Oil Cooling System

Operating instructions

6028669/00 EN . High-temperature version
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1 Introduction

This technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

It also includes safety instructions and general information about the product.

This technical file is intended solely for specially trained and authorized personnel.

1.1 Manufacturer

The product is manufactured by:

Maschinenfabrik Reinhausen GmbH
Falkensteinstraße 8
93059 Regensburg, Germany
Tel.: (+49) 9 41/40 90-0
Fax: (+49) 9 41/40 90-7001
E-mail: sales@reinhausen.com

Further information on the product and copies of this technical file are available from this address if required.

1.2 Subject to change without notice

The information contained in this technical file comprises the technical specifications approved at the time of printing. Significant modifications will be included in a new edition of the technical file.

The document number and version number of this technical file are shown in the footer.

1.3 Completeness

This technical file is incomplete without the supporting documents.

The following documents are considered supporting documents:

- Routine test report (included in the scope of delivery)
- Dimensional drawing (included in the scope of delivery)
- Technical data - General section (available on request)

Also observe generally valid legislation, standards, and guidelines as well as specifications on accident prevention and environmental protection in the respective country of use.
1.4 Safekeeping

Keep this technical file and all supporting documents ready at hand and accessible for future use at all times.

1.5 Notation conventions

This section contains an overview of the symbols and textual emphasis used.

1.5.1 Hazard communication system

Warnings in this technical file are displayed as follows.

1.5.1.1 Warning relating to section

Warnings relating to sections refer to entire chapters or sections, sub-sections or several paragraphs within this technical file. Warnings relating to sections use the following format:

⚠️ WARNING

Type of danger!

Source of the danger and outcome.

► Action

► Action

1.5.1.2 Embedded warning information

Embedded warnings refer to a particular part within a section. These warnings apply to smaller units of information than the warnings relating to sections. Embedded warnings use the following format:

⚠️ DANGER!

Instruction for avoiding a dangerous situation.

1.5.1.3 Signal words and pictograms

The following signal words are used:

<table>
<thead>
<tr>
<th>Signal word</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DANGER</td>
<td>Indicates a hazardous situation which, if not avoided, will result in death or serious injury.</td>
</tr>
<tr>
<td>WARNING</td>
<td>Indicates a hazardous situation which, if not avoided, could result in death or serious injury.</td>
</tr>
<tr>
<td>CAUTION</td>
<td>Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.</td>
</tr>
<tr>
<td>NOTICE</td>
<td>Indicates measures to be taken to prevent damage to property.</td>
</tr>
</tbody>
</table>

Table 1: Signal words in warning notices
Pictograms warn of dangers:

<table>
<thead>
<tr>
<th>Pictogram</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Pictogram" /></td>
<td>Warning of a danger point</td>
</tr>
<tr>
<td><img src="image2" alt="Pictogram" /></td>
<td>Warning of dangerous electrical voltage</td>
</tr>
<tr>
<td><img src="image3" alt="Pictogram" /></td>
<td>Warning of combustible substances</td>
</tr>
<tr>
<td><img src="image4" alt="Pictogram" /></td>
<td>Warning of danger of tipping</td>
</tr>
<tr>
<td><img src="image5" alt="Pictogram" /></td>
<td>Warning of danger of crushing</td>
</tr>
</tbody>
</table>

Table 2: Pictograms used in warning notices

1.5.2 Information system

Information is designed to simplify and improve understanding of particular procedures. In this technical file it is laid out as follows:

Important information.

1.5.3 Instruction system

This technical file contains single-step and multi-step instructions.

Single-step instructions

Instructions which consist of only a single process step are structured as follows:
Aim of action
✓ Requirements (optional).
► Step 1 of 1.
☞ Result of step (optional).
☞ Result of action (optional).

Multi-step instructions
Instructions which consist of several process steps are structured as follows:

Aim of action
✓ Requirements (optional).
1. Step 1.
   ☞ Result of step (optional).
2. Step 2.
   ☞ Result of step (optional).
   ☞ Result of action (optional).
2 Safety

This technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

▪ Read this technical file through carefully to familiarize yourself with the product.
▪ This technical file is a part of the product.
▪ Read and observe the safety instructions provided in this chapter in particular.
▪ Observe the warnings in this technical file in order to avoid function-related dangers.
▪ The product is manufactured on the basis of state-of-the-art technology. Nevertheless, risks to life and limb of the user or impairment of the product and other material assets may occur during use due to function-related dangers.

2.1 Appropriate use

If used as intended and in compliance with the requirements and conditions specified in this technical document as well as with the warnings in this technical document and attached to the product, then the product does not present any danger to people, property or the environment. This applies throughout the product's entire life, from delivery through installation and operation to disassembly and disposal.

The operational quality-assurance system ensures a consistently high quality standard, particularly in regard to the observance of health and safety requirements.

The following is considered appropriate use

▪ The product must be operated in accordance with this technical file and the agreed delivery conditions and technical data
▪ The equipment and special tools supplied must be used solely for the intended purpose and in accordance with the specifications of this technical file
▪ The product must only be used with the on-load tap-changer specified in the order

2.2 Fundamental safety instructions

To prevent accidents, disruptions and damage as well as unacceptable adverse effects on the environment, those responsible for transport, installation, operation, maintenance and disposal of the product or parts of the product must ensure the following:
Personal protective equipment

Loosely worn or unsuitable clothing increases the danger of becoming trapped or caught up in rotating parts and the danger of getting caught on protruding parts. This increases the danger to life and limb.

- All necessary devices and personal protective equipment required for the specific task, such as a hard hat, safety footwear, etc. must be worn. Observe the section "Personal protective equipment" [► Section 2.4, Page 12].
- Never wear damaged personal protective equipment.
- Never wear rings, necklaces, or other jewelry.
- If you have long hair, wear a hairnet.

Work area

Untidy and poorly lit work areas can lead to accidents.

- Keep the work area clean and tidy.
- Make sure that the work area is well lit.
- Observe the applicable laws for accident prevention in the relevant country.

Working during operation

The product may only be operated in a sound, operational condition. Otherwise it poses a danger to life and limb.

- Regularly check the operational reliability of safety equipment.
- Comply with the inspection work, maintenance work and maintenance intervals described in this technical file.

Explosion protection

Highly flammable or explosive gases, vapors and dusts can cause serious explosions and fire. This increases the danger to life and limb.

- Do not install, operate or perform maintenance work on the product in areas where a risk of explosion is present.

Safety markings

Warning signs and safety information plates are safety markings on the product. They are an important aspect of the safety concept.

- Observe all safety markings on the product.
- Make sure all safety markings on the product remain intact and legible.
- Replace safety markings that are damaged or missing.
Ambient conditions
To ensure reliable and safe operation, the product must only be operated under the ambient conditions specified in the technical data.
- Observe the specified operating conditions and requirements for the installation location.

Auxiliary materials and operating materials
Auxiliary materials and operating materials not approved by the manufacturer can lead to personal injury, damage to property and malfunctions of the product.
- Use MIDEL 7131 as the insulating fluid. Other insulating fluids on request.
- It is imperative that you consult with Maschinenfabrik Reinhausen GmbH because specific operating conditions apply to alternative insulating fluids.
- Only use conductive and grounded hoses, pipes, and pump equipment that are approved for flammable liquids.
- Only use lubricants and auxiliary materials approved by the manufacturer.
- Contact the manufacturer.

Modifications and conversions
Unauthorized or inappropriate changes to the product may lead to personal injury, material damage and operational faults.
- Only modify the product after consultation with the manufacturer.

Spare parts
Spare parts not approved by the manufacturer may lead to physical injury, damage to the product and operational faults.
- Only use spare parts approved by the manufacturer.
- Contact the manufacturer.

2.3 Personnel qualification
The person responsible for assembly, commissioning, operation, maintenance and inspection must ensure that the personnel are sufficiently qualified.

Electrically skilled person
The electrically skilled person has a technical qualification and therefore has the required knowledge and experience, and is also conversant with the applicable standards and regulations. The electrically skilled person is also proficient in the following:
- Can identify potential dangers independently and is able to avoid them.
- Is able to perform work on electrical systems.
• Is specially trained for the working environment in which (s)he works.
• Must satisfy the requirements of the applicable statutory regulations for accident prevention.

**Electrically trained persons**

An electrically trained person receives instruction and guidance from an electrically skilled person in relation to the tasks undertaken and the potential dangers in the event of inappropriate handling as well as the protective devices and safety measures. The electrically trained person works exclusively under the guidance and supervision of an electrically skilled person.

**Operator**

The operator uses and operates the product in line with this technical file. The operating company provides the operator with instruction and training on the specific tasks and the associated potential dangers arising from improper handling.

**Technical Service**

We strongly recommend having maintenance, repairs and retrofitting carried out by our Technical Service department. This ensures that all work is performed correctly. If maintenance is not carried out by our Technical Service department, please ensure that the personnel who carry out the maintenance are trained and authorized by Maschinenfabrik Reinhausen GmbH to carry out the work.

**Authorized personnel**

Authorized personnel are trained by Maschinenfabrik Reinhausen GmbH to carry out special maintenance.

**2.4 Personal protective equipment**

Personal protective equipment must be worn during work to minimize risks to health.
• Always wear the personal protective equipment required for the job at hand.
• Never wear damaged personal protective equipment.
• Observe information about personal protective equipment provided in the work area.
## Personal protective equipment to be worn at all times

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Protective clothing</strong></td>
<td>Close-fitting work clothing with a low tearing strength, with tight sleeves and with no protruding parts. It mainly serves to protect the wearer against being caught by moving machine parts.</td>
</tr>
<tr>
<td><strong>Safety shoes</strong></td>
<td>To protect against falling heavy objects and slipping on slippery surfaces.</td>
</tr>
</tbody>
</table>

### Special personal protective equipment for particular environments

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Safety glasses</strong></td>
<td>To protect the eyes from flying parts and splashing liquids.</td>
</tr>
<tr>
<td><strong>Visor</strong></td>
<td>To protect the face from flying parts and splashing liquids or other dangerous substances.</td>
</tr>
<tr>
<td><strong>Hard hat</strong></td>
<td>To protect from falling and flying parts and materials.</td>
</tr>
<tr>
<td><strong>Hearing protection</strong></td>
<td>To protect from hearing damage.</td>
</tr>
<tr>
<td><strong>Protective gloves</strong></td>
<td>To protect from mechanical, thermal, and electrical hazards.</td>
</tr>
</tbody>
</table>
3 Product description

This chapter contains an overview of the design and function of the product.

3.1 Scope of delivery

The product is packaged with protection against moisture and is delivered as follows:

- Pump unit OF 100 DOC (oil cooling unit with controller in the motor-drive unit without filter element)
- Heat exchanger
- Operating Instructions
- Dimensional drawings

Please note the following:

- Check the shipment for completeness on the basis of the shipping documents.
- Store the parts in a dry place until installation
- The product must remain in its airtight, protective wrapping and may only be removed immediately before installation

3.2 Function description

The electrical controller for the oil cooling unit is integrated into the motor-drive unit. The oil cooling unit cools the insulating fluid in the oil compartment in order that the on-load tap-changer insert is not exposed to impermissibly high temperatures. If the temperature of the insulating fluid rises above 100°C, the oil cooling unit is activated by the controller in the motor-drive unit. The insulating fluid in the oil compartment is thus cooled to the standard temperature. If the temperature falls below 80°C, the oil cooling unit is deactivated.

The oil cooling unit comprises a pump unit which acts as a pump for circulating the insulating fluid, and an air-cooled heat exchanger.
The flange connections for the insulating fluid feed are located on the bottom cover of the pump unit, and the flange connections for the insulating fluid return are located on the top cover. The pump sucks the insulating fluid up via the pipe connection A on the on-load tap-changer head cover and via the feed pipe. The insulating fluid enters the tank of the pump unit at the bottom, leaves the pump unit via the return connection and flows through the return pipe to the heat exchanger. The insulating fluid is cooled there and then flows back into the oil compartment via the pipe connection S.

Figure 1: System overview of on-load tap-changer transformer

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Oil conservator</td>
</tr>
<tr>
<td>2</td>
<td>On-load tap-changer</td>
</tr>
<tr>
<td>3</td>
<td>Active part of the transformer</td>
</tr>
<tr>
<td>4</td>
<td>Heat exchanger</td>
</tr>
<tr>
<td>5</td>
<td>Transformer tank</td>
</tr>
<tr>
<td>6</td>
<td>Fan</td>
</tr>
<tr>
<td>7</td>
<td>Cooling unit pump unit</td>
</tr>
<tr>
<td>8</td>
<td>Shielding housing</td>
</tr>
</tbody>
</table>
3.2.1 Safety devices

A fault in the cooling unit or operation when cold can lead to impermissible mechanical loads on the on-load tap-changer oil compartment, the on-load tap-changer insert and the cooling circuit. The following safety devices are provided:

<table>
<thead>
<tr>
<th>Temperature T of the insulating fluid in the oil compartment</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>T &lt; -15°C</td>
<td>• Motor-drive unit is blocked, on-load tap-change operations not possible (static operation)</td>
</tr>
<tr>
<td>120°C &lt; T &lt; 140°C</td>
<td>• Motor-drive unit is blocked, on-load tap-change operations not possible (static operation, see also Fault elimination [⇒ Section 7, Page 37] for the oil cooling unit)</td>
</tr>
</tbody>
</table>
| T > 140°C                                                  | • Motor-drive unit is blocked, on-load tap-change operations not possible (static operation, see also Fault elimination [⇒ Section 7, Page 37] for the oil cooling unit)  
  • The transformer circuit breakers have tripped  
  • The transformer is disconnected from voltage sources |

Table 3: Temperature monitoring overview (oil compartment)

<table>
<thead>
<tr>
<th>Temperature T of the insulating fluid in the pump unit</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>T &lt; -15°C</td>
<td>• The pump starter is blocked (see also Fault elimination [⇒ Section 7, Page 37] for the oil cooling unit)</td>
</tr>
</tbody>
</table>

Table 4: Temperature monitoring overview (pump unit)

Also refer to

⇒ Fault elimination [⇒ 37]
3.3 Setup/models of oil cooling unit

The oil cooling unit consists of:

- Pump unit
- Pipes for feed and return (not included in the MR scope of delivery)
- Heat exchanger (air-cooled)
- Controller in the motor-drive unit, see also TAPMOTION® ED operating instructions
- Fan (not included in the MR scope of delivery)

3.3.1 Pump unit

The pump unit comprises a pump with fitted temperature sensor PT100, manometer and oil sample valve. For transformers, one pump unit is installed per switching column.

![Figure 2: Pump unit](image)

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Temperature sensor PT100</td>
</tr>
<tr>
<td>2</td>
<td>Manometer</td>
</tr>
<tr>
<td>3</td>
<td>Pump unit</td>
</tr>
<tr>
<td>4</td>
<td>Oil sample valve</td>
</tr>
</tbody>
</table>
3.3.2 Pipes for feed and return

The pipes with accessories must be provided by the transformer manufacturer. The following pipes are necessary:

- Pipes with a nominal width not less than 50 mm and with suitable D115 flanges
- Permissible feed pipe length: 3-10 m
- Permissible return pipe length: 3-13 m

When installing the cooling system, the feed pipe and the return pipe of the pump unit must be equipped with a stop-cock (e.g. ball valve).

3.3.3 Suction pipe and return pipe

**Suction pipe in the on-load tap-changer head cover**
A suction pipe integrated in the on-load tap-changer cover extracts the insulating fluid in the area of the cover. Not all of the insulating fluid can be removed from the oil compartment with this suction pipe.

**Return pipe in the on-load tap-changer head**
A pipe installed in the on-load tap-changer head returns the insulating fluid. This return pipe must be removed in order that the on-load tap-changer insert can be removed.

Completely re-install the return pipe after installation of the on-load tap-changer insert, see on-load tap-changer commissioning and installation instructions.

**NOTICE**
Damage to the on-load tap-changer!

Failure to install the return pipes or incorrect installation may negatively affect cooling effectiveness or damage the on-load tap-changer.

► Ensure that the return pipes are installed correctly.

3.3.4 Heat exchanger

The heat exchanger was designed in response to the heat levels expected per switching column.

The heat exchanger is installed in the cooling unit return pipe to the on-load tap-changer.
Fitting a stop-cock between the heat exchanger and on-load tap-changer to allow the return pipe to be shut off simplifies on-load tap-changer maintenance. We recommend using a stop-cock with low hydraulic resistance (e.g. ball valve) for this purpose.

Figure 3: Heat exchanger
3.3.5 Fan

To ensure the necessary cooling power under all operating conditions, a fan must be installed below the heat exchanger. This fan, including main circuit and controller, must be provided by the transformer operator and is not a part of the Maschinenfabrik Reinhausen GmbH scope of delivery.

The flow of air from the fan should cover the entire cooling surface of the heat exchanger and have a minimum air flow of approximately 2 m³/s. A signal is issued by the TAPMOTION® ED motor-drive unit for controlling the fan. The on and off function of the fan is coupled with the on and off function of the pump unit via this signal. When the pump is running, the fan must also run.
4 Packaging, transport and storage

4.1 Packaging

The products are sometimes supplied with sealed packaging and sometimes in a dry state, depending on requirements.

Sealed packaging surrounds the packaged goods with plastic foil on all sides.

Products that have also been dried are identified by a yellow label on the sealed packaging. In the dry state, delivery is also possible in a transport container.

The information in the following sections should be applied as appropriate.

4.1.1 Suitability

**NOTICE**

Property damage due to incorrectly stacked crates!

Stacking the crates incorrectly can lead to damage to the packaged goods.

► The outer marking on the packaging states if, for example, the on-load tap-changer or selector has been packed upright. Never stack these crates.

► General rule: Do not stack crates above a height of 1.5 m.

► For other crates: Only stack up to 2 equally sized crates on top of one another.

The packaging is suitable to ensure undamaged and fully functional means of transportation in compliance with local transportation laws and regulations.

The packaged goods are packed in a sturdy crate. This crate ensures that, when in the intended transportation position, the packaged goods are stabilized to prevent impermissible changes in position, and that none of the parts touch the loading surface of the means of transport or touch the ground after unloading.

Sealed packaging surrounds the packaged goods with plastic foil on all sides. The packaged goods are protected from humidity using a desiccant. The plastic foil was bonded after the desiccant is added.
4.1.2 Markings

The packaging bears a signature with instructions for safe transport and correct storage. The following symbols apply to the shipment of non-hazardous goods. Adherence to these symbols is mandatory.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Symbol" /></td>
<td>Protect against moisture</td>
</tr>
<tr>
<td><img src="image2" alt="Symbol" /></td>
<td>Top</td>
</tr>
<tr>
<td><img src="image3" alt="Symbol" /></td>
<td>Fragile</td>
</tr>
<tr>
<td><img src="image4" alt="Symbol" /></td>
<td>Attach lifting gear here</td>
</tr>
<tr>
<td><img src="image5" alt="Symbol" /></td>
<td>Center of mass</td>
</tr>
</tbody>
</table>

Table 5: Shipping pictograms

4.2 Transportation, receipt and handling of shipments

**WARNING**

Danger of death and damage to property!

Danger of death and damage to property due to tipping or falling load.

- Only transport the crate when closed.
- Do not remove the securing material used in the crate during transport.
- If the product is delivered on a pallet, secure it sufficiently.
- Only trained and authorized persons may select the sling gear and secure the load.
- Do not walk under the hanging load.
- Use means of transport and lifting gear with a sufficient carrying capacity in accordance with the weight stated on the delivery slip.

In addition to oscillation stress, jolts must also be expected during transportation. In order to prevent possible damage, avoid dropping, tipping, knocking over and colliding with the product.

If a crate tips over, falls from a certain height (e.g. when slings tear) or is subject to an unbroken fall, damage must be expected regardless of the weight.

Every delivered shipment must be checked for the following by the recipient before acceptance (acknowledgment of receipt):

- Completeness based on the delivery slip
- External damage of any type

The checks must take place after unloading when the crate or transport container can be accessed from all sides.
Visible damage

If external transport damage is found upon receipt of the shipment, proceed as follows:

▪ Immediately record the identified transport damage in the shipping documents and have this countersigned by the carrier.

▪ In the event of severe damage, total loss or high damage costs, immediately notify the manufacturer and the relevant insurance company.

▪ After identifying damage, do not modify the condition of the shipment further and retain the packaging material until an inspection decision has been made by the transport company or the insurance company.

▪ Record the details of the damage immediately on site together with the carrier involved. This is essential for any claim for damages.

▪ Photograph damage to packaging and packaged goods. This also applies to signs of corrosion on the packaged goods due to moisture inside the packaging (rain, snow, condensation).

▪ **NOTICE!** If the product is delivered in sealed packaging, inspect this immediately. If the sealed packaging is damaged, do not under any circumstances install or commission the packaged goods. Either re-dry the dried packaged goods as per the operating instructions, or contact the manufacturer to agree on how to proceed. Failure to do so may result in damage to the packaged goods.

▪ Identify the damaged parts.

Hidden damage

When damages are not determined until unpacking after receipt of the shipment (hidden damage), proceed as follows:

▪ Make the party responsible for the damage liable as soon as possible by telephone and in writing, and prepare a damage report.

▪ Observe the time periods applicable to such actions in the respective country. Inquire about these in good time.

With hidden damage, it is very hard to make the transportation company (or other responsible party) liable. Any insurance claims for such damages can only be successful if relevant provisions are expressly included in the insurance terms and conditions.

4.3 Storage of shipments

**Packaged goods dried by Maschinenfabrik Reinhauen**

Upon receipt of the shipment, immediately remove the packaged goods dried by Maschinenfabrik Reinhauen from the sealed packaging and store air-tight in dry insulating oil until used if the packaged goods were not supplied in oil.

**Non-dried packaged goods**

Non-dried packaged goods but with a functional sealed packaging can be stored outdoors when the following conditions are complied with.
When selecting and setting up the storage location, ensure the following:

- Protect stored goods against moisture (flooding, water from melting snow and ice), dirt, pests such as rats, mice, termites and so on, and against unauthorized access.
- Store the crates on timber beams and planks as a protection against rising damp and for better ventilation.
- Ensure sufficient carrying capacity of the ground.
- Keep entrance paths free.
- Check stored goods at regular intervals. Also take appropriate action after storms, heavy rain or snow and so on.

Protect the packaging foil from direct sunlight so that it does not disintegrate under the influence of UV rays, which would cause the packaging to lose its sealing function.

If the product is installed more than 6 months after delivery, suitable measures must be taken without delay. The following measures can be used:

- Correctly regenerate the drying agent and restore the sealed packaging.
- Unpack the packed goods and store in a suitable storage space (well ventilated, as dust-free as possible, humidity < 50% where possible).

### 4.4 Unpacking shipments and checking for transportation damages

- **NOTICE!** Transport the packaged crate to the place where installation will take place. Do not open the sealed packaging until just before installation. If this is not done, damage to the packaged goods may occur due to ineffectively sealed packaging.

- **WARNING!** When unpacking, check the condition of the packaged goods. Secure packaged goods in an upright crate from tipping out. If this is not done, the packaged goods may be damaged and serious injuries may result.

- Check completeness of supplementary parts on the basis of the delivery slip.
5 Mounting

**DANGER**
Risk of life-threatening injury due to electric shock!
The protective housing cover of the motor-drive unit or the control cabinet (special model) is open during the function check. A lack of due care may result in electric shock.

► Do not reach into the housing when working on the device with the protective housing cover open.

**NOTICE**
Damage to the oil cooling unit!
The oil cooling unit can be damaged through incorrect drying.

► Do not dry the oil cooling unit together with the transformer.

**NOTICE**
Damage to the oil cooling unit!
Some of the oil cooling unit components are not vacuum proof.

► Keep stop-cocks closed during the entire insulation fluid filling procedure (vacuum extraction and filling).

► Open stop-cocks after the filling procedure is completed.

**NOTICE**
Damage to the oil cooling unit!
The oil cooling unit can be damaged through incorrectly laid pipes.

► Lay and secure the pipes such that the application of force on the connected components is kept to a minimum during all operating conditions.
Oil cooling unit overview

Figure 4: Oil cooling unit overview

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Return pipe (cold insulating fluid)</td>
<td>2</td>
</tr>
<tr>
<td>3</td>
<td>Feed pipe (hot insulating fluid)</td>
<td>4</td>
</tr>
<tr>
<td>5</td>
<td>Pump unit</td>
<td>6</td>
</tr>
</tbody>
</table>
Installing oil cooling unit components

The insides of the pipes must be clean and free of rust, cinders, etc.

1. Install and dry the on-load tap-changer in the transformer in accordance with the installation and commissioning instructions.

2. Rinse pipes and heat exchanger 7 with dry oil before installing them on the on-load tap-changer head. This ensures that foreign particles in the pipe system are removed from the cooling circuit.

3. Install the heat exchanger 7 with a minimum clearance of 10 cm to the transformer wall. The vent screw must be at the top.

4. Attach the fan (not included in the MR scope of delivery) 6 to the transformer such that the heat exchanger 7 is covered completely by the flow of air.

5. Attach the pump unit 5 to the transformer tank. The pump unit must have at least the same clearance to the transformer wall as the heat exchanger.

6. Install the pipes between the pipe connection A on the on-load tap-changer head cover and pipe connection on the suction side of the pump unit (feed). Note the red arrow for the direction of flow.
7. Install the pipes between the pipe connection on the pressure side of the pump unit (return) 5 and heat exchanger 7 such that the flow of air across the heat exchanger is from the bottom to the top.

8. Install the pipes between the heat exchanger 7 and pipe connection S in the on-load tap-changer head. Note the red arrow for the direction of flow.

Figure 6: On-load tap-changer head
9. Connect temperature sensor PT100 on the oil cooling unit electrically to the motor-drive unit in accordance with the connection diagram.

Figure 7: Temperature sensor PT100 on the pump unit

10. Connect the two temperature sensors PT100 on the on-load tap-changer head cover electrically to the motor-drive unit in accordance with the connection diagram.
11. Establish the correct pump unit ground connection. The ground connection of the oil cooling unit is ensured on all the flanges by 4 contact washers for each flange. The contact washers are locking devices and ensure a proper metallic contact. The ground connection for the pump unit is on the terminal box.

12. Electrically connect the pump motor and motor-drive unit in accordance with the connection diagram.

13. Electrically connect the fan (not included in the MR scope of delivery). Ensure that the pump motor contactor performs actuation via the potential-free contact in accordance with the connection diagram.

**Fill oil cooling unit with MIDEL 7131**

1. Take a sample of the insulating fluid from each transport tank and evaluate it. The values for the dielectric strength and water content must be in compliance with the limit values specified in the table Limit values for dielectric strength and water content of on-load tap-changer oil.

2. **NOTICE!** Unclean filling equipment impairs the quality of the insulating fluid. Ensure that the filling equipment is clean.

3. **NOTICE!** Closed stop-cocks damage the oil cooling unit. Open all stop-cocks.

4. Fill on-load tap-changer oil conservator.
5 Mounting

5. Set motor protective switch Q4 in the motor-drive unit to position I and rotary switch S30 to position CONTINUOUS OPERATION. The pump unit starts.

6. Once the insulating fluid level in the oil conservator reaches the minimum height, set motor protective switch Q4 to position 0. The pump unit stops.

7. Top up the insulating fluid in the oil conservator.
8. Vent the pump unit 5, heat exchanger 7, and pipe connections A and S on the on-load tap-changer via the intended valves.

Figure 9: Air-vent valve in the pump unit

Figure 10: Air-vent valve on the heat exchanger

9. Repeat steps 5 to 8 until a constant level of the insulating fluid in the oil conservator has been reached.

10. Close all air-vent valves after venting.
11. Once the installation work is complete, check the insulating fluid level in the on-load tap-changer oil conservator. **NOTICE!** Ensure that the insulating fluid in the on-load tap-changer oil conservator is between the “Minimum” and “Maximum” marks, otherwise there is a risk of explosion due to an impermissible amount of insulating fluid in the on-load tap-changer system!
6 Commissioning

In order to commission the oil cooling unit, the oil cooling unit must pass a function test and the insulating fluid level in the on-load tap-changer oil conservator must be checked.

6.1 Commissioning the oil cooling unit

NOTICE

Damage to the on-load tap-changer!

Make sure that the signaling contact which indicates that the oil has fallen below the minimum oil level in the on-load tap-changer's oil conservator has been looped into the tripping circuit of the circuit breaker and that the circuit breaker will immediately de-energize the transformer when the oil falls below this minimum oil level in the oil conservator.

Make sure that the protective relay and additional protective devices have been looped into the tripping circuit of the circuit breaker and that the circuit breaker will immediately de-energize the transformer when the protective relay or additional protective devices are tripped.

6.1.1 Preparatory measures

Before commissioning the oil cooling unit, perform a function test on the oil cooling unit.

NOTICE

Damage to the oil cooling unit!

The oil cooling unit and on-load tap-changer may be damaged due to leaks and insulating fluid loss.

Protect oil sample valve against accidental opening with padlock or lock.

If oil cooling unit components have been removed for transport, or the insulating fluid has been removed, the corresponding steps in the section Oil cooling unit installation [Section 5, Page 25] must be followed on site.

6.1.2 Oil cooling unit function test

DANGER

Risk of life-threatening injury due to electric shock!

The protective housing cover of the motor-drive unit or the control cabinet (special model) is open during the function check. A lack of due care may result in electric shock.

Do not reach into the housing when working on the device with the protective housing cover open.
6 Commissioning

**NOTICE**

**Damage to the cooling system!**
Closed stop-cocks during operation lead to overpressure in the heat exchanger and thus to leakages in the cooling system.

► Ensure that all stop-cocks are open prior to commissioning.

For the commissioning, proceed as follows:

1. Set rotary switch S30 on the motor-drive unit to the CONTINUOUS OPERATION position.
2. Perform a test run.
3. Vent.
4. Perform function test. Close the stop-cock for the return between the pump unit and heat exchanger. During operation of the oil cooling unit, the manometer must read a pressure of at least 3.6 bar.
5. If the pressure is lower than this, check the phase sequence of the motor voltage at the oil cooling unit connection: U-V-W, clockwise. In the event of a deviating phase sequence, the motor (3 AC) will not start due to the return stop in the anti-friction bearings.

Note the connection diagram applicable to your system model.

6. Open the stop-cock between the pump unit and heat exchanger after the function test.
7. Set rotary switch S30 on the motor-drive unit to the OPERATION position.

### 6.1.3 Checking the quality of the insulating fluid

Prior to initial commissioning, check the water content of the insulating fluid.

1. Switch off motor protective switch Q4.
2. Remove oil sample valve lock.
3. Remove screw cap.
4. Open oil sample valve.
5. Take oil sample (take as much as needed by the lab).
6. Record the temperature of the oil sample immediately after the oil sample is taken. Determine dielectric strength and water content at an oil sample temperature of 20°C ± 5°C. The values for the dielectric strength and water content must be in compliance with the limit values specified in the table Limit values for dielectric strength and water content of on-load tap-changer oil [►Section 10.1, Page 44].
7. Close oil sample valve.
8. Refit lock (with warning sign).
10. Switch on motor protective switch Q4.
**NOTICE**

**Damage to the on-load tap-changer!**

Damage to the on-load tap-changer by actuating with damp oil.

► Ensure that the silica gel breather for the on-load tap-changer oil conservator is in perfect condition!

The breather prevents the ingress of dampness.
7 Fault elimination

**WARNING**

Danger of explosion!

Explosive gases under the on-load tap-changer head cover can deflagrate or explode and result in severe injury or death.

► Ensure that there are no ignition sources such as open flames, hot surfaces or sparks (e.g. caused by the build-up of static charge) in the immediate surroundings and that none occur.

► De-energize all auxiliary circuits (for example tap-change supervisory device, pressure relief device, pressure monitoring device) before removing the on-load tap-changer head cover.

► Do not operate any electrical devices during the work (e.g. risk of sparks from impact wrench).

**NOTICE**

Damage to the on-load tap-changer and transformer!

If the protective relay or other protective devices trip, this can indicate damage to the on-load tap-changer and transformer. The transformer must not be energized without being inspected first.

► Check on-load tap-changer and transformer when protective relay or other protective devices have been tripped.

► Do not use the equipment again until you are sure there is no damage to the on-load tap-changer or transformer.

**NOTICE**

Damage to motor-drive unit!

Damage to the motor-drive unit due to condensate in protective housing of motor-drive unit.

► Always keep protective housing of the motor-drive unit tightly closed.

► In the event of operation interruptions of more than 2 weeks, connect and operate the anti-condensation heater in the motor-drive unit. If this is not possible, e.g. during transportation, place a sufficient amount of desiccant in the protective housing.

The table below is intended to assist with detecting and, where possible, remedying faults.

For more information, please consult the operating instructions for the RS protective relay or the relevant protective device.

In the event of faults on the on-load tap-changer or motor-drive unit which cannot be easily corrected on site, or if the RS protective relay or additional protective devices have been tripped, please inform your authorized MR representative, the transformer manufacturer or contact us directly at:

Maschinenfabrik Reinhausen GmbH
Technical Service
Postfach 12 03 60
93025 Regensburg
### Fault elimination

**Error** | **Action**
--- | ---
On-load tap-changer switches to static operation and message "Status B7, B8, B9" (K43) | • Contact MR  
• Reduce temperature of the insulating fluid in the oil compartment to <120°C* until fault elimination  
• One-time static emergency operation up to an insulating fluid temperature in the oil compartment of 140°C permissible for maximum 48 hours

On-load tap-changer switches to static operation and message "OLTC Oil Temperature >120°C" (K44) and oil cooling pump runs (K7/Q4) | • Check fan and eliminate fault  
• If the fan is OK: Contact MR  
• Reduce temperature of the insulating fluid in the oil compartment to <120°C* until fault elimination  
• One-time static emergency operation up to an insulating fluid temperature in the oil compartment of 140°C permissible for maximum 48 hours
7 Fault elimination

<table>
<thead>
<tr>
<th>Error</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>On-load tap-changer switches to static operation and message &quot;OLTC Oil Temperature &gt;120°C&quot; (K44) and oil cooling pump does not run (K7/Q4)</td>
<td><strong>Possibility 1</strong>: Temperature of the insulating fluid in the oil compartment &gt;120°C and temperature in the pump unit &lt; -15°C</td>
</tr>
<tr>
<td></td>
<td>- Pump is blocked by the controller</td>
</tr>
<tr>
<td></td>
<td>- One-time static emergency operation up to an insulating fluid temperature in the oil compartment of 140°C* permissible for maximum 48 hours</td>
</tr>
<tr>
<td></td>
<td>- If temperature is exceeded for longer:</td>
</tr>
<tr>
<td></td>
<td>▪ Thaw insulating fluid in heat exchanger / oil cooling circuit</td>
</tr>
<tr>
<td></td>
<td>▪ Reduce temperature of the insulating fluid in the oil compartment to &lt;120°C*</td>
</tr>
<tr>
<td></td>
<td><strong>Possibility 2</strong>: Temperature of the insulating fluid in the oil compartment &gt;120°C and temperature in the pump unit &gt; -15°C</td>
</tr>
<tr>
<td></td>
<td>- Contact MR</td>
</tr>
<tr>
<td></td>
<td>- Reduce temperature of the insulating fluid in the oil compartment to &lt;120°C* until fault elimination</td>
</tr>
<tr>
<td></td>
<td>- One-time static emergency operation up to an insulating fluid temperature in the oil compartment of 140°C* permissible for maximum 48 hours</td>
</tr>
<tr>
<td>Tripping of the motor protective switch Q4 (pump)</td>
<td>- Switch on motor protective switch Q4 just once. If motor protective switch Q4 trips again, do not attempt any more tap-change operations and contact MR.</td>
</tr>
<tr>
<td></td>
<td>- Reduce temperature of the insulating fluid in the oil compartment to &lt;120°C* until fault elimination</td>
</tr>
<tr>
<td></td>
<td>- One-time static emergency operation up to an insulating fluid temperature in the oil compartment of 140°C* permissible for maximum 48 hours</td>
</tr>
</tbody>
</table>

Table 6: Fault elimination

*Due to the insulating effect of the oil compartment, the transformer temperature is approximately 10°C higher than the oil compartment interior temperature*
8 Maintenance

**DANGER**

**Electric shock!**

Working on the transformer when the transformer is energized can lead to death or serious injuries.

► Switch off transformer on high and low-voltage side.
► Lock transformer to prevent unintentional restart.
► Ensure that everything is de-energized.
► Visibly connect all transformer terminals to ground (grounding leads, grounding disconnectors) and short circuit them.
► Cover or cordon off adjacent energized parts.

**DANGER**

**Electric shock!**

Working on the on-load tap-changer when on-load tap-changer components are energized can lead to death or serious injuries.

► De-energize all auxiliary circuits, such as the tap-change supervisory device, pressure relief device, pressure monitoring device.
► Make sure that everything is de-energized.

**WARNING**

**Danger of explosion!**

Explosive gases in the oil compartment of the on-load tap-changer, transformer, pipework system, oil conservator and at the dehydrating breather opening can deflagrate or explode and result in severe injury or death!

► Ensure that there are no ignition sources such as naked flame, hot surfaces or sparks (e.g. caused by the build-up of static charge) in the transformer's immediate surroundings and that none occur.
► Do not operate any electrical devices (e.g. risk of sparks from impact wrench).
► Only use conductive and grounded hoses, pipes, and pump equipment that are approved for flammable liquids.

**NOTICE**

**Damage to motor-drive unit!**

Damage to the motor-drive unit due to condensate in protective housing of motor-drive unit.

► Always keep protective housing of the motor-drive unit tightly closed.
► In the event of operation interruptions of more than 2 weeks, connect and operate the anti-condensation heater in the motor-drive unit. If this is not possible, e.g. during transportation, place a sufficient amount of desiccant in the protective housing.
8.1 Inspection

Monitoring the oil cooling unit is limited to checking the seal tightness of the cooling circuit and checking the water content in the insulating fluid.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annually</td>
<td>Check seal tightness:</td>
</tr>
<tr>
<td></td>
<td>▪ Pump unit</td>
</tr>
<tr>
<td></td>
<td>▪ Pipes</td>
</tr>
<tr>
<td></td>
<td>▪ Heat exchanger</td>
</tr>
<tr>
<td>Every 2 years</td>
<td>Check the quality of the insulating fluid in accordance with the on-load tap-changer operating instructions.</td>
</tr>
</tbody>
</table>

Table 7: Inspection plan

8.2 Maintenance intervals

<table>
<thead>
<tr>
<th>Interval</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>After 10,000 operating hours (operating hour counter for oil cooling unit in the motor-drive unit)</td>
<td>Replace pump unit. Contact the Maschinenfabrik Reinhausen GmbH Technical Service for this.</td>
</tr>
<tr>
<td>After every 2,000 hours of operation in the temperature range of 105…150°C (operating hour counter for oil cooling unit in the motor-drive unit)</td>
<td>Check oil cooling unit with controller. Contact the Maschinenfabrik Reinhausen GmbH Technical Service for this.</td>
</tr>
</tbody>
</table>

Table 8: Maintenance program
9 Disposal

For disposal, observe the national requirements applicable in the country of use.

If you have any questions about disassembly and disposal, please contact Maschinenfabrik Reinhausen GmbH's Technical Service department.
10 Technical data

<table>
<thead>
<tr>
<th>Component</th>
<th>Power</th>
<th>Voltage</th>
<th>Nominal current</th>
<th>Frequency</th>
<th>Synchronous speed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pump motor (standard)</td>
<td>1.1 kW</td>
<td>3 AC 230/400 V (other voltages on request)</td>
<td>4.10/2.35 A</td>
<td>50-60 Hz</td>
<td>3,000 rpm (50 Hz), 3,600 rpm (60 Hz)</td>
</tr>
</tbody>
</table>

Table 10: Oil cooling unit technical data
10.1 Limit values for dielectric strength and water content of on-load tap-changer oil

The following table specifies the limit values for dielectric strength (measured in accordance with IEC 60156) and water content (measured in accordance with IEC60814) of the insulating fluid.

<table>
<thead>
<tr>
<th></th>
<th>$U_d$</th>
<th>$H_2O$</th>
</tr>
</thead>
<tbody>
<tr>
<td>When commissioning</td>
<td>&gt; 60 kV/2.5 mm</td>
<td>≤ 100 ppm</td>
</tr>
<tr>
<td>the transformer for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the first time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During operation</td>
<td>&gt; 30 kV/2.5 mm</td>
<td>≤ 200 ppm</td>
</tr>
<tr>
<td>After maintenance</td>
<td>&gt; 50 kV/2.5 mm</td>
<td>≤ 100 ppm</td>
</tr>
</tbody>
</table>

Table 11: Limit values for natural ester in accordance with IEC 62770

<table>
<thead>
<tr>
<th></th>
<th>$U_d$</th>
<th>$H_2O$</th>
</tr>
</thead>
<tbody>
<tr>
<td>When commissioning</td>
<td>&gt; 60 kV/2.5 mm</td>
<td>≤ 100 ppm</td>
</tr>
<tr>
<td>the transformer for</td>
<td></td>
<td></td>
</tr>
<tr>
<td>the first time</td>
<td></td>
<td></td>
</tr>
<tr>
<td>During operation</td>
<td>&gt; 30 kV/2.5 mm</td>
<td>≤ 400 ppm</td>
</tr>
<tr>
<td>After maintenance</td>
<td>&gt; 50 kV/2.5 mm</td>
<td>≤ 150 ppm</td>
</tr>
</tbody>
</table>

Table 12: Limit values for synthetic esters in accordance with IEC 61099
11 Drawings

11.1 Schematic design of the oil cooling unit for the VACUTAP® VR® (10115107)

1. OIL CONSERVATOR OF ON-LOAD TAP-CHANGER OIL COMPARTMENT
2. OIL CONSERVATOR OF TRANSFORMER OIL COMPARTMENT
3. ON-LOAD TAP-CHANGER
4. MR PUMP UNIT
5. DEHYDRATING BREATHER
6. PROTECTIVE RELAY RS
7. STOP-COCK
8. OIL SAMPLING-VALVE
9. RADIATOR
10. FAN (NOT PART OF OUR STANDARD SCOPE OF DELIVERY)
A. HEAD COVER CONNECTION FOR OIL EXTRACTION OF ON-LOAD TAP-CHANGER
E1. BLEEDER VALVE
E2. CONNECTING FLANGE FOR OIL CONSERVATOR OF TRANSFORMER
Q, R, S. CONNECTING FLANGE (LAYOUT DEPENDING ON ON-LOAD TAP-CHANGER)
11.2 Pump unit, dimensional drawing (10115176)

The connecting flange is supplied with an O-ring. A flat gasket φ14×φ40×2 is also permitted.

The control system of the pump unit is integrated in the motor drive.

Shut-off valves are not included in the delivery of the pump unit. MR can supply such valves on request.

The pipe connection is continuously adjustable in an angle range from 150° to 225° and from 315° to 30°.

Controlled terminal for pump motor.

The connecting flange is supplied with an O-ring. A flat gasket φ14×φ40×2 is also permitted.

The control system of the pump unit is integrated in the motor drive.

Shut-off valves are not included in the delivery of the pump unit. MR can supply such valves on request.

The pipe connection is continuously adjustable in an angle range from 150° to 225° and from 315° to 30°.
11.3 On-load tap-changer head cover for VACUTAP® VR®
(10115177)

KV Koppivariante / HEAD VERSION
T1 Temperatursensor zur Temperaturregulierung
TEMPERATURE SENSOR FOR TEMPERATURE REGULATION
T2 Temperatursensor für Temperaturlogging
TEMPERATURE SENSOR FOR TEMPERATURE LOGGING
S Anschluss für Drucklauf - schwenkbar
CONNECTION FOR OIL RETURN PIPE - CONNECTIONS ORIENTABLE
A Anschluss für Ablassung - schwenkbar
CONNECTION FOR OIL EXTRACTION - CONNECTIONS ORIENTABLE
14 Antriebsseite des Wälters / DRIVE SIDE OF SELECTOR
RJA NE Rohrleitungsanschluss mit Entlüftung / PIPE CONNECTION WITH VENTING
11.4 Temperature sensors 2 x PT100 HT (10115557)

TECHNICAL DATA

HOUSING: OUTDOOR DESIGN, POWDER COATED RAL 9006 WHITE ALUMINIUM (CS)
HOUSING MATERIAL: SEAWATER RESISTANT ALUMINIUM
PROTECTION TYPE: IP66 ACCORDING TO IEC 60529 (CLOSED DEVICE)
AMBIENT TEMPERATURE: -40°C TO +150°C (-40°F TO +302°F)
OIL TEMPERATURE: -40°C TO +150°C (-40°F TO +302°F)
OPERATING MEDIUM: TRANSFORMER OIL OR AIR
CONNECTION: CABLE GLAND WITH M20x15 (CLAMPING AREA 10,8MM TO 12,8MM)
TERMINAL STRIP: SCREW TERMINAL
0,08MM² TO 2,5MM² (SINGLE AND STRANDED WIRE)
0,25MM² TO 1,5MM² (STRANDED WIRE WITH FERRULE)
AWG: 28 TO 12
1ST PT100: 2-WIRE SYSTEM 1x RED/1, 1x WHITE
2ND PT100: 2-WIRE SYSTEM 1x YELLOW/1x BLACK
SENSOR: 2x PT100 ACCORDING TO DIN EN 60751 CLASS B (2-WIRE CIRCUIT)
HIGH VOLTAGE RESISTANCE: 2,0KV / 50HZ / 1MIN. (SENSOR TO SENSOR)
2,0KV / 50HZ / 1MIN. (SENSOR TO GROUND)
CONNECTION ACCORDING TO THE ASSOCIATED CIRCUIT DIAGRAM
11.5 Heat exchanger (767802)

MODEL S: L = 900mm
F = RADIATOR WITH FLANGES
G = RADIATOR WITH MEMBERS OF EQUAL LENGTH