NOTE!

The product may have been modified after this document went to press. We expressly reserve the right to make changes to the technical data, the design or the scope of delivery.

In general, the information provided and the arrangements agreed during processing of the relevant offers and orders are binding.
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1 Safety

1.1 Safety labels

The following safety labels relating to the operation of the OILTAP® M are used in these Operating Instructions. These instructions must always be followed!

<table>
<thead>
<tr>
<th>DANGER!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refers to an imminent danger that will result in death or severe injury if not avoided.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refers to a potentially dangerous situation that may result in slight injury or material damage if not avoided.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>ATTENTION!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Refers to a potentially harmful situation that may result in damage of the product itself or of adjacent objects if not avoided.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contains important information and special notes.</td>
</tr>
</tbody>
</table>

Special safety labels are used for certain hazards, such as electric shock:

<table>
<thead>
<tr>
<th>DANGER!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of electric shock!</td>
</tr>
<tr>
<td>Refers to an imminent danger through electricity that will result in death or severe injury if not avoided.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>CAUTION!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Risk of electric shock!</td>
</tr>
<tr>
<td>Danger of tipping!</td>
</tr>
<tr>
<td>Fire hazard!</td>
</tr>
</tbody>
</table>

1.2 Safety instructions

- All warnings and safety instructions must be observed at all times!
  Failure to follow the safety instructions may lead to accidents and severe personal injury for you or your colleagues.

- Please read these operating instructions before commissioning the equipment!
  Please read these instructions before switching on the OILTAP® M. As the operator, you are responsible for ensuring that users of the device have fully understood the operating and safety instructions.

- Train your staff!
  Before asking staff to work with the OILTAP® M provide training regarding general and special safety instructions and accident prevention regulations.

- Only suitably qualified personnel should work with the OILTAP® M.
  The OILTAP® M is designed exclusively for application in electrical or energy systems and facilities operated by appropriately trained staff, i.e. staff who are familiar with the installation, assembly, commissioning and operation of such products.
1.3 Specified application

**ATTENTION!**

The function of the drive, the on-load tap-changer and the transformer may be put at risk!

Only use the on-load tap-changer with the transformer specified in the order.

Installation, electrical connection and commissioning of the on-load tap changer may only be carried out by qualified, skilled personnel and only in accordance with these operating instructions.

It is the responsibility of the operator to make sure that the tap changer is used for the specified application only.

For safety reasons, any unauthorized work such as installation, alteration, electrical connection, commissioning or modification to the on-load tap-changer equipment is forbidden without first consulting MR!

The trouble-free operation of the drive, the on-load tap-changer and the transformer may be put at risk.

**DANGER!**

Fire hazard!

All relevant fire protection regulations must be strictly observed.

---

**DANGER!**

Fire hazard!

The switching oil of the on-load tap-changer should always be treated as an inflammable liquid.

During operation, potentially explosive switching gases may accumulate under the on-load tap-changer cover, in the piping, in the oil conservator or at the dehydrating breather opening. Please ensure that there are no open fires, hot surfaces or sparks (e.g. through static charging) in the direct vicinity.

Possible sources of ignition at the on-load tap-changer:

Caution during draining of the diverter switch oil compartment and oil conservator:

Use only conductive, grounded hoses, tubes and pumping equipment suitable for flammable liquids, in order to prevent ignition the switching gases.

Caution when removing the on-load tap-changer cover:

Before starting work on the on-load tap-changer cover, all auxiliary circuits must be de-energized (e.g. tap-change supervisory control, pressure relief valve, pressure monitoring device).

No electrical devices may be used for the work (e.g. impact wrench – spark formation).

Open the stop valve between the oil conservator and the diverter switch oil compartment, then open the bleeder valve in the on-load tap-changer cover. Vent the switching gas from the space below the on-load tap-changer cover. Ensure adequate ventilation (e.g. in transformer cells and work tents). Once the switching gas has been vented and oil starts to enter through the bleeder valve, close the bleeder valve and then the stop valve between the oil conservator and the diverter switch oil compartment. Now open the bleeder valve again open and drain approx. 5-10 l of oil via the drain pipe (until the area below the on-load tap-changer cover is oil-free).

The on-load tap-changer cover must be removed, if oil is to be drained from the oil conservator via the diverter switch oil compartment. Wait approx. 15 min in order to allow the switching gases to dissipate.

Caution when working on the dehydrating breather:

When removing the dehydrating breather, ensure that no explosive gases are present in the dehydrating breather and the piping.

During normal operation small quantities of explosive gases may escape from the dehydrating breather.
2 Design/Types

The on-load tap-changer consists of the diverter switch with the tap selector attached underneath (Figure 1).

The diverter switch insert is installed in the oil compartment. The on-load tap-changer is attached to the transformer cover by means of the on-load tap-changer head.

If required, the tap selector is equipped with a change-over selector. On-load tap changer models without change-over selector are available up to a maximum of 22 operating positions. Models with change-over selector can have up to 35 operating positions, and models with multiple coarse tap selector up to 107 operating positions.

The design of the on-load tap-changer and the designation of its main parts are shown in the installation drawings 893978BE and 894205DE (see section 16).

These operating instructions apply to all standard models of the on-load tap-changer variants specified below, which are available with and without change-over selector.

Three-phase on-load tap-changers:
M III 350 Y, M III 500 Y, M III 600 Y,
M III 350 D, M III 600 D

On-load tap-changer combination (special design for delta connection):
M III 350 K, consisting of M I 351 and M II 352
M III 500 K, consisting of M I 501 and M II 502
M III 600 K, consisting of M I 601 and M II 602

Single-phase on-load tap-changer:
M I 351, M I 501, M I 601, M I 802, M I 1203, M I 1503

All single-phase on-load tap-changers are also available as a on-load tap-changer group 3 x M I ... with a common motor-drive unit. On-load tap-changers M III 350 D / M III 600 D and on-load tap-changer combination M III K, consisting of M I .../ M II ..., have a two-column construction and are also driven by a common motor-drive unit.

---

**ATTENTION!**

Damage to the on-load tap-changer!

For the on-load tap-changer MIII 350D / MIII 600D the components must be installed in the following sequence:
motor drive unit – column B – column A (see also installation drawing 894205DD).

---

Operating Instructions BA 037/06 EN OILTAP® M

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037/06 EN
Maschinenfabrik Reinhausen GmbH 2010
3 Shipment

On-load tap-changers and motor-drive unit are shipped in the adjustment position. The on-load tap-changer is packed in two parts - diverter switch and tap selector - and is well protected against moisture. Both parts are locked in the adjustment position.

The on-load tap-changer equipment is shipped as follows:

- Diverter switch oil compartment with on-load tap-changer head and built-in diverter switch insert (max. weight approx. 160 kg, Figure 2)
- Tap selector (max. weight approx. 165 kg), Figure 2, or multiple coarse tap selector, max. weight approx. 240 kg,
- Motor-drive unit TAPMOTION® ED 100/200 S (approx. 80 kg), or Motor-drive unit TAPMOTION® ED 100/200 L (approx. 130 kg, Figure 3)
- Drive shaft with coupling parts, bevel gear, guard plate, protective tube (max. approx. 20 kg, Figure 4) and protective relay RS 2001 (3.5 kg, Figure 5).

The shipment is to be fully checked for completeness on the basis of the shipping documents. The parts must be stored in a dry place until assembly.

All on-load tap-changer parts must be left wrapped in their airtight protective cover and are to be removed only shortly before installation.

**NOTE**

Drive shafts, bevel gears and protective relays are integral parts of the on-load tap-changer delivery.

**DANGER!**

Danger of tipping! Severe, even lethal bodily injuries!

Be sure to provide safe storage and/or support for all items of equipment while performing works to the on-load tap-changer, motor-drive unit or other components.

Avoid uncontrolled tipping of individual devices.
4 Installation of the on-load tap-changer for cover mounting (Figure 6)

4.1 Mounting flange
A mounting flange is required for mounting the on-load tap-changer head on the transformer cover. This mounting flange is to be designed according to the sealing surface of the on-load tap-changer head (see Figure 7 and section 16, drawing 893978BE_2 and 894205DE).

We recommend using a drilling template (see Figure 8 and section 16, drawing 8901838E) to position the stud bolts (M12, max. length 45 mm). If requested, the drilling template will be supplied with the first installation of an on-load tap-changer free of charge.

![Figure 6 Mounting flange](image)

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The hole markings in the drilling template facilitate alignment of the template with the mounting flange.</td>
</tr>
</tbody>
</table>

![Figure 7 Mounting flange](image)

4.2 On-load tap-changer with change-over selector, attachment of the on-load tap-changer head to the transformer cover
The diverter switch oil compartment is lowered through the cover aperture (= mounting flange) of the transformer and screwed to the mounting flange through the on-load tap-changer head. Then, the tap selector is fastened to the diverter switch oil compartment (see section 4.3).

Proceed as follows:
1) Set down the diverter switch oil compartment.

![DANGER!](image)

2) Clean the sealing surfaces of the mounting flange and on-load tap-changer head.
3) Place an oil-resistant gasket on the mounting flange.
4) Lift the diverter switch oil compartment by hooking up the on-load tap-changer head and carefully lower the oil compartment into the opening of the mounting flange.
5) Pay attention to the screening rings (only for \( U_m \geq 170 \text{ kV} \) and M-delta: \( U_m = 123 \text{ kV} \)).
6) Check the installation position of the on-load tap-changer head.
7) Fasten the on-load tap-changer head to the mounting flange.
4) Place the tap selector on an appropriate lifting device.
5) Raise the tap selector below the diverter switch oil compartment. Take care that the tap selector connecting leads clear the diverter switch oil compartment and remain undamaged.
6) Match the position of the two coupling parts and the attachment points of tap selector suspension and oil compartment bottom. The correct position of the two coupling parts is shown in the adjustment plan.
7) Raise the tap selector to its final height.
8) Fasten the tap selector suspension to the oil compartment bottom using the hexagon socket screws M12/w.s.8 (screw head and spring washer outside, nut inside, max. tightening torque 60 Nm, Figure 11).

9) Connect the tap selector connecting leads to the diverter switch oil compartment:
   - Remove the connecting screws from the connecting bolt. Pay attention to locking washers and screening caps.
   - Clip the tap selector connecting leads to the connecting bolts of the oil compartment (Figure 12). The terminal screening differs depending on the insulation to ground ($U_{m}$).

---

**4.3 Assembly of the diverter switch oil compartment and tap selector**

The tap selector is raised from below to the diverter switch oil compartment and connected to it. Thus the mechanical coupling for the tap selector drive is established.

Proceed as follows:

1) Set down the tap selector.

2) Have the mounting material supplied with tap selector suspension ready (6 hexagon socket screws M12/w.s.8 with spring washers and nuts).

3) Remove the blocking strip from the tap selector coupling (Figure 10).

---

**DANGER!**

Danger of tipping!
Severe, even lethal bodily injuries!
Ensure that the tap selector is positioned securely. Secure the tap selector if necessary.

---

**ATTENTION!**

Risk of incorrect coupling!
The coupling part must not be turned again once the blocking strip has been removed.
4 Installation of the on-load tap-changer for cover mounting (Figure 6)

- Use two leads per diverter switch sector.
  Arrangement from inside to outside: connecting bolt, tap selector connecting lead, locking washer, screening cap, hexagon screw M10, w.s.17, max. tightening torque 30 Nm. The screens enable the screw to be secured. After tightening the screw, bend the locking strip so that it prevents the screw head from moving.

2) Check the installed position of the on-load tap-changer head and of the complete on-load tap-changer.
3) Fasten the on-load tap changer head to the mounting flange.

4.4 On-load tap-changer without change-over selector

In these constructions the fully assembled on-load tap-changer can be lowered from above through the cover aperture of the transformer. The assembly of diverter switch oil compartment and tap selector as well as the connection of tap selector connecting leads have to be carried out according to section 4.3.

1) Lift the assembled on-load tap-changer over the mounting flange of the transformer cover and carefully lower it into the opening of the mounting flange.
Make sure not to damage the tap selector terminals and the screening rings of the diverter switch oil compartment (with \( U_{m} \geq 170 \text{ kV} \) und M-delta: \( U_{m} = 123 \text{ kV} \) only).

ATTENTION!

All connections must be carried out carefully. Use the specified tightening torques. Be sure of totally secure bolt connections and screening of the terminal locations by the screening caps supplied with the equipment.

DANGER!

Danger of tipping!
Severe, even lethal bodily injuries!
Be sure to provide safe storage and/or support for all items of equipment while performing works to the on-load tap-changer, motor-drive unit, or other components!
Avoid uncontrolled tipping of individual devices.
5 Installation of the on-load tap-changer into the bell-type tank (Figure 13)

5.1 Assembly of the diverter switch oil compartment and tap selector, connection of the tap selector connecting leads

Follow the instructions in section 4.3 for assembling the diverter switch oil compartment and the tap selector, and for connecting the tap selector connecting leads.

5.2 Installation of the on-load tap-changer into the supporting structure

1) Lift the assembled tap-changer into the supporting structure.
2) Check the installation position of the on-load tap-changer and fix it securely.

NOTE

The tap changer must be suspended exactly vertically in the supporting structure (max. deviation from vertical: 1°).
The on-load tap-changer must be mounted so that it need not be lifted by more than 5 to 20 mm to reach its final position after the bell-type tank has been positioned.

3) Install spacer blocks between the supporting structure and the supporting flange of the on-load tap-changer in such a way that the on-load tap-changer is in its envisaged final position after the bell-type tank has been positioned. By this measure the leads to be connected to the on-load tap-changer can be correctly dimensioned in length. Remove the spacer blocks after connecting the leads.

Connect the tap winding and the on-load tap-changer take-off leads according to section 6.

ATTENTION!

Damage to the on-load tap-changer and transformer!
Make sure that the connected leads do not exert any force on the on-load tap-changer. In addition, there must be sufficient clearance so that the on-load tap changer can be raised to its final installation position after the bell-type tank is attached.

The drying process and transformer ratio test are to be performed in accordance with sections 7 and 8.

DANGER!

Danger of tipping!
Severe, even lethal bodily injuries!
Be sure to provide safe storage and/or support for all items of equipment while performing works to the on-load tap-changer, motor-drive unit, or other components!
Avoid uncontrolled tipping of individual devices.

To install the on-load tap-changer into a transformer with a bell-type tank the on-load tap-changer has to be mounted onto a supporting structure. For this purpose, the on-load tap-changer is equipped with a supporting flange at the diverter switch oil compartment (=special design, see section 16, drawing 8967629E).

To attach the on-load tap-changer head to the bell-type tank we recommend the use of a mounting flange as described in section 4.1.
5.3 Preparation

Before positioning the bell-type tank, the on-load tap-changer head must be separated from the on-load tap-changer.

1) For this purpose, open the on-load tap-changer cover (24 screws M10, w.s.17, with locking washers).
2) Pay attention to the cover gasket (round rubber gasket, Figure 14).

3) Remove the position indicator dial (pull off the circlip from the shaft end, Figure 15). Take note of the red-marked area which is in the region of the on-load tap-changer head and not covered by the supporting plate of the diverter switch unit (Figure 16).

NOTE

For multiple coarse tap selectors with more than 35 operating positions, the tap position indicator must be removed (see section 5.4). If the on-load tap-changer is equipped with tap-change supervisory control, this must be disconnected (see section 5.5).

4) Remove the fixing nuts of the supporting plate (5 nuts M8, w.s.13, locking washers, Figure 17).
5) Carefully lift the diverter switch insert vertically out of the diverter switch oil compartment (Figure 18).
6) Remove the suction pipe. Pull out the connecting piece in the on-load tap-changer head to the inside (Figure 19). Pay attention to the O-rings of the connecting piece.
5 Installation of the on-load tap-changer into the bell-type tank (Figure 13)

7) Unscrew the remaining screw connections in the on-load tap-changer head (17 nuts M8/w.s.13, locking washers, Figure 20).
8) Lift off the on-load tap-changer head from the supporting flange. Take care not to damage the O-ring gasket.

**ATTENTION!**

Damage to the on-load tap-changer and transformer!
Under all circumstances avoid dropping any parts into the diverter switch oil compartment. Otherwise there is the risk that the diverter switch will be blocked. For this reason, check the quantities of small parts when disassembling and reassembling to ensure they are identical.

5.4 Removing the tap position indicator for multiple coarse tap selectors with more than 35 operating positions

5.4.1 Version with long cover (removal only possible in adjustment position)

![Diagram of adjustment position](Figure 21)

1) Switch the on-load tap changer to the adjustment position.
The markings on the cover and the dial only match in this position.
The adjustment position can be found in the connection diagram for the on-load tap-changer.
The two countersunk head screws (M5x12/w.s.3) are only accessible in the adjustment position.

2) Remove both countersunk head screws (M5x12/w.s.3)

![Diagram of removing the dial](Figure 22)

3) Pull out the dial with the cover disk between the cover and the bracket.
Ensure that the dial is horizontal in order to avoid bending the cover.

4) Remove the two hexagon head screws (M5x12/w.s.8) and the associated lock tab.

![Diagram of removing the cover and the bracket](Figure 23)

5) Pull the cover from the indicator drive shaft with the bracket facing upwards.
### 5.4.2 Version with short cover (removal possible in any position)

1) **Remove the countersunk head screw (M5x12/w.s.3).**
   2) **Now lever the pinned cover disc off the disc below.**
      Use a flat screwdriver.

![Figure 24](image)

**Figure 24** Adjustment position

3) **Pull out the dial with the cover disk between the cover and the bracket.**
   Ensure that the dial is horizontal in order to avoid bending the cover.

4) **Remove the two hex. head screws (M5x12/w.s.8) and the associated lock tab.**

![Figure 25](image)

**Figure 25** Removing the dial

5) **Pull the cover from the indicator drive shaft with the bracket facing upwards.**

![Figure 26](image)

**Figure 26** Removing the cover and the bracket
5.4.3 Installation
Re-install the components in reverse order.

Use the following fastening torques for tightening the screws:
- Countersunk head screws M5x12: 5 Nm, secured with punch mark
- Hexagonal head screws M5x12: 5 Nm, secured with punch mark

Use a hammer and a center punch for the punch mark (see Figure 27).

<table>
<thead>
<tr>
<th>Version</th>
<th>Placing the punch mark</th>
<th>Detail view of punch mark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Long cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Secure both screws with a punch mark</td>
<td>Punch mark</td>
</tr>
<tr>
<td>Short cover</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Punch mark</td>
</tr>
</tbody>
</table>
5.5 Disconnecting the tap-change supervisory control

If the on-load tap-changer is equipped with tap-change supervisory control, the cable from the tap-change supervisory control to the cable gland, which is attached to the piping flange, must be disconnected before removing the diverter switch insert.

The plug connector is protected against contact and polarity reversal.

Proceed as follows (Figure 28):

1) Switch off the supply voltage for the tap-change supervisory control.
2) Lift the plug connector A+B from the bracket (2).
3) Lift the cables on both sides of the plug connector from the brackets (3).
4) Disconnect the plug connector A+B.
   Re-insert part B in the bracket (2).
5) Move part A of the plug connector in the direction of the arrow and out of the on-load tap-changer, until it is positioned between the pipe connections and the cable can be removed freely from the diverter switch without risk of damage.

Reconnect the cables in reverse order once the diverter switch has been reinserted. Ensure that the plug connector A+B is positioned securely in the bracket (2) and that the cables rest in the brackets on both sides (3).

5.6 Positioning the bell-type tank

1) Clean the sealing surface of the supporting flange before positioning the bell-type tank.
2) Place the gasket on the supporting flange (Figure 29).
3) Remove the spacer blocks (see section 5.2).
4) Lift the bell-type tank over the active part of the transformer and position the bell-type tank.
5) Before mounting the on-load tap-changer head, clean the sealing surfaces (head underside mounting flange).
6) Place an oil-resistant gasket on the mounting flange.
7) Place the on-load tap-changer head on the mounting flange.

Pay attention to the two adjusting bolts (Figure 29) and the marks on the supporting flange and the on-load tap-changer head (Figure 30), which ensure assembly in the correct position. Depending on the specified height, a distance of 5-20 mm must be left between on-load tap-changer head and supporting flange.
Installation of the on-load tap-changer into the bell-type tank (Figure 13)

8) Lift the on-load tap-changer by means of the lifting traverse (see Figure 31 and section 16, drawing 8901800M) until the on-load tap-changer head resting on the mounting flange is raised slightly (approx. 5 mm). The on-load tap-changer head can now be screwed to the supporting flange below.

9) Fasten the on-load tap-changer head by screwing the nuts to all studs in the red-marked region not covered by the diverter switch insert supporting plate (Figure 32, see also section 5.3).

Use 17 nuts (M8/w.s.13), max. tightening torque 20 Nm, secured by locking washers.

10) Fasten the tap changer head to the mounting flange.

11) Remount the suction pipe. Make sure that the O-rings are correctly seated.

12) Lightly grease the O-rings before installing them.

13) Reinsert the diverter switch insert. Make sure that the supporting plate is in its proper position within the on-load tap-changer head (the red marked areas must be left free).

14) Attach the supporting plate: 5 nuts (M8/w.s.13), max. tightening torque 20 Nm, secured by locking washers.

15) Attach the position indicator dial by pushing the circlip onto the shaft end. The coupling pin ensures that the position indicator dial is mounted in the correct position (Figure 33).

16) Close the on-load tap-changer head with the cover. Pay attention to the O-ring gasket in the cover.

17) Fasten the on-load tap-changer cover uniformly using 24 screws (M10, w.s.17), max. tightening torque 34 Nm, Figure 34).
6 Connecting the tap winding and the on-load tap-changer connecting lead

Follow the connection diagram supplied with the on-load tap-changer for connecting the tap winding and the on-load tap-changer take-off lead.

### ATTENTION!

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

Be sure to carefully prepare and secure all connections.

Use the specified tightening torques.

The tap selector take-off leads must be assembled in such a way as to allow all leads to be connected to the tap selector without tension. If necessary, the connection ends of the tap selector take-off leads must be shaped to form an expansion loops.

---

### 6.1 Connection of the tap selector take-off leads

The tap selector terminals are indicated on the tap selector bars.

The crimped ends of the tap selector terminals are provided with a through-hole for M10 screws to allow the tap selector take-off leads to be connected by means of cable shoes (see **Figure 35**).

If required, the tap selector sizes B and C can be supplied with screening caps that can also serve as protection for the M10 screws (**Figure 36**). For the tap selector sizes D and DE screening caps are provided as standard and must be fitted. In this case a locking washer must be placed below each screening cap. The M10 connecting screws and locking washers are not part of the scope of delivery.

The through-holes of the terminals for the three-phase and single-phase on-load tap-changers with two tap selector planes are positioned vertically as standard. For ease of bridging, the through-holes of on-load tap-changers M I 802, M I 1203 and M I 1503 are arranged horizontally at the tap selector (see section 16, drawing 8904778E).
6 Connecting the tap winding and the on-load tap-changer connecting lead

6.1.1 Reversing change-over selector terminals
The (+) and (-) terminals of the reversing change-over selector are shaped in the form of lugs with a through-hole for M10 screws. Reversing change-over selector terminal K is an extended tap selector terminal (also with through-hole for M10 screws, Figure 37).

![Reversing change-over selector](image)

ATTENTION!
Impairment of the reversing change-over selector function!
Reversing change-over selector terminal K must on no account be bent or distorted as this could impair the function of the reversing change-over selector.

6.1.2 Coarse change-over selector terminals
Terminals (+), (-) and (0) of the coarse change-over selector are similar to the tap selector terminals and are attached to the respective laminated paper bars of the coarse change-over selector. Like the tap selector terminals K and n-1, the through-holes for M10 bolts are always arranged vertically (see Figure 38 and section 16, drawing 8904778E).

![Coarse change-over selector](image)

ATTENTION!
Impairment of the change-over selector function!
Tap selector take-off leads in the vicinity of the change-over selector (reversing change-over selector or coarse change-over selector) must be placed so as to allow sufficient clearance to the movable parts of the change-over selector (reversing change-over selector see Figure 39, coarse change-over selector see Figure 40).
6 Connecting the tap winding and the on-load tap-changer connecting lead

6.2 Connection of the on-load tap-changer take-off lead


1) Connect the on-load tap-changer take-off lead with the take-off terminal of the diverter switch oil compartment (through-hole for M10, Figure 41).
2) Secure the screw connection (tightening torque 30 Nm, Figure 42).

On-load tap-changer M I 802, M I 1203, M I 1503

1) Connect the on-load tap-changer take-off lead with the connecting ring (Figure 43) of the diverter switch oil compartment.
2) This connecting ring is provided with three through-holes of 12.5 mm diameter. Secure the screw connection (tightening torque 60 Nm for M12, 30 Nm for M10).

6.2.1 Connection of the tap winding and the tap selector for version with multiple coarse tap selector

In systems with multiple coarse tap selectors it is particularly important to ensure the supply cables for the tap selector and multiple coarse tap selector contacts are installed meticulously. The distances between these cables and the adjacent multiple coarse tap selector terminal contacts should be as large as possible. The tap selector terminals facing the two multiple coarse tap selector columns must be paper-insulated with a minimum thickness of 3 mm in order to provide the required dielectric strength (Figure 44).

Please refer to the specific instructions on the relevant dimension drawing.
7 Transformer ratio test

It is recommended that a transformer ratio test be carried out before the transformer undergoes drying.

To operate the drive shaft of the on-load tap-changer head, a short tube of 25 mm nominal width with a screwed-in coupling bolt of 12 mm diameter together with a hand wheel or a hand crank may be used.

For on-load tap-changers M III 350 D/M III 600 D and on-load tap-changer combinations M I... / M II... both on-load tap-changer heads, and in case of on-load tap-changer group 3 x M I... all on-load tap-changer heads, have to be connected with each other by means of the horizontal part of the drive shaft (see section 10).

When using a TAPMOTION® ED motor-drive unit, 16.5 revolutions of the on-load tap-changer drive shaft are required for one tap-change operation. The diverter switch action can be heard distinctly. When operating the change-over selector a higher torque is required. The end positions, which are indicated in the connection diagram supplied with the delivery, must never be overrun.

Therefore always check the attained operating position through the inspection window in the on-load tap-changer cover (Figure 45). Keep the number of tap-change operations without oil to a minimum (max. 250 tap-change operations). After the transformer ratio test the on-load tap-changer has to be returned to the adjustment position (see the connection diagram delivered with the equipment).

---

**NOTE**

Open the kerosene drain screw, if the transformer is to be vapor-phase dried in its own tank (see section 8.1.2).
8 Drying and oil filling procedure

8.1 Drying procedure

ATTENTION!

Damage to on-load tap-changer accessories!
The following accessories must be removed before the drying procedure and stored outside the autoclave:
- Motor-drive unit
- Protective relay
- Pressure monitoring device
- Pressure relief valve
- Bevel gear
- Temperature sensor
- Oil filter unit

The operating instructions for the respective accessories must also be followed.

As a precondition of MR’s guarantee of the dielectric properties of the on-load tap-changer, a minimum drying process must be carried out according to the following instructions (either 8.1.1 or 8.1.2).

8.1.1 Vacuum-drying

8.1.1.1 Vacuum-drying in the autoclave

Heating:
Heat the on-load tap-changer in air at atmospheric pressure, increasing the temperature by approx. 10 °C/h up to a max. temperature of 110 °C.

Pre-drying:
Pre-dry the on-load tap-changer in circulating air at a max. temperature of 110 °C applied to the on-load tap-changer for a duration of 20 hours.

Drying:
Vacuum drying at a temperature of 110 °C max. applied to the on-load tap-changer and a residual pressure of at most $10^{-3}$ bar for a duration of at least 50 hours.

NOTE
Before drying the transformer in the autoclave, the on-load tap-changer cover must be removed and stored outside the autoclave.

8.1.1.2 Vacuum-drying in the transformer tank

NOTE
If the transformer is to be dried in its own tank, the interior of the diverter switch oil compartment must be connected to vacuum by a connecting pipe, as the on-load tap-changer cover remains closed during the entire drying process.

The on-load tap-changer cover is vacuum-proof.

To ensure sufficient drying of the interior of the oil compartment and the built-in on-load tap-changer insert, a short bypass tube of 25 mm nominal width must be connected between the transformer tank and a pipe connection at the on-load tap-changer head that leads directly into the oil compartment.

Connect the bypass tube either between the pipe connections E2 and Q or pipe connections E2 and R at the on-load tap-changer head (for position of on-load tap-changer head connecting terminals see section 9). Procedure, temperature, pressure and duration of the drying process are described in section 8.1.1.1.

8.1.2 Vapor-phase drying

NOTE
Before starting the drying procedure, the kerosene drain screw in the oil compartment bottom (Figure 46) must be opened to drain the kerosene condensate from the oil compartment.

Figure 46 Kerosene drain screw
The kerosene drain screw has a hexagonal recess and is easily accessible between oil compartment bottom and tap selector gear and can be unscrewed from outside. The thread of the kerosene drain screw features a plastic coating and requires a higher turning torque from approx. 2.5 turns after it is released. The screw is then released far enough and should not be turned further.

When vapor-phase drying the transformer in its own tank (see section 8.1.2.2) the kerosene drain screw is generally not accessible from outside and can only be opened from the inside. In this case the diverter switch insert must be removed, the kerosene drain screw unscrewed with an extended socket wrench (see section 16, drawing 890182AE) and the diverter switch insert reinstalled.

8.1.2.2 Vapor-phase drying in the transformer tank
If the transformer is to be dried in its own tank, the on-load tap-changer cover remains closed during the entire drying process.

The on-load tap-changer cover is vacuum-proof.

To ensure sufficient drying of the interior of the diverter switch oil compartment and of the diverter switch insert, it is necessary to connect a common tube of at least 50 mm nominal width between the kerosene vapor lead and at least two pipe connections of the on-load tap-changer head leading into the diverter switch compartment.

For this purpose use pipe connections R and Q for on-load tap-changer type M (for position of pipe connections at the on-load tap-changer head see section 9 and drawing 893899CE, section 16).

Procedure, temperature and duration of the drying process are described in section 8.1.2.1.

---

### ATTENTION!

**Damage to the transformer!**
The kerosene drain screw must be closed again after the drying process to ensure that no oil from the diverter switch oil compartment can flow into the transformer tank (tightening torque 20 Nm).

---

### NOTE

**Before drying the transformer in the autoclave, the on-load tap-changer cover must be removed and stored outside the autoclave.**

---

#### 8.1.2.1 Vapor-phase drying in the autoclave

**Heating:**
Supply kerosene vapor at a temperature of approx. 90 °C. Keep this temperature constant for approx. 3-4 hours.

**Drying:**
Increase the kerosene vapor temperature applied to the on-load tap-changer by approx. 10 °C/h to the desired final temperature which should not exceed 125 °C. The duration of the drying procedure is normally the same as that of the transformer.
8.1.3 Operating the on-load tap-changer

The on-load tap-changer must not be operated before the diverter switch oil compartment has been filled with oil and the tap selector has been completely immersed in transformer oil.

**ATTENTION!**

Damage to bearings and gaskets!
Do not operate the on-load tap-changer after drying without oil wetting.

8.2 Filling with oil

**ATTENTION!**

Impairment of the on-load tap-changer and transformer function.
The diverter switch oil compartment and its associated oil conservator must only be filled with new insulating oil for transformers according to IEC 296. The use of other oil puts at risk the trouble-free operation of on-load tap-changer and transformer.

1) Close the on-load tap-changer head with the cover.
2) Tighten all 24 cover bolts (M10, w.s.17) equally (max. torque 34 Nm).

Fill the on-load tap-changer and the transformer simultaneously with new transformer oil under vacuum.

3) Use either connection S or R at the on-load tap-changer head to fill the on-load tap-changer with oil.
4) For evacuating purposes, a bypass tube between connections E2 and Q is to be installed in order to simultaneously apply vacuum to the transformer and the diverter switch oil compartment.

![Figure 47](image-url)
9 Pipe connections

The on-load tap-changer head is provided with 3 pipe connections for different purposes. With the exception of the pipe connections holding the penetration assemblies for the tap-change supervisory control connection cables, all pipe connections can be freely rotated once the pressure ring has been released (4 screws M10, w.s.17, see Figure 47 and section 16, drawing 893899CE).

9.1 Pipe connection R for protective relay RS 2001
Install the protective relay RS 2001 (see section 16, drawing 8990842D) according to the associated MR Operating Instructions No. 59 for the protective relay RS 2001.

9.2 Pipe connection S for suction pipe
If no feed pipe of a stationary oil filter unit is connected here, a pipe must be connected which ends with a drain valve at the side of the transformer tank at operating height.

9.3 Pipe connection Q (special design, through-hole for tap-change supervisory control), see dimension drawing 8996483E)
An optional tap-change supervisory control (standard for MIII 350D/MIII 600D) can be connected to the flanged lead-through at pipe connection Q. This pipe connection has a limited swivel range. To connect the tap-change supervisory control, remove the cover by releasing the three hex. head screws M6, w.s.10.
The cable can now be fed through the cable gland and connected to the terminals that are now visible (numbered 1-6). For on-load tap-changer sets (e.g. 3x MII...) the cable glands can be used for connecting the cables in series. Once the connections have been established, replace the cover and fasten it (3 hex. head screws M6, 3 locking washers, tightening torque 9.5 Nm).

9.4 Pipe connection Q (special design, required only with oil filter unit)
This pipe connection serves as the connection of the oil return pipe of a stationary oil filter unit. If no oil filter is connected, a dummy plug is mounted instead of the pipe connection.

9.5 Pipe connection E2
This connection is closed by a dummy plug. It leads into the oil tank of the transformer, directly under the on-load tapchanger head. When necessary, it can be connected to a collective pipe for the Buchholz relay.

NOTE
The stamped serial number of the protective relay must match the serial number of the on-load tap-changer. The protective relay must be installed as close as possible to the on-load tap-changer head in a horizontal position. The directional arrow on the protective relay must point towards the oil conservator in the mounted state. The pipe leading to the oil conservator must have an inclination of at least 2%.

DANGER!
Risk of electric shock! Risk of personal injuries or damage to equipment!
Please ensure that the lines are de-energized before opening the cable gland. For connecting the tap-change supervisory control please follow the connection diagram for the associated motor drive unit. Failure to follow these instructions can lead to bodily injuries, malfunction or damage of the tap-change supervisory control or damage to the on-load tap-changer and transformer.

Operating Instructions BA 037/06 EN OILTAP® M
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Maschinenfabrik Reinhausen GmbH 2010
26 037/06 EN
10 Mounting the motor-drive unit, bevel gear and drive shaft

10.1 Mounting the motor-drive unit
Detailed installation instructions can be found in the associated Operating Instructions no. 138 for the TAPMOTION® ED motor-drive unit.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The serial number of the motor-drive unit must match the serial number of the on-load tap-changer (nameplate). Motor-drive unit and on-load tap-changer must be in the same operating position. The adjustment position is indicated in the connection of the on-load tap-changer included in delivery. The motor-drive unit must be mounted at the intended position on the transformer tank in a vertical position and protected against transformer vibrations.</td>
</tr>
</tbody>
</table>

10.2 Mounting the bevel gear
The bevel gear is to be attached to a support on the transformer cover by 2 bolts (through-holes 18 mm diameter, see section 16, drawing 8929166E).

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>The stamped serial number must match the serial number of the on-load tap-changer. The horizontal shaft end of the bevel gear must be in proper alignment with the shaft end of the upper gear unit on the on-load tap-changer head. After loosening the pressure ring (6 bolts M8, w.s.13) the upper gear unit can be freely rotated (Figure 48). After adjusting the upper gear unit, tighten the pressure ring (max. torque 15 Nm). The above notes shall apply analogously to special design bevel gears and corner gears, as well as to intermediate bearings of the vertical or horizontal drive shaft.</td>
</tr>
</tbody>
</table>

10.3 Mounting the drive shaft (square tube)
The drive shaft must be mounted according to the associated MR Operating Instructions No. 42. The drive shaft is the mechanical connection between the motor-drive unit and the on-load tap-changer head. The bevel gear is responsible for changing the direction from vertical to horizontal direction. Accordingly, the vertical drive shaft has to be mounted between motor-drive unit and bevel gear and the horizontal drive shaft between bevel gear and on-load tap-changer head.
The drive shaft itself consists of a square tube and is to be coupled by two coupling brackets and one coupling bolt at both ends to the drive or driven shaft end of the device to be connected.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>When mounting the drive shaft make sure that the shaft ends to be connected are aligned exactly.</td>
</tr>
</tbody>
</table>

Square tubes, coupling brackets, coupling bolts, screws, nuts and lock tabs are made of corrosion-resistant steel. We recommend, however, to apply the same outside coating to these parts as to the transformer tank.

<table>
<thead>
<tr>
<th>ATTENTION!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damage to the on-load tap-changer! After drying the upper gear unit may only be turned once the diverter switch oil compartment has been filled with oil.</td>
</tr>
</tbody>
</table>

Figure 48

ATTENTION!

Damage to the on-load tap-changer!
After drying the upper gear unit may only be turned once the diverter switch oil compartment has been filled with oil.

Thrust collar
Screws M8/w.s.13
Locking washer
10 Mounting the motor-drive unit, bevel gear and drive shaft

The square tubes, the protective tube and the guard plate which serve as a foot step protection for the horizontal drive shaft over the transformer cover, are supplied in oversizes (various standard lengths) and have to be cut to the required length when they are mounted on the transformer.

Finally, balancing of the lag of the motor-drive unit relative to the diverter switch action of the on-load tap-changer must be checked (according to the Operating Instructions for the associated motor-drive unit).

On-load tap-changer set 3 x M I ..., On-load tap-changer combination M III K (M I/M II) and on-load tap-changer M III 350 D or M III 600 D (see section 16, installation drawing 894205DE).

Due to the special arrangement of three or two column constructions, the on-load tap-changer heads must be coupled together above the transformer cover.

Since swiveling of the upper gear unit will instantly initiate the switching action, make sure that the exact adjustment position of the diverter switches is regained after the adjustment of the gear units.

Proceed as follows:

1) Check that the operating positions of all on-load tap-changers are identical (inspection window in the on-load tap-changer head). Each single-phase on-load tap-changer must be in the adjustment position.

2) Turn the upper gear unit of the on-load tap-changer heads into the desired mounting position and fix them there (screw-tighten and secure the pressure rings). Take note of the arrow on the drive shaft flange below the punched serial number. The direction of the arrow indicates the rotation sense when turning the hand crank of the motor-drive unit clockwise and must be identical at all gear units.

3) Operate the single-phase on-load tap-changers separately by one step by rotating the shaft ends counter-clockwise until the diverter switch operates once.

4) Check coincidence of the operating positions of all on-load tap-changer heads.

5) Mount the horizontal drive shaft between the on-load tap-changer heads.

6) Return the whole on-load tap-changer set, that is all single-phase on-load tap-changers together, into the adjustment position. The adjustment position must be reached by turning the drive shaft in clockwise direction.

7) Check simultaneous operation of all diverter switches.

8) Check coincidence of the operating positions of all on-load tap-changer heads.

9) Mount the vertical drive shaft.

10.4 Tap-change supervisory control

On-load tap-changers M III 350 D and M III 600 D are equipped with tap-change supervisory control as standard.

On-load tap-changers 3 M I... or M III K (M I/M II) may optionally be equipped with tap-change supervisory control.

The signaling contacts, installed in the on-load tap-changer head for tap-change supervisory control during operation (terminal box at pipe connection Q, see section 16, dimension drawing 8996483D), must be connected to the corresponding terminals of the motor drive unit (see Figure 49 and the connection diagram for the corresponding motor drive unit).

The signaling contact is closed in the respective diverter switch position.

Once the tap-change supervisory control has been activated, electrical control of the motor drive unit is no longer possible.

---

**ATTENTION!**

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

Please note the following once the tap-change supervisory control activated:

- Hand crank operation is not permitted when then transformer is switched on.
- Check the function of the drive shafts and the diverter switches. Follow the instructions in MR Maintenance Manual No. 038 (OILTAP® M) for removing and checking the diverter switches.

---

**ATTENTION!**

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

Connect the tap-change supervisory control according to the connection diagram for the associated motor drive unit.
10 Mounting the motor-drive unit, bevel gear and drive shaft

Figure 49 Basic circuit diagram for tap-change supervisory control
11 Commissioning the on-load tap-changer at the transformer manufacturer’s site

11.1 Operational tests
Before applying voltage to the transformer, test tap-change operations must be carried out to check the mechanical functions of on-load tap-changer and motor-drive unit.

These tap-change operations are to be performed over the entire operating range.

Make sure that in each operating position the position indications of motor-drive unit and on-load tap-changer (inspection window in the on-load tap-changer head) read the same position.

Check, in both end positions, the automatic switching off and the function of the electrical and mechanical end position limitation (see Operating Instructions no. 138 for the motor-drive unit TAPMOTION® ED).

ATTENTION!

Damage to the on-load tap-changer and transformer!
Non-conformance of the position indication of the on-load tap-changer and motor-drive unit indicates a coupling error. Misalignment of the coupling between the on-load tap-changer and the motor drive unit may lead to damage of the on-load tap-changer and the transformer. The transformer must not be put into operation.

ATTENTION!

Impairment of the insulating properties of the on-load tap-changer.
Make sure that the suction pipe has been bled correctly. The insulation capability of the on-load tap-changer to ground is otherwise significantly impaired.

ATTENTION!

Damage to the on-load tap-changer and transformer!
Non-conformance of the position indication of the on-load tap-changer and motor-drive unit indicates a coupling error. Misalignment of the coupling between the on-load tap-changer and the motor drive unit may lead to damage of the on-load tap-changer and the transformer. The transformer must not be put into operation.

ATTENTION!

Impairment of the insulating properties of the on-load tap-changer.
Make sure that the suction pipe has been bled correctly. The insulation capability of the on-load tap-changer to ground is otherwise significantly impaired.

11.2 Complete oil filling
Bleed and fill up the on-load tap-changer completely via the oil conservator with transformer oil.

Bleed as follows:

- the oil tank of the on-load tap-changer head via the bleeder valve in the on-load tap-changer cover (E1): Open the screw cap M30/w.s.36, lift the valve tappet by means of a screwdriver (Figure 50).

- The suction pipe via the bleeder screw at the pipe connection (S): Cap nut M16/w.s.22, max. torque 9.5 Nm, slotted bleeder screw M6, (max. torque 2 Nm Figure 51).

Figure 50

Figure 51
11 Commissioning the on-load tap-changer at the transformer manufacturer’s site

11.3 Ground connections
1) Connect the ground screws of the on-load tap-changer head (2 screws M12 with nuts, w.s.19, max. torque 60 Nm) to the transformer cover (Figure 52).
2) Connect the ground screw (M12/w.s.19, max. torque 60 Nm) of the motor-drive protective housing to the transformer tank.

11.4 Electrical tests on the transformer
Upon completion of the aforementioned works it is now time to perform the electrical tests required by transformer acceptance.

Figure 52
12 Transport to the operating site

If the motor-drive unit has to be dismounted for the transport of the transformer to the operating site, operate the motor-drive unit into the adjustment position and then uncouple it.

<table>
<thead>
<tr>
<th>ATTENTION!</th>
</tr>
</thead>
<tbody>
<tr>
<td>Damage to the on-load tap-changer and transformer!</td>
</tr>
<tr>
<td>Do not operate the motor-drive unit while the on-load tap-changer is not coupled.</td>
</tr>
</tbody>
</table>

Reassembly in accordance with sections 10.1 and 10.3.

<table>
<thead>
<tr>
<th>NOTE</th>
</tr>
</thead>
<tbody>
<tr>
<td>If the transformer is filled with oil but stored or transported without oil conservator, a by-pass tube must be installed between the interior of the diverter switch oil compartment and the transformer oil tank to equalize the pressure caused by the expansion of the oil.</td>
</tr>
</tbody>
</table>

Install this bypass tube at the on-load tap-changer head between connections E2 and Q.

For short stand-by periods of 2 to 4 weeks without oil conservator, it is also sufficient to lower the oil level by approx. 5 liters.

If the transformer is to be completely emptied, drain also the switching oil of the on-load tap-changer completely.

The interior of the diverter switch oil compartment should be conserved and protected in the same way as the transformer (e.g. by filling with N₂).

For longer standing periods, the motor-drive unit heating must be connected and operated.
13 Commissioning at the operating site

Before commissioning the transformer, a function test must be carried out on on-load tap-changer and motor-drive unit according to section 11.1. The function of the protective relay RS 2001 must also be checked at this point.

Loop in signaling contact for undershooting the minimum oil level in the on-load tap-changer oil conservator in the on-load tap-changer tripping circuit.

The trip function of the connected circuit breakers should be tested by pressing the test button OFF on the protective relay RS 2001.

Make sure that closing of the circuit breakers is only possible again after the protective relay RS 2001 has been brought to the IN SERVICE position by pressing the other test button.

---

**DANGER!**

**Danger of death!**
The protective relay RS 2001 must be inserted into the tripping circuit of the circuit breakers so the transformer is immediately shut down by the circuit breakers when the protective relay RS 2001 is triggered (see Operating Instructions no. 59 for the protective relay RS 2001).

**ATTENTION!**

**Damage to the on-load tap-changer and transformer!**
Check that all stop valves between the oil conservator and the on-load tap-changer are open.

After the transformer has been switched on and the inrush current has decayed, tap-change operations can be carried out under idling or load conditions. The switching gas accumulating under the on-load tap-changer cover will cause minor oil displacement or escape via the oil conservator.

**ATTENTION!**

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

After switching on the transformer ensure that the inrush current has decayed before carrying out any tap-change operations. The inrush currents are generally many times greater than the rated transformer current and may lead to overload of the on-load tap-changer during diverter switch operation.
Monitoring the on-load tap-changer and motor-drive unit is limited to occasional visual checks of on-load tap-changer head, protective relay and motor-drive unit. For efficiency reasons these visual checks should be combined with the usual control inspections on the transformer.

Pay particular attention to the following:

- Sealing points of the on-load tap-changer head, protective relay and possible connected pipes are to be oil-proof;
- Sealings of the protective housing of the motor-drive unit;
- Trouble-free functioning of the built-in electrical heating in the protective housing of the motor-drive unit
- Sound and proper condition of the silica gel breather for the on-load tap-changer oil conservator
- Function test of the protective relay according to Operating Instructions no. 59 for protective relay RS 2001.

The insulating oils in the transformer should be monitored by the operator according to the relevant regulations (also see section 15).

The oil quality of the on-load tap-changer oil must be monitored together with that of the transformer oil and when changing the breather of the on-load tap-changer. The dielectric strength of the diverter switch oil must be determined (see section 15, Table 1).

NOTE

Damage to the on-load tap-changer due to not enough oil in the oil conservator of the on-load tap-changer! Actuation of the on-load tap-changer with too little oil in the on-load tap-changer's oil conservator may cause damage to the on-load tap-changer! Make sure that the contact for signaling the falling below the minimum oil level in the on-load tap-changer's oil conservator was looped through to the tripping circuit of the circuit-breaker and that the circuit-breaker will immediately de-energize the transformer when the oil has fallen below this minimum oil level in the oil conservator.

ATTENTION!

Damage to the on-load tap-changer and transformer! If the protective relay RS 2001 is triggered, the on-load tap-changer and transformer must be thoroughly checked. This also applies to triggering of additional on-load tap-changer safety devices (e.g. pressure relief valve, tap-change supervisory control). Only operate the equipment again when you are sure there is no damage to the on-load tap-changer or transformer.

Energizing the transformer without prior checking is not permitted!

If the protective relay RS 2001 or an auxiliary protective device at the on-load tap-changer is triggered, the diverter switch insert must be removed and checked according to Maintenance Instructions No. 290 for OILTAP® M on-load tap-changers. For further information please refer to Operating Instructions No. 059 for the protective relay RS 2001.

For more serious problems with the on-load tap-changer or motor drive unit, which cannot be rectified easily on site, or if the protective relay is triggered, please inform your authorized MR representative or the transformer manufacturer. Alternatively, contact us directly at Maschinenfabrik Reinhausen GmbH Technical Service PO Box 12 03 60 93025 Regensburg Germany Phone: +49 941 4090-0 Fax: +49 941 4090-7001 E-mail: service@reinhausen.com Web: www.reinhausen.com
15 Maintenance

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15 Maintenance

Maintenance intervals, see Table 1 and Table 2.

The scope and type of maintenance are specified in the corresponding Maintenance Instructions from MR, which are available on request. If the appropriate preparations are made, proper maintenance can be carried out within a day.

We generally recommend to have maintenance carried out by our Technical Service. That way, you can be sure that in addition to getting all work done in a professional manner, our Technical Service will also retrofit specific components in accordance with state-of-the-art manufacturing conditions.

If a service is not carried out by our Technical Service department, please ensure that the personnel who carry out the maintenance are trained by MR or are otherwise suitably qualified to carry out the work.

In such a case, we would ask you to forward us a report on the maintenance performed, to complete our maintenance files. For inquiries about spare parts we ask you to inform us about the serial number (see nameplate on on-load tap-changer head and motor-drive unit) and the number of switching operations.

In addition to the maintenance intervals mentioned above, the diverter switch insert must be replaced after 800,000 tap-change operations.

Maintenance has to be carried out on the tap selector of the on-load tap-changer after 1.2 million tap-change operations (as indicated by the counter at the motor-drive unit). In addition, the limit values for changing or treating the diverter switch oil specified in Table 1 below must be complied with.

If the number of on-load tap-changer operations per year is 15,000 or higher, we recommend the use of our stationary oil filter unit OF 100 with a paper filter insert (see Operating Instructions BA 018). The use of an oil filter unit type OF 100 with combined filter is obligatory for all type M on-load tap-changers with $U_m = 300$ kV (insulation to ground) and a phase-to-phase operating voltage at the on-load tap-changer of 245...260 kV.

Filtering of the switching oil allows the maintenance intervals to be extended.

The insulating oils in the transformer are to be monitored by the operator according to the appropriate rules and regulations.

The diverter switch oil compartment and its associated oil conservator must only be filled with new insulating oil for transformers according to IEC 60296 (Specification for unused mineral insulating oils for transformers and switchgear) and IEC 60422 (Supervision and maintenance guide for mineral insulating oils in electrical equipment).

For dielectric strength limit values see section Table 1.

The temperature of the oil sample at the time of measuring the dielectric strength should be noted. The specified values are valid for oil temperatures of $20 \, ^\circ C \pm 5 \, ^\circ C$.

<table>
<thead>
<tr>
<th>On-load tap-changer</th>
<th>Dielectric strength *)</th>
</tr>
</thead>
<tbody>
<tr>
<td>M III 350 Y, M III 500 Y, M III 600 Y</td>
<td>30 kV/2.5 mm (minimum)</td>
</tr>
<tr>
<td>M I 351 ... M I 1503</td>
<td>40 kV/2.5 mm (minimum)</td>
</tr>
<tr>
<td>M II 352, M II 502, M II 602</td>
<td>40 kV/2.5 mm (minimum)</td>
</tr>
<tr>
<td>M III 350 K, M III 600 K**)</td>
<td>40 kV/2.5 mm (minimum)</td>
</tr>
</tbody>
</table>

*) measured according to IEC 60156

**) $K = \text{combination of M I 351+M I 352, M I 501+M II 502, M I 601+M II 602}$

Table 1 Guide values for monitoring the on-load tap-changer oil
## 15 Maintenance

### Table 2  Maintenance intervals for on-load tap-changers type M in star point connection (Y) or with \( U_m < 245 \text{kV} \).

<table>
<thead>
<tr>
<th>On-load tap-changer</th>
<th>Transformer rated current</th>
<th>Number of operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>without MR oil filter unit</td>
</tr>
<tr>
<td>M III 350 Y</td>
<td>up to 350 A</td>
<td>100,000</td>
</tr>
<tr>
<td>M III 500 Y</td>
<td>up to 350 A</td>
<td>100,000</td>
</tr>
<tr>
<td></td>
<td>up to 500 A</td>
<td>80,000</td>
</tr>
<tr>
<td>M III 600 Y</td>
<td>up to 350 A</td>
<td>100,000</td>
</tr>
<tr>
<td></td>
<td>up to 600 A</td>
<td>80,000</td>
</tr>
<tr>
<td>M III K* M I 351 / M II 352</td>
<td>up to 350 A</td>
<td>100,000</td>
</tr>
<tr>
<td>M III K* M I 501 / M II 502</td>
<td>up to 500 A</td>
<td>100,000</td>
</tr>
<tr>
<td>M I 601 / M II 602</td>
<td>up to 600 A</td>
<td>100,000</td>
</tr>
<tr>
<td>M I 802</td>
<td>up to 500 A</td>
<td>100,000</td>
</tr>
<tr>
<td></td>
<td>up to 800 A</td>
<td>80,000</td>
</tr>
<tr>
<td>M I 1203</td>
<td>up to 800 A</td>
<td>80,000</td>
</tr>
<tr>
<td></td>
<td>up to 1200 A</td>
<td>70,000</td>
</tr>
<tr>
<td>M I 1503</td>
<td>up to 1200 A</td>
<td>70,000</td>
</tr>
<tr>
<td></td>
<td>up to 1500 A</td>
<td>60,000</td>
</tr>
</tbody>
</table>

* M III K = Combination M I + M II

**Example:** Type M I 351 - 123/C - 14 27 1 W; \( U_m = 123 \text{kV} \)

**Example:** Type M III 350 Y - 72.5/B - 10 19 1 G; Y = star point connection

First maintenance and regular maintenance: After 7 years or the switching numbers given in Table 2, whichever comes first.

### Table 3  Maintenance intervals for on-load tap-changers type M with \( U_m > 245 \text{kV} \) (used in autotransformers or at line end of winding) and for M III 350 D / M III 600 D.

\( U_m \) is part of the on-load tap-changer type designation.

<table>
<thead>
<tr>
<th>On-load tap-changer</th>
<th>Transformer rated current</th>
<th>Number of operations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>without MR oil filter unit</td>
</tr>
<tr>
<td>M III 350 D</td>
<td>up to 350 A</td>
<td>40,000</td>
</tr>
<tr>
<td>M III 600 D</td>
<td>up to 600 A</td>
<td>40,000</td>
</tr>
<tr>
<td>M III K* M I 351 / M II 352</td>
<td>up to 350 A</td>
<td>50,000</td>
</tr>
<tr>
<td>M III K* M I 501 / M II 502</td>
<td>up to 500 A</td>
<td>50,000</td>
</tr>
<tr>
<td>M I 601</td>
<td>up to 600 A</td>
<td>50,000</td>
</tr>
<tr>
<td>M I 802</td>
<td>up to 500 A</td>
<td>50,000</td>
</tr>
<tr>
<td></td>
<td>up to 800 A</td>
<td>40,000</td>
</tr>
<tr>
<td>M I 1203</td>
<td>up to 800 A</td>
<td>40,000</td>
</tr>
<tr>
<td></td>
<td>up to 1200 A</td>
<td>35,000</td>
</tr>
<tr>
<td>M I 1503</td>
<td>up to 1200 A</td>
<td>35,000</td>
</tr>
<tr>
<td></td>
<td>up to 1500 A</td>
<td>30,000</td>
</tr>
</tbody>
</table>

* M III K = Combination M I + M II

**Example:** Type M I 1200 - 245/D - 10 19 1 G; \( U_m = 245 \text{kV} \).

**For** \( U_m = 300 \text{kV} \) and a phase-to-phase operating voltage at the on-load tap-changer of 245...260 kV, an MR oil filter unit must be used.

First maintenance after 2 years or 20,000 operations, whichever comes first.

Regular maintenance: every 4 years without MR filter unit every 7 years with MR filter unit (combined filter) or after the number of operations indicated in Table 3 - whichever comes first.
16 Appendix

16.1 On-load tap-changer OILTAP® M, installation drawing (centric drive unit, 893978CE_1)
On-load tap-changer OILTAP® M, installation drawing (centric drive unit, 893978CE_2)
16.2 On-load tap-changer OILTAP® M III 350D / 600D, installation drawing (centric drive unit, 894205EE)

Operating Instructions BA 037/06 EN OILTAP® M

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16.3 On-load tap-changer OILTAP® M, mounting position of the tap selector terminals (8904778E)

THROUGH-HOLE VERTICAL

THROUGH-HOLE HORIZONTAL

M III 350 / 500 / 600Y – 0
M II 352 / 502 / 602 – 0
M I 351 / 501 / 601 – 0

M III 350 / 500 / 600Y – W
M II 352 / 502 / 602 – W
M I 351 / 501 / 601 – W

M I 802 – 0
M I 1203 / 1503 – 0

M I 802 – W
M I 1203 / 1503 – W

A + B
16.4 On-load tap-changer OILTAP® M, MS, R, RM, centric drive unit (893899CE)

E1 = BLEEDING FACILITY FOR ON-LOAD TAP-CHANGER HEAD
E2 = BLEEDING FACILITY FOR SPACE UNDER THE HEAD OUTSIDE
THE TAP-CHANGER OIL COMPARTMENT (SAME PIPE CONNECTION AS R, S, Q OR BLEEDER SCREW CAN BE USED)!
Q = CONNECTION FOR OIL RETURN PIPE (ONLY FOR OIL FILTER) - CONNECTIONS ORIENTABLE THROUGH 360°
S = CONNECTION FOR SUCTION PIPE - CONNECTIONS ORIENTABLE THROUGH 360°
R = CONNECTION FOR PROTECTIVE RELAY (EXCHANGEABLE WITH CONNECTION Q) - CONNECTIONS ORIENTABLE THROUGH 360°
T = THERMOMETER BAG (OPTIONALLY)
SR = INSPECTION WINDOW, RIGHT
SL = INSPECTION WINDOW, LEFT

Scale 1:25 1:11

M DRIVE SIDE OF THE TAP SELECTOR

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16.5 On-load tap-changer OILTAP® M III 350 D / 600 D, OLTC head with tap-change supervisory control (8941098E)
16.6 On-load tap-changer OILTAP® M, MS, R, RM, pipe connection with tap-change supervisory control (8996483E)

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16.7 On-load tap-changer OILTAP® M, MS, R, RM, drilling template for on-load tap-changer head (8901838E)
16.8 On-load tap-changer OILTAP® M, MS, R, RM, supporting flange, special design for bell-type tank installation for $U_m$ up to 300 kV (8967629E)
16.9 On-load tap-changer OILTAP® M, MS, R, RM, lifting traverse (8901800M)

Stahlblech / steel sheet
S235JR DIN EN 10250-2
16.10 On-load tap-changer OILTAP® M, MS, R, RM, socket wrench for kerosene drain screw (890182AE)

<table>
<thead>
<tr>
<th>SOCKET WRENCH</th>
<th>ITEM NO. 014820: L = 1350MM</th>
<th>ITEM NO. 017660: L = 1860MM</th>
</tr>
</thead>
<tbody>
<tr>
<td>TO BE USED FOR ON-LOAD TAP-CHANGERS</td>
<td>TYPE M (EXCEPT MΔ) TYPE MS</td>
<td>TYPE M III 350Δ / 600Δ TYPE T TYPE R TYPE RM TYPE G</td>
</tr>
</tbody>
</table>

24

11059747

8

11059763

1/2"

1/2"

1/2"

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### 16.11 On-load tap-changer OILTAP® M, MS, screwdrivers and wrenches for installation and inspection (8904785E)

<table>
<thead>
<tr>
<th>ITEM</th>
<th>NO.</th>
<th>DESIGNATION</th>
<th>FIG.</th>
<th>DIN</th>
<th>WRENCH SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>DOUBLE-ENDED OPEN-JAW WRENCH</td>
<td>A</td>
<td>895</td>
<td>8 x 10</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>RING &amp; OPEN-JAW WRENCH</td>
<td>C</td>
<td>3113</td>
<td>10</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>DOUBLE-ENDED OPEN-JAW WRENCH</td>
<td>A</td>
<td>895</td>
<td>13 x 17</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>DOUBLE-ENDED SOCKET WRENCH</td>
<td>B</td>
<td>896</td>
<td>13 x 17</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>DOUBLE-ENDED OPEN-JAW WRENCH</td>
<td>A</td>
<td>895</td>
<td>17 x 19</td>
</tr>
<tr>
<td>6</td>
<td>1</td>
<td>DOUBLE-ENDED OPEN-JAW WRENCH</td>
<td>A</td>
<td>895</td>
<td>22 x 24</td>
</tr>
<tr>
<td>7</td>
<td>1</td>
<td>HEXAGON SOCKET SCREW KEY</td>
<td>D</td>
<td>911</td>
<td>4</td>
</tr>
<tr>
<td>8</td>
<td>1</td>
<td>HEXAGON SOCKET SCREW KEY</td>
<td>D</td>
<td>911</td>
<td>5</td>
</tr>
<tr>
<td>9</td>
<td>1</td>
<td>HEXAGON SOCKET SCREW KEY</td>
<td>D</td>
<td>911</td>
<td>8</td>
</tr>
</tbody>
</table>

**ADDITIONAL DRAWING: 890479**

SPECIAL TOOLS FOR THE INSPECTION
### 16.12 Protective relay RS 2001, standard (8990842E)

#### Key of versions

<table>
<thead>
<tr>
<th>Version</th>
<th>Relay designation</th>
<th>Red switch</th>
<th>Contact positions</th>
<th>Arrangement of terminals</th>
<th>Design</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>In service</td>
<td>Off</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>0.65 - NO</td>
<td>A</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 - NO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0 - NO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.8 - NO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>0.65 - NC</td>
<td>B</td>
<td>2</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 - NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0 - NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.8 - NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>0.65 - CO</td>
<td>C</td>
<td>2</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 - CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0 - CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.8 - CO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>0.65 - 2NO</td>
<td>2A</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 - 2NO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0 - 2NO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.8 - 2NO</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>0.65 - 2NC</td>
<td>2B</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 - 2NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0 - 2NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.8 - 2NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>0.65 - NO + NC</td>
<td>1A &amp; 1B</td>
<td>2</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>1.2 - NO + NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>3.0 - NO + NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>4.8 - NO + NC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*NO - normally open, NC - normally closed, CO - change-over contact

The protective relay is to be connected in such a way that if it is energized, the power transformer is switched off immediately by the corresponding circuit breakers.

---

Operating Instructions BA 037/06 EN OILTAP® M

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16.13 Bevel gear CD 6400, dimensional drawing (8929166E)

The sense of rotation will be determined when placing the order.

<table>
<thead>
<tr>
<th>Ratio</th>
<th>1:1</th>
<th>1:2</th>
<th>2:1</th>
<th>3:1</th>
<th>5:2</th>
</tr>
</thead>
<tbody>
<tr>
<td>11:21</td>
<td>2:3</td>
<td>4:1</td>
<td>3:2</td>
<td>5:4</td>
<td></td>
</tr>
<tr>
<td>1:3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ca. 5 kg