MGO COOLER
THE RELIABLE SOLUTION TOWARDS LOWER SULPHER EMISSIONS

Products
COMPANY INTRODUCTION

Heinen & Hopman is a reliable partner in the global maritime sector, offering top quality products and service in the field of climate control (HVAC & Refrigeration). The no-nonsense and entrepreneurial character of the founders who established the company in 1965 is still one of the main cornerstones of Heinen & Hopman. We support our clients using our knowledge and experience by realising the best possible climate control solutions; either fully customised or with varying degrees of standardisation. Like our clients, we are continuously active on a global scale to ensure that we can always be of service. We are also constantly searching for sustainable innovations as we aim for the best and very latest solutions in collaboration with our clients. Heinen & Hopman is critically aware that a company’s greatest asset is its employees – it is they who represent the added value of our business. Our goal is to continue to expand in the global market for maritime climate control solutions in a future-proof way.

In short, you can rely on Heinen & Hopman to deploy the know-how and expertise required to solve any heating, ventilation, air conditioning and refrigeration issue onboard ships. We see complexity as a challenge, no matter where your vessel may be.

OPERATING GLOBALLY

Global networking is crucial in every line of business and the shipping industry is certainly no exception. Being able to offer the highest quality of service and products to our clients at all times and in all places is of enormous importance to us. This is why Heinen & Hopman aims to keep expanding our network and know-how and ensure we are exactly where our clients need us to be.
INTRODUCTION

The MGO Cooler has been developed in response to the MARPOL sulphur emission regulations. Currently, the most widely used fuel in the shipping industry is Heavy Fuel Oil (HFO). Because of its high content in sulphur and heavy metals, sea going vessels burning HFO emit large amounts of air pollutants, and are consequently a major environmental issue worldwide. The MARPOL sulphur emission regulations have been implemented through a series of deadlines that progressively lower the maximum sulphur content of the fuel over years.

Ships sailing in Emission Control Area (ECA) waters have already updated their operations to stricter sulphur limitations in 2010, mainly by switching to Low Sulphur Fuel Oil with a maximum sulphur content of 1.0%. In upcoming regulations the allowed maximum sulphur content will be set to 0.1%. Technically, this is impossible to achieve in a HFO. Therefore, shipping operators currently face a great challenge on how to implement the technical solutions to adapt existing or future installations to the new MARPOL standards.

MGO: the only feasible short term option

There are three options to meet the limitations:

1. Switching to low sulphur fuel oil (LFSO/ Marine gas oil/ Marine diesel oil)
   A safe and proven solution that doesn’t require great investments and it is globally available. The downside of this option is that fuel costs continue to increase.

2. Using high sulphur fuel oil (HFO) with scrubbers
   This solution doesn’t require adapting of fuel tanks or switching to more expensive fuels. However, installation is expensive and the fuel has limited availability.

3. LNG retrofit
   This solution reduces CO2, NOx, SOx, and particulate matter emissions. The costs for retrofitting existing ships will be excessive though and there is a lack of bunkering infrastructure.

In the short terms, switching to MGO/MDO is the only reliable alternative at the moment for ships operating in ECA waters.
APPLICATION

The refinery process to remove sulphur impacts viscosity and, consequently, lubricity. Operating low viscosity, poor lubricating MGO could cause damage in the engine fuel pump which is designed for high viscosity fuel (HFO) operation.

In order to provide proper film-forming properties to protect pump moving parts from wear, engine manufactures advice to keep a minimum fuel viscosity of 2cSt at the fuel pump inlet. To ensure doubtless operation at start and stop of engines, a viscosity level over 3 cSt is strongly recommended.

The Heinen & Hopman MGO cooler
Our MGO cooler has been developed based upon decades of experience in successful worldwide sold and operating Heinen & Hopman marine chillers. We have translated our expertise in climate control to fully meet our clients’ needs when adapting their operation to the upcoming emission limitations. Thanks to a precise fuel temperature control, our MGO cooler ensures an optimal protection for any type of engine when fuel is switched from HFO to MGO.

We provide compact units and customized design, easy to retrofit and adapt to any existing or new-build vessel. Furthermore, our worldwide network guarantees that the delivery, installation and maintenance time is always kept to the minimum.

MGO COOLING SYSTEMS: FOUR TYPES TO COOL MGO

- **Sea water coolers**
  Implemented by the simple use of a heat exchanger. This option is not recommendable due to risk of fuel leakages into the sea water.

- **Fresh water coolers**
  The LT cooling water available on board (typically at 36°C) is used as the cooling agent. This temperature is not low enough to meet the viscosity requirements when low sulphur (low viscosity) MGO is used for shipping within ECA.

- **Direct expansion cooling system**
  Based on a vapour-compression refrigeration cycle with freon-to-fuel heat-exchangers. Although simple and inexpensive, this alternative presents certain problems, like inaccurate control of the cooler surface temperature, safety issues and limited operation at low load (impossible below 25% of the cooling capacity).

- **Chilled fresh water/sea water cooling system**
  Chilled water is produced through a vapour-compression refrigeration cycle. Although more expensive than the previous solutions, it provides trouble-free operation at all loads, precise surface control and safe performance even with leakages.
**MARINE DISTILLATE FUELS SPECIFICATIONS (ISO 8217)**

<table>
<thead>
<tr>
<th>Grade</th>
<th>DMX</th>
<th>DMA</th>
<th>DMZ</th>
<th>DMB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Viscosity at 40°C, cSt</td>
<td>5.50 max.</td>
<td>6.00 max.</td>
<td>6.00 max.</td>
<td>11.00 max.</td>
</tr>
<tr>
<td></td>
<td>1.40 min.</td>
<td>2.00 max.</td>
<td>2.00 min.</td>
<td>2.00 min.</td>
</tr>
<tr>
<td>Density at 15°C, kg/m³</td>
<td>--</td>
<td>890.0 max.</td>
<td>890.0 max.</td>
<td>890.0 max.</td>
</tr>
<tr>
<td>Cetane index</td>
<td>45 min.</td>
<td>40 min.</td>
<td>40 min.</td>
<td>35 min.</td>
</tr>
<tr>
<td>Sulphur, mass %</td>
<td>1.00 max.</td>
<td>1.50 max.</td>
<td>1.50 max.</td>
<td>2.00 max.</td>
</tr>
<tr>
<td>Flash point, °C</td>
<td>43 min.</td>
<td>60 min.</td>
<td>60 min.</td>
<td>61 min.</td>
</tr>
<tr>
<td>Hydrogen sulphide, mg/kg</td>
<td>2.00 max.</td>
<td>2.00 max.</td>
<td>2.00 max.</td>
<td>2.00 max.</td>
</tr>
<tr>
<td>Acid number, mg KOH/g</td>
<td>0.5 max.</td>
<td>0.5 max.</td>
<td>0.5 max.</td>
<td>0.5 max.</td>
</tr>
<tr>
<td>Total sediment, hot filtration, mass %</td>
<td>--</td>
<td>--</td>
<td>--</td>
<td>0.10 max.</td>
</tr>
<tr>
<td>Oxidation stability, g/m³</td>
<td>25 max.</td>
<td>25 max.</td>
<td>25 max.</td>
<td>25 max. *</td>
</tr>
<tr>
<td>Carbon residue, micro, mass %</td>
<td>0.3 max.</td>
<td>0.3 max.</td>
<td>0.3 max.</td>
<td>0.3 max.</td>
</tr>
<tr>
<td>Cloud point, °C</td>
<td>-16 max.</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

**Pour point**

<table>
<thead>
<tr>
<th>DMX</th>
<th>DMA</th>
<th>DMZ</th>
<th>DMB</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter quality, 0°C</td>
<td>-6 max.</td>
<td>-6 max.</td>
<td>-6 max.</td>
</tr>
<tr>
<td>Summer quality, 0°C</td>
<td>0 max.</td>
<td>0 max.</td>
<td>0 max.</td>
</tr>
<tr>
<td>Appearance</td>
<td>Clear and bright</td>
<td>Clear and bright</td>
<td>Clear and bright</td>
</tr>
<tr>
<td>Water, vol %</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>Ash, mass %</td>
<td>0.010 max.</td>
<td>0.010 max.</td>
<td>0.010 max.</td>
</tr>
<tr>
<td>Lubricity, µm**</td>
<td>520 max.</td>
<td>520 max.</td>
<td>520 max.</td>
</tr>
</tbody>
</table>

*If the sample is not clear and bright, the test cannot be undertaken and the limit shall not apply.

**This requirement is applicable to fuels with a sulphur content below 0.05%**

DMA is the only fuel available where a 0.1% sulphur content can be achieved, therefore the only option that meets next ECA regulations. Low sulphur DMA has an average viscosity of 3cSt at 40°C, so a cooling system is indispensable to keep this viscosity level at fuel pump inlet, where the temperature typically reaches 60-65°C (See graph below).

The marine distillate fuel designations according to ISO 8217 are DMX, DMA, DMZ and DMB. DMX is mainly used for special applications, such as emergency engines. DMA and DMZ are the highest quality marine distillate free of black refinery feed stocks, while DMB may contain very small amounts of residual fuel traces. DMA generally corresponds to MGO, and DMB to MDO.

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**Heinen & Hopman’s expertise in chiller technology can lead you now to operate MGO without risks for your engine**

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How to read the chart: MGO is bunkered with viscosity of 2cSt at 40°C. To get a viscosity of 3cSt at engine inlet, the MGO has to be cooled from tank temperature of 45°C to 18°C.
HH MGO 20 SW

Alternatives available on request. Due to continuous product development, Heinen & Hopman reserves the right to introduce alterations without prior notice.

Don’t hesitate to contact us for more information about our service options. We are eager to explain the possibilities for your vessel or structure.

Scan the QR-code or visit heinenhopman.com
**Design parameters**

- Maximum MGO temperature in the service tank: 45°C.
- MGO cooler outlet temperature: 30°C.
- R407C evaporating temperature: 5°C.
- Design fuel flow rate calculated at maximum engine nominal power operation.
- Maximum drop temperature of 20°C/min (recommended by engine manufactures to avoid fuel thermal shock).
- Sea water temperature: 32°C. Fresh water temperature: 36°C.

**Advantages**

- Technology based on H&H’s extensive expertise in the design, manufacturing and installation of chillers.
- Accurate fuel viscosity and temperature drop control.
  The fuel viscosity is controlled indirectly by means of temperature control. A temperature sensor is installed at engine inlet. The monitored fuel oil temperature is transmitted to the PLC, which adapts the cooling capacity of the plant by means of a 3-way valve located in the chilled water return line from the fuel cooler. The PLC uses Proportional Control to ensure the temperature drop rate keeps below 20°C/min until the set point is reached.
- Available with design cooling capacities from 4 to 46 kW suitable for main engine power ranging from 2800 to 32500 kW.
- Sea water or fresh water cooled condenser.
- All types are available with 50 or 60 Hz.
- Suitable for any MGO bunkered.
  DMA quality frames distillate fuels which meet certain parameters. The DMA viscosity ranges from 1.5 to 6.0 cSt at 400C, therefore the temperature at engine inlet that ensures safe viscosity properties varies also within a range. By changing the set temperature when bunkering, any MGO can be cooled to the specific temperature required for that fuel quality to meet the optimal viscosity level.
- The compact design of the HH MGO cooler saves space on board, minimizes refrigerant charge and allows placement through the engine room hatch.
  20m pipe length with a maximum height deviation of 3m between the unit and evaporator (see product specification chart for unit dimensions by model).
- Designed according to EN 378-2008-Refrigerating Systems and Heat Pumps Safety and Environmental Requirements.
- Delivered for ‘Plug & Play’ which makes it easy to install and minimizes the ship downtime.
- Customized design and application available on request.

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**50 Hz range**

<table>
<thead>
<tr>
<th>Type</th>
<th>Qo R407C (kW)</th>
<th>Pe absorbed (kW)</th>
<th>I max (A)</th>
<th>Flow FW/ CW SW/ CW (m³/h)</th>
<th>Dimensions LxWxH (m)</th>
<th>LSFO (kg/h) flow</th>
<th>M.E. power (kW)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HH MGO 4 SW</td>
<td>4</td>
<td>1.5</td>
<td>2.8</td>
<td>2.5/0.6</td>
<td>1.1x0.6x0.64</td>
<td>510</td>
<td>2.800</td>
<td>230</td>
</tr>
<tr>
<td>HH MGO 10 SW</td>
<td>10</td>
<td>3.35</td>
<td>7.1</td>
<td>3/1.5</td>
<td>1.2x0.65x0.7</td>
<td>1274</td>
<td>7.000</td>
<td>260</td>
</tr>
<tr>
<td>HH MGO 16 SW</td>
<td>16</td>
<td>4.57</td>
<td>10.7</td>
<td>3/2.4</td>
<td>1.2x0.75x0.7</td>
<td>2039</td>
<td>11.300</td>
<td>320</td>
</tr>
<tr>
<td>HH MGO 30 SW</td>
<td>30</td>
<td>8.69</td>
<td>20.4</td>
<td>5/4.5</td>
<td>1.8x0.9x0.75</td>
<td>3822</td>
<td>21.200</td>
<td>550</td>
</tr>
<tr>
<td>HH MGO 46 SW</td>
<td>46</td>
<td>13.22</td>
<td>21.5</td>
<td>8/6.8</td>
<td>2.2x0.95x0.8</td>
<td>5861</td>
<td>32.500</td>
<td>700</td>
</tr>
</tbody>
</table>

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**60 Hz range**

<table>
<thead>
<tr>
<th>Type</th>
<th>Qo R407C (kW)</th>
<th>Pe absorbed (kW)</th>
<th>I max (A)</th>
<th>Flow FW/ CW SW/ CW (m³/h)</th>
<th>Dimensions LxWxH (m)</th>
<th>LSFO (kg/h) flow</th>
<th>M.E. power (kW)</th>
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<td>1274</td>
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<td>260</td>
</tr>
<tr>
<td>HH MGO 16 SW</td>
<td>16</td>
<td>5</td>
<td>10.1</td>
<td>3/2.4</td>
<td>1.2x0.75x0.7</td>
<td>2039</td>
<td>11.300</td>
<td>320</td>
</tr>
<tr>
<td>HH MGO 30 SW</td>
<td>30</td>
<td>10.5</td>
<td>20.4</td>
<td>5/4.5</td>
<td>1.8x0.9x0.75</td>
<td>3822</td>
<td>21.200</td>
<td>550</td>
</tr>
<tr>
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<td>46</td>
<td>12.15</td>
<td>23.7</td>
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<td>5861</td>
<td>32.500</td>
<td>700</td>
</tr>
</tbody>
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(1) Sea water type: HH MGO ... SW  Fresh Water type: HH MGO ... FW
(2) Cp= 0.45 kcal/kg•K  SFC=180 g/kW•h
Heinen & Hopman encourages a more sustainable world. By providing eco-friendly solutions and services we offer our clients the option of reducing energy consumption and thus CO2 emissions.

Heinen & Hopman

Do you require more information about our products or do you require advice? I am keen to help you further!

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