De-Energized Tap-Changer
DEETAP® DU

Operating Instructions

6028645/00 EN . High-temperature version
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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:

**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.

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:
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 product is a de-energized tap-changer which is used to set the voltage of oil-immersed transformers. The product 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 product, then the product 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 product only with the transformer specified in the order.
- The serial numbers of de-energized tap-changer and de-energized tap-changer accessories drive, drive shaft, bevel gear, protective relay etc.) must match if de-energized tap-changer and de-energized tap-changer accessories are supplied as a set for one order.
- You will find the standard valid for the product and the year of issue on the nameplate.
- Operate the product in accordance with this technical file, the agreed-upon delivery conditions and the technical data.
- Ensure that all necessary work is performed by qualified personnel only.
- Use the equipment and special tools supplied solely for the intended purpose and in accordance with the specifications of this technical file.

### 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 14].
- 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.

Operation during overload

Operating the de-energized tap-changer with currents of more than twice the rated through-current $I_r$ can lead to personal injuries and damage to the product. The de-energized tap-changer can operate with twice the rated through-current $I_r$.

- Take appropriate measures to prevent currents of more than twice the rated through-current $I_r$.

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

- Never switch the de-energized tap-changer if the transformer is energized.
- Never actuate the drive 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.

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.
2 Safety

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></th>
<th>Protective clothing</th>
<th>Safety shoes</th>
</tr>
</thead>
<tbody>
<tr>
<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>
<td>To protect against falling heavy objects and slipping on slippery surfaces.</td>
<td></td>
</tr>
</tbody>
</table>

**Special personal protective equipment for particular environments**

<table>
<thead>
<tr>
<th></th>
<th>Safety glasses</th>
<th>Visor</th>
<th>Hard hat</th>
</tr>
</thead>
<tbody>
<tr>
<td>To protect the eyes from flying parts and splashing liquids.</td>
<td>To protect the face from flying parts and splashing liquids or other dangerous substances.</td>
<td>To protect from falling and flying parts and materials.</td>
<td></td>
</tr>
</tbody>
</table>
## Hearing protection
To protect from hearing damage.

## Protective gloves
To protect from mechanical, thermal, and electrical hazards.
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:

▪ De-energized tap-changer
▪ Hand wheel or snap-on ring wrench or manual drive with shielding housing or motor-drive unit with shielding housing (depending on the order)
▪ Drive shaft with coupling parts and bevel gear (omitted for model with hand wheel/snap-on ring wrench)
▪ Technical files

Note the following information:

▪ 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

You will find more information in the "Packaging, transport, and storage" chapter.

3.2 De-energized tap-changer

3.2.1 Function description

De-energized tap-changers are used for setting the voltage of oil-immersed transformers. In contrast to on-load tap-changers, the required winding taps must be set with the transformer switched off on the high-voltage and low-voltage side.

The de-energized tap-changer is changed over from one operating position to the next by rotating an insulating drive shaft. The de-energized tap-changer is actuated using the TAPMOTION® DD manual drive, the TAPMOTION® ED motor-drive unit, a hand wheel or an operating wrench.

3.2.2 Design/versions

The DEETAP® DU de-energized tap-changer can be supplied in the following designs:

▪ Linear de-energized tap-changer
▪ Single-bridging de-energized tap-changer
▪ Double-bridging de-energized tap-changer
▪ Series-parallel de-energized tap-changer
• Star-delta de-energized tap-changer
• Buck-and-boost de-energized tap-changer
• De-energized tap-changer for special applications

The de-energized tap-changer is produced following a modular principle where maximum rated through-currents of 200 A, 400 A, 600 A, 800 A, and 1000 A are possible per contact plane.

The de-energized tap-changer can be supplied with a maximum of 5 operating positions.
The design of the de-energized tap-changer and the designation of its main parts are shown in the installation drawings in the appendix.

Figure 1: DEETAP® DU

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Tap-change supervisory device with inspection window for tap position indicator</td>
</tr>
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<td>2</td>
<td>De-energized tap-changer head</td>
</tr>
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<td>3</td>
<td>Upper gear unit</td>
</tr>
<tr>
<td>4</td>
<td>Connection contact</td>
</tr>
<tr>
<td>5</td>
<td>De-energized tap-changer cage</td>
</tr>
</tbody>
</table>
3.2.3 Nameplate

The name plate is on the de-energized tap-changer head.

Position of nameplate

3.2.4 Protective devices

To prevent the equipment from being actuated unintentionally or by unauthorized persons, the de-energized tap-changer and/or drive are provided with the following protective devices:

3.2.4.1 De-energized tap-changer with hand wheel/operating wrench on the de-energized tap-changer head

The device is equipped with the following safety devices.

3.2.4.1.1 Mechanical locking

The de-energized tap-changer can only be operated after removing the padlock. The hand wheel is removable; it can be locked using a padlock.

3.2.4.1.2 Electrical tripping and locking option

Electrically tripping and locking the transformer circuit breakers using the built-in cam switch (see functional principle on the basis of connection diagram 1531579).

The tripping circuit of the transformer circuit breakers is regarded as a closed circuit below. The specified connection diagrams are only examples. The wiring of the tripping and locking device must be laid out in accordance with the binding connection diagram based on the specific order.
Ensure that the transformer is off before a separation of the de-energized tap-changer contacts takes place when activating the hand wheel/operating wrench.

- The tripping and locking device on the de-energized tap-changer head contains two mechanically activated micro-switches S80 and S90.
- S90 is operated after each tap change of the de-energized tap-changer, i.e. it returns to its original position after the de-energized tap-changer has been operated by one tap change.
- The tripping and locking device is designed in accordance with the closed circuit current principle, i.e. a voltage drop will cause a circuit breaker to be tripped. For safety reasons, the monitoring current circuit should therefore be powered by an uninterruptible power supply.
- The transformer circuit breakers must trip automatically if micro-switch S90 of the tripping and locking device opens, i.e. the de-energized tap-changer switching shaft is rotated.
- It must be possible to switch on the transformer circuit breakers only if micro-switch S90 of the tripping and locking device is closed, i.e. the de-energized tap-changer is in a defined operating position.

3.2.4.2 TAPMOTION® DD manual drive

The device is equipped with the following safety devices.

3.2.4.2.1 Mechanical locking

Locking provided via a padlock on the manual drive.

3.2.4.2.2 Tap-change supervisory device

The electrical tap-change supervisory control is installed in a housing on the de-energized tap-changer head (dimensional drawings 725735 [⇒ Section 9.24, Page 72] and 725737, functional principle on the basis of connection diagram 2150823).

The tripping circuit of the transformer circuit breakers is regarded as a closed circuit below. The specified connection diagrams are only examples. The wiring of the tripping and locking device must be laid out in accordance with the binding connection diagram based on the specific order.

The tap-change supervisory control fulfills several functions in connection with the drive:

- Automatically tripping the connected transformer circuit breakers when the de-energized tap-changer is operated.
- Preventing the circuit breaker from being reenergized as long as the de-energized tap-changer or drive are not in a defined operating position.
- Monitoring the drive shaft between the de-energized tap-changer and drive.
When the drive is operated, the disconnection of the transformer must be triggered by the built-in cam switches S80, S90, S48, and S156 before the de-energized tap-changer contacts open. The transformer must be energized only if the de-energized tap-changer and drive are in the same operating position.

With a TAPMOTION® DD manual drive, the cam switch can be connected electrically once the terminal box on the bottom of the drive protective housing has been removed (see TAPMOTION® DD operating instructions).

- The tap-change supervisory control at the de-energized tap-changer head includes two mechanically operated micro-switches, S80 and S90.
- S90 is operated after each tap change of the de-energized tap-changer, i.e. it returns to its original position after the de-energized tap-changer has been operated by one tap change.
- S80 is operated in every operating position, i.e. it changes switching states after the de-energized tap-changer changes from one operating position to the next. It returns to its original position after a second subsequent operating position has been reached.
- The TAPMOTION® DD manual drive contains a micro-switch, S48, which is non-directional and mechanically activated, and a cam-operated directional switch, S156, which is mechanically activated.
- The tap-change supervisory control is designed in accordance with the closed-circuit current principle, i.e. a voltage drop will trip a circuit breaker. For safety reasons, the monitoring current circuit should therefore be powered by an uninterruptible power supply.

The transformer circuit breakers must be tripped automatically if
- Micro-switch S90 of the tap-change supervisory control opens, i.e. the de-energized tap-changer switching shaft is turned.
- Micro-switch S48 of the drive opens, i.e. the drive is operated.
- The position of micro-switch S80 of the tap-change supervisory control does not match the position of micro-switch S156 of the drive, i.e. the drive is operated and the drive shaft between the drive and de-energized tap-changer is uncoupled.

Reclosure of the transformer circuit breakers must be possible only if
- Micro-switch S90 of the tap-change supervisory control is closed, i.e. the de-energized tap-changer is in a defined operating position.
- Micro-switch S48 of the drive is closed, i.e. the drive is in a defined operating position.
- The position of micro-switch S80 of the tap-change supervisory control matches the position of micro-switch S156 of the drive, i.e. de-energized tap-changer and drive are in the same operating position.

3.2.4.3 TAPMOTION® ED motor-drive unit

The device is equipped with the following safety devices.
3.2.4.3.1 Mechanical locking

A mechanical locking device such as a padlock can be used or a cylinder lock can be installed.

3.2.4.3.2 Tap-change supervisory device

The tap-change supervisory control is installed in a housing on the de-energized tap-changer head (dimensional drawings 725735 [►Section 9.24, Page 72] and 725737, functional principle on the basis of connection diagram 1579393).

The tap-change supervisory control fulfills several functions in connection with the drive:

▪ Automatically tripping the connected transformer circuit breakers when the de-energized tap-changer is operated.
▪ Preventing the circuit breaker from being reenergized as long as the de-energized tap-changer or drive are not in a defined operating position.
▪ Monitoring the drive shaft between the de-energized tap-changer and drive.

The tap-change supervisory control at the de-energized tap-changer head includes two mechanically operated micro-switches, S80 and S90.

▪ S90 is operated after each tap change of the de-energized tap-changer, i.e. it returns to its original position after the de-energized tap-changer has been operated by one tap change.
▪ S80 is operated in every operating position, i.e. it changes switching states after the de-energized tap-changer changes from one operating position to the next. It returns to its original position after a second subsequent operating position has been reached.

The following are also provided in the motor-drive unit (functional principle on the basis of connection diagram 1570451, sheet 1 and sheet 2):

▪ 1 mechanical, non-directional cam switch S117 (is activated between the tap-change indicator sections 2-31)
▪ 1 mechanical, cam-operated directional switch S156 (changes the state for each change in position)

The tap-change supervisory control is designed in accordance with the closed-circuit current principle, i.e. a power failure will trip a circuit breaker. For safety reasons, the monitoring current circuit should therefore be powered by an uninterruptible power supply.

The motor-drive unit can thus only be operated electrically if the transformer circuit breaker is switched off.
3 Product description

The motor protective switch in the motor-drive unit interrupts the motor circuit and the control circuit if a change in position is attempted electrically with the circuit breaker engaged.

The circuit breaker for the transformer is tripped if:

- Micro-switch S90 (de-energized tap-changer head) of the tap-change supervisory control opens, i.e. the selector switch shaft of the de-energized tap-changer is turned.
- Non-directional cam-operated contact (motor-drive unit) S117 opens, i.e. the motor-drive unit is not in a defined position.

Switching on the transformer circuit breaker must only be possible if:

- Micro-switch S90 (de-energized tap-changer head) of the tap-change supervisory control is closed, i.e. the de-energized tap-changer is in a defined operating position.
- Non-directional cam-operated contact (motor-drive unit) S117 is closed, i.e. the motor-drive unit is in a defined position.
- Micro-switch S80 (de-energized tap-changer head) of the tap-change supervisory control and directional cam switch S156 match, i.e. de-energized tap-changer and motor-drive unit are in the same operating position.

3.2.5 Safety markings on the product

If the de-energized tap-changer is switched via hand wheel or snap-on ring wrench, the safety markings are located on the head of the de-energized tap-changer. If the de-energized tap-changer is switched using the TAPMOTION® ED motor-drive unit or the TAPMOTION® DD manual drive, the safety markings are located on the drive.

![Figure 2: Safety markings]

1 Safety marking
3.3 Drive shaft

3.3.1 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.
3.3.2 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 3: Components of the drive shaft

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></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>
3.3.2.1 Drive shaft without cardan joint and without insulator

![Diagram of drive shaft without cardan joint and without insulator](image)

Figure 4: 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.</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>
3.3.2.2 Drive shaft without cardan joint and with insulator

![Diagram of drive shaft without cardan joint and with insulator](image)

**Figure 5: 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>

3.3.2.3 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.
3.3.2.4 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.
### 3 Product description

![Drive shaft with cardan joint and with insulator (= special model)](image)

**Figure 7:** 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>
3.3.3 Identification plate

The identification plate is on the telescopic protective tube.

Figure 8: Position of the identification plate
4 Commissioning

**WARNING**

Danger of explosion!

Explosive gases in the transformer, pipe 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.

This chapter describes how to commission the de-energized tap-changer.

4.1 Commissioning transformer at operating site

4.1.1 Checking the drive

**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 drive and de-energized tap-changer are correctly coupled and that the drive is functioning correctly.

**Tests on the drive**

1. **DANGER!** Danger of explosion when tap-change operations are performed under load. Ensure that the transformer is disconnected on the high-voltage and low-voltage sides.
2. Lock transformer to prevent unintentional restart.
3. If the de-energized tap-changer is equipped with a manual drive or motor-drive unit, perform function checks as described in the relevant MR operating instructions for the drive.
4. Starting from the adjustment position, undertake trial tap-change operations across the entire range of settings.
5. **NOTICE!** An incorrectly coupled drive will damage the de-energized tap-changer. If the de-energized tap-changer is equipped with a manual drive or motor-drive unit, ensure that the tap position indicators of drive and de-energized tap-changer match in every operating position.
6. If necessary, repeat the transformer ratio test.

**Dielectric tests on transformer wiring**

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

**4.1.2 Commissioning transformer**

Proceed as follows to commission the transformer:

1. **DANGER!** Ensure that the transformer is switched off on the high-voltage and low-voltage sides. Failure to do so will result in danger of death and damage to property when commissioning the transformer.
2. Connect the drive to the tripping circuit of the transformer's circuit breaker.
3. **DANGER!** Ensure that de-energized tap-changer and drive are in the same operating position. Check that all safety measures are effective. Failure to do so will result in danger of death and damage to property when commissioning the transformer.
4. Commission the transformer.
5 Operation

The following sections describe how to operate the de-energized tap-changer and monitor the de-energized tap-changer and drive.

5.1 Carrying out tap-change operation

**NOTICE**

**Damage to the de-energized tap-changer!**

Performing tap-change operations when the temperature of the insulating fluid is too high can cause damage to the de-energized tap-changer.

- Only perform tap-change operations at insulating fluid temperatures of <105°C

Before you undertake a tap-change operation, you need to switch off and lock the transformer to prevent it switching back on.

Proceed as follows:

1. **DANGER!** Switch off transformer on high and low-voltage side. Failure to do so may result in severe injuries and property damage.
2. Lock transformer to prevent unintentional restart.
3. Make sure everything is de-energized.
4. Visibly connect all transformer terminals to ground (grounding leads, grounding disconnectors) and short circuit them.
5. Cover or cordon off adjacent energized parts.

☞ Once you have switched off and locked the transformer, you can perform tap-change operations.
6 Fault elimination

**WARNING**

Danger of death or severe injury!

Danger of death or severe injury from explosive gases under the de-energized tap-changer head cover!

► Ensure that there are no open flames, hot surfaces or sparks (for example caused by static charging) in the immediate surroundings and that none occur.

► De-energize all auxiliary circuits (such as the tap-change supervisory control) before removing the de-energized tap-changer head cover.

► Do not operate any electrical devices during the work (for example risk of sparks caused by impact wrench).

► Only use conductive and grounded hoses, pipes, and pump equipment that are approved for flammable liquids.

**NOTICE**

Damage to de-energized tap-changer and transformer!

Tripping of a protective device can indicate damage on the de-energized tap-changer and transformer! The transformer must not be energized without being inspected first!

► Check the de-energized tap-changer and transformer when a protective device has been tripped.

► Do not use the equipment again until you are sure there is no damage to the de-energized tap-changer and transformer.

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

In the event of faults on the de-energized tap-changer, and motor-drive unit, which cannot be easily corrected on site, or if a protective device has 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
Germany
Phone: +49 94140 90-0
Fax: +49 9 41 40 90-7001
E-mail: service@reinhausen.com
Internet: www.reinhausen.com

<table>
<thead>
<tr>
<th>Error pattern</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activation of tap-change supervisory device</td>
<td>Contact MR.</td>
</tr>
<tr>
<td>Tripping of motor protective switch 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>De-energized tap-changer not changing tap position (sluggishness, Raise keys/Lower keys not working)</td>
<td>Contact MR.</td>
</tr>
</tbody>
</table>
## 6 Fault elimination

<table>
<thead>
<tr>
<th>Error pattern</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<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 de-energized 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>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>Deviation from desired value during transformer ratio test</td>
<td>Contact manufacturer of transformer and, if necessary, MR and provide measured values.</td>
</tr>
</tbody>
</table>

Table 3: Fault elimination
7 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 de-energized tap-changer when de-energized tap-changer components are energized can lead to death or serious injuries.

- De-energize all auxiliary circuits, such as the tap-change supervisory device.
- Ensure that everything is de-energized.

**Danger of explosion!**

Explosive gases in the transformer, pipe 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.

**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.
7 Maintenance

7.1 Inspection

Monitoring the de-energized tap-changer and drive is limited to occasional visual inspections of the de-energized tap-changer head and drive. 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 drive</td>
</tr>
<tr>
<td>Annually</td>
<td>Sealing points of the de-energized tap-changer head</td>
</tr>
<tr>
<td>Annually</td>
<td>Check correct function of the installed electrical heater in the protective housing of motor-drive unit</td>
</tr>
</tbody>
</table>

Table 4: Inspection plan

7.2 Maintenance intervals

If, after several years of operation in one position, a de-energized tap-changer is to be operated in another position, several tap-change operations must first be performed into the desired position as well as the respective adjacent positions in order to remove potential layers of impurities on the contacts. Experience shows that up to 25 tap-change operations on each contact are necessary for this purpose. We recommend checking the effectiveness of this action using a resistance measurement.

<table>
<thead>
<tr>
<th>Interval</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>After every 20,000 tap-change operations</td>
<td>Replace de-energized 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</td>
<td>Inspect safety devices and drive components. Contact the Maschinenfabrik Reinhausen GmbH Technical Service for this.</td>
</tr>
<tr>
<td>After every 5 years of operation</td>
<td>Inspect the de-energized tap-changer. Contact the Maschinenfabrik Reinhausen GmbH Technical Service for this.</td>
</tr>
</tbody>
</table>

Table 5: Maintenance plan

Recommissioning after maintenance

To recommission the transformer after maintenance, proceed as follows:

1. Ensure that the de-energized tap-changer and drive are correctly centered.

2. **DANGER!** Ensure that the de-energized tap-changer and drive are in the same operating position. Check the correct function of all safety measures. Incorrect functioning poses a danger of death and damage to property when commissioning the transformer.
3. Carry out a transformer ratio test and fill the transformer with oil.
4. Commission the transformer.
8 Technical data

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

8.1 De-energized tap-changer properties

8.1.1 Standard version (contact circle diameter 400 / 600 mm)

### Electrical data

<table>
<thead>
<tr>
<th>Standard designs</th>
<th>DEETAP® DU I/DU III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. rated through-current $I_{\text{um}}$ (A)</td>
<td>200 400 600 800 1000 1222 1202 1622 1602 2022</td>
</tr>
<tr>
<td>Rated short-time current (kA)</td>
<td>4 6 8 10 12 16 20 20 25 25</td>
</tr>
<tr>
<td>Rated duration of short-circuits (s)</td>
<td>3 3 3 3 3 3 3 3 3 3</td>
</tr>
<tr>
<td>Rated peak withstand current (kA)</td>
<td>10 15 20 25 30 40 50 50 63 63</td>
</tr>
<tr>
<td>Basic de-energized tap-changer connections</td>
<td>Linear de-energized tap-changer for neutral application 2)</td>
</tr>
<tr>
<td></td>
<td>Linear de-energized tap-changer for delta connection</td>
</tr>
<tr>
<td></td>
<td>Single-bridging de-energized tap-changer</td>
</tr>
<tr>
<td></td>
<td>Double-bridging de-energized tap-changer</td>
</tr>
<tr>
<td></td>
<td>Series-parallel de-energized tap-changer 3)</td>
</tr>
<tr>
<td></td>
<td>Star-delta de-energized tap-changer</td>
</tr>
<tr>
<td>Rated frequency (in Hz)</td>
<td>50…60</td>
</tr>
</tbody>
</table>

Table 6: Electrical data

1) Max. rated through-currents over 2000 A possible, see special designs [1] Section 8.1.2, Page 40] and page.

2) Single-phase designs for Y applications are declared as D design.

3) The max. rated through-current is based on series connection.

### Mechanical data

<table>
<thead>
<tr>
<th>Number of operating positions</th>
<th>Max. 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>See chapter &quot;Introduction&quot;, section &quot;Variant overview&quot;</td>
</tr>
<tr>
<td>Weight</td>
<td>400 mm contact circle diameter: max. 180 kg 600 mm contact circle diameter: max. 255 kg</td>
</tr>
</tbody>
</table>
8 Technical data

Drive

- Hand wheel or hexagon shaft with operating wrench
- TAPMOTION® DD manual drive
- TAPMOTION® ED motor-drive unit

Safety devices

- Electrical locking with cam switch, operation after about 1/12 of the hand crank rotation
- Contacts: 1 normally closed and 1 normally open contact with shared change-over points
- Switching capacity, 250 V AC, 6 A (resistive load)
- 250 V AC, 2.5 A (cosφ = 0.4)

Table 7: Mechanical data

8.1.2 Special types (400/600 mm contact circle diameter)

### Electrical data

<table>
<thead>
<tr>
<th>Special designs</th>
<th>DEETAP® DU I/DU III</th>
<th>422</th>
<th>822</th>
<th>2003</th>
<th>2403</th>
<th>3033</th>
<th>3204</th>
<th>4044</th>
<th>4005</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of phases</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1/3</td>
<td>1</td>
</tr>
<tr>
<td>Max. rated through-current I_{um} (A)</td>
<td>400</td>
<td>800</td>
<td>2000</td>
<td>2400</td>
<td>3000</td>
<td>3200</td>
<td>4000</td>
<td>4000</td>
<td></td>
</tr>
<tr>
<td>Rated short-time current (kA)</td>
<td>6</td>
<td>10</td>
<td>25</td>
<td>30</td>
<td>30</td>
<td>32</td>
<td>32</td>
<td>40</td>
<td></td>
</tr>
<tr>
<td>Rated duration of short-circuits (s)</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Rated peak withstand current (kA)</td>
<td>15</td>
<td>25</td>
<td>63</td>
<td>75</td>
<td>75</td>
<td>80</td>
<td>80</td>
<td>100</td>
<td></td>
</tr>
<tr>
<td>Basic de-energized tap-changer connections</td>
<td>Linear de-energized tap-changer for neutral application 1)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Linear de-energized tap-changer for delta connection</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
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<tr>
<td></td>
<td>Single-bridging de-energized tap-changer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Double-bridging de-energized tap-changer</td>
<td></td>
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<td></td>
</tr>
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<td></td>
<td>Series-parallel de-energized tap-changer 2)</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Star-delta de-energized tap-changer</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td></td>
<td>Buck-and-boost de-energized tap-changer</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>De-energized tap-changer for special applications</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rated frequency (in Hz)</td>
<td>50…60</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 8: Electrical data

1) Single-phase designs for Y applications are declared as D design.

2) The max. rated through-current is based on series connection.

### Mechanical data

<table>
<thead>
<tr>
<th>Number of operating positions</th>
<th>Max. 5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dimensions</td>
<td>See chapter &quot;Introduction&quot;, section &quot;Variant overview&quot;</td>
</tr>
</tbody>
</table>
## 8 Technical data

### Weight
- 400 mm contact circle diameter: max. 220 kg
- 600 mm contact circle diameter: max. 290 kg

### Drive
- Hand wheel or hexagon shaft with operating wrench
- TAPMOTION® DD manual drive
- TAPMOTION® ED motor-drive unit

### Safety devices
- Electrical locking with cam switch, operation after about 1/12 of the hand crank rotation
- Contacts: 1 normally closed and 1 normally open contact with shared change-over points
- Switching capacity AC, 250 V, 8 A

Table 9: Mechanical data

### 8.2 Permissible ambient conditions

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</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 operation</td>
<td><strong>Normal temperature range</strong></td>
</tr>
<tr>
<td></td>
<td>-15...+105°C: continuous</td>
</tr>
<tr>
<td></td>
<td><strong>Increased temperature range</strong></td>
</tr>
<tr>
<td></td>
<td>105...130°C: max. 8 hours/day, max. 720 hours/year</td>
</tr>
<tr>
<td></td>
<td>130...150°C: max. 8 hours/day, max. 240 hours/year</td>
</tr>
<tr>
<td>Transport temperature, storage temperature</td>
<td>-45...+50°C</td>
</tr>
<tr>
<td>Drying temperatures</td>
<td>See chapter &quot;Mounting&quot;</td>
</tr>
<tr>
<td>Compressive strength</td>
<td>De-energized tap-changer head vacuum-proof and pressure-proof up to 0.5 bar differential pressure continuous</td>
</tr>
<tr>
<td>Insulating fluids</td>
<td>Synthetic ester fluid (IEC 61099): Midel 7131</td>
</tr>
<tr>
<td></td>
<td>Other insulating fluids on request</td>
</tr>
</tbody>
</table>

Table 10: Permissible ambient conditions
9 Drawings
9.1 Dimensional drawing type Y, contact circle diameter 400 mm, Um 36...123 kV (10115469)
9.1 Dimensional drawing type Y, contact circle diameter 400 mm, Um 36...123 kV (10115469)

9.2 Dimensional drawing type Y, contact circle diameter 600 mm, Um 36...123 kV (10115470)
9.1 Dimensional drawing type Y, contact circle diameter 400 mm, Um 36...123 kV
(10115469)
9.3 Dimensional drawing type D, contact circle diameter 400 mm, Um 36...72.5 kV (10115471)
9.1 Dimensional drawing type Y, contact circle diameter 400 mm, Um 36...123 kV (10115469)

9.4 Dimensional drawing type D, contact circle diameter 600 mm, Um 36...72.5 kV (10115472)
9.1 Dimensional drawing type Y, contact circle diameter 400 mm, $Um = 36...123 \text{kV}$

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4 SERVICE POSITIONS

3 SERVICE POSITIONS

2 SERVICE POSITIONS

M - DRIVE SIDE
9.5 Dimensional drawing type ME, contact circle diameter 400 mm, Um 36...123 kV (10115473)

- **Weight**: Max. approx. 125 kg
- **Dimension drawing valid for DET in high temperature design in model 7131**
- **For corresponding drawing refer to 1015057**
- **The connection diagram applicable to the order is binding for the designation of the terminals and phases.**
- **Design for bell-type tank mounting 725975 - available on request.**

**CAUTION**: After the de-energized tap-changer has been put into service, it must be operated only when the transformer has been disconnected on the high-voltage and on the low-voltage side. The safety measures must be strictly observed. Disregarding these warnings may result in severe damage to the de-energized tap-changer and the transformer.
9.1 Dimensional drawing type Y, contact circle diameter 400 mm, Um 36...123 kV (10115469)

9.6 Dimensional drawing type ME, contact circle diameter 600 mm, Um 36...123 kV (10115474)
9.1 Dimensional drawing type Y, contact circle diameter 400 mm, Um 36...123 kV (10115469)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

15 - MOUNTING FLANGE OF TRANSFORMER COVER
16 - FIXING SCREW M 12
17 - TRANSFORMER COVER
21 - OFF-CIRCUIT TAP-CHANGER HEAD WITH GEAR UNIT
22 - BLEEDING FACILITY FOR OFF-CIRCUIT TAP-CHANGER HEAD
23 - POSITION INDICATOR
24 - MONITORING CONTACT
25 - LIFTING LUGS
26 - EARTH CONNECTION M 10
27 - UPPER GEAR UNIT WITH DRIVE SHAFT
31 - GENEVA WHEEL CRANK
32 - OFF-CIRCUIT TAP-CHANGER HEAD WITH HAND WHEEL OR HEXAGON
33 - PADLOCK
34 - HAND WHEEL
35 - HEXAGON, SPANNER WIDTH 46
40 - INSULATING BAR CAGE
41 - TERMINAL CONTACTS OR CONNECTING CONTACTS
42 - BOTTOM IS COMPOSED OF INSULATING PARTS
M = DRIVE SIDE
▼ = MARKING TRIANGLES STAMPED
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.8 Installation drawing for cover mounting, contact circle diameter 600 mm (725873)

- MOUNTING FLANGE OF TRANSFORMER COVER
- FIXING SCREW M 12
- TRANSFORMER COVER
- OFF-CIRCUIT TAP-CHANGER HEAD WITH GEAR UNIT
- BLEEDING FACILITY FOR OFF-CIRCUIT TAP-CHANGER HEAD
- POSITION INDICATOR
- MONITORING CONTACT
- LIFTING LUGS
- EARTH CONNECTION M 10
- UPPER GEAR UNIT WITH DRIVE SHAFT (E)
- GENEA WHEEL CRANK
- OFF-CIRCUIT TAP-CHANGER HEAD WITH HAND WHEEL OR HEXAGON
- PAULock
- HAND WHEEL
- HEXAGON, SPANNER WIDTH 46
- INSULATING BAR CAGE
- TERMINAL CONTACTS OR CONNECTING CONTACTS
- BOTTOM IS COMPOSED OF INSULATING PARTS
- DRIVE SIDE
- MARKING TRIANGLES STAMPED
9.9 De-energized tap-changer head for bell-type tank, 400 mm contact circle diameter (725975)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.10 De-energized tap-changer head for bell-type tank, 600 mm contact circle diameter (725976)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.11 Lifting traverse (72673703)
9.12 Tap-change supervisory device (10115084)
9.13 Mounting flange for de-energized tap-changer head, 400 mm contact circle diameter (742006)
9.14 Customer-manufactured mounting flange for de-energized tap-changer head, 400 mm contact circle diameter (742008)
9.15 Mounting flange for de-energized tap-changer head, 600 mm contact circle diameter (742016)
9.16 Customer-manufactured mounting flange for de-energized tap-changer head, 600 mm contact circle diameter (742013)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.17 Tracing template for de-energized tap-changer head, 400 mm contact circle diameter (742018)
9.18 Tracing template for de-energized tap-changer head, 600 mm contact circle diameter (742019)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.19 Additional drawings for bottom cage ring (725935)

FIXING OF THE DEETAP® DU ON THE BOTTOM CAGE RING

CONTACT CIRCLE 400 MM

APPLICATIONS WITH UM < 245KV AND >= 245KV WITHOUT OPTIONAL BOTTOM SCREENING RING 735496:

APPLICATIONS WITH UM >= 245KV WITH OPTIONAL BOTTOM SCREENING RING 735494:

CONTACT CIRCLE 600 MM

APPLICATIONS WITH UM < 245KV 735497:

APPLICATIONS WITH UM >= 245KV 735486:
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

CONTACT CIRCLE 850 MM

APPLICATIONS WITH UM = 72,5KV 736442.

APPLICATIONS WITH UM = 170KV 736602.

APPLICATIONS WITH UM >= 245KV 736603.
9.20 Fixture for de-energized tap-changer on lower cage ring (application-specific), 400 mm contact circle, Um ≤ 145 kV (735496)

- **CAUTION:**
  - The transformer manufacturer must fix the de-energized tap-changer by means of an insulating support and provide the de-energized tap-changer with centering and torsional protection. Whereby a thermal length L = ± 6 mm must be observed. Only necessary for especially long de-energized tap-changers according to the instructions on the dimension drawing.

- **Support tightened to transformer core and coils. Insulation to match applicable operating and test voltages.**

- **View Z:**
  - Bottom cage rings
  - The holes on diameter 380 mm can also be used to fix the coils.

- **- Drive Side**
9.21  Fixture for de-energized tap-changer on lower cage ring (application-specific), 400 mm contact circle, Um ≥ 245 kV (735494)

- **CAUTION**: The transformer manufacturer must fix the de-energized tap-changer by means of an insulating support and provide the de-energized tap-changer with centering and torsional protection, whereby a thermal length L = πd / 6 mm must be observed. Only necessary for especially long de-energized tap-changers according to the instructions on the dimension drawing.

- **Support Fastened to Transformer Core and Coils Insulation to Match Applicable Operating and Test Voltages**.

- **View Z Bottom Cage Ring**:
  - The holes on diameter 300 mm can also be used to fix the DEETAP®.

- **Dimension Drawing of Individual Order**:
  - A-A
  - X
  - Z
  - Ø 51
  - 65
  - 85
  - 35
  - 15

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9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

SUGGESTION FOR ADDITIONAL FIXING

FOR APPLICATIONS 245 kV / 300 kV
X = 90 mm

FOR APPLICATIONS Un \( \geq \) 362 kV
X = 130 mm

SUPPORT FASTENED TO TRANSFORMER CORE AND COILS. INSULATION TO MATCH
APPLICABLE OPERATING AND TEST VOLTAGES.
9.22 Fixture for de-energized tap-changer on lower cage ring (application-specific), 600 mm contact circle, Um ≤ 145 kV
(735497)

CAUTION
THE TRANSFORMER MANUFACTURER MUST FIX THE DE-ENERGIZED TAP-CHANGER BY MEANS OF AN INSULATING SUPPORT AND PROVIDE THE DE-ENERGIZED TAP-CHANGER WITH CENTERING AND TORSIONAL PROTECTION, WHEREBY A THERMAL LENGTH L = ± 6 mm MUST BE OBSERVED. ONLY NECESSARY FOR ESPECIALLY LONG DE-ENERGIZED TAP-CHANGERS ACCORDING TO THE INSTRUCTIONS ON THE DIMENSION DRAWING.

DE-ENERGIZED TAP-CHANGER MANUFACTURED ACCORDING TO DIMENSION DRAWING OF INDIVIDUAL ORDER
SUPPORT FASTENED TO TRANSFORMER CORE AND COILS, INSULATION TO MATCH APPLICABLE OPERATING AND TEST VOLTAGES.

BOTTOM IS COMPOSED OF INSULATING PARTS

VIEW Z
BOTTOM CAGE RING

- DRIVE SIDE
9.23 Fixture for de-energized tap-changer on lower cage ring (application-specific), 600 mm contact circle, Um ≥ 245 kV (735486)

**CAUTION**

THE TRANSFORMER MANUFACTURER MUST FIX THE DE-ENERGIZED TAP-CHANGER BY MEANS OF AN INSULATING SUPPORT AND PROVIDE THE DE-ENERGIZED TAP-CHANGER WITH CENTERING AND TORSIONAL PROTECTION, WHEREBY A THERMAL LENGTH L = +/- 6 MM MUST BE OBSERVED ONLY NECESSARY FOR ESPECIALLY LONG DE-ENERGIZED TAP-CHANGERS ACCORDING TO THE INSTRUCTIONS ON THE DIMENSION DRAWING.

**DE-ENERGIZED TAP-CHANGER MANUFACTURED ACCORDING TO DIMENSION DRAWING OF INDIVIDUAL ORDER**

**SUPPORT FASTENED TO TRANSFORMER CORE AND COILS, INSULATION TO MATCH APPLICABLE OPERATING AND TEST VOLTAGES.**

BOTTOM IS COMPOSED OF INSULATING PARTS

**VIEW Z BOTTOM CAGE RING**

**D - DRIVE SIDE**
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)
9.24 De-energized tap-changer head, 400 mm contact circle diameter (725735)
9.25 De-energized tap-changer head, 600 mm contact circle diameter (725737)
9.26 De-energized tap-changer head with hand wheel, 400 mm contact circle diameter (725378)
9.27  De-energized tap-changer head with hand wheel, 600 mm contact circle diameter (725739)
9.28 De-energized tap-changer head with hexagon, 400 mm contact circle diameter (725740)

- Hexagon for LVS 440
- For corresponding slip-on ring wrench refer to 897951

- Lifting lug (3x)
- Width of gasket (O-ring included in delivery)

- Monitoring contact
- Position indicator
- Earth connection M10

- Nameplate
- Bleeding facility

- Drive side (M)
9.29 De-energized tap-changer head with hexagon, 600 mm contact circle diameter (725741)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.30 Take-off-terminal, 400/600 mm contact circle (725728)
9.31 Bridges for parallel connection (726215)

<table>
<thead>
<tr>
<th>MAXIMUM DIAMETER:</th>
<th>MAX. Ø</th>
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<tbody>
<tr>
<td>CONTACT CIRCLE PITCH</td>
<td>DIMENSION IN MM</td>
</tr>
<tr>
<td>06</td>
<td>435</td>
</tr>
<tr>
<td>12</td>
<td>635</td>
</tr>
<tr>
<td>18</td>
<td>885</td>
</tr>
</tbody>
</table>

All offered connecting points must be used!
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.32 Manual drive TAPMOTION® DD, standard design (736530)
9.33 Snap-on ring wrench with plug-on tube for de-energized tap-changer-head with hexagon (897851)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.34 Horizontal drive shaft (limit dimensions, 725889)

**NOTE!**

H1 – H4 are minimal distances for designing the drive shaft arrangement. The dimensions of the DEETAP® DU, which are necessary for designing the transformer tank, have to be taken from the dimension drawing or additional drawings (725723). The insulating distance between the contacts has to be taken into account.

<table>
<thead>
<tr>
<th>CONTACT CIRCLE</th>
<th>H1</th>
<th>H2</th>
<th>H3</th>
<th>H4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ø 400</td>
<td>400</td>
<td>380</td>
<td>400</td>
<td>700</td>
</tr>
<tr>
<td>Ø 600</td>
<td>630</td>
<td>610</td>
<td>460</td>
<td>500</td>
</tr>
<tr>
<td>Ø 850</td>
<td>710</td>
<td>460</td>
<td>500</td>
<td>850</td>
</tr>
</tbody>
</table>

Intermediate bearing for H1 – H4 = 2254 mm.
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

UPPER GEAR UNIT
DRIVE SHAFT LEFT

POSITION-INDICATION DISK
NOT COVERED BY DRIVE-SHAFT!

SWIVEL RANGE 310°
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.35 TAPMOTION® DD manual drive, vertical drive shaft, limit dimensions (10115056)

1. UNIT WITHOUT CARBON SHAFT, WITHOUT INSULATOR (STANDARD MODEL)

<table>
<thead>
<tr>
<th>MANUAL DRIVE</th>
<th>V 1 mm.</th>
<th>INTERMEDIATE BEARING NECESSARY IF</th>
<th>SUPPORTING BEARING NECESSARY IF</th>
<th>V 1 + 2672</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB</td>
<td>536</td>
<td>V 1 + 5832</td>
<td>V 1 + 4032</td>
<td>V 1 + 2672</td>
</tr>
</tbody>
</table>

2. UNIT WITHOUT CARBON SHAFT, WITH INSULATOR (SPECIAL DESIGN)

<table>
<thead>
<tr>
<th>MANUAL DRIVE</th>
<th>V 1 mm.</th>
<th>INTERMEDIATE BEARING NECESSARY IF</th>
<th>SUPPORTING BEARING NECESSARY IF</th>
<th>V 1 + 2672</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB</td>
<td>706</td>
<td>V 1 + 5202</td>
<td>V 1 + 4202</td>
<td>V 1 + 2672</td>
</tr>
</tbody>
</table>

3. UNIT WITH CARBON SHAFT, WITHOUT INSULATOR (SPECIAL DESIGN)

<table>
<thead>
<tr>
<th>MANUAL DRIVE</th>
<th>V 1 mm.</th>
<th>INTERMEDIATE BEARING NECESSARY IF</th>
<th>V 1 + 2664</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB</td>
<td>779</td>
<td>V 1 + 3074</td>
<td>V 1 + 2664</td>
</tr>
</tbody>
</table>

4. UNIT WITH CARBON SHAFT, WITH INSULATOR (SPECIAL DESIGN)

<table>
<thead>
<tr>
<th>MANUAL DRIVE</th>
<th>V 1 mm.</th>
<th>INTERMEDIATE BEARING NECESSARY IF</th>
<th>V 1 + 2772</th>
</tr>
</thead>
<tbody>
<tr>
<td>DB</td>
<td>979</td>
<td>V 1 + 3242</td>
<td>V 1 + 2772</td>
</tr>
</tbody>
</table>
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.36 Hand wheel drive/hexagon, tripping/locking circuit, connection diagram (1531579)

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**ATTENTION!!**

THE OFF-CIRCUIT TAP CHANGER MUST ONLY BE OPERATED WHEN THE TRANSFORMER HAS BEEN DISCONNECTED ON BOTH THE HIGH-VOLTAGE AND THE LOW-VOLTAGE SIDE. THE TRANSFORMER MUST ONLY BE RECONNECTED, WHEN OFF-CIRCUIT TAP CHANGER AND MOTOR DRIVE ARE IN THE SAME OPERATING POSITION. PLEASE NOTE THAT ONLY THE SUPERVISORY CONTROL CIRCUIT MUST BE USED FOR THE TRIPPING OF THE TRANSFORMER,

IN CASE THE OFF-CIRCUIT TAP CHANGER IS IN AN UNDEFINED POSITION, THE USE OF ANY OTHER CONTACTS OF THE MOTOR DRIVE UNIT INSTEAD OF THE SUPERVISORY CONTROL CIRCUIT MAY LEAD TO A SEVERE DAMAGE OF OFF-CIRCUIT TAP CHANGER AND TRANSFORMER AND DANGER TO LIFE AND HEALTH!
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.37 Manual drive TAPMOTION® DD, connection diagram (2150823)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)

9.38 Motor-drive unit ED-S, connection diagram (1579393)
9.7 Installation drawing for cover mounting, contact circle diameter 400 mm (725872)
## 9.39 Additional drawings (10115057)

<table>
<thead>
<tr>
<th>INSTALLATION DRAWINGS:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>INSTALLATION DRAWING - HEAD 400</td>
<td>725872:</td>
</tr>
<tr>
<td>INSTALLATION DRAWING - HEAD 600</td>
<td>725873:</td>
</tr>
<tr>
<td>DE-ENERGIZED TAP-CHANGER HEAD - HEAD 400</td>
<td>725735:</td>
</tr>
<tr>
<td>DE-ENERGIZED TAP-CHANGER HEAD - HEAD 600</td>
<td>725737:</td>
</tr>
<tr>
<td>DE-ENERGIZED TAP-CHANGER HEAD WITH HAND WHEEL - HEAD 400</td>
<td>725738:</td>
</tr>
<tr>
<td>DE-ENERGIZED TAP-CHANGER HEAD WITH HAND WHEEL - HEAD 600</td>
<td>725739:</td>
</tr>
<tr>
<td>DE-ENERGIZED TAP-CHANGER HEAD WITH HEXAGON - HEAD 400</td>
<td>725740:</td>
</tr>
<tr>
<td>DE-ENERGIZED TAP-CHANGER HEAD WITH HEXAGON - HEAD 600</td>
<td>725741:</td>
</tr>
<tr>
<td>SLIP-ON RING WRENCH WITH EXTENSION TUBE FOR OFF-CIRCUIT TAP-CHANGER HEAD WITH HEXAGON</td>
<td>897851:</td>
</tr>
<tr>
<td>DE-ENERGIZED TAP-CHANGER FOR BELL-TYPE TANK:</td>
<td></td>
</tr>
<tr>
<td>CONTACT CIRCLE - HEAD 400</td>
<td>725975:</td>
</tr>
<tr>
<td>CONTACT CIRCLE - HEAD 600</td>
<td>725976:</td>
</tr>
<tr>
<td>TERMINALS 1000A CONTACT CIRCLE 400 / 600</td>
<td>725730:</td>
</tr>
<tr>
<td>OUTPUT TERMINALS 1000A / 6-PITCH, 12-PITCH</td>
<td>725728:</td>
</tr>
<tr>
<td>HORIZONTAL DRIVE SHAFT</td>
<td>725889:</td>
</tr>
<tr>
<td>ADDITIONAL ATTACHMENT FOR CONTACT CIRCLE 400</td>
<td>735496:</td>
</tr>
<tr>
<td>ADDITIONAL ATTACHMENT FOR CONTACT CIRCLE 600</td>
<td>735497:</td>
</tr>
<tr>
<td>VERTICAL DRIVE SHAFT TAPMOTION® DD</td>
<td>10115056:</td>
</tr>
<tr>
<td>HANDWHEEL / HEXAGON SHAFT, TRIPPING-/INTERLOCKING CIRCUIT CONNECTION DIAGRAM</td>
<td>1531579:</td>
</tr>
<tr>
<td>MANUAL DRIVE TAPMOTION® DD WITH SUPERVISORY CONTROL CONNECTION DIAGRAM</td>
<td>2150823:</td>
</tr>
</tbody>
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9.40 Bevel gear CD 6400, dimensional drawing (892916)

Der Drehrichtung wird bei Bestellung festgelegt. / THE DIRECTION OF ROTATION IS DEFINED DURING ORDERING.