 124: Forbidden position of the urea mixing unit

### Exhaust gas piping

Stainless steel must be used for all exhaust gas pipe segments upstream of the SCR reactor to avoid corrosion in the exhaust gas pipe. Corrosion leads to plugging of the catalyst honeycombs inside the SCR reactor, resulting in an increase in backpressure.

For the design of the complete exhaust gas line, the following specifications have to be considered:



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- Maximum permissible temperature drop of exhaust gas line, calculated as difference of exhaust gas temperature turbine outlet and temperature SCR reactor inlet (at 5°C air temperature in the engine room): 5 K (25% – 100% engine load)
- Insulation according to SOLAS standard

Note:
The SCR system requires high exhaust gas temperatures for an effective operation. Everllence therefore recommends arranging the SCR as the first device in the exhaust gas line, followed by other auxiliaries like boiler, silencer, and so on.

**Urea piping/urea tank**

Preferred materials

All materials used for the construction of tanks and containers including tubes, valves and fittings for storage, transport, and handling must be compatible with aqueous urea solution to avoid any contamination of urea and corrosion of the device used. In order to guarantee the urea quality the following materials for tank, pipes and fittings are compatible: Stainless steel (1.4301 or 1.4509) or urea-resistant plastics (e.g. PA12) according to class requirements.

Urea tank

The urea level in the tank must be controlled by a urea level sensor.

A project specific urea minimum tank level for injector cooling has to be considered.

Water trap

Water entry into the SCR reactor must be avoided, as this can cause damage and clogging of the catalyst. Therefore a water trap has to be installed if any water could potentially enter the SCR.

Urea piping

Be aware that the complete piping layout has to be done by rigid piping. Only the last 1 m between distributor and urea injectors is covered by flexible hose.

**Ambient sensor**

The ambient sensor (within the supply of Everllence) has to be installed at a representative inlet position of the charge air for all engines. Project specific one control unit with one ambient sensor can be used for 2 engines. In this case the ambient sensor has to be placed at a representative position for both engines.

**CAN bus**

CAN bus length limitation for all CAN bus strings is 150 m.



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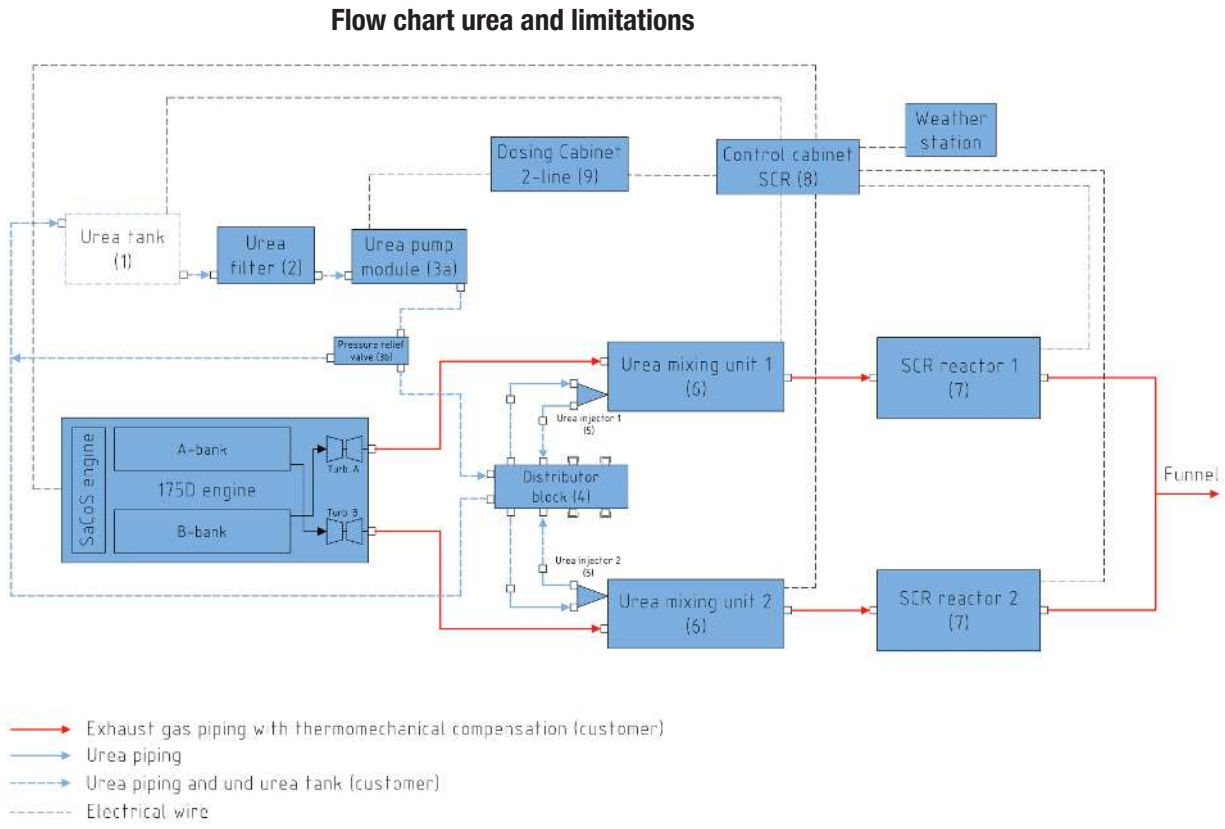



Figure 125: Simplified urea flow diagram 2-line system



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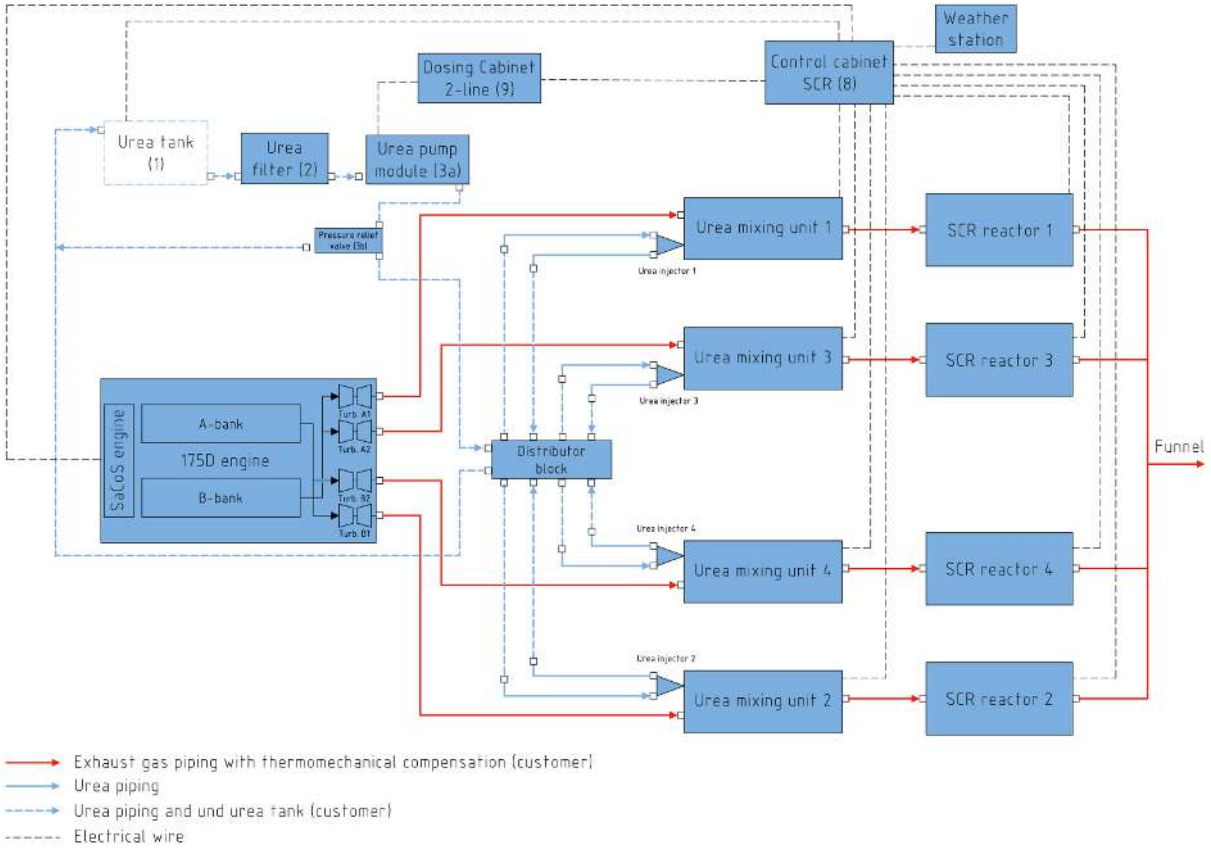



Figure 126: Simplified urea flow diagram 4-line system

| | |
|---|---|
| Max. height difference of distributor over pump | +10 m |
| Max. pipe length between distributor and injectors | 4 m |
| Max. pipe length from urea pump module to distributor | 20 m |
| Height difference pump over urea level: | 0-2 m |
| Suction line pipe length | 1-3 m |

Table 636: Installation limits urea lines



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## 5.12 Maintenance space and requirements

### 5.12.1 Space requirement for maintenance of engine

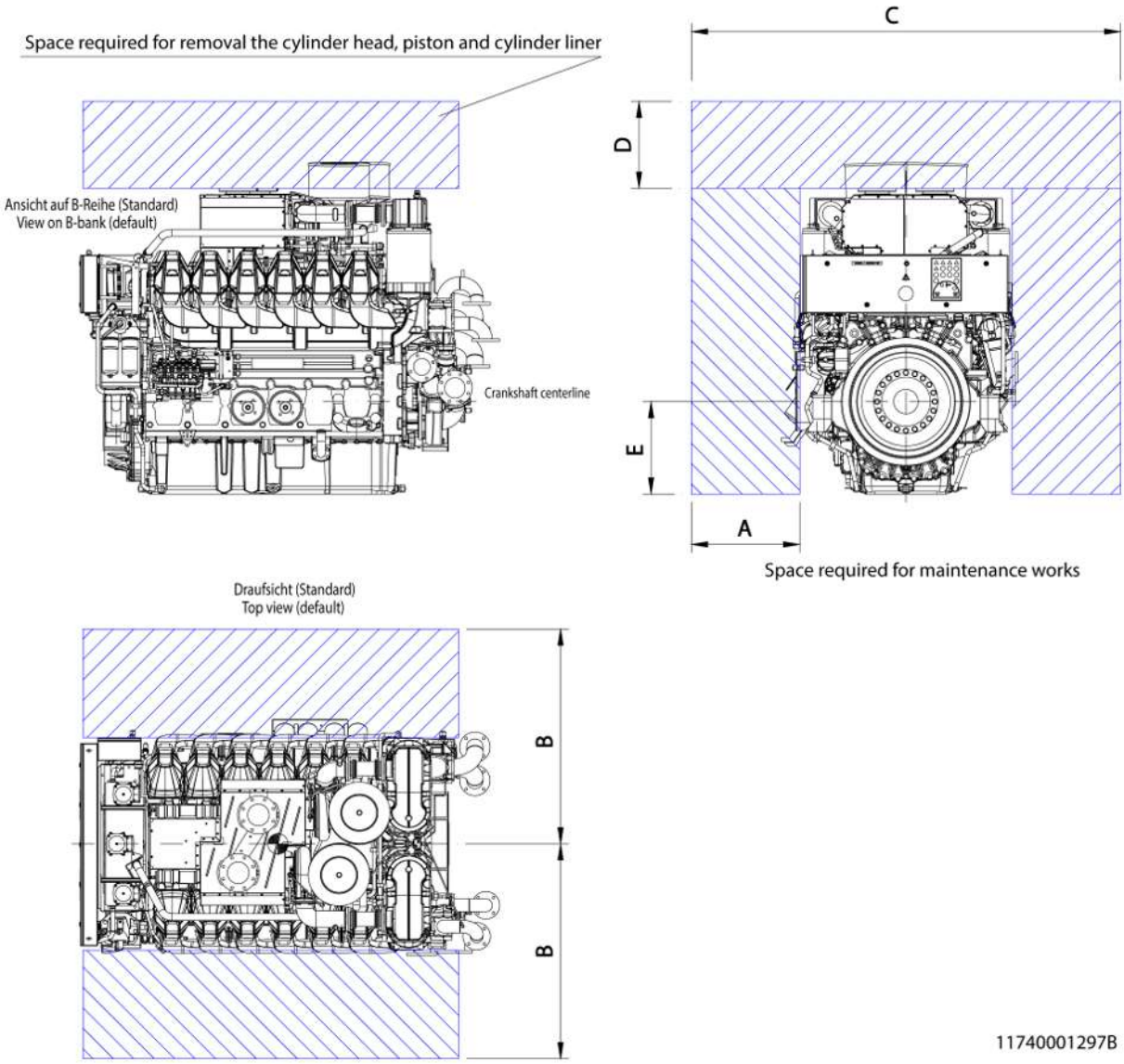



Figure 127: Space requirements for maintenance

| | | | |
|---|---|---|---|
| A | Minimum width of space on both sides | 750 mm | 29.5 in |
| B | Distance between crankshaft axis and wall | 1,485 mm | 58.5 in |
| C | Overall transversal space requirement | 2,970 mm | 117 in |
| D | Space requirement above engine | 600 mm | 23.6 in |



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| | | | |
|---|---|---|---|
| E | Height of crankshaft axis measured from mounts base plate | 640 mm | 25.2 in |

Table 637: Space requirements for maintenance

### Space requirements for twin-engine installation

The minimum distance between crank shafts in a multiple-engine installation must be strictly observed for safe operation and maintenance.

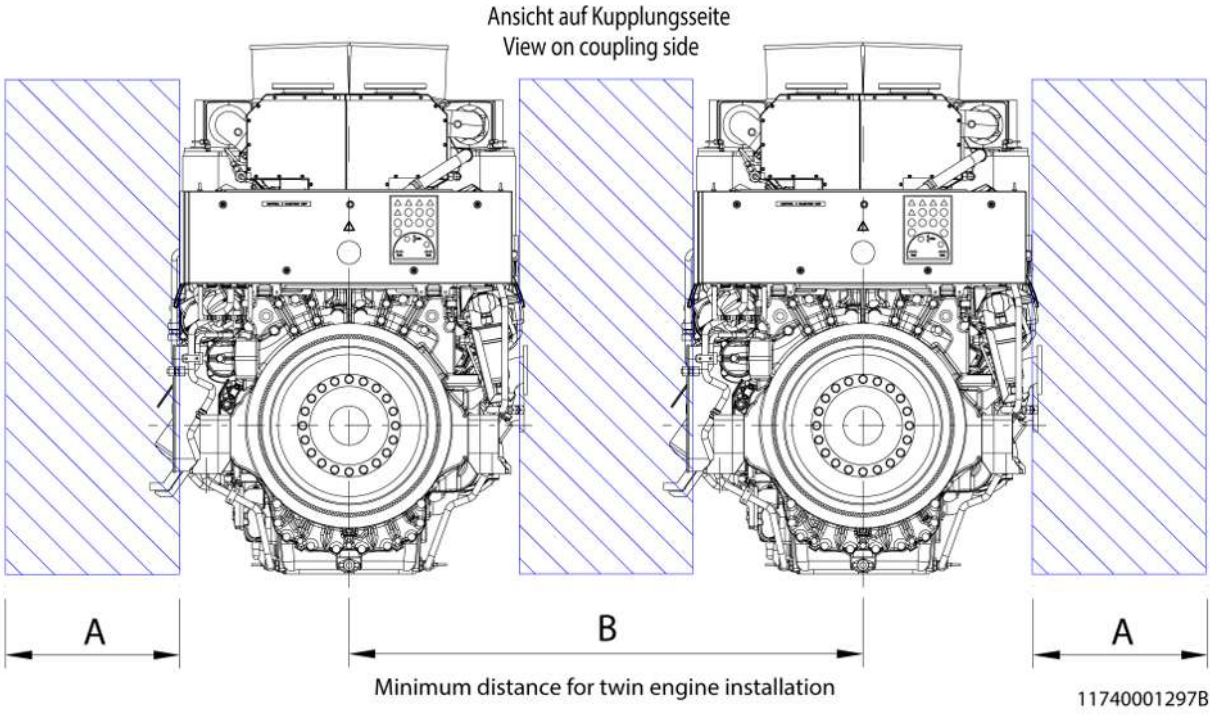



Figure 128: Space requirements for twin-engine installation

| | | | | |
|---|---|---|---|---|
| A | Minimum width of space on both sides | | 750 mm | 29.5 in |
| B | 12V | Distance between crankshafts | 2,220 mm | 87.4 in |
| | 16V, 20V | | 2,300 mm | 90.6 in |

Table 638: Space requirements for twin-engine installation

It is recommended to reserve a minimum of 750 mm (29.5 in) of maintenance space around and between the engines.

Space should also be accommodated at the crankshaft end for torsional vibration-meter installation.

**Specific requirements to the passageway, for example, of the classification societies or flag state authority may result in a higher space demand.**

Obstructions should be avoided around:

- Crankcase doors and turbocharger insulation case
- Maintenance envelope of:
  - Power unit (for example, piston, connecting rod, and liner)
  - Oil and charge air coolers
  - Turbochargers

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- Urea dosing unit
- Oil and fuel filters
- Silencer and/or aftertreatment system (for example, SCR module)

- Vibration dampers removal space
- SaCoS control unit

### 5.12.2 Space requirement for maintenance of GenSet

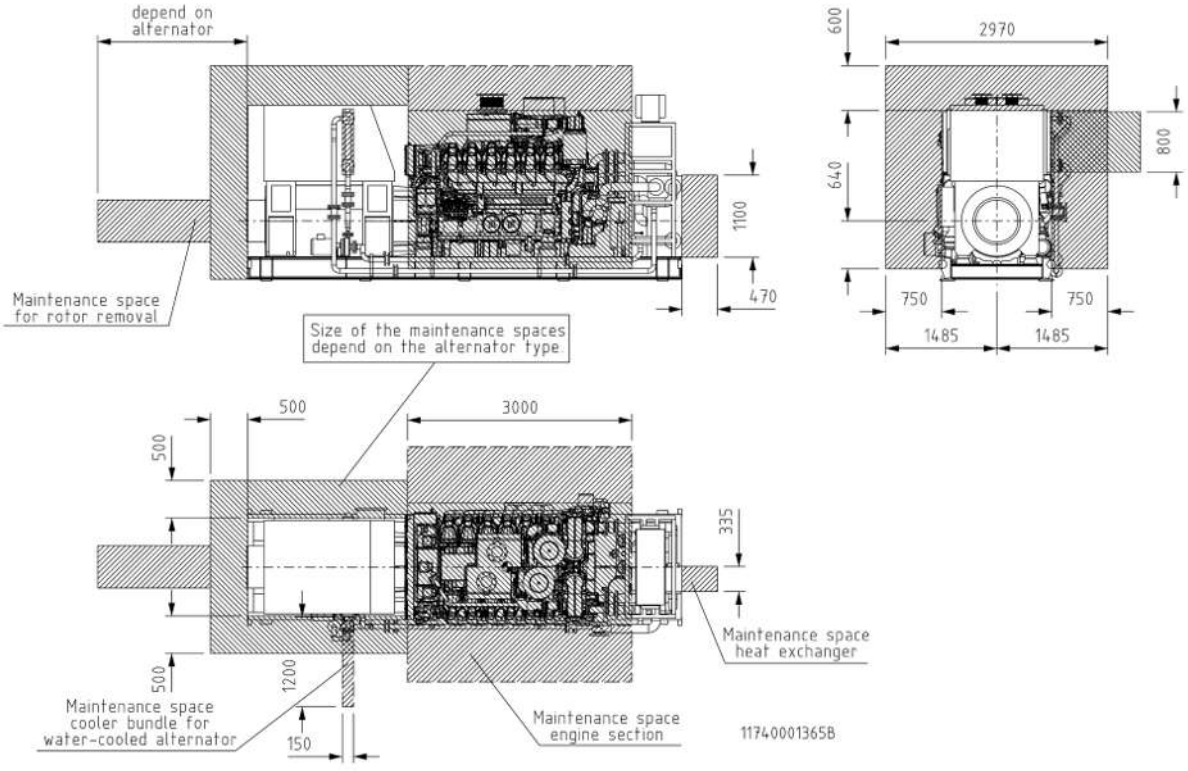



Figure 129: Space requirement for maintenance of GenSet

### 5.12.3 Major components

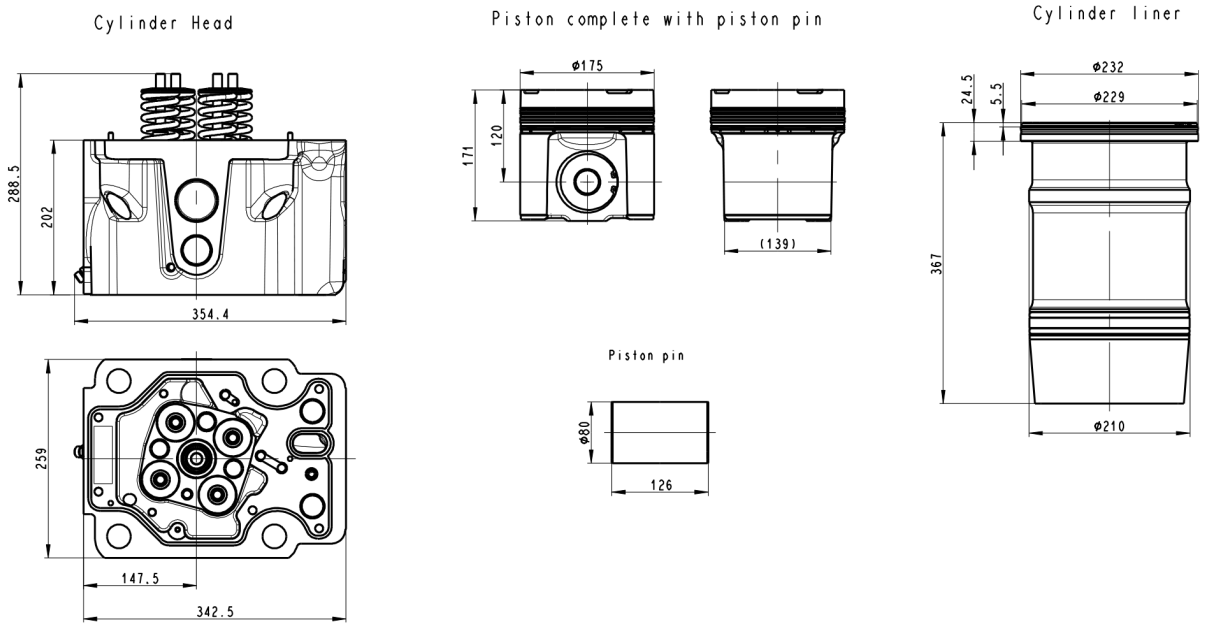



Figure 130: Major components: Cylinder head, cylinder liner, piston, piston pin

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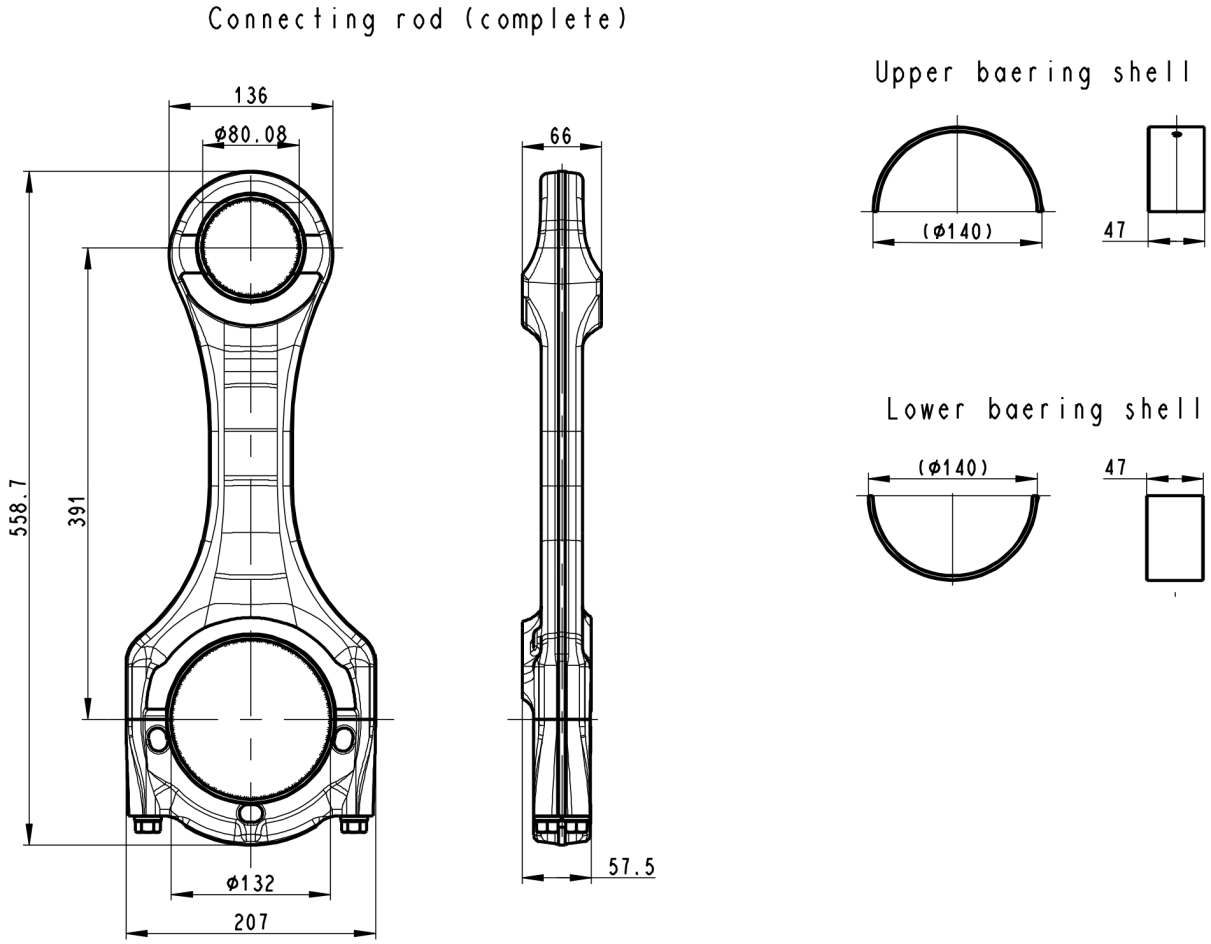



Figure 131: Major components: Connecting rod, bearing shell

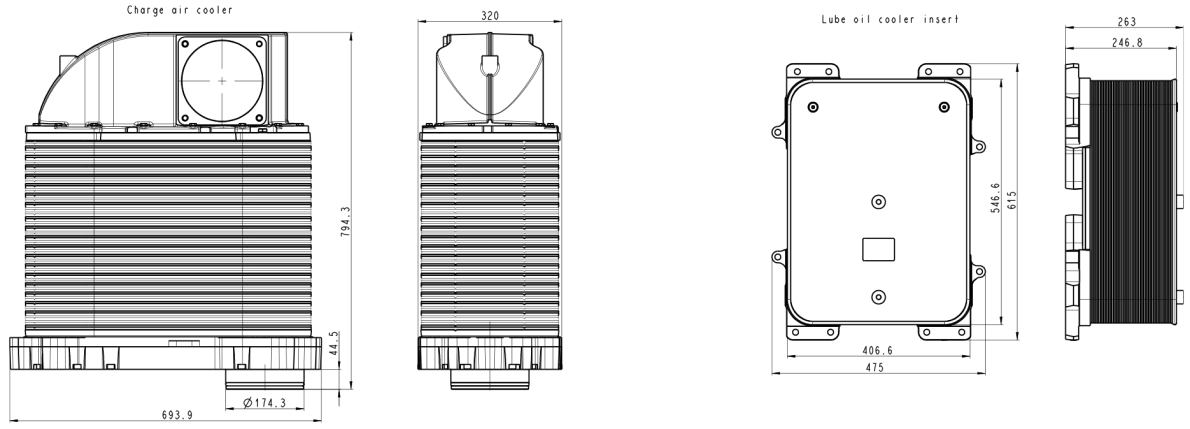



Figure 132: Major components: Charge air cooler, lube oil cooler insert

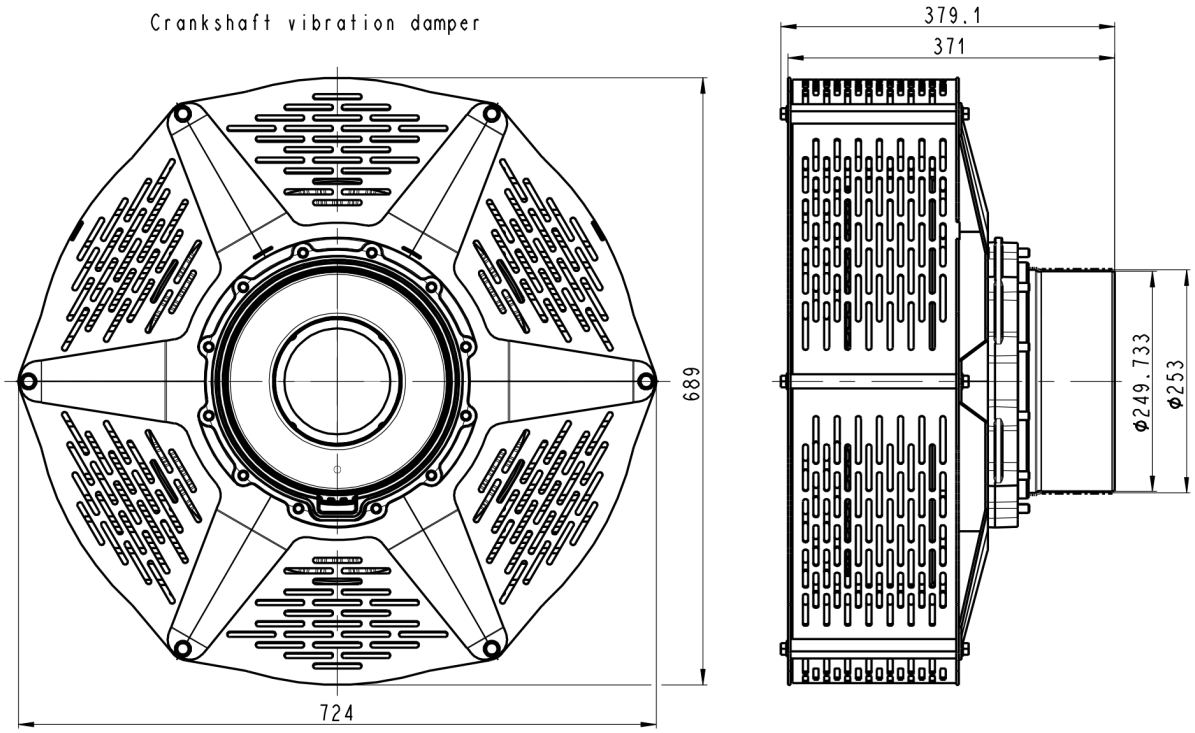



Figure 133: Major components: Crankshaft vibration damper

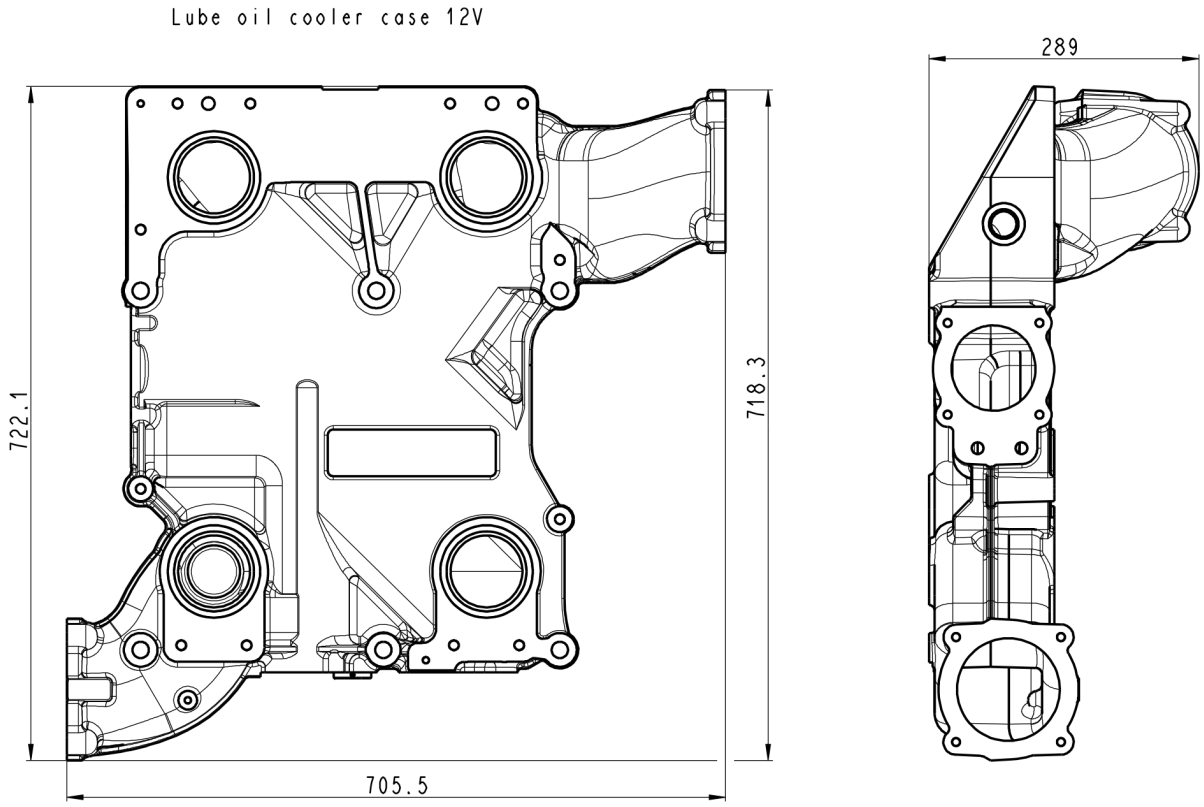



Figure 134: Major components: Lube oil cooler case 12V

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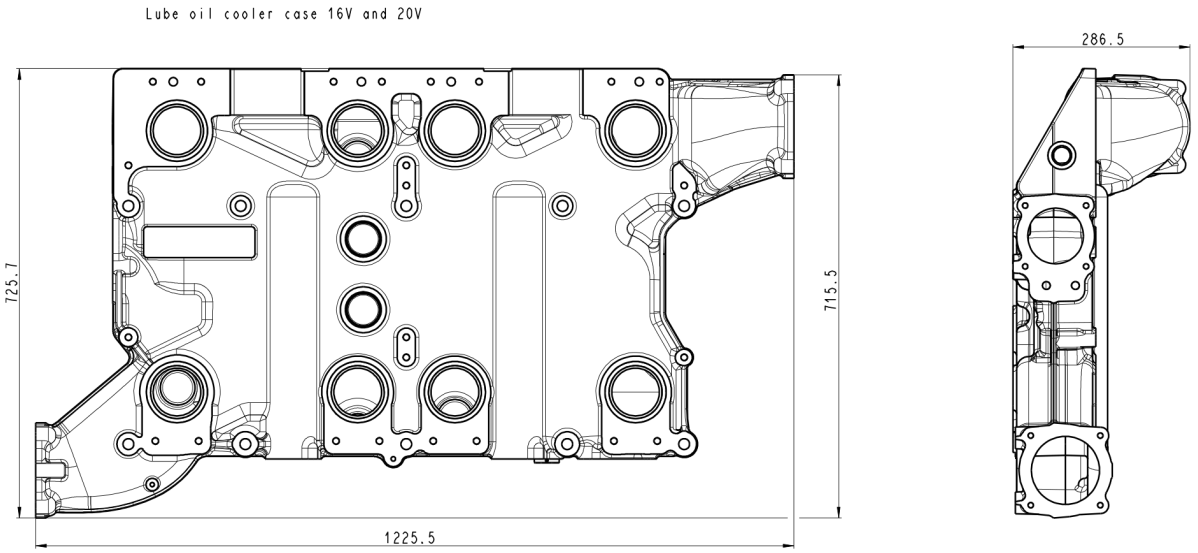



Figure 135: Major components: Lube oil cooler case 16V and 20V

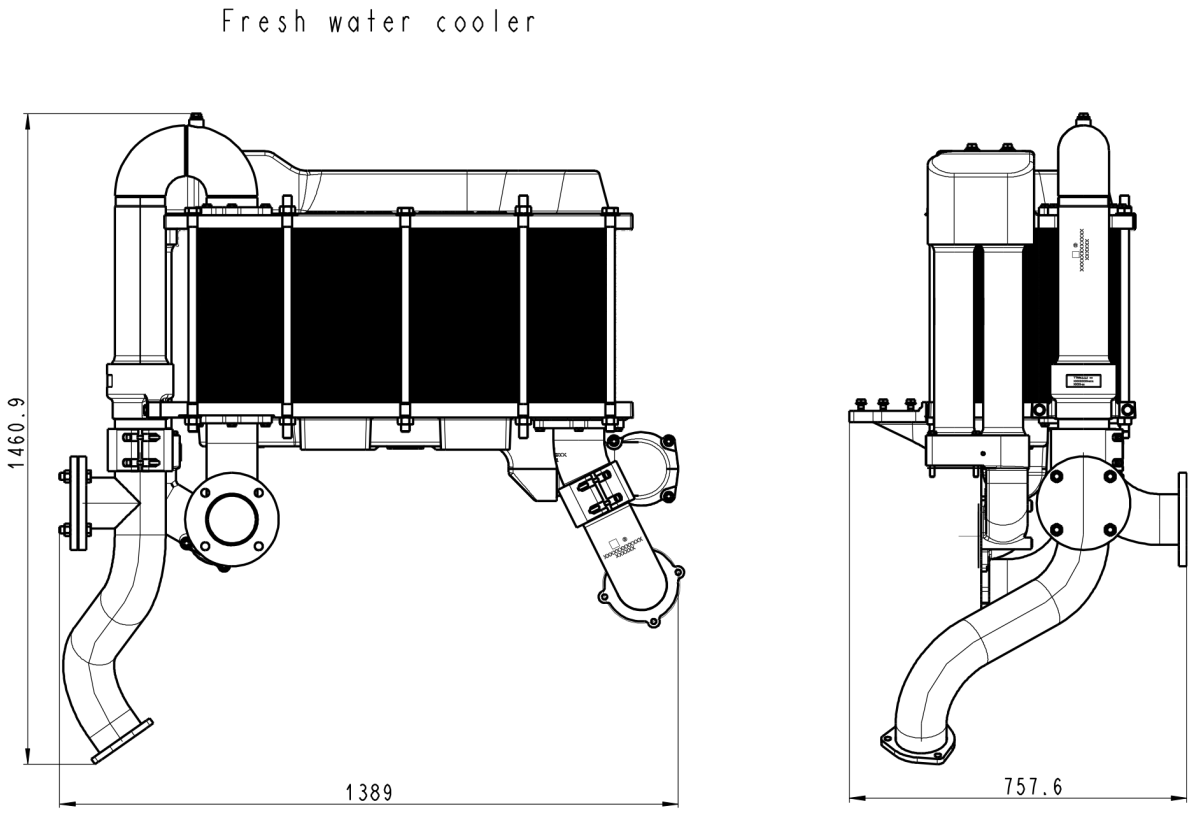



Figure 136: Major components: Fresh water cooler

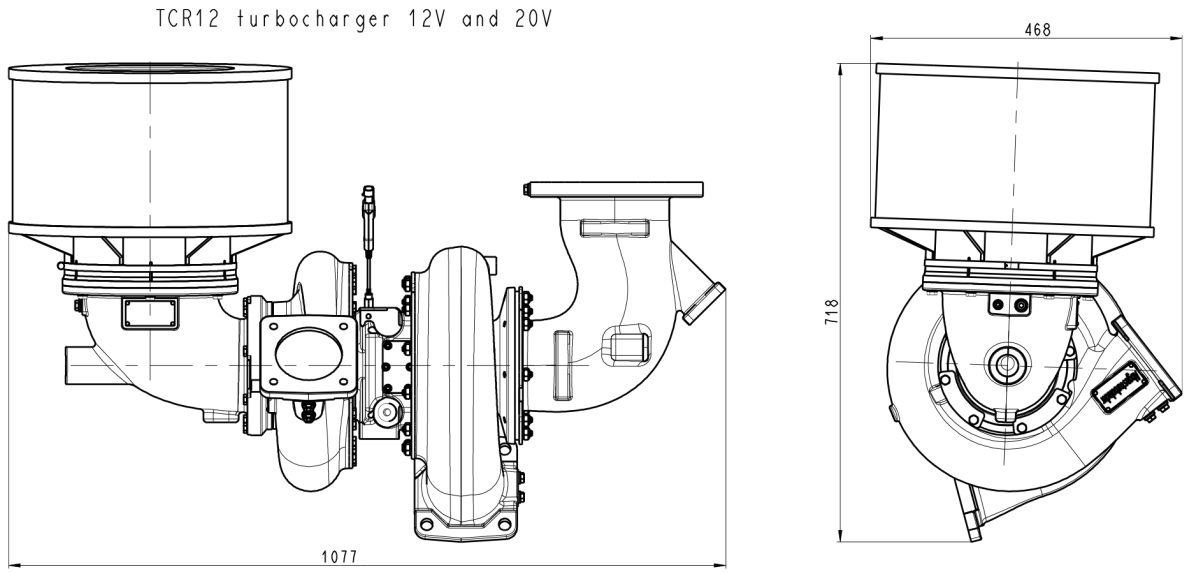



Figure 137: Major components: Turbocharger 12V and 20V, TCR12

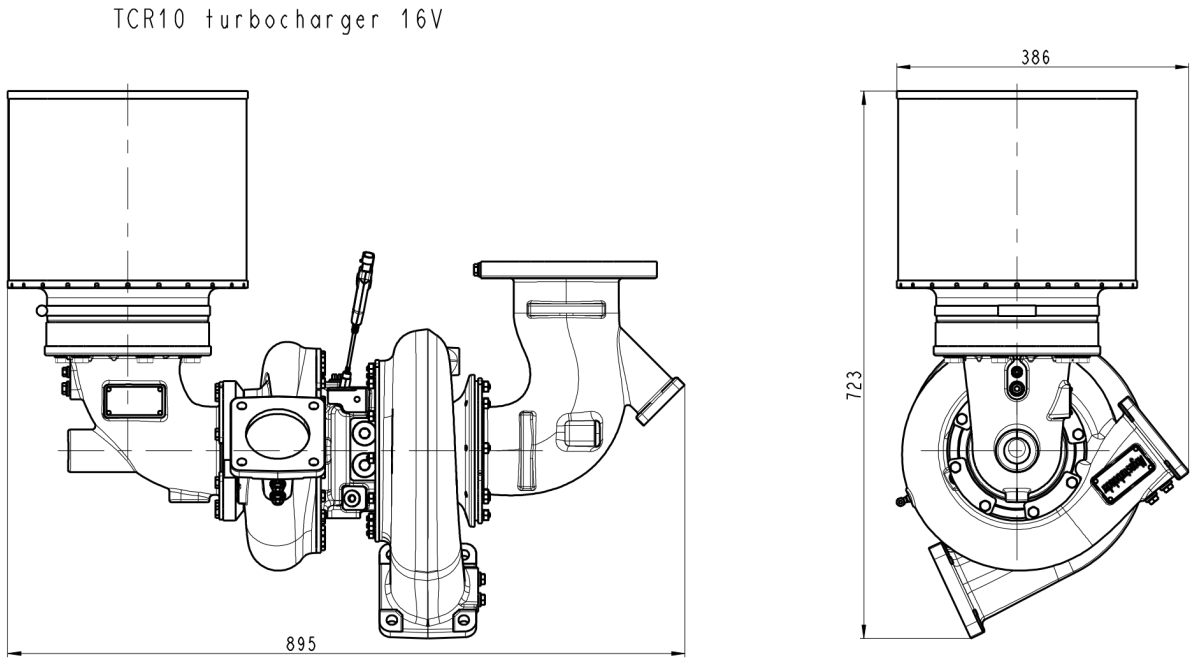



Figure 138: Major components: Turbocharger 16V, TCR10

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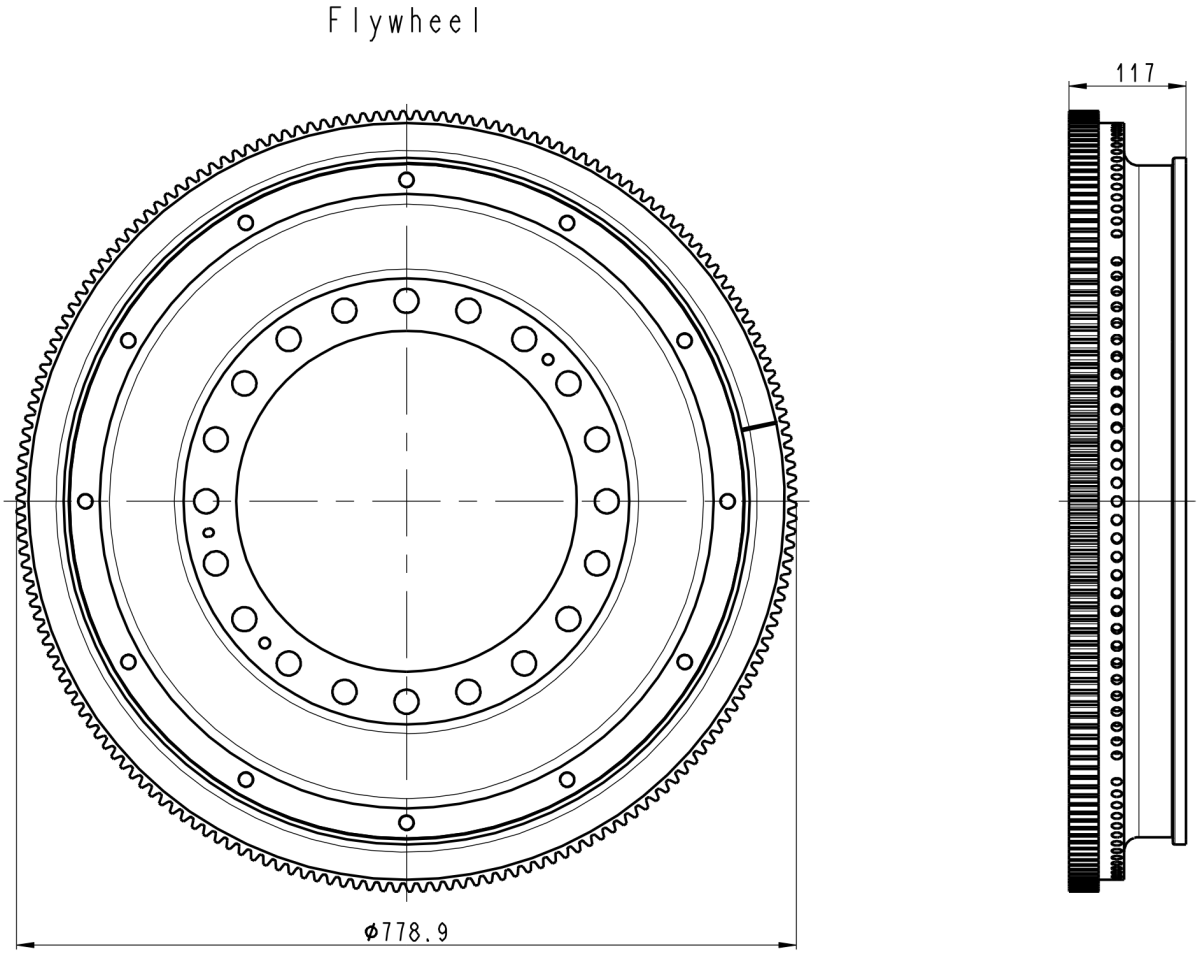



Figure 139: Major components: Flywheel



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### 5.12.4 Lifting appliance for engine

Maintenance of engine is done using lifting equipments such as lifting rails and/or pad-eyes. Lifting of these equipments should cover the entire engine maintenance envelope. It must be possible to remove the power unit and the turbocharger without pulling at an angle.

Component weights

| Components | Unit | Approximate weights | | |
|---|---|---|---|---|
| | | 12V175D | 16V175D | 20V175D |
| Cylinder head complete | kg | 64 | 64 | 64 |
| Piston with piston pin and connecting rod (for piston removal) and cylinder liner | | 55 | 55 | 55 |
| Charge air cooler | | 163 | 169 | 176 |
| Crankshaft vibration damper | | 165 | 203 | 275 |
| Lube oil cooler insert | | 140 | 112 | 122 |
| Lube oil cooler case | | 83 | 158 | 158 |
| Fresh water cooler | | 523 | 543 | 560 |
| Flywheel | | 93 | 93 | 93 |
| One TCR turbocharger | | TCR12: 120 | TCR10: 73 | TCR12: 120 |
| Note:<br>Stated figures of the component weights only for orientation and general layout of crane capacity/lifting device.<br>Final figures may deviate due to further development/design changes of the components.<br>+10% tolerance to be considered. | | | | |

Table 639: Component weights

**Space for storage**

When planning the arrangement of the lifting rails or pad-eyes, a storage space must be provided in the engine room for the dismantled engine components that can be easily reached. If the cleaning and service work is to be carried out here, additional space for cleaning troughs and work surfaces should be provided.

**Space for workshop**

Rails or pad-eyes are required in the workshop dependent on the planned service tasks.

**Lifting the engine**

Use the engine lifting device provided by Everllence, if possible.

Use the engine lifting device only with a H-formed traverse on the crane to lead the force in a vertical direction.

It is not allowed to use a 4-line chain suspension. It will cause damage to the engine. See figure Example of a 4-line chain suspension (not allowed), Page 518.

Only attach the engine to the designated lifting eye.

The lifting eye are intended for engine transportation only – not for transporting propulsion systems (engine plus gear unit).

If wrapped in special packaging with an aluminium foil, attach the engine to the lifting eye on the bearing block or transport using a transport aid (forklift) suitable for the load.

Before transporting the engine, attach the crankshaft transport locking device and the engine mounting block.

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Take note of the engine center of gravity.

Make sure that the engine cannot tip over during transportation. The engine will need extra protection to ensure it does not tip over or slide around during transportation up/down slopes and ramps.

Max. permissible diagonal pull 10°, see figure Engine lifting device, Page 515, max. load 13.5 tons.

Green pin standard shackle (8.5 tons) must be used for direct connection to the engine lifting device.

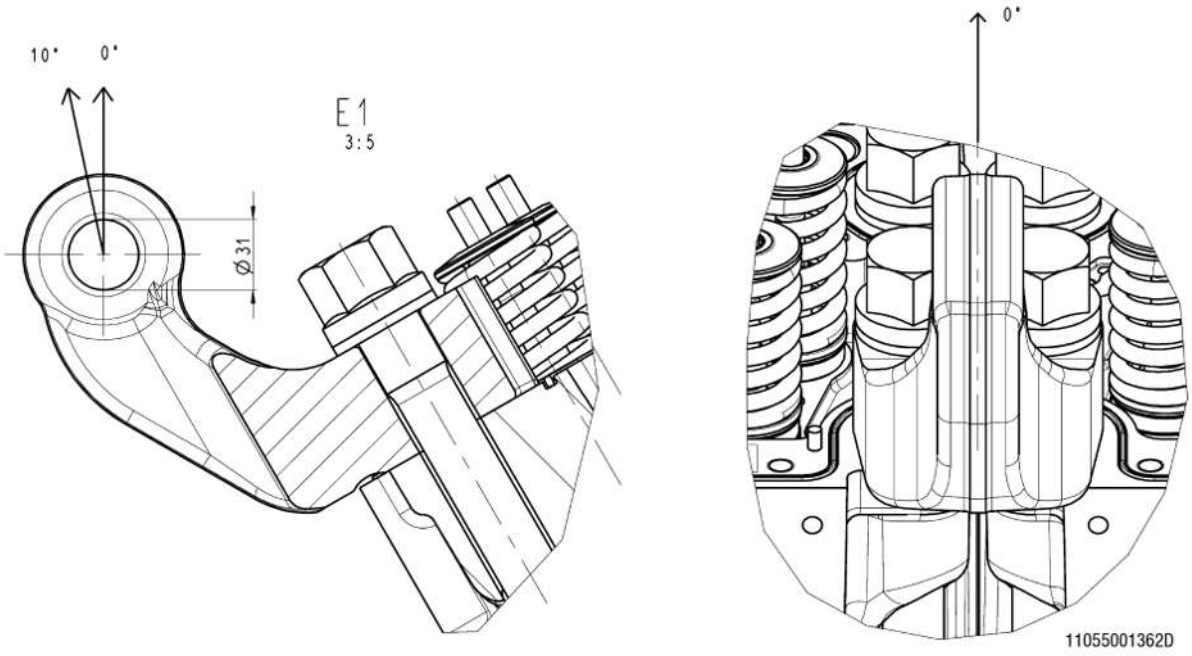



Figure 140: Engine lifting device



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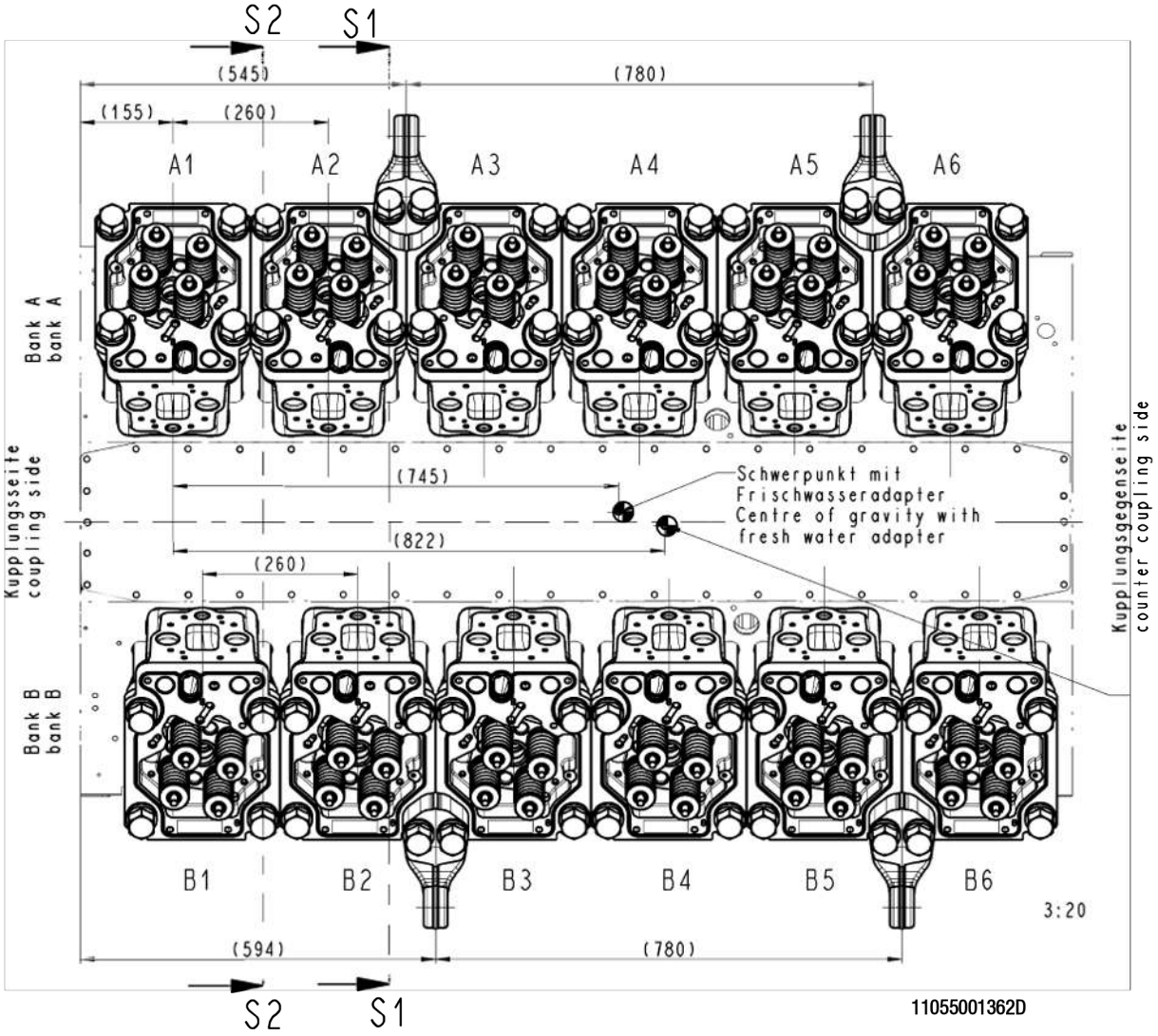



Figure 141: Lifting points at 12V175D

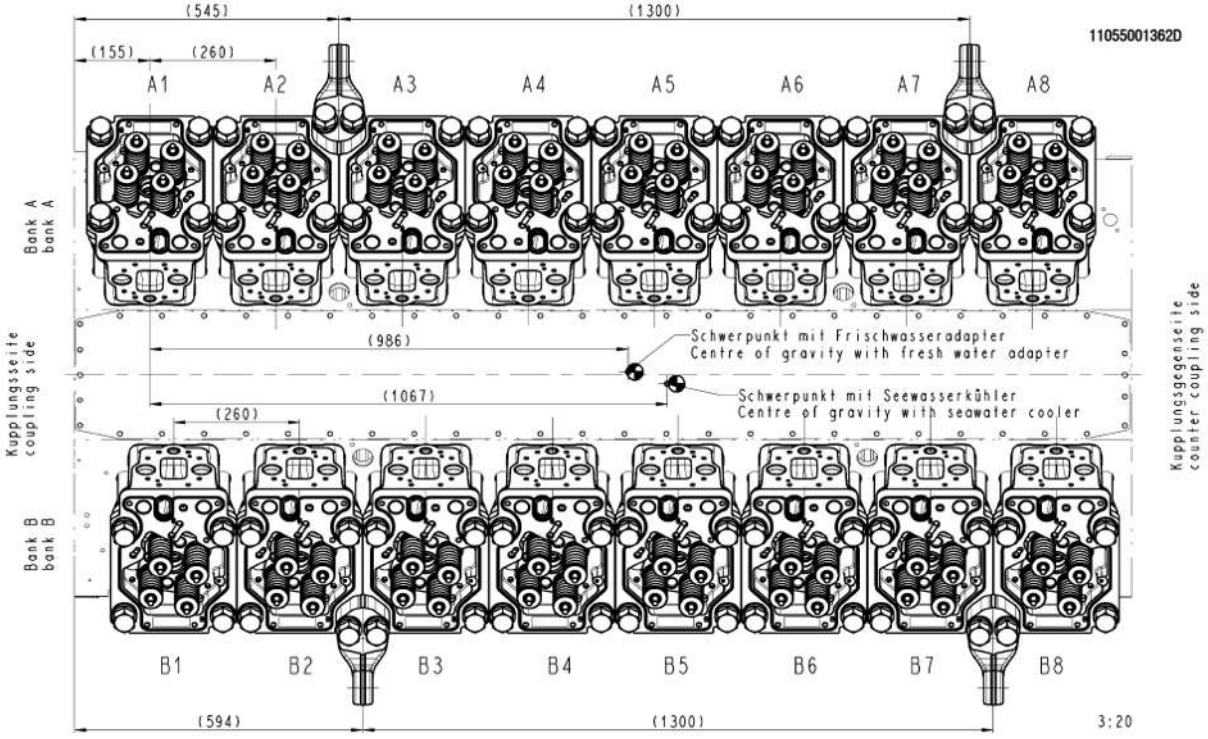



Figure 142: Lifting points at 16V175D

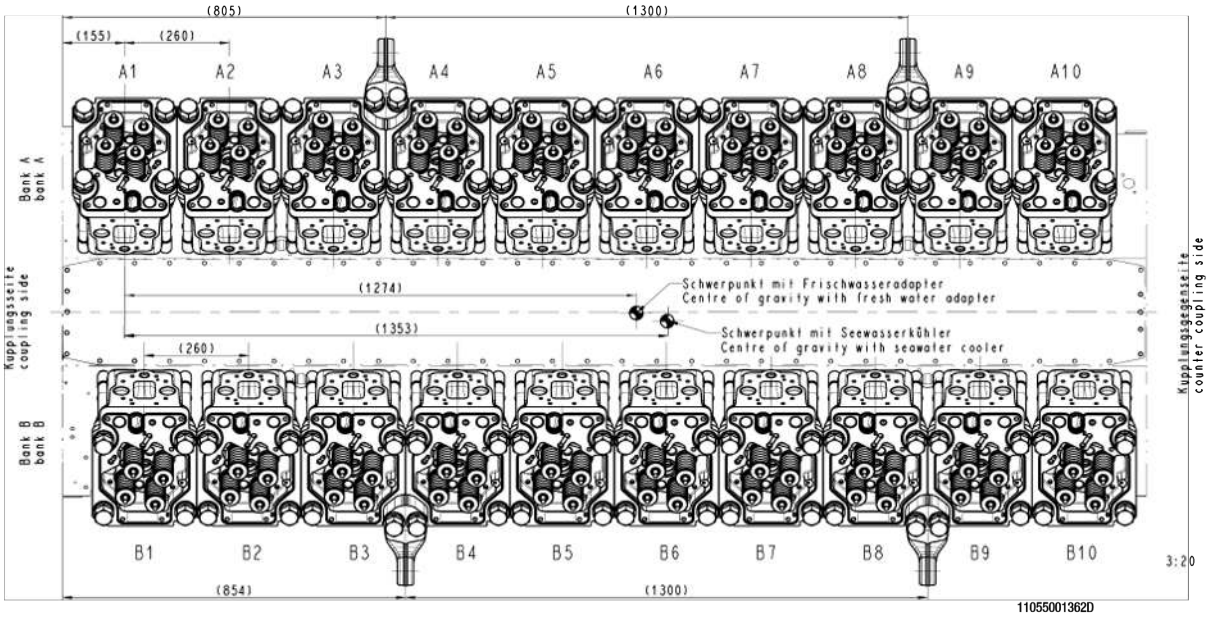



Figure 143: Lifting points at 20V175D



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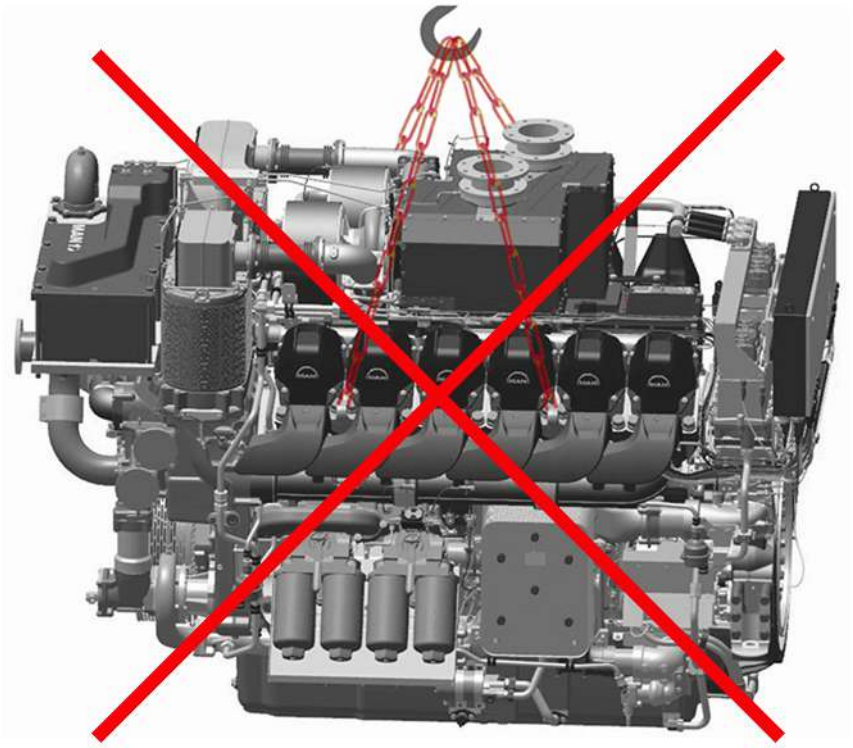


Figure 144: Example of a 4-line chain suspension (not allowed)

### Setting down the engine after transportation

Only set down the engine on firm, level surfaces.

Check in advance to ensure that the surface can bear the load and is suitable.

As a general rule, never place the engine on the oil sump, unless this has been expressly authorised by Everllence for that specific engine.

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### 5.12.5 Lifting appliance for GenSet

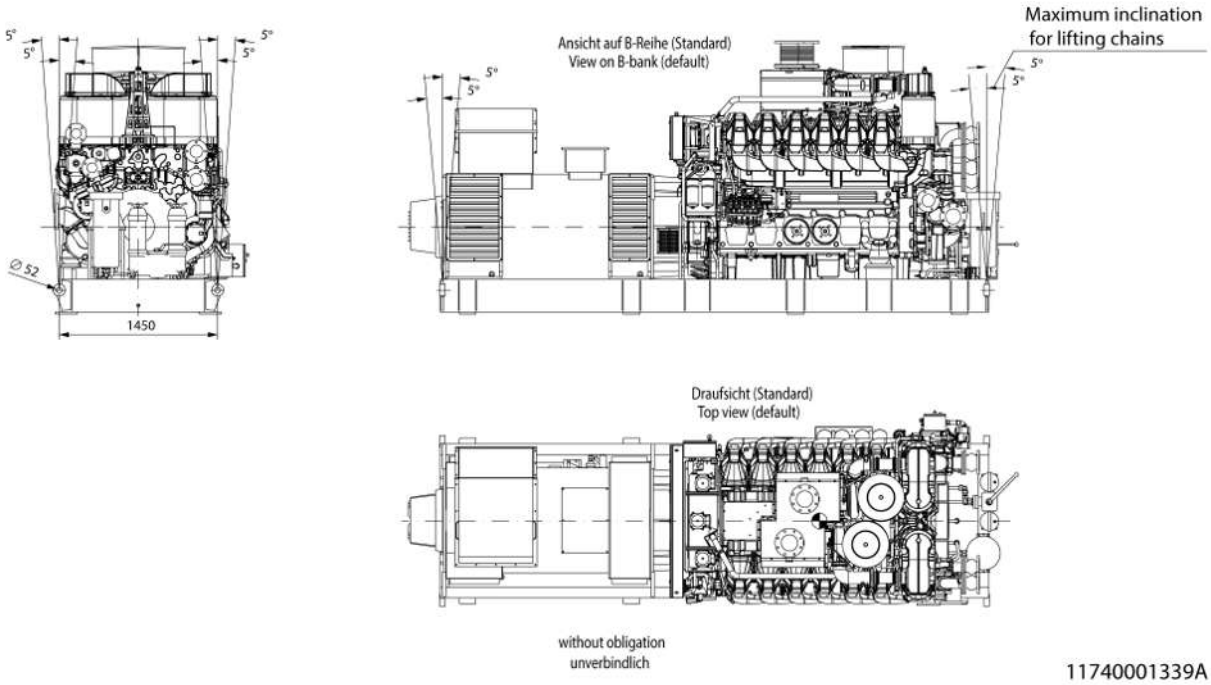



Figure 145: Lifting appliance for GenSet

The weight of the GenSet is subject to configuration. It ranges between 19 – 39 tons. Contact Everllence for further details.



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## 5.13 Main PTO

**Main PTO at counter coupling side**

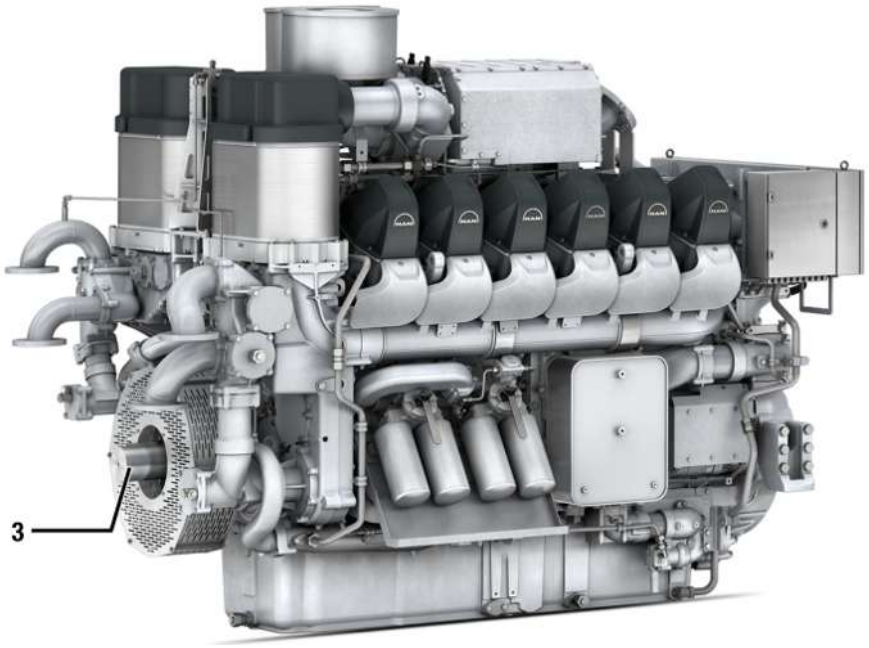



Figure 146: Main PTO

| Engine variant | Output per cylinder | Speed [rpm] | Main PTO with 80 mm shaft possible | | | Main PTO with 130 mm shaft possible | | |
|---|---|---|---|---|---|---|---|---|
| | | | 12V | 16V | 20V | 12V | 16V | 20V |
| ML | All | 2,000 | Yes | Yes | Yes | No | Yes | Yes |
| MM | 185 kW | 1,900 | Yes | Yes | Yes | No | Yes | Yes |
| MM | All other | 1,800 | Yes | Yes | Yes | Yes | Yes | Yes |
| MH | 145 kW | 1,800 | Yes | - | - | Yes | - | - |
| MA | All | All | Yes | Yes | - | Yes | Yes | - |
| MEM | All | 1,500 | Yes | Yes | Yes | Yes | Yes | Yes |
| MEM | All | 1,800 | Yes | Yes | Yes | Yes | Yes | Yes |
| MEL | All | 1,500 | Yes | Yes | Yes | Yes | Yes | Yes |
| MEL | 190 (16V: 185) | 1,800 | Yes | Yes | Yes | Yes | Yes | No |
| MEL | All other | 1,800 | Yes | Yes | Yes | Yes | Yes | Yes |
| MEV | 190 | 1,800 | Yes | Yes | Yes | Yes | Yes | No |
| MEV | All other | 1,800 | Yes | Yes | Yes | Yes | Yes | Yes |

Table 640: Applicability of main PTOs at CCS (Pos. 3 in Figure "Main PTO")



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| | Max. allowed torque at PTO | Max. moment of inertia of coupling (engine side) | Turning direction PTO (seen from CCS) |
|---|---|---|---|
| 80 mm PTO shaft | 4.8 kNm | 0.6 kg $m^2$ | Clockwise |
| 130 mm PTO shaft | 13.6 kNm | 12V: 2.6 kg $m^2$<br>16V: 2.0 kg $m^2$<br>20V: 2.0 kg $m^2$ | |

Table 641: Max. allowed torque at main PTOs (Pos. 3 in Figure "Main PTO")

The max. allowed power at the main PTO can be calculated with this formula:

$$P = T \times \frac{\pi \times n}{30}$$

With P: Power in kW, T: Torque in kNm, n: Engine speed in rpm

| Examples: | |
|---|---|
| 80 mm PTO shaft at 1,800 rpm | P = 4.8 kNm x π x 1,800 rpm / 30 = 904.8 kW |
| 130 mm PTO shaft at 1,500 rpm | P = 13.6 kNm x π x 1,500 rpm / 30 = 2,136.3 kW |

Note:

- The main PTO at counter coupling side is intended for driving hydraulic pumps, firefighting pumps or propellers.
- An elastic coupling has to be applied, proven for the intended use and axially supported with suitable bearings.
- The total vibration system is in responsibility of the customer. A torsional vibration calculation must be carried out.
- PTO shaft, coupling and other rotating parts have to be covered with a contact protection.
- Maximum output of the engine must not be exceeded.
- If an external load signal is used for engine power adjustment (see section 4.1) and the PTO is engaged, an additional external signal must deactivate the power adjustment function in the SaCoS system to ensure flawless engine operation. Consequently, power adjustment - such as compensating for lower heating values from using FAME - is not possible while the PTO is engaged. For further information, contact Everllence.

## 5.14 Engine attached alternators

| Alternator | Output | IP protection class | Electric-design according |
|---|---|---|---|
| Belt driven | 120 A | IP 00 (No protection) | Standard |

Table 642: Engine attached alternators



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## 5.15 Flywheel and flywheel housing

### 5.15.1 Flywheel arrangement

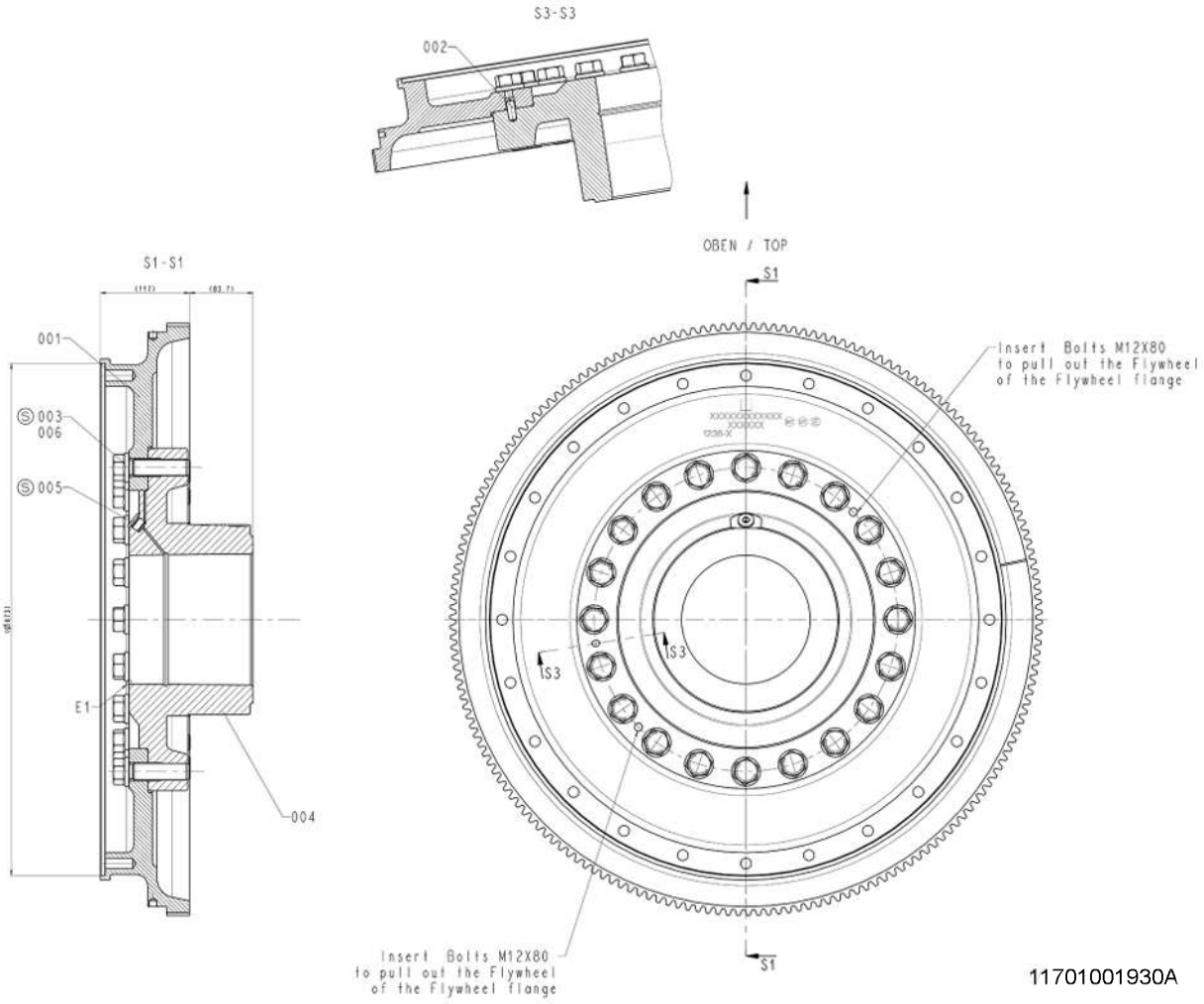



Figure 147: Flywheel arrangement 01

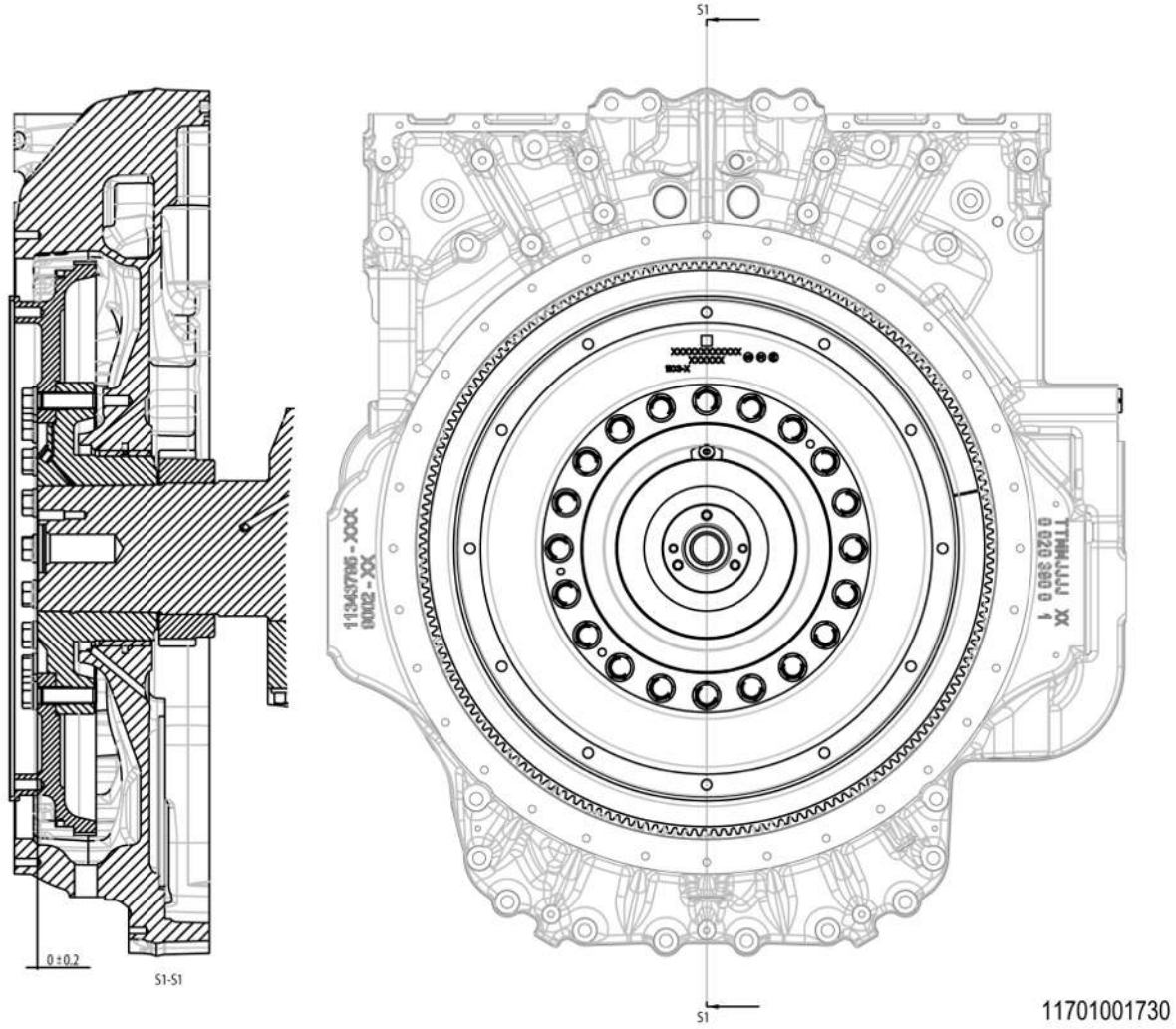



Figure 148: Flywheel arrangement 02

### 5.15.2 Bell housing/flywheel housing

The 175D comes equipped with a flywheel housing on the coupling side of the engine, which is dimensioned according to SAE 00 universal standard.

This eases the alignment of the engine and the alternator of the MEM, MEL, MEV and MA GenSets. The alignment check can easily be done by laser through the inspection covers in the adapter flange between engine and alternator.

For propulsion plants, a flywheel housing is needed that ensures that no contact with rotating parts is possible. The housing is not scope of supply of Everllence.

For GenSets in addition, the bell housing must be capable for a power transmission between generator and engine.



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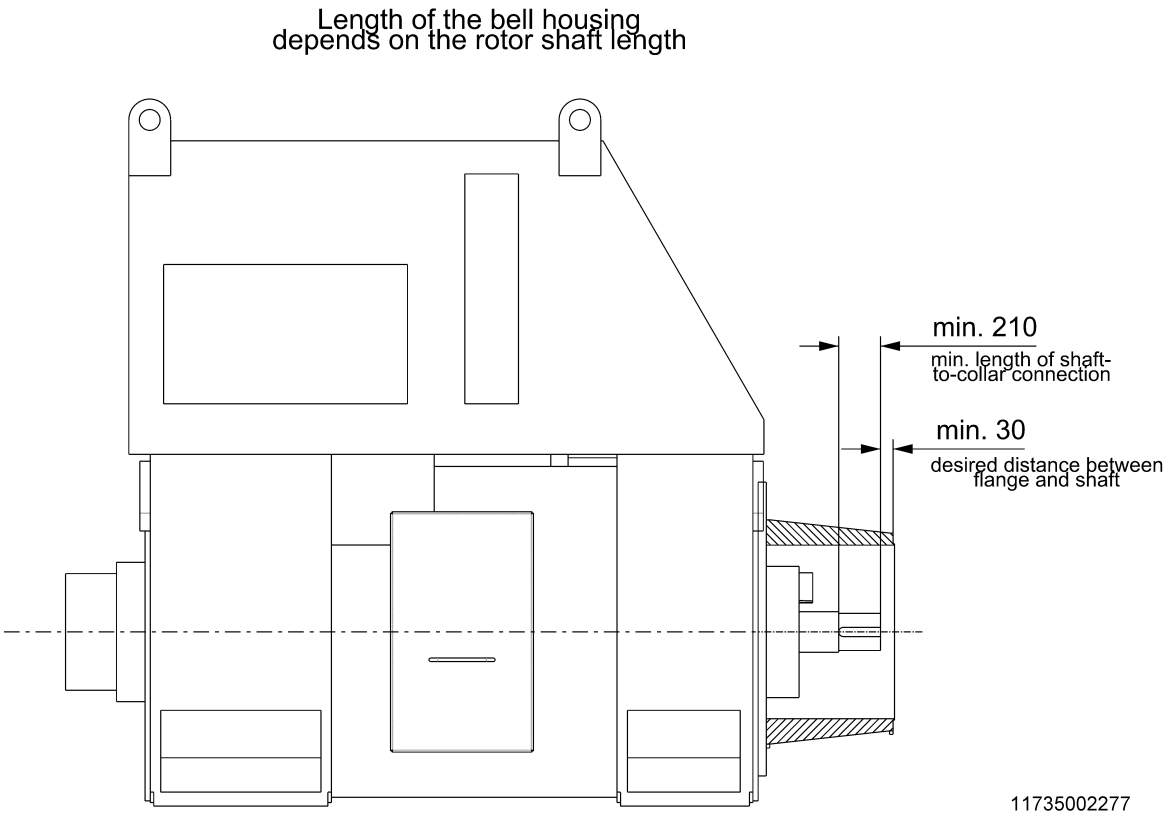
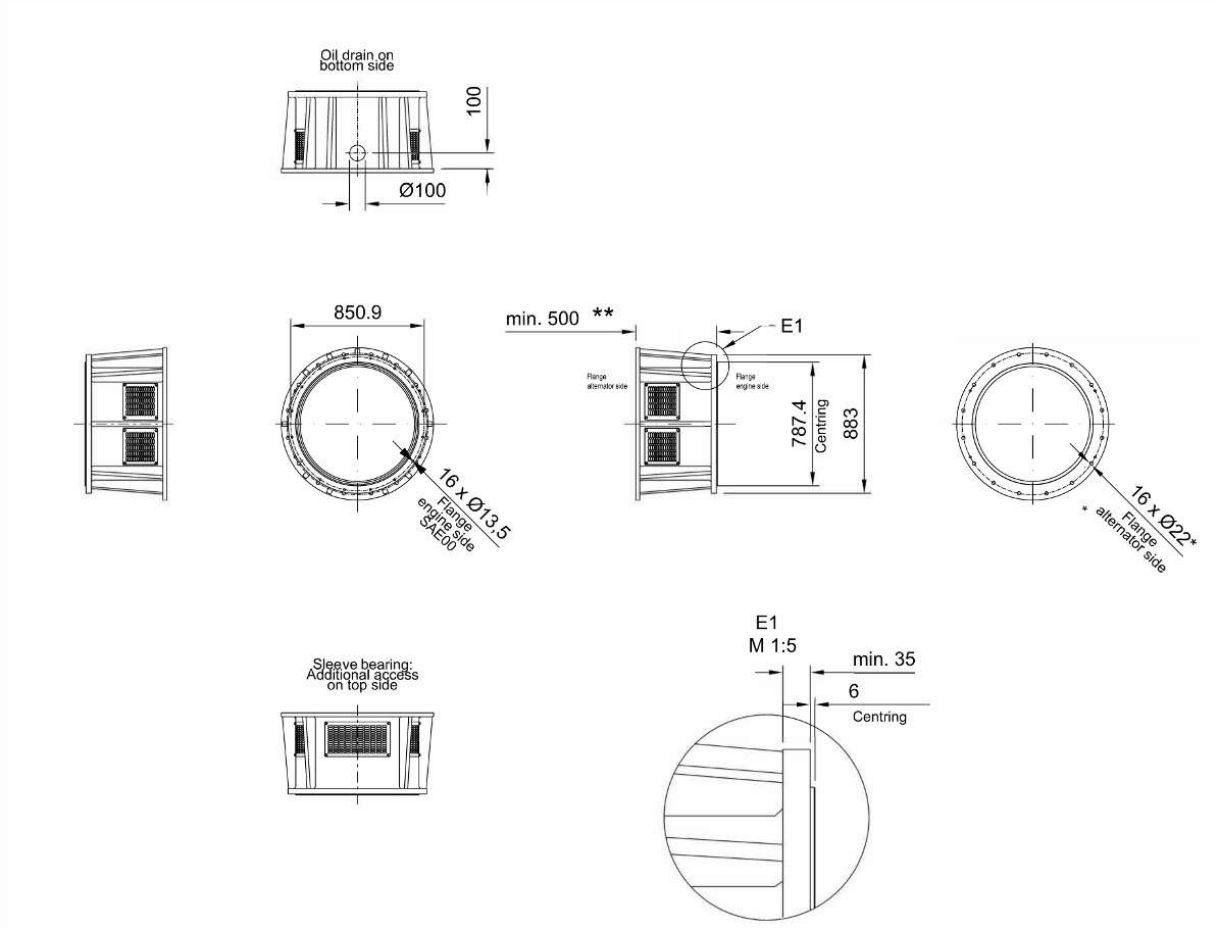



Figure 149: Generator and bell housing

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** Length of bell housing varies due to the coupling and alternator shaft
(Minimum length is 500mm)

In general: Alternator must be connected directly to the bellhousing
without any additional adaptors.

Flange alternator side:
Recommendation of Everllence: Minimal 16 x M20 with washers
The calculation and design is the responsibility of the supplier

Flange engine side:
Flange size SAE00
16 x M12 strength class 10.9 acc. DIN EN ISO 4014
Nord-Lock washers X-Series delivered by Packager

No paint on flanges at engine and alternator side
on the area of the screws/washers

11735002277

Figure 150: Bell housing



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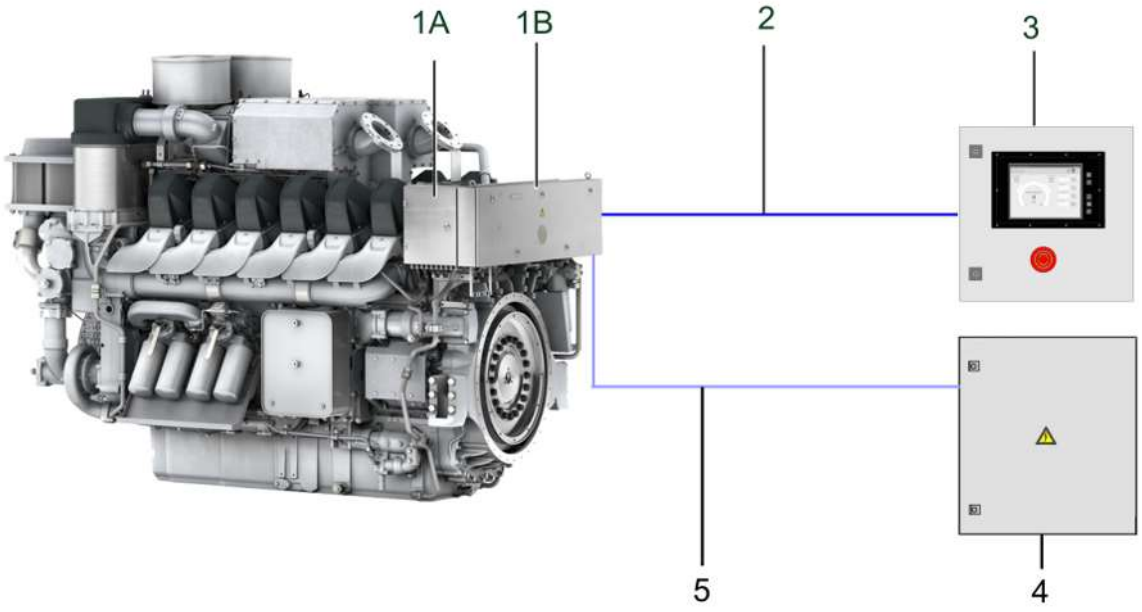
## 5.16 Engine automation

### 5.16.1 System description of SaCoS 5000

#### 5.16.1.1 Overview safety and control system SaCoS 5000

The engine is equipped with the latest generation of Everllence' engine control- and safety system SaCoS 5000 (Safety and Control System) for four-stroke diesel- and gas engines. The engine control- and safety system is responsible for complete engine operation, control, alarming and safety. All sensors and actuators are wired to the on engine mounted Control Unit.

The whole system design has a modular and flexible topology. The system bus (CAN1/CAN2) connects all modules in the Control Unit and in the Local Operating Panel, the optional Extension Cabinet and other optional components are connected via CAN3/4 – CANopen. The optional ROP, WOP or Data Logging Cabinet is connected via ethernet.




1A Control Unit, side door
1B Control Unit, front door
2 System bus CAN 1/2
3 Local Operating Panel, off engine
4 Extension Cabinet, off engine (optional)
5 CAN 3

Figure 151: Overview on SaCoS 5000

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Control Unit, side door (1A) Behind the side door the Control Unit features the power supply distribution to the modules and the HW-Interfaces to the plant. It is feed with 24 V DC via the Local Operating Panel from the voltage distributer from the plant/ship.

Control Unit, front door (1B) Behind the front door the Control Unit features the engine control module, the safety module and the injection module.

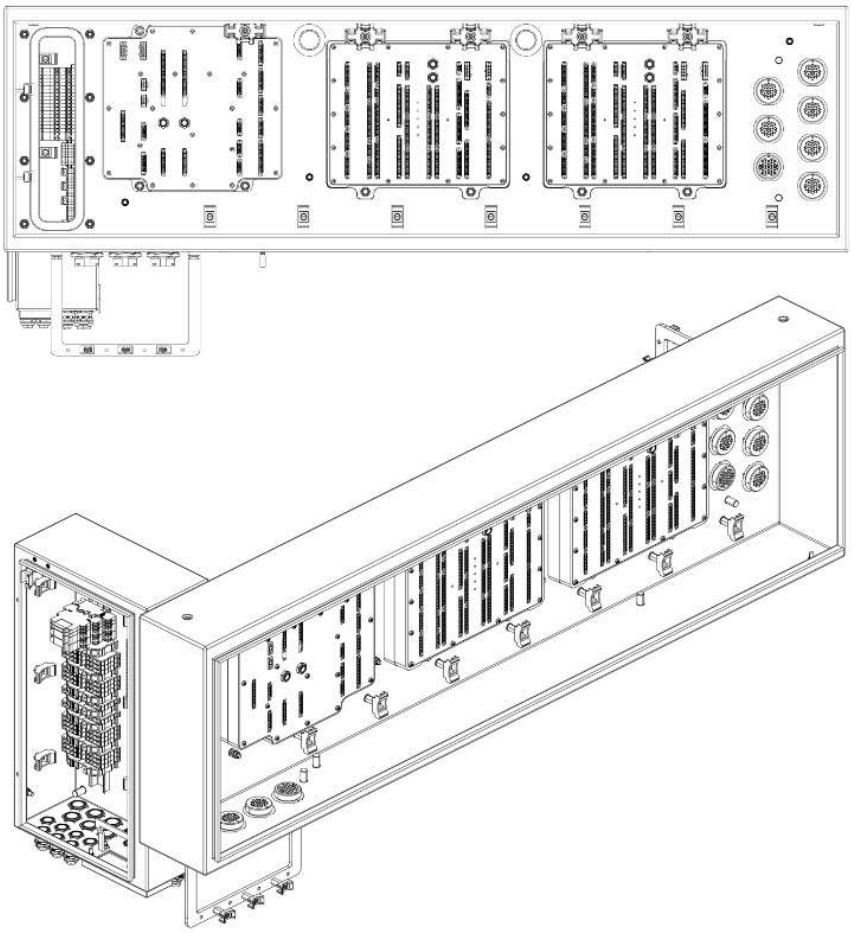


Figure 152: Control Unit

The engine safety system is installed in the safety module. The engine control and the engine alarm system are installed in the engine control module.

Both modules operate independently from each other. However, they are linked by the internal system bus. Each module features dedicated sensors used to record operating values.

The injection module controls the engine speed and actuates the injection valves.



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### System bus (2)

The system bus links all modules with each other. This redundant bus connection represents the foundation for data exchange between SaCoS 5000 modules. In this way, modules can access the redundant measured value of other modules if their own sensor should fail. I/O extensions are connected to modules via a non-redundant bus.

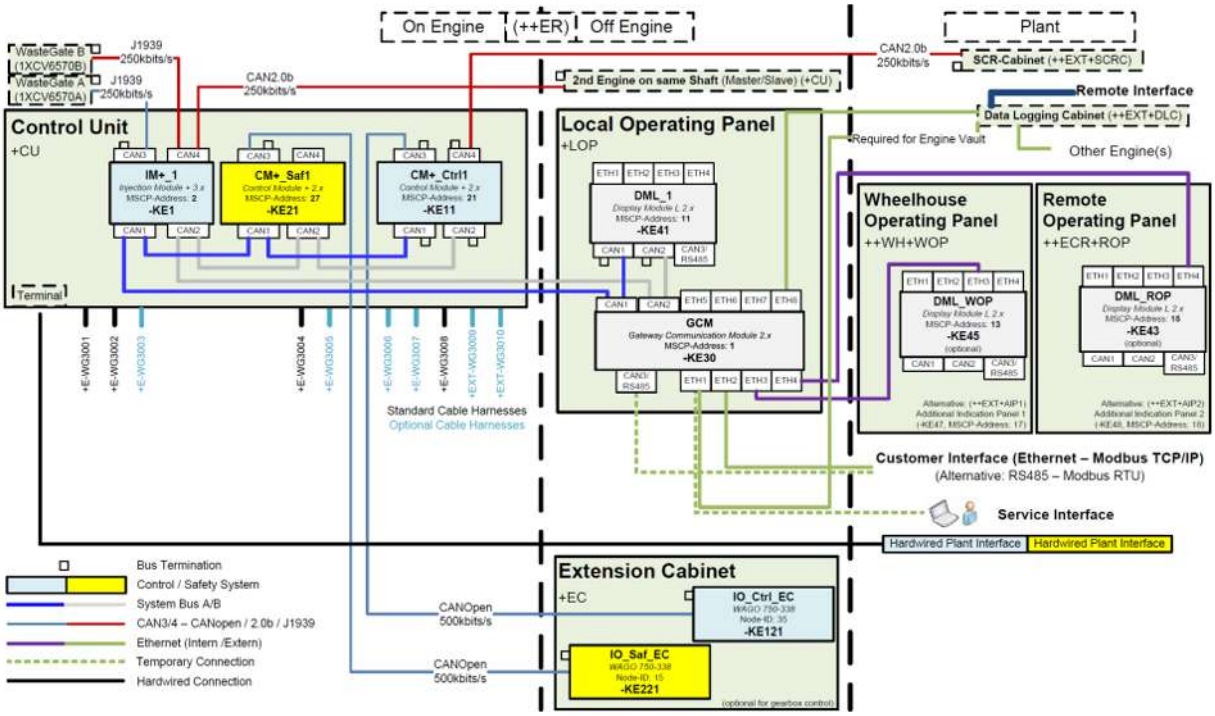



Figure 153: System bus

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## Local Operating Panel (3)

SaCoS 5000 can be directly operated from the Local Operating Panel (LOP). It is operated mainly using a TFT touchscreen that shows all operating and measured values. Many SaCoS 5000 functions, such as engine start or alarm processing, are also controlled using the touchscreen. The Local Operating Panel represents the communication interface between SaCoS 5000 and the superior system controls.

For this purpose, the Local Operating Panel features a Display Module and a Gateway Communication Module with input and output channels to the Data Logging Cabinet, Remote Operating Panel and Wheelhouse Operating Panel as well as different interfaces to the customer.

Additionally an emergency stop button is placed on the LOP.

The operation authority for the engine can be handed over from here to a Remote Operating Panel, a Wheelhouse Operating Panel or an external control system.

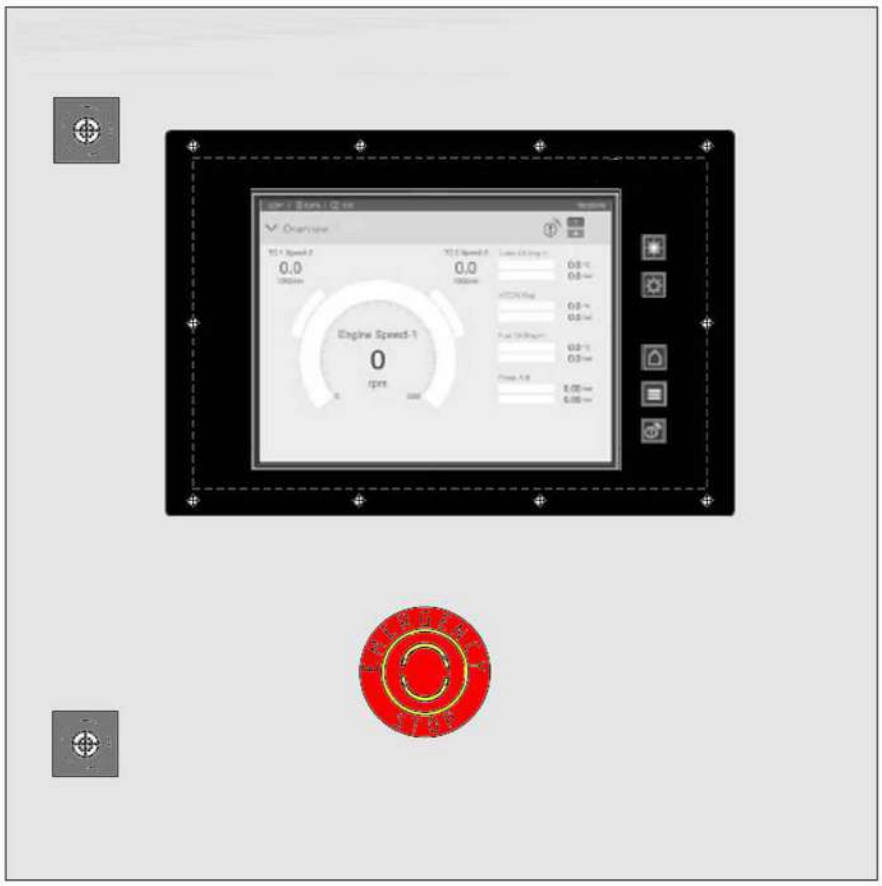



Figure 154: Local Operating Panel



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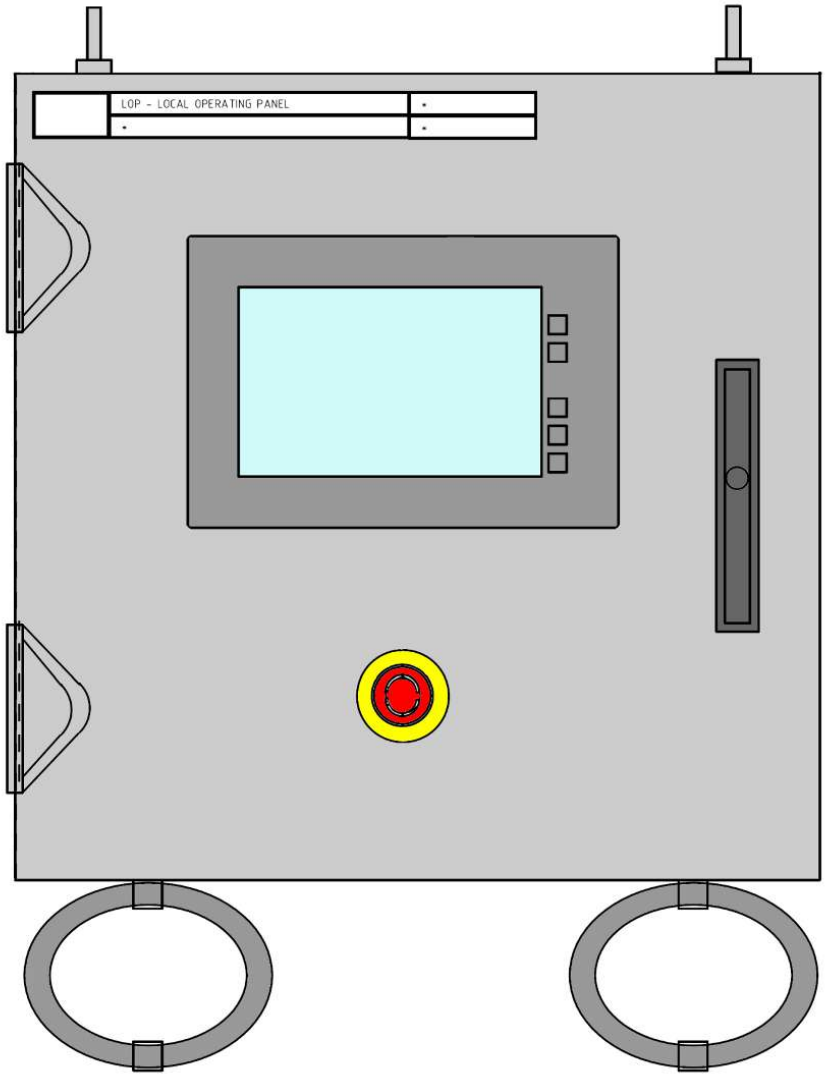



Figure 155: Local Operating Panel variant with shock mounting

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### Remote Operating Panel (optional)

With the optional Remote Operating Panel (ROP), the engine control can be operated from the engine control room. From this panel, the engine control functions can be transferred to a higher-level automation system or the optional Wheelhouse Operating Panel (WOP). An emergency stop button is placed on the ROP.

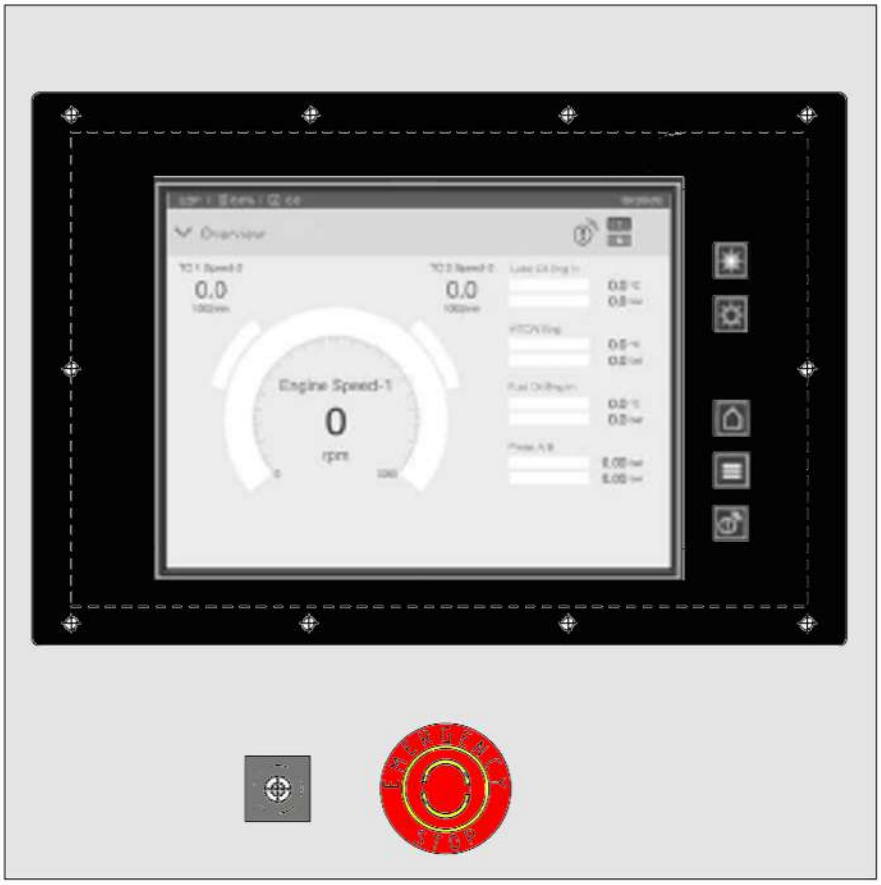



Figure 156: Remote Operating Panel



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### Wheelhouse Operating Panel (optional)

The optional Wheelhouse Operating Panel (WOP) assumes the same functions as the optional ROP, however, it is intended to be used on the bridge. An emergency stop button is placed on the WOP and additional an override-function with an override button is integrated in the optional WOP.

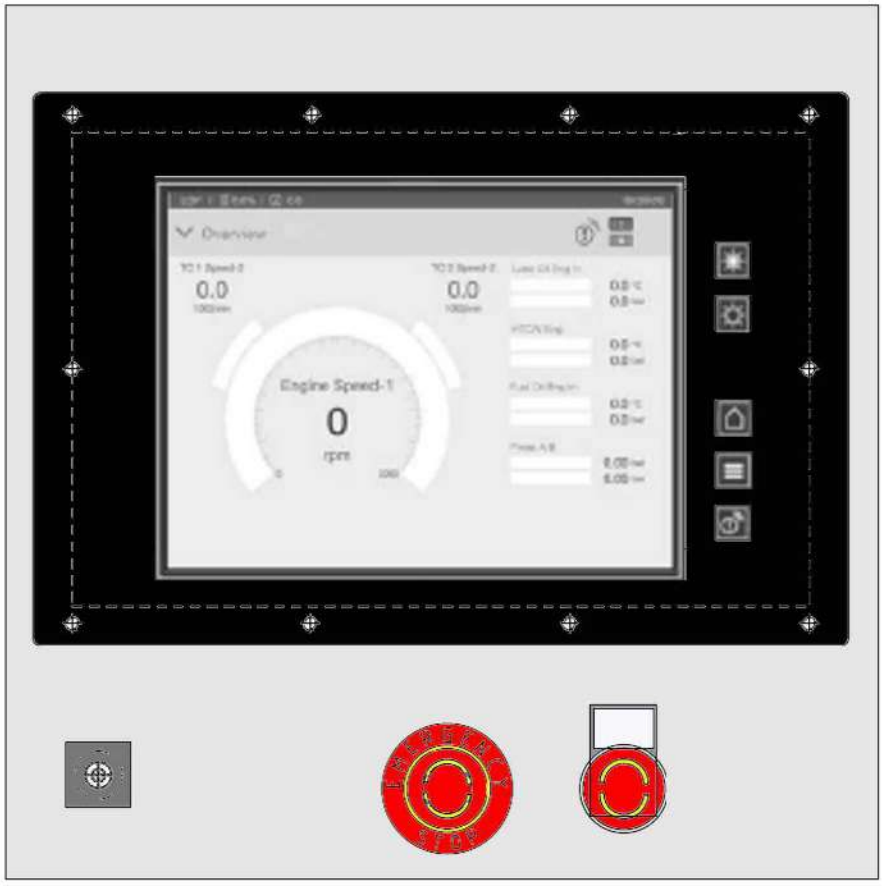



Figure 157: Wheelhouse Operating Panel

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## Overview of the Operating Panels

The following table shows the differences between the available operating panels.

| | **LOP Local Operating Panel** | **ROP Remote Operating Panel** | **WOP Wheelhouse Operating Panel** | **AIP Additional Indicating Panel** |
|---|---|---|---|---|
| Location | Engine room, close to engine | Engine control room | Bridge (Wheel-house) | anywhere |
| Availability | Mandatory | Optional | Optional | Optional, in total only three panels are possible |
| Inteded use | Local operation in engine room | Manual Remote operation from control room | Manual Remote operation from wheel-house | Remote indication, as attachment for external operation |
| features | | | | |
| Dimensions | 600 x 600 x 250 mm | 400 x 400 mm and connected cable loom 1.5 meter with terminal bar | 400 x 400 mm and connected cable loom 1.5 meter with terminal bar | 374 x 254 mm |
| Display | TFT 12" | TFT 12" | TFT 12" | TFT 12" |
| Location | Wall mounted in engine room or attached on genset frame | Desk mounting | Desk mounting | Desk mounting |
| Control type | Local manual control with control station transfer | Remote control with control station transfer Features see below | Remote control with control station transfer Features see below | Only visualization |
| Emergency stop | Yes | Yes | Yes | No |
| Engine start / stop | Yes | Optional** (application specific) | Optional** (application specific) | No |
| Speed setting | Yes | Optional** (application specific) | Optional** (application specific) | No |
| Indication of alarm / engine values | Yes | Yes | Yes | Yes |
| Ecomap / emission target selection | Yes | Yes | Yes | No |
| Starter selection | Optional | Optional | Optional | No |
| Alarm handling (acknowledge and reset) | Yes | Optional* | Optional* | No |
| Override | No | No | Yes (class specific) | No |
| Optical alarm | At display screen | At display screen | At display screen | At display screen |
| Acustic alarm | No | Yes, by buzzer | Yes, by buzzer | No |
| Brightness display | Adjustable via touch screen | Adjustable via touch screen | Adjustable via touch screen | Adjustable via touch screen |

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| | LOP Local Operating Panel | ROP Remote Operating Panel | WOP Wheelhouse Operating Panel | AIP Additional Indicating Panel |
|---|---|---|---|---|
| Display language | Basic DE / EN / ES / CN Other languages on request | Basic DE / EN / ES / CN Other languages on request | Basic DE / EN / ES / CN Other languages on request | Basic DE / EN / ES / CN Other languages on request |
| indications | | | | |
| Start blockings | Yes | Yes | Yes | Yes |
| Current alarms | Yes | Yes | Yes | Yes |
| Alarm history | Yes | Yes | Yes | Yes |
| Engine speed | Yes | Yes | Yes | Yes |
| Engine fuel index | Yes | Yes | Yes | Yes |
| TC speeds | Yes | Yes | Yes | Yes |
| Lube oil pressure and temperature | Yes | Yes | Yes | Yes |
| Fuel pressure | Yes | Yes | Yes | Yes |
| Fuel rail pressure | Yes | Yes | Yes | Yes |
| Fuel oil temperature | Yes | Yes | Yes | Yes |
| HT-Cooling water pressure and temperature | Yes | Yes | Yes | Yes |
| LT-Cooling water pressure | Yes | Yes | Yes | Yes |
| Charge air pressure and temperature | Yes | Yes | Yes | Yes |
| Splash oil temperatures | Yes | Yes | Yes | Yes |
| Exhaust gas temperature | Yes | Yes | Yes | Yes |
| Main bearing temperatures | Optional*** | Optional*** | Optional*** | Optional*** |
| Waste gate positions | Yes | Yes | Yes | Yes |
| Starting air pressure | Optional*** | Optional*** | Optional*** | Optional*** |
| Generator winding temperature | Optional*** | Optional*** | Optional*** | Optional*** |
| Generator bearings oil pressure | Optional*** | Optional*** | Optional*** | Optional*** |
| Generator bearing temperature | Optional*** | Optional*** | Optional*** | Optional*** |
| Generator cooling water temperature | Optional*** | Optional*** | Optional*** | Optional*** |
| Operating hours | Yes | Yes | Yes | Yes |

Table 643: Operating Panels

* Subject to Class approval (depending on classification society and type of ship)

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** Subject to ship application (propulsion system interface)

*** Subject to engine configuration

For each control station (engine room / control room / bridge wheelhouse) only one panel is available. In total only three panels are possible.



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### Data Logging Cabinet (optional)

The Data Logging Cabinet is used for maintaining SaCoS components (backup/restore), on-site data logging and diagnostic and to connect to Everllence Digital Services. Intelligent and for security hardened components are installed in the Data Logging Cabinet.

The Data Logging Cabinet enables through highly secure hardware and software the deployment locally or, on demand, over the air of the comprehensive Everllence Digital Services.
Everllence Digital Services include engine remote monitoring of operational data and diagnostics, troubleshooting and advice from Everllence engineers and also software and security updates in a safely manner.

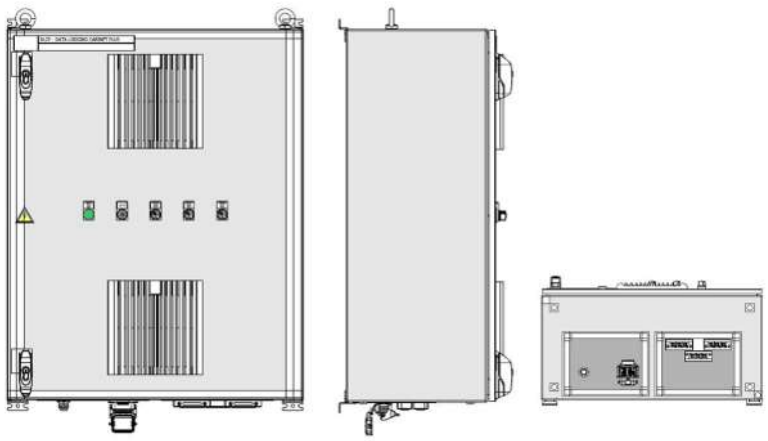


Figure 158: Data Logging Cabinet

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### SCR Control Cabinet (optional)

The SCR Cabinet contains all of the control devices for the SCR system. It is connected directly to the engine control system.

A touch screen is integrated into the front door, from where the calibration values for the urea injectors are entered.

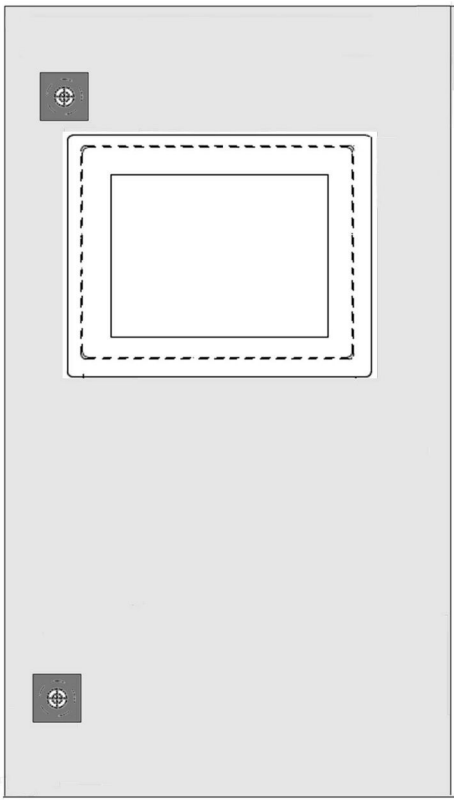


Figure 159: SCR Control Cabinet

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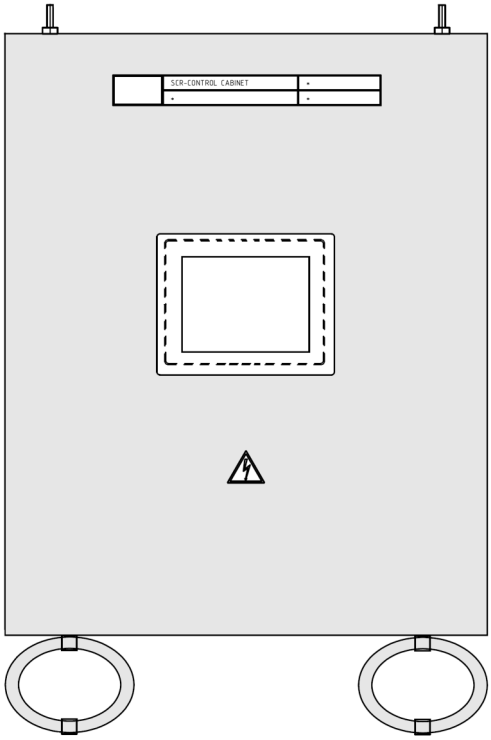



Figure 160: SCR Control Cabinet variant with shock mounting

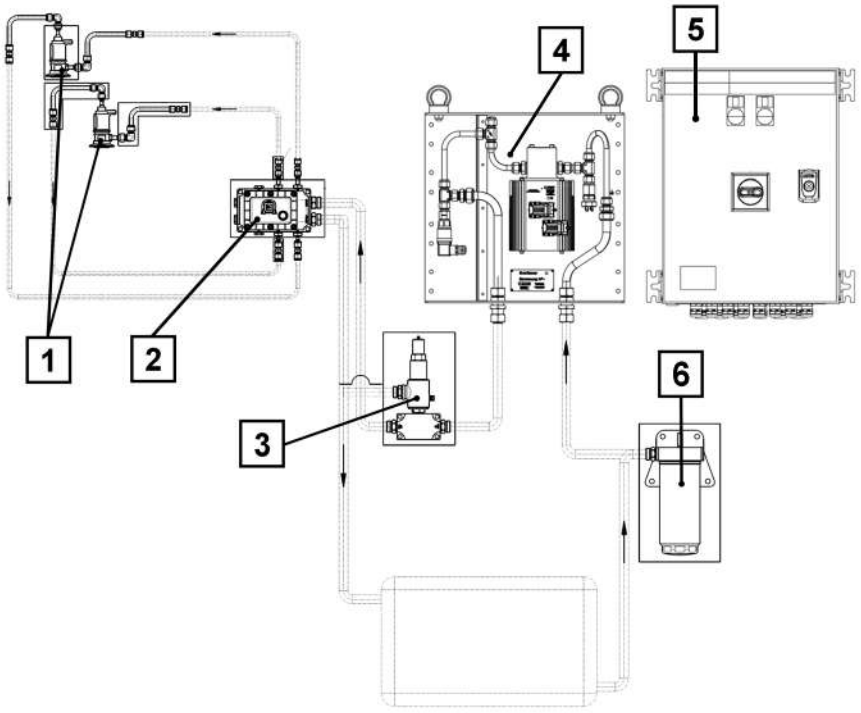
One SCR control system operates two engines. For further details see chapter SCR system description for 175D IMO Tier III variants, Page 22.

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### Urea dosing device (optional)

The urea dosing device consists of several components.

The urea is drawn from a tank through the urea filter (6) and the urea pump module (4), and then pumped through the pressure relief valve (3) via the urea distributor block (2) to the urea injectors (1). The urea pump module (4) is controlled by the dosing cabinet (5) and provides the necessary pressure at the urea injectors (1), through which the required amount of urea is metered into the exhaust gas stream.




1 Urea injectors
2 Urea distributor block
3 Pressure relief valve
4 Urea pump module
5 Dosing cabinet
6 Urea filter

Figure 161: Urea dosing device (example for a 2-line SCR system)



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#### 5.16.1.2 Cybersecurity guidelines

### Terms, abbreviations and definitions

| Term, abbreviation | Definition |
|---|---|
| G(C)M | Gateway (Communication) Module |
| DM | Display module |
| LOP | Local operating panel |
| ROP | Remote operating panel (see also WOP, wheel operating panel) |
| SCR | Selective catalytic reduction |
| IAS | Integrated alarm system (see also “customer network”) |
| PMS | Power management system |
| SDI | SaCoSone device image |
| EXPERT | Everllence tool for SaCoS parameterisation |
| Toolbox | (Virtual) device for parameterisation and backup/restore of SaCoS |
| RDP | Remote desktop protocol |
| CEON | Everllence service for recording engine data |
| DLC | Data logging cabinet |
| ER | Engine room |
| ECR | Engine control room |
| SaCoS | Safety and Control System |
| SL | SCR Single Line system (medium speed) |
| ML | SCR Multi Line system (high speed / 175D) |
| ROC | Remote operation centre |
| WBM | Web-based management |
| IC | Interface cabinet |
| eToken | SaCoS 5000 security token<br>SaCoSone security token<br>(Thales Group eToken 5110+) |

Table 644: Terms, abbreviations, and definitions

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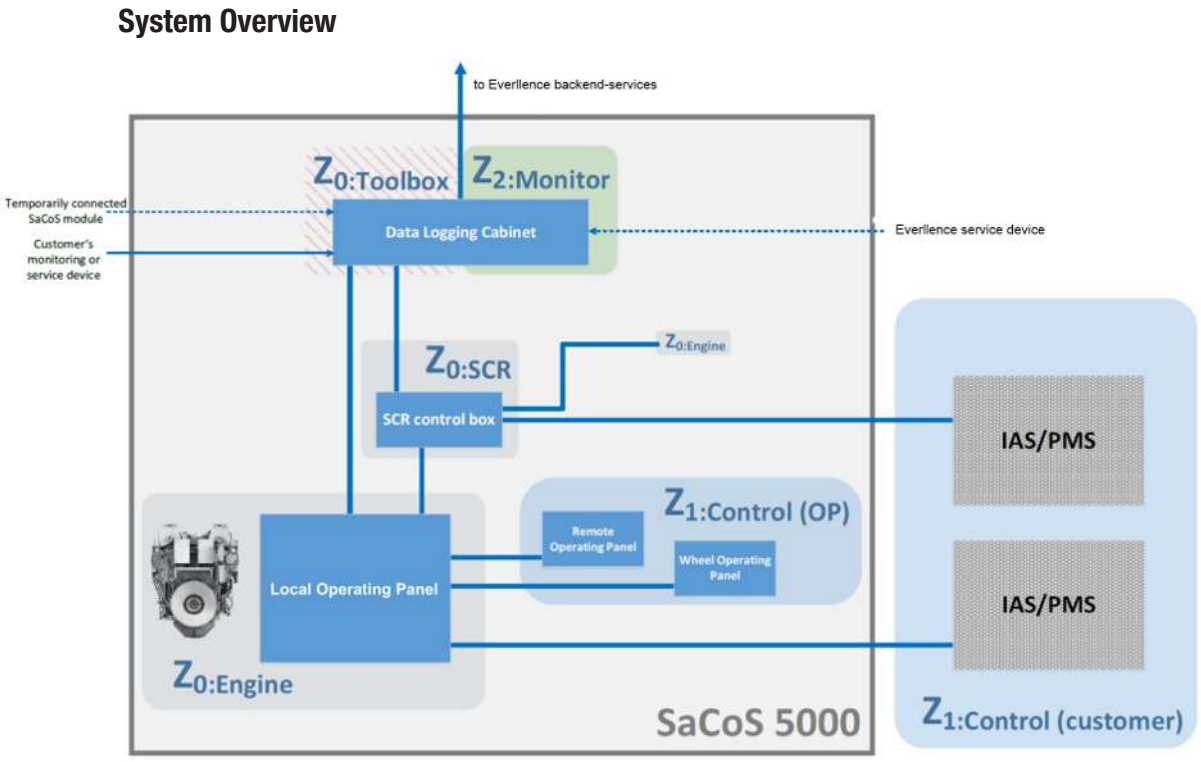



Figure 162: SaCoS 5000 with SCR and EngineVault: Zones and connections (simplified)

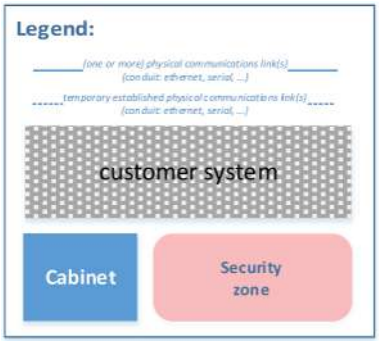



Figure 163: SaCoS 5000 with SCR and EngineVault: Zones and connections (simplified) – Legend

Figure *SaCoS 5000 with SCR and EngineVault: Zones and connections (simplified)*:
Shows a simplified overview of the SaCoS 5000 system (version with SCR and EngineVault), as well as some of the relevant zones and connections.

Figure *SaCoS 5000 with SCR and EngineVault: Zones and connections (simplified) – Legend*:
Shows the legend for the simplified overview of the SaCoS 5000 system (version with SCR and EngineVault).

The system is divided into the following main security zones:

- $Z_{0:Engine}$: Devices in this zone implement the main functionality of the engine control system.
- $Z_{0:SCR}$: Devices in this zone implement the SCR functionality and enable local monitoring and control of the SCR system.



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- $Z_{1:Control\ (OP)}$: This zone contains the control panels (including, for example, the ROP and WOP) that enable local monitoring and control of the engine control system.
- $Z_{1:Control\ (customer)}$: This zone contains the ship's integrated alarm and/or power management system(s) (IAS/PMS).
- $Z_{2:Monitor}$ and $Z_{0:Toolbox}$: These zones (not included in all SaCoS variants) include virtualised and physical devices that implement local/remote monitoring and logging of control system data, and enable local/remote system parameterisation, including restoring system backups to SaCoS modules that are temporarily connected to the data logging cabinet (DLC) for this purpose. To obtain limited, secure and interactive access to the Jumphost (also called *Engine Vault PC* in SaCoS) in the DLC and to use the described functionality, the user can connect to the system with their own device via the network connection provided for this purpose in the DLC.

The majority of the devices making up the control system are installed in locked control cabinets or units. These must be set up in restricted locations such as engine rooms (ER) and engine control rooms (ECR).

### Physical security of SaCoS

Due to their design, some SaCoS devices and communication links must be physically protected against unauthorised access at all times (i.e., including during commissioning). Only authorised and authenticated personnel may have access to these devices and connections. Such access must be logged.

The security of these protections should be assessed by the customer, taking into account the system context, system purpose, system location, assumptions about current and future threats to the customer's business, and applicable regulations.

### Secure access and storage of SaCoS data

It is necessary to keep the data created by or for SaCoS secure and protected against access by third parties.

### Secure use of the Engine Vault PC in the DLC

It is the customer’s responsibility to use the Engine Vault PC securely in accordance with the guidelines in the operating instructions.

### Securing Z1:Control(Customer)

$Z_{1:Control(Customer)}$ must be a trusted network in the sense of IACS UR E27.

A compromised SaCoS can also pose a threat to customer networks and devices, and infect or compromise the customer systems within them. The operator/integrator can implement additional measures such as installing additional network security devices to protect against this threat.

### Maintaining network segmentation

Network segmentation is one of SaCoS’s key protection measures. Therefore, the network structure set up by Everllence must not be changed.

Specifically, the following guidelines should be adhered to:

- Individual network segments must not be bridged (e.g. by connecting a device to several segments at the same time, connecting network switches from different segments to each other, or connecting devices from one segment to other segments).
- No additional devices may be connected to the SaCoS network segments.

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- The physical switches on the DLC that enable and disable the remote network connection of Everllence service staff to the Engine Vault PC for remote maintenance (designation on the cabinet), as well as the Engine Vault PC's network access to the Gateway and Display Modules (designation on the cabinet) for parameterisation, must normally be in the "disabled" position. Access should only be activated temporarily, only when required, only by authorised staff, and should be switched off again as soon as possible after completion of the work. Remote access (remote) to Engine Vault PC may only be enabled upon explicit and authenticated request from Everllence. Only those physical switches that are necessary for the functionality or activity actually required should be activated.

#### Preparation for security incidents

Residual risks may remain even if the present guidelines are followed. The customer should prepare for possible security incidents in order to be able to react to them quickly. This includes the creation of an *incident response plan*, which should address the following points, among others:

- Obtain spare parts to replace SaCoS modules that have failed or been compromised due to an attack.
- If changes are made to the system (e.g. parameterisation of the system), these changes should be saved accordingly.
- Report the security incident to Everllence via a secure channel and follow the instructions.
- Save all data relevant to the cause (may require assistance from the engine manufacturer’s 1st level support). This includes, but is not limited to, the access logs and general audit logs generated by the customer, customer devices, and the plant.
- Analyse the data and take steps to address the vulnerability that led to the incident.

The customer is also instructed to monitor the system for indications of a possible security incident to the extent possible.

#### Safe disposal

The customer is responsible for the security of potentially sensitive data when disposing of the devices.

#### User account management

The operator and service personnel are responsible for managing the access data for SaCoS devices.

#### Security Incident Report

The security incidents concerning SaCoS should be reported to Everllence PrimeServ.

### 5.16.2 Power supply of SaCoS 5000

#### 5.16.2.1 General requirements

According to classification requirements engine automation systems have to be powered by two independents power sources, one of them has to be an uninterrupted supply with capacity for sufficient operating time.

The minus conductors must be connected to each other to prevent voltage doubling in the event of a double earth fault (see DIN EN 50156-1).



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The short-circuit breaking capacity of the back-up fuses must be sufficiently large (min. 6 kA). This Short-circuit power of the feeders depends on the cable length and cable cross-section and is the responsibility of the shipyard.

For more details, please refer to requirements of specific classification society.

Provision of power supply is in responsibility of shipyard and is not included in SaCoS.

### Galvanic isolation

A fault in an IT mains (see IEC 60364-1) affects the entire galvanic island formed by the IT network. If different engines are fed from galvanically connected power supplies, then a fault in one of the engines can also affect all other engines. It is therefore the subject of the system risk assessment to determine whether engines may be galvanically connected to each other. It is strongly recommended not to supply multiple engines from galvanically connected power supplies in order to limit the impact of errors and facilitate troubleshooting. For the same reason, the power supplies of the engines must be galvanically isolated from the power supplies for other parts of the system.

### Electrical own consumption

The electrical own-consumption can be found in the relevant circuit diagrams.

### Rated operational current

| Consumer | Rated operational current |
|---|---|
| Control Unit | supplied from LOP |
| Local Operating Panel | 17A |
| Remote Operating Panel (optional) | 1A |
| Wheelhouse Operating Panel (optional) | 1A |
| Data Logging Cabinet (optional), SCR Cabinet (optional) | see relevant circuit-diagram |

Table 645: Rated operational current



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### 5.16.2.2 Power supply interface

Local Operating Panel

The LOP is the central connection point for SaCoS power supply. All consumers on engine are supplied from the LOP.

The LOP is equipped with a redundancy module and can be feeded with 2 independent power supplies.

| Voltage | Consumer | Remarks |
|---|---|---|
| 24 V DC | Local Operating Panel, via plant | All SaCoS 5000 components in the Local Operating Panel |
| 24 V DC | Local Operating Panel, via plant | Uninterruptible, buffered power supply |

Table 646: Power supply

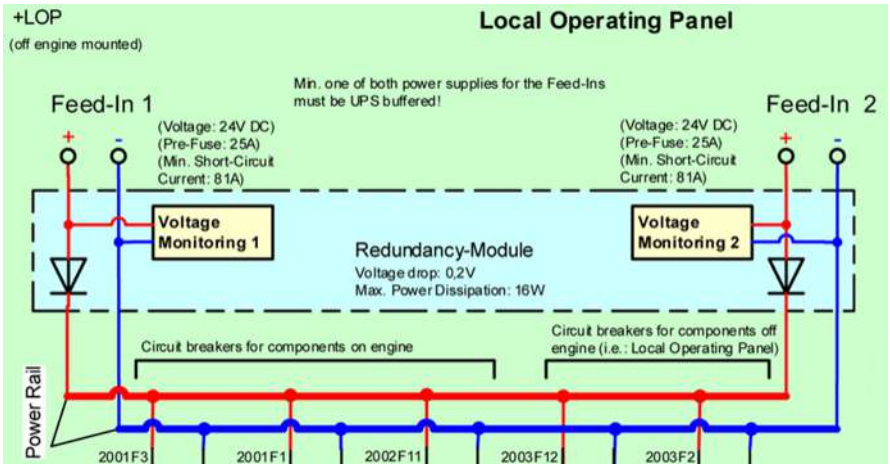



Figure 164: Power supply LOP



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Optional equipment (optional)

Optional equipment as ROP, WOP, SCR Cabinet and Data Logging Cabinet is only capable to be supplied from one power source, preferably with UPS.

| Voltage | Consumers | Remarks |
|---|---|---|
| 230 V AC | Data Logging Cabinet (optional), via plant | All components in the cabinet |
| 24 V DC | SCR Cabinet (optional), via plant | All components in the cabinet |
| 24 V DC | Remote Operating Panel (optional), via plant | All components in the panel |
| 24 V DC | Wheelhouse Operating Panel (optional), via plant | All components in the panel |

Table 647: Power supplies

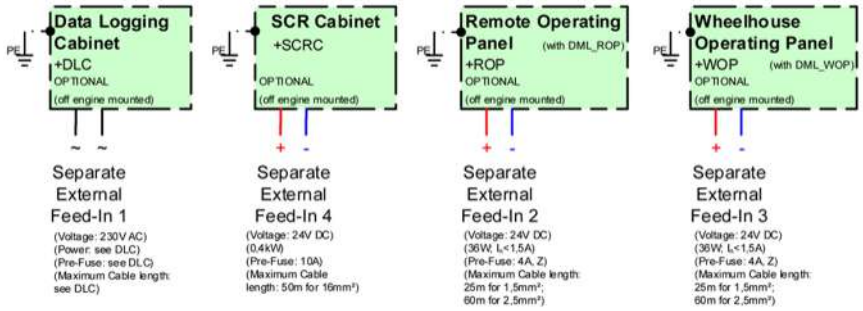



Figure 165: Power supplies optional equipment

## 5.16.3 Safety architecture of SaCoS 5000

### 5.16.3.1 Safety functions

The safety system monitors all operating data of the engine and initiates safety actions, e.g. load reduction request or engine shutdown, in case any limit values are exceeded.

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### 5.16.3.2 Emergency stop and automatic shutdown

Emergency stop and automatic shutdown

| Safety stop category | Properties |
|---|---|
| Redundant Manual Emergency Stop *ManEmStop* | • Source: Manually<br>• Safety Chain: Hardwired<br>• Processing: Redundant<br>• Override-able: No<br>• EmStop Actuators: All<br>• Providing to plant: Dedicated and as Overall Safety Stop |
| Single Manual Emergency Stop from external *ManEmStop (optional)* | • Source: Manually<br>• Safety Chain: Hardwired<br>• Processing: Wire break detection and distribution to redundancy<br>• Override-able: No<br>• EmStop Actuators: All<br>• Providing to plant: Dedicated and as Overall Safety Stop |
| Internal Automatic Emergency Stop *IntAutoEmStop* | • Source: Automatically<br>• Safety Chain: Hardwired<br>• Processing: Redundant<br>• Override-able: No<br>• EmStop Actuators: all<br>• Providing to plant: As Overall Safety Stop |
| Internal Automatic Shutdown *IntAutoSD* | • Source: Automatically<br>• Safety Chain: Hardwired<br>• Processing: Single or redundant<br>• Override-able: Yes<br>• EmStop Actuators: Individually<br>• Providing to plant: As Overall Safety Stop |
| External Emergency Stop *ExtEmStop* | • Source: Unknown<br>• Safety Chain: Hardwired<br>• Override-able: No<br>• Processing: Redundant<br>• EmStop Actuators: All<br>• Providing to plant: As Overall Safety Stop |
| External Automatic Shutdown *ExtAutoSD* | • Source: Unknown<br>• Safety Chain: Hardwired<br>• Override-able: Yes<br>• Processing: Redundant<br>• EmStop Actuators: Individually<br>• Providing to plant: As Overall Safety Stop |

Figure 166: Emergency stop and automatic shutdown

Note:
A manual emergency stop stops the engine, but does not affect the interface signals requesting the auxiliary units. During the integration, the respective integrator must determine how the system reacts.

Connection of external digital outputs to safety-relevant dual-channel digital inputs of SaCoS 5000

SaCoS 5000 owns a double-channel safety architecture. Therefore Everllence provides double-channel interfaces to external and recommends its usage. In case of manual emergency stop a single-channel emergency stop including wire break detection is offered alternatively, while the internal hardwired pro-

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cessing will be done redundantly. This single channel emergency stop may only be used in applications, where the risk analysis has shown no requirements with a Safety Integrity Level higher than 1.

Everllence will not be responsible for any increase of risk, which might be caused by the use of the single-channel manual emergency stop.

#### 5.16.3.3 Load reduction/auto slowdown

Depending on the engine configuration, there is a "load reduction request" or an "auto slowdown" to avoid overload of engine without stopping engine. If discharge is not affective, the engine will be stopped automatically.

With FPP and waterjet applications there is an auto slowdown, with CPP and generator a load reduction request.

Load reduction

The exceeding of certain parameters requires a load reduction to 60 %. The safety system supervises these parameters and requests a load reduction The load reduction has to be carried out by an external system (PMS, PCS, etc.). For safety reasons, SaCoS 5000 will not reduce the load by itself. The load reduction can be also be requested via an external system.

Auto slowdown

The exceeding of certain parameters requires an auto slowdown to 60 %. The safety system supervises these parameters and for safety reasons, SaCoS 5000 will carry out the auto slowdown by itself.

#### 5.16.3.4 Override

With the override switch on the bridge, the safety system function can be restricted to the issuing of alarms/messages and performing of emergency stops. With the override active, automatic shutdowns can be bypassed. The operator has a greater responsibility for monitoring the engine.

The emergency stops which are not affected by the override switch are:

- External emergency stop
- Internal automatic emergency stop
- Manual emergency stop

Depending on the order configuration different override scopes can be mapped, but only one of the modes is available for an application.

Override (standard)

Scope of exceptions depend on the specifications of the respective classification society.

Battle override

For emergencies, e.g. combat situations, the battle override can be activated. If the battle override is activated, 10% more power of the engine with constant power and an extension of the speed window by 80 rpm are enabled, the alarm reactions are suppressed.

When using the battle override, there are restrictions regarding usage of additional power and limitation of warranty/necessary overhaul.

Emergency genset mode

For engines which shall be operated as emergency genset, the emergency genset mode can be activated.

When using the emergency genset mode, like above, the automatic shutdowns according to classification requirements are bypassed.



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### 5.16.4 Functionality of SaCoS 5000

#### 5.16.4.1 Alarm functions

The alarm functions supervise all necessary limit values and generate alarms to indicate discrepancies. The alarm functions are processed in an area completely independent of the safety system area in all redundant modules.

#### 5.16.4.2 Self-monitoring

SaCoS 5000 carries out independent self-monitoring functions. Thus, for example the connected sensors are checked constantly for function and wire break. SaCoS 5000 reports all occurred malfunctions via alarm messages.

#### 5.16.4.3 Control- and monitoring functions

SaCoS 5000 controls all engine-internal functions as well as external components in the plant.

Speed control

The engine speed control is realised by software functions of the Injection Control Module. Engine speed and crankshaft turn angle indication is carried out by means of redundant pick ups at the camshaft.

Load limit curves

SaCoS 5000 features the following load limit curves:

- Start fuel limiter
- Maximum fuel limiter
- Charge air pressure dependent fuel limiter
- Torque limiter
- Rail pressure limiter
- Jump-rate limiter

Overspeed protection

The engine speed is monitored independently from each other in the alarm system and safety system. In case engine overspeed is detected each system actuates the shutdown device via a separate hardware channel.

Start/stop sequence

SaCoS 5000 controls all steps of the start/stop sequence, e.g.:

- Requests of lube oil and cooling water pumps
- Monitoring of the pre-lubrication
- Monitoring of the acceleration period

Monitoring

- Monitoring of main bearing (optional), flange bearing (optional) and splash-oil temperatures
- Monitoring of all operating media including fuel oil, lube oil, cooling water, start air (optional), cooling air, charge air and exhaust gas
- Monitoring of generator bearings (optional), generator windings (optional), generator cooling air (optional), generator cooling water (optional)

Control station switch-over

SaCoS 5000 controls the switch-over between the different operating panels and the switch-over to an external control system.

External functions

The scope of control functions depends on the plant configuration and must be coordinated during the project engineering phase. These control functions may cover:

- Electrical lube oil pump

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### 5.16.5 Gearbox monitoring

The optional range of functions with the “Gearbox monitoring" feature includes an additional cable that must be wired through the shipyard to the gearbox terminal box.

The cable is placed on the engine and evaluates the attached sensors to the gearbox.

For more information see the list of interfaces for the range of sensors and signal types in chapter Interfaces of SaCoS 5000, Page 552.

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### 5.16.6 Operation of SaCoS 5000

#### 5.16.6.1 Operating modes

The operating mode is pre-selected via the SaCoS interface and has to be defined during the application period.

Details regarding special operating modes on request.

Operating modes

For alternator applications:

- Droop (5-percent speed increase between nominal load and no load)

For propulsion engines:

- Isochronous

#### 5.16.6.2 Operating stations

Important functions of the engine can always be controlled from one operating panel only. The operating authorisation can be transferred between the different operating panels. The operating authorisation covers the following functions:

- Starting the engine
- Stopping the engine
- Adjusting the engine speed
- Acknowledging and resetting alarms

No operating authorisation is required for an emergency stop. An emergency stop is possible from each operating panel at any time.

Operating station changeover

The operation and control can be done from all operating panels if they are in active status. Selection and activation of the control stations is possible at all operating panels. It is not necessary to install additional speed indicators separately.

The operating rights can be handed over from an active panel to a passive panel or to an external automatic system. Therefore a handshake is necessary.

To transfer operating authorisation from an active to a passive operating panel, various operating functions must first be performed either on the active or the passive operating panel. The following functions are differentiated for transfer of operating rights:

- Taking over operating rights
- Relinquishing operating rights

These operating functions are summarised on a separate menu page in the display of the operating panel.

#### 5.16.6.3 Speed setting

Speed setting

The speed setting can be done either by means of binary contacts (e.g. for synchronisation) or by an active 4 – 20 mA analogue signal alternatively.



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#### 5.16.6.4 Starter

Redundant starter (optional) The engine is available with a redundant starter (electrical/pneumatic). At each engine start it can be selected which start system the engine should be started with. After a restart of SaCoS the electric starter is preconfigured as the primary starter.

### 5.16.7 Data Logging of SaCoS 5000

Details on data logging, such as:

- Description of what data is logged
- Description of access rights
- Analysis of data
- Description of which tools are required

etc., see document "Data Logging Cabinet SaCoS Engine Vault PC – Operating Instructions".

### 5.16.8 Interfaces of SaCoS 5000

#### 5.16.8.1 Power Management System

Hardwired interface, for remote start/stop, load setting, etc.

#### 5.16.8.2 Propulsion Optimization Interface

Standardised hardwired interface including all signals for control and safety actions between SaCoS 5000 and the propulsion control system.

This includes the following signals:

- Overload
- Operation close to the limit curve
- Propeller pitch reduction
- Engine speed
- Engine torque
- Distance to active limiter
- Derating factor (for DF engines)

This signals allow an optimized data exchange between engine and a smooth and look ahead control of the CCP propulsion system.

Clarify details at early stage of project.



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### 5.16.8.3 Data bus interface (machinery alarm system)

This interface serves for data exchange to the ship alarm system. The interface is actuated with MODBUS protocol and is available as:

- Ethernet interface MODBUS over TCP (Transmission Control Protocol)
- Serial MODBUS RTU (RS422/RS485)

The status messages, alarms and safety actions, which are generated in the system, can be transferred to the ship alarm system. All measuring values acquired by SaCoS are available for transfer, see MODBUS – List of signals.

MODBUS – List of signals
(only for reference)

| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| exhaust gas (row A) | | | | | | | | | |
| 15488 | - | operating value | exhaust gas temp cylinder A1 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15489 | - | operating value | exhaust gas temp cylinder A2 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15490 | - | operating value | exhaust gas temp cylinder A3 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15491 | - | operating value | exhaust gas temp cylinder A4 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15492 | - | operating value | exhaust gas temp cylinder A5 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15493 | - | operating value | exhaust gas temp cylinder A6 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15494 | - | operating value | exhaust gas temp cylinder A7 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15495 | - | operating value | exhaust gas temp cylinder A8 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15496 | - | operating value | exhaust gas temp cylinder A9 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15497 | - | operating value | exhaust gas temp cylinder A10 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15498 | - | operating value | exhaust gas temp turbocharger A inlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | for 12V engines |
| 15498 | - | operating value | exhaust gas temp turbocharger A1 inlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | for 16V and 20V engines |
| 15503 | 0 | load reduction request | exhaust gas temp cylinder A1 outlet high | boolean | | | | safety system | optional (either – or) |
| 15503 | 0 | auto slowdown | exhaust gas temp cylinder A1 outlet high | boolean | | | | safety system | |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15503 | 1 | load reduction request | exhaust gas temp cylinder A2 outlet high | boolean | | | | safety system | optional (either – or) |
| 15503 | 1 | auto slowdown | exhaust gas temp cylinder A2 outlet high | boolean | | | | safety system | |
| 15503 | 2 | load reduction request | exhaust gas temp cylinder A3 outlet high | boolean | | | | safety system | optional (either – or) |
| 15503 | 2 | auto slowdown | exhaust gas temp cylinder A3 outlet high | boolean | | | | safety system | |
| 15503 | 3 | load reduction request | exhaust gas temp cylinder A4 outlet high | boolean | | | | safety system | optional (either – or) |
| 15503 | 3 | auto slowdown | exhaust gas temp cylinder A4 outlet high | boolean | | | | safety system | |
| 15503 | 4 | load reduction request | exhaust gas temp cylinder A5 outlet high | boolean | | | | safety system | optional (either – or) |
| 15503 | 4 | auto slowdown | exhaust gas temp cylinder A5 outlet high | boolean | | | | safety system | |
| 15503 | 5 | load reduction request | exhaust gas temp cylinder A6 outlet high | boolean | | | | safety system | optional (either – or) |
| 15503 | 5 | auto slowdown | exhaust gas temp cylinder A6 outlet high | boolean | | | | safety system | |
| 15503 | 6 | load reduction request | exhaust gas temp cylinder A7 outlet high | boolean | | | | safety system | optional (either – or) |
| 15503 | 6 | auto slowdown | exhaust gas temp cylinder A7 outlet high | boolean | | | | safety system | |
| 15503 | 7 | load reduction request | exhaust gas temp cylinder A8 outlet high | boolean | | | | safety system | optional (either – or) |
| 15503 | 7 | auto slowdown | exhaust gas temp cylinder A8 outlet high | boolean | | | | safety system | |
| 15503 | 8 | load reduction request | exhaust gas temp cylinder A9 outlet high | boolean | | | | safety system | optional (either – or) |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15503 | 8 | auto slowdown | exhaust gas temp cylinder A9 outlet high | boolean | | | | safety system | |
| 15503 | 9 | load reduction request | exhaust gas temp cylinder A10 outlet high | boolean | | | | safety system | optional (either – or) |
| 15503 | 9 | auto slowdown | exhaust gas temp cylinder A10 outlet high | boolean | | | | safety system | |
| 15503 | 10 | load reduction request | exhaust gas temp turbocharger A inlet high | boolean | | | | safety system | optional (either – or) |
| 15503 | 10 | auto slowdown | exhaust gas temp turbocharger A inlet high | boolean | | | | safety system | |
| 15504 | 0 | load reduction request | exhaust gas temp cylinder A1 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15504 | 0 | auto slowdown | exhaust gas temp cylinder A1 outlet mean value deviation high | boolean | | | | safety system | |
| 15504 | 1 | load reduction request | exhaust gas temp cylinder A2 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15504 | 1 | auto slowdown | exhaust gas temp cylinder A2 outlet mean value deviation high | boolean | | | | safety system | |
| 15504 | 2 | load reduction request | exhaust gas temp cylinder A3 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15504 | 2 | auto slowdown | exhaust gas temp cylinder A3 outlet mean value deviation high | boolean | | | | safety system | |
| 15504 | 3 | load reduction request | exhaust gas temp cylinder A4 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15504 | 3 | auto slowdown | exhaust gas temp cylinder A4 outlet mean value deviation high | boolean | | | | safety system | |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15504 | 4 | load reduction request | exhaust gas temp cylinder A5 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15504 | 4 | auto slowdown | exhaust gas temp cylinder A5 outlet mean value deviation high | boolean | | | | safety system | |
| 15504 | 5 | load reduction request | exhaust gas temp cylinder A6 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15504 | 5 | auto slowdown | exhaust gas temp cylinder A6 outlet mean value deviation high | boolean | | | | safety system | |
| 15504 | 6 | load reduction request | exhaust gas temp cylinder A7 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15504 | 6 | auto slowdown | exhaust gas temp cylinder A7 outlet mean value deviation high | boolean | | | | safety system | |
| 15504 | 7 | load reduction request | exhaust gas temp cylinder A8 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15504 | 7 | auto slowdown | exhaust gas temp cylinder A8 outlet mean value deviation high | boolean | | | | safety system | |
| 15504 | 8 | load reduction request | exhaust gas temp cylinder A9 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15504 | 8 | auto slowdown | exhaust gas temp cylinder A9 outlet mean value deviation high | boolean | | | | safety system | |
| 15504 | 9 | load reduction request | exhaust gas temp cylinder A10 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15504 | 9 | auto slowdown | exhaust gas temp cylinder A10 outlet mean value deviation high | boolean | | | | safety system | |
| 15510 | 12 | alarm | exhaust gas temp after waste gate inflow high | boolean | | | | alarm system | optional |
| 15513 | 0 | system alarm | exhaust gas temp cylinder A1 outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15513 | 1 | system alarm | exhaust gas temp cylinder A2 outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15513 | 2 | system alarm | exhaust gas temp cylinder A3 outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15513 | 3 | system alarm | exhaust gas temp cylinder A4 outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15513 | 4 | system alarm | exhaust gas temp cylinder A5 outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15513 | 5 | system alarm | exhaust gas temp cylinder A6 outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15513 | 6 | system alarm | exhaust gas temp cylinder A7 outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15513 | 7 | system alarm | exhaust gas temp cylinder A8 outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15513 | 8 | system alarm | exhaust gas temp cylinder A9 outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15513 | 9 | system alarm | exhaust gas temp cylinder A10 outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15513 | 10 | system alarm | exhaust gas temp turbocharger A inlet-1 signal failure | boolean | | | | alarm system | for 12V engines |
| 15513 | 10 | system alarm | exhaust gas temp turbocharger A1 inlet-1 signal failure | boolean | | | | alarm system | for 16V and 20V engines |
| exhaust gas (row B) | | | | | | | | | |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15514 | - | operating value | exhaust gas temp cylinder B1 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15515 | - | operating value | exhaust gas temp cylinder B2 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15516 | - | operating value | exhaust gas temp cylinder B3 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15517 | - | operating value | exhaust gas temp cylinder B4 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15518 | - | operating value | exhaust gas temp cylinder B5 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15519 | - | operating value | exhaust gas temp cylinder B6 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15520 | - | operating value | exhaust gas temp cylinder B7 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15521 | - | operating value | exhaust gas temp cylinder B8 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15522 | - | operating value | exhaust gas temp cylinder B9 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15523 | - | operating value | exhaust gas temp cylinder B10 outlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | optional |
| 15524 | - | operating value | exhaust gas temp turbocharger B inlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | for 12V engines |
| 15524 | - | operating value | exhaust gas temp turbocharger B1 inlet | Temp. (abs) °C | 1 | 0 | 800 | safety system | for 16V and 20V engines |
| 15529 | 0 | load reduction request | exhaust gas temp cylinder B1 outlet high | boolean | | | | safety system | optional (either – or) |
| 15529 | 0 | auto slowdown | exhaust gas temp cylinder B1 outlet high | boolean | | | | safety system | |
| 15529 | 1 | load reduction request | exhaust gas temp cylinder B2 outlet high | boolean | | | | safety system | optional (either – or) |
| 15529 | 1 | auto slowdown | exhaust gas temp cylinder B2 outlet high | boolean | | | | safety system | |
| 15529 | 2 | load reduction request | exhaust gas temp cylinder B3 outlet high | boolean | | | | safety system | optional (either – or) |
| 15529 | 2 | auto slowdown | exhaust gas temp cylinder B3 outlet high | boolean | | | | safety system | |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15529 | 3 | load reduction request | exhaust gas temp cylinder B4 outlet high | boolean | | | | safety system | optional (either – or) |
| 15529 | 3 | auto slowdown | exhaust gas temp cylinder B4 outlet high | boolean | | | | safety system | |
| 15529 | 4 | load reduction request | exhaust gas temp cylinder B5 outlet high | boolean | | | | safety system | optional (either – or) |
| 15529 | 4 | auto slowdown | exhaust gas temp cylinder B5 outlet high | boolean | | | | safety system | |
| 15529 | 5 | load reduction request | exhaust gas temp cylinder B6 outlet high | boolean | | | | safety system | optional (either – or) |
| 15529 | 5 | auto slowdown | exhaust gas temp cylinder B6 outlet high | boolean | | | | safety system | |
| 15529 | 6 | load reduction request | exhaust gas temp cylinder B7 outlet high | boolean | | | | safety system | optional (either – or) |
| 15529 | 6 | auto slowdown | exhaust gas temp cylinder B7 outlet high | boolean | | | | safety system | |
| 15529 | 7 | load reduction request | exhaust gas temp cylinder B8 outlet high | boolean | | | | safety system | optional (either – or) |
| 15529 | 7 | auto slowdown | exhaust gas temp cylinder B8 outlet high | boolean | | | | safety system | |
| 15529 | 8 | load reduction request | exhaust gas temp cylinder B9 outlet high | boolean | | | | safety system | optional (either – or) |
| 15529 | 8 | auto slowdown | exhaust gas temp cylinder B9 outlet high | boolean | | | | safety system | |
| 15529 | 9 | load reduction request | exhaust gas temp cylinder B10 outlet high | boolean | | | | safety system | optional (either – or) |
| 15529 | 9 | auto slowdown | exhaust gas temp cylinder B10 outlet high | boolean | | | | safety system | |
| 15529 | 10 | load reduction request | exhaust gas temp turbocharger B inlet high | boolean | | | | safety system | optional (either – or) |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15529 | 10 | auto slowdown | exhaust gas temp turbocharger B inlet high | boolean | | | | safety system | |
| 15530 | 0 | load reduction request | exhaust gas temp cylinder B1 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15530 | 0 | auto slowdown | exhaust gas temp cylinder B1 outlet mean value deviation high | boolean | | | | safety system | |
| 15530 | 1 | load reduction request | exhaust gas temp cylinder B2 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15530 | 1 | auto slowdown | exhaust gas temp cylinder B2 outlet mean value deviation high | boolean | | | | safety system | |
| 15530 | 2 | load reduction request | exhaust gas temp cylinder B3 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15530 | 2 | auto slowdown | exhaust gas temp cylinder B3 outlet mean value deviation high | boolean | | | | safety system | |
| 15530 | 3 | load reduction request | exhaust gas temp cylinder B4 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15530 | 3 | auto slowdown | exhaust gas temp cylinder B4 outlet mean value deviation high | boolean | | | | safety system | |
| 15530 | 4 | load reduction request | exhaust gas temp cylinder B5 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15530 | 4 | auto slowdown | exhaust gas temp cylinder B5 outlet mean value deviation high | boolean | | | | safety system | |
| 15530 | 5 | load reduction request | exhaust gas temp cylinder B6 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15530 | 5 | auto slowdown | exhaust gas temp cylinder B6 outlet mean value deviation high | boolean | | | | safety system | |
| 15530 | 6 | load reduction request | exhaust gas temp cylinder B7 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15530 | 6 | auto slowdown | exhaust gas temp cylinder B7 outlet mean value deviation high | boolean | | | | safety system | |
| 15530 | 7 | load reduction request | exhaust gas temp cylinder B8 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15530 | 7 | auto slowdown | exhaust gas temp cylinder B8 outlet mean value deviation high | boolean | | | | safety system | |
| 15530 | 8 | load reduction request | exhaust gas temp cylinder B9 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15530 | 8 | auto slowdown | exhaust gas temp cylinder B9 outlet mean value deviation high | boolean | | | | safety system | |
| 15530 | 9 | load reduction request | exhaust gas temp cylinder B10 outlet mean value deviation high | boolean | | | | safety system | optional (either – or) |
| 15530 | 9 | auto slowdown | exhaust gas temp cylinder B10 outlet mean value deviation high | boolean | | | | safety system | |
| 15539 | 0 | system alarm | exhaust gas temp cylinder B1 outlet -1 signal failure | boolean | | | | alarm system | optional |
| 15539 | 1 | system alarm | exhaust gas temp cylinder B2 outlet -1 signal failure | boolean | | | | alarm system | optional |
| 15539 | 2 | system alarm | exhaust gas temp cylinder B3 outlet -1 signal failure | boolean | | | | alarm system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15539 | 3 | system alarm | exhaust gas temp cylinder B4 outlet -1 signal failure | boolean | | | | alarm system | optional |
| 15539 | 4 | system alarm | exhaust gas temp cylinder B5 outlet -1 signal failure | boolean | | | | alarm system | optional |
| 15539 | 5 | system alarm | exhaust gas temp cylinder B6 outlet -1 signal failure | boolean | | | | alarm system | optional |
| 15539 | 6 | system alarm | exhaust gas temp cylinder B7 outlet -1 signal failure | boolean | | | | alarm system | optional |
| 15539 | 7 | system alarm | exhaust gas temp cylinder B8 outlet -1 signal failure | boolean | | | | alarm system | optional |
| 15539 | 8 | system alarm | exhaust gas temp cylinder B9 outlet -1 signal failure | boolean | | | | alarm system | optional |
| 15539 | 9 | system alarm | exhaust gas temp cylinder B10 outlet -1 signal failure | boolean | | | | alarm system | optional |
| 15539 | 10 | system alarm | exhaust gas temp turbocharger B inlet-1 signal failure | boolean | | | | alarm system | for 12V engines |
| 15539 | 10 | system alarm | exhaust gas temp turbocharger B1 inlet-1 signal failure | boolean | | | | alarm system | for 16V and 20V engines |
| main bearing temperatures | | | | | | | | | |
| 15540 | - | operating value | flange bearing GDS temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15541 | - | operating value | main bearing 1 temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15542 | - | operating value | main bearing 2 temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15543 | - | operating value | main bearing 3 temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15544 | - | operating value | main bearing 4 temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15545 | - | operating value | main bearing 5 temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15546 | - | operating value | main bearing 6 temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15547 | - | operating value | main bearing 7 temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15548 | - | operating value | main bearing 8 temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15549 | - | operating value | main bearing 9 temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15550 | - | operating value | main bearing 10 temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15551 | - | operating value | main bearing 11 temp | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15552 | 0 | system alarm | flange bearing GDS temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 1 | system alarm | main bearing 1 temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 2 | system alarm | main bearing 2 temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 3 | system alarm | main bearing 3 temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 4 | system alarm | main bearing 4 temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 5 | system alarm | main bearing 5 temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 6 | system alarm | main bearing 6 temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 7 | system alarm | main bearing 7 temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 8 | system alarm | main bearing 8 temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 9 | system alarm | main bearing 9 temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 10 | system alarm | main bearing 10 temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 11 | system alarm | main bearing 11 temp.-2 signal failure | boolean | | | | safety system | optional |
| 15552 | 12 | system alarm | flange bearing CGDS temp.-2 signal failure | boolean | | | | safety system | optional |
| 15553 | 0 | auto shutdown | flange bearing GDS temp. high | boolean | | | | safety system | optional |
| 15553 | 1 | auto shutdown | main bearing 1 temp high | boolean | | | | safety system | optional |
| 15553 | 2 | auto shutdown | main bearing 2 temp high | boolean | | | | safety system | optional |
| 15553 | 3 | auto shutdown | main bearing 3 temp high | boolean | | | | safety system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15553 | 4 | auto shutdown | main bearing 4 temp high | boolean | | | | safety system | optional |
| 15553 | 5 | auto shutdown | main bearing 5 temp high | boolean | | | | safety system | optional |
| 15553 | 6 | auto shutdown | main bearing 6 temp high | boolean | | | | safety system | optional |
| 15553 | 7 | auto shutdown | main bearing 7 temp high | boolean | | | | safety system | optional |
| 15553 | 8 | auto shutdown | main bearing 8 temp high | boolean | | | | safety system | optional |
| 15553 | 9 | auto shutdown | main bearing 9 temp high | boolean | | | | safety system | optional |
| 15553 | 10 | auto shutdown | main bearing 10 temp high | boolean | | | | safety system | optional |
| 15553 | 11 | auto shutdown | main bearing 11 temp high | boolean | | | | safety system | optional |
| 15553 | 12 | auto shutdown | flange bearing CGDS temp high | boolean | | | | safety system | optional |
| splash-oil temperatures | | | | | | | | | |
| 15557 | - | operating value | splash-oil temp compartment 1 | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15558 | - | operating value | splash-oil temp compartment 2 | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15559 | - | operating value | splash-oil temp compartment 3 | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15560 | - | operating value | splash-oil temp compartment 4 | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15561 | - | operating value | splash-oil temp compartment 5 | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15562 | - | operating value | splash-oil temp compartment 6 | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15563 | - | operating value | splash-oil temp compartment 7 | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15564 | - | operating value | splash-oil temp compartment 8 | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15565 | - | operating value | splash-oil temp compartment 9 | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15566 | - | operating value | splash-oil temp compartment 10 | Temp. (abs) °C | 0.01 | 0 | 12000 | safety system | optional |
| 15567 | 0 | system alarm | splash-oil temp compartment 1-2 signal failure | boolean | | | | safety system | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15567 | 1 | system alarm | splash-oil temp compartment 2-2 signal failure | boolean | | | | safety system | optional |
| 15567 | 2 | system alarm | splash-oil temp compartment 3-2 signal failure | boolean | | | | safety system | optional |
| 15567 | 3 | system alarm | splash-oil temp compartment 4-2 signal failure | boolean | | | | safety system | optional |
| 15567 | 4 | system alarm | splash-oil temp compartment 5-2 signal failure | boolean | | | | safety system | optional |
| 15567 | 5 | system alarm | splash-oil temp compartment 6-2 signal failure | boolean | | | | safety system | optional |
| 15567 | 6 | system alarm | splash-oil temp compartment 7-2 signal failure | boolean | | | | safety system | optional |
| 15567 | 7 | system alarm | splash-oil temp compartment 8-2 signal failure | boolean | | | | safety system | optional |
| 15567 | 8 | system alarm | splash-oil temp compartment 9-2 signal failure | boolean | | | | safety system | optional |
| 15567 | 9 | system alarm | splash-oil temp compartment 10-2 signal failure | boolean | | | | safety system | optional |
| 15568 | 0 | auto shutdown | splash-oil temp compartment 1 high | boolean | | | | safety system | optional |
| 15568 | 1 | auto shutdown | splash-oil temp compartment 2 high | boolean | | | | safety system | optional |
| 15568 | 2 | auto shutdown | splash-oil temp compartment 3 high | boolean | | | | safety system | optional |
| 15568 | 3 | auto shutdown | splash-oil temp compartment 4 high | boolean | | | | safety system | optional |
| 15568 | 4 | auto shutdown | splash-oil temp compartment 5 high | boolean | | | | safety system | optional |
| 15568 | 5 | auto shutdown | splash-oil temp compartment 6 high | boolean | | | | safety system | optional |
| 15568 | 6 | auto shutdown | splash-oil temp compartment 7 high | boolean | | | | safety system | optional |
| 15568 | 7 | auto shutdown | splash-oil temp compartment 8 high | boolean | | | | safety system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15568 | 8 | auto shutdown | splash-oil temp compartment 9 high | boolean | | | | safety system | optional |
| 15568 | 9 | auto shutdown | splash-oil temp compartment 10 high | boolean | | | | safety system | optional |
| 15568 | 11 | auto shutdown | splash-oil temp compartment 1 mean value deviation gradient positive high | boolean | | | | safety system | optional |
| 15568 | 12 | auto shutdown | splash-oil temp compartment 2 mean value deviation gradient positive high | boolean | | | | safety system | optional |
| 15568 | 13 | auto shutdown | splash-oil temp compartment 3 mean value deviation gradient positive high | boolean | | | | safety system | optional |
| 15568 | 14 | auto shutdown | splash-oil temp compartment 4 mean value deviation gradient positive high | boolean | | | | safety system | optional |
| 15568 | 15 | auto shutdown | splash-oil temp compartment 5 mean value deviation gradient positive high | boolean | | | | safety system | optional |
| 15569 | 0 | auto shutdown | splash-oil temp compartment 1 mean value deviation high | boolean | | | | safety system | optional |
| 15569 | 1 | auto shutdown | splash-oil temp compartment 2 mean value deviation high | boolean | | | | safety system | optional |
| 15569 | 2 | auto shutdown | splash-oil temp compartment 3 mean value deviation high | boolean | | | | safety system | optional |
| 15569 | 3 | auto shutdown | splash-oil temp compartment 4 mean value deviation high | boolean | | | | safety system | optional |
| 15569 | 4 | auto shutdown | splash-oil temp compartment 5 mean value deviation high | boolean | | | | safety system | optional |
| 15569 | 5 | auto shutdown | splash-oil temp compartment 6 mean value deviation high | boolean | | | | safety system | optional |
| 15569 | 6 | auto shutdown | splash-oil temp compartment 7 mean value deviation high | boolean | | | | safety system | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15569 | 7 | auto shutdown | splash-oil temp compartment 8 mean value deviation high | boolean | | | | safety system | optional |
| 15569 | 8 | auto shutdown | splash-oil temp compartment 9 mean value deviation high | boolean | | | | safety system | optional |
| 15569 | 9 | auto shutdown | splash-oil temp compartment 10 mean value deviation high | boolean | | | | safety system | optional |
| 15569 | 10 | auto shutdown | splash-oil temp compartment 6 mean value deviation gradient positive high | boolean | | | | safety system | optional |
| 15569 | 11 | auto shutdown | splash-oil temp compartment 7 mean value deviation gradient positive high | boolean | | | | safety system | optional |
| 15569 | 12 | auto shutdown | splash-oil temp compartment 8 mean value deviation gradient positive high | boolean | | | | safety system | optional |
| 15569 | 13 | auto shutdown | splash-oil temp compartment 9 mean value deviation gradient positive high | boolean | | | | safety system | optional |
| 15569 | 14 | auto shutdown | splash-oil temp compartment 10 mean value deviation gradient positive high | boolean | | | | safety system | optional |
| 15572 | 0 | system alarm | splash-oil temp compartment 1 sensor-1 cut-off | boolean | | | | alarm system | optional |
| 15572 | 1 | system alarm | splash-oil temp compartment 2 sensor-1 cut-off | boolean | | | | alarm system | optional |
| 15572 | 2 | system alarm | splash-oil temp compartment 3 sensor-1 cut-off | boolean | | | | alarm system | optional |
| 15572 | 3 | system alarm | splash-oil temp compartment 4 sensor-1 cut-off | boolean | | | | alarm system | optional |
| 15572 | 4 | system alarm | splash-oil temp compartment 5 sensor-1 cut-off | boolean | | | | alarm system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15572 | 5 | system alarm | splash-oil temp compartment 6 sensor-1 cut-off | boolean | | | | alarm system | optional |
| 15572 | 6 | system alarm | splash-oil temp compartment 7 sensor-1 cut-off | boolean | | | | alarm system | optional |
| 15572 | 7 | system alarm | splash-oil temp compartment 8 sensor-1 cut-off | boolean | | | | alarm system | optional |
| 15572 | 8 | system alarm | splash-oil temp compartment 9 sensor-1 cut-off | boolean | | | | alarm system | optional |
| 15572 | 9 | system alarm | splash-oil temp compartment 10 sensor-1 cut-off | boolean | | | | alarm system | optional |
| EDS - operating values | | | | | | | | | |
| 15587 | - | operating value | flange bearing CGDS temp. | °C | 0.01 | 0 | 12000 | alarm system | optional |
| 15629 | - | operating value | charge air temp cooler A inlet | °C | 0.01 | 0 | 30000 | alarm system | optional |
| 15641 | 4 | system alarm | charge air temp cooler A inlet-1 signal failure | boolean | | | | alarm system | optional |
| 15642 | - | operating value | engine torque relative | % | 0.1 | -200 | 1200 | speed control | |
| 15658 | 8 | system alarm | engine torque transmitter signal failure | boolean | | | | alarm system | optional |
| 15665 | - | status information | start stop progress index | boolean | 1 | | | alarm system | optional |
| 15674 | - | status information | engine start with skipped pre-lubrication counter | boolean | 1 | 0 | 65535 | alarm system | optional |
| media pressures | | | | | | | | | |
| 15676 | - | operating value | lube oil pressure engine inlet-1 | pressure (bar) | 0.01 | 0 | 1000 | alarm system | optional |
| 15678 | - | operating value | HTCW pressure cylinder cooling inlet-1 | pressure (bar) | 0.01 | 0 | 1000 | alarm system | optional |
| 15680 | - | operating value | LTCW pressure CA cooler inlet-1 | pressure (bar) | 0.01 | 0 | 1000 | alarm system | optional |
| 15681 | - | operating value | fuel oil pressure engine inlet-1 | pressure (bar) | 0.01 | 0 | 1600 | alarm system | optional |
| 15684 | - | operating value | start air pressure-1 | pressure (bar) | 0.01 | 0 | 4000 | alarm system | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15686 | - | operating value | charge air pressure engine inlet row B-1 | pressure (bar) | 0.01 | 0 | 1000 | alarm system | optional |
| 15688 | - | operating value | lube oil pressure filter inlet | pressure (bar) | 0.01 | 0 | 1000 | alarm system | optional |
| 15689 | - | operating value | crankcase pressure-1 | pressure (mbar) | 0.01 | –2000 | 2000 | alarm system | optional |
| 15690 | - | operating value | crankcase pressure-2 | pressure (mbar) | 0.01 | –2000 | 2000 | safety system | optional |
| 15691 | - | operating value | seawater pressure pump outlet | pressure (bar) | 0.01 | 0 | 1000 | alarm system | optional |
| 15692 | 0 | system alarm | lube oil pressure engine inlet-1 signal failure | boolean | | | | alarm system | optional |
| 15692 | 2 | system alarm | HTCW pressure cylinder cooling inlet-1 signal failure | boolean | | | | alarm system | optional |
| 15692 | 4 | system alarm | LTCW pressure charge air cooler inlet-1 signal failure | boolean | | | | alarm system | optional |
| 15692 | 5 | system alarm | fuel oil pressure engine inlet-1 signal failure | boolean | | | | alarm system | optional |
| 15692 | 8 | system alarm | start air pressure-1 signal failure | boolean | | | | alarm system | optional |
| 15692 | 10 | system alarm | charge air pressure engine inlet row B-1 signal failure | boolean | | | | alarm system | optional |
| 15692 | 12 | system alarm | lube oil pressure filter inlet signal failure | boolean | | | | alarm system | optional |
| 15692 | 13 | system alarm | crankcase pressure-1 signal failure | boolean | | | | alarm system | optional |
| 15692 | 14 | system alarm | crankcase pressure-2 signal failure | boolean | | | | safety system | optional |
| 15692 | 15 | system alarm | sea water pressure pump outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15709 | 3 | system alarm | gear lube oil pressure-2 signal failure | boolean | | | | alarm system | optional |
| media temperatures | | | | | | | | | |
| 15727 | - | operating value | lube oil temp engine inlet | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |
| 15731 | - | operating value | HTCW temp cylinder cooling outlet | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15733 | - | operating value | charge air temp engine inlet row A | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |
| 15734 | - | operating value | charge air temp engine inlet row B | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |
| 15735 | - | operating value | LTCW temp charge air cooler intlet | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |
| 15736 | - | operating value | fuel oil temp engine inlet-1 | Temp. (abs) °C | 0.01 | 0 | 20000 | alarm system | optional |
| 15738 | - | operating value | gear lube oil temp. | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |
| 15739 | - | operating value | gear thrust bearing temp. | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |
| 15743 | 0 | system alarm | lube oil temp. engine inlet-1 signal failure | boolean | | | | alarm system | optional |
| 15743 | 4 | system alarm | HTCW temp. cylinder cooling outlet-1 signal failure | boolean | | | | alarm system | optional |
| 15743 | 6 | system alarm | charge air temp. engine inlet row A-1 signal failure | boolean | | | | alarm system | optional |
| 15743 | 7 | system alarm | charge air temp. engine inlet row B-1 signal failure | boolean | | | | alarm system | optional |
| 15743 | 8 | system alarm | LTCW temp. charge air cooler intlet-1 signal failure | boolean | | | | alarm system | optional |
| 15743 | 9 | system alarm | fuel oil temp. engine inlet-1 signal failure | boolean | | | | alarm system | optional |
| 15743 | 11 | system alarm | gear lube oil temp. signal failure | boolean | | | | alarm system | optional |
| 15743 | 12 | system alarm | gear thrust bearing temp. signal failure | boolean | | | | alarm system | optional |
| media temperatures | | | | | | | | | |
| 15744 | - | operating value | intake air temp. row B-1 | Temp. (abs) °C | 0.01 | -5000 | 8000 | alarm system | optional |
| 15747 | - | operating value | splash-oil temp mean value | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |
| 15748 | - | operating value | exhaust gas temp cylinder outlet row A MV | Temp. (abs) °C | 1 | 0 | 800 | alarm system | optional |
| 15749 | - | operating value | exhaust gas temp cylinder outlet row B MV | Temp. (abs) °C | 1 | 0 | 800 | alarm system | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15756 | - | operating value | exhaust gas temp after waste gate in-flow | Temp. (abs) °C | 1 | 0 | 800 | alarm system | optional |
| 15757 | - | operating value | exhaust gas temp turbocharger A2 inlet | Temp. (abs) °C | 1 | 0 | 800 | alarm system | optional |
| 15758 | - | operating value | exhaust gas temp turbocharger B2 inlet | Temp. (abs) °C | 1 | 0 | 800 | alarm system | optional |
| 15760 | 0 | system alarm | intake air temp. row B signal failure | boolean | | | | alarm system | optional |
| 15760 | 12 | system alarm | exhaust gas temp after waste gate in-flow-1 signal failure | boolean | | | | alarm system | optional |
| 15760 | 13 | system alarm | exhaust gas temp turbocharger A2 in-let-1 signal failure | boolean | | | | alarm system | optional |
| 15760 | 14 | system alarm | exhaust gas temp turbocharger B2 in-let-1 signal failure | boolean | | | | alarm system | optional |
| miscellaneous values | | | | | | | | | |
| 15778 | - | operating value | engine speed | rpm | 1 | 0 | 2500 | safety system | optional |
| 15779 | - | operating value | engine fuel admis-sion | % | 0.1 | 0 | 1100 | alarm system | optional |
| 15780 | - | operating value | turbocharger A1 speed-1 | rpm | 10 | 0 | 8000 | alarm system | for 16V and 20V en-gines |
| 15780 | - | operating value | turbocharger A speed-1 | rpm | 10 | 0 | 8000 | alarm system | for 12V en-gines |
| 15781 | - | operating value | turbocharger B1 speed-1 | rpm | 10 | 0 | 8000 | alarm system | for 16V and 20V en-gines |
| 15781 | - | operating value | turbocharger B speed-1 | rpm | 10 | 0 | 8000 | alarm system | for 12V en-gines |
| 15783 | - | operating value | generator DE bearing temp.-1 | Temp. (abs) °C | 0.01 | 0 | 20000 | safety system | optional |
| 15784 | - | operating value | generator NDE bear-ing temp.-1 | Temp. (abs) °C | 0.01 | 0 | 20000 | safety system | optional |
| 15785 | - | operating value | generator winding L1 temp.-1 | Temp. (abs) °C | 0.01 | 0 | 20000 | safety system | optional |
| 15786 | - | operating value | generator winding L2 temp.-1 | Temp. (abs) °C | 0.01 | 0 | 20000 | safety system | optional |
| 15787 | - | operating value | generator winding L3 temp.-1 | Temp. (abs) °C | 0.01 | 0 | 20000 | safety system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15791 | - | operating value | engine speed set-point ramped | rpm | 1 | 0 | 1500 | IM | optional |
| 15792 | - | operating value | engine speed analog setpoint | rpm | 1 | 0 | 1500 | IM | optional |
| 15793 | - | operating value | generator actual power | kW | 1 | -30000 | 30000 | generator | optional, signed integer |
| 15794 | 2 | system alarm | turbocharger A speed-1 signal failure | boolean | | | | safety system | for 12V engines |
| 15794 | 2 | system alarm | turbocharger A1 speed-1 signal failure | boolean | | | | safety system | for 16V and 20V engines |
| 15794 | 3 | system alarm | turbocharger B speed-1 signal failure | boolean | | | | safety system | for 12V engines |
| 15794 | 3 | system alarm | turbocharger B1 speed-1 signal failure | boolean | | | | safety system | for 16V and 20V engines |
| 15794 | 5 | system alarm | generator DE bearing temp.-1 signal failure | boolean | | | | safety system | optional |
| 15794 | 6 | system alarm | generator NDE bearing temp.-1 signal failure | boolean | | | | safety system | optional |
| 15794 | 7 | system alarm | generator winding L1 temp.-1 signal failure | boolean | | | | safety system | optional |
| 15794 | 8 | system alarm | generator winding L2 temp.-1 signal failure | boolean | | | | safety system | optional |
| 15794 | 9 | system alarm | generator winding L3 temp.-1 signal failure | boolean | | | | safety system | optional |
| 15795 | - | operating value | engine operating time | h | 1 | 0 | 65535 | alarm system | optional |
| 15797 | - | operating value | engine operating time in overload | h | 1 | 0 | 65535 | alarm system | optional |
| 15802 | - | operating value | lambda (combustion) | % | 0.01 | 0 | 2500 | alarm system | optional |
| Media pressures and temperatures redundant value deviation | | | | | | | | | |
| 15829 | 0 | system alarm | lube oil pressure engine inlet sensor deviation high | boolean | | | | alarm system | optional |
| 15829 | 3 | system alarm | HTCW pressure cylinder cooling inlet sensor deviation high | boolean | | | | alarm system | optional |
| 15830 | 0 | system alarm | lube oil temp engine inlet sensor deviation high | boolean | | | | alarm system | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15830 | 3 | system alarm | HTCW temp cylinder cooling outlet sensor deviation high | boolean | | | | alarm system | optional |
| splash-oil temperatures redundant value deviation | | | | | | | | | |
| 15831 | 0 | system alarm | splash-oil temp. compartment 1 sensor deviation high | boolean | | | | alarm system | optional |
| 15831 | 1 | system alarm | splash-oil temp. compartment 2 sensor deviation high | boolean | | | | alarm system | optional |
| 15831 | 2 | system alarm | splash-oil temp. compartment 3 sensor deviation high | boolean | | | | alarm system | optional |
| 15831 | 3 | system alarm | splash-oil temp. compartment 4 sensor deviation high | boolean | | | | alarm system | optional |
| 15831 | 4 | system alarm | splash-oil temp. compartment 5 sensor deviation high | boolean | | | | alarm system | optional |
| 15831 | 5 | system alarm | splash-oil temp. compartment 6 sensor deviation high | boolean | | | | alarm system | optional |
| 15831 | 6 | system alarm | splash-oil temp. compartment 7 sensor deviation high | boolean | | | | alarm system | optional |
| 15831 | 7 | system alarm | splash-oil temp. compartment 8 sensor deviation high | boolean | | | | alarm system | optional |
| 15831 | 8 | system alarm | splash-oil temp. compartment 9 sensor deviation high | boolean | | | | alarm system | optional |
| 15831 | 9 | system alarm | splash-oil temp. compartment 10 sensor deviation high | boolean | | | | alarm system | optional |
| main bearing temperatures redundant value deviation | | | | | | | | | |
| 15832 | 0 | system alarm | flange bearing GDS temp. sensor deviation high | boolean | | | | alarm system | optional |
| 15832 | 1 | system alarm | main bearing 1 temp. sensor deviation high | boolean | | | | alarm system | optional |
| 15832 | 2 | system alarm | main bearing 2 temp. sensor deviation high | boolean | | | | alarm system | optional |
| 15832 | 3 | system alarm | main bearing 3 temp. sensor deviation high | boolean | | | | alarm system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15832 | 4 | system alarm | main bearing 4 temp. sensor deviation high | boolean | | | | alarm system | optional |
| 15832 | 5 | system alarm | main bearing 5 temp. sensor deviation high | boolean | | | | alarm system | optional |
| 15832 | 6 | system alarm | main bearing 6 temp. sensor deviation high | boolean | | | | alarm system | optional |
| 15832 | 7 | system alarm | main bearing 7 temp. sensor deviation high | boolean | | | | alarm system | optional |
| 15832 | 8 | system alarm | main bearing 8 temp. sensor deviation high | boolean | | | | alarm system | optional |
| 15832 | 9 | system alarm | main bearing 9 temp. sensor deviation high | boolean | | | | alarm system | optional |
| 15832 | 10 | system alarm | main bearing 10 temp. sensor deviation high | boolean | | | | alarm system | optional |
| 15832 | 11 | system alarm | main bearing 11 temp. sensor deviation high | boolean | | | | alarm system | optional |
| 15832 | 12 | system alarm | flange bearing CGDS temp. sensor deviation high | boolean | | | | alarm system | optional |
| common alarms of safety system | | | | | | | | | |
| 15836 | 12 | notice | service function active | boolean | | | | alarm or safety system | optional |
| 15837 | 0 | system alarm | collective auto shutdown active | boolean | | | | alarm or safety system | class relevant, collective signal |
| 15837 | 1 | system alarm | collective load reduction active | boolean | | | | safety system | class relevant, collective signal |
| 15837 | 5 | manual emergency stop | manual emergency stop from external active | boolean | | | | safety system | optional, single channel (175D only) |
| shutdowns | | | | | | | | | |
| 15839 | 0 | auto shutdown-1 | lube oil pressure engine inlet low | boolean | | | | safety system | optional |
| 15839 | 7 | auto shutdown-1 | HTCW temp. cylinder cooling outlet high | boolean | | | | safety system | optional |
| 15839 | 9 | auto shutdown | collective main bearing temp high | boolean | | | | safety system | optional, collective signal |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15839 | 10 | auto shutdown | collective splash-oil temp compartment high | boolean | | | | safety system | optional, collective signal |
| 15839 | 11 | auto shutdown | collective splash-oil temp mean value deviation high | boolean | | | | safety system | optional, collective signal |
| 15840 | 0 | auto emergency stop-1 | engine overspeed active | boolean | | | | safety system | optional |
| 15840 | 2 | auto shutdown | gear lube oil pressure low low | boolean | | | | safety system | optional |
| 15840 | 7 | auto emergency stop-2 | engine overspeed active | boolean | | | | alarm system | optional |
| 15841 | 7 | auto shutdown | engine torque relative deviation internal/ measured high1 | boolean | | | | safety system | optional |
| 15842 | 0 | auto shutdown-1 | auto shutdown from external ch.1 active | boolean | | | | safety system | optional |
| 15843 | 3 | auto shutdown | generator NDE bearing temp high | boolean | | | | safety system | optional |
| 15843 | 4 | auto shutdown | generator DE bearing temp high | boolean | | | | safety system | optional |
| 15843 | 5 | auto shutdown | generator winding L1 temp high | boolean | | | | safety system | optional |
| 15843 | 6 | auto shutdown | generator winding L2 temp high | boolean | | | | safety system | optional |
| 15843 | 7 | auto shutdown | generator winding L3 temp high | boolean | | | | safety system | optional |
| load reductions | | | | | | | | | |
| 15847 | 0 | load reduction request | HTCW pressure cylinder cooling inlet low | boolean | | | | safety system | (either – or) |
| 15847 | 0 | auto slowdown | HTCW pressure cylinder cooling inlet low | boolean | | | | safety system | |
| 15847 | 1 | load reduction request | lube oil pressure engine inlet low | boolean | | | | safety system | (either – or) |
| 15847 | 1 | auto slowdown | lube oil pressure engine inlet low | boolean | | | | safety system | |
| 15847 | 2 | load reduction request | HTCW temp cylinder cooling outlet high | boolean | | | | safety system | (either – or) |
| 15847 | 2 | auto slowdown | HTCW temp cylinder cooling outlet high | boolean | | | | safety system | |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15847 | 3 | load reduction request | lube oil temp engine inlet high | boolean | | | | safety system | (either – or) |
| 15847 | 3 | auto slowdown | lube oil temp engine inlet high | boolean | | | | safety system | |
| 15847 | 4 | load reduction request | turbocharger A speed high | boolean | | | | safety system | (either – or) |
| 15847 | 4 | auto slowdown | turbocharger A speed high | boolean | | | | safety system | |
| 15847 | 5 | load reduction request | gear lube oil temp. high | boolean | | | | safety system | optional, derived from analogue or binary signal |
| 15847 | 6 | load reduction request | gear thrust bearing temp. high | boolean | | | | safety system | optional, derived from analogue or binary signal |
| 15847 | 7 | load reduction request | common exhaust gas temp cylinder outlet high | boolean | | | | safety system | collective signal, optional (either – or) |
| 15847 | 7 | auto slowdown | common exhaust gas temp cylinder outlet high | boolean | | | | safety system | |
| 15847 | 8 | load reduction request | common exhaust gas temp cylinder outlet mean value deviation high | boolean | | | | safety system | collective signal, optional (either – or) |
| 15847 | 8 | auto slowdown | common exhaust gas temp cylinder outlet mean value deviation high | boolean | | | | safety system | |
| 15848 | 5 | load reduction request | gear lube oil pressure low | boolean | | | | safety system | (either – or) |
| 15848 | 5 | auto slowdown | gear lube oil pressure low | boolean | | | | safety system | |
| 15848 | 8 | load reduction request | fuel oil common rail pressure limiting valve open<br>– or -<br>fuel oil common rail pressure limiting valve A open | boolean | | | | safety system | (either – or) |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15848 | 8 | auto slowdown | fuel oil common rail pressure limiting valve open – or - fuel oil common rail pressure limiting valve A open | boolean | | | | safety system | |
| 15848 | 9 | load reduction request | fuel oil common rail pressure limiting valve B open | boolean | | | | safety system | (either – or) |
| 15848 | 9 | auto slowdown | fuel oil common rail pressure limiting valve B open | boolean | | | | safety system | |
| 15848 | 10 | load reduction request | turbocharger B speed high | boolean | | | | safety system | (either – or) |
| 15848 | 10 | auto slowdown | turbocharger B speed high | boolean | | | | safety system | |
| 15849 | 2 | load reduction request | generator lube oil pressure DE bearing low | boolean | | | | safety system | (either – or) |
| 15849 | 2 | auto slowdown | generator lube oil pressure DE bearing low | boolean | | | | safety system | |
| 15849 | 3 | load reduction request | generator lube oil pressure NDE bearing low | boolean | | | | safety system | (either – or) |
| 15849 | 3 | auto slowdown | generator lube oil pressure NDE bearing low | boolean | | | | safety system | |
| 15849 | 11 | load reduction request | charge air temp engine inlet row A high | boolean | | | | safety system | (either – or) |
| 15849 | 11 | auto slowdown | charge air temp engine inlet row A high | boolean | | | | safety system | |
| 15849 | 12 | load reduction request | charge air temp engine inlet row B high | boolean | | | | safety system | (either – or) |
| 15849 | 12 | auto slowdown | charge air temp engine inlet row B high | boolean | | | | safety system | |
| auto disengage | | | | | | | | | |
| 15852 | 0 | auto disengage | clutch medium pressure low | boolean | | | | safety system | optional |
| auto shutdown | | | | | | | | | |
| 15853 | 1 | auto shutdown-2 | lube oil pressure engine inlet low | boolean | | | | safety system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15853 | 5 | auto shutdown-2 | HTCW temp. cylinder cooling outlet high | boolean | | | | safety system | optional |
| 15853 | 11 | auto shutdown-2 | auto shutdown from external ch.2 active | boolean | | | | safety system | optional |
| system errors of safety system | | | | | | | | | |
| 15854 | 7 | system alarm | gear lube oil pressure low low switch wire break | boolean | | | | safety system | optional |
| system errors of alarm system | | | | | | | | | |
| 15856 | 0 | system alarm | collective system alarm from alarm system active | boolean | | | | alarm system | class relevant, collective signal |
| 15856 | 9 | system alarm | starter battery charging failure | boolean | | | | alarm system | optional |
| 15856 | 15 | system alarm | pump control common failure | boolean | | | | alarm system | |
| 15857 | 10 | information | HTCW heat recovery release off | boolean | | | | alarm system | optional |
| 15857 | 13 | system alarm | generator actual power signal failure | boolean | | | | alarm system | optional |
| 15860 | 10 | system alarm | waste gate row A failure | boolean | | | | alarm system | optional |
| 15860 | 11 | system alarm | waste gate row B failure | boolean | | | | alarm system | optional |
| 15860 | 14 | system alarm | SCR control CAN4 communication failure | boolean | | | | alarm system | optional |
| 15861 | 0 | alarm | collective pre-alarm active | boolean | | | | alarm system | optional, collective signal |
| 15861 | 2 | status information | modbus transmit toggle bit (live-bit) | boolean | | | | alarm system | class relevant, toggle bit, alternating every 5s |
| 15861 | 3 | alarm | collective pre-alarm of load reduction signals | boolean | | | | alarm system | optional, load reduction imminent; collective signal |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15861 | 4 | alarm | collective pre-alarm of shutdown signals | boolean | | | | alarm system | optional, auto shut-down imminent; collective signal |
| alarms | | | | | | | | | |
| 15862 | 4 | alarm | LTCW pressure CA cooler inlet low | boolean | | | | alarm system | optional |
| 15862 | 5 | alarm | fuel oil pressure engine inlet low | boolean | | | | Alarm system | class relevant |
| 15862 | 6 | alarm | start air pressure low | boolean | | | | alarm system | class relevant |
| 15863 | 0 | alarm | fuel oil temps engine inlet high | Boolean | | | | alarm system | optional |
| 15864 | 1 | alarm | LTCW temp. charge air cooler inlet high | boolean | | | | alarm system | optional |
| 15864 | 6 | alarm | lube oil filter on engine diff. pressure high | boolean | | | | alarm system | class relevant |
| 15865 | 1 | alarm | seawater pressure low | boolean | | | | Alarm system | optional |
| 15865 | 3 | alarm | lube oil level oil pan low | boolean | | | | alarm system | optional |
| 15865 | 5 | alarm | crankcase press. high | boolean | | | | alarm system | class relevant |
| 15867 | 6 | alarm | charge air temp engine inlet row A low | boolean | | | | alarm system | optional |
| 15867 | 14 | alarm | charge air temp engine inlet row B low | boolean | | | | alarm system | optional |
| 15867 | 15 | alarm | fuel oil filter on engine diff. pressure high | boolean | | | | alarm system | optional |
| system errors of speed control | | | | | | | | | |
| 15870 | 10 | system alarm | crankshaft position not synchronised {ecu_bmk} {module_type_name} {ecu_address} | boolean | | | | speed control | |
| 15870 | 11 | system alarm | crankshaft position not synchronised {ecu_bmk} {module_type_name} {ecu_address} | boolean | | | | speed control | |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| engine start failures/blockings | | | | | | | | | |
| 15872 | 8 | start blocking | auto shutdown from external active | boolean | | | | alarm system | optional |
| 15873 | 4 | start blocking | turning gear not disengaged | boolean | | | | alarm system | class relevant |
| 15873 | 6 | start blocking | engine stop sequence not completed | boolean | | | | alarm system | optional |
| 15873 | 7 | start blocking | collective auto shutdown active | boolean | | | | alarm system | optional, auto shutdown or emergency stop not yet reset |
| 15873 | 9 | start blocking | engine start failure not acknowledged | boolean | | | | alarm system | optional |
| 15873 | 13 | start failure | engine pre-lubrication pressure not sufficient | boolean | | | | alarm system | optional |
| 15873 | 15 | start blocking | start air pressure low | boolean | | | | alarm system | optional |
| 15874 | 0 | start failure | ignition speed not reached | boolean | | | | alarm system | optional |
| 15874 | 1 | start failure | engine minimum speed not reached | boolean | | | | alarm system | optional |
| 15874 | 5 | start failure | emergency stop test failed | boolean | | | | alarm system | class relevant |
| 15874 | 9 | start failure | gear lube oil pressure not sufficient | boolean | | | | alarm system | optional |
| 15875 | 0 | start blocking | electric engine starter protection active | boolean | | | | alarm system | optional |
| 15875 | 2 | start blocking | fuel oil pressure engine inlet low | boolean | | | | alarm system | optional |
| 15875 | 3 | start blocking | gear shaft brake active | boolean | | | | alarm system | optional |
| 15875 | 4 | start blocking | engine start release from external not available | boolean | | | | alarm system | optional |
| 15875 | 7 | start blocking | clutch engaged | boolean | | | | alarm system | optional |
| 15875 | 12 | start failure | turning gear not disengaged | boolean | | | | alarm system | class relevant |
| engine status information | | | | | | | | | |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15876 | 2 | status information | engine starting | boolean | | | | alarm system | optional |
| 15876 | 3 | status information | engine running | boolean | | | | alarm system | optional |
| 15876 | 4 | status information | engine stopped | boolean | | | | alarm system | |
| 15876 | 6 | status information | engine emergency start detected | boolean | | | | alarm system | |
| 15876 | 8 | status information | remote control not active | boolean | | | | alarm system | |
| 15876 | 14 | status information | engine start possible | boolean | | | | alarm system | optional |
| 15877 | 0 | status information | engine pre-lubrication pressure sufficient | boolean | | | | alarm system | optional |
| 15879 | 1 | control command | HTCW pre-heating on request | boolean | | | | alarm system | optional |
| 15879 | 14 | control command | engine pre-lubrication pump on-request | boolean | | | | alarm system | optional |
| 15881 | 15 | operating value | external operating rights active | boolean | | | | alarm system | |
| 15882 | 14 | control command | lube oil pre-heating request | boolean | | | | alarm system | |
| 15887 | 5 | status information | engine at standstill | boolean | 1 | | | alarm system | optional |
| 15887 | 7 | status information | HTCW heat recovery release active | boolean | 1 | | | alarm system | optional |
| 15887 | 8 | status information | LTCW pre-heating on-request | boolean | 1 | | | alarm system | optional |
| 15887 | 10 | status information | collective start blocking active | boolean | 1 | | | alarm system | optional, collective signal |
| 15888 | 1 | status information | extended engine performance map active | boolean | | | | alarm system | optional |
| safety system status information | | | | | | | | | |
| 15889 | 2 | status information | battle override active | boolean | | | | safety system | optional |
| 15889 | 4 | status information | override crankcase monitoring active | boolean | | | | safety system | optional, LR classification only |
| shutdown signals and emergency stops | | | | | | | | | |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15890 | 11 | auto emergency stop-2 | emergency stop from external ch.2 active | boolean | | | | safety system | optional |
| 15890 | 12 | auto shutdown | generator lube oil pressure DE bearing low | boolean | | | | safety system | optional |
| 15890 | 13 | auto shutdown | generator lube oil pressure NDE bearing low | boolean | | | | safety system | optional |
| 15891 | 8 | manual emergency stop-1 | collective manual emergency stop active | boolean | | | | safety system | class relevant |
| 15891 | 9 | manual emergency stop-2 | collective manual emergency stop active | boolean | | | | safety system | class relevant |
| 15891 | 10 | auto shutdown-1 | SaCoS module configuration deviation | boolean | | | | safety system | |
| 15891 | 11 | auto shutdown-2 | SaCoS module configuration deviation | boolean | | | | safety system | |
| 15891 | 12 | auto shutdown | engine stop monitoring failure | boolean | | | | safety system | |
| 15891 | 15 | auto shutdown | number of faulty cylinders high | boolean | | | | safety system | optional |
| shutdowns | | | | | | | | | |
| 15908 | 1 | auto shutdown | engine running phase plausibility failure | boolean | | | | safety system | |
| 15908 | 2 | auto shutdown | engine common phase plausibility failure | boolean | | | | safety system | |
| 15909 | 13 | auto shutdown | crankcase pressure high | boolean | | | | safety system | optional |
| 15910 | 2 | auto shutdown | crankcase pressure total loss of signals | boolean | | | | safety system | optional |
| 15910 | 4 | auto shutdown | crankcase pressure gradient high | boolean | | | | safety system | optional |
| 15911 | 5 | auto shutdown | reset blocking of activated external auto shutdown | boolean | | | | safety system | |
| 15911 | 6 | auto shutdown | reset blocking of activated internal auto shutdown | boolean | | | | safety system | |
| 15911 | 7 | auto emergency stop | reset blocking of activated external emergency stop | boolean | | | | safety system | |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15911 | 8 | auto emergency stop | reset blocking of activated internal emergency stop | boolean | | | | safety system | |
| engine load, lambda control | | | | | | | | | |
| 15912 | 1 | alarm | engine power relative low | boolean | | | | alarm system | optional |
| 15912 | 2 | alarm | engine power relative high | boolean | | | | alarm system | optional |
| 15914 | 11 | alarm | charge air pressure engine inlet setpoint deviation high | boolean | | | | alarm system | |
| 15914 | 13 | alarm | lambda control row A setpoint determination failure | boolean | | | | alarm system | |
| 15914 | 14 | alarm | lambda control row B setpoint determination failure | boolean | | | | alarm system | |
| 15918 | 2 | auto shutdown | exhaust gas temp. mean value row A to B deviation high | boolean | | | | safety system | optional |
| battery | | | | | | | | | |
| 15921 | 0 | system alarm | starter battery charging active input signal failure | boolean | | | | alarm system | optional |
| generator cooling water pump | | | | | | | | | |
| 15922 | 8 | system alarm | generator cooling water pump control common failure active | boolean | | | | alarm system | optional |
| fuel oil injection release | | | | | | | | | |
| 15925 | 12 | status information | engine start: **fuel oil injection release** active | boolean | 1 | | | IM | |
| cylinder individual fuel oil CR alarms (row A) | | | | | | | | | |
| 15927 | 0 | system alarm | fuel oil injection valve cylinder A1 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15927 | 1 | system alarm | fuel oil injection valve cylinder A2 failure | boolean | | | | IM | optional, fuel oil injection valve |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15927 | 2 | system alarm | fuel oil injection valve cylinder A3 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15927 | 3 | system alarm | fuel oil injection valve cylinder A4 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15927 | 4 | system alarm | fuel oil injection valve cylinder A5 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15927 | 5 | system alarm | fuel oil injection valve cylinder A6 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15927 | 6 | system alarm | fuel oil injection valve cylinder A7 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15927 | 7 | system alarm | fuel oil injection valve cylinder A8 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15927 | 8 | system alarm | fuel oil injection valve cylinder A9 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15927 | 9 | system alarm | fuel oil injection valve cylinder A10 failure | boolean | | | | IM | optional, fuel oil injection valve |
| cylinder individual fuel oil CR alarms (row B) | | | | | | | | | |
| 15928 | 0 | system alarm | fuel oil injection valve cylinder B1 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15928 | 1 | system alarm | fuel oil injection valve cylinder B2 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15928 | 2 | system alarm | fuel oil injection valve cylinder B3 failure | boolean | | | | IM | optional, fuel oil injection valve |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15928 | 3 | system alarm | fuel oil injection valve cylinder B4 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15928 | 4 | system alarm | fuel oil injection valve cylinder B5 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15928 | 5 | system alarm | fuel oil injection valve cylinder B6 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15928 | 6 | system alarm | fuel oil injection valve cylinder B7 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15928 | 7 | system alarm | fuel oil injection valve cylinder B8 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15928 | 8 | system alarm | fuel oil injection valve cylinder B9 failure | boolean | | | | IM | optional, fuel oil injection valve |
| 15928 | 9 | system alarm | fuel oil injection valve cylinder B10 failure | boolean | | | | IM | optional, fuel oil injection valve |
| IM.1 CR common alarms of all IMs | | | | | | | | | |
| 15932 | 7 | alarm | IM.1 module temp. high | boolean | | | | IM.1 | optional |
| 15932 | 12 | auto emergency stop | engine overspeed detected by IM.1 active | boolean | | | | IM.1 | optional |
| IM.1/2 CR common alarms of all IMs, 1x per engine | | | | | | | | | |
| 15934 | 0 | system alarm | fuel oil common rail pressure-1 signal failure | boolean | | | | IM | single: IM/1, redundant: IM/1 |
| 15934 | 0 | system alarm | fuel oil common rail A pressure-1 signal failure | boolean | | | | IM | single: IM/1, redundant: IM/1 |
| 15934 | 3 | system alarm | fuel oil common rail pressure setpoint deviation high | boolean | | | | IM | optional, single: IM/1, redundant: IM/1,2 |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15934 | 3 | system alarm | fuel oil common rail A pressure setpoint deviation high | boolean | | | | IM | optional, single: IM/1, redundant: IM/1,2 |
| 15934 | 8 | system alarm | fuel oil common rail B pressure-1 signal failure | boolean | | | | IM | single: IM/1, redundant: IM/1 |
| 15934 | 11 | system alarm | fuel oil common rail B pressure setpoint deviation high | boolean | | | | IM | optional, single: IM/1, redundant: IM/1,2 |
| IM.1 collective alarms | | | | | | | | | |
| 15936 | 0 | alarm | HW analogue input: generator load signale failure | boolean | | | | IM.1 | |
| 15936 | 1 | system alarm | engine speed analog setpoint IM.1 input signal failure | boolean | | | | IM.1 | |
| 15937 | 14 | status information | fuel index turbocharger speed limiter active IM.1 | boolean | | | | IM | |
| 15938 | 8 | system alarm | crankshaft position not synchronised IM.1 | boolean | | | | IM.1 | |
| 15938 | 9 | start failure | crankshaft position not synchronised IM.1 | boolean | | | | IM.1 | optional |
| 15938 | 10 | auto shutdown | crankshaft position not synchronised IM.1 | boolean | | | | IM.1 | |
| CR common alarms | | | | | | | | | |
| 15942 | 1 | alarm | fuel oil common rail pressure limiting valve open (rail pressure gradient based) | boolean | | | | alarm system | optional |
| 15942 | 1 | alarm | fuel oil common rail pressure limiting valve row A open (rail pressure gradient based) | boolean | | | | alarm system | optional |
| 15942 | 2 | alarm | fuel oil common rail pressure limiting valve row B open (rail pressure gradient based) | boolean | | | | alarm system | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 15942 | 9 | alarm | fuel oil break leakage high-pressure pipe high | boolean | | | | alarm system | optional, CR and conv. injection |
| 15944 | 2 | alarm | fuel oil common rail PLV opening failure | boolean | | | | alarm system | optional |
| 15944 | 2 | alarm | fuel oil common rail PLV A opening failure | boolean | | | | alarm system | optional |
| 15944 | 3 | alarm | fuel oil common rail PLV max. duration in open state exceeded | boolean | | | | alarm system | optional |
| 15944 | 4 | alarm | fuel oil common rail PLV max. number of opening cycles exceeded | boolean | | | | alarm system | optional |
| 15944 | 5 | alarm | fuel oil common rail PLV opened too early | boolean | | | | alarm system | optional |
| 15944 | 5 | alarm | fuel oil common rail PLV A opened too early | boolean | | | | alarm system | optional |
| 15944 | 6 | alarm | fuel oil common rail PLV open during engine start | boolean | | | | alarm system | optional |
| 15944 | 6 | alarm | fuel oil common rail PLV A open during engine start | boolean | | | | alarm system | optional |
| 15944 | 8 | alarm | fuel oil common rail PLV B opening failure | boolean | | | | alarm system | optional |
| 15944 | 11 | alarm | fuel oil common rail PLV B opened too early | boolean | | | | alarm system | optional |
| 15944 | 12 | alarm | fuel oil common rail PLV B open during engine start | boolean | | | | alarm system | optional |
| IM.1/2 values | | | | | | | | | |
| 16236 | - | operating value | fuel oil injection begin cylinder A1 | °BTDC | 0.01 | 0 | 5000 | | |
| 16237 | - | operating value | fuel oil injection begin cylinder A2 | °BTDC | 0.01 | 0 | 5000 | | |
| 16238 | - | operating value | fuel oil injection begin cylinder A3 | °BTDC | 0.01 | 0 | 5000 | | |
| 16239 | - | operating value | fuel oil injection begin cylinder A4 | °BTDC | 0.01 | 0 | 5000 | | |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16240 | - | operating value | fuel oil injection begin cylinder A5 | °BTDC | 0.01 | 0 | 5000 | | |
| 16241 | - | operating value | fuel oil injection begin cylinder A6 | °BTDC | 0.01 | 0 | 5000 | | |
| 16242 | - | operating value | fuel oil injection begin cylinder A7 | °BTDC | 0.01 | 0 | 5000 | | |
| 16243 | - | operating value | fuel oil injection begin cylinder A8 | °BTDC | 0.01 | 0 | 5000 | | |
| 16244 | - | operating value | fuel oil injection begin cylinder A9 | °BTDC | 0.01 | 0 | 5000 | | |
| 16245 | - | operating value | fuel oil injection begin cylinder A10 | °BTDC | 0.01 | 0 | 5000 | | |
| 16253 | - | operating value | fuel oil injection duration cylinder A1 | ms | 0.01 | 0 | 2000 | | |
| 16254 | - | operating value | fuel oil injection duration cylinder A2 | ms | 0.01 | 0 | 2000 | | |
| 16255 | - | operating value | fuel oil injection duration cylinder A3 | ms | 0.01 | 0 | 2000 | | |
| 16256 | - | operating value | fuel oil injection duration cylinder A4 | ms | 0.01 | 0 | 2000 | | |
| 16257 | - | operating value | fuel oil injection duration cylinder A5 | ms | 0.01 | 0 | 2000 | | |
| 16258 | - | operating value | fuel oil injection duration cylinder A6 | ms | 0.01 | 0 | 2000 | | |
| 16259 | - | operating value | fuel oil injection duration cylinder A7 | ms | 0.01 | 0 | 2000 | | |
| 16260 | - | operating value | fuel oil injection duration cylinder A8 | ms | 0.01 | 0 | 2000 | | |
| 16261 | - | operating value | fuel oil injection duration cylinder A9 | ms | 0.01 | 0 | 2000 | | |
| 16262 | - | operating value | fuel oil injection duration cylinder A10 | ms | 0.01 | 0 | 2000 | | |
| 16266 | - | operating value | engine power relative | % | 0.1 | 0 | 1100 | | optional |
| 16268 | - | operating value | fuel quantity unlimited | % | 0.1 | 0 | 1000 | | optional, PID unlimited |
| 16269 | 1 | system alarm | fuel adaption at limit | boolean | | | | alarm system | optional |
| 16270 | - | operating value | fuel oil injection begin cylinder B1 | °BTDC | 0.01 | 0 | 5000 | | |
| 16271 | - | operating value | fuel oil injection begin cylinder B2 | °BTDC | 0.01 | 0 | 5000 | | |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16272 | - | operating value | fuel oil injection begin cylinder B3 | °BTDC | 0.01 | 0 | 5000 | | |
| 16273 | - | operating value | fuel oil injection begin cylinder B4 | °BTDC | 0.01 | 0 | 5000 | | |
| 16274 | - | operating value | fuel oil injection begin cylinder B5 | °BTDC | 0.01 | 0 | 5000 | | |
| 16275 | - | operating value | fuel oil injection begin cylinder B6 | °BTDC | 0.01 | 0 | 5000 | | |
| 16276 | - | operating value | fuel oil injection begin cylinder B7 | °BTDC | 0.01 | 0 | 5000 | | |
| 16277 | - | operating value | fuel oil injection begin cylinder B8 | °BTDC | 0.01 | 0 | 5000 | | |
| 16278 | - | operating value | fuel oil injection begin cylinder B9 | °BTDC | 0.01 | 0 | 5000 | | |
| 16279 | - | operating value | fuel oil injection begin cylinder B10 | °BTDC | 0.01 | 0 | 5000 | | |
| 16280 | - | operating value | fuel oil pre-injection begin | °ca | 0.01 | 100 | 2000 | | |
| 16282 | - | operating value | fuel oil pre-injection duration | ms | 0.1 | 0 | 100 | | |
| 16284 | - | operating value | ambient air pressure IM.1 | mbar abs | 1 | 0 | 1200 | | optional, from IM/1 onboard pressure transmitter |
| 16287 | - | operating value | fuel oil injection duration cylinder B1 | ms | 0.01 | 0 | 2000 | | |
| 16288 | - | operating value | fuel oil injection duration cylinder B2 | ms | 0.01 | 0 | 2000 | | |
| 16289 | - | operating value | fuel oil injection duration cylinder B3 | ms | 0.01 | 0 | 2000 | | |
| 16290 | - | operating value | fuel oil injection duration cylinder B4 | ms | 0.01 | 0 | 2000 | | |
| 16291 | - | operating value | fuel oil injection duration cylinder B5 | ms | 0.01 | 0 | 2000 | | |
| 16292 | - | operating value | fuel oil injection duration cylinder B6 | ms | 0.01 | 0 | 2000 | | |
| 16293 | - | operating value | fuel oil injection duration cylinder B7 | ms | 0.01 | 0 | 2000 | | |
| 16294 | - | operating value | fuel oil injection duration cylinder B8 | ms | 0.01 | 0 | 2000 | | |
| 16295 | - | operating value | fuel oil injection duration cylinder B9 | ms | 0.01 | 0 | 2000 | | |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16296 | - | operating value | fuel oil injection duration cylinder B10 | ms | 0.01 | 0 | 2000 | | |
| 16297 | - | operating value | fuel oil post-injection begin | °BTDC | 0.01 | 100 | 2000 | | offset from main injection begin |
| 16298 | - | operating value | fuel oil post-injection duration row A | ms | 0.1 | 0 | 100 | | |
| 16299 | - | operating value | fuel oil post-injection duration row B | ms | 0.1 | 0 | 100 | | |
| miscellaneous values | | | | | | | | | |
| 16304 | - | operating value | generator cooling water inlet temp. | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |
| 16305 | - | operating value | generator cooling water outlet temp. | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |
| 16306 | - | operating value | generator cooling air inlet temp | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |
| 16307 | - | operating value | generator cooling air outlet temp | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | optional |
| 16310 | - | operating value | gear stern tube bearing temp. | Temp. (abs) °C | 0.01 | 0 | 12000 | alarm system | |
| miscellaneous values | | | | | | | | | |
| 16312 | - | operating value | turbocharger A2 speed-1 | rpm | 10 | 0 | 8000 | alarm system | optional |
| 16313 | - | operating value | turbocharger B2 speed-1 | rpm | 10 | 0 | 8000 | alarm system | optional |
| 16314 | - | operating value | generator lube oil pressure DE bearing | pressure (bar) | 0.01 | 0 | 1000 | alarm system | optional |
| 16315 | - | operating value | generator lube oil pressure NDE bearing | pressure (bar) | 0.01 | 0 | 1000 | alarm system | optional |
| miscellaneous system alarms | | | | | | | | | |
| 16320 | 0 | system alarm | generator cooling water inlet temp. signal failure | boolean | | | | alarm system | optional |
| 16320 | 1 | system alarm | generator cooling water outlet temp. signal failure | boolean | | | | alarm system | optional |
| 16320 | 2 | system alarm | generator cooling air inlet temp. signal failure | boolean | | | | alarm system | optional |
| 16320 | 3 | system alarm | generator cooling air outlet temp. signal failure | boolean | | | | alarm system | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16320 | 6 | system alarm | gear stern tube bearing temp. signal failure | boolean | | | | alarm system | |
| 16320 | 8 | system alarm | turbocharger A2 speed-1 signal failure | boolean | | | | safety system | optional |
| 16320 | 9 | system alarm | turbocharger B2 speed-1 signal failure | boolean | | | | safety system | optional |
| 16320 | 10 | system alarm | generator lube oil pressure DE bearing-1 signal failure | boolean | | | | alarm system | optional |
| 16320 | 11 | system alarm | generator lube oil pressure NDE bearing-1 signal failure | boolean | | | | alarm system | optional |
| miscellaneous values | | | | | | | | | |
| 16322 | - | operating value | fuel oil quantity | mm³/str | 1 | 0 | 30000 | | |
| 16325 | - | operating value | fuel oil main injection begin basic | °BTDC | 0.1 | 0 | 5000 | | |
| 16326 | - | operating value | pickup adjustment TDC offset | °ca | 0.01 | -250 | 250 | | |
| 16327 | - | operating value | fuel oil common rail pressure-1 | bar | 1 | 0 | 3000 | | |
| 16327 | - | operating value | fuel oil common rail A pressure-1 | bar | 1 | 0 | 3000 | | |
| 16328 | - | operating value | fuel oil common rail B pressure-1 | bar | 1 | 0 | 3000 | | |
| 16329 | - | operating value | fuel oil common rail pressure setpoint | bar | 1 | 0 | 3000 | | |
| 16329 | - | operating value | fuel oil common rail A pressure setpoint | bar | 1 | 0 | 3000 | | |
| 16330 | - | operating value | fuel oil common rail A suction throttle pos. setpoint | % | 0.1 | 0 | 1000 | | |
| 16331 | - | operating value | fuel oil common rail B suction throttle pos. setpoint | % | 0.1 | 0 | 1000 | | |
| 16332 | - | operating value | fuel oil common rail B pressure setpoint | bar | 1 | 0 | 3000 | | optional |
| 16337 | 6 | alarm | fuel oil common rail pressure total loss of signals | | | | | | |
| valves and flaps | | | | | | | | | |
| 16355 | - | operating value | waste gate row A position | % | 0.1 | 0 | 1000 | alarm system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16356 | - | operating value | waste gate row B position | % | 0.1 | 0 | 1000 | alarm system | optional |
| 16370 | 0 | system alarm | waste gate row A position setpoint deviation high | boolean | | | | alarm system | optional |
| 16370 | 1 | system alarm | waste gate row B position setpoint deviation high | boolean | | | | alarm system | optional |
| alarms | | | | | | | | | |
| 16517 | 0 | alarm | generator cooling water inlet temp. high | boolean | | | | alarm system | class relevant |
| 16517 | 1 | alarm | generator cooling water outlet temp. high | boolean | | | | alarm system | class relevant |
| 16517 | 2 | alarm | generator cooling air inlet temp. high | boolean | | | | alarm system | class relevant |
| 16517 | 3 | alarm | generator cooling air outlet temp. high | boolean | | | | alarm system | class relevant |
| 16517 | 6 | alarm | fuel oil pump protection filter diff. pressure high | boolean | | | | alarm system | optional |
| 16517 | 8 | alarm | fuel oil plant filter diff. pressure high | boolean | | | | alarm system | optional |
| 16517 | 9 | alarm | fuel oil water separator diff. pressure high | boolean | | | | alarm system | optional |
| 16517 | 12 | alarm | generator cooling water leakage high | boolean | | | | alarm system | optional |
| 16518 | 15 | alarm | generator cooling water flow low | boolean | | | | alarm system | optional |
| 16519 | 8 | system alarm | continuous charge air deficiency (diesel mode) | boolean | | | | alarm system | optional |
| 16519 | 11 | system alarm | engine emergency start detected | boolean | | | | alarm system | |
| 16519 | 12 | alarm | engine stall detected | boolean | | | | alarm system | |
| input external systems → SaCoS - binary signals | | | | | | | | | |
| 16593 | 3 | binary input bus signal | external engine start request | boolean | 1 | | | alarm system | optional |
| 16593 | 4 | binary input bus signal | external engine stop request | boolean | 1 | | | alarm system | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16593 | 5 | binary input bus signal | external acknowledge/reset request | boolean | 1 | | | alarm system | optional |
| 16593 | 14 | binary input bus signal | modbus receive toggle bit | boolean | 1 | | | alarm system | optional, toggle bit, alternating every 2 s |
| status information | | | | | | | | | |
| 16595 | 0 | status information | fuel oil common rail PLV A open | boolean | 1 | | | alarm system | |
| 16595 | 0 | status information | fuel oil common rail PLV open | boolean | 1 | | | alarm system | |
| 16595 | 1 | status information | fuel oil common rail PLV B open | boolean | 1 | | | alarm system | |
| alarms | | | | | | | | | |
| 16597 | 1 | alarm | charge air pressure engine inlet row B high | boolean | | | | alarm system | optional |
| 16597 | 3 | alarm | HTCW level expansion tank low | boolean | | | | alarm system | optional |
| 16597 | 4 | alarm | LTCW level expansion tank low | boolean | | | | alarm system | optional |
| 16597 | 5 | alarm | water level fuel oil water separator 1 high | boolean | | | | alarm system | optional |
| 16597 | 9 | system alarm | Cylinder torque relative deviation internal/ measured high | boolean | | | | alarm system | |
| 16597 | 11 | alarm | charge air temp. cooler A inlet high | boolean | | | | alarm system | optional |
| 16597 | 12 | alarm | intake air temp. IMO limit exceeded | boolean | | | | alarm system | optional |
| 16597 | 15 | alarm | water level fuel oil water separator 2 high | boolean | | | | alarm system | optional |
| system errors of alarm system | | | | | | | | | |
| 16640 | 0 | system alarm | fuel oil injection row A high voltage failure | boolean | | | | alarm or safety system | |
| 16640 | 1 | system alarm | fuel oil injection row B high voltage failure | boolean | | | | alarm or safety system | |
| 16640 | 7 | auto emergency stop | engine speed total loss of signals detected by IM.1 | boolean | | | | alarm or safety system | |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16640 | 13 | system alarm | IM.1 power supply failure | boolean | | | | alarm or safety system | |
| 16640 | 15 | notice | pre-heating required for next engine start | boolean | | | | alarm or safety system | optional |
| 16641 | 2 | operating value | gear lube oil pump on-request | boolean | 1 | | | alarm or safety system | |
| 16641 | 3 | operating value | gear lube oil filter diff. pressure high | boolean | 1 | | | alarm or safety system | optional |
| 16641 | 4 | alarm | gear lube oil level low | boolean | 1 | | | alarm or safety system | optional |
| 16641 | 5 | load reduction request | clutch medium pressure low | boolean | 1 | | | alarm or safety system | optional |
| 16641 | 6 | alarm standby lube oil | clutch medium pressure low | boolean | 1 | | | alarm or safety system | optional |
| 16641 | 7 | operating value | gear output shaft rotation direction ahead active | boolean | 1 | | | alarm or safety system | |
| 16641 | 8 | operating value | clutch ahead valve disengaged position active | boolean | 1 | | | alarm or safety system | |
| 16641 | 9 | operating value | clutch ahead valve engaged position active | boolean | 1 | | | alarm or safety system | |
| 16641 | 10 | operating value | clutch ahead engaged | boolean | 1 | | | alarm or safety system | |
| 16641 | 11 | operating value | clutch astern valve disengaged position active | boolean | 1 | | | alarm or safety system | |
| 16641 | 12 | operating value | clutch astern valve engaged position active | boolean | 1 | | | alarm or safety system | |
| 16641 | 13 | operating value | clutch astern engaged | boolean | 1 | | | alarm or safety system | |
| 16641 | 14 | operating value | clutch ahead engage command | boolean | 1 | | | alarm or safety system | |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16641 | 15 | operating value | clutch ahead disengage command | boolean | 1 | | | alarm or safety system | |
| 16642 | 0 | operating value | clutch astern engage command | boolean | 1 | | | alarm or safety system | |
| 16642 | 1 | operating value | clutch astern disengage command | boolean | 1 | | | alarm or safety system | |
| 16642 | 2 | operating value | clutch ahead engage request from external | boolean | 1 | | | alarm or safety system | |
| 16642 | 3 | operating value | clutch ahead disengage request from external | boolean | 1 | | | alarm or safety system | |
| 16642 | 4 | status information | clutch ahead engaged indication | boolean | 1 | | | alarm or safety system | |
| 16642 | 5 | status information | clutch ahead disengaged | boolean | 1 | | | alarm or safety system | |
| 16642 | 6 | operating value | clutch ahead ready for engaging | boolean | 1 | | | alarm or safety system | |
| 16642 | 7 | operating value | clutch astern engage request from external | boolean | 1 | | | alarm or safety system | |
| 16642 | 8 | operating value | clutch astern disengage request from external | boolean | 1 | | | alarm or safety system | |
| 16642 | 9 | status information | clutch astern engaged indication | boolean | 1 | | | alarm or safety system | |
| 16642 | 10 | status information | clutch astern disengaged | boolean | 1 | | | alarm or safety system | |
| 16642 | 11 | operating value | clutch astern ready for engaging | boolean | 1 | | | alarm or safety system | |
| 16642 | 12 | operating value | manual clutch disengage from external | boolean | 1 | | | alarm or safety system | |
| 16642 | 13 | auto disengage | manual clutch disengage from external active | boolean | 1 | | | alarm or safety system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16643 | 4 | system alarm | ambient air pressure IM.1 signal failure | | 1 | | | | |
| 16643 | 7 | system alarm | air path control - exhaust gas temp. turbocharger inlet control failure | | 1 | | | | optional |
| 16644 | 3 | system alarm | cam index error | | 1 | | | | optional |
| 16646 | 13 | auto emergency stop-1 | emergency stop from external Ch.1 active | | 1 | | | | optional |
| 16646 | 14 | system alarm | emergency stop from external Ch.1 signal failure | | 1 | | | | |
| 16646 | 15 | system alarm | emergency stop from external Ch.2 signal failure | | 1 | | | | |
| 16647 | 5 | system alarm | engine fuel index output signal failure | | 1 | | | | |
| 16647 | 6 | system alarm | engine power relative high | | 1 | | | | optional |
| 16647 | 7 | system alarm | engine pre-lubrication pump on-command output signal failure | | 1 | | | | optional |
| 16647 | 9 | system alarm | engine speed analog setpoint request input signal failure | | 1 | | | | optional |
| 16647 | 10 | system alarm | engine speed droop zero request signal failure | | 1 | | | | optional |
| 16647 | 11 | system alarm | engine speed output signal failure -1 | | 1 | | | | optional |
| 16647 | 13 | system alarm | engine speed setpoint decrease request signal failure IM.1 | | 1 | | | | |
| 16647 | 15 | system alarm | engine speed setpoint increase request signal failure IM.1 | | 1 | | | | |
| 16648 | 2 | system alarm | engine standby subphase plausibility failure | | 1 | | | | optional |
| 16648 | 5 | system alarm | engine start release from external signal failure | | 1 | | | | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16648 | 7 | system alarm | engine start valve open request output signal failure | | 1 | | | | optional |
| 16648 | 9 | system alarm | engine stopping phase plausibility failure | | 1 | | | | optional |
| 16654 | 11 | system alarm | fuel adaption control fuel oil injection valve map at limit | | 1 | | | | |
| 16656 | 7 | system alarm | fuel oil control valve at high limit | | 1 | | | | optional |
| 16656 | 7 | system alarm | fuel oil control valve row A at high limit | | 1 | | | | optional |
| 16656 | 8 | system alarm | fuel oil control valve row B at high limit | | 1 | | | | optional |
| 16656 | 9 | system alarm | fuel oil control valve row B threshold high | | 1 | | | | optional |
| 16656 | 10 | system alarm | fuel oil control valve row B threshold low | | 1 | | | | optional |
| 16656 | 11 | system alarm | fuel oil control valve row A threshold high | | 1 | | | | optional |
| 16656 | 11 | system alarm | fuel oil control valve threshold high | | 1 | | | | optional |
| 16656 | 12 | system alarm | fuel oil control valve row A threshold low | | 1 | | | | optional |
| 16656 | 12 | system alarm | fuel oil control valve threshold low | | 1 | | | | optional |
| 16656 | 13 | system alarm | fuel oil filter on engine diff. press. high input signal failure | | 1 | | | | optional |
| 16659 | 9 | system alarm | HTCW heat recovery release output signal failure | | 1 | | | | optional |
| 16659 | 10 | system alarm | HTCW pre-heating control failure | | 1 | | | | optional |
| 16661 | 11 | system alarm | load reduction request output signal failure | | 1 | | | | optional |
| 16666 | 3 | system alarm | manual emergency stop collector output signal failure | | 1 | | | | |
| 16666 | 4 | system alarm | manual emergency stop collector relay 1 signal failure | | 1 | | | | |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16666 | 5 | system alarm | manual emergency stop collector relay 2 signal failure | | 1 | | | | |
| 16666 | 10 | manual emergency stop | manual emergency stop from LOP Ch.1 active | | 1 | | | | optional |
| 16666 | 11 | manual emergency stop | manual emergency stop from LOP Ch.2 active | | 1 | | | | optional |
| 16666 | 12 | manual emergency stop | manual emergency stop from ROP Ch.1 active | | 1 | | | | optional |
| 16666 | 13 | manual emergency stop | manual emergency stop from ROP Ch.2 active | | 1 | | | | optional |
| 16666 | 14 | system alarm | manual emergency stop from ROP Ch.2 signal failure | | 1 | | | | optional |
| 16666 | 15 | manual emergency stop | manual emergency stop from WH Ch.1 active | | 1 | | | | optional |
| 16667 | 0 | manual emergency stop | manual emergency stop from WH Ch.2 active | | 1 | | | | optional |
| 16667 | 1 | system alarm | manual emergency stop from WH Ch.2 signal failure | | 1 | | | | optional |
| 16668 | 4 | system alarm | override active output signal failure | | 1 | | | | optional |
| 16668 | 5 | system alarm | override crankcase monitoring active output signal failure | | 1 | | | | optional |
| 16668 | 6 | system alarm | override crankcase monitoring from WH active | | 1 | | | | optional |
| 16668 | 7 | system alarm | override crankcase monitoring from WH signal failure | | 1 | | | | optional |
| 16668 | 8 | system alarm | override from WH active | | 1 | | | | optional |
| 16668 | 9 | system alarm | override from WH signal failure | | 1 | | | | optional |
| 16672 | 10 | system alarm | pre-alarm load reduction collector output signal failure | | 1 | | | | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 16672 | 11 | system alarm | pre-alarm safety stop collector output signal failure | | 1 | | | | optional |
| 16673 | 1 | system alarm | selector switch local/ remote control signal failure | | 1 | | | | optional |
| 16675 | 12 | system alarm | turning gear disengaged input signal failure | | 1 | | | | optional |
| 16675 | 13 | system alarm | turning gear not disengaged | | 1 | | | | optional |
| 16677 | 6 | system alarm | manual emergency stop from ROP Ch.1 signal failure | | 1 | | | | optional |
| 16677 | 7 | system alarm | manual emergency stop from WH Ch.1 signal failure | | 1 | | | | optional |
| 16677 | 8 | system alarm | manual emergency stop from LOP Ch.1 signal failure | | 1 | | | | optional |
| 16677 | 9 | system alarm | manual emergency stop from LOP Ch.2 signal failure | | 1 | | | | optional |
| 16682 | 2 | system alarm | fuel oil break leakage high pressure pipe signal failure | | 1 | | | | |
| 16683 | 9 | system alarm | manual emergency stop collector relay 1 deviation | | 1 | | | | optional |
| 16683 | 10 | system alarm | manual emergency stop collector relay 2 deviation | | 1 | | | | optional |
| 16701 | - | operating value | clutch medium pressure | bar | 0.01 | 0 | 10 | alarm or safety system | optional |
| miscellaneous values | | | | | | | | | |
| 32928 | 0 | system alarm | splash-oil temp. compartment 1-1 signal failure | boolean | | | | safety system | optional |
| 32928 | 1 | system alarm | splash-oil temp. compartment 2-1 signal failure | boolean | | | | safety system | optional |
| 32928 | 2 | system alarm | splash-oil temp. compartment 3-1 signal failure | boolean | | | | safety system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 32928 | 3 | system alarm | splash-oil temp. compartment 4-1 signal failure | boolean | | | | safety system | optional |
| 32928 | 4 | system alarm | splash-oil temp. compartment 5-1 signal failure | boolean | | | | safety system | optional |
| 32928 | 5 | system alarm | splash-oil temp. compartment 6-1 signal failure | boolean | | | | safety system | optional |
| 32928 | 6 | system alarm | splash-oil temp. compartment 7-1 signal failure | boolean | | | | safety system | optional |
| 32928 | 7 | system alarm | splash-oil temp. compartment 8-1 signal failure | boolean | | | | safety system | optional |
| 32928 | 8 | system alarm | splash-oil temp. compartment 9-1 signal failure | boolean | | | | safety system | optional |
| 32928 | 9 | system alarm | splash-oil temp. compartment 10-1 signal failure | boolean | | | | safety system | optional |
| 32929 | 0 | system alarm | flange bearing GDS temp. -1 signal failure | boolean | | | | safety system | optional |
| 32929 | 1 | system alarm | main bearing 1 temp.-1 signal failure | boolean | | | | safety system | optional |
| 32929 | 2 | system alarm | main bearing 2 temp.-1 signal failure | boolean | | | | safety system | optional |
| 32929 | 3 | system alarm | main bearing 3 temp.-1 signal failure | boolean | | | | safety system | optional |
| 32929 | 4 | system alarm | main bearing 4 temp.-1 signal failure | boolean | | | | safety system | optional |
| 32929 | 5 | system alarm | main bearing 5 temp.-1 signal failure | boolean | | | | safety system | optional |
| 32929 | 6 | system alarm | main bearing 6 temp.-1 signal failure | boolean | | | | safety system | optional |
| 32929 | 7 | system alarm | main bearing 7 temp.-1 signal failure | boolean | | | | safety system | optional |
| 32929 | 8 | system alarm | main bearing 8 temp.-1 Signal Failure | boolean | | | | safety system | optional |
| 32929 | 9 | system alarm | main bearing 9 temp.-1 signal failure | boolean | | | | safety system | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 32929 | 10 | system alarm | main bearing 10 temp.-1 signal failure | boolean | | | | safety system | optional |
| 32929 | 11 | system alarm | main bearing 11 temp.-1 signal failure | boolean | | | | safety system | optional |
| miscellaneous values | | | | | | | | | |
| 32932 | 0 | system alarm | HTCW pressure cylinder cooling inlet-2 signal failure | boolean | | | | safety system | optional |
| 32932 | 2 | system alarm | Lube Oil pressure engine inlet-2 signal failure | boolean | | | | safety system | optional |
| 32933 | 0 | system alarm | HTCW temp cylinder cooling outlet-2 signal failure | boolean | | | | safety system | optional |
| 32935 | 0 | system alarm | generator lube oil pressure DE bearing-2 signal failure | boolean | | | | safety system | optional |
| 32935 | 1 | system alarm | generator lube oil pressure NDE bearing-2 signal failure | boolean | | | | safety system | optional |
| 32946 | 12 | start blocking-1 | SaCoS module configuration deviation | boolean | | | | safety system | |
| 32946 | 13 | start blocking -2 | SaCoS module configuration deviation | boolean | | | | safety system | |
| 32947 | 0 | start blocking | configuration mode active | boolean | | | | safety system | optional |
| 32947 | 1 | start blocking | engine operating phase plausibility failure | boolean | | | | safety system | |
| 32947 | 3 | start blocking | fuel oil injection test mode active | boolean | | | | safety system | optional |
| 32947 | 4 | start blocking | number of faulty cylinders high | boolean | | | | safety system | optional |
| 32947 | 5 | start blocking | service function active | boolean | | | | safety system | optional |
| 32947 | 6 | start blocking | preparation sequence control communication failure | boolean | | | | safety system | optional |
| 32947 | 8 | start failure | fuel oil common rail start pressure low | boolean | | | | safety system | optional |
| 32947 | 9 | start failure | injection release failure | boolean | | | | safety system | optional |
| 32947 | 10 | start failure | engine starting phase plausibility failure | boolean | | | | safety system | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 32947 | 11 | start failure | engine starting sub-phase plausibility failure | boolean | | | | safety system | optional |
| 32947 | 12 | start failure | engine pre-lubrication failure | boolean | | | | safety system | optional |
| 32948 | 1 | start failure | preparation sequence control communication failure | boolean | | | | safety system | optional |
| operating values exhaust gas temperature | | | | | | | | | |
| 32951 | - | operating value | exhaust gas temp. cylinder A1 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32952 | - | operating value | exhaust gas temp. cylinder A2 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32953 | - | operating value | exhaust gas temp. cylinder A3 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32954 | - | operating value | exhaust gas temp. cylinder A4 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32955 | - | operating value | exhaust gas temp. cylinder A5 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32956 | - | operating value | exhaust gas temp. cylinder A6 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32957 | - | operating value | exhaust gas temp. cylinder A7 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32958 | - | operating value | exhaust gas temp. cylinder A8 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32959 | - | operating value | exhaust gas temp. cylinder A9 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32960 | - | operating value | exhaust gas temp. cylinder A10 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32961 | - | operating value | exhaust gas temp. cylinder B1 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32962 | - | operating value | exhaust gas temp. cylinder B2 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 32963 | - | operating value | exhaust gas temp. cylinder B3 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32964 | - | operating value | exhaust gas temp. cylinder B4 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32965 | - | operating value | exhaust gas temp. cylinder B5 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32966 | - | operating value | exhaust gas temp. cylinder B6 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32967 | - | operating value | exhaust gas temp. cylinder B7 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32968 | - | operating value | exhaust gas temp. cylinder B8 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32969 | - | operating value | exhaust gas temp. cylinder B9 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| 32970 | - | operating value | exhaust gas temp. cylinder B10 outlet mean value deviation | °C | 1 | 0 | 200 | | optional |
| status information of fuel oil injection valve | | | | | | | | | |
| 34301 | - | status information | fuel oil injection valve cylinder A1 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34302 | - | status information | fuel oil injection valve cylinder A1 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34303 | - | status information | fuel oil injection valve cylinder A2 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34304 | - | status information | fuel oil injection valve cylinder A2 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34305 | - | status information | fuel oil injection valve cylinder A3 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34306 | - | status information | fuel oil injection valve cylinder A3 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 34307 | - | status information | fuel oil injection valve cylinder A4 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34308 | - | status information | fuel oil injection valve cylinder A4 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34309 | - | status information | fuel oil injection valve cylinder A5 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34310 | - | status information | fuel oil injection valve cylinder A5 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34311 | - | status information | fuel oil injection valve cylinder A6 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34312 | - | status information | fuel oil injection valve cylinder A6 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34313 | - | status information | fuel oil injection valve cylinder A7 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34314 | - | status information | fuel oil injection valve cylinder A7 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34315 | - | status information | fuel oil injection valve cylinder A8 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34316 | - | status information | fuel oil injection valve cylinder A8 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34317 | - | status information | fuel oil injection valve cylinder A9 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34318 | - | status information | fuel oil injection valve cylinder A9 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34319 | - | status information | fuel oil injection valve cylinder A10 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34320 | - | status information | fuel oil injection valve cylinder A10 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34321 | - | status information | fuel oil injection valve cylinder B1 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 34322 | - | status information | fuel oil injection valve cylinder B1 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34323 | - | status information | fuel oil injection valve cylinder B2 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34324 | - | status information | fuel oil injection valve cylinder B2 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34325 | - | status information | fuel oil injection valve cylinder B3 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34326 | - | status information | fuel oil injection valve cylinder B3 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34327 | - | status information | fuel oil injection valve cylinder B4 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34328 | - | status information | fuel oil injection valve cylinder B4 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34329 | - | status information | fuel oil injection valve cylinder B5 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34330 | - | status information | fuel oil injection valve cylinder B5 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34331 | - | status information | fuel oil injection valve cylinder B6 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34332 | - | status information | fuel oil injection valve cylinder B6 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34333 | - | status information | fuel oil injection valve cylinder B7 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34334 | - | status information | fuel oil injection valve cylinder B7 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34335 | - | status information | fuel oil injection valve cylinder B8 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34336 | - | status information | fuel oil injection valve cylinder B8 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 34337 | - | status information | fuel oil injection valve cylinder B9 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34338 | - | status information | fuel oil injection valve cylinder B9 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| 34339 | - | status information | fuel oil injection valve cylinder B10 runcode (low word) | boolean | 1 | 0 | 65535 | | optional |
| 34340 | - | status information | fuel oil injection valve cylinder B10 runcode (high word) | boolean | 1 | 0 | 65535 | | optional |
| pre-alarms exhaust gas temperature | | | | | | | | | |
| 34621 | 0 | pre-alarm load reduction | exhaust gas temp. cylinder A1 outlet high | boolean | | | | | optional |
| 34621 | 1 | pre-alarm load reduction | exhaust gas temp. cylinder A2 outlet high | boolean | | | | | optional |
| 34621 | 2 | pre-alarm load reduction | exhaust gas temp. cylinder A3 outlet high | boolean | | | | | optional |
| 34621 | 3 | pre-alarm load reduction | exhaust gas temp. cylinder A4 outlet high | boolean | | | | | optional |
| 34621 | 4 | pre-alarm load reduction | exhaust gas temp. cylinder A5 outlet high | boolean | | | | | optional |
| 34621 | 5 | pre-alarm load reduction | exhaust gas temp. cylinder A6 outlet high | boolean | | | | | optional |
| 34621 | 6 | pre-alarm load reduction | exhaust gas temp. cylinder A7 outlet high | boolean | | | | | optional |
| 34621 | 7 | pre-alarm load reduction | exhaust gas temp. cylinder A8 outlet high | boolean | | | | | optional |
| 34621 | 8 | pre-alarm load reduction | exhaust gas temp. cylinder A9 outlet high | boolean | | | | | optional |
| 34621 | 9 | pre-alarm load reduction | exhaust gas temp. cylinder A10 outlet high | boolean | | | | | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 34621 | 10 | pre-alarm load reduction | exhaust gas temp. turbocharger A inlet high | boolean | | | | | optional |
| 34621 | 11 | pre-alarm load reduction | exhaust gas temp. cylinder B1 outlet high | boolean | | | | | optional |
| 34621 | 12 | pre-alarm load reduction | exhaust gas temp. cylinder B2 outlet high | boolean | | | | | optional |
| 34621 | 13 | pre-alarm load reduction | exhaust gas temp. cylinder B3 outlet high | boolean | | | | | optional |
| 34621 | 14 | pre-alarm load reduction | exhaust gas temp. cylinder B4 outlet high | boolean | | | | | optional |
| 34621 | 15 | pre-alarm load reduction | exhaust gas temp. cylinder B5 outlet high | boolean | | | | | optional |
| 34622 | 0 | pre-alarm load reduction | exhaust gas temp. cylinder B6 outlet high | boolean | | | | | optional |
| 34622 | 1 | pre-alarm load reduction | exhaust gas temp. cylinder B7 outlet high | boolean | | | | | optional |
| 34622 | 2 | pre-alarm load reduction | exhaust gas temp. cylinder B8 outlet high | boolean | | | | | optional |
| 34622 | 3 | pre-alarm load reduction | exhaust gas temp. cylinder B9 outlet high | boolean | | | | | optional |
| 34622 | 4 | pre-alarm load reduction | exhaust gas temp. cylinder B10 outlet high | boolean | | | | | optional |
| 34622 | 5 | pre-alarm load reduction | exhaust gas temp. turbocharger B inlet high | boolean | | | | | optional |
| 34622 | 6 | pre-alarm load reduction | exhaust gas temp. cylinder A1 outlet mean value deviation high | boolean | | | | | optional |
| 34622 | 7 | pre-alarm load reduction | exhaust gas temp. cylinder A2 outlet mean value deviation high | boolean | | | | | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 34622 | 8 | pre-alarm load reduction | exhaust gas temp. cylinder A3 outlet mean value deviation high | boolean | | | | | optional |
| 34622 | 9 | pre-alarm load reduction | exhaust gas temp. cylinder A4 outlet mean value deviation high | boolean | | | | | optional |
| 34622 | 10 | pre-alarm load reduction | exhaust gas temp. cylinder A5 outlet mean value deviation high | boolean | | | | | optional |
| 34622 | 11 | pre-alarm load reduction | exhaust gas temp. cylinder A6 outlet mean value deviation high | boolean | | | | | optional |
| 34622 | 12 | pre-alarm load reduction | exhaust gas temp. cylinder A7 outlet mean value deviation high | boolean | | | | | optional |
| 34622 | 13 | pre-alarm load reduction | exhaust gas temp. cylinder A8 outlet mean value deviation high | boolean | | | | | optional |
| 34622 | 14 | pre-alarm load reduction | exhaust gas temp. cylinder A9 outlet mean value deviation high | boolean | | | | | optional |
| 34622 | 15 | pre-alarm load reduction | exhaust gas temp. cylinder A10 outlet mean value deviation high | boolean | | | | | optional |
| 34623 | 0 | pre-alarm load reduction | exhaust gas temp. cylinder B1 outlet mean value deviation high | boolean | | | | | optional |
| 34623 | 1 | pre-alarm load reduction | exhaust gas temp. cylinder B2 outlet mean value deviation high | boolean | | | | | optional |
| 34623 | 2 | pre-alarm load reduction | exhaust gas temp. cylinder B3 outlet mean value deviation high | boolean | | | | | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 34623 | 3 | pre-alarm load reduction | exhaust gas temp. cylinder B4 outlet mean value deviation high | boolean | | | | | optional |
| 34623 | 4 | pre-alarm load reduction | exhaust gas temp. cylinder B5 outlet mean value deviation high | boolean | | | | | optional |
| 34623 | 5 | pre-alarm load reduction | exhaust gas temp. cylinder B6 outlet mean value deviation high | boolean | | | | | optional |
| 34623 | 6 | pre-alarm load reduction | exhaust gas temp. cylinder B7 outlet mean value deviation high | boolean | | | | | optional |
| 34623 | 7 | pre-alarm load reduction | exhaust gas temp. cylinder B8 outlet mean value deviation high | boolean | | | | | optional |
| 34623 | 8 | pre-alarm load reduction | exhaust gas temp. cylinder B9 Outlet mean value deviation high | boolean | | | | | optional |
| 34623 | 9 | pre-alarm load reduction | exhaust gas temp. cylinder B10 outlet mean value deviation high | boolean | | | | | optional |
| pre-alarms lube oil temperature & pressure | | | | | | | | | |
| 34623 | 10 | pre-alarm load reduction | lube oil temp. engine inlet high | boolean | | | | | optional |
| 34623 | 11 | pre-alarm load reduction | lube oil temp. engine inlet low | boolean | | | | | optional |
| 34623 | 12 | pre-alarm auto shutdown | lube oil pressure engine inlet low | boolean | | | | | optional |
| pre-alarms turbocharger speed | | | | | | | | | |
| 34623 | 14 | pre-alarm load reduction | turbocharger A speed high | boolean | | | | | optional |
| 34623 | 15 | pre-alarm load reduction | turbocharger B speed high | boolean | | | | | optional |
| pre-alarms main bearing temperature | | | | | | | | | |
| 34624 | 0 | pre-alarm auto shutdown | flange bearing GDS temp. high | boolean | | | | | optional |
| 34624 | 1 | pre-alarm auto shutdown | main bearing 1 temp. high | boolean | | | | | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 34624 | 2 | pre-alarm auto shutdown | main bearing 2 temp. high | boolean | | | | | optional |
| 34624 | 3 | pre-alarm auto shutdown | main bearing 3 temp. high | boolean | | | | | optional |
| 34624 | 4 | pre-alarm auto shutdown | main bearing 4 temp. high | boolean | | | | | optional |
| 34624 | 5 | pre-alarm auto shutdown | main bearing 5 temp. high | boolean | | | | | optional |
| 34624 | 6 | pre-alarm auto shutdown | main bearing 6 temp. high | boolean | | | | | optional |
| 34624 | 7 | pre-alarm auto shutdown | main bearing 7 temp. high | boolean | | | | | optional |
| 34624 | 8 | pre-alarm auto shutdown | main bearing 8 temp. high | boolean | | | | | optional |
| 34624 | 9 | pre-alarm auto shutdown | main bearing 9 temp. high | boolean | | | | | optional |
| 34624 | 10 | pre-alarm auto shutdown | main bearing 10 temp. high | boolean | | | | | optional |
| 34624 | 11 | pre-alarm auto shutdown | main bearing 11 temp. high | boolean | | | | | optional |
| 34624 | 12 | pre-alarm auto shutdown | flange bearing CGDS temp. high | boolean | | | | | optional |
| 34624 | 14 | pre-alarm auto shutdown | collective main bearing temp. high | boolean | | | | | optional, collective signal |
| pre-alarms splash-oil temperature | | | | | | | | | |
| 34625 | 0 | pre-alarm auto shutdown | splash-oil temp. compartment 1 high | boolean | | | | | optional |
| 34625 | 1 | pre-alarm auto shutdown | splash-oil temp. compartment 2 high | boolean | | | | | optional |
| 34625 | 2 | pre-alarm auto shutdown | splash-oil temp. compartment 3 high | boolean | | | | | optional |
| 34625 | 3 | pre-alarm auto shutdown | splash-oil temp. compartment 4 high | boolean | | | | | optional |
| 34625 | 4 | pre-alarm auto shutdown | splash-oil temp. compartment 5 high | boolean | | | | | optional |
| 34625 | 5 | pre-alarm auto shutdown | splash-oil temp. compartment 6 high | boolean | | | | | optional |
| 34625 | 6 | pre-alarm auto shutdown | splash-oil temp. compartment 7 high | boolean | | | | | optional |
| 34625 | 7 | pre-alarm auto shutdown | splash-oil temp. compartment 8 high | boolean | | | | | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 34625 | 8 | pre-alarm auto shutdown | splash-oil temp. compartment 9 high | boolean | | | | | optional |
| 34625 | 9 | pre-alarm auto shutdown | splash-oil temp. compartment 10 high | boolean | | | | | optional |
| 34625 | 10 | pre-alarm auto shutdown | splash-oil temp. compartment 1 mean value deviation high | boolean | | | | | optional |
| 34625 | 11 | pre-alarm auto shutdown | splash-oil temp. compartment 2 mean value deviation high | boolean | | | | | optional |
| 34625 | 12 | pre-alarm auto shutdown | splash-oil temp. compartment 3 mean value deviation high | boolean | | | | | optional |
| 34625 | 13 | pre-alarm auto shutdown | splash-oil temp. compartment 4 mean value deviation high | boolean | | | | | optional |
| 34625 | 14 | pre-alarm auto shutdown | splash-oil temp. compartment 5 mean value deviation high | boolean | | | | | optional |
| 34625 | 15 | pre-alarm auto shutdown | splash-oil temp. compartment 6 mean value deviation high | boolean | | | | | optional |
| 34626 | 0 | pre-alarm auto shutdown | splash-oil temp. compartment 7 mean value deviation high | boolean | | | | | optional |
| 34626 | 1 | pre-alarm auto shutdown | splash-oil temp. compartment 8 mean value deviation high | boolean | | | | | optional |
| 34626 | 2 | pre-alarm auto shutdown | splash-oil temp. compartment 9 mean value deviation high | boolean | | | | | optional |
| 34626 | 3 | pre-alarm auto shutdown | splash-oil temp. compartment 10 mean value deviation high | boolean | | | | | optional |
| pre-alarms miscellaneous values | | | | | | | | | |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 34626 | 4 | pre-alarm load reduction | HTCW temp. cylinder cooling outlet high | boolean | | | | | optional |
| 34626 | 6 | pre-alarm auto shutdown | HTCW temp. cylinder cooling outlet high | boolean | | | | | optional |
| 34627 | 2 | pre-alarm auto shutdown | engine torque relative deviation internal/ measured high | boolean | | | | | optional |
| 34627 | 4 | pre-alarm auto emergency stop | engine overspeed active | boolean | | | | | optional |
| 34627 | 7 | pre-alarm auto shutdown | generator DE bearing temp. high | boolean | | | | | optional |
| 34627 | 8 | pre-alarm auto shutdown | generator NDE bearing temp. high | boolean | | | | | optional |
| 34627 | 9 | pre-alarm auto shutdown | generator winding L1 temp. high | boolean | | | | | optional |
| 34627 | 10 | pre-alarm auto shutdown | generator winding L2 temp. high | boolean | | | | | optional |
| 34627 | 11 | pre-alarm auto shutdown | generator winding L3 temp. high | boolean | | | | | optional |
| 34628 | 0 | pre-alarm auto shutdown | collective splash-oil temp. compartment high | boolean | | | | | optional, collective signal |
| 34628 | 1 | pre-alarm auto shutdown | collective splash-oil temp. mean value deviation high | boolean | | | | | optional, collective signal |
| 34628 | 2 | pre-alarm load reduction | HTCW pressure cylinder cooling inlet low | boolean | | | | | |
| 34628 | 4 | pre-alarm load reduction | collective exhaust gas temp. cylinder outlet high | boolean | | | | | optional, collective signal |
| 34628 | 5 | pre-alarm load reduction | collective exhaust gas temp. cylinder outlet mean value deviation high | boolean | | | | | optional, collective signal |
| 34628 | 8 | pre-alarm load reduction | charge air temp. engine inlet row A high | boolean | | | | | optional |
| 34628 | 9 | pre-alarm load reduction | charge air temp. engine inlet row B high | boolean | | | | | optional |
| 34629 | 8 | pre-alarm load reduction | gear thrust bearing temp. high | boolean | | | | | optional |
| 34629 | 9 | pre-alarm load reduction | clutch medium pressure low | boolean | | | | | optional |

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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 34629 | 10 | pre-alarm load reduction | gear lube oil temp. high | boolean | | | | | optional |
| 34630 | 3 | pre-alarm auto shutdown | exhaust gas temp. mean value row A to B deviation high | | | | | | optional |
| 34630 | 4 | pre-alarm auto shutdown | crankcase pressure high | | | | | | optional |
| 34630 | 5 | pre-alarm auto shutdown | crankcase pressure gradient high | | | | | | optional |
| 34630 | 6 | pre-alarm auto shutdown | splash-oil temp. compartment 1 mean value deviation gradient positive high | | | | | | optional |
| 34630 | 7 | pre-alarm auto shutdown | splash-oil temp. compartment 2 mean value deviation gradient positive high | | | | | | optional |
| 34630 | 8 | pre-alarm auto shutdown | splash-oil temp. compartment 3 mean value deviation gradient positive high | | | | | | optional |
| 34630 | 9 | pre-alarm auto shutdown | splash-oil temp. compartment 4 mean value deviation gradient positive high | | | | | | optional |
| 34630 | 10 | pre-alarm auto shutdown | splash-oil temp. compartment 5 mean value deviation gradient positive high | | | | | | optional |
| 34630 | 11 | pre-alarm auto shutdown | splash-oil temp. compartment 6 mean value deviation gradient positive high | | | | | | optional |
| 34630 | 12 | pre-alarm auto shutdown | splash-oil temp. compartment 7 mean value deviation gradient positive high | | | | | | optional |
| 34630 | 13 | pre-alarm auto shutdown | splash-oil temp. compartment 8 mean value deviation gradient positive high | | | | | | optional |
| 34630 | 14 | pre-alarm auto shutdown | splash-oil temp. compartment 9 mean value deviation gradient positive high | | | | | | optional |



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| Address | Bit | Signal class | Description | Unit | Factor | Lower limit | Upper limit | Control device | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| 34630 | 15 | pre-alarm auto shutdown | splash-oil temp. compartment 10 mean value deviation gradient positive high | | | | | | optional |

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### 5.16.8.4 Interfaces between plant and SaCoS 5000

Caption

Digital Input: Powered with 24 V DC by Everllence's Control Module.
Digital Output (NO contact signal): Designed as relay output switching a maximum of 250 V AC/DC, 6 A.
Min. switching current: 10 mA at 12 V. Interrupting rating (ohmic load) max. 140 W (24 V DC), 1,500 VA (250 V AC).
Analog Input (4 – 20 mA): Passive signal. Everllence does not deliver 24 V DC for the signal.
Analog Output (4 – 20 mA): Active signal. Galvanically isolated by Everllence. Expected load resistance: 50 ohm – 800 ohm at 24 V DC.



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## Interfaces between plant and SaCoS 5000

| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Manual emergency stop from external, two channel | Digital Input | Plant Control → SaCoS 5000<br>Emergency stop button in external system: if the contact is closed, the emergency stop is tripped and the engine is shutting down.<br>Plausibility monitoring is carried out.<br>Channel 1 and 2 have to be actuated simultaneously, otherwise an alarm is emitted via SaCoS panels/ Modbus. | 5HZ1012-1 |
| Manual emergency stop from external, two channel | Digital Input | Plant Control → SaCoS 5000<br>Emergency stop button in external system: if contact is closed, an emergency stop is tripped and the engine is shutting down.<br>Plausibility monitoring is carried out.<br>Channel 1 and 2 have to be actuated simultaneously, otherwise an alarm is emitted via SaCoS panels/ Modbus. | 5HZ1012-2 |
| Manual emergency stop from external, single channel | Digital Input | Plant Control → SaCoS 5000<br>Emergency stop button in external system: if contact is closed, an emergency stop is tripped and the engine is shutting down.<br>Single channel emergency shutdown with wirebreak monitoring<br>(can alternatively be used instead of two channel emergency stop 5HZ1012 if on ship side a two channel safety system is not available). | 15HZ1012 |
| Emergency stop from external, two channel | Digital Input | Plant Control → SaCoS 5000<br>Emergency stop from external system: if the contact is closed, the emergency stop is tripped and the engine is shutting down.<br>Plausibility monitoring is carried out.<br>Channel 1 and 2 have to be actuated simultaneously, otherwise an alarm is emitted via SaCoS panels/ Modbus. | 3EXSZ0099-1 |
| Emergency stop from external, two channel | Digital Input | Plant Control → SaCoS 5000<br>Emergency stop from external system: if contact is closed, an emergency stop is tripped and the engine is shutting down.<br>Plausibility monitoring is carried out.<br>Channel 1 and 2 have to be actuated simultaneously, otherwise an alarm is emitted via SaCoS panels/ Modbus. | 3EXSZ0099-2 |

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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Auto shutdown from external, two channel | Digital Input | Plant Control → SaCoS 5000<br>This interface is released 15 seconds after SaCoS is powered on.<br>If the contact is closed, an auto shutdown is tripped and the engine is shutting down.<br>Indication via SaCoS panels/Modbus.<br>Plausibility monitoring is carried out.<br>Channel 1 and 2 have to be actuated simultaneously, otherwise an alarm is emitted via SaCoS panels/ Modbus.<br>This signal is not mandatory. It may be used by Plant control optionally.<br>The shutdown can always be overridden (if override is intended for respective engines). | 2EXSZ0099-1 |
| Auto shutdown from external, two channel | Digital Input | Plant Control → SaCoS 5000<br>This interface is released 15 seconds after SaCoS is powered on.<br>If the contact is closed, an auto shutdown is tripped and the engine is shutting down.<br>Indication via SaCoS panels/Modbus.<br>Plausibility monitoring is carried out.<br>Channel 1 and 2 have to be actuated simultaneously, otherwise an alarm is emitted via SaCoS panels/ Modbus.<br>This signal is not mandatory. It may be used by plant control optionally.<br>The shutdown can always be overridden (if override is intended for respective engines). | 2EXSZ0099-2 |
| Overall safety stop, ch. 1 | Digital Output | Plant Control ← SaCoS 5000<br>The contact is closed as soon as SaCoS performs an auto shutdown or a manual emergency stop.<br>Following action is required in case of diesel mechanical application:<br>If clutch is available: Disengage clutch.<br>If no clutch is available: Reduce pitch to zero.<br>Following action is required in case of diesel electrical application: The generator circuit breaker has to be opened.<br>The contact is opened if the engine is at standstill and ACK and Reset have been activated.<br>In parallel to the contact, a 24 kΩ resistor is installed for external wire break monitoring. | 3EYSZ1012.1-1 |



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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Overall safety stop, ch. 2 | Digital Output | Plant Control ← SaCoS 5000<br>The contact is closed as soon as SaCoS performs an auto shutdown or a manual emergency stop.<br>Following action is required in case of diesel mechanical application:<br>If clutch is available: Disengage clutch.<br>If no clutch is available: Reduce pitch to zero.<br>Following action is required in case of diesel electrical application: The generator circuit breaker has to be opened.<br>The contact is opened if the engine is at standstill and ACK and Reset have been activated.<br>In parallel to the contact, a 24 kΩ resistor is installed for external wire break monitoring. | 3EYSZ1012.1-2 |
| Load reduction request | Digital Output | Plant Control ← SaCoS 5000<br>Certain engine conditions require a load reduction to 60 % of the rated load<br>(→ for further information refer to the Modbus list and LMC).<br>Load reduction has to be initiated by external system.<br>Automatic load reduction is only initiated for FPP applications by "engine slowdown". | 1EYCS1022 |
| Wheelhouse override safety actions | Digital Input | Plant Control → SaCoS 5000<br>If the contact is closed, all load reduction requests and all auto shutdowns that can be overridden are suppressed. The project-specific list of measuring and control devices (LMC) indicates if an auto shutdown cannot be overridden.<br>The override button has to be actuated pre-emptively. If an auto shutdown or load reduction request is already active, a later actuation of the override button is without effect.<br>The contact must be bridged with a 24 kΩ resistor for the wire break monitoring. | 2HOS1013 |
| Wheelhouse override safety actions CCM | Digital Input | Plant Control → SaCoS 5000<br>This signal is only required if the crankcase monitoring shutdown (oil mist detector, splash oil monitoring, main bearing monitoring) has to be overridden and if the classification society LRS has been selected.<br>If the contact is closed, all crankcase monitoring shutdowns are overridden.<br>The contact must be bridged with a 24 kΩ resistor for the wire break monitoring. | 4HOS1013 |

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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Battle override | Digital Input | Plant Control → SaCoS 5000<br>If the contact is closed, all load reduction requests and all auto shutdowns which can be overridden are suppressed.<br>The project-specific list of measuring and control devices (LMC) indicates whether a shutdown can be overridden or not.<br>The override button has to be actuated pre-emptively. If auto shutdown or load reduction request is already active, a later actuation of the battle override button is without effect.<br>In addition a torque limiter offset of 10 % is added which means more or less a power increase.<br>And an offset to the maximum speed (default 0 %) is added which allows a higher maximum speed.<br>In case of battle override the external analogue speed setpoint range should be enlargered during commissioning if a maximum speed offset > 0 % is used.<br>Speed alarm and shutdown levels will not be increased.<br>The contact must be bridged with a 24 kΩ resistor for wire break monitoring. | 6HOS1013 |
| Engine start release from external not available | Digital Input | Plant Control → SaCoS 5000<br>The engine can only be started if this contact is closed. The contact should be opened if engine start shall be prohibit.<br>As soon as engine starts up the contact can be opened again.<br>If the contact is defect (e.g. wire break) at engine standstill and the engine is equipped with air starter the engine can only be started via emergency start (giving manually air on air starter). Then all start blockings are overridden and engine will start up, but without safety monitoring by SaCoS. As soon as safety system is activated (limit value 1SSH1000, see table Measuring and control devices of SaCoS 5000 (only for reference), Page 634), safety monitoring is active again. | 1EXSB0099 |
| SACOS System common alarm | Digital Output | Plant Control ← SaCoS 5000<br>The contact is closed as soon as a pre-alarm or system alarm is active. This contact does not indicate load reduction requests or auto shutdowns/emergency stops. | 3EYQA0100 |



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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| External engine start possible | Digital Output | Plant Control ← SaCoS 5000<br>If the contact is closed, start blockings are not active.<br>The engine can only be started via SaCoS panels or via PMS if the contact is closed.<br>If the start procedure has to be aborted due to a start failure, the contact is opened again. The start failure has to be corrected and acknowledged. The reason for start failure is transmitted via Modbus.<br>If the engine is running (signal "Engine running"), the contact is opened again. | 1EYSB0099 |
| External operation active | Digital Output | Plant Control ← SaCoS 5000<br>The contact is closed if external control is active.<br>If control authority is active at LOP, ROP or WOP the contact is open. | 1EYS1014 |
| Engine speed indication | Analog Output | Plant Control ← SaCoS 5000<br>For indication purpose; the signal provides the actual engine speed.<br>4 mA corresponds to 0 U/min.<br>20 mA corresponds to 2.400 rpm for 175D. | 2SYI1005 |
| Engine speed analog setpoint from external | Analog Input | Plant Control → SaCoS 5000<br>This signal is only considered if signal “Analogue Speed Setpoint Request” is high and control via ROP or WOP or external is selected.<br>Following default settings:<br>▪ Propulsion application:<br>▪ 4 mA equates to 550 rpm<br>▪ 20 mA equates to rated speed + 100 rpm<br>▪ Genset application – fix speed:<br>▪ 4 mA equates to “rated speed – 15 rpm”<br>▪ 20 mA equates to “rated speed + 15 rpm”<br>▪ Genset application – variable speed:<br>▪ 4 mA equates to 1000 rpm<br>▪ 20 mA equates to 1900 rpm<br>Ramp up speed: 20 rpm/se | 1SXC1005 |

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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Engine speed analog setpoint request | Digital Input | Plant Control → SaCoS 5000<br>This signal is only considered if control via ROP or WOP or external is selected.<br>When the contact is closed, analogue speed setting is activated. When contact is open, digital speed setting is activated.<br>Thus, even during loss of this signal (wire break), the digital speed setting remains activated.<br>Special function with Alpha propulsion control system AT3000: If SaCoS ServicePortal parameter 26612 (“Backup Mode Alpha enabled”) = TRUE then the purpose of the digital input changes.<br>With each positive edge at the input the output “Backup Control Active” toggles. If output “Backup Control Active” is active, digital speed setting is activated and analogue speed setting deactivated. And vice versa: If output “Backup Control Active” is inactive, digital speed setting is deactivated and analogue speed setting activated. | 1EXS1005 |
| Engine speed setpoint decrease request | Digital Input | Plant Control → SaCoS 5000<br>By closing the contact the plant control requests a decrease of engine speed.<br>This signal is only considered if signal “Analogue Speed Setpoint Request” is not active and external control is activated.<br>The speed setting rate is 1 rpm/sec (default). | 1EXCSL1005 |
| Engine speed setpoint increase request | Digital Input | Plant Control → SaCoS 5000<br>By closing the contact the plant control requests an increase of engine speed.<br>This signal is only considered if signal “Analogue Speed Setpoint Request” is not active and external control is activated.<br>The value is adjustable via SaCoS ServicePortal tool by Everllence staff. The speed setting rate is 1 rpm/sec (default). | 1EXCSH1005 |
| Constant speed request | Digital Input | Plant Control → SaCoS 5000<br>By closing the contact the engine will immediately goes to 1.500 rpm (default).<br>Value is adjustable via SaCoS ServicePortal tool by Everllence-staff.<br>This signal overrules other inputs as “External Request De-/Increase Speed Setpoint” or “External Analog Speed Setpoint”. | 1EXCSZ1005 |



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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Generator circuit breaker closed or clutch engaged | Digital Input | Plant Control → SaCoS 5000<br>Signal from generator control or from clutch control indicates that engine is under load. Signal is used for switchover of parameter sets and from isochronous to droop operation. | 1EXTS1096/ 2EXTS1130 |
| Engine PTO shaft engaged | Digital Input | Plant Control → SaCoS 5000<br>For indication of engaged additional load, needed to switch of internal fuel adaption mode at generator drives with big load at PTO shaft. | 1EXTS1066 |
| Fuel admission at any limiter | Digital Output | Plant Control ← SaCoS 5000<br>SaCoS 5000 indicates via this signal that the fuel admission is approximating the load limit of the speed governor (charge air limiter, torque limiter, external limiter). The PCS should not increase the pitch further.<br>Signal properties:<br>▪ The signal is not an alarm, thus it is not saved.<br>▪ The signal is not a delayed-action.<br>▪ The signal is not on the Modbus.<br>▪ The display indication can be found in "engine status".<br>▪ The calculation of the signal is based on the current load value when approximating the limiter (default value: 5 % below actual limiter). The 5 % are only recommended. The value can be adjusted during initial operation, because the value depends on the reaction of PCS. | 2EYSH1022 |
| Generator actual power / engine torque | Analog Input | Plant Control → SaCoS 5000<br>SaCoS 5000 uses this signal for governing speed.<br>The analogue value of the hard-wired signal of 4 mA corresponds to a nominal generator active power of -10 %, the value of 20 mA corresponds to a nominal generator active power plus 10 %". Unit is "kW".<br>Range until -10 % is important otherwise SaCoS detects by mistake wirebreak at reverse power.<br>An exact specification of the signal can be found in the Project Guide. The signal is important for diesel electrical plants and has to be connected always! | 1WT1096/ 1WT1023 |
| Engine absolute torque | Analog Output | Plant Control ← SaCoS 5000<br>The signal provides the actual absolute engine power.<br>4 mA corresponds to 0 % engine power (=idle load).<br>20 mA corresponds to 120 % engine power.<br>Absolute Engine power ~ (Engine torque * engine speed) – friction power. Means the signal corresponds to the power provided at shaft. | 1WYI1023 |

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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| External engine start request | Digital Input | Plant Control → SaCoS 5000<br>The contact has to be realised as a pulse contact with a pulse length of at least 1 seconds.<br>If the contacts "External Operation Active" and "Engine Start Possible" are active, the start process is initiated by closing the contact.<br>After engine stop, a timer of 60 minutes is started. Within this time period of 60 minutes, the next engine start will be without delay and without pre lubrication. | 1EXCS0099 |
| External engine stop request | Digital Input | Plant Control → SaCoS 5000<br>The contact must be realised as a pulse contact with a pulse length of at least 1 second.<br>The contact can only be used If the contact "External Operation Active" is active.<br>By closing this contact the engine shuts down until standstill.<br>Before the contact is activated, the plant control has to unload the engine and open the generator circuit breaker or clutch. | 2EXCS0099 |
| Request hand-over operating rights to ext. | Digital Output | Plant Control ← SaCoS 5000<br>The contact is closed if an operator at an active SACOS panel has requested a takeover of control by external control. | 1EYCS1014 |
| Confirmation takeover of transfer operating rights by external | Digital Input | Plant Control → SaCoS 5000<br>If signal 1EYCS1014 is active this contact has to be closed to acknowledge the takeover of control by external control. | 2EXTS1014 |
| Request take over operating rights for SACOS | Digital Output | Plant Control ← SaCoS 5000<br>The contact is closed if control is requested at an SACOS operating panel at external control this information shall indicate that control should be handed over to SACOS. | 2EYCS1014 |
| Horn on command | Digital Output | Plant Control ← SaCoS 5000<br>The contact is closed when a transfer of the control station is started but not yet acknowledged by another control station.<br>The signal is intended to be used for activation of acoustic alarm in engine room. | 1EYCS0402 |
| Confirmation transfer operating rights to SACOS | Digital Input | Plant Control → SaCoS 5000<br>If signal 2EYCS1014 is active this contact has to be closed to acknowledge the handover of control to SACOS. | 1EXTS1014 |



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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Request hand-over operating rights to SACOS | Digital Input | Plant Control → SaCoS 5000<br>The contact is closed if an operator at the external control station has requested to take over of control by a SACOS panel. | 1EXCS1014 |
| Request take over operating rights for external | Digital Input | Plant Control → SaCoS 5000<br>The contact is closed if control is requested at external control this information indicates at SACOS panels that control should be handed over to External control station. | 2EXCS1014 |
| PCS backup control selected | Digital Output | Plant Control ← SaCoS 5000<br>Contact is only used in combination with propulsion control AT3000 (if SaCoS ServicePortal parameter 26612: Backup Mode Alpha enabled = TRUE). With each positive edge at input “External Analogue Speed Setpoint Request” this output toggles.<br>If output “Backup Control Active” is active, digital speed setting is activated and analogue speed setting deactivated.<br>And vice versa: If output “Backup Control Active” is inactive, digital speed setting is deactivated and analogue speed setting activated. | 1EYS1120 |
| For releases generator excitation / syncronisation release / pitch release | Digital Output | Plant Control ← SaCoS 5000<br>Contact is closed if engine speed ≥ 95 % nominal speed. This signal can be used for release of generator excitation or generator synchronisation. | 9EYS1005 |
| For releases generator excitation/ syncronisation release/ pitch release | Digital Output | Plant Control ← SaCoS 5000<br>Contact is closed if engine speed is within a defined speed window. | 10EYS1005 |
| Engine pre-lubrication deactivation | Digital Input | Plant Control → SaCoS 5000<br>Necessary pre-lubrication of engine can be skipped by closing that contact if contact is closed engine starts without pre-lubrication. | 5EXCSM2100 |
| Start air pressure | Analog Input | Plant Control → SaCoS 5000<br>Sensor only used if pneumatical start system is provided. If pressure underruns limit value 1PAL7170 an alarm will be triggered. | 1PT7170 |
| Sea water pressure | Analog Input | Plant Control → SaCoS 5000<br>Only available without attached sea water cooler in case of attached sea water cooler sensor is attached to engine 1PAL4120 an alarm will be triggered. | 1PT4120 |
| Fuel oil water separator diff pressure | Analog Input | Plant Control → SaCoS 5000<br>If fuel oil water separator pressure is below limit value 1PDAH5066 an alarm will be triggered. Alarm is already released at engine standstill. | 1PDT5066 |

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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Water level f. o. water separator 1 high | Digital Input | Plant Control → SaCoS 5000<br>If contact is open an alarm will be triggered. Alarm is already released at engine standstill. | 1LS5066 |
| Water level f. o. water separator 1 high | Digital Input | Plant Control → SaCoS 5000<br>If contact is open an alarm will be triggered. Alarm is already released at engine standstill. | 2LS5066 |
| Differential pressure fuel oil pre-filter too high | Digital Input | Plant Control → SaCoS 5000<br>If contact is open an alarm will be triggered. Alarm is already released at engine standstill. | PDS5064 |
| HT-cooling water pressure expansion tank | Digital Input | Plant Control → SaCoS 5000<br>If contact is open an alarm will be triggered. Alarm is already released at engine standstill. | 1LS3100 |
| LT-cooling water pressure expansion tank | Digital Input | Plant Control → SaCoS 5000<br>If contact is open an alarm will be triggered. Alarm is already released at engine standstill. | 1LS4100 |
| Pre-lubrication pump on request | Digital Output | Plant Control ← SaCoS 5000<br>Request of electric engine pump for pre-lubrication:<br>The contact is closed as soon as engine start is triggered. When pre-lubrication time has expired the contact is opened and the engine starts immediately.<br>Contact is further closed by manual request from ServicePortal for a maximum duration of five minutes. | 1EYCSM2100 |
| HTCW preheating pump on request | Digital Output | Plant Control ← SaCoS 5000<br>The contact is closed as soon as engine is at standstill.<br>Definition of engine standstill: Engine RPM < 1SSL1000 for at least 5 seconds. | 1EYCS3110 |



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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| LTCW preheating on request | Digital Output | Plant Control ← SaCoS 5000<br>This contact is designed for engines with the requirement of running low loads (e. g. < 15 % MCR) at a low air intake temperature (e. g. -25 °C).<br>This leads to the necessity of preheating the charge air via the charge air cooler integrated in the LT cooling water system.<br>As no further major components provide enough heat to the LTCW-system a LTCW-preheating unit is required.<br>The unit is located off engine and uses this contact for start/stop of operation.<br>For the required heat and border temperatures refer to section “Engine operation under arctic conditions”, figure “Required preheater size to avoid heat extraction from LT system”.<br>To ensure a safe operation a hysteresis with the stop signal of 2 % is programmed.<br>Furthermore a heating-on delay of 10 seconds and a heating-off delay of 30 seconds. | 1EYCS4110 |
| HTCW heat recovery release | Digital Output | Plant Control ← SaCoS 5000<br>The contact is closed if the cooling water temperature of the engine outlet (1TE3180) exceeds a specific temperature level (1TAL3180). The closing of the contact is carried out with delay.<br>In parallel the Modbus bit “HTCW Heat Recovery Release Active” is activated.<br>The contact is opened if the temperature drops below the limit 1TAL3180 (including hysteresis).<br>As long as the contact remains closed, external heat consumers may take heat from the cooling water system. The contact has not been designed as an automatic start/stop for external heat<br>consumers. The function only indicates that the engine is producing sufficient waste heat to be used for external systems. | 1EYSB3180 |
| Exh. Gas temp after waste gate inflow | PT1000 | Plant Control → SaCoS 5000<br>Optional, only in combination with third party SCR, temperature sensor at SCR exhaust gas inlet, customer supply. | 1TE6592 |
| Generator winding temperatur L1 | Analog Input PT1000 | Generator → SaCoS 5000<br>The signal is used to evaluate the temperature of the winding L1 and the alarm on SaCoS-panels/Modbus when exceeding a certain value.<br>When exceeding the next higher value, SaCoS 5000 can trigger an automatic shutdown (depending on generator specification). | 1TE1095-L1 |

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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Generator winding temperatur L2 | Analog Input PT1000 | Generator → SaCoS 5000<br>The signal is used to evaluate the temperature of the winding L1 and the alarm on SaCoS-panels/Modbus when exceeding a certain value.<br>When exceeding the next higher value, SaCoS 5000 can trigger an automatic shutdown (depending on generator specification). | 1TE1095-L2 |
| Generator winding temperatur L3 | Analog Input PT1000 | Generator → SaCoS 5000<br>The signal is used to evaluate the temperature of the winding L1 and the alarm on SaCoS-panels/Modbus when exceeding a certain value.<br>When exceeding the next higher value, SaCoS 5000 can trigger an automatic shutdown (depending on generator specification). | 1TE1095-L3 |
| Generator bearing temperature drive end | Analog Input PT1000 | Generator → SaCoS 5000<br>The signal is used to evaluate the temperature of the generator bearing driven end (DE) and the alarm on SaCoS panels/Modbus when exceeding a certain value.<br>When exceeding the next higher value, SaCoS 5000 can trigger an automatic shutdown (depending on generator specification). | 1TE1094-DE |
| Generator bearing temperature drive end | Analog Input PT1000 | Generator → SaCoS 5000<br>The signal is used to evaluate the temperature of the generator bearing driven end (DE) and the alarm on SaCoS-panels/Modbus when exceeding a certain value.<br>When exceeding the next higher value, SaCoS 5000 can trigger an automatic shutdown (depending on generator specification). | 2TE1094-DE |
| Generator bearing temperature non drive end | Analog Input PT1000 | Generator → SaCoS 5000<br>The signal is used to evaluate the temperature of the generator bearing nondriven end (NDE) and the alarm on SaCoS panels/Modbus when exceeding a certain value.<br>When exceeding the next higher value SaCoS 5000 can trigger an automatic shutdown (depending on generator specification). | 1TE1094-NDE |
| Generator bearing temperature non drive end | Analog Input PT1000 | Generator → SaCoS 5000<br>The signal is used to evaluate the temperature of the generator bearing nondriven end (NDE) and the alarm on SaCoS panels/Modbus when exceeding a certain value.<br>When exceeding the next higher value SaCoS 5000 can trigger an automatic shutdown (depending on generator specification). | 2TE1094-NDE |



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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Generator cooling air inlet temp | Analog Input PT1000 | Generator → SaCoS 5000<br>The signal is used to evaluate the inlet air temperature of the generator cooler and the alarm on SaCoS panels/Modbus when exceeding a certain value. | 1TE7670 |
| Generator cooling air outlet temp | Analog Input PT1000 | Generator → SaCoS 5000<br>The signal is used to evaluate the outlet air temperature of the generator cooler and the alarm on SaCoS panels/Modbus when exceeding a certain value. | 1TE7680 |
| Level switch generator cooling water leakage | Digital Input | Generator → SaCoS 5000<br>The alarm is active if the contact is open.<br>The signal is used to evaluate the cooling water leakage of the generator and the alarm to SaCoS-panels/ Modbus. | 1LS3780 |
| Lube oil pressure generator bearing drive end | Analog Input PT1000 | Generator → SaCoS 5000<br>Connected to Control Module/Alarm.<br>If pressure underruns limit value 1PAL2790-DE an alarm will be triggered. | 1PT2790-DE |
| Lube oil pressure generator bearing drive end | Analog Input PT1000 | Generator → SaCoS 5000<br>Connected to Control Module/Safety.<br>If pressure underruns limit value 2PZL2790-DE an auto shutdown will be triggered. | 2PT2790-DE |
| Lube oil pressure generator bearing non drive end | Analog Input PT1000 | Generator → SaCoS 5000<br>Connected to Control Module/Alarm.<br>If pressure underruns limit value 1PAL2790-NDE an alarm will be triggered. | 1PT2790-NDE |
| Lube oil pressure generator bearing non drive end | Analog Input PT1000 | Generator → SaCoS 5000<br>Connected to Control Module/Safety.<br>If pressure underruns limit value 2PZL2790-NDE an auto shutdown will be triggered. | 2PT2790-NDE |
| Generator cooling water flow ok | Digital Input | Generator → SaCoS 5000<br>If contact is still open when generator cooling water pump runs an alarm will be triggered with a delay of 5 seconds. | 1FS3770 |
| Generator cooling water pump on request | Digital Output | Plant Control ← SaCoS 5000<br>The contact is closed as soon as engine starting sequence begins. It is closed then engine runs. It opens again if engine has stopped and a postcooling time of 3 minutes has been exceeded. | 1EYCSM3700 |

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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Pump control common alarm not tripped | Digital Input | Plant Control → SaCoS 5000<br>If contact is open an alarm will be triggered. Alarm is already released at engine standstill.<br>Alarm includes all failures which are monitored at generator cooling water pump starter (e. g. circuit breakers, earth fault, etc.). | 1EXSF1160 |
| Gear Lube Oil Press. | Analog Input | Gear Box → SaCoS 5000<br>Only with option gearbox monitoring.<br>Only for indication of gearbox inlet lube oil pressure scaling 0-6 bar (default). | 1PT2970 |
| Gear Lube Oil Press. Not Sufficient (Lube Oil Pressure Switch) - Start Release<br>Gear lube oil pressure sufficient | Digital Input | Gear Box → SaCoS 5000<br>Only with option gearbox monitoring.<br>For start release of engine start release at closed contact. | 1PFL2970<br>3PS2970 |
| Gear Lube Oil Press. Low Low (Lube Oil Pressure Switch) - Shutdown Request | Digital Input | Gear Box → SaCoS 5000<br>Only with option gearbox monitoring.<br>For engine shutdown in case of lube oil pressure low low shutdown at closed contact. | 2PS2970 |
| Gear Lube Oil Press. Low (Lube Oil Pressure Switch) - Load Reducation Request | Digital Input | Gear Box → SaCoS 5000<br>Only with option gearbox monitoring.<br>For engine shutdown in case of lube oil pressure low low load reduction request/slow down at closed contact. | 1PS2970 |
| Gear Lube Oil Temp. | PT1000/PT100 | Gear Box → SaCoS 5000<br>Only with option gearbox monitoring.<br>For indication and alarming of lube oil temperature at gearbox inlet/oil cooler outlet. | 1TE2970<br>1TE2978 |
| Gear Lube Oil Temp. | PT1000/PT100 | Gear Box → SaCoS 5000<br>Only with option gearbox monitoring.<br>For indication and load reduction request of lube oil temperature at gearbox inlet/oil cooler outlet. | 2TE2970<br>2ET2978 |
| Gear Thrust Bearing Temp. | PT1000/PT100 | Gear Box → SaCoS 5000<br>Only with option gearbox monitoring.<br>For indication and alarming of gear thrust bearing temperature high. | 1TE2980 |
| Gear Thrust Bearing Temp. | PT1000/PT100 | Gear Box → SaCoS 5000<br>Only with option gearbox monitoring.<br>For indication and load reduction request of gear thrust bearing temperature high. | 2TE2980 |



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| Signal name | Type | Interface description | Measuring point |
|---|---|---|---|
| Gear Lube Oil Filter Diff. Press. High | Digital Input | Gear Box → SaCoS 5000<br>Only with option gearbox monitoring.<br>For alarming of differential pressure at gearbox lube oil temperature high alarm at open contact. | 1PDS2970 |
| Gear Lube Oil Level Low | Digital Input | Gear Box → SaCoS 5000<br>Only with option gearbox monitoring.<br>For alarming of lube oil level at gearbox low alarm at open contact. | 1LS2970 |



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### 5.16.9 Technical data of SaCoS 5000

#### 5.16.9.1 Design

Design of cabinets

- Wall-mounted cabinets
- Cable entries: From below
- Accessible by front door, door with locks
- Opening angle: 110°
- Standard colour: Light grey (RAL7035)
- Ingress protection: IP54/IP55/IP66

#### 5.16.9.2 Environmental conditions

Components on engine and wall-mounted cabinets

- Ambient air temperature: +5 °C to +60 °C
  - Exception: an ambient air temperature of +5 °C to +45 °C applies to the Data Logging Cabinet and the SCR Cabinet
  - Exception: an ambient air temperature of +5 °C to +55 °C applies to the Local Operating Panel with shock mounting
- Relative humidity: < 96 %
- Vibrations: < 0.7 g

#### 5.16.9.3 Measures/Weights

Local Operating Panel

| | |
|---|---|
| Width | 600 mm |
| Height | 600 mm |
| Depth | 250 mm |
| Weight | approx. 25 kg |
| Protection class | IP55 |

Local Operating Panel variant with shock mounting

| | |
|---|---|
| Width | 700 mm |
| Height | 865 mm |
| Depth | 565 mm |
| Weight | approx. 100 kg |
| Protection class | IP55 |

Remote Operating Panel / Wheelhouse Operating Panel (optional)

| | |
|---|---|
| Width | 400 mm |
| Height | 400 mm |
| Depth | - |
| Weight | approx. 10 kg |
| Protection class | IP54 in installed condition |

Additional Indicating Panel (optional)

| | |
|---|---|
| Width | 374 mm |
| Height | 254 mm |
| Depth | - |

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| | | |
|---|---|---|
| | Weight | approx. 10 kg |
| | Protection class | IP54 in installed condition |
| Data Logging Cabinet (optional) | Width | 800 mm |
| | Height | 1000 mm |
| | Depth | 400 mm |
| | Weight | approx. 60 kg |
| | Protection class | IP54 |
| Data Logging Cabinet variant with shock mounting (optional) | Width | 800 mm |
| | Height | 1000 mm |
| | Depth | 400 mm |
| | Weight | approx. 100 kg |
| | Protection class | IP54 |
| SCR Cabinet (optional) | Width | 400 mm |
| | Height | 800 mm |
| | Depth | 300 mm |
| | Weight | approx. 30 kg |
| | Protection class | IP66 |
| SCR Cabinet variant with shock mounting (optional) | Width | 800 mm |
| | Height | 1165 mm |
| | Depth | 615 mm |
| | Weight | approx. 100 kg |
| | Protection class | IP66 |

## 5.16.10 Cabling/sensors of SaCoS 5000

### 5.16.10.1 Cabling

General

See current schematics, cable plan and the document "**Installation requirements customer"** in the planning documentation for further details.

The cable work in customer scope depends from the engine application:

Genset-application

Control Unit, Local Operating Panel and Extension Cabinet (optional) are mounted on engine/gear and prewired by Everllence.

No further cables for the SaCoS 5000 are in Everllence scope of supply.

Propulsion-application

Only Control Unit is mounted and prewired by Everllence.

For the cabling between Local Operating Panel and Control Unit, Extension Cabinet and Control Unit and fuel oil coalesce/filter and Control Unit cables are to be defined by Everllence.

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### 5.16.10.2 Sensors

| | |
|---|---|
| Temperature sensors | The temperature sensors are PT1000 sensors. |
| | Double PT1000 sensors are used for redundant measuring points. |
| Pressure transmitter | All pressure transmitters are pre-adjusted and calibrated by the manufacturer, such that the operator does not need to perform temperature compensation, zero and range setting. |
| | The pressure transmitters are designed for permanent vibrations. |
| Speed sensors | Contact-free pulse transmitters are used for the speed recording. |



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### 5.16.11 Measuring and control devices of SaCoS 5000 (only for reference)

Exemplary list for project planning

| No. | Measuring point | Description | Function | Measuring Range | Location | Connected to | Depending on option |
|---|---|---|---|---|---|---|---|
| Engine speed | | | | | | | |
| 1 | 1SE1000 | speed pickup engine speed | crankshaft speed | - | engine | CU | - |
| 2 | 2SE1000 | speed pickup engine speed | crankshaft speed | - | engine | CU | - |
| 3 | 1SE1004Ax/ Bx | speed pickup TC Ax/Bx speed | indication, monitoring | 0–100000 rpm/ 0–3333 Hz | TC on engine | CU | - |
| 4 | 1SE1005 | speed pickup engine speed | camshaft speed | - | engine | CU | - |
| Engine start | | | | | | | |
| 1 | 1SSV1011 | solenoid valve engine start | actuated during engine start | - | engine | CU | pneumatic starter |
| 2 | xEM1011 | Electric motor | actuated during engine start | - | engine | CU | electrical starter |
| Emergency stop | | | | | | | |
| 1 | 1HZ1012/-x | push button manual emergency stop from LOP | emergency stop | - | LOP | - | - |
| 2 | 2HZ1012/-x | push button manual emergency stop from ROP | emergency stop | - | ECR | CU | customer |
| 3 | 3HZ1012/-x | push button manual emergency stop from WH | emergency stop | - | WH | CU | customer |
| 4 | 5HZ1012 | push button manual emergency stop from external | emergency stop | - | off engine | - | customer |
| 5 | 15HZ1012 | push button single channel manual emergency stop from external | emergency stop | - | off engine | - | customer |
| 6 | 2HOS1013 | push button override from WH | override | - | WH | CU | customer |
| 7 | 4HOS1013 | push button override crankcase monitoring from WH | override | - | WH | CU | customer |

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| No. | Measuring point | Description | Function | Measuring Range | Location | Connected to | Depending on option |
|---|---|---|---|---|---|---|---|
| 8 | 6HOS1013 | push button battle override | override | - | WH | CU | customer |
| Engine Torque | | | | | | | |
| 1 | 1WT1023 | torque transmitter engine torque | - | - | engine | - | - |
| Main and flange bearings | | | | | | | |
| 1 | 1TE1063/-x | temp sensor flange bearing GDS temp-x | indication, alarm, engine protection | 0–150°C | engine | CU | crankcase monitoring |
| 2 | xTE1064/-x | temp sensor main bearing x temp-x | indication, alarm, engine protection | 0–150°C | engine | CU | crankcase monitoring |
| 3 | 1TE1065/-x | temp sensor flange bearing CGDS temp-x | indication, alarm, engine protection | 0–150°C | engine | CU | crankcase monitoring |
| Turning Gear | | | | | | | |
| 1 | 1GOS1070 | limit switch turning gear engaged | start blocking while turning gear engaged | - | engine | CU | - |
| Generator | | | | | | | |
| 1 | xTE1094-DE | temp sensor generator bearing DE temp | indication, alarm, engine protection | 0–150°C | generator | CU | generator monitoring |
| 2 | xTE1094-NDE | temp sensor generator bearing NDE temp | indication, alarm, engine protection | 0–150°C | generator | CU | generator monitoring |
| 3 | 1TE1095-Lx | temp sensor generator winding Lx temp | indication, alarm, engine protection | 0–200°C | generator | CU | generator monitoring |
| 4 | 1WT1096 | analog input signal generator actual power | indication | - | generator | CU | generator monitoring |
| Battery | | | | | | | |



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| No. | Measuring point | Description | Function | Measuring Range | Location | Connected to | Depending on option |
|---|---|---|---|---|---|---|---|
| 1 | 1EXTS1150 | binary input signal starter battery charging active | alarm | - | - | - | electrical starter |
| 2 | 1EYCS1150 | binary output signal starter battery charging request | alarm | - | - | - | electrical starter |
| 3 | 2EYCS1150 | binary output signal direct driven battery charging generator selected | alarm | - | - | - | electrical starter |
| 4 | 1EM1150 | electric generator battery charging generator | - | - | engine | - | - |
| Lube oil system | | | | | | | |
| 1 | 1PT2165 | pressure transmitter lube oil press. filter inlet | alarm at high press | 0–10 bar | engine | CU | - |
| 2 | 1TE2170/-x | temp sensor lube oil temp engine inlet | alarm at high temp | - | engine | CU | - |
| 3 | xPT2170 | pressure transmitter lube oil pressure engine inlet | alarm at low lube oil pressure | 0–10 bar | engine | CU | - |
| 4 | 1PDS2170 | differential pressure switch lube oil filter on engine | filter contamination | - | engine | CU | - |
| 5 | xPT2790-DE | pressure transmitter generator lube oil pressure DE bearing | alarm at low lube oil pressure | - | generator | CU | generator monitoring |
| 6 | xPT2790-NDE | pressure transmitter generator lube oil pressure NDE bearing | alarm at low lube oil pressure | - | generator | CU | generator monitoring |
| Crankcase | | | | | | | |
| 1 | xPT2800 | pressure transmitter crankcase pressure | alarm | –70–70 mbar | engine | CU | - |
| 2 | 2LS2810 | level switch oil level in oil pan | alarm at low level | - | engine | CU | - |
| Splash oil | | | | | | | |
| 1 | xTE2880/-x | temp sensor splash-oil temp compartment X | splash oil monitoring | 0–150 °C | engine | CU | - |
| Gearbox | | | | | | | |

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| No. | Measuring point | Description | Function | Measuring Range | Location | Connected to | Depending on option |
|---|---|---|---|---|---|---|---|
| 1 | 1LS2970 | level switch gear lube oil level low | - | | gearbox | CU | - |
| 2 | 1PT2970 | pressure transmitter gear lube oil pressure | - | | gearbox | CU | - |
| 3 | xTE2970 | temp sensor gear lube oil temp | - | 0–150 °C | gearbox | CU | - |
| 4 | xTE2980 | temp sensor gear thrust bearing temp | - | 0–150 °C | gearbox | CU | - |
| Cooling water | | | | | | | |
| 1 | 1LS3100 | level switch HTCW expansion tank level | level monitoring | - | off engine | CU | customer |
| 2 | 1EYCS3110 | binary output signal HTCW pre-heating request | pre-heating request | - | - | CU | - |
| 3 | xPT3170 | pressure transmitter HTCW pressure cylinder cooling inlet | alarm at low pressure | 0–6 bar | engine | CU | - |
| 4 | 1TE3180/-x | temp sensor HTCW temp cylinder cooling outlet | alarm, indication | - | engine | CU | - |
| 5 | 1EYCSM3700 | binary output signal generator cooling water pump on-request | alarm, indication | - | generator | CU | generator monitoring |
| 6 | 1FS3770 | flow switch generator cooling water flow | alarm, indication | - | generator | CU | generator monitoring |
| 7 | 1LS3780 | level switch generator cooling water leakage | level monitoring | - | generator | CU | generator monitoring |
| 8 | 1LS4100 | level switch LTCW level expansion tank | level monitoring | - | off engine | CU | customer |
| 9 | 1EYCSM4110 | binary output signal LTCW pre-heating on-request | alarm, indication | - | generator | CU | generator monitoring |
| 10 | 1PT4120 | pressure transmitter seawater pressure pump outlet | alarm, indication | 0–10 bar | - | CU | customer |
| 11 | 1PT4170 | pressure transmitter LTCW pressure CA cooler inlet | alarm, indication | 0–6 bar | engine | CU | - |
| Fuel system | | | | | | | |



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| No. | Measuring point | Description | Function | Measuring Range | Location | Connected to | Depending on option |
|---|---|---|---|---|---|---|---|
| 1 | 2PDS5064 | differential pressure switch fuel oil plant filter | alarm, indication | - | off engine | - | - |
| 2 | 1PT5066 | differential pressure transmitter fuel oil water separator differential pressure | alarm, indication | -1-5 bar/ 4-20 mA | off engine | CU | - |
| 3 | 1LS5066 | level switch fuel oil water separator chamber1 | level monitoring | - | off engine | CU | customer |
| 4 | 2LS5066 | level switch fuel oil water separator chamber2 | level monitoring | - | off engine | CU | customer |
| 5 | 1TE5070-1 | temp sensor fuel oil temp engine inlet | alarm, indication | - | engine | CU | - |
| 6 | 1PT5070 | pressure transmitter fuel oil pressure engine inlet | pressure of low pressure fuel system common rail | 0–40 bar | engine | CU | - |
| 7 | 1PDS5070 | differential pressure switch fuel oil filter on engine | filter contamination | - | engine | CU | - |
| 8 | 1FCV5075/-x | suction throttle valve fuel oil high-pressure pump 1 row x | volume control of low pressure fuel | - | engine | CU | - |
| 9 | 1PT5076A/B | pressure transmitter fuel oil rail pressure | pressure of high pressure fuel system common rail | 0–2700 bar | engine | CU | - |
| 10 | 1LS5076 | level switch fuel oil break leakage high-pressure pipe | high pressure fuel system leakage detection | - | engine | CU | - |
| 11 | xFSV5078x | injection valve fuel oil injection cylinder Ax/Bx | fuel injection | - | engine | CU | - |
| 12 | 1PZ5081x | pressure limiting valve fuel oil rail pressure row x | fuel injection | - | engine | - | - |

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| No. | Measuring point | Description | Function | Measuring Range | Location | Connected to | Depending on option |
|---|---|---|---|---|---|---|---|
| Charge air | | | | | | | |
| 1 | 1TE6100B | temp sensor intake air temp row B | alarm, indication | –50–80 °C | engine | CU | - |
| 2 | 1TE6170A/-x | temp sensor charge air temp cooler A inlet | alarm, indication | 0–300 °C | engine | CU | - |
| 3 | 1TE6180A/B/-x | temp sensor charge air temp engine inlet row A/B | alarm, indication | -20–120 °C | engine | CU | - |
| 4 | 1PT6180B | pressure transmitter charge air pressure engine inlet row B | alarm, indication | 0-6 bar | engine | CU | - |
| Exhaust gas | | | | | | | |
| 1 | xTE6570A/B | temp sensor exhaust gas temp cylinder Ax/Bx outlet | indication, alarm, engine protection | 0–800 °C | engine | CU | cylinder exhaust gas monitoring |
| 2 | 1XCV6570A/B | variable flap waste gate row A/B | exhaust gas blow off at high TC speed | - | engine | CU | - |
| 3 | 1ET6570A/B | analog output signal waste gate row A/B position setpoint | - | - | engine | CU | - |
| 4 | 1GT6570A/B | analog input signal waste gate row A/B position feedback | - | - | engine | CU | - |
| 5 | 1TE6575Ax/Bx | temp sensor exhaust gas temp TC Ax/Bx inlet | indication, alarm, TC protection | 0–800 °C | engine | CU | - |
| 6 | 1TE6592/-x | temp sensor/temp sensor element exh. gas temp. after waste gate inflow-x | indication, alarm, TC protection | 0–800 °C | off engine | CU | - |
| Start air | | | | | | | |
| 1 | 1PT7170 | pressure transmitter start air pressure | alarm, indication | 0–40 bar | off engine | CU | pneumatic starter |
| Cooling air | | | | | | | |
| 1 | 1TE7670 | temp sensor generator cooling air inlet temp | alarm, indication | 0–120 °C | generator | CU | generator monitoring |



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| No. | Measuring point | Description | Function | Measuring Range | Location | Connected to | Depending on option |
|---|---|---|---|---|---|---|---|
| 2 | 1TE7680 | temp sensor generator cooling air outlet temp | alarm, indication | 0–120 °C | generator | CU | generator monitoring |

Table 648: List of measuring and control devices

## 5.17 Propulsion control system – Propeller

### 5.17.1 Alphatronic 3000 system description for fixed pitch propeller systems

#### System overview

Alphatronic 3000 (AT3000) is the propulsion control system developed by Everllence for the Everllence diesel and gas engine range.

The basic features of the Alphatronic 3000 system design are:

- Remote control of a propulsion line with four-stroke engine, reverse gear and fixed pitch propeller (FPP).
- Remote propulsion power setup with engine start/stop.
- Engine speed setting and gear clutch control for ahead and astern thrust.
- Electric shaft control of handles on bridge ensuring bumpless transfer of responsibility.
- Automatic engine overload protection by limitation of engine torque.
- Automatic slowdown and running-up load program.
- Power limitation function between shaft lines to ensure safe operation of the vessel.
- Logical ergonomics and clear layout of panels, levers, buttons, displays and touch screens for perfect interaction between navigator/operator and propulsion system.
- Easy installation of modularised components.

#### Modularity

Depending on the propulsion engines' application, plant scope and functionality, additional display and control functions can be added in order to meet the requirements of the classification societies and customers. As central element, the PCU (propulsion control unit) communicates between the control stations as well as with engines and plant equipment. Due to its modularity, the complete control system can be customised up to a high degree in order to fulfill the customer's individual needs.

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**Alphatronic 3000 system configuration – 175D twin FPP plant**

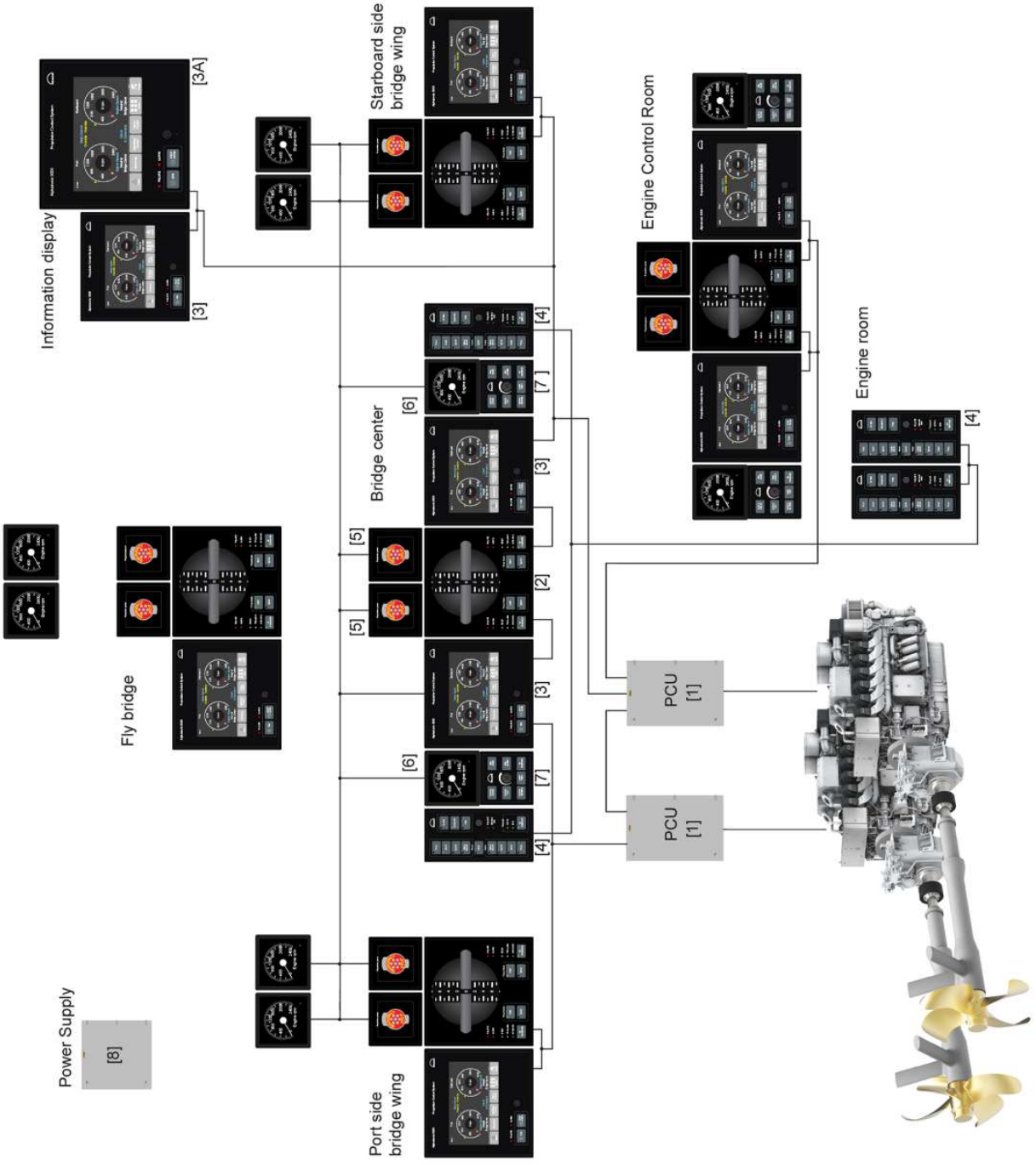



Figure 167: Alphatronic 3000 system configuration – 175D twin FPP plant

To the items which are numbered in the figure above from [1] to [8], you find further information in the sections Alphatronic 3000 main components – Propeller, Page 642 and Alphatronic 3000 requirements, Page 646.

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### 5.17.2 Alphatronic 3000 main components – Propeller

The following items are part of the Alphatronic 3000 system configuration, see figure Alphatronic 3000 system configuration – 175D twin FPP plant, Page 641. They are numbered in the figure from [1] to [7].

#### [1] Propulsion control unit (PCU)

The propulsion control unit (PCU) is delivered in a cabinet intended for bulkhead installation in the machinery space. The control unit comprises I/O modules for interfaces to the machinery and to the external systems. The included digital processor unit is handling the system software related to normal control level, which incorporates the following main control functions:

- Automatic load control with engine overload protection and engine running-up load program
- Automatic load reduction and slowdown control
- Electric shaft control of all included levers ensuring bumpless transfer of responsibility
- Engine start/stop and gear clutch control
- Self-monitoring and system failure alarm handling

#### [2] Double manoeuvre handle panel (MHP)

The manoeuvre handle panel (MHP) is the primary control device for the main propeller. The panel is always located on the ship's bridge, normally also in the ECR and optionally on the bridge wings and fly bridge. A control station will comprise one MHP in a suitable version for the actual propulsion plant.

For engines with a reversible gear and FPP, the control of the clutches to ahead/astern is included in the lever, which can also include a possible trolling function for coupling control during manoeuvring and slow steaming.

The double-handle version is for independency of the two shaft lines divided into two separate electric circuits. All handles comprise a stepper motor for alignment (electric shaft system) of the levers according to the commands from the lever in command.

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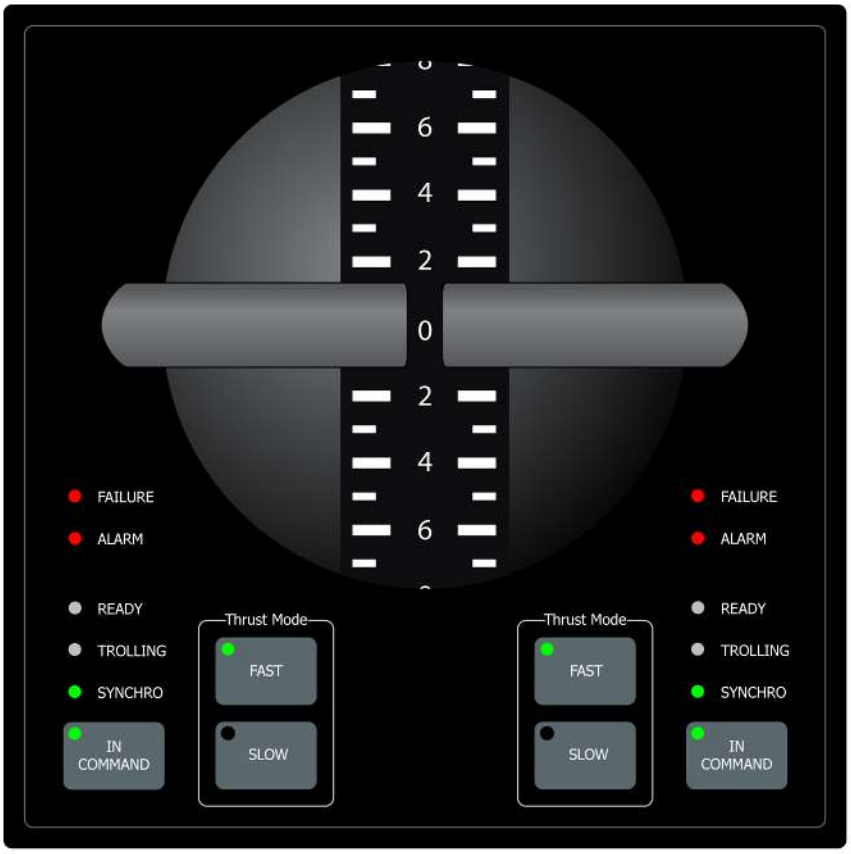



Figure 168: [2] Double-handle version MHP for FPP




Figure 169: MHP in a simple control station console



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### [3] Propulsion control panel (PCP) 7" display module

The propulsion control panel (PCP) with 7" display module comprises a touch screen with soft keys for handling transfer of control responsibility and setup of propulsion power. In addition to propulsion setup the display is handling the general monitoring and alarm for the propulsion control system as well.

The control functions related to "shutdown" and "load reduction" from the engine safety system are also available in the display panel.

The PCP is optional for bridge wing positions.




Figure 170: [3] Propulsion control panel – PCP – For FPP

### [3A] Information display 15"

Like for the 7" touch screen in the PCP, a separate 15" information display can be tailor-made to the specific engine and propulsion system applications. Standard main menus for FPP propulsion plants are available and other menus can be customised and implemented on request.

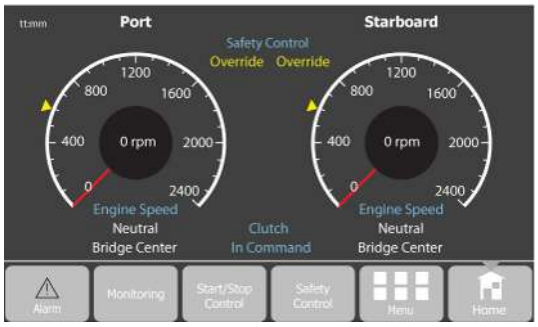



Figure 171: [3A] PCP information display

### [4] Telegraph order panel (TOP)

The telegraph order panel (TOP) is operating totally independently of the propulsion remote control system. According to SOLAS requirements, at least one telegraph panel per propeller shaft must be available on the bridge control location and in the engine room for safety and redundancy reasons. However, the telegraph panel can be placed on any bridge control station where the

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telegraph order communication is expected to be relevant. The telegraph can be used for independent order communication from the bridge to the engine room.

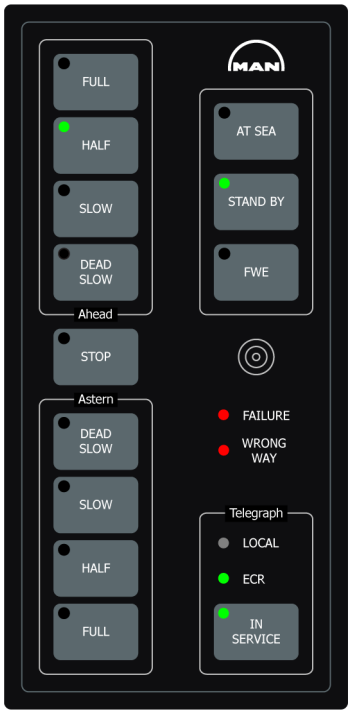



Figure 172: [4] Telegraph order panel – TOP

### [5] Emergency stop panel (ESP)

The propulsion power emergency stop panel (ESP) is operating totally independently of the propulsion remote control system. According to regulatory, at least one emergency stop panel per propeller shaft must be available on the bridge control location and in the ECR. For safety reasons, it is recommended to incorporate an emergency stop panel on all control stations.




Figure 173: [5] Emergency stop panel – ESP

### [6] Instrument panel for rpm indication (Q96)

Quadratic analogue dial instrument – illuminated with 0 – 2,400 rpm scale and anti-glare glass.



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Figure 174: [6] Engine speed instrument panel – Q96

**[7] Backup panel for 175D (BUP)**

In addition to the two standard control levels "Normal control" and "Local control", a third level may be delivered if requested by the customer. For backup control a backup panel is available for hardwired speed and clutch control from the bridge and ECR. The backup control delivers – without feedback – direct speed and clutch orders to the engine and gearbox.




Figure 175: [7] Backup panel – BUP

## 5.17.3 Alphatronic 3000 requirements

The following item is part of the Alphatronic 3000 system configuration, see figure Alphatronic 3000 system configuration – 175D twin FPP plant, Page 641. There the power supply is numbered with [8].

**[8] Power supply with battery backup**

Being an essential consumer, the power to the propulsion control system is divided into two different distribution lines. The main supply for the two power supplies must be from independent sections of the main power system on board the vessel. In the installation documentation, the two supplies are described as Power A and Power B.

Power A must be supplied by an AC/DC converter to ensure galvanic isolation, and Power B must be a 24 V DC no-break power supply with at least 30 minutes battery backup.

The power from the two power supplies are distributed in three groups each:

- Propulsion control system: Nominal load 80 W, peak load 150 W
- Bridge propulsion control panels: Nominal load 100 W, peak load 200 W
- Local propulsion control system: Nominal load 150 W, peak load 200 W

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The power supply is normally a standard required yard supply. On request, a power supply unit with duplicated power input, battery backup and fuses for power distribution to the propulsion control systems can be incorporated in the Alphatronic 3000 scope of delivery.

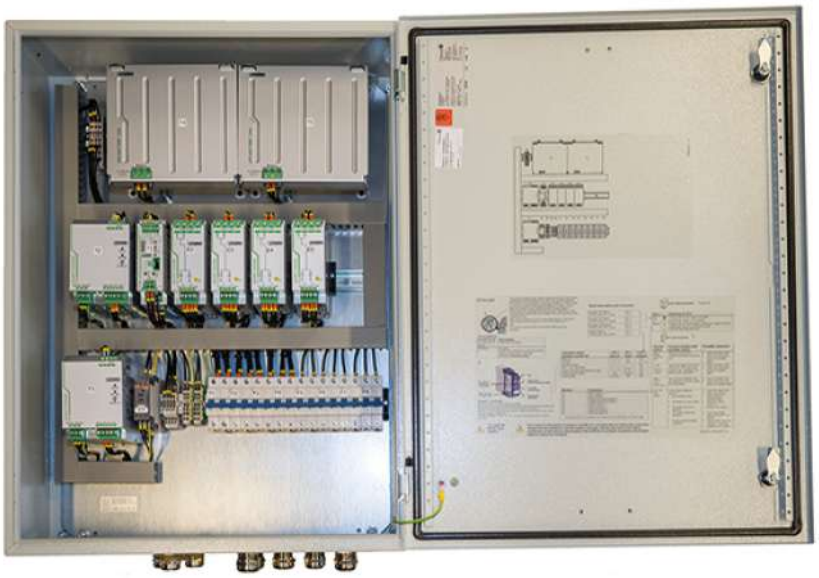


Figure 176: [8] Power supply unit

### 5.17.4 Alphatronic 3000 functionality

#### Engine synchronisation – Standard

Automatic thrust and engine power synchronisation for twin screw propulsion plants. The double manoeuvre handle panels have levers for independent control of two engines via two separate electric circuits. Within a minor deviation of starboard and port side control lever positions, the thrust and power orders will be automatically aligned and synchronised. The levers can at any time be moved away from each other and the synchronisation will automatically be disabled.

#### Gearbox clutch trolling control – Optional

For engines driving reversible gearboxes and FPPs, the control of the clutches to ahead/astern is included in the levers of the manoeuvre handle panel, which can also include a possible trolling function for coupling slip control during manoeuvring and slow steaming.

#### Speed pilot – Optional

A speed pilot feature is available with connection to the ship‘s GPS system for "Speed over ground" (SOG) input. The speed pilot optimises the voyage planning and operational speeds e.g. for pulling, steaming and convoy sailing – with fuel saving potentials of up to 4 %.



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**Exhaust gas underwater outlet control – Optional**

An Alphatronic 3000 function that controls the position of the exhaust gas outlet flaps depending on various parameters such as engine and propeller speed, gearbox clutched-in for ahead propulsion, ship speed etc. – in order to assure smooth and clean operation of vessels having the underwater exhaust gas outlet feature.

### 5.17.5 Alphatronic 3000 interfaces

**Standard engine interface for 175D**

The interface comprises hardwired interface for engine safety system, control transfer and engine speed and load control. Optionally remote start and stop of engines can be included.

**Optional interface for shaft brake control**

A propeller shaft brake can be controlled by Alphatronic 3000. Some gearbox designs feature the possibility of automatically activating a hydraulic shaft brake when clutching out. Contact the gearbox supplier in every case.

The Alphatronic 3000 propeller/gear interface features shaft brake control via hardwired interfaces to the gearbox control and enables independent functionality in normal and backup control level. The interfaces comprise functionality for oil pump control, remote clutch control and shaft brake control.

**Interfaces to external control and monitoring systems**

- Optional interface to ship alarm system
  Alarm and monitoring parameters provided by the Alphatronic 3000 propulsion control system for monitoring and announcement in the ship's alarm system are specified in a plant-specific summary of alarms. The data transmitted on the modbus to the ship's alarm system comprises a combination of alarm parameters requiring the attention from an engineer, propulsion status and monitoring parameters available for general information in the ship's alarm and control system.
  Refer to our standard reference drawing: 2173577-0 Summary of Alarms (A 7-page document not inserted in this Project Guide – will be forwarded upon request).
- Optional interface to voyage data recorder (VDR)
  The status in the normal control system is transmitted to the voyage data recorder system via a NMEA serial line according to IEC/EN 61996 and IEC/EN 61162-1. The status in the telegraph system is independent of the normal control status and is also transmitted to the voyage data recorder system via an NMEA serial line according to IEC/EN 61996 and IEC/EN 61162-1.
  Refer to our standard reference drawing: 2171083-3 VDR interface for normal control level (A 5-page document not inserted in this Project Guide – will be forwarded upon request).
  And refer to our standard reference drawing: 2171084-5 VDR interface for telegraph orders and backup control level (A 4-page document not inserted in this Project Guide – will be forwarded upon request).
- Optional interface to GPS for Alphatronic 3000 speed pilot and master clock
  An interface from the GPS is required if the optional Alphatronic 3000 speed pilot is included in the supply. The interface is made according to the NMEA 0183 standard for interfacing marine electric devices.
  A GPRMC sentence comprising "Speed over ground" information is ex-

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pected to be received from the GPS. The interface for the GPS can as well comprise the master clock functionality with control of UTC and local time via a ZDA sentence from the GPS to Alphatronic 3000.
Refer to:
– Our standard reference drawing: 2172660-2 Interface for Speed Pilot and
– our standard reference drawing: 2188788-6 Interface to Master Clock.

Further, the Alphatronic 3000 can include interface to the ship's navigation system if the ship speed and course are intended to be automatically controlled by a high level route planning system.

- Optional interface to DP and joystick control system
  It's possible to transfer the control of the main propeller to an external control system such as a dynamic positioning system or a joystick control system. Control can be transferred to an external system when the manoeuvring responsibility is on the bridge, the engine is running and the propeller is engaged. During joystick control, the engine is still fully protected against overload.
  With independent interfaces to a dynamic positioning system and a joystick control system the Alphatronic 3000 system fulfils the IMO requirements for dynamic position class 2 (DP2).
  Refer to our standard reference drawing: 2176193-8 Interface to DP system and/or joystick control system (A 3-page document not inserted in this Project Guide – will be forwarded upon request).

## 5.17.6 Alphatronic 3000 installation

### Cable plans and cabling

Cable plans and connection lists showing each cable connection to control system terminals are supplied by Everllence – when a purchase contract has been signed and upon receipt of all necessary shipyard information. In order to ensure the optimum function, reliability and safety of the control system, without compromise, the following installation requirements must be taken into consideration:

- Power supply cables must be at least of size 2.5 $mm^2$.
- If the supply cable length between the bridge and the engine room is in excess of 60 metres, the voltage drop should be considered.
- The signal cables should have wires with cross sectional area of min. 0.75 and max. 1.5 $mm^2$.
- All cables should be shielded and the screen must be connected to earth (terminal boxes) at both ends.
- Signal cables are not to be located alongside any other power cables conducting high voltage (i.e. large motors) or radio communication cables. The remote control signals can be disturbed by current induced into the cables from their immediate environment. Induced current may disturb or even damage the electronic control system if the cables are not installed according to our guidance.

### Installation guidance

Purpose

The purpose of this document is to describe the general requirements for installation of an Alphatronic 3000 propulsion control system on board a ship.

Installation documantation



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For mechanical installation of delivered equipment refer to the dimension drawings of the individual units to be installed. For each workstation our recommended layout for the workstation is forwarded.

The types of cables specified in this document are referring to the plant specific cable installation documents forwarded to the yard.

For interfaces to external systems, descriptions of expected signals exchanged with the external systems are forwarded.

### Mechanical installation

The delivered control cabinet is intended for installation on the bulkhead, allowing 30 to 100 centimetres of free space between the bottom of the cabinet and the deck. This provides space for cables coming in through the cable flanges in the bottom of the cabinet. The cable flanges may be removed for drilling of holes for cable glands suitable for the cables delivered by the installation yard.

Components delivered in terminal boxes or cabinets must not be removed from their casing. For electrical noise protection, an electric ground connection must be made from the cabinet to the ship's hull.

The cabinets must be installed on a place suitable for service inspection. Do not install the cabinets close to devices generating heat. The enclosure protection of cabinets intended for indoor installation on bridge or in machinery space is IP54. The enclosure protection of units intended for open deck or bridge wings is IP56.

The delivered control panels are fixed in the consoles by 4 M6 nuts from the rear after insertion of the panel from the front. For arrangement of propulsion control stations, refer to the layout drawings delivered for the vessel in question.

**Note:**
**As standard the control panels are delivered for indoor installation. Panels intended for open deck or open bridge wings will be delivered with special gaskets for enclosure protection IP56 according to required protection for equipment on ship's deck.**

### Power supply

As an essential consumer the power to the propulsion control system must be divided in two different distribution systems. The main supply for the two power supplies must be from independent sections of the main power system on board the vessel. In the installation documentation the two supplies are described as Power A and Power B.

Power A must be supplied by an AC/DC converter to ensure galvanic isolation, and Power B must be a 24 V DC no break power supply with at least 30 minutes battery backup.

| | |
|---|---|
| Voltage: | 24 V DC + 30 % – 25 % incl. voltage ripple |
| Voltage ripple: | 10 % AC rms over steady DC voltage |

The power from the two power supplies are distributed in three groups each:

| | |
|---|---|
| Propulsion control system: | Nominal load 80 W, peak load 150 W |
| Bridge propulsion control panels: | Nominal load 100 W, peak load 200 W |
| Local propulsion control system: | Nominal load 150 W, peak load 200 W |
| Max. current each: | 10 Amp, fused |

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**Type of cables used for the Alphatronic 3000 system**

Type 1
Cables used for power supplies and hardwired input/output:
Shielded cables with stranded wires must be used. The size of the power supply cables is specified in the cable plan, but must always have sufficient capacity to ensure that the voltage drop does not exceed 1 volt from power supply to last consumer in the system.

Type 2
Communication cable for serial input/outputs:
Shielded cables with stranded wires twisted in pairs must be used.

Type 3
Network communication cables:
The network cables between the propulsion control unit and the control panels.

| | |
|---|---|
| Wires: | Four twisted pairs, stranded wires (4 x 2 x 0.5 or 4 x 2 x 0.75) |
| Impedance: | Approximately 100 Ω |
| Shielding: | Copper braid shield with drain wire on the cable |
| Examples of cables: | BELDEN AWG 24, type No. 8102 |
| | LOCAP, type AWG 20, Digital No. 17-0130-01 |
| | NK Cables, type LJST-HF 2 x 2 x 0.5 |
| | FMGCG 2 x 2 x 0.75 |

Type 4
Industrial ethernet Cat 5e ES cable:
TCP/IP communication.

| | |
|---|---|
| | Electrical data at 20 °C |
| | Loop resistance ≤ 120 Ω/km |
| | Signal run time ≤ 5.3 ns/m |
| | Insulation resistance ≤ 500 mΩ x km |
| | Characteristic impedance 1 – 100 MHz (100 ±15) Ω |
| | Surface transfer impedance of screen 10 MHz ≤ 10 mΩ/m |
| | Test voltage (wire/wire/screen rms 50 Hz 1 min) = 700 V |
| Examples of cables: | |
| Supplier: | LEONI Special Cables GmbH |
| Type: | L-9YH(ST)CH 2 x 2 x 0.34/1.5-100 GN VZ |
| Supplier part number: | 202280 L45467-J16-B26 |

Type 5
CAN bus communication cables:
SaCoS CAN bus communication and propeller indication panels.

| | |
|---|---|
| Type: | Databus 120 Ω, 2 x 0.5 + 0.5 |
| Impedance: | 120 Ω |
| Example of cables: | |



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Supplier: HUBER+SUHNER

Type 6
Not used.

Type 7
Data cable 4 x 2 x 0.5 Cat 5e SFTP marine approved cable.

Type 8
Data cable 4 x 2 x 0.5 Cat 5e SFTP marine approved cable with RJ45 connectors. From the C-Rail with ethernet terminals on bridge and in ECR to the display panels the yard must deliver patch cables type Cat 5e SFTP with RJ45 male connectors.

Type 9
LEONI fiber breakout cable AT-V(ZN)H(ZN)H4 fiber type G 62,5 126 OM1 STB900 H with cable color (1-red, 2-green, 3-blue, 4-yellow) DNV approved or similar.

NB
Fiber cable to be connected with SC connector type on all 4 fibers in both ends. SC connector type HUBER+SUHNER SC Plug G50-125;G62,5/125 or similar.

Note:
Only stranded Cu wires are accepted for installations on ships.

### Cable installation

For layout of cables and specific terminal connections, refer to the cable plan and connection lists delivered for the vessel in question.

Note:
The individual cables shown on the cable plan must not be put together as one.

Laying-up of cables

When placing the cables in the vessel, the following must be taken into consideration:

- Paralleling with mains voltage or radio cables (both radio supply and antenna) for more than 5 m, must be at a minimum distance of 500 mm. Crossing of mains voltage or radio cables in right angles must be at a minimum distance of 200 mm.
- All screens must be connected to the cabinets and made as short and broad as possible.

### Cable specification

Example: W051A 4 x 2 x 0.75 (3)

| | |
|---|---|
| W | Reference for a cable to be delivered by the yard |
| 051A | Identification number for a specific cable, where the extension A indicates that the cable is a connection between units located on a common control station |
| 4 x 2 | Number of wires in the cable (here 8 wires arranged in 4 sets of twisted pairs) |
| x 0.75 | Wire size (cross-sectional area in $mm^2$) |
| (3) | Cable type according to cable specifications in this document |

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### Marking of cables and wires

All cables must be marked so they are easily recognisable, according to the Everllence forwarded cable plan. All wires must be marked with the marking of the plug and terminal they are inserted in.

### Cable screens

Only shielded cables must be used for the Alphatronic 3000 system. The cable screen must be connected in both ends of the cable. Three types of screen connections are used in the Alphatronic 3000 system.

### Terminal boxes in engine room

Cables connected to units located in the engine room will enter the terminal box through a special EMC cable gland designed for connection of the cable screen inside the cable gland. To fulfil the requirements of the enclosure protection IP54 all cable glands not used must be sealed before the ship goes into service.

### Control cabinet intended for location in ECR

Cables connected to control cabinets located in the engine control room or on the bridge have a ground (GND) rail for connection of the cable screens inside the cabinet close to the entrance of the cable.

### Consoles mounted control panels

Cables connected to control panels in engine control room and on the bridge consoles must be fitted to the panel protection cover with the cable screen connected to the cover close to the terminal plugs.

### Checking wires

We recommend portable digital multimeter for measuring Ω values, when checking the installation by the "ringing through" method.

Note:
The wires must not be tested for short circuits by high voltage equipment, i.e. meggers.



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**Label placed inside propulsion control cabinet – Valid for the complete installation**




Figure 177: Label placed inside propulsion control cabinet – Valid for the complete installation

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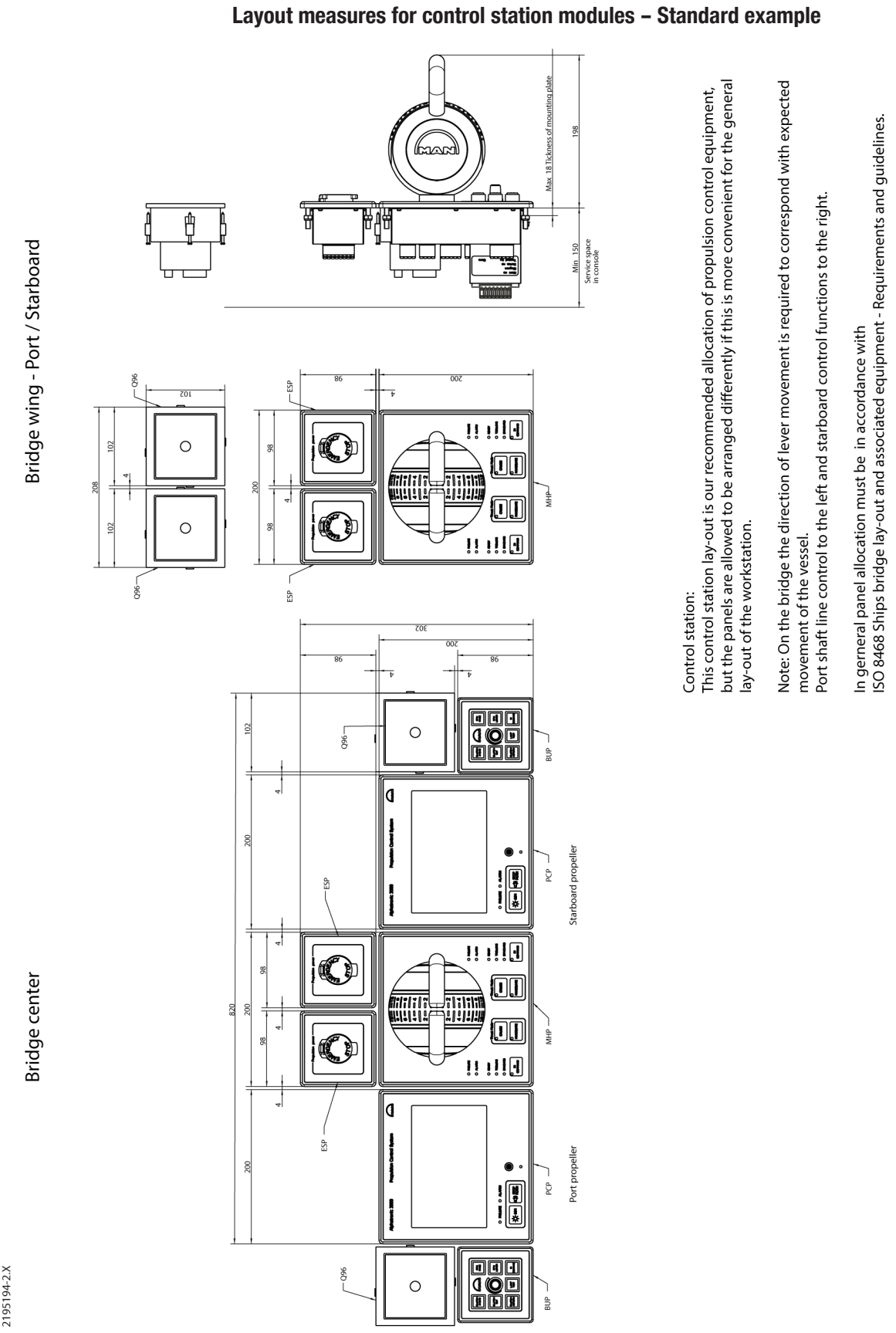



Figure 178: Layout measures for control station modules – Standard example

**Cut-out measures for control station modules – Standard example**

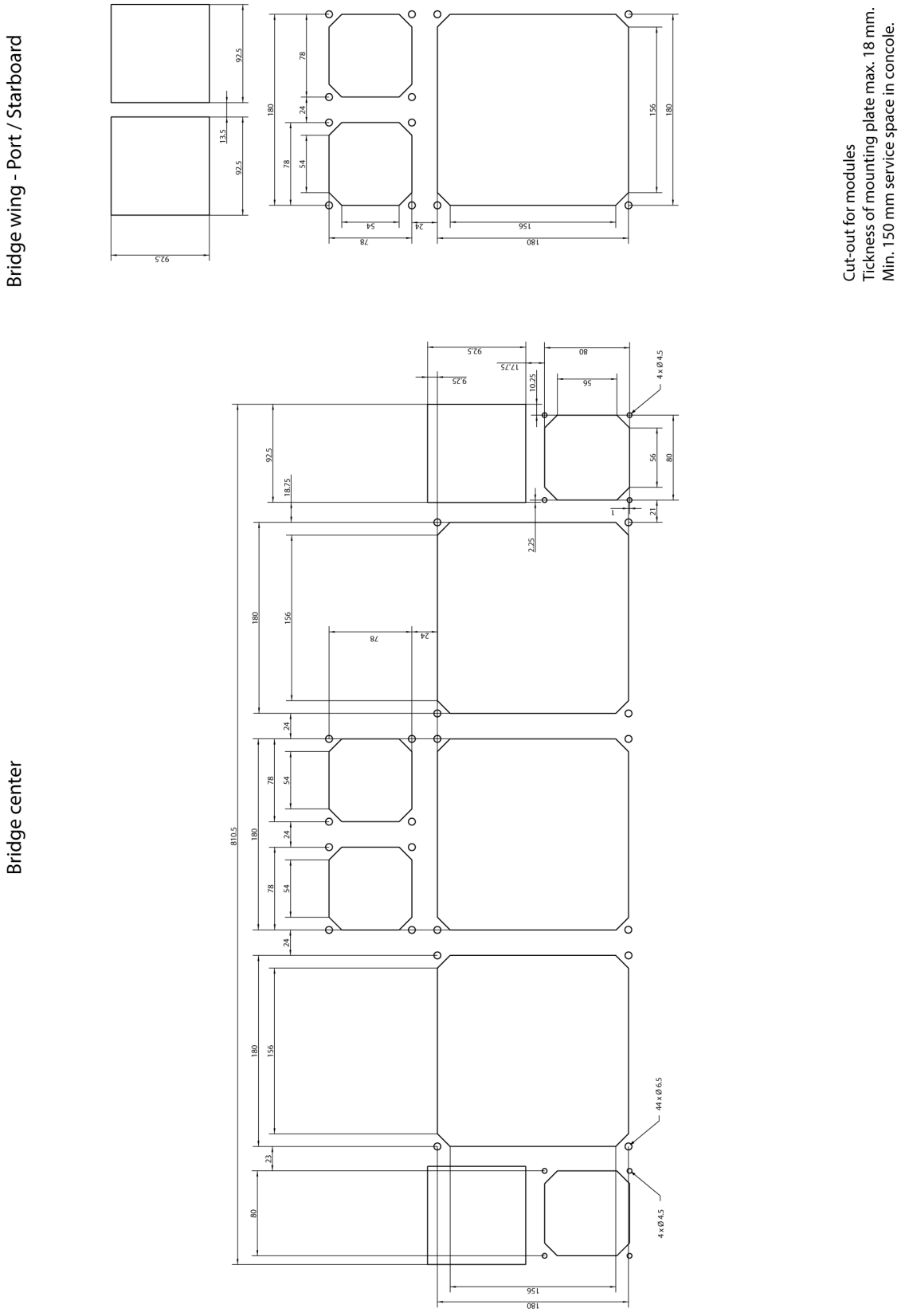



Figure 179: Cut-out measures for control station modules – Standard example

### Layout measures for standard cabinets

Propulsion control unit – H x W x D cabinet dimensions:
800 x 600 x 200 mm

Power supply unit – H x W x D cabinet dimensions:
800 x 600 x 200 mm



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## 5.18 Propulsion control system – Waterjet

### 5.18.1 Alphatronic 3000 system description for waterjet systems

**Alphatronic 3000 system configuration – 175D twin waterjet plant**

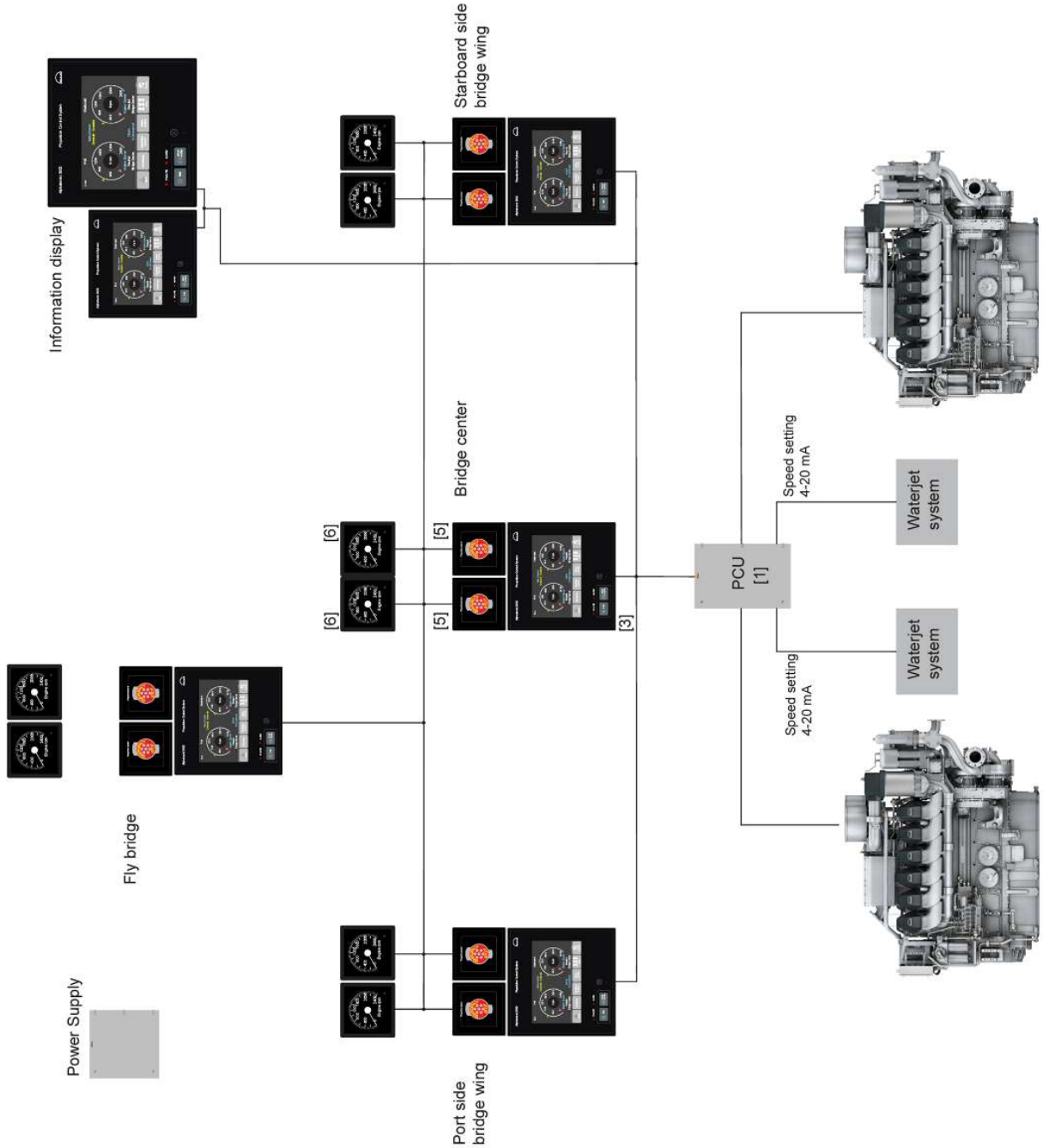



Figure 180: Alphatronic 3000 system configuration – 175D twin waterjet plant

To the items which are numbered in the figure above, with [1], [3] and [5], you find further information in the section Alphatronic 3000 main components – Waterjet, Page 659.

### 5.18.2 Alphatronic 3000 main components – Waterjet

The following items are part of the Alphatronic 3000 system configuration for twin water jet plant, see figure Alphatronic 3000 system configuration – 175D twin waterjet plant, Page 658. They are numbered in the figure with [1], [3] and [5].

#### [1] Propulsion control unit (PCU)

The propulsion control unit (PCU) is delivered in a cabinet intended for bulkhead installation in the machinery space. The control unit comprises I/O modules for interfaces to the machinery and to the external systems. The included digital processor unit is handling the system software related to normal control level, which incorporates the following main control functions:

- Automatic load control with engine overload protection and engine running-up load program
- Automatic load reduction and slowdown control including waiting program for switchboard
- Engine start/stop and gear clutch control
- Self-monitoring and system failure alarm handling

#### [3] Propulsion control panel (PCP) 7" Display module

The PCP with 7" display module comprises a touch screen with soft keys handling general monitoring and alarms for the propulsion control system.

The control function related to "shutdown" and "load reduction" from the engine safety system are also available in the display panel.

The PCP is optional for bridge wing positions.

#### [5] Emergency stop panel (ESP)

The propulsion power emergency stop panel is operating totally independently of the propulsion remote control system. According to regulatory, at least one emergency stop panel per propeller shaft must be available on the bridge control location and in the ECR. For safety reasons, it is recommended to incorporate an emergency stop panel on all control stations.

All other monitoring and display panels are optional and not included as standard for waterjet systems.

Note:
**The Alphatronic manoeuvre handle panels (MHP), however, can't be included here and as a result the waterjet manoeuvre handle panels and control levers are to be supplied by the waterjet supplier.**

Further: The above sections related to fixed pitch propeller systems, see sections:

Alphatronic 3000 requirements, Page 646

Alphatronic 3000 functionality, Page 647

Alphatronic 3000 interfaces, Page 648

Alphatronic 3000 installation, Page 649
– are also valid for waterjet systems.

For CP Propeller systems and any other propulsors and plant configurations not mentioned in the above Alphatronic 3000 description, contact Everllence directly.



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## 5.19 Gearboxes

### 5.19.1 General

The 175D engine is approved for usage in classified multi-engine and unclassified marine propulsion plants.

For propeller and water jet plants, a single input, single reduction marine gearbox is typically required to achieve the optimum shaft speed. Fixed pitch propellers (FPP) require a reversing gearbox, while controllable pitch propellers (CPP) and water jets (WJ) are normally used in combination with non-reversing gearboxes.

Since the 175D is only available in counter-clockwise rotation execution, in order to guarantee counter-rotating controllable pitch propellers either one of the following measures should be considered:

- Starboard and port gearboxes in opposite rotation executions (e.g. starboard CW/CW, port CW/CCW).
- Starboard and port engines arranged in opposite orientations and gearboxes in different layout executions as sketched in figure below.

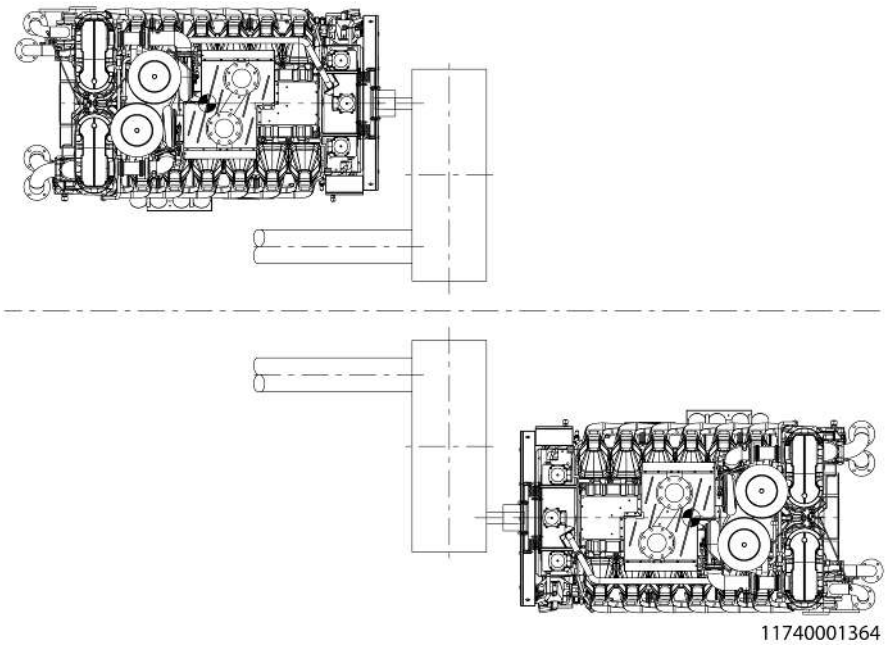
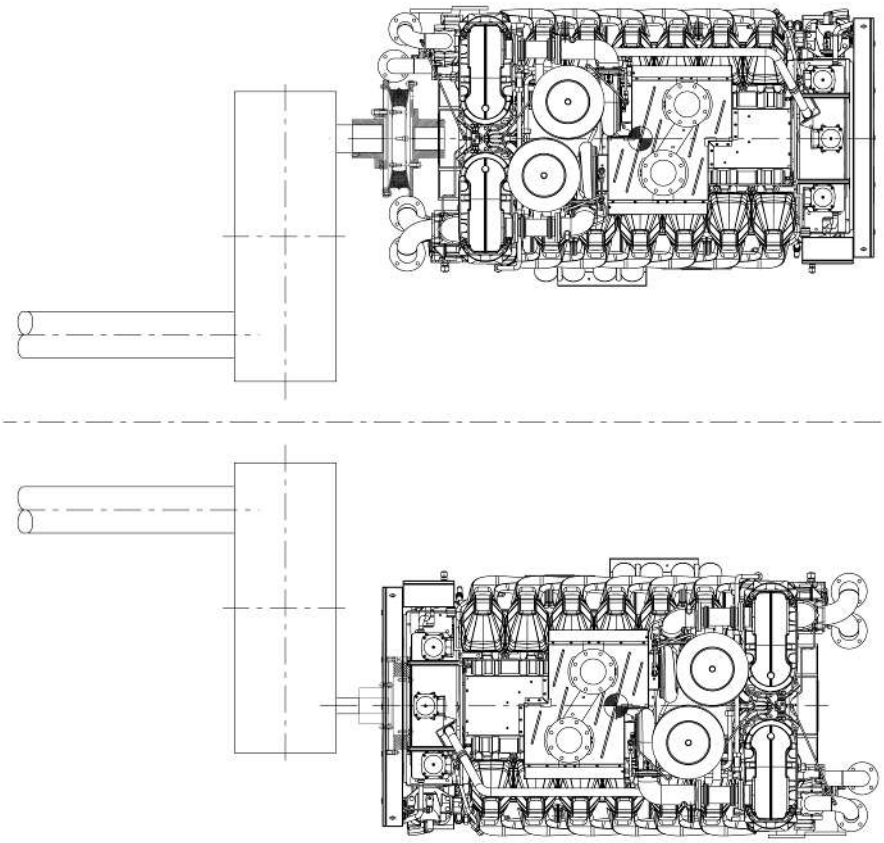



Figure 181: Engines arranged in opposite orientations

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Figure 182: Engines arranged with opposite rotation direction by turning it 180°

Azimuth thrusters and Voith-Schneider propellers do not require gearboxes as they have integrated speed reduction. More sophisticated, application-specific configurations, such as combined diesel and diesel (CODAD) or electric hybrid propulsion, are also possible. Contact Everllence for assistance in planning these types of applications.

The layout of the propulsion plant heavily depends on the type of application and its specific requirements. Selection of appropriate gearboxes is influenced by several characteristics: Annual usage, load profile, classification society, class notations, reduction ratio and engine room layout.

Reduction ratios typically cover the range 1:1.5 to 1:7.5 with vertical offset between input and output shafts. A horizontal offset execution is also available for several gearbox models.

### 5.19.2 Mounting concept

The 175D is designed to be installed on resilient mounts. Usage of traditional fixed mountings (chockfast or equivalent) is not permissible. Standard marine cone rubber mounts provide an effective and proven solution with a significantly higher performance in terms of structure borne noise for most applications.

Depending on the criticality of structure borne noise signature, several mounting options are available:



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### Gearbox on rigid mounts

This layout is typical for commercial applications with no requirements on vibration levels (workboats, ferries, fast boats). An elastic coupling between engine and gearbox compensates the misalignment during operation. The propeller thrust is directly transferred through the gearbox's internal thrust bearing to the ship foundation. No additional components are required.

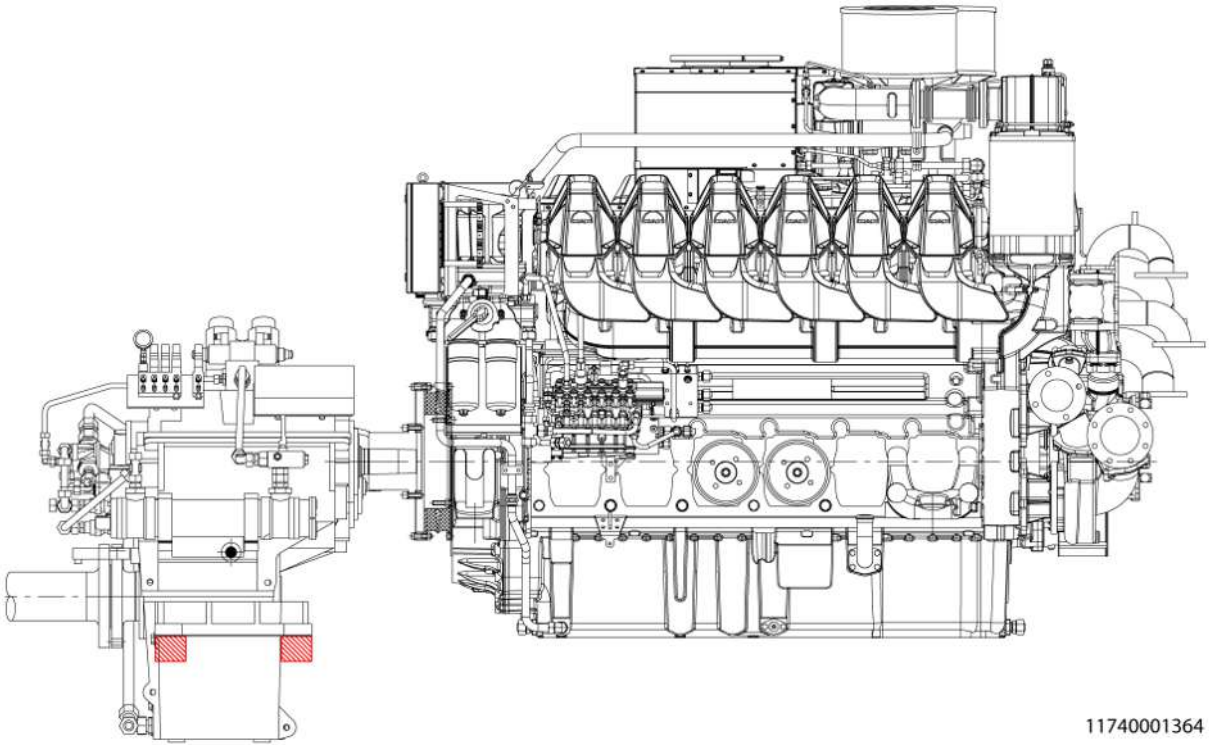



Figure 183: Gearbox on rigid mountings

### Gearbox on resilient mounts

When low vibration levels are mission critical (yachts and pleasure crafts), the gearbox can be resiliently mounted. In this case, a separate thrust block and an additional elastic coupling between gearbox and propeller shaft are required. The removal of propeller thrust and the individual mounting of engine and gearbox allow a full optimisation of the structure-borne signature.

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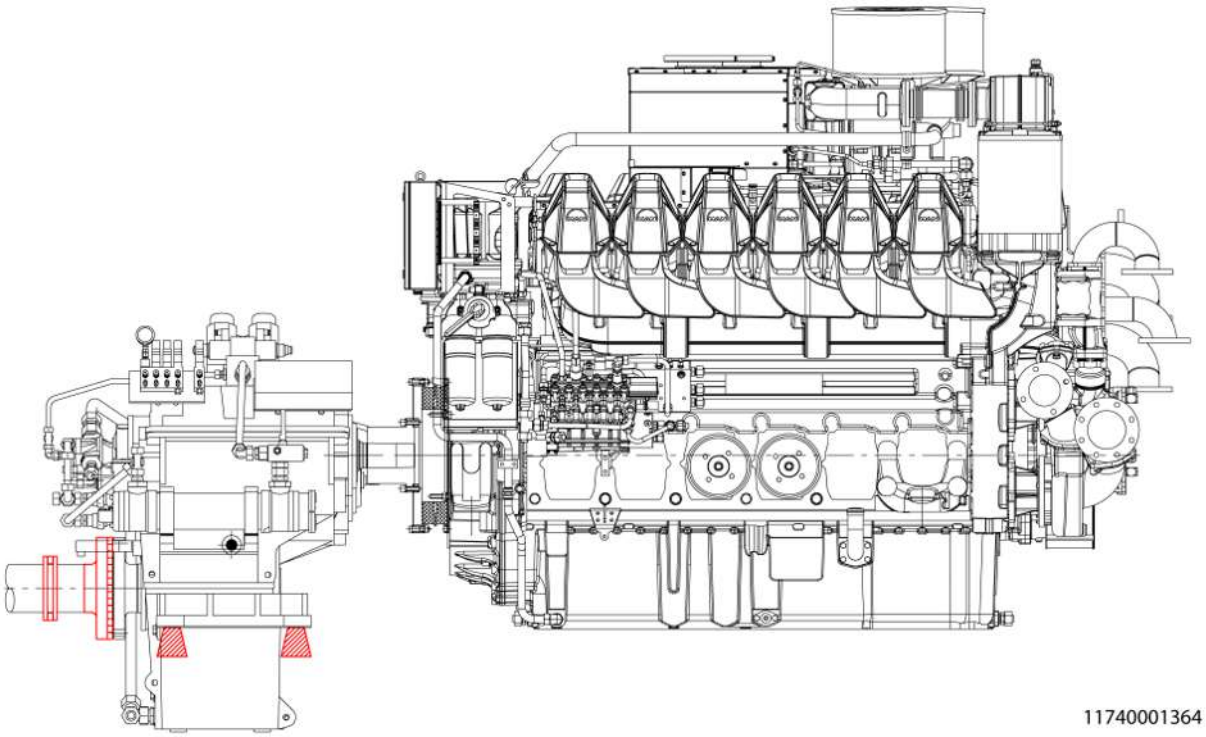



Figure 184: Gearbox on resilient mountings

### Gearbox on semi-resilient mounts

This is an intermediate solution, which combines the simplicity of rigid mounts with a moderate reduction of structure-borne noise. It can be successfully applied to applications where low vibration levels are required but are not mission critical. The elastic coupling between gearbox and propeller shaft is still required, while a dedicated thrust block is not necessary as the propeller thrust is transferred through the gearbox's internal thrust bearing to the semi-resilient mounts and ultimately to the ship foundations. Due to limitation in the damping performance of semi-resilient mounts, this layout cannot guarantee a full structure borne noise optimisation.



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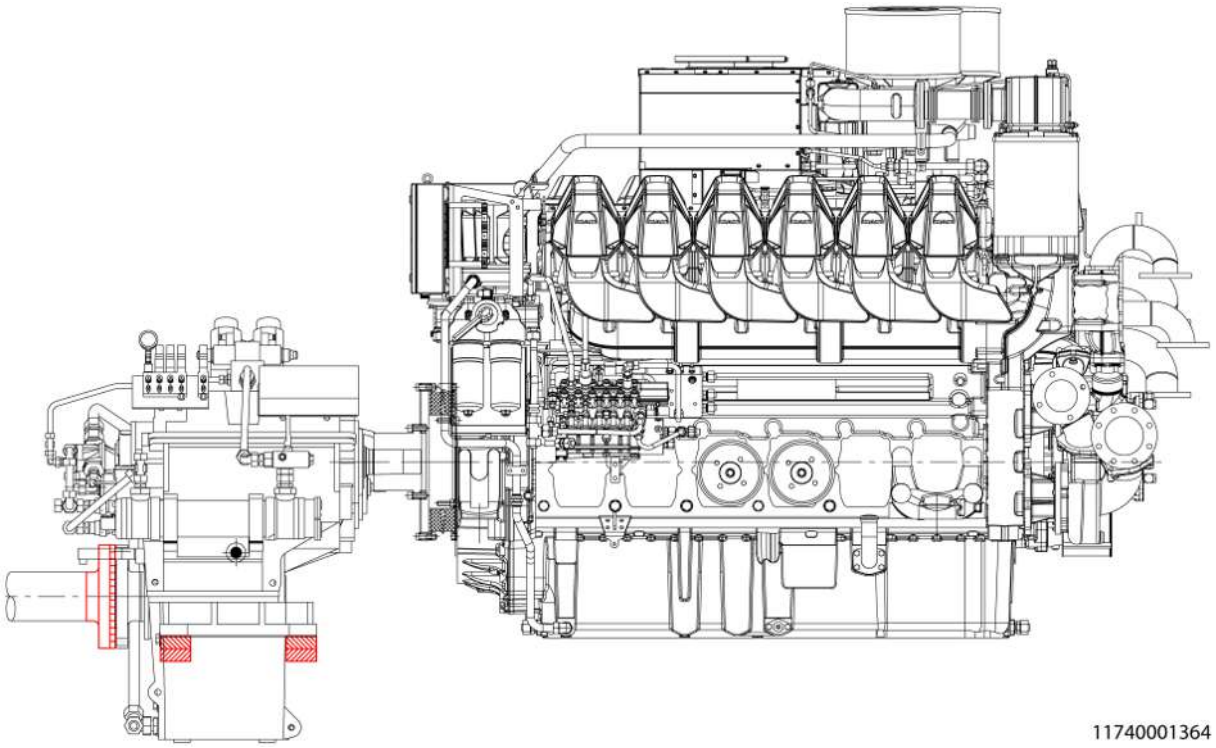



Figure 185: Gearbox on semi-resilient mountings

Additional project-specific solutions for special applications (navy, oceanographic research vessels, etc.) are available. Contact Everllence for assistance in planning these types of applications.

### 5.19.3 Gearbox configuration

All gearbox configurations include standard features:

- Input shaft with taper 1:30
- Output flange
- Oil pump
- Duplex filter
- Heat exchanger, cooling media seawater, maximum inlet temperature 32 °C
- Electrically operated clutch control valve
- Thrust bearing (reversing gearboxes only)
- Standard supervision according to table below

Supervision packages, in accordance with the specific requirements of different classification societies are available as options.

| Feature | Reversing gearbox | Non-reversing gearbox |
|---|---|---|
| Pressure switch, low operating oil pressure | Yes | Yes |
| Temperature sensor, lube oil after heat exchanger | Yes | Yes |
| Lube oil filter contamination indicator | Yes | Yes |
| Thermometer, lube oil after heat exchanger | Yes | Yes |



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| Feature | Reversing gearbox | Non-reversing gearbox |
|---|---|---|
| Pressure gauge, operating oil pressure | Yes | Yes |
| Interfaces for pressure switch, clutch "ahead/astern" engaged | Yes | No |
| Pressure switch, clutch "ahead" engaged | No | Yes |

Table 649: Standard supervision

### Gearbox cooling

An adequate flow of cooling water has to be provided in order to guarantee a proper and safe operation. The engine-driven seawater pump on the 175D has been designed to provide enough additional flow for a typical gearbox.

### Power take-off

Available on request. It can be used to drive auxiliary pumps or, in combination with a controllable pitch propeller, an auxiliary generator at synchronous speed.

### Output counter flange

Available on request to provide a convenient connection of the propeller shaft to a rigidly mounted gearbox.

### Trailing pump

Available on request. An auxiliary oil pump driven by the secondary gear, which guarantees lubrication for a rotating output shaft while the input shaft is at standstill (propeller in windmilling operation). A trailing pump is therefore advised for fixed pitched propellers and controllable pitch propellers without full-feathering capability.

### Trolling function

Available on request. Used in combination with a fixed pitched propeller to allow operation below nominal minimum propeller speed. It works by regulating the oil pressure to achieve a controlled slip of the clutch. A continuous variation of propeller rpms in the range 20%–80% of nominal minimum propeller speed is possible, greatly improving maneuverability of fixed pitched propeller applications.

### Shaft brake

Available on request. Advised for fixed pitched propeller applications to lock a shaft in case of failures of shaft bearings, stern tube or gearbox.

## 5.20 High-efficient electric propulsion plants with variable speed GenSets (EPROX-DC)

Recent developments in electric components, which are used in an electric propulsion plant show solutions for a fuel-saving propulsion system. For many years, electric propulsion employs alternating current (AC) for the main switchboards. Since some years also direct current (DC) distributions are applied (DC-grids). In such a system AC components, like alternators and E-propulsion motors are combined with variable speed drives and a DC distribution. The DC distribution allows the diesel engines to operate with variable speed



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for highest fuel-oil efficiency at each load level. It enables a decoupled operation of the diesel engines, propulsion drives and other consumers of electric power, where each power source and consumer can be controlled and optimised independently.

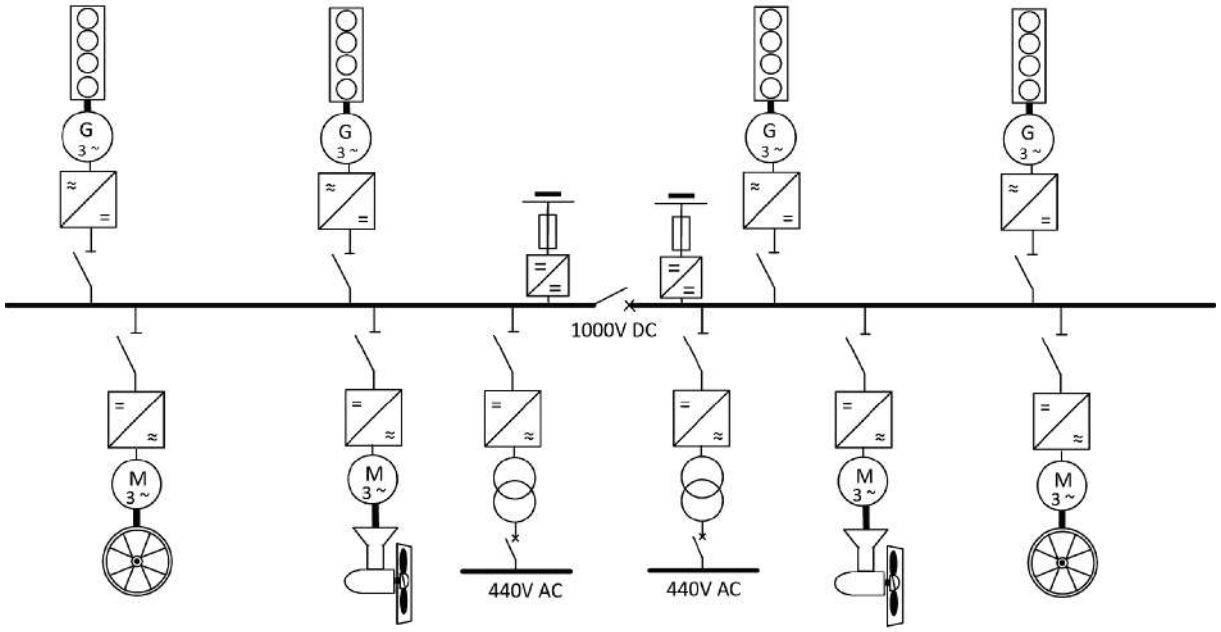



Figure 186: Example: High-efficient electric propulsion plant based on a DC distribution; with integrated batteries for energy storage

As a result constant speed operation for the diesel engines is no longer a constraint. With a DC distribution the utilisation of an enlarged engine operation map with a speed range of 60 % to 100 % is possible. According to the total system load each engine can operate at an individual speed set point, in order to achieve a minimum in fuel oil consumption.

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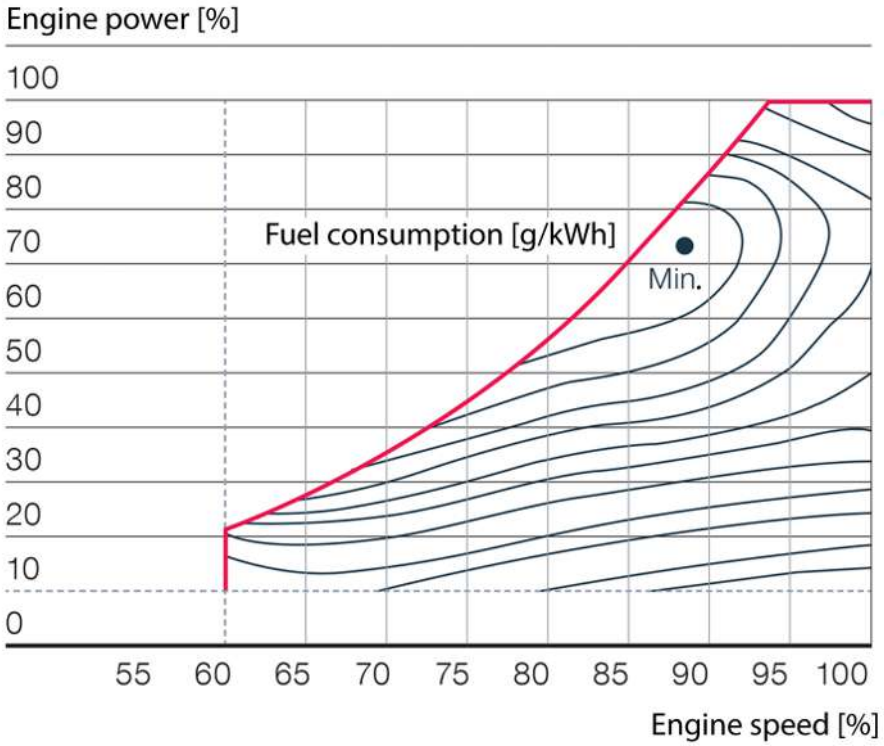



Figure 187: Typical SFOC map for a four stroke medium speed diesel engine (for illustration purpose only)

Another major advantage of EPROX-DC is the easy integration of energy storage systems, like batteries. They reduce the transient loads on the engines, improve the dynamic response of the propulsion system and therefore the maneuverability of the vessel (electric boost and electric spinning reserve). Also fast load applications are removed from the engines, load peaks are smoothed and rapid power fluctuations from the vessel´s grid are absorbed (peak shaving).

It is also beneficial to run the engines always on a high and constant loading, where the specific fuel oil consumption of the diesel engines is lowest. This degree of freedom can be utilised and surplus power can charge the batteries. If less system power is required, one engine can be shut down, with the remaining ones running still with a high loading, supported by power out of the batteries (strategic loading of the engines).



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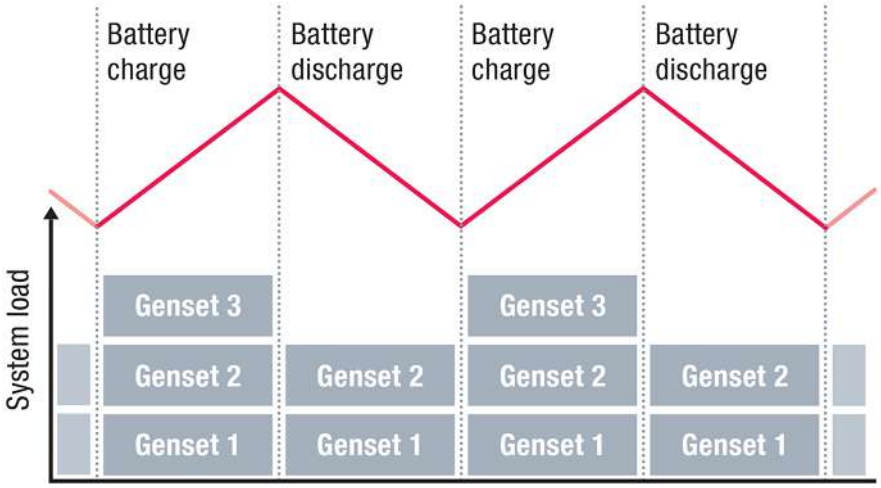



Figure 188: Batteries enable the diesel engines to operate strategically at a high loading, respectively with low specific fuel oil consumption

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# 6 Annex

## 6.1 Safety instructions and necessary safety measures

The following list of basic safety instructions, in combination with further engine documentation like user manual and working instructions, should ensure a safe handling of the engine. Due to variations between specific plants, this list does not claim to be complete and may vary with regard to project-specific requirements.

### 6.1.1 General

There are risks at the interfaces of the engine, which have to be eliminated or minimised in the context of integrating the engine into the plant system. Responsible for this is the legal person which is responsible for the integration of the engine.

Following prerequisites need to be fulfilled:

- Layout, calculation, design and execution of the plant have to be state of the art.
- All relevant classification rules, regulations and laws are considered, evaluated and are included in the system planning.
- The project-specific requirements of Everllence regarding the engine and its connection to the plant are implemented.
- In principle, the more stringent requirements of a specific document is applied if its relevance is given for the plant.

### 6.1.2 Safety equipment and measures provided by plant-side

- Proper execution of the work

  Generally, it is necessary to ensure that all work is properly done according to the task trained and qualified personnel.

  All tools and equipment must be provided to ensure adequate accesible and safe execution of works in all life cycles of the plant.

  Special attention must be paid to the execution of the electrical equipment. By selection of suitable specialised companies and personnel, it has to be ensured that a faulty feeding of media, electric voltage and electric currents will be avoided.
- Fire protection

  A fire protection concept for the plant needs to be executed. All from safety considerations resulting necessary measures must be implemented. The specific remaining risks, e.g. the escape of flammable media from leaking connections, must be considered.

  Generally, any ignition sources, such as smoking or open fire in the maintenance and protection area of the engine is prohibited.

  Smoke detection systems and fire alarm systems have to be installed and in operation.
- Electrical safety

  Standards and legislations for electrical safety have to be followed. Suitable measures must be taken to avoid electrical short circuit, lethal electric shocks and plant specific topics as static charging of the piping through the media flow itself.



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- Noise and vibration protection

  The noise emission of the engine must be considered early in the planning and design phase. A soundproofing or noise encapsulation could be necessary. The foundation must be suitable to withstand the engine vibration and torque fluctuations. The engine vibration may also have an impact on installations in the surrounding of the engine, as galleries for maintenance next to the engine. Vibrations act on the human body and may dependent on strength, frequency and duration harm health.

- Thermal hazards

  In workspaces and traffic areas hot surfaces must be isolated or covered, so that the surface temperatures comply with the limits by standards or legislations.

- Composition of the ground

  The ground, workspace, transport/traffic routes and storage areas have to be designed according to the physical and chemical characteristics of the excipients and supplies used in the plant.

  Safe work for maintenance and operational staff must always be possible.

- Adequate lighting

  Light sources for an adequate and sufficient lighting must be provided by plant-side. The current guidelines should be followed (100 Lux is recommended, see also DIN EN 1679-1).

- Working platforms/scaffolds

  For work on the engine working platforms/scaffolds must be provided and further safety precautions must be taken into consideration. Among other things, it must be possible to work secured by safety belts. Corresponding lifting points/devices have to be provided.

- Setting up storage areas

  Throughout the plant, suitable storage areas have to be determined for stabling of components and tools.

  It is important to ensure stability, carrying capacity and accessibility. The quality structure of the ground has to be considered (slip resistance, resistance against residual liquids of the stored components, consideration of the transport and traffic routes).

- Engine room ventilation

  An effective ventilation system has to be provided in the engine room to avoid endangering by contact or by inhalation of fluids, gases, vapours and dusts which could have harmful, toxic, corrosive and/or acid effects.

  The engine room ventilation must ensure a maximum engine room temperature, with following boundary conditions:

  – Maximum air temperature in the area of the engine and its components ≤ 45°C.

  – Maximum air temperature at least 5K below the flash point of any liquids, that is present within the engine room.

- Intake air filtering

  In case air intake is realised through piping and not by means of the turbocharger´s intake silencer, appropriate measures for air filtering must be provided. It must be ensured that particles exceeding 5 µm will be restrained by an air filtration system.

- Quality of the intake air

  It has to be ensured that combustible media will not be sucked in by the engine.



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Intake air quality according to the section Specification for intake air (combustion air), Page 411 has to be guaranteed.

- Emergency stop system

  The emergency stop system requires special care during planning, realisation, commissioning and testing at site to avoid dangerous operating conditions. The assessment of the effects on other system components caused by an emergency stop of the engine must be carried out by plant-side.

- Fail-safe 24 V power supply

  Because engine control, alarm system and safety system are connected to a 24 V power supply this part of the plant has to be designed fail-safe to ensure a regular engine operation.

- Hazards by rotating parts/shafts

  Contact with rotating parts must be excluded by plant-side (e.g. free shaft end, flywheel, coupling).

- Safeguarding of the surrounding area of the flywheel

  The entire area of the flywheel has to be safeguarded by plant-side.

  Special care must be taken, inter alia, to prevent from: Ejection of parts, contact with moving machine parts and falling into the flywheel area.

- Securing of the starting air pipe

  To secure against unintentional restarting of the engine during maintenance work, a disconnection and depressurisation of the engine´s starting air system must be possible. A lockable starting air stop valve must be provided in the starting air pipe to the engine.

- Consideration of the blow-off zone of the crankcase cover´s relief valves

  During crankcase explosions, the resulting hot gases will be blown out of the crankcase through the relief valves. This must be considered in the overall planning.

- Installation of flexible connections

  For installation of flexible connections follow strictly the information given in the planning and final documentation and the manufacturer manual.

  Flexible connections may be sensitive to corrosive media. For cleaning only adequate cleaning agents must be used (see manufacturer manual). Substances containing chlorine or other halogens are generally not permissible.

  Flexible connections have to be checked regularly and replaced after any damage or lifetime given in manufacturer manual.

- Connection of exhaust port of the turbocharger to the exhaust gas system of the plant

  The connection between the exhaust port of the turbocharger and the exhaust gas system of the plant has to be executed gas tight and must be equipped with a fire proof insulation.

  The surface temperature of the fire insulation must not exceed 220 °C.

  In workspaces and traffic areas, a suitable contact protection has to be provided whose surface temperature must not exceed 60 °C.

  The connection has to be equipped with compensators for longitudinal expansion and axis displacement in consideration of the occurring vibrations (the flange of the turbocharger may reach temperatures of > 600 °C).

- Media systems



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The stated media system pressures must be complied. It must be possible to close off each plant-side media system from the engine and to depressurise these closed off pipings at the engine. Safety devices in case of system overpressure must be provided.

- Drainable supplies and excipients

  Supply system and excipient system must be drainable and must be secured against unintentional recommissioning (EN 1037). Sufficient ventilation at the filling, emptying and ventilation points must be ensured. The residual quantities which must be emptied have to be collected and disposed of properly.

- Spray guard has to be ensured for liquids possibly leaking from the flanges of the plant´s piping system. The emerging media must be drained off and collected safely.

- Signs

  – Following figure shows exemplarily the risks in the area of a combustion engine. This may vary slightly for the specific engine.

    This warning sign has to be mounted clearly visibly at the engine as well as at all entrances to the engine room.




Figure 189: Warning sign E11.48991-1108

  – Prohibited area signs.

    Depending on the application, it is possible that specific operating ranges of the engine must be prohibited.

    In these cases, the signs will be delivered together with the engine, which have to be mounted clearly visibly on places at the engine which allow intervention of the engine operation.

- Optical and acoustic warning device



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Communication in the engine room may be impaired by noise. Acoustic warning signals might not be heard. Therefore it is necessary to check where at the plant optical warning signals (e.g. flash lamp) should be provided.

## 6.2 Programme for Factory Acceptance Test (FAT)

According to quality guide line: Q10.09053-0015

See overleaf!



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QUALITY STANDARD May 2018

| MAN | Shop test of 4-stroke High-speed marine diesel Engines | Q10.09053-0015 |
|---|---|---|
| MDT-FRH / PEQ | - Test conditions - | Page 1 of 2 |

| | Operating points at acceptance test | ABS | BV | DNV-GL | LR | RINA | JG (NK) | IACS | RS | CCS | CR | MD |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Governor test*) | X | X | X | X | X | X | X | X | X | X | X |
| | Testing of safety and monitoring system*) | X | X | X | X | X | X | X | X | X | X | X |
| MAIN ENGINES (Diesel & Gas) | Maximum continous rating 0 %<br>25 %<br>50 %<br>75 %<br>85 %<br>90 %<br>100 %[1)]<br>110%<br><br>CPP and Genset applications tested with constant speed<br><br>FPP applications tested on propeller curve (recommended MAN propeller curve) | ---<br>M<br>M<br>M<br>---<br>M[2)]<br>30[3)]<br>15[3)] | ---<br>M<br>M<br>M<br>---<br>M[2)]<br>30[3)]<br>15[3)] | ---<br>---<br>M<br>M<br>---<br>M[2)]<br>30[3)]<br>15[3)] | ---<br>M<br>M<br>M<br>---<br>M[2)]<br>30[3)]<br>15[3)] | M<br>M<br>M<br>M<br>---<br>M[2)]<br>30[3)]<br>15[3)] | ---<br>M<br>M<br>M<br>---<br>---<br>30[3)]<br>15[3)] | ---<br>M<br>M<br>M<br>---<br>M[2)]<br>30[3)]<br>15[3)] | ---<br>M<br>M<br>M<br>---<br>M[2)]<br>30[3)]<br>15[3)] | ---<br>M<br>M<br>M<br>---<br>M[2)]<br>30[3)]<br>15[3)] | ---<br>M<br>M<br>M<br>---<br>M[2)]<br>30[3)]<br>15[3)] | M<br>M<br>M<br>M<br>M<br>---<br>30<br>15 |
| AUXILIARY ENGINES (Diesel & Gas) | Maximum continous rating 0 %<br>10 %<br>25 %<br>50 %<br>75 %<br>100 %[1)]<br>110 %<br><br>Constant speed | M<br>---<br>M<br>M<br>M<br>30[3)]<br>15[3)] | M<br>---<br>M<br>M<br>M<br>30[3)]<br>15[3)] | ---<br>---<br>---<br>M<br>M<br>30[3)]<br>15[3)] | M<br>---<br>M<br>M<br>M<br>30[3)]<br>15[3)] | M<br>---<br>M<br>M<br>M<br>30[3)]<br>15[3)] | ---<br>---<br>M<br>M<br>M<br>30[3)]<br>15[3)] | M<br>---<br>M<br>M<br>M<br>30[3)]<br>15[3)] | M<br>---<br>M<br>M<br>M<br>30[3)]<br>15[3)] | M<br>---<br>M<br>M<br>M<br>30[3)]<br>15[3)] | M<br>---<br>M<br>M<br>M<br>30[3)]<br>15[3)] | M<br>M<br>M<br>M<br>M<br>30<br>15 |

*) **Could be done before FAT or by customer request / Outcome to be stated in FAT protocol**
1) **Two readings have to be taken at an interval of 15 min**
2) **Could be replaced by MCR loadpoint 85%**
3) **According to agreement with the Class the running time can be reduced to 30 and 15 minutes**
**M = Measure: Within sufficient time to achieve steady state condition of all engine parameters.**

| MAN Diesel & Turbo SE | Established: Rasmussen, PEPFS<br>Changed: | Verified: Tretter, PEQAI<br>Adorf, PEPAT<br>Dr. Heider, EEEFT | Approved:<br>Dr. Zeppenfeld, PEQ |
|---|---|---|---|

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Modifications: See edge marking

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*Uncontrolled document, when printed!*

Figure 190: Shop test of four-stroke high-speed marine diesel engines – Part 1

The operating values to be measured and recorded during the acceptance test have been specified in accordance with ISO Standard 3046-1 and with the rules of the classification societies.

**Additional informations:**

**Testing of safety and monitoring system:**
All tests should be carried out in low load operation or in idle speed. Alarm signals and engine shutdowns have to be checked by:

1. *simulating a pressure drop on the main lube oil system,*
2. *simulating a splash oil temperature deviation of one cylinder unit to the mean value of the splash oil temperatures (if applicable),*
3. *simulating an oil mist increasement inside the crank case (if applicable),*
4. *simulating an engine overspeed with the test function of the engine control*

Additionaly the manual emergency start and stop systems have to be tested.

**Engine inspection:**
After the FAT program engine components have to be checked so far it is possible without dismantling [Visual check of crank case, camshafts, rollers, gear drive]. A dismantling of components should be done only if abnormalities during engine test procedure or component inspection occurres. The condition of engine and engine components have to be stated in the FAT protocol.

**The operating values have to be confirmed by the customer or his representative, the classification's representativ e and the person responsible for the acceptance test by their signature on the test report.**

**High Speed Light Craft Applications:**
An IMO – NOx certification has to be recorded on the load points 100%/75%/50%/25% of fuel stop power.

**IMO NOx Certification:**
At IMO NOx Certification (parent engine FAT) all load points will be conducted with reduced LT-cooling water flow to ensure that this engine will have the highest NOx emission level among all of the engines in the engine group (see NOx Technical Code 2008 - chapter 4.4.8.1).

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Figure 191: Shop test of four-stroke high-speed marine diesel engines – Part 2

## 6.3 Engine running-in

### Prerequisites

Engines require a running-in period in case one of the following conditions applies:

- When put into operation on site, if
  - after test run the pistons or bearings were dismantled for inspection or
  - the engine was partially or fully dismantled for transport.
- After fitting new drive train components, such as cylinder liners, pistons, piston rings, crankshaft bearings, big-end bearings and piston pin bearings.

### Supplementary information

Operating Instructions

During the running-in procedure the unevenness of the piston-ring surfaces and cylinder contact surfaces is removed. The running-in period is completed once the first piston ring perfectly seals the combustion chamber. i.e. the first piston ring should show an evenly worn contact surface. If the engine is subjected to higher loads, prior to having been running-in, then the hot exhaust gases will pass between the piston rings and the contact surfaces of the cylinder. The oil film will be destroyed in such locations. The result is material damage (e.g. burn marks) on the contact surface of the piston rings and the cylinder liner. Later, this may result in increased engine wear and high lube oil consumption.

The time until the running-in procedure is completed is determined by the properties and quality of the surfaces of the cylinder liner, the quality of the fuel and lube oil, as well as by the load of the engine and speed. The running-in periods indicated in following figures may therefore only be regarded as approximate values.

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### 6.3.1 Standard running-in for FAT or at overhauls or replacement of power units

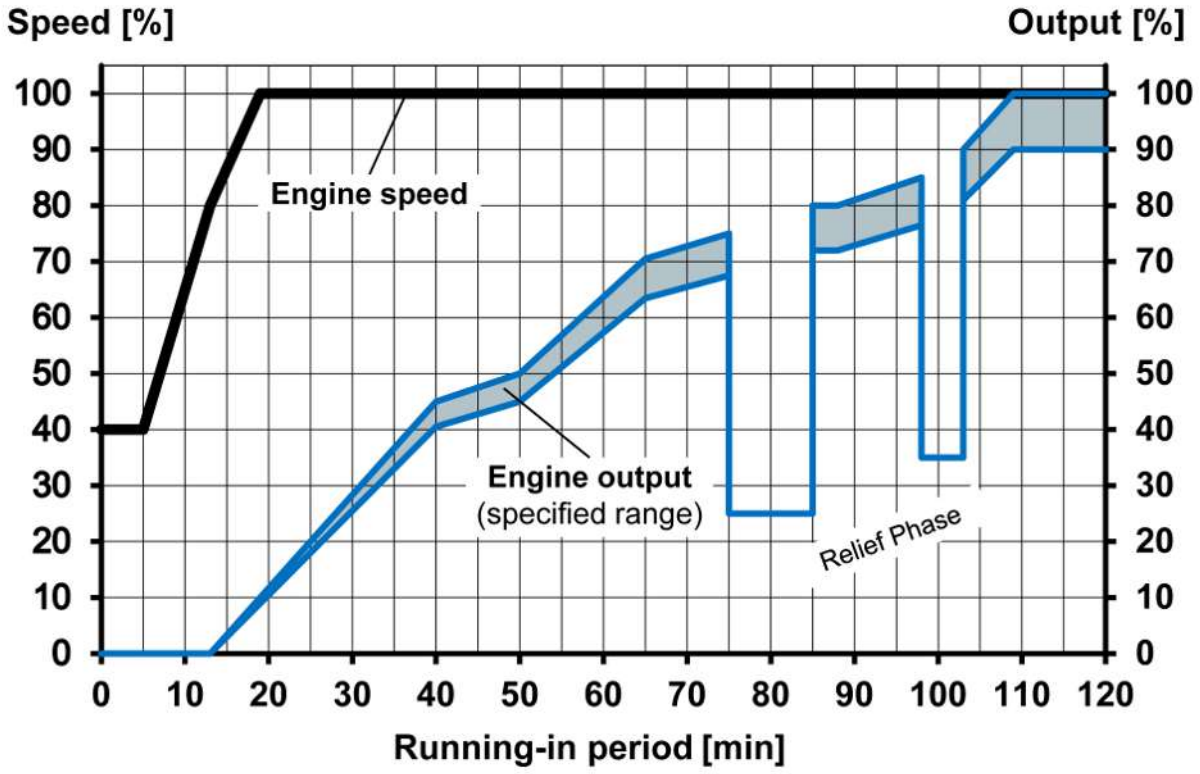



Figure 192: Standard running-in programme engines (constant speed)

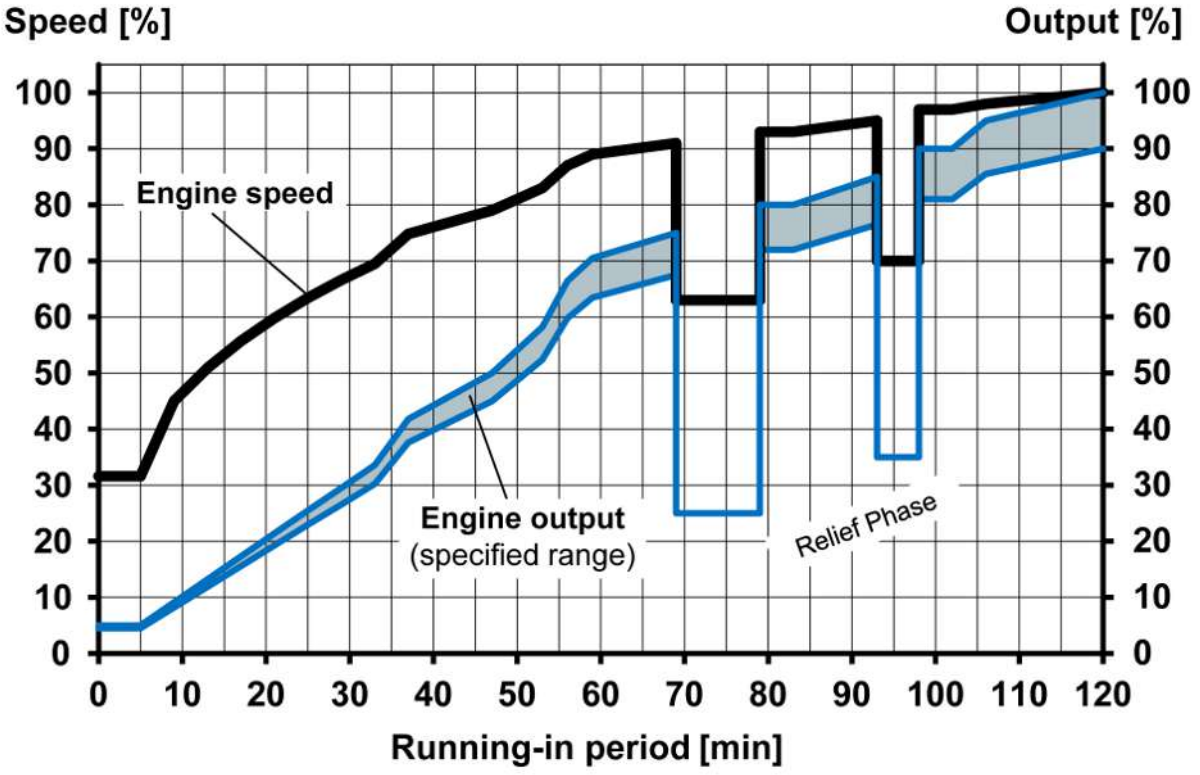



Figure 193: Standard running-in programme engines (variable speed)



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### 6.3.2 Running-in for commissioning/sea trial program

| Steps | Description | Hours |
|---|---|---|
| 1 | Running 10 % load | 1 |
| 2 | Running 25 % load | 1 |
| 3 | Running 50 % load | 1 |
| 4 | Running 75 % load | 1 |
| 5 | Running 100 % load | 1 |
| 6 | Adjustments of load and load control | 1.5 |
| 7 | Running 100 % load check after adjustments | 0.5 |

Table 650: Commissioning/sea trial program

## 6.4 Definitions

**Auxiliary GenSet/auxiliary generator operation**

A generator is driven by the engine, hereby the engine is operated at constant speed. The generator supplies the electrical power not for the main drive, but for supply systems of the vessel.

Load profile with focus between 40% and 80% load.

Engine´s certification for compliance with the $NO_x$ limits according D2 Test cycle. See within section Engine ratings (output) for different applications if the engine is released for this kind of application and the corresponding available output $P_{Application}$.

**Blackout**

The classification societies define blackout on board ships as a loss of the main source of electrical power resulting in the main and auxiliary machinery to be out of operation and at the same time all necessary alternative energies (e.g. start air, battery electricity) for starting the engines are available.

**Dead ship condition**

The classification societies define dead ship condition as follows:

- The main propulsion plant, boilers and auxiliary machinery are not in operation due to the loss of the main source of electrical power.
- In restoring propulsion, the stored energy for starting the propulsion plant, the main source of electrical power and other essential auxiliary machinery is assumed not to be available.
- It is assumed that means are available to start the emergency generators at all times. These are used to restore the propulsion.

**Designation of engine sides**

- Coupling side, CS

  The coupling side is the main engine output side and is the side to which the propeller, the alternator or other working machine is coupled.
- Free engine end/counter coupling side, CCS

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The free engine end is the front face of the engine opposite the coupling side.

### Designation of cylinders

The cylinders are numbered in sequence, from the coupling side, 1, 2, 3 etc. In V engines, looking on the coupling side, the left hand bank of cylinders is designated A, and the right hand bank is designated B. Accordingly, the cylinders are referred to as A1-A2-A3 or B1-B2-B3, etc.

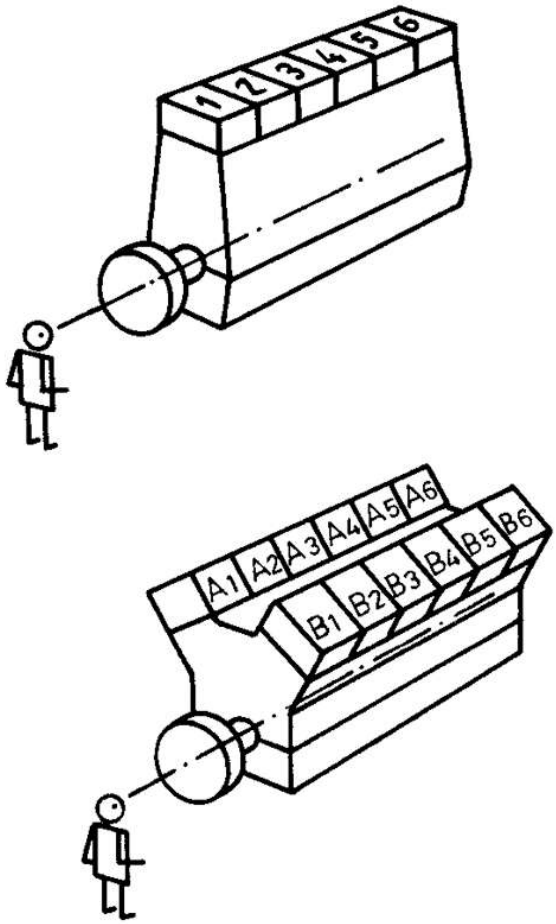



Figure 194: Designation of cylinders



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### Direction of rotation

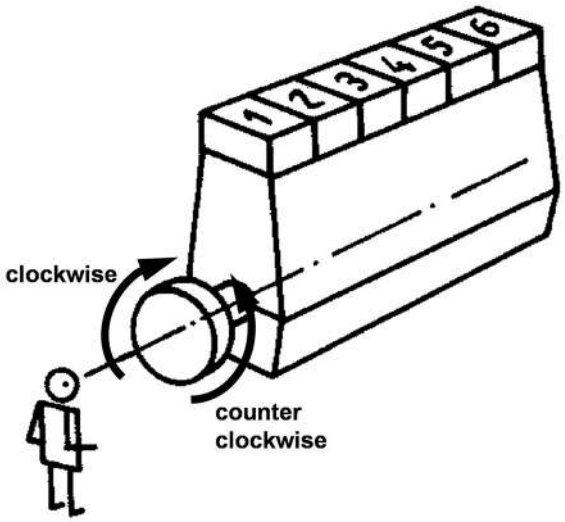



Figure 195: Designation: Direction of rotation seen from flywheel end

### Electric propulsion

The generator being driven by the engine supplies electrical power to drive an electric motor. The power of the electric motor is used to drive a controllable pitch or fixed pitch propeller, pods, thrusters, etc.

Load profile with focus between 80% and 95% load.

Engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle. See within section Engine ratings (output) for different applications if the engine is released for this kind of application and the corresponding available output $P_{Application}$.

### GenSet

The term "GenSet" is used, if engine and electrical alternator are mounted together on a common base frame and form a single piece of equipment.

### Gross calorific value (GCV)

This value supposes that the water of combustion is entirely condensed and that the heat contained in the water vapor is recovered.

### Idling operation

Idling/Idling operation refers to operation:

- Before the engine is coupled to the propulsion system or to the mechanical dredge pump
- Of the GenSet with open Genoswitch

A distinction is made between:

- Idling at minimum speed and
- Idling at rated speed

### Mechanical propulsion with controllable pitch propeller (CPP)

A propeller with adjustable blades is driven by the engine.

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The CPP´s pitch can be adjusted to absorb all the power that the engine is capable of producing at nearly any rotational speed.

Load profile with focus between 80% and 95% load.

Engine´s certification for compliance with the $NO_x$ limits according E2 Test cycle. See within section Engine ratings (output) for different applications if the engine is released for this kind of application and the corresponding available output $P_{Application}$.

### Mechanical propulsion with fixed pitch propeller (FPP)

A fixed pitch propeller is driven by the engine. The FPP is always working very close to the theoretical propeller curve (power input ~ $n^3$). A higher torque in comparison to the CPP even at low rotational speed is present.

Load profile with focus between 80% and 95% load.

Engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle. See within section Engine ratings (output) for different applications if the engine is released for this kind of application and the corresponding available output $P_{Application}$.

### Multi-engine propulsion plant

In a multi-engine propulsion plant at least two or more engines are available for propulsion.

### Net calorific value (NCV)

This value supposes that the products of combustion contain the water vapor and that the heat in the water vapor is not recovered.

### No-load operation

As soon as the engine has been coupled, or a GenSet with closed Geno switch has been connected to electrical grid and no load has yet been delivered, this is named as no-load operation.

### Offshore application

Offshore construction and offshore drilling place high requirements regarding the engine´s acceleration and load application behaviour. Higher requirements exist also regarding the permissible engine´s inclination.

Due to the wide range of possible requirements such as flag state regulations, fire fighting items, redundancy, inclinations and dynamic positioning modes all project requirements need to be clarified at an early stage.

### Output

- ISO standard output (as specified in DIN ISO 3046-1)

  Maximum continuous rating of the engine at nominal speed under ISO conditions, provided that maintenance is carried out as specified.
- Operating-standard-output (as specified in DIN ISO 3046-1)

  Maximum continuous rating of the engine at nominal speed taking in account the kind of application and the local ambient conditions, provided that maintenance is carried out as specified. For marine applications this is stated on the type plate of the engine.
- Fuel stop power (as specified in DIN ISO 3046-1)



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Fuel stop power defines the maximum rating of the engine theoretical possible, if the maximum possible fuel amount is used (blocking limit).

- Rated power (in accordance to rules of DNV)

  Maximum possible continuous power at rated speed and at defined ambient conditions, provided that maintenances carried out as specified.
- Output explanation

  Power of the engine at distinct speed and distinct torque.
- 100% output

  100% output is equal to the rated power only at rated speed. 100% output of the engine can be reached at lower speed also if the torque is increased.
- Nominal output

  = rated power.
- MCR

  Maximum continuous rating.
- ECR

  Economic continuous rating = output of the engine with the lowest fuel consumption.

### Overload power (at FAT or SAT/sea trial)

Only if required by rules of classification societies, it is admitted to operate the engine at 110% of rated power for a maximum of 1 h in total as part of the FAT or SAT/sea trial and in addition a maximum of 1 h in total as part of the comissioning of the plant. Engine operation has to be done under supervision of trained Everllence personal.

### Single-engine propulsion plant

In a single-engine propulsion plant only one single-engine is available for propulsion.

### Suction dredger application (mechanical drive of pumps)

For direct drive of a suction dredger pump by the engine via gear box the engine speed is directly influenced by the load on the suction pump.

The power demand of the dredge pump needs to be adapted to the operating range of the engine, particularly while start-up operation. Load profile with focus between 80% and 100% load.

Engine´s certification for compliance with the $NO_x$ limits according C1 Test cycle. See within section Engine ratings (output) for different applications if the engine is released for this kind of application and the corresponding available output $P_{Application}$.

### Water jet application

A marine propulsion system that creates a jet of water that propels the vessel. The water jet propulsion is always working close to the theoretical propeller curve (power input ~ $n^3$). With regard to its requirements the water jet propulsion is identical to the mechanical propulsion with FPP.

Load profile with focus between 80% and 95% load.



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Engine´s certification for compliance with the $NO_x$ limits according E3 Test cycle. See within section Engine ratings (output) for different applications if the engine is released for this kind of application and the corresponding available output $P_{Application}$.

**Weight definitions for SCR**

- Handling weight (reactor only):

  This is the "net weight" of the reactor without catalysts, relevant for transport, logistics, etc.
- Operational weight (with catalysts):

  That's the weight of the reactor in operation, that is equipped with a layer of catalyst and the second layer empty – as reserve.
- Maximum weight structurally:

  This is relevant for the static planning purposes maximum weight, that is equipped with two layers catalysts.

## 6.5 Abbreviations

| Abbreviation | Explanation |
|---|---|
| BN | Base number |
| CBM | Condition based maintenance |
| CCM | Crankcase monitoring system |
| CCS | Counter coupling side |
| CS | Coupling side |
| ECR | Economic continuous rating |
| EDS | Engine diagnostics system |
| GCV | Gross calorific value |
| GVU | Gas Valve Unit |
| HFO | Heavy fuel oil |
| HT CW | High temperature cooling water |
| LT CW | Low temperature cooling water |
| MCR | Maximum continuous rating |
| DMB | Diesel oil |
| DMA | Gas oil |
| MN | Methane number |
| NCV | Net calorific value |
| OMD | Oil mist detection |
| SaCoS | Safety and control system |
| SAT | Site acceptance test |
| SECA | Sulphur emission control area |
| SP | Sealed plunger |



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| Abbreviation | Explanation |
|---|---|
| STC | Sequential turbocharging |
| TAN | Total acid number |
| TBO | Time between overhaul |
| TC | Turbocharger |
| TC | Temperature controller |
| ULSHFO | Ultra low sulphur heavy fuel oil |

## 6.6 Symbols

Note:
The symbols shown should only be seen as examples and can differ from the symbols in the diagrams.

| DESIGNATION | SYMBOL | CODE | DESIGNATION | SYMBOL | CODE |
|---|---|---|---|---|---|
| MAIN CIRCUIT (FLOW DIRECTION SHOWN) | | | FLEXIBLE PIPE CONNECTION | | EH |
| SECONDARY CIRCUIT | | | EXPANSION BELLOWS (STEEL) | | EB |
| CONTROL AIR PIPE, PULSE LINE, ELECTRICAL LINE | | | 2/2 (TWO-PORT, TWO-POSITION) DIRECTIONAL CONTROL SOLENOID-OPERATED VALVE | | |
| CAPILLARY TUBE (WITH THERMOSTATIC REGULATORS) | | | 3/2 (THREE-PORT, TWO-POSITION) DIRECTIONAL CONTROL VALVE | | |
| LAGGED PIPE | | | GENERAL SHUT-OFF VALVE | | V |
| STEAM HEATED PIPE (HEAVY FUEL OIL OPERATION, MAIN CIRCUIT) | | | GATE VALVE | | GV |
| ELECTRICALLY HEATED PIPE (HEAVY FUEL OIL OPERATION, MAIN CIRCUIT) | | | STRAIGHT-WAY VALVE | | V |

Figure 196: Symbols used in functional and pipeline diagrams 1

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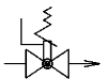
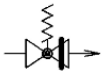
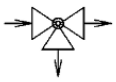
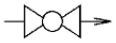
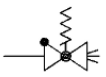
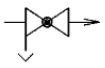
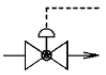
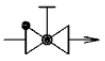
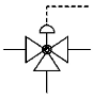
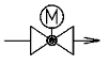
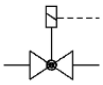
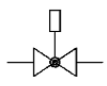
| DESIGNATION | SYMBOL | CODE | DESIGNATION | SYMBOL | CODE |
|---|---|---|---|---|---|
| ANGLE VALVE |  | V | GENERAL SHUT-OFF VALVE, MOTOR DRIVEN |  | MOV |
| VALVE WITH MINIMUM FLOW |  | V | QUICK ACTING SHUT-OFF VALVE |  | V |
| GENERAL THREE-WAY VALVE |  | CK | SAFETY VALVE (STRAIGHT WAY) |  | PSV |
| THREE-WAY VALVE |  | V | SAFETY VALVE (ANGLE) |  | PSV |
| COCK |  | CK | BACK PRESSURE VALVE (STRAIGHT WAY) |  | BPV |
| SHUT-OFF VALVE WITH VENTILATION |  | V | BACK PRESSURE VALVE (ANGLE) |  | BPV |
| NON-RETURN VALVE |  | NRV | DIAPHRAGM VALVE (PNEUMATICALLY-OPERATED) |  | DV |
| NON-RETURN VALVE (CAN BE SHUT OFF) |  | NRV | DIAPHRAGM SHUTTLE VALVE |  | DV |
| ANGLE NON-RETURN VALVE |  | NRV | MOTORISED VALVE |  | MOV |
| SOLENOID-OPERATED VALVE |  | SOV | GENERAL THREE-WAY VALVE, MOTOR DRIVEN |  | MOV |
| SOLENOID-OPERATED VALVE (AUTOMATIC VENT) |  | SOV | MOTORISED SHUTTLE VALVE |  | MOV |
| GENERAL SHUT-OFF VALVE, GENERAL DRIVE |  | V | GENERAL SHUT-OFF VALVE WITH TRANSATORY MOTON VALVE |  | V |

Figure 197: Symbols used in functional and pipeline diagrams 2



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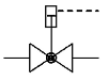
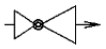
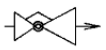
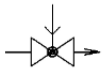
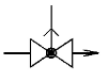
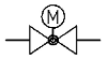
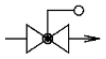
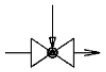
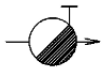
| DESIGNATION | SYMBOL | CODE | DESIGNATION | SYMBOL | CODE |
|---|---|---|---|---|---|
| PISTON-OPERATED VALVE |  | POV | PRESSURE REDUCING VALVE |  | PCV |
| SHUTTLE VALVE WITH DRIVE PISTON |  | POV | PRESSURE CONTROL VALVE |  | PCV |
| SELF-CLOSING VALVE (STRAIGHT WAY) |  | QV | TEMPERATURE REGULATOR (SELF-ACTUATING DISTRIBUTION VALVE) |  | TCV |
| SELF-CLOSING VALVE (ANGLE) |  | QV | TEMPERATURE REGULATOR (SELF-ACTUIATING MIXING VALVE) |  | TCV |
| AUTOMATIC OPENING VALVE |  | V | TEMPERATURE CONTROL VALVE, ELECTRICALLY CONTROLLED |  | TCV |
| FLOAT VALVE |  | LOV | VANE HAND PUMP |  | P |
| SPRING-LOADED ADJUSTABLE PRESSURE LIMITING VALVE |  | PCV | WATER TRAP |  | TR |
| SAFETY VALVE |  | PSV | OIL TRAP |  | TR |
| FLOW-CONTROL VALVE, ADJUSTABLE |  | | CONDENSATE TRAP, CAN BE SHUT OFF |  | TR |
| NON-RETURN VALVE, UNIDIRECTIONAL FLOW |  | | ACCUMULATOR, GAS CYLINDER |  | |
| NON-RETURN VALVE WITH SPRING, NORMALLY CLOSED |  | | OILER |  | |
| PILOTED NON-RETURN VALVE WITH SPRING, FLOW IN BOTH DIRECTIONS POSSIBLE DUE TO CONTROL PRESSURE |  | | HEATING COIL (STEAM OR WATER) |  | H |

Figure 198: Symbols used in functional and pipeline diagrams 3



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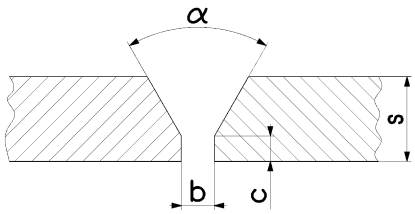
| DESIGNATION | SYMBOL | CODE | DESIGNATION | SYMBOL | CODE |
|---|---|---|---|---|---|
| PLUG-IN HEATER (STEAM OR WATER) | | H | SUCTION STRAINER | | STR |
| PLUG-IN HEATER (ELECTRIC) | | H | SUCTION BELL | | SB |
| BACKFLOW PREVENTER (DISCOTYP) | | NRV | FLAME TRAP | | GS |
| NON-RETURN FLAP | | NRF | VENT | | |
| STRAINER | | STR | VENT WITH FLAME TRAP | | |
| FUNNEL (OPEN) | | FU | VENT, OUTBOARD ABOVE DECK | | |
| FUNNEL (CLOSED) | | FU | VENT CAP | | |
| OVERFLOW CHECK TANK, DISCHARGE FUNNEL | | FU | Withdrawal point for fuel oil sample | | |

Figure 199: Symbols used in functional and pipeline diagrams 4

## 6.7 Pipe treatment

### 6.7.1 Pipeline welding

Area of Application — Air pipes, fuel pipes, oil pipes, water pipes, steam pipes.




α angle 60°

Figure 200: Weld preparation



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| s- material thickness | 1-2.0 | 2.5-3.0 | 3.2-5 | 5-8 |
|---|---|---|---|---|
| b | 1 | 2 | 3 | 4 |
| c | 0 | 1 | 1.5 | 2 |

Table 651: All dimensions in mm

General

Everllence requires using the TIG welding method (Tungsten – Inert – Gas) for all welding seams in contact with fluid.

If pipes are made of stainless steel, make sure that the flanges used are made of the same material.

In addition make sure, that proper welding material is used.

### 6.7.2 Cleaning and treatment after welding operation

If stainless-steel pipes are used, cleaning may be omitted provided the weld seams are of high quality. Otherwise, the following steps must be performed.

All pipes attached to the engine shall be cleaned mechanically or mechanically/chemically after manufacture. In case of a longer period between cleaning and fitting, the pipes must be preserved and sealed at the ends. Sealing plugs or caps in eye-catching colours are suitable for this purpose so that they are not overlooked during installation.

Piping of cooling water, exhaust gas and intake air systems shall be cleaned mechanically.

Mechanical and chemical cleaning is performed on lubricating oil, fuel, compressed air, steam and water condensate system piping.

Isolating and regulating units, as well as other devices may only be fitted after the cleaning process.

The entire lubricating oil, fuel and water system must be thoroughly purged before commissioning the engine installation.

The compressed air system must be blown out.

Mechanical cleaning

Scale and weld splatter shall be removed carefully from the welded joints, using a chisel, file or grinding disc. If pipes of stainless steel are grinded out, make sure that suitable tools are used, which could not cause any workpiece corrosion.

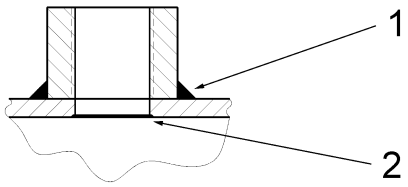
The complete tube section shall be knocked with a hammer and blown through with compressed air at the same time, to remove the smallest particles.

All pipe connections are to be blocked off until assembly.

Provide unobstructed access to welding joints in contact with fluid.

This means: Fitting flange connections at places that are inaccessible.

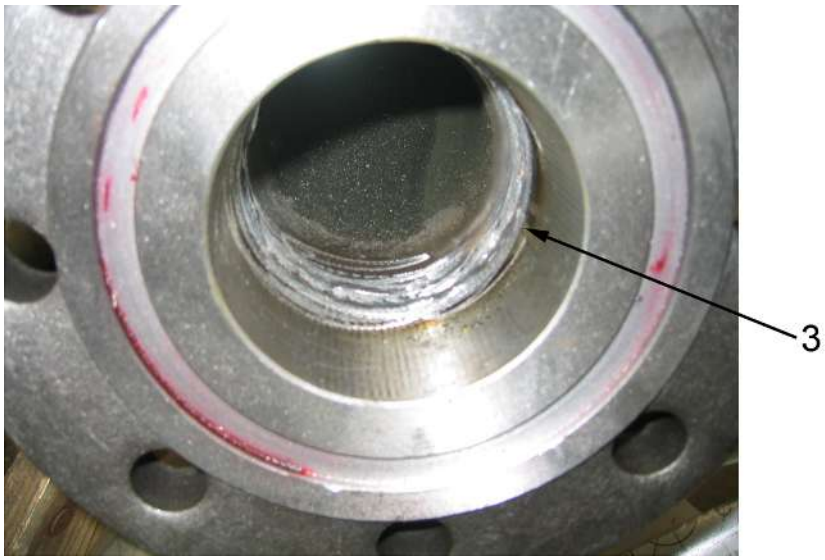
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1 Welding joint
2 After welding: drilled and deburred

Figure 201: Threaded sleeves for fitting the measurement sensors must be installed as follows

**Examples of proper installation**




3 Welding seam after proper mechanical rework

Figure 202: Proper installation

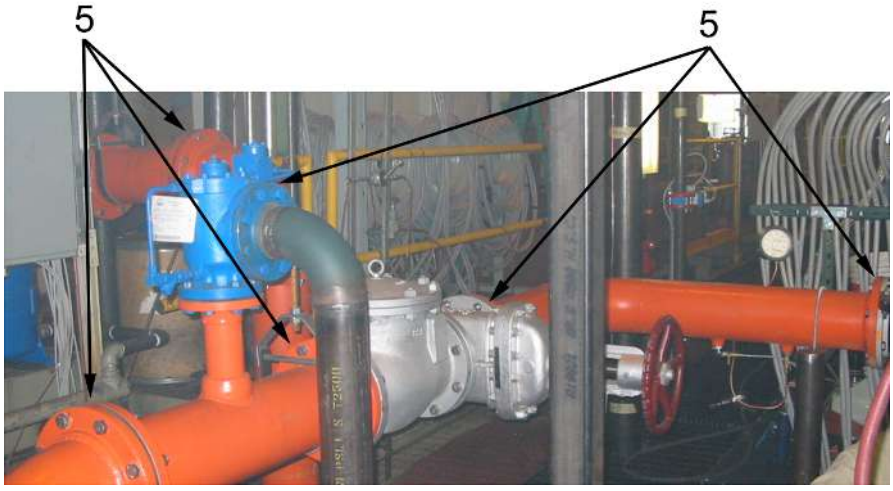


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4 Pipe opening for sleeve connection made using a twist drill and deburred after sleeve welding.

Figure 203: Proper installation



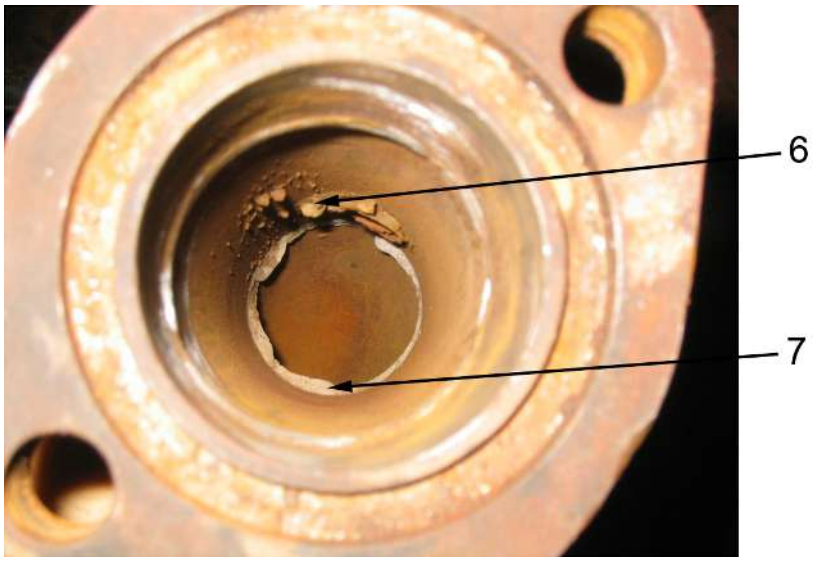

5 Fitting the flanges to avoid any inaccessible welding seams

Figure 204: Proper installation



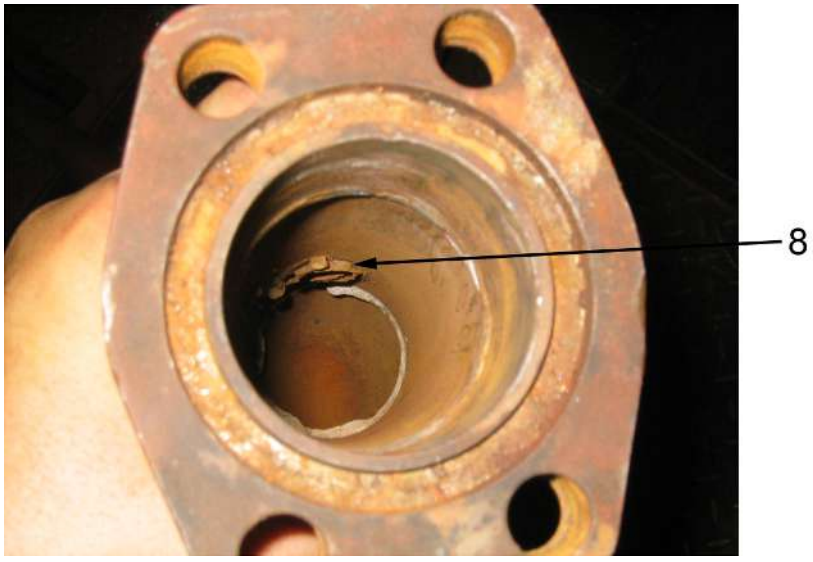
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**Example: Insufficient rework**




6 Scale and welding beads have not been removed
7 Insufficient or no rework of the welding joints

Figure 205: Insufficient rework

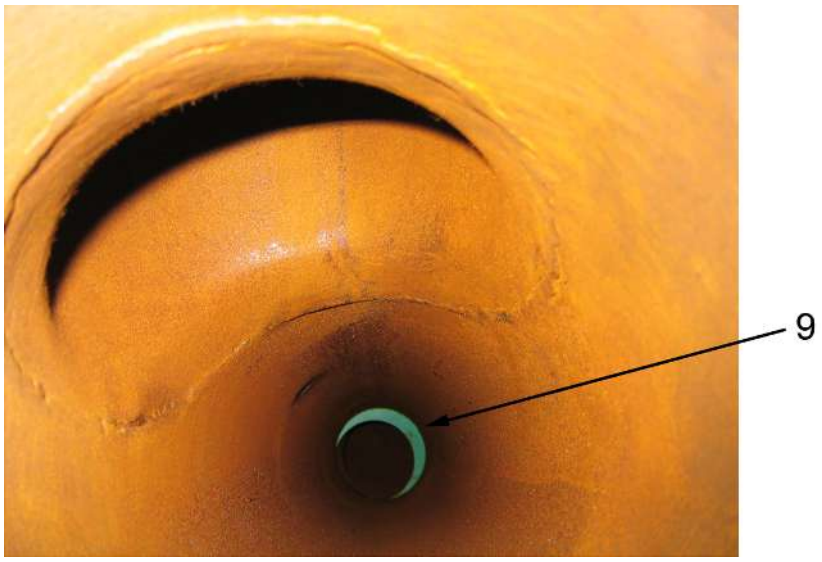



8 Pipe opening for attached sleeve using welding torch – unacceptably fitted

Figure 206: Insufficient rework



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9 Seal projects into the pipe

Figure 207: Insufficient rework




10 Welding seams are inaccessible from the inside

Figure 208: Insufficient rework



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**Stainless steel pipes**




Stainless steel pipe with steel flange

Figure 209: Stainless steel pipes



Figure 210: Stainless steel pipes



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11 This welding joint must be reworked!
Welding joint with slag on a stainless steel pipe resulted from improper welding process

Figure 211: Stainless steel pipes




TIG welding joint on a stainless steel pipe of a good quality

Figure 212: Stainless steel pipes

Chemical cleaning

For pipes cleaned mechanically and chemically, an acid bath is required.

**The acid bath device essentially consists of:**

- an acid bath
- a water bath for washing the acid off
- an alkaline bath for neutralising and phosphating

The regional protection regulations must also be observed.



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**Treatment of steel pipes**

1. Acid bath pickling
   Hydrochloric acid (HCl) is available commercially at a concentration of 31 – 33 %, and with less than 1 % arsenic.
   Mixing ratio for the bath:
   HCl : H2O = 3 : 2 (parts by weight)

NOTICE

**Handling acid**

**When using, observe the following items.**

- Pour the acid into water, not the other way around
- The treatment shall not be performed at a temperature below 20℃
- The duration is determined by visual inspection
- With pipes with threads, acid corrosion on the crest of the thread must be monitored. It determines the duration of treatment in this case

2. After completion of the pickling procedure, the acid solution adhering to the pipes must be washed off in the water bath.
3. Neutralisation of the acid solution remaining in the grooves and pores of the surface texture in a trisodium phosphate bath.
   Here, the pipes are simultaneously coated with a phosphate layer which provides short-term protection against corrosion.
   Mixing ratio for the bath:
   Na3PO4 : H2O = 1 : 8 (parts by weight)
   Treatment temperature: 80°C

Pressure testing of pipelines

During the system flushing, the pipes must be tested for tightness.

Preservation of pipelines

When stored for a short period indoors in a dry environment, phosphating and an oil film are sufficient for corrosion protection (inside and outside). Also during long-term storage, phosphating before the actual preservation with slushing oil or lacquer (only outside) offers a good basic preservation.

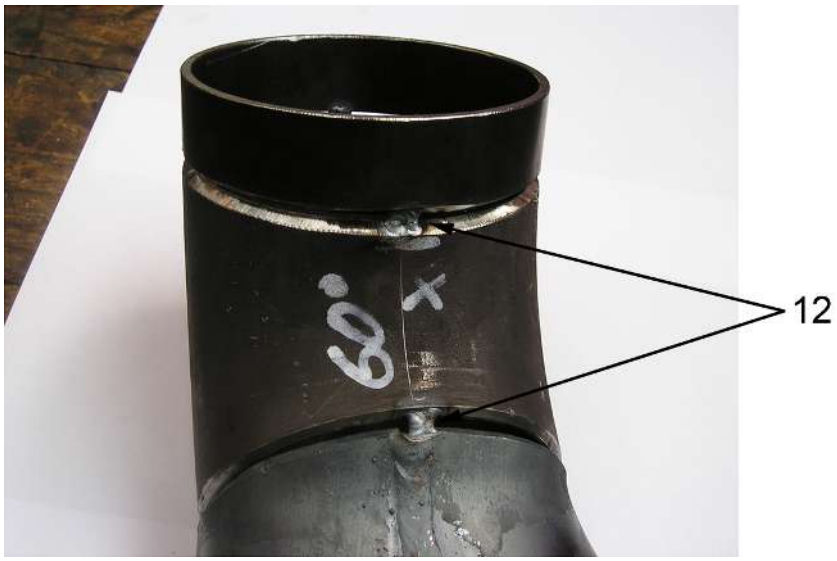
Open pipe ends, connection points and threaded sleeves are to be sealed with coloured plastic caps. They must always be removed before fitting.



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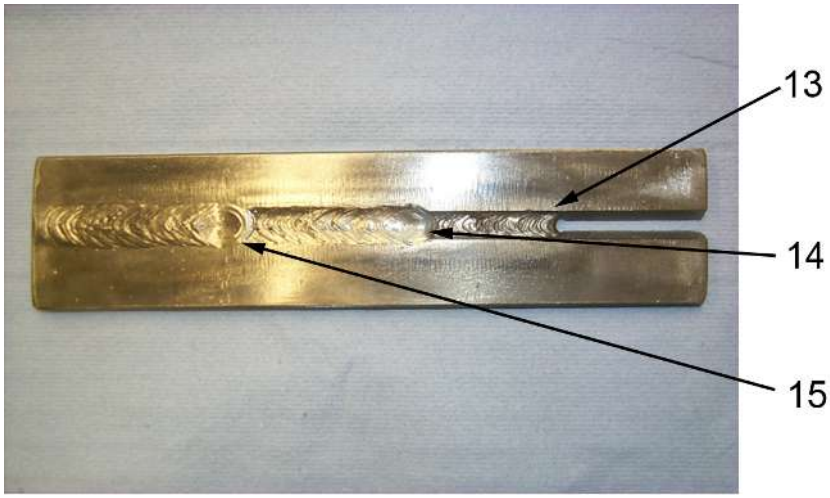
Pipe processing – step by step

**Pipe elbow**




12 Pipe preparation, tacking

Figure 213: Pipe elbow

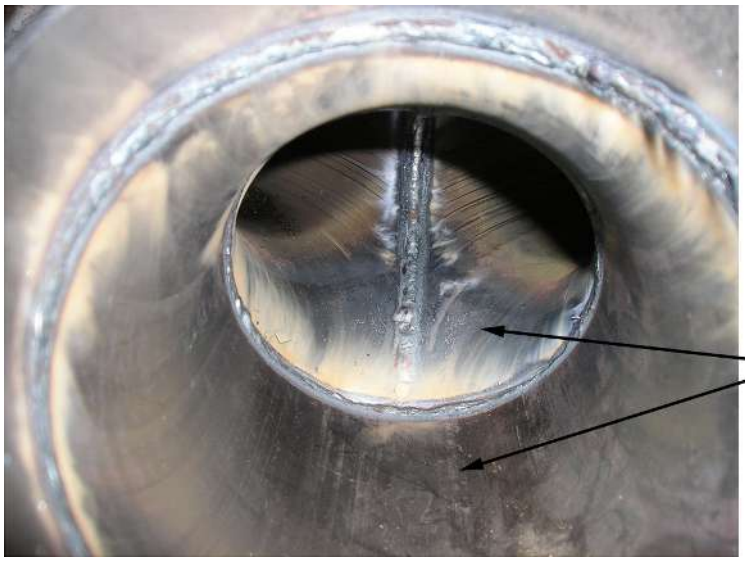



13 Root pass: TIG welding
14 Interpass: TIG/MAG/E welding
15 Final pass: TIG/MAG/E welding

Figure 214: Pipe elbow



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16 TIG pipe welding joint, not mechanically machined

Figure 215: Pipe elbow



Y-pipe inside after mechanical machining of the welding joints, subsequently neutralised and preserved

Figure 216: Pipe elbow



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**Flange connection**




17 Flange preparation, tacking

Figure 217: Flange connection



Flange fitting, tacking

Figure 218: Flange connection



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18 Flange – pipe welding inside

Figure 219: Flange connection

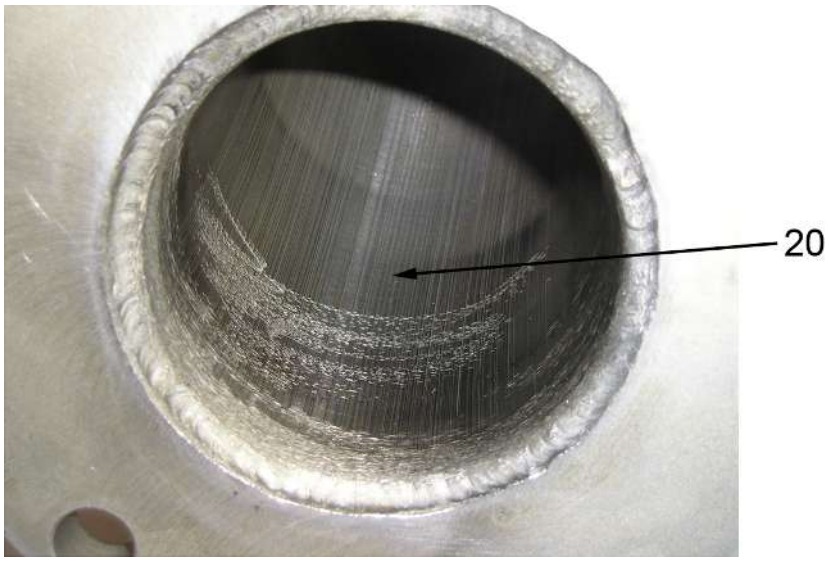



19 Flange welding joint, mechanically machined

Figure 220: Flange connection

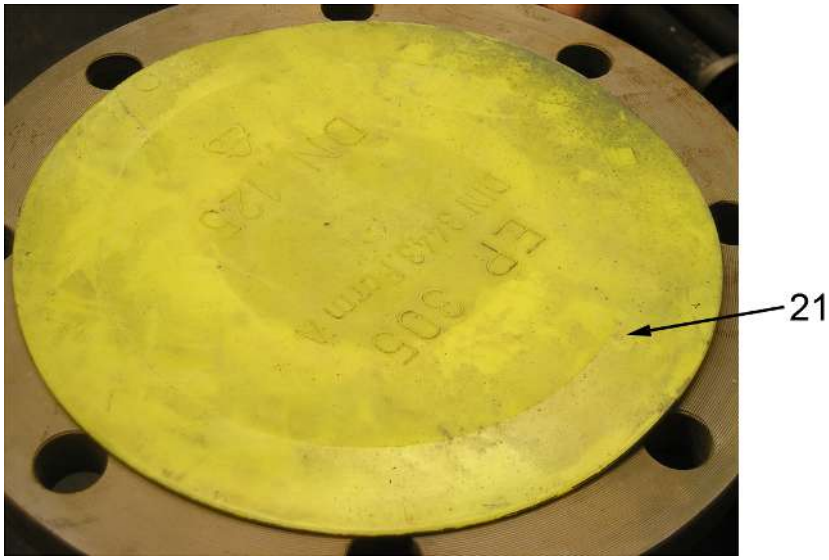


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20 Pipes chemically, mechanically cleaned and preserved

Figure 221: Flange connection




21 Pipe sealed with cover

Figure 222: Flange connection



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**Pipe with weld-on sleeves**




22 Tube section with a bore for threaded sleeves, mechanically machined inside

Figure 223: Pipe with weld-on sleeves




23 Tube section with weld-on threaded sleeves.
TIG welding; threads may need to be recut after acidification and neutralisation

Figure 224: Pipe with weld-on sleeves



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24 Close sleeves with sealing plugs

Figure 225: Pipe with weld-on sleeves




25 Plug
Pipe preserved with lacquer outside, pipe ready-to-fit

Figure 226: Pipe with weld-on sleeves



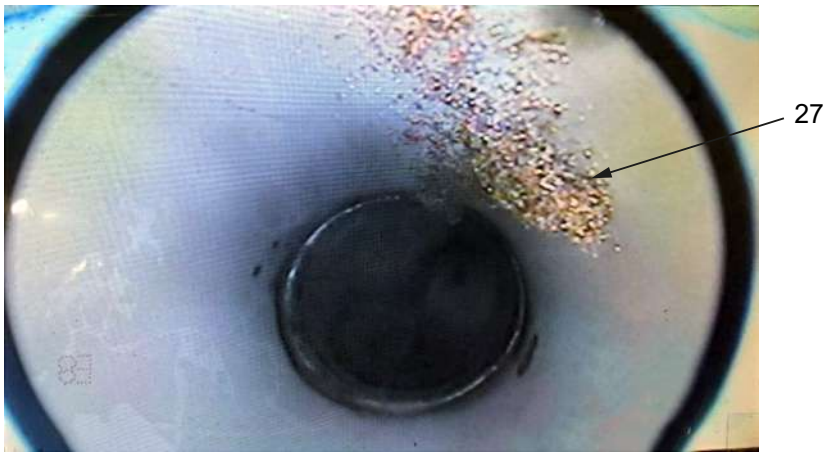
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26 During installation, pay attention to cleanliness.
Particles and system-foreign fluid must be removed out of the pipes

Figure 227: Pipe with weld-on sleeves

**Gas pipe**

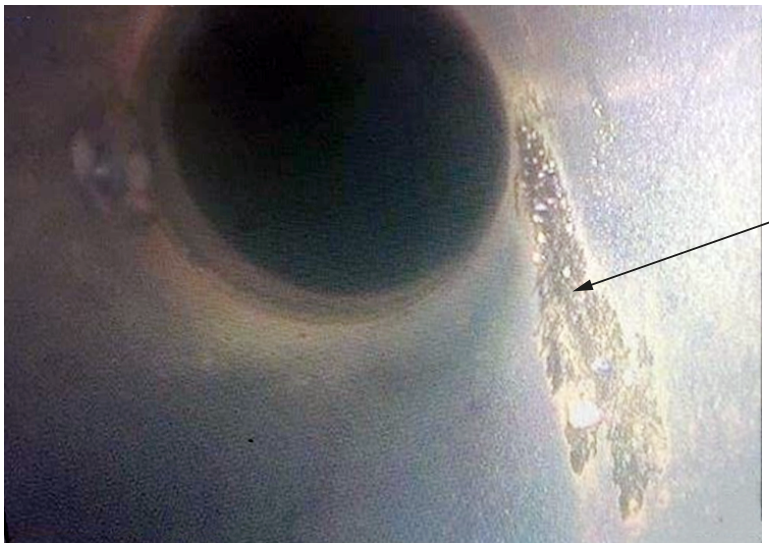



27 Contamination in gas pipe detected during endoscopy.
Particles must be removed from the pipeline.

Figure 228: Gas pipe

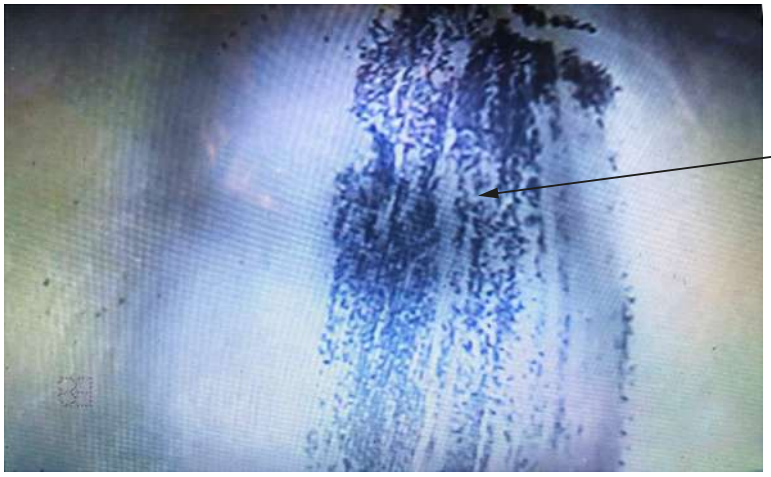


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28 Contamination in gas pipe detected during endoscopy. Particles must be removed from the pipeline.

Figure 229: Gas pipe

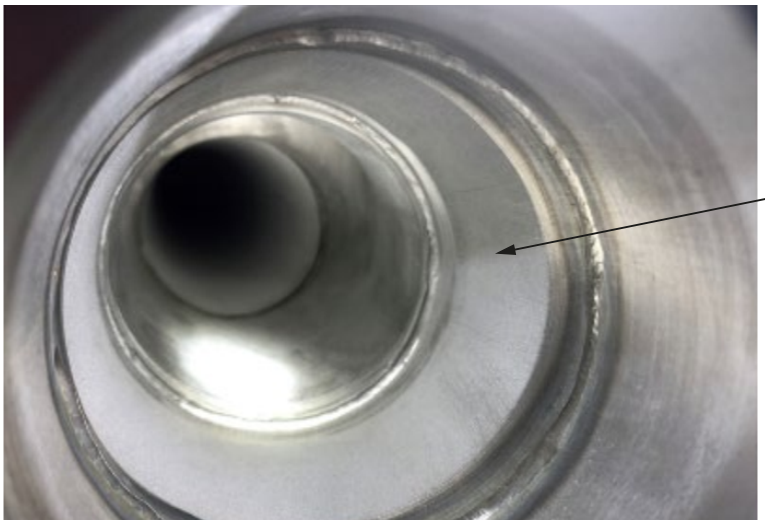



29 Contamination in gas pipe detected during endoscopy. Particles must be removed from the pipeline.

Figure 230: Gas pipe



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30 Gas pipe, clean condition
Unprotected surfaces, clean welds using the TIG welding procedure.

Figure 231: Gas pipe




31 Cleaning by pigging;
foam inserts

Figure 232: Gas pipe



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32 Cleaning by pigging;
testing the foam insert

Figure 233: Gas pipe

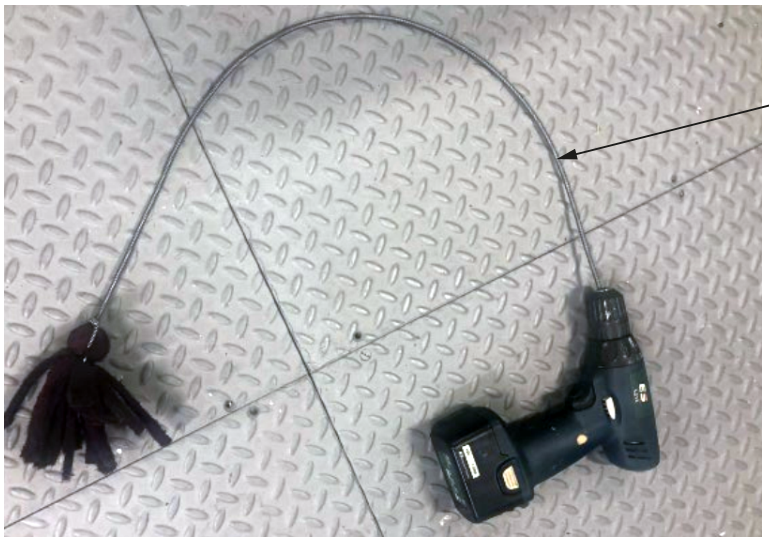



33 Cleaning by pigging;
collecting the foam insert on the engine inlet side, compensator connection side

Figure 234: Gas pipe



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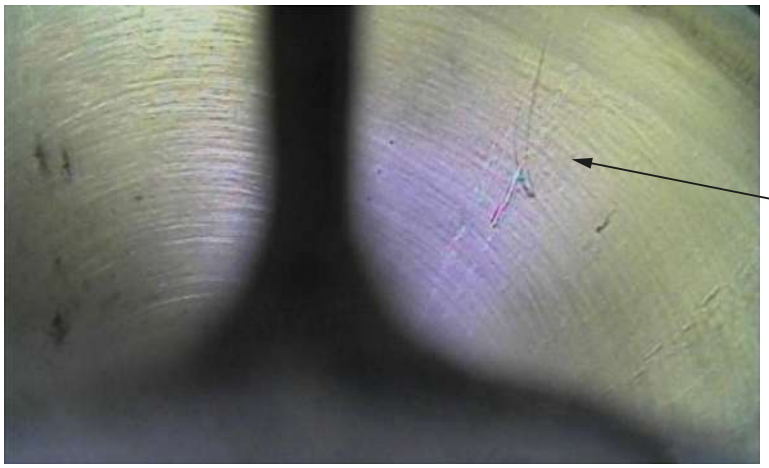

34 Mechanical cleaning:
flexible rotation line

Figure 235: Gas pipe




35 Mechanical cleaning pads in gas pipes

Figure 236: Gas pipe

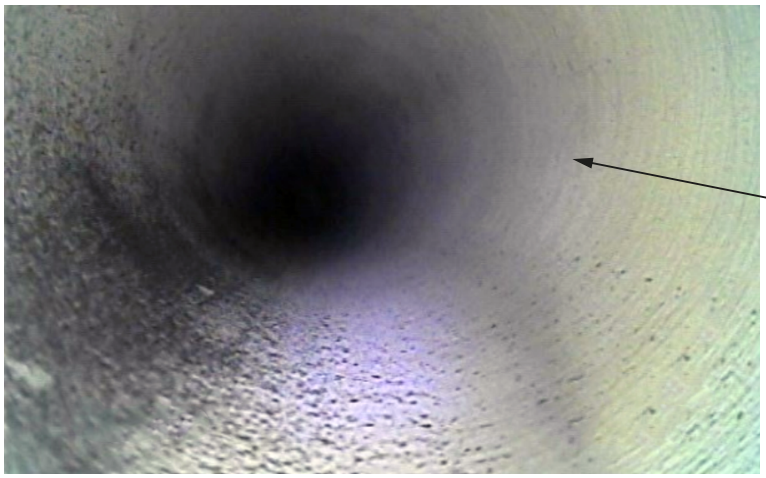



36 Gas pipe: no complaints

Figure 237: Gas pipe



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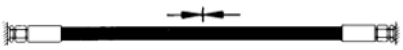
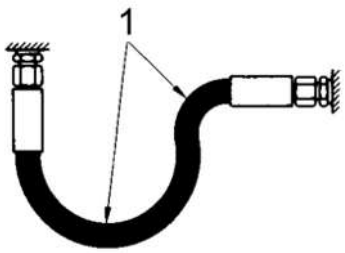
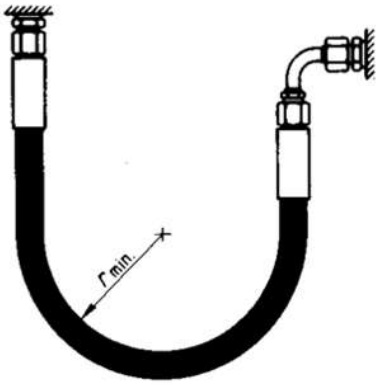

37 Gas pipe: no complaints

Figure 238: Gas pipe

### 6.7.3 Pipe and hose installation

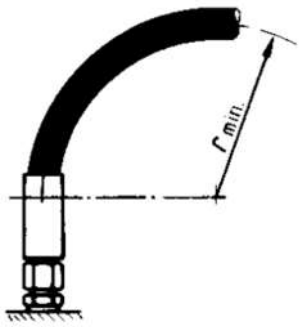
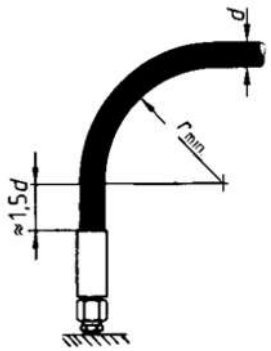
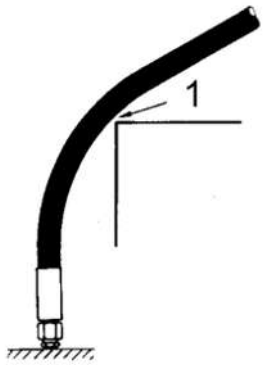
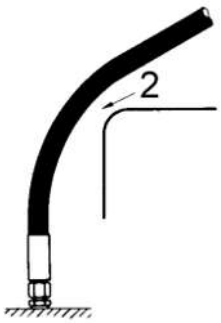
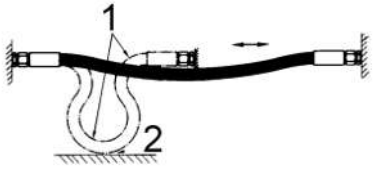
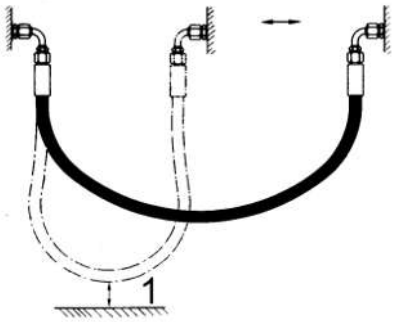
Hose pipes

When using and installing hose lines, make sure that they are fitted properly and observe permissible tolerances.

| incorrect | correct |
|---|---|
| Hose pipes must be fitted so as to avoid their tensile strains under all operating conditions, except for their dead weight; the same applies to hose load in case of short lengths. | |
|  |  |
| Hose load | Tensile strain |
| | |
| Hose lines must be fitted following their normal position, as far as possible, while the bend radii shall not be below the minimum permissible values. | |
|   |   |
| 1 to small bend radii | |
| | |



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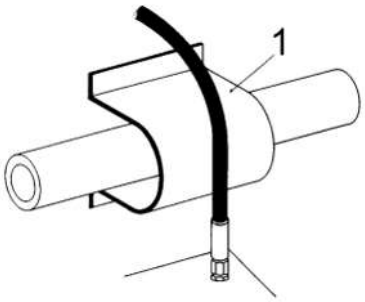
| incorrect | correct |
|---|---|
| For bent fitting, the hose line length must be selected so that the constructive designed hose bending begins only after a length of ≈ 1.5d; bend protection must be provided if necessary. | |
|  |  |
| | |
| Outer mechanical effects on the hose lines, including the hose scuffing at components or among each other, must be avoided by suitable arrangement and fixing. If necessary, the hoses must be protected with protective coating. Sharp-edged components must be covered. | |
|  |  |
| 1 abrasion | 2 sufficient distance |
| | |
| When connecting a hose line to moving components, the hose length must be sized so that the minimum permissible bending radius is observed and/or the pipe line is not additionally tensioned within the whole movement range. | |
|  |  |





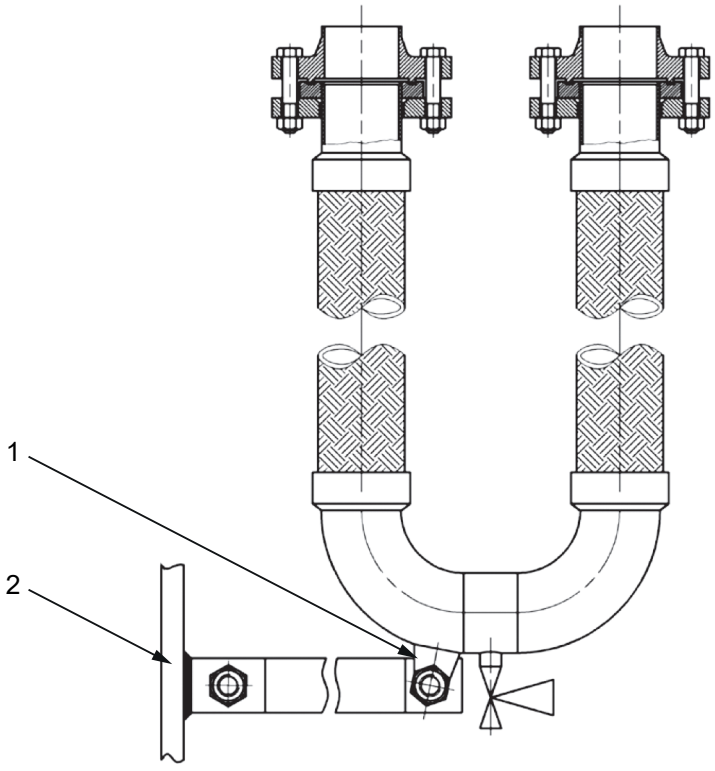
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| incorrect | correct |
|---|---|
| 1 to small bend radii | 1 observe sufficient distance! |
| 2 abrasion | |




1 Heat protection

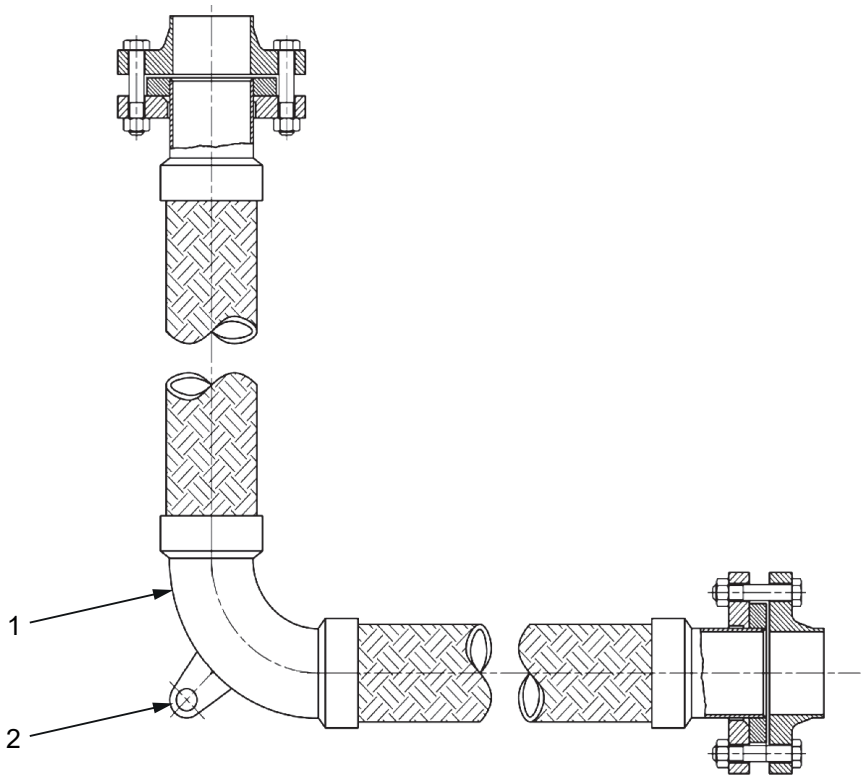
Figure 239: In case of high external temperatures, the hose lines must be either fitted at a sufficient distance to heat radiating components or protected by suitable appliances (screen).




1 Holding eyelet
2 Ship structure

Figure 240: If an additional holding eyelet is available, the hose line must be secured accordingly. Please also check drawings and instructions.

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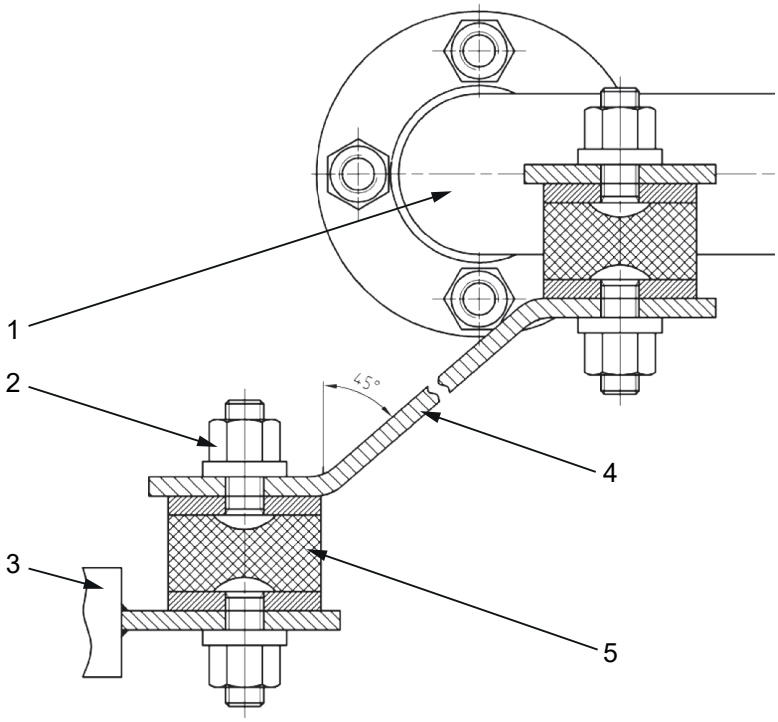



1 The 90° bend must be suspended with springs
2 Holding eyelet

Figure 241: Fastening via holding eyelet



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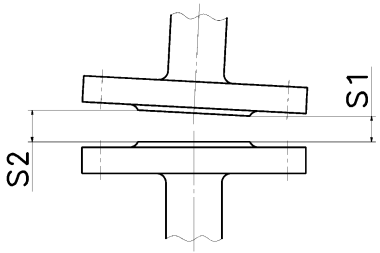



1 Metal hose line
2 Lock nut, washer
3 Ship structure
4 Flat steel 5x60 (suggestion)
5 Rubber block support

Figure 242: Example with rubber buffer (extract from drawing)

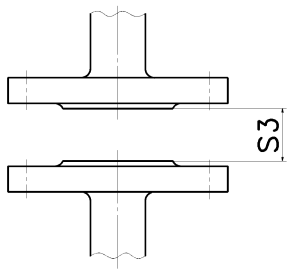
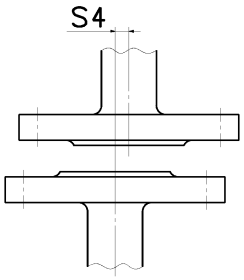
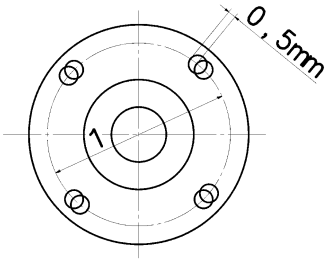
## Pipe connections

When installing steel pipes make sure that they are fitted properly and observe permissible tolerances. High loads on flange connections in the system and on the engine are not permissible.

| Illustrations | Installation tolerances |
|---|---|
|   | max. Tolerance (S2-S1)<br>-0.3 mm for DN<150<br>-0.4 mm for DN 200 to 300<br>-0.5 mm for DN >300 |
| S1 tolerance | |
| S2 tolerance | |
| | |



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| Illustrations | Installation tolerances |
|---|---|
|  | S3 distance between the flanges.<br>-Seal thickness +1.0 mm |
| S3 distance | |
| | |
|  | Maximum permissible lateral movement<br>S4 ≤ 0.5 mm |
| S4 lateral movement | |
| | |
|  | The screw holes are positioned on the pitch circle diameter <0.5 mm at a permissible turning offset in accordance with DIN 2501-1 |
| 1 pitch circle diameter | |

## 6.8 Flushing and start-up preparations

### 6.8.1 Flushing of the lube oil system

Flushing the lube oil system isn't necessary because it is delivered as a closed system.

In case additional oil treatment equipment is added, the external system has to be cleaned before installation according to section Pipe treatment, Page 687. The filtration grade on these engines is 10 µm, so flushing of the external system has to be completed with a 10 µm filter or lower. The external pump and filter have to be supplied by the yard.



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When working on the system, absolute cleanliness must be maintained. During any work on opened systems, welding and grinding must be prohibited to prevent dirt ingress. Opened pipe flanges on the engine and in the system must be closed immediately.

### 6.8.2 Flushing of the fuel oil system

In principle, it isn't necessary to flush the fuel oil system if the external pipes are cleaned according to section Pipe treatment, Page 687. No particles will enter the engine since the engine-mounted filter act as a safety filter. In case the system is dirty the plant fuel filter will be blocked (alarm for blocked filter will occur). The filtration grade of the plant fuel filter is 1 µm and the engine-mounted filter is 1 µm.

If the engine is equipped with an engine attached fuel oil feed pump, it is not possible to flush the external fuel oil system by use of this pump (pump only operational when engine running). Instead an external pump and filters are required for flushing the external systems, this pump and filter is not Everllence delivery.

When working on the system, absolute cleanliness must be maintained. During any work on opened systems, welding and grinding must be prohibited to prevent dirt ingress. Opened pipe flanges on the engine and in the system must be closed immediately.

### 6.8.3 Flushing the starting air system

The starting air system is “flushed” by blowing out the system using the starting air cylinder. For this purpose the flange connection of the starting air pipe on the main starting valve is temporary dismantled and laid free to the atmosphere.

If the system is blown out using compressed air at the pressure of 30 bar, a sufficient pipe fixing must be provided to prevent damages to other components.

When blowing out, the shut-off valves must be opened as far as possible, and the system must be blown out minimum with 2 to 3 cylinder fillings.

If the result is not satisfactory, the process must be repeated and other suitable measures must be taken if necessary.

The pilot air line cleaning is performed in the same sequence as the blow-out of the main starter air pipe described above.

## 6.9 Preservation, packaging, storage

### 6.9.1 General

#### Introduction

Engines are internally and externally treated with preservation agent before delivery. The type of preservation and packaging must be adjusted to:

- Means of transport
- Type and period of storage

Improper storage may cause severe damage to the product.



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### Packaging and preservation of engine

The type of packaging depends on:

- The requirements imposed with transport and storage period
- Climatic and environmental effects
- Which preservative agents are used

As standard, the preservation and packaging of an engine is designed for a storage period of 12 month (longer storage period > 12 months, sea freight and storage under tropic conditions to be clarified).

Note:
The packaging must be protected against damage. It must only be removed when:

- A follow-up preservation is required
- The packaged material is to be used
- Shortly before operating the engine

The condition of the packaging must be checked regularly and repaired in case of damage. Especially a VCI packaging can only provide a proper corrosion protection if it is intact and completely closed.

In addition, the engine interiors are protected by vapour phase corrosion protection. Inner compartments must not be opened while transportation and storage. Otherwise, a re-preservation of the opened compartment will be required. The inner corrosion protection can remain inside the engine.

If bare metal surfaces get exposed for example, by disassembly of the coupling device, the unprotected metal must be treated with agent "h" according to the list of recommended anti-corrosion agents (Corrosion protection).

Note:
During storage and in case of a follow-up preservation the crankshaft must not be turned. If the crankshaft is turned, usually for the first time after preservation this will be done during commissioning, the preservation is partially removed. If the engine is to be stored again for a period thereafter, then adequate re-preservation is required.

### Preservation and packaging of loose equipment

Unless stated otherwise in the customer specification, the preservation and packaging of loose equipment and engine parts which are dismantled for transport, must be carried out such that:

- The preservation and packaging of loose equipment and engine parts will not be damaged during transport
- The corrosion protection remains fully intact for at least 12 months when stored in a roofed dry room

### Transport

Transport and packaging of the engine, loose equipment and engine parts must be coordinated.

After transportation, any damage to the corrosion protection and packaging must be rectified, and/or Everllence must be notified immediately.



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### 6.9.2 Storage location and duration

**Storage location**

Storage location of engine

The storage location must be in a closed and weather protected area.

The storage location must meet the following requirements:

- Engine is stored on firm and dry ground.
- Packaging material does not absorb any moisture from the ground.
- Engine is accessible for visual checks.

Storage location of loose equipment

Loose equipment must always be stored in a roofed dry room.

The storage location must meet the following requirements:

- Parts are protected against environmental effects and the elements.
- The room must be well ventilated.
- Parts are stored on firm and dry ground.
- Packaging material does not absorb any moisture from the ground.
- Parts cannot be damaged.
- Parts are accessible for visual inspection.
- An allocation of loose equipment to the order or requisition must be possible at all times.

Note:
Packaging made of or including VCI paper or VCI film must not be opened or must be closed immediately after opening.

**Storage conditions**

In general the following requirements must be met:

- Minimum ambient temperature: –10 °C
- Maximum ambient temperature: +60 °C

In case these conditions cannot be met, contact Everllence for clarification.

**Storage period**

The permissible storage period of 12 months must not be exceeded.

Before the maximum storage period is reached:

- Check the condition of the stored engine and loose equipment.
- Renew the preservation or install the engine or components at their intended location.

### 6.9.3 Follow-up preservation when preservation period is exceeded

A follow-up preservation must be performed before the maximum storage period has elapsed, i.e. generally after 12 months.

Request assistance by authorised personnel of Everllence.

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### 6.9.4 Removal of corrosion protection

Packaging, corrosion protection and silica gel must only be removed from the engine **immediately before commissioning** the engine in its installation location.

Remove outer protective layers, any foreign body from engine or component (VCI packs, blanking covers, etc.), check engine and components for damage and corrosion, perform corrective measures, if required.

The preservation agents sprayed inside the engine do not require any special attention. They will be washed off by engine oil during subsequent engine operation.

Contact Everllence if you have any questions.

### 6.9.5 Engine colour and paint finish

#### Engine colour

Engine standard colour according RAL colour table is RAL 7040 Window grey. Other colours on request.

#### Engine paint finish

The engine is coated with a standard industrial painting consisting of a two-layer coating structure with a primer and a top coat. After engine assembly, the whole layer build-up is applied manually by spraying onto the accessible outer surfaces of the engine. Two-component coating products based on epoxy resin are used for this purpose.

The finished coating has good mechanical and chemical resistances, but shows the chalking and discoloration typical of epoxy resin, which is caused by weathering, UV light or increased temperatures. Although the regular operating temperatures do not affect the function and the stability of the coating, visually perceptible discolouration can occur, especially with light colours. Due to the manual application of the coating products after assembly, surface corrosion may occasionally occur on individual engine areas under unfavourable ambient conditions.

A premium coating system can be offered on request if higher visual requirements are placed on the appearance and coating of the engine, especially if white and light colours are desired.



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