On-Load Tap-Changer
VACUTAP® VR®

Operating Instructions

6028618/00 EN . High-temperature version
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The product may have been altered since this document was published.
We reserve the right to change the technical data, design and scope of supply.
Generally the information provided and agreements made when processing the individual quotations and orders are binding.
The original operating instructions were written in German.
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1 Introduction

This technical file contains detailed descriptions for monitoring during operation, fault elimination, and maintenance.

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

Information about installation can be found in the installation and commissioning instructions.

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 Completeness

This technical file is incomplete without the supporting documents.

The following documents are considered supporting documents:

- Unpacking instructions
- Supplement
- Routine test report
- Connection diagrams
- Dimensional drawings
- Order confirmation

1.3 Safekeeping

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

1.4 Notation conventions

This section contains an overview of the symbols and textual emphasis used.
1.4.1 Hazard communication system

Warnings in this technical file are displayed as follows.

1.4.1.1 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

1.4.1.2 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.

1.4.1.3 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

1.4.2 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](image6)

1.4.3 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:
1 Introduction

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

The on-load tap-changer adjusts the transmission ratio of transformers without interrupting the load flow. The on-load tap-changer is designed solely for use in electrical energy systems and facilities in accordance with IEC 61936-1. If used as intended and in compliance with the requirements and conditions specified in this technical file as well as the warning notices in this technical file and attached to the on-load tap-changer, then the on-load tap-changer does not present any danger to people, property or the environment. This applies throughout service life of the product, from delivery to installation and operation through to disassembly and disposal.

The following is considered appropriate use:
▪ Use the on-load tap-changer only with the transformer specified in the order.
▪ Only use remote switching of the on-load tap-changer if the transformer is energized.
▪ Always operate the on-load tap-changer in conjunction with the oil cooling unit and the temperature sensors.
▪ Ensure that there are no installed parts above the on-load tap-changer head cover or the protective relay which either radiate heat themselves onto the on-load tap-changer head cover or protective relay or which prevent the dissipation of heat.
▪ The serial numbers of on-load tap-changer and on-load tap-changer accessories (drive, drive shaft, bevel gear, protective relay, etc.) must match if the on-load tap-changer and on-load tap-changer accessories are supplied as a set for one order.
▪ You will find the standard applicable to the on-load tap-changer and the year of issue on the nameplate.
▪ Operate the on-load tap-changer in accordance with this technical file, the agreed delivery conditions and technical data.
▪ Ensure that all necessary work is performed by qualified personnel only.
• Only use the equipment and special tools included in delivery for the intended purpose and in accordance with the specifications of this technical file.

• The on-load tap-changer is not intended to be used with an oil filter unit.

### Permitted electrical operating conditions

In addition to the design data in accordance with the order confirmation, observe the following limits for the through-current and the step voltage:

In the standard version, the on-load tap-changer is designed for sinusoidal 50/60 Hz AC current with a curve form symmetrical to the zero axis and can switch twice the rated through-current $I_r$ at its rated step voltage $U_{ir}$.

Exceeding the rated step voltage $U_{ir}$ for a short period by up to 10% is permitted if the rated through-current $I_r$ is not exceeded.

#### 2.2 Inappropriate use

Use is considered inappropriate if the product is used in a way other than as described in the "Appropriate use" section. In addition, observe the following:

### Prohibited electrical operating conditions

All operating conditions that do not comply with the design data in accordance with the order confirmation are prohibited.

Prohibited operating conditions may arise due to short circuits as well as due to inrush current impulses when energizing transformers or other electrical machines. This applies to the affected transformer itself just as it does to transformers electrically connected in parallel or serially or other electrical machines.

Higher voltages may occur due to transformer overexcitation following load shedding, for example.

Operations outside of the permitted operating conditions can lead to injury to persons and damage to the product.

• Prevent any such operations outside of the permitted operating conditions by taking suitable measures.

#### 2.3 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:
2 Safety

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 2.5, Page 13].
- 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.

Explosion protection

Impermissible on-load tap-change operations can lead to severe explosions and fire. This poses a danger to life and limb.

- Never actuate the motor-drive unit with the hand crank if the transformer is energized.
- Never actuate the motor-drive via the RAISE key / LOWER key on the motor-drive unit if the transformer is energized.
- Never actuate the motor-drive unit manually via the voltage regulator in the danger zone of the transformer if the transformer is energized.
- Ensure that no persons are in or enter the danger zone of the transformer during an on-load tap-change operation.
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.

2.4 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.

2.5 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><strong>Protective clothing</strong></th>
<th>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.</th>
</tr>
</thead>
<tbody>
<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><strong>Safety glasses</strong></th>
<th>To protect the eyes from flying parts and splashing liquids.</th>
</tr>
</thead>
<tbody>
<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 On-load tap-changer

3.1.1 Function description

On-load tap-changers are used to adjust the transmission ratio of transformers without interrupting the load flow. Fluctuations in voltage occurring in the power transmission grid, for example, can therefore be compensated for. For this purpose, on-load tap-changers are fitted in transformers and connected to the active part of the transformer.
A motor-drive unit which receives a control impulse (e.g. from a voltage regulator) changes the operating position of the on-load tap-changer, as a result of which the transformer’s transmission ratio is adapted to the prevailing operating requirements.

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

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></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>Oil cooling unit</td>
</tr>
<tr>
<td>8</td>
<td>Shielding housing</td>
</tr>
<tr>
<td>9</td>
<td>Motor-drive unit</td>
</tr>
<tr>
<td>10</td>
<td>Vertical drive shaft</td>
</tr>
<tr>
<td>11</td>
<td>Pipe (hot insulating fluid)</td>
</tr>
<tr>
<td>12</td>
<td>Pipe (cooled insulating fluid)</td>
</tr>
</tbody>
</table>
3 Product description

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>13</td>
<td>Bevel gear</td>
</tr>
<tr>
<td>14</td>
<td>Horizontal drive shaft</td>
</tr>
<tr>
<td>15</td>
<td>Upper gear unit</td>
</tr>
<tr>
<td>16</td>
<td>RS protective relay</td>
</tr>
</tbody>
</table>

### 3.1.2 Design/versions

The on-load tap-changer consists of the on-load tap-changer head, oil compartment with built-in diverter switch insert and the selector mounted below (also available with change-over selector on request).

The design and designation of the most important on-load tap-changer components are shown in the installation drawings in the appendix.
For the number of maximum operating positions of the on-load tap-changer, refer to the technical data.

Figure 2: Design of VACUTAP® VR

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>On-load tap-changer head</td>
</tr>
<tr>
<td>2</td>
<td>Temperature sensor</td>
</tr>
<tr>
<td>3</td>
<td>Pipe bend</td>
</tr>
<tr>
<td>4</td>
<td>Oil compartment</td>
</tr>
<tr>
<td>5</td>
<td>Tap selector</td>
</tr>
<tr>
<td>6</td>
<td>Change-over selector (optional)</td>
</tr>
<tr>
<td>7</td>
<td>On-load tap-changer head cover</td>
</tr>
<tr>
<td>8</td>
<td>Rupture disk</td>
</tr>
<tr>
<td>9</td>
<td>Upper gear unit</td>
</tr>
</tbody>
</table>
3.1.2.1 Pipe connections

There are 5 pipe connections on the on-load tap-changer head and on-load tap-changer head cover for various purposes. Depending on the order, some or all of these pipe connections are fitted with pipe bends ex factory.

All pipe bends without terminal box for the tap-change supervisory device can be freely swiveled once the pressure ring is loosened.

![Figure 3: Pipe connections with pipe bends](image)

**Pipe connection Q**

The connection cable of the tap-change supervisory device delivered as an option is routed through pipe connection Q. Pipe connection Q is closed with a blank cover on the on-load tap-changer version without tap-change supervisory device.

The functions of the R and Q pipe connections can be interchanged. You must, however, use the long pipe bend on the pipe connection through which the tap-change supervisory control cable is to be threaded.

**Pipe connection S**

Pipe connection S is provided for returning the insulating fluid from the heat exchanger. The pipe bend on pipe connection S is equipped with a vent screw so that the pipe system can be bled.

**Pipe connection R**

Pipe connection R is provided for attaching the protective relay and connecting the on-load tap-changer oil conservator.

The functions of the R and Q pipe connections can be interchanged. You must, however, use the long pipe bend on the pipe connection through which the tap-change supervisory control cable is to be threaded.
Pipe connection E2

Pipe connection E2 is sealed off with a blank cover. It leads into the oil tank of the transformer, directly under the on-load tap-changer head and can be connected to a collective pipe for the Buchholz relay, if necessary. This pipe connection serves a further purpose, namely to equalize the pressure between the transformer tank and oil compartment of the on-load tap-changer, which is necessary for drying, oil filling and transportation of the transformer.

Pipe connection A

Pipe connection A in the on-load tap-changer head cover is provided for feeding the insulating fluid into the pump unit of the oil cooling unit.

3.1.3 Nameplate and serial number

The nameplate with the serial number is on the on-load tap-changer head cover.

Figure 4: Position of nameplate
The serial number can also be found on the selector.

Figure 5: Serial number

3.1.4 Protective devices

The following protective devices for the product are included as standard in the scope of delivery or are available as options.

3.1.4.1 Protective relay

3.1.4.1.1 Function description

The protective relay is looped into the circuit breaker tripping circuit, thus protecting the on-load tap-changer and transformer in the event of a fault within the on-load tap-changer oil compartment. It is tripped when the specified speed of flow from the on-load tap-changer head to the oil conservator is exceeded due to a fault. The flowing insulating fluid actuates the flap valve which tips over into position OFF. The contact in the dry-reed magnetic switch is thereby actuated, the circuit breakers are tripped, and the transformer is de-energized.

The protective relay is a component of an on-load tap-changer filled with insulating fluid and its properties conform to the respective applicable version of IEC publication 60214-1.

Diverter switch operations at rated switching capacity or at permissible overload will not cause the protective relay to trip.
The protective relay responds to flow, not to gas accumulated in the protective relay. It is not necessary to bleed the protective relay when filling the transformer with insulating fluid. Gas accumulation in the protective relay is normal.

3.1.4.1.2 Design/versions

Front view

Figure 6: Protective relay RS 2001/T

1. Inspection window
2. Pressure equalization element

Rear view

Figure 7: Protective relay RS 2001/T

1. Dummy plug
2. Nameplate
3 Product description

View from above

Figure 8: Protective relay RS 2001/T

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gasket</td>
</tr>
<tr>
<td>2</td>
<td>Potential tie-in</td>
</tr>
<tr>
<td>3</td>
<td>Terminal box cover</td>
</tr>
<tr>
<td>4</td>
<td>Slotted head screw for potential tie-in</td>
</tr>
<tr>
<td>5</td>
<td>OPERATION (reset) test button</td>
</tr>
<tr>
<td>6</td>
<td>Slotted head screw for protective cover</td>
</tr>
<tr>
<td>7</td>
<td>OFF (test tripping) test button</td>
</tr>
<tr>
<td>8</td>
<td>Cable gland</td>
</tr>
<tr>
<td>9</td>
<td>Protective cover</td>
</tr>
<tr>
<td>10</td>
<td>Dummy plug</td>
</tr>
<tr>
<td>11</td>
<td>Connection terminal</td>
</tr>
<tr>
<td>12</td>
<td>Pressure equalization element</td>
</tr>
<tr>
<td>13</td>
<td>Cylinder head screw for protective conductor connection</td>
</tr>
</tbody>
</table>

3.1.4.1.3 Nameplate

The nameplate is on the back of the protective relay.

Figure 9: Nameplate
3.1.4.1.4 Safety markings

The following safety markings in accordance with DIN EN 60255-27 are used on the product:

Figure 10: Overview of safety markings

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Protective conductor connection</td>
</tr>
<tr>
<td>2</td>
<td>Notice, danger of electric shock</td>
</tr>
<tr>
<td>3</td>
<td>Notice, observe the documentation</td>
</tr>
</tbody>
</table>

3.1.4.2 Rupture disk

The rupture disk is a pressure relief device without signaling contact in accordance with IEC 60214-1 and is located in the on-load tap-changer head cover.

The rupture disk responds to a defined overpressure in the oil compartment of the on-load tap-changer.

3.1.4.3 Tap-change supervisory device

The tap-change supervisory device monitors both the drive shaft between on-load tap-changer(s) and motor-drive unit and the correct switching of the diverter switch.

3.1.4.4 Temperature monitoring

The temperature monitoring system monitors, controls and records the temperature of the insulating fluid in the oil compartment of the on-load tap-changer.

The controller of the temperature monitoring system is integrated into the motor-drive unit.

You will find further information on temperature monitoring in the operating instructions for the motor-drive unit and oil cooling unit.
3.2 Drive shaft

3.2.1 Function description

The drive shaft is the mechanical connection between motor-drive and on-load tap-changer head / de-energized tap-changer head.

The bevel gear changes the direction from vertical to horizontal.

Accordingly, the vertical drive shaft has to be mounted between drive and bevel gear, and the horizontal drive shaft between bevel gear and on-load tap-changer or de-energized tap-changer.
3.2.2 Design/versions

The drive shaft consists of a square tube and is coupled at each end by two coupling brackets and one coupling bolt to the driving or driven shaft end of the device to be connected.

Figure 11: Components of the drive shaft

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Bevel gear</td>
</tr>
<tr>
<td>2</td>
<td>Hose clip</td>
</tr>
<tr>
<td>3</td>
<td>Telescopic protective tube</td>
</tr>
<tr>
<td>4</td>
<td>Coupling bracket</td>
</tr>
<tr>
<td>5</td>
<td>Square tube</td>
</tr>
<tr>
<td>6</td>
<td>Coupling bolt</td>
</tr>
<tr>
<td>7</td>
<td>Adapter ring</td>
</tr>
<tr>
<td>8</td>
<td>Protective cover</td>
</tr>
<tr>
<td>9</td>
<td>Hose clip</td>
</tr>
</tbody>
</table>
3.2.2.1 Drive shaft without cardan joint and without insulator

Figure 12: Drive shaft without cardan joint and without insulator (= standard version)

<table>
<thead>
<tr>
<th>Configuration</th>
<th>V 1 min</th>
<th>Intermediate bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle of hand crank – middle of bevel gear (maximum permissible axial offset 2°)</td>
<td>536 mm</td>
<td>When the maximum value of 2472 mm is exceeded, it is necessary to use an intermediate bearing. V 1 ≤ 2472 mm (without intermediate bearing) V 1 &gt; 2472 mm (with intermediate bearing)</td>
</tr>
</tbody>
</table>
3.2.2.2 Drive shaft without cardan joint and with insulator

Figure 13: Drive shaft without cardan joint and with insulator (= special model)

<table>
<thead>
<tr>
<th>Configuration</th>
<th>V 1 min</th>
<th>Intermediate bearing</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle of hand crank – middle of bevel gear (maximum permissible axial offset 2°)</td>
<td>706 mm</td>
<td>When the maximum value of 2472 mm is exceeded, it is necessary to use an intermediate bearing.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V 1 ≤ 2472 mm (without intermediate bearing)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>V 1 &gt; 2472 mm (with intermediate bearing)</td>
</tr>
</tbody>
</table>

3.2.2.3 Drive shaft with cardan joints, without insulator

An axial displacement of maximum 20° to the side facing away from the transformer is permitted for the vertical drive shaft with cardan joints. An axial displacement of maximum 2° to the side facing the transformer is permitted.
3.2.2.4 Drive shaft with cardan joint and with insulator

An axial displacement of maximum 20° to the side facing away from the transformer is permitted for the vertical drive shaft with cardan joints and insulator. An axial displacement of maximum 2° to the side facing the transformer is permitted.
Figure 15: Drive shaft with cardan joint and with insulator (= special model)

<table>
<thead>
<tr>
<th>Configuration</th>
<th>V 1 min [mm]</th>
<th>Intermediate bearing for [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Middle of hand crank – middle of bevel gear</td>
<td>978</td>
<td>V 1 &gt; 2772</td>
</tr>
</tbody>
</table>
3.2.3 Identification plate

The identification plate is on the telescopic protective tube.

Figure 16: Position of the identification plate
4 Commissioning

**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 during commissioning 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.

**WARNING**

Overloading the on-load tap-changer can lead to explosion and, due to spraying hot oil and flying parts, to death and serious injuries. Property damage is highly probable.

► Ensure that the on-load tap-changer is not overloaded.

► Ensure use of the on-load tap-changer in accordance with section "Appropriate use".

► Prevent operations outside of the permitted operating conditions by taking suitable measures.

This chapter describes how to commission the on-load tap-changer.

4.1 Commissioning transformer at operating site

Before energizing the transformer, check that the motor-drive unit and protective devices are functioning correctly and fill the on-load tap-changer oil compartment with fresh insulating fluid. To do so, proceed as follows:

4.1.1 Filling the oil compartment of the on-load tap-changer with insulating fluid

1. **NOTICE!** Check whether the on-load tap-changer head cover has a flange for attaching a pressure relief device. If it does, operation without a pressure relief device is not permitted and may result in damage to the on-load tap-changer.

   Fit a pressure relief device which is approved for this on-load tap-changer on the on-load tap-changer head.
2. Establish a connecting lead between pipe connection E2 and one of the pipe connections R, S or Q to ensure equal pressure in the oil compartment and transformer during evacuation.

Figure 17: Connecting lead between E2 and Q

3. Fill on-load tap-changer with fresh Midel 7131 using one of the two free pipe connections on the on-load tap-changer head.

Figure 18: Pipe connections S and R

4. Remove sample from the oil compartment.

5. Record the temperature of the sample immediately after the sample is taken.

6. Determine dielectric strength and water content at a sample temperature of 20°C ± 5°C. The dielectric strength and water content must comply with the limit values specified in the technical data.
4.1.2 **Bleeding on-load tap-changer head and pipe system**

Prior to commissioning, you must bleed the on-load tap-changer head and the pipe system.

4.1.2.1 **Bleeding on-load tap-changer head**

1. Open all forward valves and return valves in the pipe system.
2. Remove screw cap on air-vent valve E1 on the on-load tap-changer head cover.

![Figure 19: Screw cap](image)

3. Use screwdriver to lift valve tappet on air-vent valve E1 and bleed on-load tap-changer head.

![Figure 20: Valve tappet](image)

4. Seal air-vent valve E1 with screw cap (tightening torque 10 Nm).
4.1.2.2 Bleeding the pipe system

1. Remove the screw caps on the pipe bends on pipe connections A and S.

   ![Figure 21: Screw cap](image)

2. Open the vent screw and bleed the pipe system.
3. Close the vent screw and seal with the screw caps.
4. Bleed the pipe system at other points at which the option of bleeding has been provided. More information can be found in the operating instructions for the oil cooling unit.

4.1.3 Checking motor-drive unit

**NOTICE**

Damage to the on-load tap-changer / de-energized tap-changer!

Damage to the on-load tap-changer / de-energized tap-changer due to actuation of the on-load tap-changer / de-energized tap-changer without insulating fluid.

- Ensure that the selector / de-energized tap changer is fully immersed in insulating fluid and that the oil compartment of the on-load tap-changer is completely filled with insulating fluid.
**NOTICE**

**Damage to the on-load tap-changer and motor-drive unit!**

Damage to on-load tap-changer and motor-drive unit due to incorrect use of position transmitter equipment.

- Only circuits stated in the chapter Technical data for position transmitter equipment may be connected to the position transmitter module connections.

- The switchover point of the position transmitter equipment in the motor-drive unit is not the same as the switchover point of the diverter switch operation. This depends on the type of diverter switch. This fact should be noted when project planning the locking circuits between the motor-drive unit and external equipment (e.g. transformer circuit breaker).

- Therefore, the “Tap changer in operation” position transit contact shown in the connection diagram should be used for external monitoring, locking and control purposes instead of the position transmitter equipment.

Prior to commissioning the transformer, check whether the motor-drive unit and on-load tap-changer are correctly coupled and that the motor-drive unit functions correctly.

**Tests on the motor-drive unit**

1. Perform function checks as described in relevant MR operating instructions for motor-drive unit.

2. **NOTICE!** An incorrectly coupled motor-drive unit will lead to damage to the on-load tap-changer. Undertake trial tap-change operations across the entire range of settings. Ensure that in each operating position, the tap position indicators of motor-drive unit and on-load tap-changer (inspection window in the on-load tap-changer head) match.

**Dielectric tests on transformer wiring**

- Note information relating to dielectric tests on transformer wiring in relevant MR operating instructions for motor-drive unit.


- Check that the protective relay is functioning correctly before commissioning the transformer:

1. Ground the transformer on the high-voltage side and low-voltage side. Ensure that the grounding for work connection on the transformer is not removed during testing.

2. Ensure that the transformer remains de-energized during testing.

3. Deactivate the automatic fire extinguishing device.

4. Loosen the three screws on the terminal box cover and lift off the terminal box cover.
4 Commissioning

5. Remove the slotted head screw for potential tie-in and remove the terminal box cover with wire.
6. Press OFF test button.
7. Leave the transformer's danger zone.
8. Ensure that the transformer's circuit breaker cannot be closed.
   ⇒ Passive protection test
9. Press OPERATION test button.
10. Leave the transformer's danger zone.
11. Close the transformer's circuit breaker with isolating switches open and the transformer grounded on all sides.
12. Press OFF test button.
13. Ensure that the transformer's circuit breaker is open.
   ⇒ Active protection test.
14. Press OPERATION test button to reset the protective relay.
15. Position the wire for the terminal box cover and affix using the slotted head screw.
16. Attach the terminal box cover and secure with screws.

4.1.5 Commissioning the transformer

- Oil cooling unit is mounted and ready for operation.
- Temperature sensors are connected and looped into the tripping circuit of the circuit breaker.
- The signaling contact for falling below the minimum oil level in the on-load tap-changer's oil conservator is looped into the tripping circuit of the circuit breaker.
- The protective relay and additional protective devices are looped into the circuit breaker's tripping circuit.
- The motor-drive unit and all protective devices are functioning correctly and are ready for use.
- The oil compartment of the on-load tap-changer is completely filled with insulation fluid.
- All stop-cocks between on-load tap-changer and oil conservator of the on-load tap-changer are open.

1. Switch on transformer.

2. **NOTICE!** Inrush current impulses can be significantly greater than the transformer rated current and may lead to current paths with asymmetrical or non-sinusoidal curve shapes and, as a result, overload the on-load tap-changer during the diverter switch operation. Only perform tap-change operations - whether under no load or under load conditions - once the in-rush current impulse has subsided.
5 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, remeding 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
### 5 Fault elimination

<table>
<thead>
<tr>
<th>Fault description</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tripping of protective relay (e.g. RS)</td>
<td>See section &quot;Tripping the protective relay and re-commissioning the transformer [► Section 5.1, Page 41]&quot; Also contact MR.</td>
</tr>
<tr>
<td>Activation of tap-change supervisory device</td>
<td>The motor-drive unit can no longer be electrically actuated once the tap-change supervisory device has been activated. Manual operation of the motor-drive unit via the hand crank when the transformer is switched on is prohibited. On-load tap-changer and transformer must be checked. Depending on the cause of tripping, take measurements / carry out checks on the transformer. Contact MR to check the on-load tap-changer.</td>
</tr>
<tr>
<td>Activation of rupture disk in on-load tap-changer head cover</td>
<td>On-load tap-changer and transformer must be checked. Depending on the cause of tripping, take measurements / carry out checks on the transformer. Contact MR to check the on-load tap-changer.</td>
</tr>
<tr>
<td>Tripping of motor protective switch Q1 in motor-drive unit</td>
<td>See chapter &quot;Fault elimination&quot; in the operating instructions of the TAPMOTION® ED motor-drive unit</td>
</tr>
<tr>
<td>Tripping of signaling contact that indicates that the fill level has fallen below the minimum in the on-load tap-changer oil conservator</td>
<td>Check pipe system (pipes etc.) and on-load tap-changer head for leaks. Check the fill level and the quality of the insulating fluid in accordance with the operating instructions for the on-load tap-changer. If the fill level has fallen below the limit values, also contact MR.</td>
</tr>
<tr>
<td>On-load tap-changer not changing tap position (sluggishness, Raise keys / Lower keys not working, no audible di- verter switch action)</td>
<td>Contact MR.</td>
</tr>
<tr>
<td>No change in voltage on transformer despite change in position on motor-drive unit</td>
<td>Contact MR.</td>
</tr>
<tr>
<td>Tap position indicator on motor-drive unit and on-load tap-changer different</td>
<td>Contact MR.</td>
</tr>
<tr>
<td>Noises on drive shaft or motor-drive unit when changing tap position</td>
<td>Ensure proper mounting of the drive shaft in accordance with its operating instructions. Check that hose clips and protective covers are seated correctly. Contact MR in the event of noise from the motor-drive unit.</td>
</tr>
<tr>
<td>Red message on monitoring unit</td>
<td>If possible read out database and send to MR along with error code.</td>
</tr>
<tr>
<td>Warning or tripping of Buchholz relay on transformer</td>
<td>Notify manufacturer of transformer.</td>
</tr>
<tr>
<td>Deviation from desired value when measuring winding resistance of transformer</td>
<td>Contact manufacturer of transformer and, if necessary, MR, and provide measured values.</td>
</tr>
<tr>
<td>Deviation from desired value during dissolved gas analysis (transformer oil)</td>
<td>Contact manufacturer of transformer and, if necessary, MR, and provide measured values.</td>
</tr>
<tr>
<td>Fault description</td>
<td>Action</td>
</tr>
<tr>
<td>----------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Deviation from desired value during transformer ratio test</td>
<td>Contact manufacturer of transformer and, if necessary, MR, and provide measured values.</td>
</tr>
<tr>
<td>Deviation from limit value for diverter switch oil values</td>
<td>Carry out oil change, check oil conservator breather of on-load tap-changer.</td>
</tr>
<tr>
<td>On-load tap-changer switches to static operation and message “Status B7, B8, B9”</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 of 140°C* in the oil compartment permissible for a maximum of 48 hours</td>
</tr>
<tr>
<td>On-load tap-changer switches to static operation and message “OLTC Oil Temperature &gt;120°C” (K44) and oil cooling pump runs (K7/Q4)</td>
<td>▪ Check fan and eliminate fault</td>
</tr>
<tr>
<td></td>
<td>▪ If the fan is OK: 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 of 140°C* in the oil compartment permissible for a maximum of 48 hours</td>
</tr>
<tr>
<td>On-load tap-changer switches to static operation and message “OLTC Oil Temperature &gt;120°C” (K44) and oil cooling pump does not run (K7/Q4)</td>
<td>▪ Possibility 1: 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 of 140°C* in the oil compartment permissible for a maximum of 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>▪ Possibility 2: 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 of 140°C* in the oil compartment permissible for a maximum of 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 of 140°C* in the oil compartment permissible for a maximum of 48 hours</td>
</tr>
</tbody>
</table>

Table 3: Fault elimination
5 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*

5.1 Tripping the protective relay and re-commissioning the transformer

**WARNING**

**Danger of explosion!**

Explosive gases in the protective relay can deflagrate or explode and result in severe injury or death.

► Wait 15 minutes after switching off the transformer before beginning further work on the protective relay so that the gases can dissipate.

► Ensure that there are no ignition sources such as naked 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 before beginning work.

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

**WARNING**

**Danger of death or severe injury!**

Danger of severe injury or death if on-load tap-changer and transformer are insufficiently tested.

► Be sure to contact Maschinenfabrik Reinhausen to check on-load tap-changer and transformer if the protective relay has tripped.

► Only use the equipment again when you are sure there is no damage to the on-load tap-changer or transformer.

When the circuit breakers have been tripped by the protective relay, proceed as follows:

1. Establish time of tripping.
2. Determine operating position of on-load tap-changer.
3. As a precaution, block the motor-drive unit by tripping the motor protective switch to prevent the on-load tap-changer from being actuated by remote control.
4. Check the on-load tap-changer head cover. If insulating fluid is leaking, close the oil conservator stop valve immediately.
5. Check whether the flap valve of the protective relay is in the OFF or OPERATION position.

5.1.1 Flap valve in OPERATION position

If the flap valve is in the OPERATION position, there may be a fault in the tripping circuit. Check the tripping circuit in this case. If you are not able to clarify why the protective relay tripped, be sure to contact Maschinenfabrik Reinhausen to check the on-load tap-changer.
5.1.2 Flap valve in OFF position

If the flap valve is in the OFF position, proceed as follows:

1. Ensure that the transformer is not started up under any circumstances.
2. Contact and inform Maschinenfabrik Reinhausen of the following:
   - Serial number of protective relay and on-load tap-changer
   - What was the load of the transformer at the instant of tripping?
   - Was the on-load tap-changer moved immediately before or during tripping?
   - Did any other protective devices of the transformer respond at the instant of tripping?
   - Were switching operations in the network being carried out at the instant of tripping?
   - Were overvoltages registered at the instant of tripping?
3. Take further action in agreement with Maschinenfabrik Reinhausen.

5.1.3 Re-commissioning the transformer

Once the reason for the protective relay tripping has been established and remedied, you can re-commission the transformer:

1. Check the protective relay [Section 4.1.4, Page 36].
2. Commission the transformer.
6 Maintenance

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.

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.

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.

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.
6.1 Inspection

Monitoring the on-load tap-changer and motor-drive unit is limited to occasional visual checks of the on-load tap-changer head, protective relay and motor-drive unit, as well as testing the insulating fluid. For efficiency reasons these visual inspections can be combined with the usual checks on the transformer.

Check the following:

<table>
<thead>
<tr>
<th>Interval</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annually</td>
<td>Check door seal, cable bushings, and ventilation of protective housing of motor-drive unit.</td>
</tr>
<tr>
<td>Annually</td>
<td>Check sealing points of on-load tap-changer head, protective relay, and connected pipes.</td>
</tr>
<tr>
<td>Annually</td>
<td>Check correct functioning of the installed electrical heater in the protective housing of the motor-drive unit.</td>
</tr>
<tr>
<td>Annually</td>
<td>Check correct function of protective relay.</td>
</tr>
<tr>
<td>Annually</td>
<td>Check perfect condition of the silica gel breather for the on-load tap-changer oil conservator.</td>
</tr>
<tr>
<td>Every 2 years</td>
<td>Check the quality of the insulating fluid.</td>
</tr>
<tr>
<td></td>
<td>1. Remove sample from oil compartment.</td>
</tr>
<tr>
<td></td>
<td>2. Record the temperature of the sample immediately after the sample is taken.</td>
</tr>
<tr>
<td></td>
<td>3. Determine dielectric strength and water content at an insulating fluid temperature of 20°C ± 5°C. The dielectric strength and water content must comply with the limit values specified in the technical data.</td>
</tr>
<tr>
<td></td>
<td>4. If the limit values are not complied with, change the insulating fluid in accordance with the section &quot;Changing the insulating fluid&quot;.</td>
</tr>
</tbody>
</table>

Table 4: Inspection plan

6.2 Maintenance intervals

Maintenance intervals without MR monitoring system

**WARNING**

**Danger of explosion!**

If pending maintenance work is not carried out immediately, this may lead to death or serious injury as a result of a progressive short circuit, for example.

► Adherence to the following maintenance intervals is mandatory.
If you are operating the on-load tap-changer without an MR monitoring system, the following maintenance intervals shall apply.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>After every 100,000 switching operations (motor-drive unit counter reading)</td>
<td>Replace on-load tap-changer. 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 safety devices, oil cooling unit including controller and diverter switch insert. Contact the Maschinenfabrik Reinhausen GmbH Technical Service for this.</td>
</tr>
<tr>
<td>After every 5 years of operation</td>
<td>Check selector. Contact the Maschinenfabrik Reinhausen GmbH Technical Service for this.</td>
</tr>
</tbody>
</table>

Table 5: Maintenance plan without MR monitoring system

A label on the inside of the door of the TAPMOTION® ED motor-drive unit also specifies the relevant maintenance interval.

Figure 22: Label showing maintenance intervals
Maintenance intervals with MR monitoring system

**WARNING**

Danger of explosion!

If pending maintenance work is not carried out immediately, this may lead to death or serious injury as a result of a progressive short circuit, for example.

- Contact the Maschinenfabrik Reinhausen GmbH Technical Service department as soon as the MR monitoring system issues a maintenance warning.
- In the event of failure or shutdown of the MR monitoring system, observe the maintenance intervals as specified in the maintenance plan without the MR monitoring system.

If you are operating the on-load tap-changer with an MR monitoring system, the maintenance intervals displayed by the MR monitoring system shall apply. More information can be found in the operating instructions for the MR monitoring system.

### 6.3 Changing the insulation fluid

**NOTICE**

Damage to the on-load tap-changer!

Small parts in the oil compartment may block the diverter switch insert, thereby damaging the on-load tap-changer.

- Ensure that parts do not fall into the oil compartment.
- Check that all small parts are accounted for.

Change the insulating fluid in the on-load tap-changer oil compartment and oil conservator if the dielectric strength and water content are not in compliance with the limit values specified in the technical data.

To do so, proceed as follows.

#### 6.3.1 Moving on-load tap-changer to adjustment position

1. Make a note of the current operating position of the on-load tap-changer.
2. Move the on-load tap-changer to the adjustment position. The adjustment position is indicated in the on-load tap-changer connection diagram.

#### 6.3.2 Removing horizontal drive shaft

**NOTICE**

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

Damage to on-load tap-changer and transformer if motor-drive unit is operated when not coupled!

- Never operate the motor-drive unit if the horizontal drive shaft has been removed.
- As a precaution, block the motor-drive unit against electrical operation by actuating the motor protective switch (see operating instructions for "Tap-motion® ED").
1. Loosen hose clips on protective cover of horizontal drive shaft, remove protective cover.

Figure 23: Removing protective cover
2. Depending on version, loosen 4 or 6 screws on coupling brackets to upper gear unit and bevel gear.

![Figure 24: Loosening coupling brackets](image)

3. Remove horizontal drive shaft. Be sure not to lose the coupling bolts.

![Figure 25: Removing drive shaft](image)

### 6.3.3 Emptying the oil compartment and oil conservator

1. Ensure that the stop-cock between oil conservator and on-load tap-changer is open.

2. Remove the screw cap on air-vent valve E1 on the on-load tap-changer head cover.

3. Use a screwdriver to lift the valve tappet on air-vent valve E1.
   - The gas under the on-load tap-changer head cover escapes. When doing so, ensure sufficient ventilation.
4. Once the gas has been discharged and insulating fluid is flowing out of the air-vent valve, close the air-vent valve.

5. Close the stop-cock between the oil conservator and on-load tap-changer.

6. Open the air-vent valve E1 again and drain off the insulating fluid until the area under the on-load tap-changer head cover is unoccupied.

7. Remove the screws and washers from the on-load tap-changer head cover.

8. Remove on-load tap-changer head cover.

9. Suck the insulating fluid out of the oil compartment.

10. Open the stop-cock between oil conservator and on-load tap-changer.

   The insulating fluid flows out of the oil conservator into the oil compartment.

11. Suck the insulating fluid out of the oil compartment.

6.3.4 Filling the oil compartment and oil conservator with fresh insulating fluid

1. **NOTICE!** Unsuitable insulating fluids cause damage to the on-load tap-changer. Fill the oil compartment of the on-load tap-changer with fresh Midel 7131 via the pipe connection S up to the level of the upper edge of the coupling shaft.
2. Insert the new o-ring untwisted in the on-load tap-changer head cover.

3. Position the on-load tap-changer head cover on the on-load tap-changer head in such a way that the red triangular markings on the on-load tap-changer head and the on-load tap-changer head cover are aligned.

![Figure 28: Triangular markings and o-ring](image)

4. Screw the on-load tap-changer head cover onto the on-load tap-changer head.

![Figure 29: On-load tap-changer head cover](image)

5. **NOTICE!** Unsuitable insulating fluids cause damage to the on-load tap-changer. Fill the oil conservator with fresh Midel 7131.

6. Vent the on-load tap-changer head via air-vent valve E1 on the on-load tap-changer head cover. To do this, remove screw cap and lift valve tappet with a screwdriver.

7. Seal air-vent valve E1 with screw cap (tightening torque 10 Nm).
8. Remove screw cap from pipe connection S.

9. Open vent screw and bleed pipe system.


11. Seal vent screw with screw cap.

12. Check the level in the oil conservator and top up with insulating fluid if necessary.

13. Re-vent the on-load tap-changer head via air-vent valve E1 and the pipe system on the pipe connection S via the vent screw.

14. Flush the pipe system and take a sample of the insulating fluid sample from the oil compartment via pipe connection S.

15. Record the temperature of the sample immediately after the sample is taken.

16. Determine dielectric strength and water content at a sample temperature of 20°C ± 5°C. The dielectric strength and water content must comply with the limit values specified in the technical data (after maintenance).
6.3.5 Installing horizontal drive shaft

1. Secure horizontal drive shaft between upper gear unit and bevel gear with coupling brackets and 4 or 6 screws. Refer to the drive shaft operating instructions for details.

Figure 31: Securing drive shaft
2. Use hose clips to secure protective cover to horizontal drive shaft.

3. For special design types featuring cardan shafts, be sure to check the expansion bellows and the lubricant reservoir of the cardan shafts.

You will find a detailed description of how to fit the drive shaft in the MR operating instructions “Drive shaft”.

6.3.6 Centering on-load tap-changer and motor-drive unit

Center on-load tap-changer and motor-drive unit as described in relevant MR operating instructions for motor-drive unit.
### 7 Technical data

An overview of all key technical data for the on-load tap-changer and motor-drive unit exists in the form of separate documents, which are available on request.

#### 7.1 Technical data for on-load tap-changer

##### 7.1.1 On-load tap-changer properties

<table>
<thead>
<tr>
<th>On-load tap-changer</th>
<th>Electrical data for VACUTAP® VRM I/II/III</th>
</tr>
</thead>
<tbody>
<tr>
<td>VRM I 501</td>
<td>VRM III 500 Y</td>
</tr>
<tr>
<td>Maximum rated through-current $I_{\text{rm}}$ [A]</td>
<td>500</td>
</tr>
<tr>
<td>Rated short-time current [kA]</td>
<td>5</td>
</tr>
<tr>
<td>Rated duration of short-circuits [s]</td>
<td>3</td>
</tr>
<tr>
<td>Rated peak withstand current [kA]</td>
<td>12.5</td>
</tr>
<tr>
<td>Maximum rated step voltage $U_{\text{rm}}$ [V]</td>
<td>3 000</td>
</tr>
<tr>
<td>Step capacity $P_{\text{stm}}$ [kVA]</td>
<td>1 500</td>
</tr>
<tr>
<td>Rated frequency [Hz]</td>
<td>50...60</td>
</tr>
</tbody>
</table>

Table 6: Electrical data for VACUTAP® VRM I/II/III

1) For on-load tap-changer VACUTAP® VRM I 1203 with a rated through-current $I_{\text{r}} > 1,000$ A, contact Maschinenfabrik Reinhausen GmbH regarding the permissible overload and number of tap-change operations.

<table>
<thead>
<tr>
<th>Mechanical data for VACUTAP® VRM I/III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of operating positions</td>
</tr>
<tr>
<td>Number of equipped sectors</td>
</tr>
<tr>
<td>Number of sectors</td>
</tr>
<tr>
<td>Selector sizes</td>
</tr>
<tr>
<td>Dimensions</td>
</tr>
<tr>
<td>Weight</td>
</tr>
<tr>
<td>Displacement and oil volume</td>
</tr>
</tbody>
</table>

Table 7: Mechanical data for VACUTAP® VRM I/III
7.1.2 Permissible ambient conditions

<table>
<thead>
<tr>
<th>Permissible ambient conditions</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air temperature during operation</td>
<td>-25...+50°C</td>
</tr>
<tr>
<td>Temperature of the insulating fluid in the transformer in operation</td>
<td>Normal temperature range: -15...+105°C: continuous. Increased temperature range: 105...130°C: max. 8 hours/day, max. 720 hours/year. 130...150°C: max. 8 hours/day, max. 240 hours/year.</td>
</tr>
<tr>
<td>Temperature of the insulating fluid in the oil compartment in operation</td>
<td>-15...+120°C</td>
</tr>
<tr>
<td>Transport temperature, storage temperature</td>
<td>-40...+50°C</td>
</tr>
<tr>
<td>Drying temperatures</td>
<td>See installation and commissioning instructions, chapter &quot;Assembly&quot;</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>See technical data TD 61 – general section</td>
</tr>
<tr>
<td>Insulating fluids</td>
<td>Synthetic ester fluid (IEC 61099): Midel 7131. Other insulating fluids on request</td>
</tr>
<tr>
<td>Installation height of the oil conservator</td>
<td>See technical data TD 61 – general section</td>
</tr>
<tr>
<td>Installation height above sea level</td>
<td>See technical data TD 61 – general section</td>
</tr>
</tbody>
</table>

Table 8: Permissible ambient conditions

7.2 Technical data for protective relay

General technical data

The technical data for the protective relay RS 2001 is listed in the following. In accordance with DIN EN 60255-1, operational accuracy = base accuracy.

<table>
<thead>
<tr>
<th>Housing</th>
<th>Outdoor model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Degree of protection</td>
<td>IP65</td>
</tr>
<tr>
<td>Relay actuation</td>
<td>Flap valve with aperture</td>
</tr>
<tr>
<td>Weight</td>
<td>approx. 3.5 kg</td>
</tr>
<tr>
<td>Oil flow speed of available types when tripping (oil temperature 20°C)</td>
<td>0.65 ± 0.15 m/s. 1.20 ± 0.20 m/s. 3.00 ± 0.30 m/s. 4.80 ± 0.30 m/s.</td>
</tr>
</tbody>
</table>

Table 9: General technical data

Tripping switch

The protective relay is supplied with several independent dry-reed magnetic switches. These can be designed as normally open (NO) or normally closed (NC) contacts and are electrically isolated from each other.
Electrical data for normally closed (NC) dry-reed magnetic switch

**Electrical data**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DC switching capacity</td>
<td>1.2 W…200 W</td>
</tr>
<tr>
<td>AC switching capacity (50 Hz)</td>
<td>1.2 VA…400 VA</td>
</tr>
<tr>
<td>Switching voltage AC/DC</td>
<td>24 V…250 V</td>
</tr>
<tr>
<td>Switched current AC/DC</td>
<td>4.8 mA…2 A</td>
</tr>
</tbody>
</table>

Table 10: Electrical data

**Switching capacity (switching load on an off)**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum switched current AC/DC (lowest voltage)</td>
<td>50 mA (at 24 V)</td>
</tr>
<tr>
<td>Minimum switched current AC/DC (highest voltage)</td>
<td>4.8 mA (at 250 V)</td>
</tr>
<tr>
<td>Maximum switched current DC (highest current)</td>
<td>1.6 A (at 125 V with L/R = 40 ms)</td>
</tr>
<tr>
<td>Maximum switched current DC (highest voltage)</td>
<td>0.9 A (at 250 V with L/R = 40 ms)</td>
</tr>
<tr>
<td>Maximum switched current AC (highest current)</td>
<td>2 A (at 125 V with cos φ = 0.6)</td>
</tr>
<tr>
<td>Maximum switched current AC (highest voltage)</td>
<td>1.6 A (at 250 V with cos φ = 0.6)</td>
</tr>
<tr>
<td>Switching operations</td>
<td>1,000 cycles</td>
</tr>
</tbody>
</table>

Table 11: Switching capacity (switching load on an off)

**Dielectric strength**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>AC dielectric strength between all voltage-carrying connections and the grounded parts</td>
<td>2,500 V, 50 Hz, test duration 1 minute</td>
</tr>
<tr>
<td>AC dielectric strength between the opened contacts</td>
<td>2,000 V, 50 Hz, test duration 1 minute</td>
</tr>
</tbody>
</table>

Table 12: Dielectric strength

Electrical data for normally open (NO) dry-reed magnetic switch

**Electrical data**

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DC switching capacity</td>
<td>1.2 W…250 W</td>
</tr>
<tr>
<td>AC switching capacity (50 Hz)</td>
<td>1.2 VA…400 VA</td>
</tr>
<tr>
<td>Switching voltage AC/DC</td>
<td>24 V…250 V</td>
</tr>
<tr>
<td>Switched current AC/DC</td>
<td>4.8 mA…2 A</td>
</tr>
</tbody>
</table>

Table 13: Electrical data
7 Technical data

### Switching capacity (switching load on an off)

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum switched current AC/DC (lowest voltage)</td>
<td>50 mA (at 24 V)</td>
</tr>
<tr>
<td>Minimum switched current AC/DC (highest voltage)</td>
<td>4.8 mA (at 250 V)</td>
</tr>
<tr>
<td>Maximum switched current DC (highest current)</td>
<td>2 A (at 125 V with L/R = 40 ms)</td>
</tr>
<tr>
<td>Maximum switched current DC (highest voltage)</td>
<td>1 A (at 250 V with L/R = 40 ms)</td>
</tr>
<tr>
<td>Maximum switched current AC (highest current)</td>
<td>2 A (at 125 V with $\cos \varphi = 0.6$)</td>
</tr>
<tr>
<td>Maximum switched current AC (highest voltage)</td>
<td>1.6 A (at 250 V with $\cos \varphi = 0.6$)</td>
</tr>
<tr>
<td>Switching operations</td>
<td>1,000 cycles</td>
</tr>
</tbody>
</table>

Table 14: Switching capacity (switching load on an off)

### Dielectric strength

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AC dielectric strength between all voltage-carrying connections and the grounded parts</td>
<td>2,500 V, 50 Hz, test duration 1 minute</td>
</tr>
<tr>
<td>AC dielectric strength between the opened contacts</td>
<td>2,000 V, 50 Hz, test duration 1 minute</td>
</tr>
</tbody>
</table>

Table 15: Dielectric strength

### Ambient conditions

<table>
<thead>
<tr>
<th>Description</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ambient temperature $T_a$</td>
<td>-40°C…+50°C</td>
</tr>
<tr>
<td>Oil temperature</td>
<td>&lt;130 °C</td>
</tr>
<tr>
<td>Air pressure</td>
<td>Corresponds to 0 m…4,000 m above sea level</td>
</tr>
</tbody>
</table>

Table 16: Ambient conditions

#### 7.2.1 Protective relay with several dry-reed magnetic switches

The protective relay is supplied with several independent dry-reed magnetic switches. These can be designed as normally open (NO) or normally closed (NC) contacts and are electrically isolated from each other.
### 7.2.2 Tests

#### Electrical safety

<table>
<thead>
<tr>
<th>IEC 61010-1</th>
<th>Safety requirements for electrical measurement and control and regulation equipment and laboratory instruments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Overvoltage category III</td>
</tr>
<tr>
<td></td>
<td>• Contamination level 2</td>
</tr>
</tbody>
</table>

Table 17: Electrical safety
7.3 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 18: 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 19: Limit values for synthetic esters in accordance with IEC 61099
8 Drawings

8.1 Dimensional drawings
ON-LOAD TAP-CHANGER VACUTAP® VR
INSTALLATION DRAWING VR S/M - B/C/D/DE
DIMENSION DRAWING

SELECTOR SIZE

<table>
<thead>
<tr>
<th>Um</th>
<th>1kV1</th>
<th>MAX. PULL-OUT HEIGHT [mm]</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>VRS</td>
</tr>
<tr>
<td>725</td>
<td>1200</td>
<td>1590</td>
</tr>
<tr>
<td>123</td>
<td>1380</td>
<td>1480</td>
</tr>
<tr>
<td>170</td>
<td>1460</td>
<td>1610</td>
</tr>
<tr>
<td>245</td>
<td>1560</td>
<td>1790</td>
</tr>
<tr>
<td>300</td>
<td>1712</td>
<td>1862</td>
</tr>
<tr>
<td>362</td>
<td>1815</td>
<td>1965</td>
</tr>
<tr>
<td>420</td>
<td>1934</td>
<td>2084</td>
</tr>
</tbody>
</table>

11 MOUNTING FLANGE ON TRANSFORMER COVER
12 M12 FIXING SCREW
13 ON-LOAD TAP-CHANGER HEAD DASKET
14 POSITION INDICATOR, REMOVE BEFORE REMOVING THE DIVERTER SWITCH INSERT
15 INJECTION WINDOW
16 Ø 15 HOLES
17 SUCTION PIPE
21 ON-LOAD TAP-CHANGER HEAD
22 COVER SCREW
23 COVER DASKET
24 ON-LOAD TAP-CHANGER HEAD DASKET
25 CENTRAL GEAR UNIT WITH 25a DRIVE SHAFT
26 PIPE CONNECTION R FOR PROTECTIVE RELAY
27 PIPE CONNECTION S WITH VENT SCREW (OPTIONAL)
28 PIPE CONNECTION (OPTIONAL)
29a AIR-VENT VALVE OF THE ON-LOAD TAP-CHANGER HEAD COVER
29b VENTING OPTION FOR THE TRANSFORMER OIL CHAMBER
31 DIVERTER SWITCH OIL COMPARTMENT
32 OIL COMPARTMENT BASE
33 SHIELDING RINGS FOR UM OF 170 kV OR GREATER
34 OIL COMPARTMENT CONNECTION TERMINAL
35 CONNECTION CONTACT FOR ON-LOAD TAP-CHANGER TAKE-OFF LEAD
36 TAKE-OFF RING FOR ON-LOAD TAP-CHANGER TAKE-OFF LEAD
41 SELECTOR SUSPENSION
42 SELECTOR GEAR
43 FINE TAP SELECTOR
44 CHANGE-OVER SELECTOR
45 SELECTOR CONNECTION CONTACTS (SEE ASOCIATED DIMENSIONAL DRAWING)
46 CHANGE-OVER SELECTOR CONNECTION CONTACTS (SEE ASOCIATED DIMENSIONAL DRAWING)
47 SELECTOR CONNECTING LEAD
51 DIVERTER SWITCH INSERT
52 TRANSITION RESISTANCES
53 EYEBOLT
54 SELECTOR DRIVE SIDE
### Installation Position of Selector Connection Contacts

**On-Load Tap-Changer VACUTAP® VR**

#### Dimensions in mm

- **Φ 11**
- **20**
- **16**
- **10**
- **8**

**Notes:**
- Dimensions are exclusive of the outer insulation.
- All dimensions are subject to tolerances.

**Date:** 19.10.2016
**Change No.:** 12
**Serial Number:** 1077668

---

**Table: Changed Dates and Serial Numbers**

<table>
<thead>
<tr>
<th>DATE</th>
<th>NAME</th>
<th>DOCUMENT NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>19.10.2016</td>
<td>CTEPRAKTK2</td>
<td>SED 51658/49 001 00</td>
</tr>
<tr>
<td>19.10.2016</td>
<td>HILTMR</td>
<td>CHANGE NO. 1076668</td>
</tr>
<tr>
<td>19.10.2016</td>
<td>PROGASTCHUK</td>
<td>12</td>
</tr>
</tbody>
</table>

---

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TECHNICAL DATA

HOUSING: OUTDOOR DESIGN, POWDER COATED RAL 9006 WHITE ALUMINIUM (C5)

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 M20x1.5 (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(2)
2ND PT100: 2-WIRE SYSTEM 1x YELLOW(3), 1x BLACK(4)

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

SCALE 1:1 (1:2)

MEMBRANE VENT

ASSEMBLY INTERFACE

FREELY ROTATABLE

M6 / WRENCH 10

MA = 7.5 Nm

100 H8

45° Ø 36,5

> 75,5

Class B

PT100

PT100

1 2 3 4

1 2 3 4

1ST PT100 2-WIRE SYSTEM 1x RED(1), 1x WHITE(2)
2ND PT100 2-WIRE SYSTEM 1x YELLOW(3), 1x BLACK(4)

© MASCHINENFABRIK REINHAUSEN GMBH 2018
8.2 On-load tap-changer head
Der Drehsinr wird bei Bestellung festgelegt. / THE DIRECTION OF ROTATION IS DEFINED DURING ORDERING.
PIPE CONNECTION WITH TAP-CHANGE SUPERVISORY CONTROL BUSHING WITHOUT OIL FILTER UNIT

NOTICE!
The vent screw (2) of the mounted housing (1) has to be on the top.

ON-LOAD TAP-CHANGER HEAD

A 1:1
REPRESENTED WITHOUT COVER

M20x15
CLAMPING RANGE FOR CONNECTION CABLE:
EXTERNAL DIAMETER: 7 - 13 mm

RATED CONTINUOUS CURRENT: 2A
RATED VOLTAGE DC/AC (50Hz): 24V ... 250V
DIELECTRIC STRENGTH: 1150V / 50Hz / 1 Min.

DIELECTRIC TEST OF ALL VOLTAGE CARRYING TERMINALS TO GROUND:
2000V AC, 50Hz, TEST-DURATION 1 Min.

CONNECTION TERMINALS FOR TAP-CHANGE SUPERVISORY CONTROL
WIRING SEE CONNECTION DIAGRAM OF THE MOTOR-DRIVE UNIT
FUNCTION DIAGRAM FOR TAP-CHANGE SUPERVISORY CONTROL SEE MOTOR-DRIVE CONNECTION DIAGRAM

ON-LOAD TAP-CHANGER VACUTAP® VM, VR
PIPE CONNECTION WITH TAP-CHANGE SUPERVISORY CONTROL
8.3 Adjustment plans

- **M** = DRIVE SIDE OF THE SELECTOR
- **A** = ON-LOAD TAP-CHANGER TAKE-OFF TERMINAL

DIVERTER SWITCH INSERT

TOP VIEW

1 SECTOR

2 SECTORS

3 SECTORS

SELECTOR COUPLING

GENEVA WHEEL TOP

SELECTOR

SELECTOR PLANE I

SELECTOR PLANE II


ON-LOAD TAP-CHANGER VACUTAP® VR
VR S/M V/I/I - B/C/D/DE - 0 - 10/14/18 PITCH
ADJUSTMENT PLAN
The connection diagram of the on-load tap-changer is binding for the designation and the equipment of the terminals and phases.

- Drive side of the selector (M)
- On-load tap-changer take-off terminal (A)

Diverter switch insert
Top view

1 sector
2 sectors
3 sectors

Selector coupling

Geneva wheel lower

Selector

Selector plane I

Selector plane II

On-load tap-changer VACUTAP® VR
VR S/M 1/II/III - B/C/D/DE - 0 - 12/16 pitch
Adjustment Plan

- Drive side of the selector
- On-load tap-changer take-off terminal

**On-Load Tap-Changer Vacutap® VR**

**Adjustment Plan**

**On-Load Tap-Changer Head**

**Diverter Switch**

**Diverter Switch Insert**

**Selector Coupling**

**Geneva Wheel Lower**

**Selector**

**Selector Plane I**

**Selector Plane II**

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- **M** = DRIVE SIDE OF THE SELECTOR
- **A** = ON-LOAD TAP-CHANGER TAKE-OFF TERMINAL

DIVERTER SWITCH INSERT TOP VIEW

DIVERTER SWITCH

SELECTOR COUPLING

GENEVA WHEEL LOWER

SELECTOR

10 PITCH REPRESENTATION

SELECTOR PLANE I

SELECTOR PLANE II

ON-LOAD TAP-CHANGER VACUTAP® VR
VR S/M I - B/C/D/DE - W
ADJUSTMENT PLAN

- \( M \) = DRIVE SIDE OF THE SELECTOR HEAD
- \( A \) = ON-LOAD TAP-CHANGER TAKE-OFF TERMINAL

DIVERTER SWITCH INSERT TOP VIEW

DIVERTER SWITCH

SELECTOR COUPLING

GENEVA WHEEL LOWER

SELECTOR

10 PITCH REPRESENTATION

SELECTOR PLANE I

SELECTOR PLANE II

ON-LOAD TAP-CHANGER VACUTAP® VR
VR S/M II/III - B/C/D/DE - W
ADJUSTMENT PLAN

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- M = DRIVE SIDE OF THE SELECTOR
- A = ON-LOAD TAP-CHANGER TAKE-OFF TERMINAL

DIVERTER SWITCH INSERT
TOP VIEW

DIVERTER SWITCH

SELECTOR COUPLING

GENEVA WHEEL LOWER

SELECTOR

LOWER SELECTOR PLANE

UPPER SELECTOR PLANE

ON-LOAD TAP-CHANGER VACUTAP® VR
VRS WITH MULTIPLE COARSE CHANGE-OVER SECTOR, 10 PITCH
ADJUSTMENT PLAN / 2-5 COARSE TAP CONNECTIONS

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= DRIVE SIDE OF THE SELECTOR

= ON-LOAD TAP-CHANGER TAKE-OFF TERMINAL

DIVERTER SWITCH INSERT

TOP VIEW

3 SECTORS

1 SECTOR

SELECTOR COUPLING

GENEVA WHEEL LOWER

SELECTOR

LOWER SELECTOR PLANE

UPPER SELECTOR PLANE

ON-LOAD TAP-CHANGER VACUTAP® VR

VRS WITH MULTIPLE COARSE CHANGE-OVER SELECTOR, 12 PITCH

ADJUSTMENT PLAN / 2-5 COARSE TAP CONNECTIONS

\[ M \] = DRIVE SIDE OF THE SELECTOR

\[ A \] = ON-LOAD TAP-CHANGER TAKE-OFF TERMINAL

DIVERTER SWITCH INSERT

TOP VIEW

DIVERTER SWITCH

SELECTOR COUPLING

GENEVA WHEEL LOWER

SELECTOR

LOWER SELECTOR PLANE

UPPER SELECTOR PLANE

ON-LOAD TAP-CHANGER VACUTAP® VR
VRS WITH MULTIPLE COARSE CHANGE-OVER SELECTOR, 14 PITCH
ADJUSTMENT PLAN / 2-5 COARSE TAP CONNECTIONS

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M = DRIVE SIDE OF THE SELECTOR

A = ON-LOAD TAP-CHANGER TAKE-OFF TERMINAL

DIVERTER SWITCH INSERT

TOP VIEW

1 SECTOR

3 SECTORS

SELECTOR COUPLING

GENEVA WHEEL LOWER

SELECTOR

LOWER SELECTOR PLANE

UPPER SELECTOR PLANE

ON-LOAD TAP-CHANGER VACUTAP® VR
VRS WITH MULTIPLE COARSE CHANGE-OVER SELECTOR, 16 PITCH
ADJUSTMENT PLAN / 2-5 COARSE TAP CONNECTIONS

= DRIVE SIDE OF THE SELECTOR

= ON-LOAD TAP-CHANGER TAKE-OFF TERMINAL

DIVERTER SWITCH INSERT
TOP VIEW

1 SECTOR

3 SECTORS

SELECTOR COUPLING

GENEVA WHEEL LOWER

SELECTOR

LOWER SELECTOR PLANE

UPPER SELECTOR PLANE

DE-ENERGIZED TAP-CHANGER VACUTAP® VR
VRS WITH MULTIPLE COARSE CHANGE-OVER SELECTOR, 18 PITCH
ADJUSTMENT PLAN / 2-5 COARSE TAP CONNECTIONS
## Glossary

<table>
<thead>
<tr>
<th><strong>Dielectric strength</strong></th>
<th><strong>IP</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Material-specific property of isolators [kV/2.5 mm]; maximum electrical field strength without a breakdown (arc)</td>
<td>Ingress protection</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>IEC</strong></th>
<th><strong>MR</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>The International Electrotechnical Commission (IEC for short) is involved in the preparation and publication of international standards for electrical, electronic and related technologies.</td>
<td>Maschinenfabrik Reinhausen GmbH</td>
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