Preservation and Represervation Specifications

All MTU series for diesel and gas engines
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1 General Information

1.1 Notes on the use and validity of preservation and re-preservation specifications

**Used symbols and means of representation**

The following instructions are highlighted in the text and must be observed:

This symbol indicates instructions, tasks and operations that must be followed to avoid hazards to persons as well as damage to or destruction of material.

**Note:**

An note provides special instructions that must be observed when performing a task.

**Applicability of this publication**

The current amendment status of these preservation specifications is shown in the Revision overview (→ Page 49).

The preservation specifications are modified or supplemented as required. Before using them, make sure you have the latest version. The latest version is also available at: http://www.mtu-online.com/mtu/mtu-valuecare/mtu-valueservice-Technische-Dokumentation.

If you have further queries, please contact your MTU representative.

**Other applicable documents**

- Preservation specifications of the gearbox manufacturer
- Engine documentation
- Safety data sheets for preservation media
- Current MTU Fluids and Lubricants Specifications
- MTU packaging manual

**Validity of the preservation specifications**

These preservation specifications define the media for preservation/re-preservation (preservatives) and the guidelines for de-preservation and packaging of MTU engines.

The preservation specifications apply to all diesel and gas engines from MTU Friedrichshafen GmbH following delivery from the factory:

- Reserve stock engines
- Installed engines that have not yet been put into service
- Field engines with extended downtime, e.g. normal out-of-service periods, out-of-service-periods for scheduled maintenance or unscheduled repair work.

The preservation / re-preservation scope is the same for all engine models. When preserving complete PowerPacks, the preservation specifications of component manufacturers, e.g. of the gearbox, generator, preheating unit and couplings, must also be observed.

In addition to these preservation specifications, the corresponding engine documentation must also be observed. Work and tests during an interruption of operation and prior to a renewed startup are to be performed according to the engine documentation.

The measures described in the following section are restricted to the MTU engine.

Exception: For the 1800 series, they refer to the complete PowerPack.
Warranty

Use of the approved preservatives, either under the brand name or in accordance with the specifications given in this publication, constitutes part of the warranty conditions.

The supplier of the preservatives is responsible for the worldwide standard quality of the named products.

MTU Friedrichshafen GmbH accepts no responsibility whatsoever for improper or illegal use of the preservatives which it has approved. Users of the products named in these specifications are therefore obliged to inform themselves of the locally valid regulations.

As the re-preservation intervals and the medium also depend on the storage conditions and type of packaging, the warranty shall become invalid in the event of incorrect storage or packaging.
1.2 Safety instructions for handling preservatives

| i | Preservatives for drive systems can be inherently dangerous. Certain regulations must be obeyed when handling, storing and disposing of these substances. |

These regulations are contained in the manufacturers' instructions, legal requirements and technical guidelines valid in the individual countries. Great differences can apply from country to country and a generally valid guide to applicable regulations for preservatives is therefore not possible within this publication.

Users of the products named in these specifications are therefore obliged to inform themselves of the locally valid regulations. MTU Friedrichshafen GmbH accepts no responsibility whatsoever for improper or illegal use of the preservatives which it has approved.
2 Preservation and re-preservation

2.1 Notes on preservation and re-preservation

Preservation

"Preservation" refers to initial preservation in the factory or the preservation of a field engine prior to an extended out-of-service period. MTU engines are usually delivered with initial preservation as per factory standard MTV 5073. This is generally carried out during the acceptance test on the test bench.

In the event of long operation interruptions, machined and unprotected surfaces, such as cylinder running surfaces, are prone to corrosion and therefore need to be preserved.

Preservation measures are carried out in the same manner as re-preservation. The scope of preservation depends on the duration of the out-of-service period.

Field engines and engines that were put out of service for a scheduled major overhaul must be preserved immediately after their last service period.

Coolant circuits must always be preserved after the coolant has been drained. Preservation is not required if the coolant is left in the system.

Preservation must be repeated at regular intervals (re-preservation).

Re-preservation

"Re-preservation" refers to the renewal of already existing preservation at specified time intervals. The intervals differ for internal and external preservation and – for internal preservation – according to the different media (oil, fuel, coolant) and filling levels. For re-preservation intervals, refer to (→ Page 17) and (→ Page 19).

As the re-preservation intervals and the medium also depend on the storage conditions and type of packaging, the warranty shall become invalid in the event of incorrect storage or packaging.

For storage and transport conditions, see (→ Page 15).

Preservatives

The service life, operational reliability and function of the drive systems are largely dependent on the fluids, lubricants and preservatives employed. The correct selection and treatment of these fluids, lubricants and preservatives are therefore extremely important.

For preservation and re-preservation of MTU engines, only the preservatives approved in these preservation specifications must be used (→ Page 9).

Documentation requirements

(Re-)preservation, de-preservation and monitoring of an engine with climate-compatible packaging must be documented by the person responsible:
- Preservation/re-preservation check sheet (→ Page 8)
- Instruction sheet for de-preservation if climate-compatible packaging is used (→ Page 37)
- Monitoring Sheet for engines with climate-compatible packaging (→ Page 48)
2.2 Check sheet for preservation and re-preservation

All preservation work that is performed must be recorded on the check sheet shown below. For engines stored with a manufacturer guarantee, the Monitoring Sheet (→ Page 48) must also be filled out and sent back to MTU Friedrichshafen GmbH in due time before putting the engine back into operation.

Correct completion of the preservation tasks as specified in the preservation specifications must be certified on this check sheet by the person completing the various tasks.

<table>
<thead>
<tr>
<th>Engine model:</th>
<th>Engine No.:</th>
<th>Acceptance date:</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Tasks performed</th>
<th>Date</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lube oil system</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Preserved with preservation oil.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Oil brand used: .........................</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Fuel system</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Preserved with preservative fuel.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Fuel filter, prefilter and fuel lines have not been drained.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Preservative fuel used: .........................</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cooling system, filled</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Has been preserved with prepared coolant.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Coolant not drained.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Brand of coolant used: .........................</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Cooling system, unfilled</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Preserved with an approved corrosion inhibitor for internal preservation of the coolant circuit</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Corrosion inhibitor drained.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Corrosion inhibitor used: .........................</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Combustion chamber</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Preserved with preservation oil.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Oil brand used: .........................</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Non-painted parts</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Painted with corrosion inhibitor.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Engine openings sealed as specified.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• All parts to be kept free of paint, such as flywheel, starter ring gear and starter pinion as well as non-painted sections of the control linkage and the uncovered coupling flange (as appropriate) for the 3-phase generator are brush-coated with corrosion-inhibiting oil.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Corrosion inhibitor used: .........................</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Further procedure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. After completing preservation work, put the completed check sheet into a closed plastic sleeve.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Seal the sleeve at the open side and attach it to the engine so that it is clearly visible.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Store the check sheet until de-preservation beside the engine and send back to MTU Friedrichshafen GmbH in good time before initial operation.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
3 Approved preservatives

3.1 Preservatives – Requirements

These preservation specifications define the preservatives for the preservation and re-preservation of MTU engines.

Preservatives are divided into groups according to their operating areas:
• Initial operation and corrosion inhibitor for internal preservation of the oil circuit
• Corrosion inhibitors for internal preservation of the coolant circuit
• Corrosion inhibitors for internal preservation of the fuel system
• Corrosion inhibitor for preservation of the combustion chamber
• Corrosion inhibitors for external preservation

Test standards for preservatives

The following test standards are used for the evaluation and selection of preservatives for MTU engines:

<table>
<thead>
<tr>
<th>Test standard</th>
<th>Designation</th>
</tr>
</thead>
<tbody>
<tr>
<td>DIN</td>
<td>Federal German Standards Institute</td>
</tr>
<tr>
<td>EN</td>
<td>European Standards</td>
</tr>
<tr>
<td>ISO</td>
<td>International standard</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society for Testing and Materials</td>
</tr>
<tr>
<td>IP</td>
<td>Institute of Petroleum</td>
</tr>
</tbody>
</table>

Approval of preservatives

For preservation and re-preservation of MTU engines, only the preservatives approved in these preservation specifications must be used.

The conditions for the approval of preservatives are defined in MTU delivery standards (MTL):
• MTL 5051 for initial operation and preservative oil
• MTL 5052 for corrosion inhibitors for external preservation

The preservation product manufacturer is informed in writing if his product is approved by MTU.

Note on initial operation

Before initial operation, the engine has to be de-preserved (→ Page 36).
3.2 Corrosion inhibitor for internal preservation

3.2.1 Corrosion inhibitors for the oil circuit and combustion chamber

The media in the table below, with one exception, are suitable for internal preservation of the oil circuit as well as preservation of the combustion chamber.

Important: Shell Rimula R6 ME 5W-30 must not be used to preserve the combustion chamber.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Brand name</th>
<th>Part No.</th>
<th>Remarks</th>
<th>Suitability for engine preservation filled</th>
<th>Suitability for engine preservation unfilled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cepsa Lubricantes S.A.</td>
<td>Cepsa Rodaje Y Proteccion SAE 30</td>
<td>–</td>
<td>Full-load engine oil as per Oil Category 1</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Exxon Mobil</td>
<td>Mobilarma 524</td>
<td>–</td>
<td>Preservative oil: Only approved for preservation run</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Fuchs</td>
<td>Titan Universal HD 30 MTU</td>
<td>X00058057 (barrel) X00013236 (tanker)</td>
<td>Full-load engine oil as per Oil Category 2</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>SRS Schmierstoff Vertrieb GmbH</td>
<td>SRS Antikorrol M Plus SAE 30</td>
<td>X00058336 (barrel) X00058338 (tanker)</td>
<td>Full-load engine oil as per Oil Category 2</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td>SRS Motorenöl O-236 SAE 15W-40</td>
<td>X00057300</td>
<td>Full-load engine oil as per Oil Category 2</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Shell</td>
<td>Shell Running-In Oil 7294 SAE 30</td>
<td>–</td>
<td>Preservative oil: Only approved for preservation run</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Shell Rimula R6 ME 5W-30</td>
<td></td>
<td>X00009123 X00058058 (barrel)</td>
<td>Special application: Only approved for 1800PP series Engine oil as per Oil Category 3 without improved corrosion protection</td>
<td>x</td>
<td>–</td>
</tr>
</tbody>
</table>

Table 1: Corrosion inhibitors for the oil circuit and combustion chamber

- x  Suitable for engine preservation
- - Unsuitable for engine preservation
### 3.2.2 Corrosion inhibitor for coolant circuit

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Brand name</th>
<th>Part No.</th>
<th>Remarks</th>
<th>Suitability for engine preservation</th>
</tr>
</thead>
</table>
| BASF                    | Glysacorr P113*)                  | X00046660  | 9 – 11% vol. application concentration  
• Optimum corrosion protection during draining < 40 °C  
• Reduced corrosion protection during hot draining  
• 100 h maximum operating period  
• Not an engine coolant! | – x                                |
| BASF                    | Glysacorr P113 Antifreeze*)        | X00055338  | 40 – 50% vol. application concentration  
• Optimum corrosion protection during draining < 40 °C  
• Reduced corrosion protection during hot draining  
• 100 h maximum operating period  
• Antifreeze protection up to -18 °C at 40% vol.  
up to -28 °C at 50% vol.  
• Not an engine coolant! | x x                                |
| Houghton Deutschland GmbH | Oil 9156*)                        | –          | 1 – 2% vol. application concentration  
• The engine must be flushed prior to filling with actual engine coolant  
• Exception: If Oil 9156 is approved as coolant additive for the relevant series (see applicable Fluids and Lubricants Specifications) | – x                                |
| Others                  | All corrosion inhibiting antifreezes approved for the respective series in accordance with the applicable Fluids and Lubricants Specifications | –          | The engine can then be operated with this engine coolant. Precondition:  
• Corrosion inhibiting antifreeze is approved for engine operation  
• Shelf life not expired | x –                                |

* “Approved preservatives” in the following section also referred to as inhibitor concentration, see Information.

---

Table 2: Corrosion inhibitor for coolant circuit

- **x** Suitable for engine preservation
- **–** Unsuitable for engine preservation

*) in the following section also referred to as inhibitor concentration, see Information
In contrast to coolants, inhibitor concentrations also protect the coolant circuit against corrosion when drained.

As inhibitor concentrations can also contain vapor-phase inhibitors, ensure that the coolant circuits are always hermetically sealed to prevent inhibitors from escaping, thus reducing the corrosion protection.

Aqueous corrosion inhibitors and emulsions are not approved for engine preservation when filled. Reason: Lack of antifreeze protection and susceptibility to microbiological attack.

If no corrosion inhibiting antifreeze is approved for a series, an appropriate coolant additive can be selected from the approved of the 4000 series/containing light alloy (see applicable Fluids and Lubricants Specifications A001061/xx). Ensure, however, that prior to engine operation this coolant is replaced by a coolant approved in the Fluids and Lubricants Specifications of the relevant series.

For series that only have application approval for emulsions, storage with filled corrosion inhibiting antifreeze is impermissible.

When mixing coolant or inhibitor concentration, only use clean, clear water of the following quality:

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sum of alkaline earth metals (Water hardness)</td>
<td>0 mmol/l</td>
<td>2.7 mmol/l</td>
</tr>
<tr>
<td>pH value at 20 °C</td>
<td>6.5</td>
<td>8.0</td>
</tr>
<tr>
<td>Chloride ions</td>
<td>–</td>
<td>100 mg/l</td>
</tr>
<tr>
<td>Sulfate ions</td>
<td>–</td>
<td>100 mg/l</td>
</tr>
<tr>
<td>Sum of anions</td>
<td>–</td>
<td>200 mg/l</td>
</tr>
<tr>
<td>Bacteria, fungi, yeasts</td>
<td>are not permitted!</td>
<td></td>
</tr>
</tbody>
</table>

If the limit values for the water are exceeded, hardness or mineral content can be decreased by adding demineralized water.
### 3.2.3 Corrosion inhibitor for the fuel system

#### Diesel engines

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Brand name</th>
<th>Part No.</th>
<th>Comments</th>
<th>Suitability for engine preservation</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRS Schmierstoff Vertrieb GmbH</td>
<td>SRS Calibration Fluid</td>
<td>X00057309</td>
<td>Test oil as per ISO 4113</td>
<td>x</td>
</tr>
<tr>
<td>Shell</td>
<td>V – Oil 1404</td>
<td>–</td>
<td>Test oil as per ISO 4113</td>
<td>x</td>
</tr>
<tr>
<td>–</td>
<td>Diesel fuel B0*)</td>
<td>X00056047</td>
<td>without biodiesel</td>
<td>x</td>
</tr>
<tr>
<td>–</td>
<td>Diesel fuel B0*) + 9 - 13% SRS Anti-korrol M Plus SAE 30</td>
<td>X00056047</td>
<td>without biodiesel</td>
<td>x</td>
</tr>
<tr>
<td>SRS Schmierstoff Vertrieb GmbH</td>
<td>–</td>
<td>X00058336</td>
<td>without biodiesel</td>
<td>x</td>
</tr>
<tr>
<td>–</td>
<td>Diesel fuel B0*) + 9 - 13% Titan Universal HD</td>
<td>X00056047</td>
<td>without biodiesel</td>
<td>x</td>
</tr>
</tbody>
</table>

*Table 3: Corrosion inhibitor for the fuel system of diesel engines*

- x Suitable for engine preservation
- – Unsuitable for engine preservation

*) see Information

B0 is diesel fuel in accordance with DIN EN 590 without biodiesel. Diesel fuel according to DIN EN 590 (also referred to as B7) normally contains an additive of 7% biodiesel and must not be used for preservation.

#### Gas engines (natural gas and biogas)

When the engine is shut down, it can be assumed that the entire fuel system is filled with air only. If, however, there are still small amounts of gas in the engine, they do not have a corrosive effect. Preservation is therefore not required.

However, you should ensure that there is no moisture between mixture cooler and cylinder head. If moisture is detected, the engine must be run 2 to 3 hours in partial load.

The approved gases are listed in the current Fluids and Lubricants Specifications.
3.3 Corrosion inhibitors for external preservation

When preserving the engine exterior shell, all non-painted parts must be treated with a corrosion inhibitor. This forms a waxy protective coating after the solvent has evaporated.

<table>
<thead>
<tr>
<th>Manufacturer</th>
<th>Brand name</th>
<th>Part No.</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Castrol Ltd.</td>
<td>Rustilo 181</td>
<td>–</td>
<td>waxy protective coating</td>
</tr>
<tr>
<td>Valvoline Oel</td>
<td>Tectyl 846-K-19</td>
<td>X00057275</td>
<td>waxy protective coating</td>
</tr>
<tr>
<td></td>
<td></td>
<td>X00057276</td>
<td></td>
</tr>
</tbody>
</table>

*Table 4: Corrosion inhibitors for external preservation*

**Re-preservation requirement**

- every 3 years under normal storage conditions or with use of climate packaging
- every 12 months under difficult storage conditions
4 Re-preservation intervals

4.1 Dependency between storage conditions and type of packaging

Preserved engines must be re-preserved to retain the corrosion protection. Only approved preservatives (→ Page 9) must be used for re-preservation. The re-preservation intervals depend on the storage conditions and type of packaging.

**Storage**

A distinction is made between the following storage conditions:

<table>
<thead>
<tr>
<th>Storage</th>
<th>Operating areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal</td>
<td>• frost-free, closed and heated rooms, clean</td>
</tr>
<tr>
<td></td>
<td>• max. temperature fluctuations between 10 and 40 °C</td>
</tr>
<tr>
<td></td>
<td>• monthly average relative air humidity ≤ 65%</td>
</tr>
<tr>
<td>Difficult</td>
<td>• dust or contamination</td>
</tr>
<tr>
<td></td>
<td>• dew point undershot &gt; 20% of the month</td>
</tr>
<tr>
<td></td>
<td>• monthly average relative air humidity &gt; 65%</td>
</tr>
<tr>
<td>Unsuitable</td>
<td>• salt-laden air</td>
</tr>
<tr>
<td></td>
<td>• outdoor storage</td>
</tr>
<tr>
<td></td>
<td>• ocean transport, dispatch to polar and tropical regions</td>
</tr>
</tbody>
</table>

**Packaging**

The type of engine packaging depends on the storage and transport conditions.

<table>
<thead>
<tr>
<th>Type of packaging</th>
<th>Operating areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Commercially available packaging</td>
<td>• for storage under normal or difficult conditions with differences in re-</td>
</tr>
<tr>
<td></td>
<td>preservation intervals</td>
</tr>
<tr>
<td>Climate-compatible packaging</td>
<td>• for unsuitable storage and transport conditions to simulate storage</td>
</tr>
<tr>
<td></td>
<td>conditions that are as normal as possible; climate-compatible packaging,</td>
</tr>
<tr>
<td></td>
<td>however, does not protect against frost</td>
</tr>
<tr>
<td></td>
<td>• check the humidity indicator in the special packaging every 3 to 4 months</td>
</tr>
</tbody>
</table>
4.2 Interpretation examples

The change intervals are based on fresh media with current date of manufacturer. If media are already old, the change interval is reduced by the aging period.

Example 1: Engine with unfilled medium circuits in commercially available packaging

A preserved engine with unfilled medium circuits is to be stored for 24 months in a closed, frostproof warehouse. The engine is wrapped in commercially available packaging. What are the re-preservation requirements?

In this case, the table for engines with unfilled medium circuits is relevant (→ Page 19).

Unfilled medium circuits → normal storage conditions → commercially available packaging:

• The medium circuits (oil, fuel, coolant) and the combustion chamber must be re-preserved every 12 months.
• The preservation of the engine outer shell (non-painted parts) must be replaced every 36 months.

Example 2: Engine with unfilled medium circuits in climate-compatible packaging

A preserved engine with unfilled medium circuits is to be stored for 60 months in climate-compatible packaging. What are the re-preservation requirements?

In this case, the table for engines with unfilled medium circuits is relevant (→ Page 19).

Unfilled medium circuits → unsuitable storage conditions → climate-compatible packaging:

• The medium circuits (oil, fuel, coolant) and the combustion chamber must be re-preserved every 36 months.
• The preservation of the engine outer shell (non-painted parts) must be replaced every 36 months.

Example 3: Engine with filled medium circuits

An engine with filled medium circuits (approved preservatives without aging) is to be taken out of service for approx. 12 months and stored under difficult conditions. What are the re-preservation requirements?

In this case, the table for engines with filled medium circuits is relevant (→ Page 17).

Filled medium circuits → difficult storage conditions → commercially available packaging:

• Oil: No measures necessary because the filled preservative oil does not have to be replaced until after 36 months. (Exception: after 24 months with 1800 series PowerPack)
• Coolant: No measures necessary because the filled coolant does not have to be replaced until after 24 or 36 month (depending on product).
• Fuel: The filled diesel fuel must be replaced every 6 months.
• The combustion chamber must be re-preserved every 6 months.
• The preservation of the engine outer shell (non-painted parts) must be replaced every 12 months.

Before putting a preserved engine with filled medium circuits back into operation, check whether the filled preservatives are approved for engine operation (see valid Fluids and Lubricants Specifications). If not, switch to approved fluids and lubricants.
## 4.3 Re-preservation intervals

### 4.3.1 Engines with filled medium circuits

### Re-preservation intervals for filled medium circuits (oil, fuel, coolant), combustion chamber and external preservation

**Notes:**
- Climate-compatible packaging is not permissible with filled medium circuits.
- For definition of storage conditions and packaging types, see (→ Page 15).
- For examples on how to determine re-preservation intervals, see (→ Page 16).

<table>
<thead>
<tr>
<th>Storage conditions</th>
<th>Re-preservation interval in months</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Filled medium circuits (oil, fuel, coolant)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>Oil circuit</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Fuel system</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Coolant circuit</td>
<td>–</td>
</tr>
<tr>
<td>Difficult</td>
<td>Oil circuit</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Fuel system</td>
<td>commercially avail. packaging</td>
</tr>
<tr>
<td></td>
<td>Coolant circuit</td>
<td>–</td>
</tr>
<tr>
<td>Unsuitable</td>
<td>Oil circuit</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Fuel system</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Coolant circuit</td>
<td>–</td>
</tr>
</tbody>
</table>
### Table 5: Re-preservation intervals for filled medium circuits, combustion chamber and external preservation

#### Additional specifications on oil circuit

With complete filling with the following named media, re-preservation of the lube oil circuit takes place at the following intervals:

<table>
<thead>
<tr>
<th>Product</th>
<th>Replacement</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>SRS Anticorrol M Plus SAE 30</td>
<td>after 3 years</td>
<td>Following this, the engine must only be operated with these oils if they are listed for the corresponding series as approved engine oil in the valid Fluids and Lubricants Specifications.</td>
</tr>
<tr>
<td>SRS engine oil O-236 SAE 15-W40</td>
<td>after 3 years</td>
<td></td>
</tr>
<tr>
<td>Titan Universal HD 30 MTU</td>
<td>after 3 years</td>
<td></td>
</tr>
<tr>
<td>Cepsa Rodaje Y Proteccion SAE 30</td>
<td>after 3 years</td>
<td></td>
</tr>
<tr>
<td>Shell Running-In Oil 7294 SAE 30</td>
<td>after 3 years</td>
<td>Engine must not be operated subsequently with these media. Not an engine oil!</td>
</tr>
<tr>
<td>Mobilarma 524</td>
<td>after 3 years</td>
<td></td>
</tr>
<tr>
<td>Shell Rimula R6 ME 5W-30</td>
<td>after 2 years</td>
<td>only approved for 1800 series Power Packs</td>
</tr>
</tbody>
</table>

#### Additional specifications for coolant circuit

With complete filling with the following named media, re-preservation of the coolant circuit takes place at the following intervals:

<table>
<thead>
<tr>
<th>Product</th>
<th>Replacement</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glysacorr P113 Antifreeze</td>
<td>2 years after date of manufacture</td>
<td>Engine must not be operated with this medium. Not an engine coolant!</td>
</tr>
<tr>
<td>Corrosion inhibiting antifreeze approved for the corresponding series</td>
<td>3 years after date of manufacture</td>
<td>Engine can be operated with this medium if the corresponding conditions have been met (see notes on the corrosion inhibitors for the coolant circuit (→ Page 11)).</td>
</tr>
</tbody>
</table>
### 4.3.2 Engines with unfilled medium circuits

**Re-preservation intervals for unfilled medium circuits (oil, fuel, coolant), combustion chamber and external preservation**

**Notes:**
- For definition of storage conditions and packaging types, see (→ Page 15).
- For examples on how to determine re-preservation intervals, see (→ Page 16).

<table>
<thead>
<tr>
<th>Storage conditions</th>
<th>Re-preservation interval in months</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Unfilled medium circuits (oil, fuel, coolant)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>6</td>
<td>12</td>
</tr>
<tr>
<td>Normal</td>
<td>commercial-ly avail. packaging</td>
<td></td>
</tr>
<tr>
<td>Difficult</td>
<td>commercially avail. packaging</td>
<td></td>
</tr>
<tr>
<td>Unsuitable</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Difficult</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Unsuitable</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Combustion chamber</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>–</td>
<td>commercial-ly avail. packaging</td>
</tr>
<tr>
<td>Normal</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Difficult</td>
<td>commercially avail. packaging</td>
<td></td>
</tr>
<tr>
<td>Unsuitable</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Difficult</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Unsuitable</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>External preservation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Normal</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Normal</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Difficult</td>
<td>–</td>
<td>commercial-ly avail. packaging</td>
</tr>
<tr>
<td>Unsuitable</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Difficult</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Unsuitable</td>
<td>–</td>
<td>–</td>
</tr>
</tbody>
</table>

*Table 6: Re-preservation intervals for unfilled medium circuits, combustion chamber and external preservation*
5  Re-preservation with operation option of engine

5.1  Service interruption of up to one month

Note: The following description applies to installed engines.

Preservation measures are not necessary.

- It is sufficient to close the emergency-air shutoff flaps, if fitted.
- All fluids and lubricants remain in the engine.
- If it is necessary to drain fluids and lubricants, the procedure for diesel engines (→ Page 22) or gas engines (→ Page 23) should be adopted.
5.2 Service interruption of 1 to 3 months

5.2.1 Diesel and gas engine – Storage with filled medium circuits

Note:
- The following description applies equally to installed and removed engines.
- If engine removal is planned, the preservation measures must be carried out prior to engine removal.
- If aqueous corrosion inhibitors are used in the coolant circuit and there is a risk of frost during storage, a switch must be made to corrosion inhibiting antifreeze.
- Before putting the engine into operation, ensure that a switch has been made to an approved coolant if necessary. The engine must not be operated with antifreeze if only aqueous coolant additives are approved. The coolant additives approved for an engine or the respective application are shown in the relevant Fluids and Lubricants Specifications.

Starting engine
1. Run engine until operating temperature is reached.
2. Run engine for approx. 30 second up to rated speed and shut down when rated speed is reached. The engine must not be started again.
3. All fluids and lubricants remain in the engine.

Note: Sealing of the openings differs depending on whether the engine is installed or removed.

Sealing the openings on installed engine
- The following openings must be sealed tight against moisture:
  - Cooling air inlet
  - Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
  - Exhaust outlet
  - Crankcase breather (where possible; with venting to atmosphere)

Sealing the openings on removed engine
- The following openings must be sealed tight against moisture:
  - Cooling air inlet
  - Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
  - Exhaust outlet
  - Crankcase breather (where possible; with venting to atmosphere
  - Coolant circuit
  - Fuel circuit
  - Lube oil circuit
  - Hydraulic oil circuit
  - Electrical plug connectors
5.2.2 Diesel engine – Storage with unfilled medium circuits

Note:
• The following description applies equally to installed and removed engines.
• If engine removal is planned, the preservation measures must be carried out prior to engine removal.

**Internal preservation and drainage**

1. Clean engine if necessary.
2. Drain coolant (if present).
3. Completely fill coolant circuit with approved inhibitor concentration (→ Page 11).

Note: To bypass the flushing procedure during coolant filling for initial operation, the use of inhibitor concentration "Glysacorr P 113" instead of the emulsifiable corrosion inhibitor oil "Oil 9156" is recommended.
4. Fill fuel system completely with an approved corrosion inhibitor for internal preservation of the fuel system which is suitable for unfilled engine (→ Page 13).
5. If necessary, replace engine oil with an approved initial operation corrosion inhibitor for internal preservation of the oil circuit and which is suitable for an unfilled engine (→ Page 10).
6. Operate engine at increased idling speed for approx. 10 minutes. The inhibitor concentration must reach operating temperature.
7. Shut down engine.
8. Drain engine oil.
9. Allow engine to cool down to max. 40 °C.
10. Drain inhibitor concentration.

Note: Sealing of the openings differs depending on whether the engine is installed or removed. The medium circuits must be sealed immediately after draining the media.

**Sealing the openings on installed engine**

▲ The following openings must be sealed tight against moisture:
- Cooling air inlet
- Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
- Exhaust outlet
- Crankcase breather (where possible; with venting to atmosphere)

**Sealing the openings on removed engine**

▲ The following openings must be sealed tight against moisture:
- Cooling air inlet
- Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
- Exhaust outlet
- Crankcase breather (where possible; with venting to atmosphere)
- Coolant circuit
- Fuel circuit
- Lube oil circuit
- Hydraulic oil circuit
- Electrical plug connectors
5.2.3 Gas engine – Storage with unfilled medium circuits

Note: • The following description applies equally to installed and removed engines. • If engine removal is planned, the preservation measures must be carried out prior to engine removal.

**Internal preservation and drainage**

1. Clean engine if necessary.
2. Drain coolant (if present).
3. Completely fill coolant circuit with approved inhibitor concentration (→ Page 11).

Note: To bypass the flushing procedure during coolant filling for initial operation, the use of inhibitor concentration "Glyscorr P 113" instead of the emulsifiable corrosion inhibitor oil "Oil 9156" is recommended.
4. If necessary, replace engine oil with an approved initial operation corrosion inhibitor for internal preservation of the oil circuit and which is suitable for an unfilled engine (→ Page 10).
5. Run the engine for at least 15 minutes at half load. The inhibitor concentration must reach operating temperature.
7. Drain engine oil.
8. Allow engine to cool down to max. 40 °C.

Note: Sealing of the openings differs depending on whether the engine is installed or removed. The medium circuits must be sealed immediately after draining the media.

**Sealing the openings on installed engine**

≥ The following openings must be sealed tight against moisture:
  • Cooling air inlet
  • Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
  • Exhaust outlet
  • Crankcase breather (where possible; with venting to atmosphere)

**Sealing the openings on removed engine**

≥ The following openings must be sealed tight against moisture:
  • Cooling air inlet
  • Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
  • Exhaust outlet
  • Crankcase breather (where possible; with venting to atmosphere)
  • Coolant circuit
  • Fuel circuit
  • Lube oil circuit
  • Hydraulic oil circuit
  • Electrical plug connectors
5.3 Service interruption of more than 3 months

5.3.1 Diesel engine – Storage with filled medium circuits

Note:
• The following description applies equally to installed and removed engines.
• If engine removal is planned, the preservation measures must be carried out prior to engine removal.
• If accessibility is insufficient in installed state to carry out preservation (e.g. no access to charge-air manifold), the engine must be removed to carry out preservation work and set up on ground run block or test bench, or another solution is worked out after consultation with MTU.

**Internal preservation**

1. Clean engine if necessary.
2. Leave engine oil in engine if it is an oil approved for preservation (→ Page 10). Otherwise replace filled engine oil with an approved oil, or carry out initial filling with this oil.
3. Fill fuel system with an approved fuel (→ Page 13). If a fuel is already filled and is unsuitable for engine storage, it must be replaced.
4. Drain coolant if necessary and fill with approved corrosion inhibiting antifreeze (→ Page 11) or leave existing corrosion inhibiting antifreeze in coolant circuit. Alternatively, the inhibitor concentration "Glysacorr P113 antifreeze" can be filled for engine storage.
5. Operate engine at increased idling speed for approx. 10 minutes. The coolant must have reached operating temperature.
7. All media remain in the system. These medium circuits must be filled completely.

**Preservation of combustion chamber**

1. Seal the decompression openings.
2. Fill corrosion inhibitor oil for initial operation at least up to the Min mark.
3. Remove end cover for combustion air intake and exhaust gas discharge.
4. Provide access to the charge-air manifold. This can be done by removing flame-start canisters, sensors, covers or pipes. Access to the charge-air manifold must always be established downstream of the intercooler, pressure fine filter / air filter and exhaust turbocharger.
5. Bar warm engine with starting equipment. The engine must not start. To do this:
   • actuate the stop lever for mechanical governors.
   • with electronic governors, the power supply must be disconnected and the engine barred via emergency start or another suitable manner.
6. While the engine is being barred, use a fine-atomizing spray gun to spray initial operation corrosion inhibiting oil into the charge-air pipe openings (→ Page 10) for about 15 seconds.
7. Seal off the combustion air intake and exhaust outlet openings immediately against moisture / humidity.
8. Seal access to the charge-air pipes.

Note: Sealing of the openings differs depending on whether the engine is installed or removed.

**Sealing the openings on installed engine**

- The following openings must be sealed tight against moisture:
  • Cooling air inlet
  • Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
  • Exhaust outlet
  • Crankcase breather (where possible; with venting to atmosphere)
Sealing the openings on removed engine

The following openings must be sealed tight against moisture:

- Cooling air inlet
- Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
- Exhaust outlet
- Crankcase breather (where possible; with venting to atmosphere)
- Coolant circuit
- Fuel circuit
- Lube oil circuit
- Hydraulic oil circuit
- Electrical plug connectors

Preservation of non-painted parts (external preservation)

Coat or spray non-painted parts of engine outer shell with corrosion inhibitor for external preservation (→ Page 14).
5.3.2 Diesel engine – Storage with unfilled medium circuits

Note:
• The following description applies equally to installed and removed engines.
• If engine removal is planned, the preservation measures must be carried out prior to engine removal.
• If accessibility is insufficient in installed state to carry out preservation (e.g. no access to charge-air manifold), the engine must be removed to carry out preservation work and set up on ground run block or test bench, or another solution is worked out after consultation with MTU.

**Internal preservation and drainage**

1. Clean engine if necessary.
2. Drain coolant (if present).
3. Completely fill coolant circuit with approved inhibitor concentration (→ Page 11).

Note: To bypass the flushing procedure during coolant filling for initial operation, the use of inhibitor concentration “Glysacorr P 113” instead of the emulsifiable corrosion inhibitor oil “Oil 9156” is recommended.
4. Fill fuel system completely with an approved corrosion inhibitor for internal preservation of the fuel system which is suitable for unfilled engine (→ Page 13).
5. If necessary, replace engine oil with an approved initial operation corrosion inhibitor for internal preservation of the oil circuit and which is suitable for an unfilled engine (→ Page 10).
6. Operate engine at increased idling speed for approx. 10 minutes. The inhibitor concentration must reach operating temperature.
7. Shut down engine.
8. Drain engine oil.
9. Allow engine to cool down to max. 40 °C.
10. Drain inhibitor concentration.

**Preservation of combustion chamber**

1. Seal the decompression openings.
2. Fill corrosion inhibitor oil for initial operation at least up to the Min mark.
3. Remove end cover for combustion air intake and exhaust gas discharge.
4. Provide access to the charge-air manifold. This can be done by removing flame-start canisters, sensors, covers or pipes. Access to the charge-air manifold must always be established downstream of the intercooler, pressure fine filter / air filter and exhaust turbocharger.
5. Bar warm engine with starting equipment. The engine must not start. To do this:
   • actuate the stop lever for mechanical governors.
   • with electronic governors, the power supply must be disconnected and the engine barred via emergency start or another suitable manner.
6. While the engine is being barred, use a fine-atomizing spray gun to spray initial operation corrosion inhibiting oil into the charge-air pipe openings (→ Page 10) for about 15 seconds.
7. Seal off the combustion air intake and exhaust outlet openings immediately against moisture / humidity.
8. Seal access to the charge-air pipes.

Note: Sealing of the openings differs depending on whether the engine is installed or removed. The medium circuits must be sealed immediately after draining the media.

**Sealing the openings on installed engine**

The following openings must be sealed tight against moisture:
• Cooling air inlet
• Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
• Exhaust outlet
• Crankcase breather (where possible; with venting to atmosphere)
Sealing the openings on removed engine

- The following openings must be sealed tight against moisture:
  - Cooling air inlet
  - Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
  - Exhaust outlet
  - Crankcase breather (where possible; with venting to atmosphere)
  - Coolant circuit
  - Fuel circuit
  - Lube oil circuit
  - Hydraulic oil circuit
  - Electrical plug connectors

Preservation of non-painted parts (external preservation)

- Coat or spray non-painted parts of engine outer shell with corrosion inhibitor for external preservation (→ Page 14).
5.3.3 Gas engine – Storage with filled medium circuits

Note:  
- The following description applies equally to installed and removed engines.
- If engine removal is planned, the preservation measures must be carried out prior to engine removal.
- If accessibility is insufficient in installed state to carry out preservation (e.g. no access to charge-air manifold), the engine must be removed to carry out preservation work and set up on ground run block or test bench, or another solution is worked out after consultation with MTU.

Internal preservation

1. Clean engine if necessary.
2. Leave engine oil in engine if it is an approved oil (→ Page 10). Otherwise replace filled engine oil with an approved oil, or carry out initial filling with this oil.
3. Fill fuel system with an approved gas (→ Page 13).
4. Drain coolant if necessary and fill with approved corrosion inhibiting antifreeze (→ Page 11) or leave existing corrosion inhibiting antifreeze in coolant circuit. Alternatively, the inhibitor concentration “Glysacorr P113 antifreeze” can be filled for engine storage.
5. Run the engine for 15 minutes at half load. The coolant must have reached operating temperature.
7. Oil and coolant remain in the system. These medium circuits must be filled completely.

Preservation of combustion chamber

1. Seal the decompression openings.
2. Fill corrosion inhibitor oil for initial operation at least up to the Min mark.
3. Remove end cover for combustion air intake and exhaust gas discharge.
4. Provide access to the charge-air manifold. This can be done by removing flame-start canisters, sensors, covers or pipes. Access to the charge-air manifold must always be established downstream of the intercooler, pressure fine filter / air filter and exhaust turbocharger.
5. Safely disconnect the gas supply by closing the gas line.
6. Use the starting system to bar the engine. The engine must not start.
7. While the engine is being barred, use a fine-atomizing spray gun to spray initial operation corrosion inhibiting oil into the charge-air pipe openings (→ Page 10) for about 15 seconds.
8. The starter unit must only be used to bar the engine if the engine is filled at least up to the “Min” mark and the oil filters are filled with initial operation corrosion-inhibiting oil.
9. Seal off the combustion air intake and exhaust outlet openings against moisture / humidity once again.
10. Seal access to the charge-air pipes.

Note: Sealing of the openings differs depending on whether the engine is installed or removed.

Sealing the openings on installed engine

- The following openings must be sealed tight against moisture:
  - Cooling air inlet
  - Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
  - Exhaust outlet
  - Crankcase breather (where possible; with venting to atmosphere)
Sealing the openings on removed engine

The following openings must be sealed tight against moisture:
- Cooling air inlet
- Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
- Exhaust outlet
- Crankcase breather (where possible; with venting to atmosphere)
- Coolant circuit
- Fuel circuit
- Lube oil circuit
- Hydraulic oil circuit
- Electrical plug connectors

Preservation of non-painted parts (external preservation)

Coat or spray non-painted parts of engine outer shell with corrosion inhibitor for external preservation (→ Page 14).
5.3.4 Gas engine – Storage with unfilled medium circuits

Note:
• The following description applies equally to installed and removed engines.
• If engine removal is planned, the preservation measures must be carried out prior to engine removal.
• If accessibility is insufficient in installed state to carry out preservation (e.g. no access to charge-air manifold), the engine must be removed to carry out preservation work and set up on ground run block or test bench, or another solution is worked out after consultation with MTU.

Internal preservation
1. Clean engine if necessary.
2. Drain coolant (if present).
3. Completely fill coolant circuit with approved inhibitor concentration (→ Page 11)
   Note: To bypass the flushing procedure during coolant filling for initial operation, the use of inhibitor concentration “Glysacorr P 113” instead of the emulsifiable corrosion inhibitor oil "Oil 9156" is recommended.
4. Fill fuel system with an approved gas (→ Page 13).
5. If necessary, replace engine oil with an approved initial operation corrosion inhibitor for internal preservation of the oil circuit and which is suitable for an unfilled engine (→ Page 10).
6. Run the engine for 15 minutes at half load. The inhibitor concentration must reach operating temperature.
7. Shut down engine.
8. Drain engine oil.
9. Allow engine to cool down to max. 40° C.
10. Drain inhibitor concentration.

Preservation of combustion chamber
1. Seal the decompression openings.
2. Fill corrosion inhibitor oil for initial operation at least up to the Min mark.
3. Remove end cover for combustion air intake and exhaust gas discharge.
4. Provide access to the charge-air manifold. This can be done by removing flame-start canisters, sensors, covers or pipes. Access to the charge-air manifold must always be established downstream of the intercooler, pressure fine filter / air filter and exhaust turbocharger.
5. Safely disconnect the gas supply by closing the gas line.
6. Use the starting system to bar the engine. The engine must not start.
7. While the engine is being barred, use a fine-atomizing spray gun to spray initial operation corrosion inhibiting oil into the charge-air pipe openings (→ Page 10) for about 15 seconds.
8. The starter unit must only be used to bar the engine if the engine is filled at least up to the “Min” mark and the oil filters are filled with initial operation corrosion-inhibiting oil.
9. Seal off the combustion air intake and exhaust outlet openings immediately against moisture / humidity.
10. Seal access to the charge-air pipes.

Note: Sealing of the openings differs depending on whether the engine is installed or removed. The medium circuits must be sealed immediately after draining the media.

Sealing the openings on installed engine

The following openings must be sealed tight against moisture:
• Cooling air inlet
• Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
• Exhaust outlet
• Crankcase breather (where possible; with venting to atmosphere)
Sealing the openings on removed engine

- The following openings must be sealed tight against moisture:
  - Cooling air inlet
  - Combustion-air inlet (close the emergency-air shutoff flaps if they are provided)
  - Exhaust outlet
  - Crankcase breather (where possible; with venting to atmosphere)
  - Coolant circuit
  - Fuel circuit
  - Lube oil circuit
  - Hydraulic oil circuit
  - Electrical plug connectors

Preservation of non-painted parts (external preservation)

- Coat or spray non-painted parts of engine outer shell with corrosion inhibitor for external preservation (→ Page 14).
6 Re-preservation without operation option of engine

6.1 Diesel and gas engine – Storage with filled medium circuits

Note:
- The described procedure is a guideline, which has to be adapted to the specific engine in each case. Work sequence details may vary from engine to engine. Please contact your MTU partner if you have any questions.
- For power station engines, re-preservation on the test bench is recommended.
- Where possible, the individual preservation measures should be carried out at the same time.

Preparation
1. Check of local specifications.

Prior to engine storage with filled medium circuits, clarify whether this is permissible with regard to hazardous goods and environmental protection regulations.

2. If necessary, the engine must be cleaned prior to (re-)preservation.
3. Prime the engine.

Only bar the engine after it has been primed. Therefore, first prime the engine and then build up oil pressure, then preserve the cooling and fuel circuit as well as the combustion chamber.

Preservation of the lube oil circuit
1. Drain old oil if necessary.
2. Remove priming connection from crankcase.
3. Connect oil priming pump.
4. This pressure pump is used to pump a corrosion inhibitor approved for internal preservation of the oil circuit, and suitable for filled engine (→ Page 10) into the oil circuit.
5. Remove the turbocharger oil return line, which is the last element in the oil circuit to be supplied with oil.
6. Pump oil under pressure into the circuit until it emerges from the turbocharger oil return line.
7. Reinstall turbocharger oil return line. This ensures that the entire lube oil circuit is completely filled.
8. Bar engine manually one to two rotations.
9. Leave the oil in the engine.
10. Due to aging, the oil must be replaced in accordance with the specified re-preservation intervals (→ Page 17).

Preservation of the coolant circuit
1. Drain old coolant if necessary.
2. The coolant circuit is completely filled with an approved medium suitable for filled engine (→ Page 11) and then hermetically sealed.
3. Open all thermostats so that the medium reaches all areas of the coolant circuit.
4. Leave the medium in the engine.
5. Due to aging, the medium must be replaced in accordance with the specified re-preservation intervals (→ Page 17).

Mixing of different media is impermissible.
Preservation of combustion chamber

1. Seal the decompression openings.
2. Open air pipe downstream of intercooler.
3. When oil pressure has built up, use a fine-atomizing spray gun to spray approved corrosion inhibitor for internal preservation of the oil circuit (→ Page 10) approx. 15 seconds into the openings of the air pipes. Use the starting system to bar the engine. The engine must not start.
4. Carefully seal air inlet and exhaust outlet. This prevents venting via the opened inlet and exhaust valves at the cylinders in overlap position.

Preservation of the fuel system

Note: Storage with filled fuel system is not envisaged for gas engines (→ Page 13). The procedure for preservation of the fuel system only applies to diesel engines.

1. Fill fuel system completely with an approved corrosion inhibitor for internal preservation which is suitable for filled engine storage (→ Page 13).
2. The preservative must reach all areas of the fuel system. It may be necessary to bar the engine. The engine must not start.

Preservation of non-painted parts (external preservation)

▶ Coat or spray non-painted parts of engine outer shell with corrosion inhibitor for external preservation (→ Page 14).
6.2 Diesel and gas engine – Storage with unfilled medium circuits

Note:  
• The described procedure is a guideline, which has to be adapted to the specific engine in each case. Work sequence details may vary from engine to engine. Please contact your MTU partner if you have any questions.  
• For power station engines, re-preservation on the test bench is recommended.  
• Where possible, the individual preservation measures should be carried out at the same time.

Preparation

1. If necessary, the engine must be cleaned prior to (re-)preservation.  
2. Prime the engine.

Only bar the engine after it has been primed. Therefore, first prime the engine and then build up oil pressure, then preserve the cooling and fuel circuit as well as the combustion chamber.

Note: Seal off all medium circuits against moisture / humidity immediately after draining the preservative.

Preservation of the lube oil circuit

1. Remove priming connection from crankcase.  
2. Connect oil priming pump.  
3. This pressure pump is used to pump a corrosion inhibitor approved for internal preservation of the oil circuit, and suitable for filled engine, (→ Page 10) into the oil circuit.  
4. Remove the turbocharger oil return line, which is the last element in the oil circuit to be supplied with oil.  
5. Pump oil under pressure into the circuit until it emerges from the turbocharger oil return line.  
6. Reinstall turbocharger oil return line. This ensures that the entire lube oil circuit is completely filled.  
7. Bar engine manually one to two rotations.  
8. Leave the oil in the engine for 24 hours.  
9. Then drain the oil completely.

Preservation of the coolant circuit

1. The coolant circuit is filled completely with an approved inhibitor concentration (→ Page 11) and then sealed hermetically.  
2. Open all thermostats so that the medium reaches all areas of the coolant circuit.  
3. If no circulation is possible in the engine (e.g. via a heated pressure testing trolley):  
   a) Leave the inhibitor concentration for 24 hours in the engine.  
   b) Then completely drain the inhibitor concentration (drain temperature < 40 °C).  
4. Seal the coolant circuit hermetically against moisture.

Preservation of combustion chamber

1. Seal the decompression openings.  
2. Open air pipe downstream of intercooler.  
3. When oil pressure has built up, use a fine-atomizing spray gun to spray approved corrosion inhibitor for internal preservation of the oil circuit (→ Page 10) approx. 15 seconds into the openings of the air pipes. Use the starting system to bar the engine. The engine must not start.  
4. Carefully seal air inlet and exhaust outlet. This prevents venting via the opened inlet and exhaust valves at the cylinders in overlap position.
Preservation of the fuel system

Note: Preservation of the fuel system of gas engines is not envisaged (→ Page 13). The procedure for preservation of the fuel system only applies to diesel engines.

1. Fill fuel system completely with an approved corrosion inhibitor for internal preservation which is suitable for unfilled engine storage (→ Page 13).
2. The preservative must reach all areas of the fuel system. It may be necessary to bar the engine. The engine must not start.
3. Leave the fuel for 24 hours in the engine.
4. Drain the fuel completely.

Preservation of non-painted parts (external preservation)

▲ Coat or spray non-painted parts of engine outer shell with corrosion inhibitor for external preservation (→ Page 14).
7 De-preservation

7.1 De-preservation prior to operation

Note:
- Before putting the engine back into operation, the preservation agent must be removed.
- De-preservation is not required on installed field engines with out-of-service periods up to 3 months. Only the end covers must be removed.
- Before putting the engine into operation, ensure that a switch has been made to an approved coolant if necessary. The engine must not be operated with antifreeze if only aqueous coolant additives are approved. The coolant additives approved for an engine or the respective application are shown in the relevant Fluids and Lubricants Specifications.

De-preservation prior to operation

1. Clean engine if necessary.
2. Remove all covers.
3. Drain corrosion inhibitor oil if necessary.

Note: The next step is not required for new deliveries; necessary after 1 year at the latest.
4. Replace oil filter (elements).

Note: The next step is not required for new deliveries; necessary after 1 year at the latest.
5. Only for diesel engines: Replace fuel filter (elements).
6. Fill with engine oil.
7. Bar engine manually.
8. Prepare engine for putting it back into operation.
9. Drain inhibitor concentration if necessary.
10. Fill with or renew coolant.

Notes on operation

- Put engine into operation according to the engine documentation.

Special information on gas engine:
The preservative oil has a significantly higher ash content than continuous operation oil. Prior to operation, the preserved engine must therefore be flushed with a continuous operation oil as per the Fluids and Lubricants Specifications.
7.2 Instruction sheet for de-preservation if climate-compatible packaging is used

Before opening the packaging, please read this instruction sheet and follow the instructions without fail, in particular the notes on when it is necessary to notify MTU Friedrichshafen GmbH.

Instruction sheet for de-preservation of engines

1. Read off the humidity values on the humidity indicator (→ Page 39) and enter them on the Monitoring Sheet (→ Page 48).
   Evaluation:
   a If all three fields on the humidity indicator show blue, everything is OK.
   b If fields 30 and 40 have turned partly or completely pink, examine the packaging for damage. If the packaging is damaged, notify MTU.
   c If all three fields are pink, do not open the packaging material and report to MTU.

2. If the humidity values are OK and if there are no other visible defects, remove the laminated aluminum foil from the engine.

3. Check engine externally when foil has been removed.
   Enter date and findings of check in Monitoring Sheet.

4. Visually check all rubber hose connections.
   The connections must not be brittle or swollen.

5. In the event of objections, contact MTU without delay and wait for further messages.
   In the meantime, do not prepare or modify the engine for installation, but store it so that it is dry and covered.

6. Enter the date of de-preservation on the Monitoring Sheet.

7. Do not remove the seals of the engine opening until just prior to use. The relates to:
   • Turbocharger inlet
   • Exhaust manifold outlet
   • Coolant inlet and outlet
   • Connecting flanges for vent lines at coolant distribution pipes

8. For initial operation, please observe the engine documentation.
8 Packaging

8.1 Types of packaging

The type of engine packaging depends on the storage and transport conditions.

At MTU Friedrichshafen GmbH, a distinction is made between the following types of packaging:

- Commercially available packaging → goods are intended for immediate use
- Climate-compatible packaging → for protection of goods susceptible to corrosion during ocean transport, shipping to polar and tropical regions and for unsuitable storage conditions

Note: “Climate-compatible packaging” corresponds to the special packaging in earlier editions of the Fluids and Lubricants Specifications. The term has been adapted to the packaging manual.

In the case of long-term storage of engines, for example, for 3, 5 or 10 years in climate packaging, regular re-preservation in accordance with the specified intervals (→ Page 17) and (→ Page 19) is nevertheless necessary.

Engines and drive units require special packaging for transportation at sea, in polar or tropical regions and for long-term storage. The preserved engine must be additionally protected with climate-compatible packaging. With climate-compatible packaging, where possible all media must be completely drained out of the respective medium circuit (fuel, oil, coolant). The climate-compatible packaging must be applied directly after preservation. Ensure that any engine painting has hardened beforehand.

Climate-compatible packaging:

- can reduce the effects of unsuitable storage conditions, although it does not provide frost protection
- is absolutely necessary for sea transport and transport in tropical and polar regions due to the threat of exterior shell corrosion

Notes:

- Incorrect storage will render the warranty invalid.
- The humidity indicator of climate-compatible packaging must be checked every 3 to 4 months. The result must be documented in accordance with (→ Page 48) and measures initiated if necessary.
- Existing special agreements still retain their validity.
- The following descriptions refer to the use of climate-compatible packaging for the storage of preserved engines.
8.2 Climate-compatible packaging – Design

The following packing aids are used for the climate-compatible packaging:

A – Outer layers of bonded-layer material (e.g. laminated aluminum foil)
B – Water-absorbing desiccant (e.g. silica gel)
C – Humidity indicator

The packaged products are shrink-wrapped in composite foil and the enclosed air is extracted. When desiccant packs are placed in the packaging, the residual moisture is reduced to a desired relative air humidity. The climate packaging prevents condensation on the metal surface and thus any resulting corrosion damage.

A – Outer layers of bonded-layer material

The outer layers consist of tightly-bonded layers of aluminum composite foil which has limited permeability to water vapor and gas.

The laminated aluminum foil used at MTU consists of polyethylene and aluminum with the following properties:

- Temperature range for the application: +70 °C to −55 °C
- Water vapor permeability: 0.1 g/m² per day at 38 °C and 80% relative humidity (in comparison, PVC flexible foil WVP: 6 g/m² per day)

For composite foils used at MTU, refer to the list of consumables (→ Page 42).

B – Desiccant

Desiccant, normally silica gel, is the common term for an agent that absorbs water and is used in climate packaging. The desiccant is in packs of highly-permeable (for water vapor) and strong material (e.g. sodium crepe paper) which are placed in the transport package.

Example of a desiccant pack

For desiccant packs used at MTU, refer to the list of consumables (→ Page 42).
Calculation of the required desiccant units.

The amount of desiccant units to be used in packaging for shipping depends on the climatic conditions and on storage at the destination.

The minimum quantity of desiccant units to be used is to be calculated as follows:

<table>
<thead>
<tr>
<th>Climatic zone</th>
<th>Desiccant units (DU) per area of composite foil in m² (A)</th>
<th>+</th>
<th>DUs per kg packaging aid (PA)</th>
<th>= Desiccant units (DU)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A (apart from Russia)</td>
<td>6 x A</td>
<td>+</td>
<td>17 x PA</td>
<td>DUs per shipping package</td>
</tr>
<tr>
<td>B (USA, Canada, Mediterranean region, Near East)</td>
<td>8 x A</td>
<td>+</td>
<td>20 x PA</td>
<td>DUs per shipping package</td>
</tr>
<tr>
<td>C (Russia, South and Central America, Middle East and Far East)</td>
<td>17 x A</td>
<td>+</td>
<td>20 x PA</td>
<td>DUs per shipping package</td>
</tr>
</tbody>
</table>

Table 7: Calculation of desiccant units

Procedure:

1. Measure surface A of the laminated aluminum foil for the packaging.
2. Weigh the packing aids (PAs), such as wood, corrugated cardboard etc., required to support and pad the engine within the laminated aluminum foil.
3. Determine in and through which climatic zones the engine is to be sent and stored in the packaging.
4. Calculate the required desiccant units (DUs).

Note: If the laminated aluminum foil is damaged after replacing it or touching it up, perform the following calculation of the DUs again.

Calculation example for desiccant units:

- Packaging for climatic zone C
- Area of composite foil: 10 m²
- Weight of packing aids: 3 kg

Calculation:

<table>
<thead>
<tr>
<th></th>
<th>17 DU x 10</th>
<th>+</th>
<th>20 DU x 3</th>
<th>= DUs per shipping package</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calculation</td>
<td>170 DUs</td>
<td>+</td>
<td>60 DUs</td>
<td>230 DUs</td>
</tr>
</tbody>
</table>

Result: 230 desiccant units (DUs) are required for adequate protection of the engine.

C – Humidity indicator

To monitor the degree of saturation of the desiccant, a humidity indicator is attached to the aluminum foil packaging.

Humidity indicators show when the specified relative air humidity is exceeded by changing color. The increase in relative air humidity, e.g. if the packaging is not airtight or the laminated aluminum foil is damaged, poses a risk of corrosion to the engine.

A vision panel with humidity indicator is screwed into the laminated aluminum foil, which must be as far away from the desiccant as possible. The vision panel allows the relative air humidity within the laminated aluminum foil or any changes to be checked at all times.
Example of a humidity indicator

Note: The air humidity inside the packaging must be checked regularly every 3 to 4 months (→ Page 48). Measures to be carried out in case of changes to the relative air humidity are listed in the following table.

### Reading the humidity indicator

<table>
<thead>
<tr>
<th>Area</th>
<th>Discoloration as an indicator of the relative air humidity</th>
<th>Measures to be initiated</th>
</tr>
</thead>
</table>
| 30   | Pink discoloration: Relative humidity above 30%           | • Shorten checking period  
      |                                                            | • Check humidity indicator every 4 weeks |
| 40   | Pink discoloration: Relative humidity above 40%           | • Replace desiccant, ensure the amount is correct; calculation: (→ Page 40)  
      |                                                            | • Distribute new desiccant evenly in the packaging area  
      |                                                            | • Extract air from the packaging and reseal composite foil (→ Page 47) |
| 50   | Pink discoloration: Relative humidity above 50%           | • Check packaged products  
      |                                                            | • Re-preserve the engine  
      |                                                            | • Replace desiccant, ensure the amount is correct; calculation: (→ Page 40)  
      |                                                            | • Distribute new desiccant evenly in the packaging area  
      |                                                            | • Extract air from the packaging and reseal composite foil (→ Page 47) |

Note: The humidity indicator regenerates itself automatically. Replacement following opening and sealing of the packaging area is not required.
8.3 Climate-compatible packaging – Installation

Preconditions

☑ If the engine is not new or not thoroughly overhauled by MTU (both are already preserved), preservation in accordance with this publication is required before the climate packaging can be used.

☑ All engine fluids and lubricants must be drain as completely as possible.

☑ Check whether a transport locking device is prescribed for the engine. If so, lock crankshaft and engine mount according to the engine documentation.

Special tools, Material, Spare parts

<table>
<thead>
<tr>
<th>Designation / Use</th>
<th>Part No.</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual foil-welding device (commercially available)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hard rubber plates</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Loctite 5970 sealant, permanently elastic</td>
<td>50773</td>
<td></td>
</tr>
<tr>
<td>Laminated aluminium foil, 1.00 m wide</td>
<td>49576</td>
<td></td>
</tr>
<tr>
<td>Laminated aluminium foil, 1.25 m wide</td>
<td>49577</td>
<td></td>
</tr>
<tr>
<td>Laminated aluminium foil, 1.50 m wide</td>
<td>49579</td>
<td></td>
</tr>
<tr>
<td>PE foam foil, 1.25 m wide, 4 mm thick</td>
<td>49578</td>
<td></td>
</tr>
<tr>
<td>Vision panel</td>
<td>20448</td>
<td></td>
</tr>
<tr>
<td>Vision panel with humidity indicator</td>
<td>20447</td>
<td></td>
</tr>
<tr>
<td>Desiccant, 125 g = 4 units</td>
<td>49542</td>
<td></td>
</tr>
<tr>
<td>Desiccant, 250 g = 8 units</td>
<td>49543</td>
<td></td>
</tr>
<tr>
<td>Desiccant, 500 g = 16 units</td>
<td>49544</td>
<td></td>
</tr>
<tr>
<td>Desiccant, 1000 g = 32 units</td>
<td>49545</td>
<td></td>
</tr>
</tbody>
</table>

Manual foil-welding device

Various manual foil-welding device models are available on the market. One supplier, for example:

- W. Kopp Verpackungsmaschinen
  Stettener Str. 111–117
  73732 Esslingen – Waeldenbronn
  Germany

Model: Manual sealing device HSD 95 Cell
Packing the engine

1. Use a hollow punch to knock out a passage for the anchor bolts.
2. Place hard rubber plates on the transport trestle in the area of the anchor bolts.

3. In the area of the bolt entry, thoroughly coat the hard rubber plates with permanently elastic sealant.

4. Use a hollow punch to knock out a passage for the anchor bolts.
5. Place laminated aluminium foil in position and, in the area of the bolt entry, thoroughly coat with permanently elastic sealant.
6. Place the hard rubber plates once again on the laminated aluminium foil in the area of the bolt entry.

7. Place foam foil on the hard rubber plates to provide additional protection for the laminated aluminium foil.

8. Mount engine on transport trestle and bolt on engine mounting.

Result: The complete system is firmly press-fitted and compact.

Padding the edges and corners of the engine block

Cushion edges and corners of the engine block that could damage the laminated aluminium foil with foam foil.
Applying the desiccant

Note: The desiccant units must not come into direct contact with corrosive engine components.

1. Insert the calculated number of desiccant units. Calculation example: (→ Page 39).
2. The desiccant units must be fastened in the upper third of the sealed cover and attached to the engine block, freely suspended if possible.
3. Use suitable fastening materials for the desiccant units (e.g. string or adhesive tape) to prevent damage to the desiccant units, the engine or the laminated aluminium foil.

Installation of humidity indicator and vision panel

1. The holes for the humidity indicator and the vision panel are to be cut into the laminated aluminum foil at a point that is clearly visible and as far away from the desiccant units as possible.
2. The vision panel is to be fastened in such a way that the engine number can be checked.

3. Screw the humidity indicator and vision panel into the laminated aluminium foil.
Sealing the laminated aluminum foil

1. Seal the laminated aluminium foil using the manual foil-welding device (→ Page 42).

2. Prior to final sealing of the laminated aluminium foil, use a vacuum pump (e.g. vacuum cleaner) to extract the entrapped air in the packaging. Avoid excessively tight fitting of the laminated aluminium foil because stress during transportation can result in chafing of the laminated aluminium foil.

Result:
- The vacuum created results in the laminated aluminium foil to lie lightly against the engine.
- Extracting the air removes the humidity in the air, thus reducing the humidity within the packaging.

Leak-tightness check

Note: If the packaging is not sufficiently tight, it will lose its tension within 30 minutes and expand.

- If the packaging is not airtight, the leak can be detected by blowing air into the packaging and resealing the packaging.
8.4 Climate-compatible packaging – Check and repair

Special tools, Material, Spare parts

<table>
<thead>
<tr>
<th>Designation / Use</th>
<th>Part No.</th>
<th>Qty.</th>
</tr>
</thead>
<tbody>
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<td>49576</td>
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<td>49577</td>
<td></td>
</tr>
<tr>
<td>Laminated aluminium foil, 1.50 m wide</td>
<td>49579</td>
<td></td>
</tr>
<tr>
<td>Desiccant, 125 g = 4 units</td>
<td>49542</td>
<td></td>
</tr>
<tr>
<td>Desiccant, 250 g = 8 units</td>
<td>49543</td>
<td></td>
</tr>
<tr>
<td>Desiccant, 500 g = 16 units</td>
<td>49544</td>
<td></td>
</tr>
<tr>
<td>Desiccant, 1000 g = 32 units</td>
<td>49545</td>
<td></td>
</tr>
</tbody>
</table>

Note: When checking the climate packaging, the laminated aluminum foil must not be damaged. Open the transport box (if available) with utmost care. The condition of the laminated aluminum foil must be inspected thoroughly during customs, stock or storage checks. Corrosion protection is no longer guaranteed if the laminated aluminum foil is damaged.

Checking the air humidity

1. Check humidity level regularly every 3 to 4 months.
2. Enter findings in Monitoring Sheet (→ Page 48). If the engine’s warranty period is still valid, send the Monitoring Sheet to MTU Friedrichshafen GmbH after commissioning.

Replacing desiccant

1. Open the laminated aluminium foil at the upper area and remove the desiccant.
2. Place the same amount of new desiccant in the upper area.
3. Extract air and reseal laminated aluminium foil with manual foil-welding device (→ Page 42) until airtight.

Repair of climate-compatible packaging

Note: If the laminated aluminium foil is damaged, the damaged section can be cut out and replaced by a repair piece. Incorrect repair work, e.g. using adhesive tape, is not permitted since it would not maintain the vacuum in the packaging.

1. Cut out damaged laminated aluminum foil section.
2. Seal new laminated aluminum foil section with manual foil-welding device.
3. Place new desiccant in packaging.
4. Prior to final sealing of the laminated aluminium foil, use a vacuum pump (e.g. vacuum cleaner) to extract the entrapped air in the packaging.
5. Reseal laminated aluminium foil with manual foil-welding device.
8.5 Monitoring Sheet for engines with climate-compatible packaging

The following checks are to be made before, during and at the end of the engine storage period and correct execution must be confirmed by date and signature.

Note: For new products, the delivery date must always be entered.

<table>
<thead>
<tr>
<th>Engine model:</th>
<th>Engine No.:</th>
<th>Delivery date:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Date of scheduled initial operation of engine:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Task</th>
<th>Date</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Visual inspection of special packaging for damage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Relative air humidity: ______ %</td>
<td></td>
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</tr>
<tr>
<td>7</td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12</td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>13</td>
<td>Inspection of the hygrometer before opening the packaging</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Relative air humidity: ______ %</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14</td>
<td>De-preservation completed</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>No.</th>
<th>Possible necessary correction work (e.g. on the aluminum foil or transport box)</th>
<th>Date of Design</th>
<th>Name of person responsible</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Important note on the warranty period**

- Notify MTU Friedrichshafen GmbH:
  - if two or all three fields of the humidity indicator are pink
  - if, during de-preservation of the engine, external signs of corrosion or damage to the rubber hose connections are detected
  - in due time before initial operation of the engine
9 Overview of Changes

9.1 Overview of change to previous edition

Changes to previous edition
NONE, first issue.
# Appendix

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<th>Description</th>
</tr>
</thead>
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</tr>
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