On-load tap-changers, types UCC and UCD with motor-drive mechanism, type BUE

Installation and Commissioning Guide
Recommended Practices

ABB recommends careful consideration of the following factors when installing on-load tap-changers:

Before you install or commission a unit, make sure that the personnel doing the job have read and fully understood the Installation and Commissioning Guide provided with the unit.

To avoid damaging the unit, never exceed the operating limits stated in delivery documents and on rating plates.

Do not alter or modify a unit without first consulting ABB.

Follow local and international wiring regulations at all times.

Use only factory authorized replacement parts and procedures.

WARNING, CAUTION and NOTE

--- WARNING ---
A WARNING provides information which, if disregarded, could cause injury or death.

--- CAUTION ---
A CAUTION provides information which, if disregarded, could cause damage to the equipment.

NOTE: A NOTE provides additional information to assist in carrying out the work described.

Safety Precautions

--- WARNING ---
Unused transformer oil is slightly harmful. Fumes from unused warm oil may irritate the respiratory organs and the eyes. After long and repeated contact with transformer oil skin becomes very dry.

Used on-load tap-changer oil from diverter switch housings and selector switch housings contains harmful substances. Fumes are irritating to the respiratory organs and the eyes and are very easily set on fire. Used transformer oil may well be carcinogenic.

Avoid contact with the oil as much as possible and use oiltight protective gloves when handling the oil.

First aid:
Skin contact: Wash the hands. Use skin cream to counteract drying.
In the eyes: Rinse the eyes in clean water.
Swallowing: Drink water or milk. Avoid vomiting. Call a doctor.

Collect used oil in oil drums.

To be continued on the next page.
Waste and cleaning up: Should be absorbed by an absorber. Treat it as hazardous to the environment.

Upon fire: The fire should be extinguished by using powder, foam or carbon acid.

---

**WARNING**

Be aware of the risk for slipperiness caused by oil spillage for instance when working on the transformer cover.

---

**WARNING**

The motor-drive mechanism must not be installed in any explosive atmosphere. The electrical equipment creates sparks which can cause an explosion.

---

**WARNING**

Before any work is carried out on the on-load tap-changer:
Make sure that the transformer is disconnected and that earthing is properly carried out. Obtain a signed certificate from the engineer in charge.

---

**WARNING**

Before carrying out work on the on-load tap-changer, put the LOCAL/REMOTE switch in the motor-drive mechanism to position 0. It is also recommended to shut the door of the motor-drive mechanism and pad lock it when work is carried out on the on-load tap-changer. The key should be kept by the operator. This is done to avoid unexpected start of the motor-drive mechanism.

---

**WARNING**

Before starting any work inside the motor-drive mechanism, the auxiliary power must be switched off.

N.B. The motor, contactors and heating element may be energized from separate sources.

---

**During Drying of the Transformer**

---

**CAUTION**

The diverter switch should not be installed during drying, since the process removes grease needed for operation.

---

**CAUTION**

During drying with hot air and vacuum, the maximum permitted pressure difference for the diverter switch housing is 100 kPa at the maximum permitted temperature of 135 °C (275 °F).
CAUTION
During drying by the vapour phase process the cover of the diverter switch housing and the bottom valve should be left open. The valve is opened with the special bottom valve key, a long hexagonal rod. The maximum permitted temperature is 135 °C (275 °F).

CAUTION
Use the special bottom valve key only (delivered with the on-load tap-changer) to operate the bottom valve through the oil draining tube. The use of a stiffer tool may damage the valve.

CAUTION
Do not operate the on-load tap-changer during the drying process or afterwards until it is filled with oil, to avoid seizing.

Mounting of Gaskets

CAUTION
Sealing surfaces and gaskets must be clean and undamaged. Diametrically opposed bolts in sealing joints must be tightened alternately several times, beginning with a low tightening torque and finally with the recommended tightening torque as described in section 1.8 Tightening Torque, in this guide.

During Oil Filling

WARNING
When oil that has been used in a diverter switch housing is pumped out, conducting tubes and hoses that are earthed should be used to avoid the risk of explosion due to the gases produced by the arcs during service.

CAUTION
Do not fill oil into the diverter switch housing if the transformer tank is under vacuum and the diverter switch housing is not.

CAUTION
Do not fill oil into the transformer tank if the diverter switch housing is under vacuum and the transformer tank is not.

CAUTION
Leave a gas cushion on top of the oil in the diverter switch housing.
After Oil Filling

--- CAUTION ---
Do not energize the transformer earlier than three hours after oil filling in atmospheric pressure. This waiting period is needed to allow air bubbles to disappear.

--- NOTE ---
Check the oil level one month after filling. It is usual for the oil level of the oil conservator to fall due to gas absorption in the oil from the gas-cushion in the on-load tap-changer, if the on-load tap-changer is not operated. Restore the gas-cushion and the oil level according to section 6.5.

During Service

--- WARNING ---
Small amounts of explosive gases will always come out from the breathing devices (dehydrating breather or one-way breather). Make sure that no open fire, hot surfaces or sparks occur in the immediate surroundings of the breathing devices.

--- WARNING ---
If a failure in power supply occurs during operation, the operation will be completed when the power returns.

--- WARNING ---
The hand crank must not be inserted during electrical operation.

--- WARNING ---
If the on-load tap-changer is not in its exact position and the hand crank is pulled out, the motor-drive mechanism will start and go to the exact position if the power supply is on.

--- CAUTION ---
After a pressure relay trip, follow the instructions in the chapter "Pressure Relay" in the Repair Guide.

--- CAUTION ---
The pressure relay is a calibrated monitoring instrument. It must be handled with care and protected against careless handling or any kind of mechanical damage. Do not open the package of the pressure relay until you are about to install it on the on-load tap-changer.
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</table>
1 Introduction

The arrangement of on-load tap-changers types UCC and UCD are shown in Figs. 1 and 2.

A UCC on-load tap-changer has always tap selector IV. A UCD on-load tap-changer has tap selector III or G.

To make transportation easy the on-load tap-changer is delivered in three main parts. These are diverter switch housing, tap selector and motor-drive mechanism.

The on-load tap-changer is performed for cover-mounting and for yoke-mounting. Cover-mounting means that the diverter switch housing is lowered through the hole in the transformer tank and then bolted straight onto the transformer cover, and after that the tap selector is mounted. Yoke-mounting means that the on-load tap-changer is temporarily put on a fork located on the active part of the transformer. Yoke mounting allows the transformer manufacturer to connect the windings to the on-load tap-changer before drying and without having the transformer cover mounted. The transformer cover is then lowered onto the tank, and the on-load tap-changer is lifted and bolted to the cover. Please use the appropriate instruction for cover-mounting or yoke-mounting in chapter 3.

At cover-mounting the diverter switch housing is installed on the transformer cover before joining with the tap selector.

After the drying process of the transformer the motor-drive mechanism and bevel gear are fitted to the transformer tank and the drive shafts are fitted to complete the assembly of motor-drive mechanism, bevel gear and on-load tap-changer before oil filling and testing.

The arrangement of the on-load tap-changer systems is shown in Figs. 2-2b.

Position numbers in the Installation Guide, for example SA11 (see chapter 5) correspond with those in the packing list for the on-load tap-changer.

All instructions are for one on-load tap-changer unit. In case of more than one unit on the transformer, carry out the same procedures for each unit.
1.1 Type Designation

Example: UCDRE 650/1000/III

Type of switching
- L Linear
- R Plus/Minus
- D Coarse/Fine

Type of connection
- N Three-phase star point (one unit)
- E Single-phase (one unit)

Impulse withstand voltage to earth

Maximum rated through-current

Tap selector size


**Fig. 1.**

- **Tap selector size IV**
- **Tap selector size III**
- **Tap selector size G**

- Serial No.
- Diverter switch housing
- Shielding ring (not in combination with tap selector size G)
- Serial No. in the bottom of the diverter switch (see Fig. 29)
1 Introduction

**Fig. 2.** Type of connection, N, 1200 A

---

**Fig. 2a.** One two-phase unit and one single-phase unit with motor-drive mechanisms for delta connection, 1200 A

---

**Fig. 2b.** Three single-phase units with three motor-drive mechanism for three-phase full insulation, 2000 A.
1.2 Required Tools

- Normal set of open end wrenches (up to 24 mm)  General
- Normal set of sockets (up to 24 mm)  General
- Normal set of screw drivers  General
- Socket handle  General
- Set of pliers, including cutting pliers  General
- Dynamometric wrench 5-85 Nm  General
- Sliding caliper  General
- Allen key sockets 5 and 10 mm  3
- Pipe Wrench  3.2
- Bottom valve key (delivered with the on-load tap-changer)  3.2.1, 4 and 6.2
- Lifting bar. Article No. LL 133 016-D  3.2.2
- Special hand crank for operating the on-load tap-changer on the bevel gear (can be ordered from ABB, under "further requirements" on the ordering data sheet. Art. No. LL117 016-M).  3.4
- Hack saw (only for installation)  5
- File  5
- Folding ruler  5
- Air pump with hose, pressure gauge (0–250 kPa) and connection with internal thread R 1/8”  5.3
- Tool for opening of oil drum  6
- Container, 50 litres  6
- Small oil pump with connection to the oil valve (For connection dimensioning see the dimension drawing for the on-load tap-changer).  6

1.3 Required Material

- Rags for cleaning  General
- Single-phase diagram for the on-load tap-changer  General
- Gasket for transformer flange  3.1, 3.2.3
- Insulating paper  3.1, 3.2
- Insulating bushings  3.2
1.4 Oil

The oil quality should be of Class II according to IEC publication 296.

Table 1. Weight of oil in kg.

<table>
<thead>
<tr>
<th>Type designation</th>
<th>Oil weight</th>
<th>¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>UCC.. 380/...., UCD.. 380/....</td>
<td>700</td>
<td></td>
</tr>
<tr>
<td>UCC.. 650/...., UCD.. 650/....</td>
<td>760</td>
<td></td>
</tr>
<tr>
<td>UCC.. 1050/...., UCD.. 1050/....</td>
<td>860</td>
<td></td>
</tr>
</tbody>
</table>

¹) The oil for the conservator is not included.

**WARNING**

Do not energize the transformer until oil has been filled according to chapter 6, Oil Filling, in this guide.

1.5 Oil Conservator

The on-load tap-changer has to be connected to an oil conservator. ABB recommends to use a separate conservator for the on-load tap-changers with both oil and air side separated from the main conservator of the transformer.
1 Introduction

The volume of the conservator should be such, that there is oil left in the conservator even at the lowest oil temperature expected and such that no flooding can occur at the highest oil temperature expected. Even transformers with more than one on-load tap-changer unit require only one conservator.

A suitable dimension of the tube for connection to the conservator is an inner diameter of approximately 20 mm. The tube should be inclined at least 3 degrees to avoid gas cushions in the tube. A valve in the connection to the conservator is recommended.

The conservator must be equipped with a breathing device that does not allow moist air into the conservator and that allows the gas from the arcs to disappear.

The conservator should also be equipped with an oil level indicator and an alarm contact for low oil level is recommended.

1.6 Oil Filter Unit for Continuous Oil Filtration

If the on-load tap-changer should have an oil filter unit for continuous oil filtration from ABB, installation and commissioning instructions are found in the manual for the oil filter unit, "Oil filter unit for On-Load Tap-Changers, Manual" delivered with the oil filter unit.

1.7 Weights

Motor-drive mechanism BUE 1 weight: approximately 130 kg

Motor-drive mechanism BUE 2 weight: approximately 155 kg

The weights of the motor-drive mechanism and drive-shaft system are not included in the weights given on next page.
1 Introduction

**Table 2. Weights for UCC on-load tap-changers**

<table>
<thead>
<tr>
<th>On-load tap-changer Type designation</th>
<th>Approx. weight in kg</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tap-changer without oil 1)</td>
<td>Required oil</td>
</tr>
<tr>
<td>UCC.N.../.../IV</td>
<td>380/800, 1200</td>
<td>1050</td>
</tr>
<tr>
<td></td>
<td>380/1600</td>
<td>1140</td>
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<tr>
<td></td>
<td>650/800, 1200</td>
<td>1090</td>
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<td>650/1600</td>
<td>1180</td>
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<td>1050/800, 1200</td>
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<td></td>
<td>1050/1600</td>
<td>1200</td>
</tr>
<tr>
<td>UCC.E.../.../IV</td>
<td>380/3600</td>
<td>1040</td>
</tr>
<tr>
<td></td>
<td>380/4200</td>
<td>1130</td>
</tr>
<tr>
<td></td>
<td>650/3600</td>
<td>1080</td>
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<tr>
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<td>650/4200</td>
<td>1170</td>
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<td></td>
<td>1050/3600</td>
<td>1100</td>
</tr>
<tr>
<td></td>
<td>1050/4200</td>
<td>1190</td>
</tr>
</tbody>
</table>

1) The weight of the diverter switch, approximately 250 kg, is included.

**Table 3. Weights for UCD on-load tap-changers**

<table>
<thead>
<tr>
<th>On-load tap-changer Type designation</th>
<th>Approx. weight in kg</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tap-changer without oil 1)</td>
<td>Required oil</td>
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<tr>
<td>UCD.N.../.../III</td>
<td>380/1000</td>
<td>900</td>
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<td></td>
<td>650/1000</td>
<td>940</td>
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<td>1050/1000</td>
<td>960</td>
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<td>UCD.E.../.../III</td>
<td>380/1000</td>
<td>840</td>
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<td></td>
<td>380/1800</td>
<td>870</td>
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<tr>
<td></td>
<td>380/2400</td>
<td>900</td>
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<tr>
<td></td>
<td>650/1000</td>
<td>880</td>
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<tr>
<td></td>
<td>650/1800</td>
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<td>380/2000</td>
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<td></td>
<td>650/1200</td>
<td>860</td>
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<td></td>
<td>650/2000</td>
<td>890</td>
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<td>650/3000, 3600</td>
<td>920</td>
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<td></td>
<td>1050/3000, 3600</td>
<td>950</td>
</tr>
</tbody>
</table>

1) The weight of the diverter switch, approximately 250 kg, is included.
1.8 Tightening Torque

The following tightening torques are recommended:

For metallic screw joints:
- M6, 10 Nm ±10 %
- M8, 24.5 Nm ±10 %
- M10, 49 Nm ±10 %
- M12, 84 Nm ±10 %
- M16, 205 Nm ±10 %

For non-metallic screw joints:
- M10, 9 Nm ±10 %
- M12, 13 Nm ±10 %
- M16, 22 Nm ±10 %

if not otherwise is stated in this guide.

2 Receiving

2.1 Unpacking

Check that the packages are free from transport damage. Open the covers of the transport boxes, Remove the supporting block of wood. If any package is damaged a careful investigation must be carried out.

Lift the on-load tap-changer parts in their lifting eyes according to Fig. 3.

2.2 Inspection on Receipt

1. Check that the diverter switch housing, tap selector, motor-drive mechanism and accessories are undamaged.

2. If transport damage is found, and it is judged that correct operation of the on-load tap-changer is not possible, a damage report should be sent to the insurance company. It is also recommended that photographs are taken of the damaged details. Mark the photos with ABB’s reference number and the serial number of the on-load tap-changer and send them to ABB for comments.

3. Check that the parts delivered, type designations and the serial number agrees with the delivery documents, e.g. the packing list or ABB’s order acknowledgement. The serial numbers to be checked are those on the rating plate, on the diverter switch housing and on the tap selector. The serial number on the parts belonging to one on-load tap-changer unit should all be the same.

2.3 Temporary Storage before Assembly

If the on-load tap-changer is not to be assembled immediately, once the delivery has been approved the on-load tap-changer and the motor-drive mechanism must be kept warm and dry indoors. Let the units be kept in their plastic enclosures and leave the drying agent until assembly.
3 Installation in the Transformer

The cover-mounting method or yoke-mounting method is used.

--- WARNING ---

The intermediate gear and the insulating shaft of the diverter switch housing moves during operation. Keep away during operation to avoid injuries!

--- WARNING ---

The diverter switch housing and the tap selector are designed to be lifted in the lifting eyes, see Fig. 3.

--- WARNING ---

To put down the complete on-load tap-changer to stand on the floor without any support on the top of the on-load tap-changer means a risk for tilting with risk for injuries to people and damage to the equipment.

--- Fig. 3. How to lift. ---
3.1 Cover-Mounting

(For Yoke-Mounting, see section 3.2).

The diverter switch housing and tap selector are delivered packed separately.

3.1.1 UCC with Tap Selector size IV

1. Unpack the diverter switch housing and the tap selector. Remove the drying agents and the yellow cushions with vapour phase inhibitor for protection against corrosion in the tap selector and on the diverter switch housing.

2. Fit the gasket into the on-load tap-changer flange on the transformer cover, see Fig. 5. (This gasket is not included in the delivery).

3. When the impulse withstand voltage to earth exceeds 380 kV, the on-load tap-changer is provided with shielding rings. Before mounting the diverter switch housing on the transformer cover two shielding rings must be dismantled, see Fig. 7.

![Fig. 4.](image1)

![Fig. 5.](image2)
4. Lift the diverter switch housing in the lifting eyes as shown in Fig. 3 and lower it carefully through the opening in the transformer top cover, see Fig. 4. Place the diverter switch housing correctly in position for mounting the outer shaft system (see transformer drawing). The studs on the flange on the transformer cover shall fit into the holes in the flange of the diverter switch housing. Mount thirty washers and M16 nuts, see Fig. 5. Tighten the nuts.

5. If the impulse withstand voltage exceeds 380 kV, mount first the upper of the two dismantled shielding rings on the diverter switch housing and then the lower, see Fig. 7.

6. Put the tap selector in position for joining to the diverter switch housing. Lift in the lifting eyes as shown in Fig. 3.

7a. In case the on-load tap-changer is equipped with a tie-in resistor for mounting under the tap selector, the tie-in resistor should be mounted after joining the tap selector to the diverter switch housing. After mounting the tie-in resistor, the on-load tap-changer must not be put down standing on the tie-in resistor. It must be hanging, for instance in a traverse.

---

**WARNING**

To put down the on-load tap-changer to stand on the floor with the tie-in resistor mounted means a great risk for tilting the on-load tap-changer with risk for injuries to people and damage of the equipment.

---

7b. In case the on-load tap-changer is equipped with a tie-in resistor switch, the switch is mounted under the tap selector at delivery. A special support in the box makes it standing on the tap selector bottom. If this special support is taken out of the box, the tap selector can be standing on this during joining to the diverter switch housing. After joining, the complete on-load tap-changer is lifted and the special support is removed. The complete on-load tap-changer must not be put on the special support. It must be hanging, for instance in a traverse.

---

**WARNING**

To put down the on-load tap-changer to stand on the floor with the tie-in resistor switch mounted means a great risk for tilting the on-load tap-changer with risk for injuries to people and damage of the equipment.

---

8. Remove the transport locking and the lifting eyes with fasteners from the top section of the tap selector, see Fig. 6.

---

**CAUTION**

*Do not operate the tap selector until it is connected to the diverter switch housing.*
9. Lift the diverter switch housing in position and fit the tap selector to the diverter switch housing, see Fig. 4. The tap selector driving pin shall fit into the large gear wheel slot, see Fig. 7, A-A.

**CAUTION**

*The driving crank on the tap selector must not be moved more than slightly to engage the slot in the large gear wheel of the diverter switch housing.*

10. Insert four M12x110 screws, two M12x40 and spring washers, see Fig. 7, through the selector upper part to the six supports of the diverter switch housing. Tighten the screws.

**WARNING**

*The diverter switch housing and the tap selector contains moving parts. Be cautious!*

11. Connect the supplied conductors between the diverter switch housing and tap selector, see Fig. 7. The conductor ends and their connecting points have the same markings. Fasten the conductors with cleats, see Fig. 7, A-A. The number of conductors is varying depending on rated through current and the type of connection.

12. If the impulse withstand voltage to earth exceeds 380 kV, insulate the connections on the tap selector by winding paper around them to a thickness of approximately 3 mm, see Fig. 7, B-B. The paper shall be of the same quality as used for insulation of conductors within the active part of the transformer.

13. If the impulse withstand voltage to earth exceeds 380 kV, mount the supplied shielding rings (DS 10) at the bottom of the tap selector, see Fig. 7.

**CAUTION**

*After mounting the shielding ring the on-load tap-changer must not stand on the shielding ring.*

14. Continue with section 3.3
3 Installation in the Transformer

Fig. 7. UCC.N (star point type)
3.1.2 UCD with Tap Selector size III

1. Unpack the diverter switch housing and the tap selector. Remove the drying agents and the yellow cushions with vapour phase inhibitor for protection against corrosion in the tap selector and on the diverter switch housing.

2. Fit the gasket into the on-load tap-changer flange on the transformer cover, see Fig. 5. (This gasket is not included in the delivery.)

3. When the impulse withstand voltage to earth exceeds 380 kV, the on-load tap-changer is provided with shielding rings. Before mounting the diverter switch housing on the transformer cover two shielding rings must be dismantled, see Fig. 9.

4. Lift the diverter switch housing in the lifting eyes as shown in Fig. 3 and lower it carefully through the opening in the transformer top cover, see Fig. 4. Place the diverter switch housing correctly in position for mounting the outer shaft system (see transformer drawing). The studs on the flange on the transformer cover shall fit into the holes in the flange of the diverter switch housing. Mount thirty washers and M16 nuts, see Fig. 5. Tighten the nuts.

5. If the impulse withstand voltage exceeds 380 kV, mount first the upper of the two dismantled shielding rings on the diverter switch housing and then the lower, see Fig. 9.

6. Put the tap selector in position for joining to the diverter switch housing. Lift in the lifting eyes as shown in Fig. 3.

7a. In case the on-load tap-changer is equipped with a tie-in resistor for mounting under the tap selector, the tie-in resistor is mounted after joining the tap selector to the diverter switch housing. After mounting the tie-in resistor, the on-load tap-changer must not be put down standing on the tie-in resistor. It must be hanging, for instance in a traverse.

---

**WARNING**

To put down the on-load tap-changer to stand on the floor with the tie-in resistor mounted means a great risk for tilting the on-load tap-changer with risk for injuries to people and damage of the equipment.

---

7b. In case the on-load tap-changer is equipped with a tie-in resistor switch, the switch is mounted under the tap selector at delivery. A special support in the box makes it standing on the tap selector bottom. If this special support is taken out of the box, the tap selector can be standing on this during joining, to the diverter switch housing. After joining the complete on-load tap-changer is lifted and the special support is removed. The complete on-load tap-changer must not be put on the special support. It must be hanging, for instance in a traverse.

---

**WARNING**

To put down the on-load tap-changer to stand on the floor with the tie-in resistor switch mounted means a great risk for tilting the on-load tap-changer with risk for injuries to people and damage of the equipment.
8. Remove the transport locking and the lifting eyes with fasteners from the top section of the tap selector, see Fig. 8.

---

**CAUTION**

*Do not operate the tap selector until it is connected to the diverter switch housing.*

---

![Diagram showing transport locking and lifting eyes](TC_00216)

---

**Fig. 8.

9. Lift the diverter switch housing in position and fit the tap selector to the diverter switch housing, see Fig. 4. The tap selector driving pin shall fit into the large gear wheel slot, see Fig. 9, A-A.

---

**CAUTION**

*The driving crank on the tap selector must not be moved more than slightly to engage the slot in the large gear wheel of the diverter switch housing.*

---

10. Insert four M10x40 screws and washers, see Fig. 10, through the tap selector upper part to the four supports of the diverter switch housing. Tighten the screws.

---

**WARNING**

*The diverter switch housing and the tap selector contains moving parts. Be cautious!*

---

11. Connect the supplied conductors between the diverter switch housing and tap selector, see Fig. 9. The conductor ends and their connecting points have the same markings. Fasten the conductors with cleats, see Fig. 9, A-A. The number of conductors is varying depending on the rated through current and the type of connection.

12. If the impulse withstand voltage to earth exceeds 380 kV, insulate the connections on the tap selector by winding paper around them to a thickness of approximately 3 mm, see Fig. 7, B-B. The paper shall be of the same quality as used for insulation of conductors within the active part of the transformer.

13. If the impulse withstand voltage to earth exceeds 380 kV, mount the supplied shielding ring (DS10) at the bottom plate of the tap selector, see Fig. 9, detail D.

---

**CAUTION**

*After mounting the shielding ring, the on-load tap-changer must not stand on the shielding ring.*

---

14. Continue with section 3.3.
Fig. 9. UCD.N (star point type)

Fig. 10.

Shielding ring (not to be dismantled)

Upper shielding ring (To be dismantled)

V-contacts

Lower shielding ring (To be dismantled)

Support
Plain washer 14x30x2.5
Spring washer

Socket screw M10x40 (4x)

Socket screw M8 x 25 (4x)

Spring washer

Locking nut M8

Detail D

Slot in the large gear wheel of the diverter switch housing

Driving pin of the tap selector

Tap selector

Current collector

Conductor

Shielding cap

Diverter switch housing

Plain washer 13x34x3

Spring washer

Socket screw M12 x 45

Locking nut M12

B – B

A – A

Cleat

Insulating nut M16

Insulating screw M16

TC_00095
3.1.3 UCD with Tap Selector size G

1. Unpack the diverter switch housing and the tap selector. Remove the drying agents and the yellow cushions with vapour phase inhibitor for protection against corrosion in the tap selector and on the diverter switch housing.

2. Fit the gasket into the on-load tap-changer flange on the transformer cover, see Fig. 5 (This gasket is not included in the delivery).

3. When the impulse withstand voltage to earth exceeds 380 kV, the on-load tap-changer is provided with shielding rings. Before mounting the diverter switch housing on the transformer cover the lower shielding ring must be dismantled, see Fig. 17.

4. Lift the diverter switch housing in the lifting eyes as shown in Fig. 3 and lower it carefully through the opening in the transformer top cover, see Fig. 4. Place the diverter switch housing correctly in position for mounting the outer shaft system (see transformer drawing). The studs on the flange on the transformer cover shall fit into the flange of the diverter switch housing. Mount thirty washers and M16 nuts, see Fig. 5. Tighten the nuts.

5. If the impulse withstand voltage to earth exceeds 380 kV, mount the dismantled shielding ring on the diverter switch housing, see Fig. 17.

6. Put the tap selector in position for joining to the diverter switch housing. Lift in the lifting eyes as shown in Fig. 3.

   In case the on-load tap-changer is equipped with a tie-in resistor for mounting under the tap selector, the tie-in resistor is mounted after joining the tap selector to the diverter switch housing. After mounting the tie-in resistor, the on-load tap-changer must not be put down standing on the tie-in resistor. It must be hanging, for instance in a traverse.

7. Remove the transport locking and the lifting eyes with fasteners from the top section of the tap selector, see Fig. 11.

---

**CAUTION**

Do not operate the tap selector until it is connected to the diverter switch housing.

---

**Fig. 11.**
8. Lift the diverter switch housing in position and fit the tap selector to the diverter switch housing, see Fig. 4. The tap selector driving pin shall fit into the large gear wheel slot, see Fig. 17, A-A.

**CAUTION**

_The driving crank on the tap selector must not be moved more than slightly to engage the slot in the large gear wheel of the diverter switch housing._

9. The tap selector (size G) can be delivered with mechanical end position barrier, see Fig. 17, C – C. This device prevent the tap selector to pass the end positions, if the on-load tap-changer and the motor-drive mechanism are not correctly assembled.

The pin of the end position barrier mechanism shall fit in the hole of the diverter switch housing, see Fig. 19.

**WARNING**

_The diverter switch housing and the tap selector contains moving parts. Be cautious!_

10. Insert six M12x50 screws and washers, see Fig. 18 through the selector upper part to the six supports of the diverter switch housing. Tighten the screws.

11. If the on-load tap-changer should be equipped with tie-in resistors, the tie-in resistors are integrated with a tie-in resistor switch in a cylinder, see Fig. 12. The unit is packed separately.

**CAUTION**

_Neither the tap selector nor the on-load tap-changer should be standing on the tie-in resistor switch after assembly._

The tap selector has to be in the delivery position (shown on the single phase diagram delivered with the unit).

a. Lift the on-load tap-changer high enough to make the mounting of the tie-in resistor unit possible.

b. Remove the locking device from the potential switch, see Fig. 12.

**CAUTION**

_The shaft of the tie-in resistor switch must not be turned._
c. Dismount the screw and the washers in the bottom of the tap selector, see Fig. 13.
d. Lift the tie-in resistor unit against the tap selector and connect the potential connection with the removed screw and washers, see Figs. 14 and 15.

e. The pin in the tap selector shaft must be in position to fit in the slot of the potential switch shaft. The lip in the potential switch cylinder shall fit in the cut of the tap selector, see Fig. 14.

**Fig. 14.**

---

**Fig. 15.**
f. Lift the tie-in resistor switch. Check that the potential connection do not disturb the function of the potential switch and the tap selector. Turn the tie-in resistor cylinder counter clock-wise so the brackets of the potential switch enter the center supports of the tap selector, see Fig. 16. Mount the insulating bolts (3 pcs) and nuts and lock them according to the same principle used for insulating bolted joints in the transformer active part (PVA-glue or similar).

Fig. 16.

Insulating nut
Tap selector center support
Insulating bolt
Bracket of the potential switch

Terminals for connection to active part.

TC_00175

g. Electrical connection is done under section 3.3.
Fig. 17. UCD.N
(star point type)

Shielding ring (to be dismantled)
Diverter switch housing

V-contacts
X-contacts
Cleat
Conductors
Tap selector
Insulating screws M16x130 and nuts

Driving pin of the tap selector
Slot in the large gear wheel of the diverter switch housing
Spacer (Al) Ø40
Cleat
Insulating screws and nuts M16

Fig. 18.

Plain washer 13x34x3
Spring washer
Socket screw M12 x 50 (6x)

Plain washer 13x34x3
Socket screw M12 x 45
Spring washer
Locking nut M12

The tap selector can be delivered with mechanical end position barrier.
12. Connect the supplied conductors between the diverter switch housing and tap selector, see Fig. 17. The conductor ends and their connecting points have the same markings. Fasten the conductors with cleats, see Fig. 17, A-A. The number of conductors is varying depending on the rated through current and the type of connection.

13. If the impulse withstand voltage to earth exceeds 380 kV, insulate the connections on the tap selector by winding paper around them to a thickness of approximately 3 mm, see Fig. 7, B-B. The paper shall be of the same quality as used for insulation of conductors within the active part of the transformer.

14. Continue with section 3.3.
3.2 Yoke-Mounting

(Pre-mounting on active part of the transformer).
(For Cover-Mounting, see section 3.1).

The top section of the diverter switch housing is designed to be divided into an upper and a lower flange, see Figs. 21 and 23, to fit the yoke-mounting.

![Diagram of yoke-mounting](image)

Fig. 20. Yoke mounting principle

Before lifting and joining the diverter switch housing to the transformer cover, it is placed on a yoke fork (two beams) which is fastened on the upper transformer yoke, see Fig. 20.

**NOTE:** The guiding pins used on the yoke fork should be insulated with bushings in order to prevent circulation current in the yoke fork when the transformer is energized.

The mounting of the on-load tap-changer on the yoke fork can be carried out by two alternative methods depending on when the transformer ratio measurement is carried out:

- Transformer ratio measurement before drying process, see section 3.2.1.
- Transformer ratio measurement after drying process, see section 3.2.2.

For mounting on transformer cover after drying process, see section 3.2.3.

---

**CAUTION**

To avoid seizing, do not operate the on-load tap-changer, neither during the drying process nor afterwards, until the diverter switch housing is filled with oil and the tap selector is immersed in oil.
3.2.1 Mounting when the Transformer Ratio Measurement is carried out before Drying

1. Assemble the diverter switch housing and the tap selector as follows:
   - UCC with tap selector IV, see section 3.1.1, steps 1, 6-13
   - UCD with tap selector III, see section 3.1.2, steps 1, 6-13
   - UCD with tap selector G, see section 3.1.3, steps 1, 6-13

2. Lift the on-load tap-changer onto the yoke fork (use the lifting eyes at the top of the on-load tap-changer, see Fig. 3). Place the on-load tap-changer correctly in position for mounting the outer shaft system (see transformer drawings). Insert the supplied guiding pins DS 7 and insulating bushings (not included in the delivery) in the lower flange, see Fig. 21. The guiding pin shall be secured by centre punch marks in the pins, see Fig. 21.

![Fig. 21.](image)

3. Mount the conductors between the regulating winding and the tap selector according to section 3.3.

4. Carry out transformer ratio measurement according to section 3.4 in this guide.

![Fig. 22.](image)
5. Dismantle the diverter switch housing cover, see Fig. 23, by removing the screws. Store the cover fasteners and O-ring in a dust-free place.

6. If vapour phase process is going to be used: Remove the plug in the T-coupling for the oil draining tube. To open the bottom valve, let the "bottom valve key" (DS16), slide down through the oil draining tube and, when it has gripped the valve, rotate it in anti-clockwise direction until there is stop after approximately 6 turns, see Fig. 24. Remount the dismantled plug.

7. Dismantle the diverter switch by carefully lifting it straight out of the diverter switch housing by its lifting eye, see Fig. 23. Store the diverter switch in a dry and dustfree place.

8. Remove the oil draining tube by hand or by means of a pipe wrench, using a cloth between the tube and the pipe wrench to protect the tube. Store the tube in the diverter switch housing until it is remounted.
9. Loosening the screws for the four clamps that keep the bevel gear and remove the bevel gear. Take care of O-ring, clamps and fasteners. Store the bevel gear in a dust-free place.

**CAUTION**

*Do not remove the locking device of the bevel gear.*

10. Mount the locking device DS 4 on the driving shaft of the on-load tap-changer, see Fig. 23.

**CAUTION**

*The driving shaft must not be rotated.*

11. Remove the nuts and washers inside the upper flange and remove the flange by lifting in the lifting eyes. Store the upper flange, its O-ring and fasteners in a dry and dust-free place.

12. The on-load tap-changer is now ready for drying together with the transformer. Follow instructions in chapter 4.

### 3.2.2 Mounting when the Transformer Ratio Measurement is carried out after Drying

1. Assemble the diverter switch housing and the tap selector as follows:
   - UCC with tap selector IV, section 3.1.1, steps 1, 6-13
   - UCD with tap selector III, section 3.1.2, steps 1, 6-13
   - UCD with tap selector G, section 3.1.3, steps 1, 6-13

2. Follow instructions according to section 3.2.1, steps 5-12.

3. Apply the lifting equipment LL330 016-D in position according to Fig. 25.

**NOTE:** The lifting equipment must be tilted when applying.

4. Lift the on-load tap-changer onto the yoke fork (use the lifting equipment according to step 3). Place the on-load tap-changer correctly in position for mounting the outer shaft system (see transformer drawing). Insert the supplied guiding bolts DS 7, and insulating bushings (not included in delivery) in the lower flange, see Fig. 21. The guiding bolts shall fit into the holes in the yoke fork and be secured by punch marks in the pins. When the on-load tap-changer is in place, remove the lifting equipment.

5. Mount the conductors between the transformer winding and the tap selector according to section 3.3.

6. The on-load tap-changer is now ready for drying together with the transformer. Follow the instructions in chapter 4.
3.2.3 Mounting on Transformer Cover

(After drying process.)

1. After the transformer cover is mounted, place the gasket in the flange for the on-load tap-changer. (This gasket is not included in the on-load tap-changer delivery).

*NOTE:* Do not insert the studs for the upper flange in the transformer cover flange. This is carried out in step 8.

2. Remove the locking device DS 4 from the driving shaft, see Fig. 26.

__________________________
**CAUTION**

Be careful not to drop the locking device and the screw.

__________________________
**CAUTION**

The driving shaft must not be rotated.

__________________________

3. Place the O-ring in its groove in the lower flange.
4. Place the upper flange over the opening in the transformer cover. Turn the upper flange so the flange for the bevel gear is aligned with the driving shaft. The screws in the lower flange shall fit into the holes in the upper flange, see Fig. 28.

5. Apply the lifting equipment according to Fig. 27 and lift the on-load tap-changer slowly until it just touches the upper flange.

![Fig. 26.](image)

6. When the flanges touch, mount thirty M8 nuts, spring washers and washers, see Fig. 28. Tightening the nuts alternately until fully home. Retighten all nuts with 24.5 Nm.

7. Place the O-ring of the bevel gear unit in its groove in the upper flange, see Fig. 29. Remount the bevel gear unit in the position it had before dismantling (make sure the pin in the bottom of the gearbox fits into the hole in the top section) and make sure that the pin in the vertical shaft end fits into the driving shaft slot, without rotating the driving shaft. Fix the gear unit in the flange by its four clamps screws M8x20 and washers.
**CAUTION**

The gear box must not be forced down! If the coupling does not engage, lift the gear box and adjust the setting of the driving pin.

8. Insert thirty M16 studs through holes in the upper flange, down into threaded holes in the flange of the transformer cover. If the studs do not fit, the position of the on-load tap-changer must be adjusted, which may require lifting. After mounting the studs, remove the lifting tool and tighten the nuts.

9. Mount the oil draining tube, see Fig. 28. If a pipe wrench is used, there must be cloth protection between the wrench and the tube.

10. Remove the plug at the end of the T-coupling, see Fig. 30, slide down the "bottom valve key", and close it by turning it clockwise approximately 6 turns. Tighten with 40 Nm. Remount the plug.

11. Install the diverter switch according to section 4.3.
3.3 Connection to Terminals

Connection to the tap selector should follow the connection diagram supplied with the on-load tap-changer.

In order to obtain maximum reliability of the tap selector contacts, the temperature rise of the conductors connected to the tap selector should be kept as low as possible and should in no case exceed 30K above the surrounding oil.

--- CAUTION ---

*All terminals must have conductors or connections.*

If there are connections between parallel conductors from the diverter switch on the tap selector terminal, the parallel conductors from the active part of the transformer shall also be connected together on the tap selector terminals (in order to avoid circulation currents through the tap selector contacts, see Fig. 31).

![Diagram of tap selector connections](TC_00130)

*Fig. 31.*

If the impulse withstand voltage to earth exceeds 380 kV, the conductor connections on the tap selector shall be insulated by winding paper around them to a thickness of 3 mm, see Fig. 7, B-B. The paper shall be of the same quality as used for insulating conductors within the active part of the transformer.

--- CAUTION ---

*All connections shall be made carefully and in such a way that there is no risk that they can become disconnected. The conductors must not cause mechanical strain on the tap selector terminal. Each conductor shall be curved to take up expansion. See Fig. 32.*
NOTE: When yoke mounted, inserts (wooden blocks, or similar) are placed between the yoke fork and the lower flange of the diverter switch housing, see Fig. 33, making the conductors mounted at correct final height. The wooden blocks must be removed before mounting the on-load tap-changer on the transformer cover.

CAUTION
It is recommended that the distance between the cylinders or the bars of the tap selector and any conductor is at least 50 mm. The transformer manufacturer is responsible for keeping sufficient large insulation distances.
3.4 Transformer Ratio Measurement

The transformer ratio measurement may be carried out before or after the drying process.

If it is carried out before drying, no drive system is mounted. The on-load tap-changer has thus to be operated directly on the shaft coupling of the bevel gear on the upper flange. A special hand crank can be ordered from ABB, see section ”1.2 Required Tools” in this guide.

If it is carried out after drying, it is recommended to be carried out when the drive system is mounted, see chapter 5 ”Final Assembly” in this guide, to simplify the operation of the on-load tap-changer.

---

**CAUTION**

The on-load tap-changer should be operated through the whole operating range, both in lower and raise direction, when carrying out ratio measurement.

---

**CAUTION**

Before process, the on-load tap-changer is allowed to be operated maximum three times through the regulating range unless it is not immersed. After process the on-load tap-changer has to be immersed in oil before operating.

---

**CAUTION**

The end positions must not be overrun during ratio measurement. When operating the on-load tap-changer without drive system, check the designation of the end positions on the single phase diagram and watch the position indicator in the bevel gear in order to avoid overrunning of the end position.

---

**CAUTION**

Watch the voltmeter during the on-load tap-changer operations. No fast voltage drops may occur during operation. If such drops occur, the diverter switch is installed incorrectly or the on-load tap-changer is not correctly connected to the winding.
3.4.1 Transformer Ratio Measurement before Drying

1. Remove the locking device from the gear unit on the upper flange, see Fig. 22. Keep the locking device for remounting after transformer ratio measurement. Also remove the cover of the bevel gear to get access to the position indicator. Keep all fasteners and the gasket for remounting. Note the position of the on-load tap-changer.

2. Operate the on-load tap-changer by applying the special hand crank mentioned above on the shaft coupling of the bevel gear. Adjust the length of the handle. Be careful not to damage the coupling.

*NOTE: When operating through the middle position on an on-load tap-changer with change-over selector, the torque on the hand crank will be higher.*

3. After the measurement, the on-load tap-changer must be operated in the direction and to the position given in the single-phase diagram as the delivery position. The right position designation should be shown in the "window" in the position indicator in the bevel gear of the on-load tap-changer and the "window" should face the red point in the bevel gear housing exactly, see Fig. 39. Then remount the locking device on the bevel gear and the cover of the bevel gear. Fit the gasket properly.

3.4.2 Transformer Ratio Measurement after Drying

---

**CAUTION**

*To avoid seizing, do not operate the on-load tap-changer until it is filled with oil.*

---

Carry out this measurement after the drive system is mounted.

Operate the on-load tap-changer by means of the motor-drive mechanism.

Operate the on-load tap-changer in the direction and to the position given in the single-phase diagram as the delivery position after the measurement.
4 Drying

The on-load tap-changer is dried together with the transformer using one of the following processes: alternating hot-air and vacuum or vapour-phase at a temperature of max. 135 °C (275 °F).

4.1 Observations before Processing

1. If not earlier done, lift the diverter switch out from the housing, see section 3.2.1 steps 5 and 7. The pressure relay with its test vent and the oil filter, if any, should be dismantled and kept protected from dust e.g. in a plastic bag or in their original packing.

2. Do not expose the diverter switch housing to any pressure difference between inside and outside during the vapour-phase process. During the hot air and vacuum process, the maximum permitted pressure differential is 100 kPa at a temperature of 135 °C (275 °F).

During the vapour-phase process the bottom valve of the diverter switch housing should be open. To open the bottom valve, proceed as follows, see Fig. 24:

a. Remove the plug on top of the oil draining tube, see Fig. 24.

b. Use the bottom valve key (DS16) through the oil draining tube, see Fig. 24.

c. Turn the valve anticlockwise to its stop, approximately 6 turns.

d. Remount the plug.

e. Remove the O-ring in the lower flange (for mounting on active part only)

4.2 Observations after Processing

CAUTION

To avoid seizing, do not operate the on-load tap-changer, neither during the drying process nor afterwards, until it is filled with oil.

1. Make sure that all liquid has been drained from the diverter switch housing when vapour-phase process has been carried out. Close the bottom valve, see section 3.2.3, step 10.

CAUTION

Make sure the bottom valve key is removed after the valve has been closed.

2. The cleats, on the upper section of the tap selector, holding the conductors between the diverter switch housing and the tap selector should be retightened (tightening torque 15 Nm) and locked by method specified by the transformer manufacturer for similar screw joints.
3. If a tie-in resistor from ABB is supplied, its screw joints are to be retightened (tightening torque 15 Nm) and locked by the method specified by the transformer manufacturer for similar screw joints.

4. If the tap selector has supporting plates these should also be retightened and locked by method specified by the transformer manufacturer for similar screw joints. (Only tap selector IV in reinforced design).

### 4.3 Installation of Diverter Switch

When yoke-mounted, carry out section 3.2.3 before installing the diverter switch.

---

**CAUTION**

Check the serial numbers to make sure that the diverter switch is mounted in the correct housing, see Fig. 34.

---

**CAUTION**

Make sure that the diverter switch housing is clean and free from water and that no foreign objects (tools etc.) are left in the housing.

---

**CAUTION**

Lower the diverter switch into its housing carefully so that neither the diverter switch nor the housing are damaged.

---

The diverter switch is provided with guiding slots on opposite sides that fit against the guiding bars in the diverter switch housing, see Figs. 34 and 35.

Rotate the diverter switch so the widest slot is aligned with the widest guiding bar, see Figs. 34 and 35.

When the diverter switch is lowered, check visually that its plug-in contacts are aligned with the contacts in the cylinder wall.

The top part of the diverter switch lifting device should be at least 1 mm under the level of the machined surface of the upper flange, see Fig. 36 when lowered to its final position. If not, push the diverter switch down to its final position.

In order to ensure that the diverter switch pin has engaged the coupling disc, carry out at least three tap change operations in one direction. A distinct sound is heard when the diverter switch operates which indicates that the driving pin of the diverter switch has been connected.

Insert the O-ring for the cover in the upper flange. Mount the on-load tap-changer cover. Turn the cover so the guiding pin in the housing is facing the guiding hole in the cover. (The cover has to be pressed down in order to overcome the spring force of the springs that hold the diverter switch pressed in place.) Insert screws and washers and tighten them.
Lifting eye

Lifting device

Springs

Shielding-ring (not on 380 kV)

Plug-in contacts

Guiding slots

Tie-rod

Driving pin

Serial number

TC_00128

Fig. 34.
Fig. 35.

Fig. 36.
Fig. 37.

Fig. 38.
5 Final Assembly

5.1 Mounting of the Motor-Drive Mechanism

See Fig. 39.

Proceed as follows:

1. Mount the motor-drive mechanism onto the transformer. The mounting holes on the transformer should be leveled within 1 mm. If adjustment is needed, shims should be used.

2. Install the bevel gear SA 21 on the edge of the transformer cover, see Fig. 40.

3. Check that the position indicator in the motor-drive mechanism shows the same position as the indicator inside the bevel gear of the on-load tap-changer, see Fig. 39.

________________________________________________________
WARNING
Do not energize the transformer before the on-load tap-changer and the motor-drive mechanism are correctly assembled.
Fig. 39. Position alignment for UCC, UCD with motor-drive mechanism type BUE
5.2 Mounting of External Drive Shafts

The external drive shafts consist of square tubes and shall be connected to the spherical shaft ends on bevel gears and motor-drive mechanism by means of two coupling halves. The square shafts and protective tubes must be cut before mounting.

---

**CAUTION**

*Before mounting of shafts and couplings, everything must be cleaned and greased for correct function.*

---

Apply a thin layer of grease, GULF-718EP Synthetic grease or Mobilgrease 28 or SHELL-Aero Shell Grease 22 to all spherical shaft ends and unpainted surfaces of the bevel gears.

**NOTE:** *The multihole couplings should be greased.*

The inclination of the shaft (the square tube) must not be more than $4^\circ$ (≈70mm for every 1000 mm shaft length).

**NOTE:** *The tubes around shafts and couplings are for protection.*

---

**CAUTION**

*Make sure that all locking devices (on the bevel gear of the on-load tap-changer and in the motor-drive) are mounted and the on-load tap-changer and the motor-drive are in the same service position.*

---

The arrangement of the driving shaft system is shown in Fig. 40. Check that the motor-drive mechanism is in its exact position according to Fig. 39 (the red mark on the brake disc facing the red mark on the brake assembly). If not, loosen the locking device and adjust it to its exact position. Remount the locking device.
SA10  Hose clip
SA11  Coupling halves
SA12  Hexhead cap screw M6
SA13  Washer
SA14  Vertical square shaft
SA15  Vertical protective tube
SA16  Vertical protective tube
SA17  Clamp
SA18  Hexhead bolt M10
SA19  Washer
SA20  O-ring
SA21  Bevel gear
SA22  Horizontal square shaft
SA23  Horizontal protective tube
SA24  Horizontal protective tube
SA25  Information plate

Fig. 40. External shaft system
5.2.1 Mounting of Vertical Drive Shaft

1. Mount the bevel gear SA21 on the transformer, with O-ring SA20, four clamps SA17, hexagon head bolts M10, SA18 and washers SA19, see Fig. 40.

2. Determine the dimension K2 between the spherical shaft ends, see Fig. 41a.

3. Cut the vertical square shaft, SA14, to dimension = K2 minus 6 mm. Remove the burrs.

4. Cut the protective tubes SA15 and SA16 so both of them get the same length LB2 according to the table 3 below.

Table 3. Length dimensions for LB2

<table>
<thead>
<tr>
<th>K2 = 200 to 290 mm</th>
<th>K2 = 291 to 600 mm</th>
<th>K2 = greater than 600 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>LB2 = ( \frac{K2+180}{2} ) mm</td>
<td>LB2 = ( \frac{K2+220}{2} ) mm</td>
<td>LB2 = ( \frac{K2+410}{2} ) mm</td>
</tr>
</tbody>
</table>

Example: K2 measured to 350 mm. LB2 is then \( \frac{350+220}{2} = \frac{570}{2} = 285 \text{ mm} \)

5. See Fig. 41b. Fit two coupling halves, SA11, on one end of the square shaft with six screws SA12 and washers SA13. Push the shaft to the bottom of the fitting in the coupling halves. Tighten the two screws A, see Fig. 41h, first and then the other. Put on the two protective tubes, SA15 and SA16, (the greater diameter upmost) and two hose clips SA10.

6. See Fig. 41c. Connect the square shaft with the mounted coupling halves to the shaft of the bevel gear. Mount two coupling halves SA11 to the other end of the square shaft and the shaft of the motor-drive mechanism. Push the shaft to the bottom of the fitting in the coupling halves. Tighten the screws lightly and check that the shaft can be moved approximately 2 mm in axial direction (axial play). Check the dimension shown in Fig. 41e. Tighten the screws A first and thereafter the other.

7. Fig. 41d. Mount the tube with the greater diameter, SA16, to the bevel gear with a hose clip and the other SA15 to the flange on the motor-drive mechanism. Leave about 3 mm play to the flange ring (see Fig. 41f) for water draining.

**NOTE:** The tube with greater diameter shall be mounted to the bevel gear.

**NOTE:** Tighten always the screws A first and then the other, according to Fig. 41h.
5.2.2 Mounting of Horizontal Drive Shaft

1. Determine the dimension K1 between the spherical shaft ends, see Fig. 42a.

![Fig. 42a.]

2. Cut the horizontal square shaft SA22 to dimension = K1 minus 6 mm. Remove the burrs.

![Fig. 42b.]

3. Cut the protective tube SA23 and SA24 in the unslotted end so that both of them get the same length LB1 according to the table below.

**NOTE:** Protective tube SA23 has one slotted end.

### Table 4. Length dimension for LB1

<table>
<thead>
<tr>
<th>Dimension</th>
<th>K1 = 170 to 290 mm</th>
<th>K1 = 291 to 600 mm</th>
<th>K1 = greater than 600 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>LB1</td>
<td>(\frac{K1+200}{2}) mm</td>
<td>(\frac{K1+250}{2}) mm</td>
<td>(\frac{K1+500}{2}) mm</td>
</tr>
</tbody>
</table>

**Example:** K1 measured to 400 mm. LB1 is then \(\frac{400+250}{2} = \frac{650}{2} = 325\) mm

**NOTE:** If K1 is greater than 600 mm the mounted tubes shall overlap each other at least 300 mm. Dismounting and inspection of the couplings should be possible when one of the tubes is pushed into the other.

4. Fit two coupling halves, SA11, on one end of the square shaft with six screws SA12 and washers, SA13. Push the shaft to the bottom of the fitting in the coupling halves. Tighten the two screws A first and then the others, see Fig. 41h. Put on the two protective tubes, SA23 and SA24, the slotted end of SA23 in the non-overlapping end, and two hose clips SA10, see Fig. 42b.

5. Dismount the locking device on the bevel gear of the diverter switch housing by loosing the two M5 crosshead screws, see Fig. 42a.
6. Connect the square shaft with the mounted coupling halves to the shaft of the bevel gear SA21, see Fig. 42c. Mount two coupling halves SA11 to the other end of the square shaft and to the shaft of the bevel gear on the on-load tap-changer. Push the shaft to the bottom of the fitting in the coupling halves. Tighten light the screws and check that the shaft can be moved approximately 2 mm in axial direction (axial play). Check the dimension shown in Fig. 41e. Tighten the two screws A first and thereafter the other, see Fig. 41h.

7. The motor-drive mechanism and the on-load tap-changer should have the same indicated tap position and be in their exact positions.

The motor-drive mechanism and on-load tap-changer are in the same position when the position indicators in both of them show the same position, see Fig. 39.

The motor-drive mechanism is in exact position since section 5.2 has been carried out.

The on-load tap-changer is in exact position when the "window" where the position is read in the bevel gear is facing the red point in the gear box housing exactly, see Fig. 39.

If the gear box is not in its exact position, see Fig. 39, loosen the two screws in the multihole coupling on the gearbox, see Fig. 42d, and find the position of the screws that positions the opening in the brass toothed wheel closest to the red point in the gear box housing. The deviation from exact alignment is given in Fig. 39. Tighten the screws.

---

**CAUTION**

Assembly with the on-load tap-changer and the motor-drive mechanism in different operating positions may cause a transformer break down.
8. Push the two protective tubes on to the bevel gears and clamp them with hose clips, SA10, see Fig. 42e.

**NOTE:** The slot of the protective tube SA23 shall be facing downwards.

Apply the self-adhesive information plates SA25 around the tubes on about the middle of the tube length.

---

**WARNING**

The bevel gear contains moving gears. Be cautious!

### 5.2.3 Before Operation

1. Check again that the on-load tap-changer and the motor-drive mechanism are in the same position.

2. Remove the locking device of the motor-drive mechanism, see Fig. 43.
5.3 Pressure Relay

5.3.1 General

The diverter switch housing of the on-load tap-changer is supplied with a pressure relay. In the event of overpressure in the diverter switch housing, and if correctly connected, the relay trips the transformer main circuit breakers. It is also recommended to connect the pressure relay in the trip circuit of the power supply during testing of the transformer.

--- CAUTION ---

After a pressure relay trip, follow the instructions in the chapter “Pressure Relay” in the Repair Guide.

--- CAUTION ---

To take the transformer into service after a pressure relay trip without carrying out a careful investigation of the diverter switch by lifting it out of the diverter switch housing, and repairing faults, if any, may cause severe damages to the on-load tap-changer and the transformer.

The pressure relay can easily be tested by applying air pressure by means of a pump to the test tap on the valve and the handle can be pad-locked in the service position.

--- CAUTION ---

The pressure relay is a calibrated monitoring instrument. It must be handled with care and protected against careless handling or any kind of mechanical damage. Do not open the package of the pressure relay until you are about to install it on the on-load tap-changer.

5.3.2 Installation

Remove the cover from the flange on the upper part of the on-load tap-changer and install the pressure relay. Make sure that the gasket is correctly fitted.

Remove the cover from the pressure relay and connect the cables to the terminal block. The cable gland includes an O-ring sealing between the gland and the pressure relay housing.

If the gland has to be changed to another type, the seal against the housing must be secured by a gasket or sealing liquid (example Loctite 275).

Remount the cover.

--- CAUTION ---

Tighten the cable gland with care, torque max 5 Nm.
5.3.3 Checking at Commissioning of the Transformer

1. Set the valve handle in the test position as shown on the information plate.
2. Connect the air pump and the pressure gauge to the test tap on the pressure relay.
3. Raise the pressure until the pressure relay trips the circuit breakers for the transformer.
4. Read the pressure on the manometer and check against the pressure stated on the information plate. Max. permitted deviation is ± 10 %.
5. Check that the alarm signal disappears when the pressure is lowered.
6. After finishing the check, turn back the valve handle to service position.

5.4 Assembly of Accessories

All details which have been removed for the transport are specified on the packing list. The openings on the on-load tap-changer are sealed by transport covers.

1. Remove the transport covers.
2. Check the O-rings. Make sure they are pressed into the bottom of the groove on the flanges.
3. Assemble all remaining accessories. Tightening torque for the nuts according to section 1.8.
5.5 Connection to the Oil Conservator

*NOTE:* If oil filling is carried out under vacuum without oil conservator, this section is carried out after the oil filling.

Remove the transport cover on the flange for connection to the oil conservator. Make sure the O-ring is in place on the flange and connect the pipe to the oil conservator. Tighten the nuts.

---

**CAUTION**

*In case where the conservator is common for the transformer and the on-load tap-changer, an oil filter must be placed in the pipe between the on-load tap-changer and the conservator.*

---

Oil filter with housing can be ordered from ABB.
6 Oil Filling

6.1 Filling Methods and Restrictions

Oil filling can be carried out at atmospheric pressure or under vacuum. The wall between the diverter switch housing and the transformer tank is designed to withstand vacuum on one side and atmospheric pressure on the other side. It is not allowed to have vacuum on one side and the pressure of a high oil column on the other side.

NOTE: Oil filling may be carried out in different ways depending on what the transformer manufacturer finds convenient as long as the rules above are fulfilled and the on-load tap-changer is filled with oil to the correct level with a gas cushion on the top.

The methods below are recommended and if they are followed in detail no pressure limits are exceeded and oil levels and gas cushions will be correct.

After oil filling, a gas cushion should remain on the top of the oil in the diverter switch housing.

The connection to the oil conservator is designed to automatically give a gas cushion when filling at atmospheric pressure. When filling under vacuum a certain amount of oil has to be drained in order to obtain the gas cushion.

NOTE: The oil dissolves gases, especially if degassed oil is used. If the number of operations is low, the gas cushion may be dissolved in the oil. The oil level in the oil conservator should be checked after a month in service and if the oil level is lower than after the oil filling, (corrected for temperature differences), the gas cushion should be restored according to section 6.5 ”Restoring the Gas Cushion” in this guide.

6.2 Before Filling

At commissioning: Open the cover and check that the diverter switch housing is dry and clean. Check that the bottom valve is closed. Follow step 10 in section 3.2.3. Tightening torque 40 Nm (see Fig. 30). Remount cover as per section 4.3.
6.3 Filling at Atmospheric Pressure

1. Open the conservator valve, if any.
2. Dismantle the breathing device on the conservator for the on-load tap-changer.
3. Pump oil into the diverter switch housing via the oil valve (connection dimensions, see the dimension drawing for the on-load tap-changer). Continue until the conservator is filled to the correct level at the actual temperature. See even section 1.5.
4. Shut the oil valve and disconnect the pump.
5. Remount the breathing device. Make sure the connection to the breathing device is properly sealed.

---

**CAUTION**

*Do not energize the transformer earlier than three hours after oil filling in atmospheric pressure. This waiting period is needed to allow air bubbles to disappear.*

---

6.4 Filling under Vacuum

Filling under vacuum is not necessary but may be carried out with some of the following procedures. After filling under vacuum, no standing time is needed. The methods below ensure that no permitted pressure differentials are exceeded.

---

*Fig. 45.*

*Fig. 46. Oil filling at vacuum*
6.4.1 Oil Conservator Filled Afterwards

1. If an oil filter is mounted on the flange for the oil conservator (only on transformers with a common oil conservator for both the transformer and the on-load tap-changer), it should be removed.

2. Establish a connection between the transformer and the diverter switch housing, for instance by putting oil valves on the flange for the conservator and the flange for the gas operated relay respectively and connect a tube between the valves, see Fig. 46. Close the oil valve.

3. Open the valves mounted under point 2. Put the transformer under vacuum. (The on-load tap-changer is put under vacuum automatically).

4. Let oil in through the oil valve of the on-load tap-changer (for connection dimensions, see the dimension drawing for the on-load tap-changer).

5. Let an oil amount equal to or slightly less than what is given in section 1.4 enter into the diverter switch housing. When the on-load tap-changer is filled with oil, shut the oil valve.

6. When atmospheric pressure is restored in the transformer, shut the connection between the transformer and the on-load tap-changer by closing both the valves in the connection.

7. Remove the connection tube between the valves mounted under point 2.

8. Restore the gas cushion in the diverter switch housing according to section 6.5.1 "Restoring the Gas Cushion, procedure", point 2-6 in this guide.

9. Remove the oil valve on the flange for the conservator and remount the oil filter, if any. Connect the tube to the conservator. Make sure the O-ring is properly in place.

10. **Open the valve in the tube to the conservator.**

11. Fill oil to the correct level in the conservator according to section 1.5 in this guide.

12. Mount the breathing device on the oil conservator. Make sure the connection to the breathing device is properly sealed.

*NOTE: By using this method, the oil valve on the flange for the gas operated relay must be left there. The connection to the gas operated relay is made on the oil valve.*

6.4.2 Oil Conservator Filled under Vacuum

1. Establish a connection between the oil conservator for the transformer and the oil conservator for the on-load tap-changer.

2. Open the valve between the on-load tap-changer and the conservator and close the oil valve.

3. Put the transformer under vacuum. (The on-load tap-changer is put under vacuum automatically).
4. Let oil in through the oil valve of the on-load tap-changer. (For connection dimensions, see the dimension drawing for the on-load tap-changer).

5. Shut the oil valve when the oil level in the oil conservator is correct at the actual temperature, see even section 1.5.

6. When atmospheric pressure is restored in the transformer, remove the connection between the two conservators and connect the breathing device to the oil conservator for the on-load tap-changer. Make sure the connection to the breathing device is properly sealed.

7. Restore the gas cushion in the diverter switch housing according to section 6.5.1 "Restoring the Gas Cushion, procedure”, point 1-6 and 9 in this guide.

6.5 Restoring the Gas Cushion

Check the oil level in the oil conservator one month after oil filling. If the oil level is lower now than when the oil filling was finished (correct for temperature differences!) and no leakages are observed, the gas cushion has been solved in the oil and has to be restored.

The procedure below is used for on-load tap-changers without oil filter unit for continuous oil filtration. In case the on-load tap-changer is equipped with an oil filter unit for continuous oil filtration from ABB, and it is installed according to our recommendations, follow the instructions in "Oil filter unit for on-load tap-changers, manual” for restoring the gas cushion.

CAUTION

To operate the on-load tap-changer with a too small or no gas cushion means a risk for a trip of the pressure relay.

WARNING

The oil in the diverter switch housing may be hot. Be cautious!

WARNING

There is always a cushion of explosive gases in the top of the diverter switch housing. No open fire, hot surfaces or sparks may be present during opening of the housing or draining from the valve. After the cover is removed let the gas vent away approximately 15 min before any work is started.

WARNING

Before any work is carried out on the on-load tap-changer:
Make sure that the transformer is disconnected and that earthing is properly carried out. Obtain a signed certificate from the engineer in charge.
6.5.1 Procedure

1. Close the valve in the tube to the conservator.
2. Connect the oil pump to the oil valve. (For connection dimensions, see the dimension drawing for the on-load tap-changer), see Figs. 45 and 47.
3. Open the oil valve and the air release valve.
4. Start the oil pump and drain approximately 45 litres of oil into a clean and dry container.
5. Close the air release valve.
6. Close the oil valve and disconnect the pump.
7. Connect the output side of the pump to the oil valve.
8. Open the oil valve.
9. Open the valve in the tube to the conservator!
10. Pump the earlier drained 45 litres of oil back into the diverter switch housing.
11. Close the oil valve and disconnect the pump.
12. The level in the oil conservator and the gas cushion are now restored.

---

**CAUTION**

Avoid to do the restoring in damp weather since moisture will get into the diverter switch housing. If the restoring has to be done in such weather, the incoming air has to be dehydrated and the drained oil protected from water.

---

*Fig. 47.*
7 Electrical Connection and Testing

7.1 General

Before the transformer is energized, tests have to be carried out to make sure that all mechanical and electrical connections are correct, and to check the proper functioning of the motor-drive mechanism and the on-load tap-changer.

When testing the transformer, the on-load tap-changer can be operated either by the hand crank or electrically. When operating electrically the motor-drive mechanism is connected according to section 7.2.

7.2 Connecting and Testing the Motor-Drive Mechanism and the On-Load Tap-Changer

Connect earth connection from the transformer to the earth terminal on the on-load tap-changer flange.

Connect earth connection from the transformer to the earth terminal on the motor-drive mechanism.

Connect the motor supply and the control supply to the correct terminals in the motor-drive mechanism as shown by the circuit diagram supplied with the on-load tap-changer.

Operate the motor-drive mechanism by means of the hand crank to a position in the middle of the range but not in a through position ( = a position with a letter in).

Turn the control selector switch to position LOCAL. Then give an impulse for RAISE-operation. If the phase sequence is wrong, (three-phase supply), the motor-drive mechanism will start in LOWER-direction. The motor-drive mechanism will stop when it has made approximately half of the complete operation and it will operate back and forth without the on-load tap-changer changes position until the control selector-switch is turned to position 0.

If the phase sequence is wrong, reverse two of the motor supply cables in order to get the correct sequence.

---

**WARNING**

Dangerous voltage!

Run the motor-drive mechanism and check that the red mark on the brake disc stops within the tolerance of ±25 degrees from exact position, see Fig. 39. For adjustment, see 1ZSE 5492-126, Maintenance Guide for UCC/UCD.
Operate the driving mechanism electrically between the end positions. Check the end stops. When trying to operate it electrically beyond the end position, the motor should not get started. Check the mechanical end stop by trying to hand crank it beyond the end position. After a couple of turns on the hand crank it should be mechanically stopped. Hand crank back to the end position (where the indicator flag is positioned in the middle). Operate the on-load tap-changer electrically to the other end position and repeat the test procedure above.

**WARNING**
The transformer should in no case be energized with an end stop out of order.

### 7.3 Electrical Tests on Transformer

Acceptance tests on the transformer or commissioning can now be performed.

### 7.4 After Energizing

**WARNING**
Before any work is carried out on the on-load tap-changer:
Make sure that the transformer is disconnected and the earthing is properly done.
Obtain a signed certificate from the engineer in charge.
8 Transport

8.1 Dismantling before Transport

The on-load tap-changer is usually transported without accessories (pressure relay, motor-drive mechanism, bevel gear and drive shafts) to prevent damage to them. To make sure that everything is set up properly on site with a minimum of work, it is important to put the on-load tap-changer in the position and operated from the position given in the single-phase diagram delivered with the unit and fit locking devices properly during dismantling in the transformer factory. Dismantling of motor-drive mechanism and drive shafts is done in the opposite order of assembly.

8.1.1 Dismantling Preparations

NOTE: Before dismantling, mark the details to facilitate identification.

Check the disc brake in the motor-drive mechanism. Use the hand crank to adjust the position so the red mark on the brake disc, exactly matches the mark on the brake pad assembly, see Fig. 39. Install the locking device on the motor-drive mechanism, see Fig. 43.

1. If the horizontal shaft should be dismantled: See Fig. 40.

Loosen the hose clips holding the protection tubes to the bevel gears. Push one of the protective tubes into the other. Loosen the screws holding the coupling halves in one end of the shaft and detach them. Detach the horizontal shaft. Mark the details.

Remount the locking device on the bevel gear of the diverter switch housing, see Fig. 42a.

2. If the vertical shaft should be dismantled: See Fig. 40.

Loosen the hose clips holding the protective tubes to the bevel gear and Motor-Drive Mechanism. Push one of the protective tubes into the other. Detach the screws holding the bevel gear. Detach the bevel gear by carefully lifting it off the shaft while holding the vertical shaft. Detach the vertical shaft including protective tubes by lifting it off the coupling of the motor-drive mechanism.

3. Pack screws, clamps, protective tubes, shafts, hose clips, protection cover, coupling halves, bevel gear and seals for transportation to site.

4. If the pressure relay should be dismantled, see Fig. 44.

Remove the electrical connection to the pressure relay and loosen the nuts. Remove the pressure relay and put it back in the delivery package. Mount the O-ring and the cover. Tighten the nuts.

5. If other accessories are to be dismantled of transport reasons, pack them back in the packages they were delivered in and put back the transport covers. Mount the O-rings and tighten the nuts.
8.2 Oil Level During Transport

The following adjustments of the oil level should be carried out when the on-load tap-changer should be transported.

---

**CAUTION**

*Take care to avoid ingestion of moist air when oil is drained. If the ambient air is moist, let incoming air pass through a dehydrating breather with slow air flow to obtain proper dehydration.*

---

8.2.1 Transformer filled with Oil

The transformer is transported filled with oil. When the transformer is transported filled with oil the on-load tap-changer should also be transported filled with oil.

8.2.1.1 Conservator mounted

The diverter switch housing should be filled to normal operating level and the valve to the conservator should be open.

8.2.1.2 Conservator dismounted

The oil level of the diverter switch housing should be lowered to 150 mm below the upper edge of the housing.

When the conservator is removed, take off the cover of the diverter switch housing and drain oil with a pump to 150 mm below the upper edge of the housing. Remount the cover. Turn the cover so the guiding pin in the housing is facing the guiding hole in the cover. Make sure the gasket is properly in place. Seal all flange connections by mounting gaskets and covers. Shut all valves.

8.2.2 Transformer drained

The transformer is transported without oil. When the transformer is transported without oil the on-load tap-changer should also be transported without oil.
8.2.2.1 Conservator mounted

Drain the oil from the diverter switch housing by means of a pump connected to the oil valve. Let the on-load tap-changer be in contact with the ambient air through the breathing device on the conservator.

8.2.2.2 Conservator dismounted

Drain the oil from the diverter switch housing by means of a pump connected to the oil valve. Open the air release valve, see Fig. 47, if necessary.

Seal the diverter switch housing against the ambient air by mounting covers with gaskets and shut all valves.

9 Commissioning

This chapter describes tasks to be carried out on the on-load tap-changer when the transformer is being installed and tested on site.

--- CAUTION ---

The motor-drive mechanism must be protected against condensation.

Energize the heater when power is available. When not, put drying agent inside the motor-drive cabinet and seal the vents.

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Fig. 48. On-load tap-changer system

Fig. 48 shows the arrangement of the on-load tap-changer, motor-drive mechanism and driveshafts.

The pressure relay is usually delivered in a separate package and installed at commissioning. Depending on the transport requirements, the transformer may be delivered with the motor-drive mechanism and drive-shaft system mounted or not mounted. The on-load tap-changer may be delivered filled with oil or without oil. Please use the relevant parts of this manual to carry out commissioning.

For information about tools, materials and oil required, see relevant parts in chapter 1 of this guide.
9.1 Connection to the Oil Conservator

Follow appropriate parts of the instructions in section 5.5.
Connect the cables to the low level alarm contact on the oil level indicator.

9.2 Mounting the Motor-Drive Mechanism and Drive Shafts

The motor-drive mechanism and drive-shaft system should have been assembled and disassembled in the transformer factory according to the transport sections in this guide. Locking devices should have been installed when it was disassembled. If all locking devices are in place according to the transport sections in this guide, there should be no need for adjustments.

If necessary, sections 5.1 and 5.2 give complete information for fitting and adjusting of the shaft system.

NOTE: Check all fittings and alignments, even if the shaft system has been set up in the transformer factory.

9.2.1 Mounting of the Motor-Drive Mechanism

See Fig. 39.
Proceed as follows:

1. Mount the motor-drive mechanism onto the transformer. The mounting holes on the transformer should be levelled within 1 mm. If adjustment is needed, shims should be used.

2. Install the bevel gear on the edge of the transformer cover.

3. Check that the position indicator in the motor-drive mechanism shows the same position as the indicator inside the bevel gear of the on-load tap-changer.

4. Remove the drying agent inside the cabinet.

__________ CAUTION __________
Do not energize the transformer before the on-load tap-changer and the motor-drive mechanism are correctly assembled.

9.2.2 Disc Brake

Run the motor-drive mechanism and check that the red mark on the brake disc stops within the tolerance of ±25 degrees from exact position, see Fig. 39. For adjustment, see IZSE 5492-126, Maintenance Guide for UCC/UCD.
9.2.3 **Mounting of the External Drive Shafts**

The external drive shafts consist of square tubes and shall be connected to the spherical shaft ends on bevel gears and motor-drive mechanism by means of two coupling halves.

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**CAUTION**

*Before mounting of shafts and couplings, everything must be cleaned and greased for correct function.*

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Apply a thin layer of grease, GULF-718EP Synthetic grease or Mobilgrease 28 or SHELL-Aero Shell Grease 22 to all spherical shaft ends and unpainted surfaces of the bevel gears.

**NOTE:** The multihole coupling should be greased.

**NOTE:** The tubes around shafts and couplings are for protection.

The arrangement of the driving shaft system is shown in Fig. 40.

---

**CAUTION**

*Make sure that all locking devices (on the bevel gear, on the on-load tap-changer and in the motor drive) are mounted and the on-load tap-changer and the motor-drive are in the same service position.*

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Check that the motor-drive mechanism is in its exact position according to Fig. 39. The red mark on the brake disc facing the red mark on the brake assembly. If not, loosen the locking device and adjust it to its exact position. Remount the locking device.

9.2.4 **Mounting of the Vertical Drive Shaft**

1. Mount the bevel gear SA21 on the transformer with O-ring, SA20, clamps SA17 screws and washers, see Figs. 49b and 49d.

2. Put the square shaft SA14 with protective tubes SA15 and SA16 and hose clips according to Fig. 49a. Connect the square shaft with the mounted coupling halves to the motor-drive. Mount two coupling halves SA11 to the other end of the square shaft and the shaft of the bevel gear, see Fig. 49b. Push the shaft to the bottom of the fitting in the coupling halves, see Fig. 50c. Tighten the screws lightly and check that the shaft can be moved approximately 2 mm in axial direction (axial play). Check the dimension shown in Fig. 50f. Tighten the screws A first and thereafter the other, see Fig. 50d.

3. Mount the protective tube with the greater diameter, SA16 to the bevel gear with a hose clip, and the other tube SA15 to the flange of the motor-drive mechanism, see Fig. 49c. Leave about 3 mm play to the flange ring, see Fig. 49e, for water draining.
9.2.5 Mounting of the Horizontal Drive Shaft

1. Dismantle the locking device from the bevel gear on the diverter switch housing.

![Fig. 50a.](image)

2. Put the square shaft, protective tubes and hose clips according to Fig. 50b.

![Fig. 50b.](image)

![Fig. 50c.](image)

3. Connect the square shaft with the mounted coupling halves to the shaft of the bevel gear, see Fig. 50c. Mount two coupling halves SA11 to the other end of the square shaft and the shaft of the other bevel gear. Push the shaft to the bottom of the fitting in the coupling halves. Tighten the screws lightly and check that the shaft not can be moved more than 2 mm in axial direction (axial play). Tighten the screws A first and thereafter the other, see Fig. 50d.

4. The motor-drive mechanism and the on-load tap-changer should have the same indicated tap position and be in their exact positions.

The motor-drive mechanism and on-load tap-changer are in the same position when the position indicators in both of them show the same position, see Fig. 39.

The motor-drive mechanism is in exact position since section 9.2.2 has been carried out.

The on-load tap-changer is in exact position when the ”window” where the position is read in the bevel gear is facing the red point in the gear box housing exactly, see Fig. 39.

If the gear box is not in its exact position, loosen the two screws in the multihole coupling on the gearbox and find the position of the screws that positions the opening in the brass toothed wheel closest to the red point in the gear box housing. The maximum deviation from exact alignment is given in Fig 39. Tighten the screws.

---

**CAUTION**

*Assembly with the on-load tap-changer and the motor-drive mechanism in different operating positions may cause a transformer break down.*
**NOTE:** If the driving pin in the spherical end of the coupling does not fit in the slot in the coupling halves SA11, loosen the M8 screws and turn the multihole coupling just as much as needed to fit the driving pin into the slot in the coupling.

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**CAUTION**

Do not rotate the bevel gear shaft. The exact position will then be lost.

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Fit the screws to the holes that are aligned with the holes in the disc of the bevel gear on the on-load tap-changer. The disc might be turned a few degrees if needed for aligning the holes. Then remount the locking nuts and tighten, see Fig. 50g.

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5. Push the two protective tubes on the bevel gears and clamp them with hose clips SA10, see Fig. 50h.

**NOTE:** The slot of the protective tube SA23 shall be facing downwards.

The self-adhesive information plates SA25 are about the middle of the tube length.

**NOTE:** The door of the motor-drive mechanism can be locked with a pad-lock (not included in the delivery).

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**WARNING**

The bevel gear contains moving gears. Be cautious!
9.2.6 Before Operation

1. Check again that the on-load tap-changer and the motor-drive mechanism are in the same operating position, see section 5.1.

2. Remove the locking device of the motor-drive mechanism, see Fig. 51.

*NOTE:* The door of the motor drive mechanism cabinet can be locked with a padlock (not included in the delivery).

![Fig. 51. Locking device of motor-drive mechanism](image)

9.3 Pressure Relay

Follow appropriate parts of section 5.3.

9.4 Accessories

Remount all other accessories, if any, that have been dismounted for the transport. Follow appropriate parts of section 5.4.

9.5 Oil Filling

Follow appropriate parts of chapter 6.
9.6 Electrical Connection and Testing

Make all wiring work and make the appropriate tests according to chapter 7. Remove the drying agent inside the cabinet of the motor-drive mechanism.

9.6.1 Motor Protection

The function of the protective motor switch is checked. For three-phase AC motors, one of the phase fuses is removed and the function time of the protective motor switch is checked by a RAISE or LOWER operation. The protective motor switch should release within 60 seconds at a current setting equal to the rated current of the motor at the actual voltage.

**CAUTION**

*If the protective motor switch has not released within 60 seconds, disconnect the power and check the settings with the rating plate of the motor. Adjust if necessary and check again when the motor has cooled down.*

**WARNING**

The motor power voltage is dangerous.

Protective motor switches for DC motors and for single-phase AC motors are not tested.

9.6.2 Disc Brake

For BUE:

Run the motor-drive mechanism and check again that the red mark on the brake disc stops within the tolerance of ±25 degrees from exact position, see Fig. 39. For adjustment, see IZSE 5492-126, Maintenance Guide for UCC and UCD.

9.6.3 Counter

Check that the counter is functioning at RAISE and LOWER operations.
9.6.4 Position Transmitter and other Position Switches
Check the function of the position transmitter and other position switches.

9.6.5 Light
Check that the light is switched on when the door is opened and goes out when the door is closed.

9.6.6 Heater
Switch off all power supplies and feel with a finger that the heater has been warmed up during earlier tests. Switch on the power afterwards.

9.7 Putting into Operation
Put the LOCAL/REMOTE switch to REMOTE. Reset the drag hands. Make sure that no tools or foreign objects are left in the motor-drive cabinet or on the transformer cover. Close the door to the motor-drive.