On-load tap-changers, type UZE and UZF Maintenance guide
Original instruction

The information provided in this document is intended to be general and does not cover all possible applications. Any specific application not covered should be referred directly to ABB, or its authorized representative.

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Recommended practices

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

Before you start any work, make sure that the personnel doing the job have read and fully understood the maintenance 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.

Safety warnings

The following warnings and notes are used in the manual:

![WARNING](image)

WARNING indicates an imminently hazardous situation, which if not avoided will result in death or serious injury. This signal word is to be limited to the most extreme situations.

WARNING also indicates a potentially hazardous situation, which if not avoided could result in death or serious injury.

![CAUTION](image)

CAUTION indicates a potentially hazardous situation, which if not avoided may result in minor or moderate injury. It may also be used to alert of unsafe practices.

CAUTION may also indicate property-damage-only hazards.

INFO provides additional information to assist in carrying out the work described and to provide trouble-free operation.

Safety precautions

![WARNING](image)

The maintenance guide should be read and fully understood before any work is started, and the procedures in this document should be followed at all times.

![WARNING](image)

Before any work is carried out on the tap-changer:

Make sure that the transformer is disconnected and that grounding is properly conducted. Obtain a signed certificate from the engineer in charge.

![WARNING](image)

Before starting any work in the on-load tap-changer, the protective motor switch and the LOCAL/REMOTE switch are to be set at LOCAL or "0".

![WARNING](image)

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

NOTE: The motor, contactors and heating element may be energized from separate sources.

![CAUTION](image)

Approval should be given for inspection as well as for operating the on-load tap-changer.

![CAUTION](image)

ABB recommends that only maintenance engineers trained by ABB carry out contact replacement.
During service

WARNING
Small amounts of explosive gases may be emitted from the breathing devices (dehydrating breather or one-way breather). Make sure that no open fires, hot surfaces or sparks occur in the immediate vicinity of the breathing devices.

WARNING
If a power supply failure 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 tap-changer is not at 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 “Trip or alarm from supervisory devices” in the user's manual.

During oil handling

WARNING
Unused transformer oil is 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 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 highly flammable. Used transformer oil may well be carcinogenic. Avoid contact with the oil and use oil-tight protective gloves when handling the oil.

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

Collect used oil in oil drums.

Waste and clean-up: Should be absorbed by an absorber. Treat it as hazardous to the environment.

In the event of fire: Any fires should be extinguished with powder, foam or carbonic acid extinguishing agents.

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

The oil in the selector switch compartment may be hot. Be cautious!

WARNING

There is always a cushion of explosive gases over the oil surface. This is sucked into the on-load tap-changer tank during draining of the oil. No open fire, hot surfaces or sparks may be present when the front cover is opened.

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.

CAUTION

Do not fill the tap-changer with oil if the transformer tank is under vacuum and the tap-changer is not.

CAUTION

Do not fill the transformer tank with oil if the tap-changer is under vacuum and the transformer tank is not.

After oil filling

CAUTION

Do not energize the transformer earlier than three hours after oil filling at atmospheric pressure. This waiting period is needed to allow air bubbles to dissipate.
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1. Introduction

1.1 General

The UZ range of on-load tap-changers manufactured by ABB has been developed over many years to provide maximum of reliability. The simple and rugged design gives a service life equal to the service life of the transformer. Minimum maintenance is required for trouble-free operation. The only parts requiring maintenance are contacts that might need replacement during the service life, the insulating oil and the motor-drive mechanism.

The design allows excellent access to all parts, making inspection and maintenance quick and simple.

The tap-changer type UZE/UZF is placed in a tank separated from the transformer tank, see Fig. 1. The motor-drive mechanism is attached to the side of the tap-changer tank.

Fig. 1. UZE and UZF models.
The tap-changer generally comprises three phases. Main components for each phase are:
- Moulding
- Selector-switch (with replaceable fixed and moving contacts)
- Transition resistors
- Change-over selector for plus/minus or coarse/fine switching

It is necessary to inspect and clean the tap-changer inside at regular intervals.

Besides the maintenance of the tap-changer and cleaning of the oil, the motor-drive mechanism should be checked and lubricated. The pressure relay should also be checked.

Fig. 2 shows the general arrangement of a UZ-type tap-changer. The main component is the selector-switch (combined tap selector and diverter switch). For maintenance the oil is drained and the front cover is opened. The contacts are then immediately visible and can be inspected for wear.

The separate tap-changer tank keeps the oil of the tap-changer separated from the oil in the transformer. This is required since the oil of the tap-changer deteriorates as a result of the operations of the selector-switch. The oil needs to be checked and filtered at regular intervals to maintain adequate dielectric strength as well as to prevent mechanical wear.
1.2 Maintenance schedule
Maintenance of the tap-changer consists of three major steps:
- Inspection
- Overhaul
- Contact replacement

1.2.1 Inspection
On the rating plate, “inspection once a year” is recommended. This primarily concerns the motor-drive mechanism and refers to a visual inspection inside the cabinet to check that nothing is loose, and the heater is functioning.

In the motor-drive mechanism a counter registers every tap-changer operation. During inspection the counter is read. If possible, motor and counter are tested by operating one step and then back.

If the tap-changer has its own oil conservator, the breather and the oil level indicator on the oil conservator are checked.

The inspection is carried out while the transformer is in service.

1.2.2 Overhaul
The contact life and the frequency of operations determine the time interval between overhauls.

The number of operations run by the tap-changer is recorded by a counter, housed in the motor-drive mechanism. The registered number of operations should be noted at every inspection and overhaul.

The tap-changer should normally be overhauled regularly at intervals of 1/5 of the estimated contact life. The relevant information is stated on the rating plate. Hereby, the contact wear can be followed and necessary preparations can be made for replacing the contacts.

If the tap-change operations occur infrequently and a very long time elapses until the number of operations amounts to 1/5 of the estimated contact life, the interval between overhauls should be limited to the time stated on the rating plate (normally 7 years). If the operating voltage over any of the regulating windings exceeds 15 kV, the interval between overhauls is limited to 3 years.

1.2.3 Contact replacement
On the rating plate of the tap-changer the estimated contact life at rated load is stated.

The contacts will withstand a very large number of switching operations. For normal power transformers the number of operations of the selector-switch is approximately 20 per day, which means that replacement of the contacts normally is not necessary during the life of the transformer. (In case of tap-changers on furnace transformers the frequency of operations may be considerably higher).

CAUTION
The number of operations must in no case exceed 500,000, due to weakening spring tension of the contacts.

1.3 Tightening torque
The following tightening torques are recommended unless otherwise stated in this installation guide:

<table>
<thead>
<tr>
<th>Size</th>
<th>Torque (Nm)</th>
<th>Tolerance</th>
</tr>
</thead>
<tbody>
<tr>
<td>M6</td>
<td>10</td>
<td>±10 %</td>
</tr>
<tr>
<td>M8</td>
<td>24.5</td>
<td>±10 %</td>
</tr>
<tr>
<td>M10</td>
<td>49</td>
<td>±10 %</td>
</tr>
<tr>
<td>M12</td>
<td>84</td>
<td>±10 %</td>
</tr>
</tbody>
</table>

(Units: lbf x ft)
2. Inspection

The inspection consists of a visual check of the motor-drive mechanism and the conservator once a year while the transformer is in service.

In the motor-drive mechanism the following points are to be checked:
- Motor and counter
- Heater
- The counter's value

On the conservator the following are to be checked:
- Oil level
- Breather

If the tap-changer is equipped with an oil filter unit from ABB it should be inspected once a year according to the oil filter manual.

2.1 Required tools
The following equipment is required for the inspection:
- Set of screwdrivers
- Pen and note pad
- Air pump (if the conservator has an air-relief valve)

2.2 Procedure

**WARNING**
This work must be carried out from ground level since the transformer is energized.

**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.

**CAUTION**
Approval should be given for inspection as well as for operating the tap-changer.

1. Check the breather, see section 3.6.
2. Check the oil level. The oil level should be according to section 3.13.3 Oil Filling.
3. Open the cabinet door and turn the switch to the LOCAL position. Then turn the control switch to the RAISE (LOWER) position.
4. Check that the motor works properly, the position indicator increases one step, and the counter advances one step for each operation. Record the counter's value. The counter shows the number of operations run by the tap-changer (the overhaul-schedule can be determined with the help of this information).
5. Turn the control switch to the LOWER (RAISE) position. Check that the motor also works properly in that direction, the position indicator decreases one step and the counter advances one step more. Reset the draghands.
6. Check the emergency stop. Give a RAISE or LOWER impulse and after about one second press the emergency stop. The operation should be interrupted. Reset the emergency stop by turning the knob clockwise. The started operation should now be completed. Operate back to service position.
7. Check the earth fault protector (option). If the motor-drive mechanism is equipped with an outlet, the earth fault protector should be tested by pressing the test knob on the outlet.
8. Disconnect the incoming auxiliary power.
9. Check by feeling with a finger on the protection plate that the heater has been functioning.
10. Reconnect the incoming auxiliary power.
11. Complete the inspection by turning the switch to the REMOTE position and closing the cabinet door.
1. Protective motor switch
2. Locking device prepared for padlock
3. Air vent
4. Draghand for min. position
5. Position indicator
6. Draghand for max. position
7. Counter
8. Lamp (25 W socket E14)
9. Shaft for handcrank
10. Emergency stop
11. Tap-change in progress indicator
   (Red = in progress, White = in position)
12. Heater 50 W (+ Option 250 W)
13. (Option) Outlet with earth fault protector
14. (Option) Thermostat or hygrostat for extra heater 250 W
15. Terminal blocks
16. RAISE/LOWER switch
17. LOCAL/REMOTE switch
   (Remote position for automatic operation)
18. (Option) Switch for extra heater
19. Serial number
20. Door-operated switch for lamp
21. Handcrank
22. Descriptions and circuit diagram

Fig. 3. Layout of motor-drive mechanism.
3. Overhaul

3.2 Procedure
The overhaul procedure includes the following points:

- Oil testing and oil draining
- Cleaning the tap-changer
- Oil filtration
- Checking contacts
- Checking the transition resistors
- Checking the pressure relay
- Checking the motor-drive mechanism
- Operation test
- Checking before closing
- Oil filling
- Putting into operation

3.3 Preparations

If the tap-changer is oil filled under atmospheric pressure, a waiting period of three hours is needed before energizing. To save out of service time of the transformer, carry out all work on the tap-changer and do the oil filling before the maintenance of the motor-drive mechanism is started.

3.3.1 Tap-changer position
Note the position of the tap-changer to enable restart of the transformer in the right position.

3.3.2 Disconnection and earthing of the transformer

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

WARNING
Before starting any work in the tap-changer the protective motor switch and the LOCAL/REMOTE switch must be set at LOCAL or "0".
3.3.3 Oil volumes
The necessary number of empty drums or suitable barrels for collecting and filtering of the oil in the tap-changer should be kept ready. The drums must be carefully cleaned and free from water. New oil should be of class II according to IEC 60296.

**CAUTION**

Do not energize the transformer until oil has been filled as per section 3.13.

The volume of the oil conservator is not included.

Alternatively, the oil may be replaced by new oil and the used oil filtered at some later occasion. A certain quantity of new oil, say 100 litres, should be kept ready to replace waste oil.

<table>
<thead>
<tr>
<th>UZE: 3-phase tank (Fig. 1):</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UZE.. 200–250/...</td>
<td>about 600 litres</td>
</tr>
<tr>
<td>UZE.. 380/...</td>
<td>about 1100 litres</td>
</tr>
<tr>
<td>UZE.. 550-650/...</td>
<td>about 1450 litres</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>UZF: 3-phase tank (Fig. 1) excl. oil conservator:</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>UZF.. 200–250/...</td>
<td>about 500 litres</td>
</tr>
<tr>
<td>UZF.. 380/...</td>
<td>about 900 litres</td>
</tr>
<tr>
<td>UZF.. 550-650/...</td>
<td>about 1250 litres</td>
</tr>
</tbody>
</table>

**Oil conservator for UZF made by ABB, oil volumes at 20 °C (68 °F)**

| UZF.. 200–250/... | about 30 litres |
| UZF.. 380/... | about 60 litres |
| UZF.. 550-650/... | about 80 litres |

3.3.4 Recommended set of spare parts

- Fixed contacts (single)
- Fixed contacts (double) (if any)
- Moving main and switching contact unit (one per phase)
- Moving transition contact unit (one per phase)

For information about spare parts, see the Spare parts list, 1ZSE 5492-132.
3.4 Oil testing and oil draining

The tank of the tap-changer is equipped with an oil valve placed on the side plate. For connection dimension, see the dimension drawing for tap-changer.

**WARNING**

When oil that has been used in a selector switch compartment 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.

Take an oil-sample from the oil valve and carry out the dielectric strength test according to IEC 60156 (between spherical calottes, distance 2.5 mm).

The dielectric strength of the oil should not be allowed to be less than 120 kV/cm (30 kV measured in a gap, according to IEC 60156) for an tap-changer in service. For new oil or after filtering the old oil, the dielectric strength must be at least 160 kV/cm (40 kV according to above) to be allowed for filling the tap-changer.

When taking the oil-sample, first drain some oil into a bucket to clean the valve.

Use the filtering equipment or the pump to drain oil from the tap-changer into a carefully cleaned oil drum. Connect the pump to the oil valve and drain the oil from the tap-changer tank and the conservator. Draining can be effected quickly if filtering equipment is used and at the same time the whole oil quantity will be filtered once.

If the oil conservator of the tap-changer is common with the oil conservator of the transformer tank, close the valve in the pipe connection to the oil conservator and open the oil valve. After a while, open the air release valve.

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![Fig. 4. Contact spare parts.](image-url)
3.5 Cleaning and oil filtration

If the tap-changer is equipped with an oil filter unit for continuous oil filtration from ABB that is maintained and operated according to the instructions, no further filtration or cleaning should be necessary.

3.5.1 Cleaning the tap-changer

**WARNING**

There is always a cushion of explosive gases over the oil surface. This is sucked into the tap-changer tank during draining of the oil. No open fire, hot surfaces or sparks may be present when the front cover is opened.

After draining, open the front cover of the tank of the tap-changer and wash it clean with oil by using a filter press hose or pump.

**WARNING**

The hands or tools must be kept away from the contacts when making a manual or electrical operation. The contact arm is operated by a spring battery and can cause severe damage.

After washing, wipe the inside of the tap-changer clean with lint-free rags (not cotton waste). Carefully wipe off carbon residues from the epoxy mouldings.

3.5.2 Oil filtration

The drained oil should be filtered until it is cleaned and has regained the high dielectric strength required. The breakdown value for purified oil should be at least 160 kV/cm, which corresponds to 40 kV measured in a gap according to IEC 60156.

To check the result of the filtering, take test samples before and after the oil has been filled into the tap-changer.

3.6 Checking of breather

If the oil conservator has a dehydrating breather, and more than half of the drying agent has changed colour, it must be dried or replaced. For drying, see section 3.6.1.

The drying agent normally starts to change colour from the bottom of the breather. If it has changed colour at the top, there is a leakage in the connections to the conservator. Locate the leakage and seal it.

If the breather has an oil trap check the oil level.

**WARNING**

The breathers and the tube from the conservator contains explosive gases. No open fire, hot surfaces or sparks may be present when loosening the breather.

If the tap-changer is equipped with an air relief valve, (one-way breather) check it by applying air pressure to the outlet of the valve. No air leakage is allowed through the valve. If leaky, replace the valve.

3.6.1 Drying of the drying agent

To replace the drying agent, proceed as follows:

Dismantle the breather and empty the agent.

Replace with new drying agent. Alternatively, dry the old agent by placing it on a net and putting it in an oven, temperature approximately +100 °C (+212 °F), until it changes colour again.

Fill the breather with drying agent. Clean the threads and apply sealing tape. Remount the breather.
3.7 Checking contacts

3.7.1 Contact alignment
Operate the tap-changer by normal spring operation. Check that the moving main contact goes up on the flat part of the fixed contact. The centre of the main contact tip must be at least 1 mm in on the flat part after finished operation, see Fig. 8. If the 1 mm is not achieved, the contact blade might be loosened and turned within the clearance of the holes. Make this inspection both with falling and lifting contact arm. If the 1 mm still is not reached the shaft couplings have too much play and the worn details must be replaced. Check the tightening of the screws holding the contact blades with a dynamometric wrench. Tightening torque 15 Nm ± 10 %.

Check that the pins as well as the screws in the shaft couplings have not worked loose.

3.7.2 Moving contact
If the moving contacts are replaced, also replace any fixed contacts that are considerably worn, in order to minimize the wear of the new moving contacts. If the tap-changer has only used a few positions during the period of operating, you may replace any worn contacts in these positions with unworn contacts from positions not used.

Replace a moving contact when the diameter of its contact rollers is reduced to the diameters given in Table 1. Measure the diameter of each roller halfway between the roller ends. See Fig. 5. For contact replacement, see section 3.8.1.

Compare the measurement of the most worn roller with the diameters given in Table 1.

In each phase, dismantle the fixed contact closest to the front cover and operate the tap-changer to this position. Now all the rollers can be measured.

When the measurement is done, operate the tap-changer to another position and remount all the fixed contacts, see section 3.8.2.

Table 1. Contact minimum dimensions.

<table>
<thead>
<tr>
<th>Revision (according to recommendations on the rating plate)</th>
<th>Measure d (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>≤ 18.5</td>
</tr>
<tr>
<td>2</td>
<td>≤ 18</td>
</tr>
<tr>
<td>3</td>
<td>≤ 17.5</td>
</tr>
<tr>
<td>4</td>
<td>≤ 17</td>
</tr>
<tr>
<td>5</td>
<td>≤ 17</td>
</tr>
</tbody>
</table>

The base for the dimensions in Table 1 is: At the same service conditions in the future, the contacts are not likely to be worn out before next overhaul.

CAUTION

If the tap-changer has exceeded 500,000 operations, the contacts must be replaced, due to weakening spring tension of the contacts.
3.7.3 Fixed contact with tips of copper-tungsten
Check the degree of contact burning and establish which side is most worn. Then check, on the most worn side of the contact, using a mirror, which surface (upper or lower part) is least worn. Measure the wear on this surface 8 mm up on the tip, according to Fig. 6. The contact may have to be loosened to make the measurement possible.

Replace the contact if worn beyond the limits stated in Table 2.

Table 2. Contact minimum dimensions.

<table>
<thead>
<tr>
<th>Revision (According to recommendations on the rating plate)</th>
<th>b = 34 mm Measure a (mm)</th>
<th>b = 27 mm Measure a (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>≤ 3.0 (2.5)</td>
<td>≤ 3.5 (3.0)</td>
</tr>
<tr>
<td>2</td>
<td>≤ 2.5 (2.0)</td>
<td>≤ 3.5 (3.0)</td>
</tr>
<tr>
<td>3</td>
<td>≤ 2.5 (2.0)</td>
<td>≤ 2.5 (2.5)</td>
</tr>
<tr>
<td>4</td>
<td>≤ 2.0 (1.5)</td>
<td>≤ 2.0 (2.5)</td>
</tr>
<tr>
<td>5</td>
<td>≤ 1.5 (1.5)</td>
<td>≤ 1.5 (2.5)</td>
</tr>
</tbody>
</table>

The base for the dimensions in Table 2 is: at the same service conditions in the future, the contacts are not likely to be worn out before next overhaul.

The values within brackets apply to situations of equal wear of the contact’s upper and lower surfaces (within ± 0.5 mm).

As applicable, reinstall the old contacts or install new ones, according to instructions in section 4.2 Fixed Contacts. Tightening torque 15 Nm ± 10 %.

Fig. 6. Fixed contact with tips of copper-tungsten.
3.7.4 Fixed contact made of copper
Check the degree of contact burning and establish which side is most worn. Then check, on the most worn side of the contact, using a mirror, which surface (upper or lower part) is least worn. Measure the wear on this surface 20 mm up on the contact, according to Fig. 7. The contact may have to be loosened to make the measurement possible.

Replace the contact if worn beyond the limits stated in Table 3.

Table 3. Contact minimum dimensions.

<table>
<thead>
<tr>
<th>Revision (According to recommendations on the rating plate)</th>
<th>b = 34 mm Measure a (mm)</th>
<th>b = 27 mm Measure a (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>≥ 2.0 (2.5)</td>
<td>≥ 4.5 (5.0)</td>
</tr>
<tr>
<td>2</td>
<td>≥ 2.5 (3.0)</td>
<td>≥ 5.5 (6.0)</td>
</tr>
<tr>
<td>3</td>
<td>≥ 3.0 (3.5)</td>
<td>≥ 5.5 (6.0)</td>
</tr>
<tr>
<td>4</td>
<td>≥ 3.5 (4.0)</td>
<td>≥ 6.0 (6.5)</td>
</tr>
<tr>
<td>5</td>
<td>≥ 3.5 (4.0)</td>
<td>≥ 6.0 (6.5)</td>
</tr>
</tbody>
</table>

The base for the dimensions in Table 3 is: At the same service conditions in the future the contacts are not likely to be worn out before next overhaul.

The values within brackets apply to situations of equal wear of the contact’s upper and lower surfaces (within ± 0.5 mm).

As applicable, reinstall the old contacts or install new ones, according to instructions in section 3.8.2. Tightening torque 15 Nm ± 10%.
3.8 Contact replacement

**CAUTION**

ABB recommends that only maintenance engineers trained by ABB carry out contact replacement.

3.8.1 Moving contacts

The transition contact unit and the moving main contact unit are delivered as assembled sets. When changing the moving contacts the whole unit must be replaced.

First the transition resistors must be removed by loosening 2 bolts (A) (Fig. 9). Also remove 4 bolts (B) at the other end of the contact arm. Then remove the complete transition contact unit by unscrewing the 2 bolts (C). The removal can be facilitated by bending with a screwdriver. The moving main contact unit is removed by unbolting the 2 bolts (D).

**CAUTION**

Note the number and the positions of the washers and make sure the washers will be correctly remounted.

If the moving contacts are replaced, also replace any fixed contacts that are considerably worn, in order to minimize wear on the new moving contacts.

Thereafter mount the new main contact unit and transition contact unit. Mount the main contact by tightening the two screws (D). The transition contact unit will be correctly positioned by the guiding of the roll pins and fixed by tightening the two bolts (C). Assemble the transition resistors by first tightening the four screws (B) and then the two screws (A). All bolts should be tightened according to Fig. 9. It is not necessary to use a torque wrench. The stated torques (in brackets) are guide values only.

3.8.2 Fixed contacts

To remove the fixed contact blades you have to loosen the two socket screws. On UZE and UZF 550/... and 650/..., the shields on the fixed contacts should not be removed.

When mounting the new contact blades, the socket screws should be tightened by a torque of 15 Nm ± 10 %. Make sure the lock washers are mounted.

After replacing the contacts, operate the tap-changer by normal spring operation. Check that the moving main contact goes up on the flat part of the fixed contact, see Fig. 8. The centre of the main contact tip must be at least 1 mm in on the flat part after finished operation. This inspection should be made in all positions on all three phases and operation in both directions. If the 1 mm distance is not achieved, the contact blade might be loosened and turned within the clearance of the holes.

**WARNING**

The hands or tools must be kept away from the contacts when making a manual or electrical operation. The contact arm is operated by a spring battery and can cause severe damage.

![Fig. 8. Main contact placement.](image-url)
3.9 Checking the transition resistors
Operate the tap-changer to a position where the moving contacts are placed on single fixed contacts.

Connect one of the cables from the ohmmeter to one transition contact and the other cable to the moving main switching contact, measure the resistance and proceed with the other phases. See Fig. 9.

Measure the resistance of each resistor and compare with values given on the rating plate. The values may not differ by more than 10 %.

Check that the resistors are undamaged.

Check that the screw joints for contacts, resistors, etc., have not worked loose.

3.10 Pressure relay and other protection devices
Instructions for functional check and replacement of the pressure relay, and other protection devices, are available in the assortment guide, 1ZSC000562-AAD.

Fig. 9. Transition resistor and contacts.
3.11 Checking of motor-drive mechanism
The motor-drive mechanism should be checked and lubricated at the same time as the tap-changer is overhauled.

The overhaul includes the following points:

**Before disconnecting the power supply**
- Motor protection function
- Earth fault protector (option)
- Counter function

**After disconnecting the power supply**
- Heater function
- V-belt tightness
- Cable connections
- Tightness of the gland for the main shaft
- Disc brake function
- Starting contact movement
- Position transmitter and other position switches
- Lubrication

Reconnect the power supply and make operation tests according to section 3.12.

3.11.1 Motor protection
The function of the protective motor switch has to be checked. For three-phase AC motors, remove one of the phase fuses and check the function time of the protective motor switch by a RAISE or LOWER operation. The protective motor switch must release within 60 seconds at a current setting equal to the rated current of the motor at the actual voltage.

If the protective motor switch do not trip within 60 seconds, switch off the power and adjust the current setting. Repeat the test when the motor is cold.

**WARNING**

The motor power voltage is dangerous.

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

3.11.2 Earth fault protector (option)
If the motor-drive mechanism is equipped with an outlet, the earth fault protector should be tested by pressing the test knob on the outlet.

3.11.3 Counter
Check that the counter functions at RAISE and LOWER operations.

3.11.4 Heater
Disconnect the incoming auxiliary power.

**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.

Open the control panel.

Check by feeling with a finger at the protection plate that the heating element has been functioning.

3.11.5 V-belt
Check that the V-belt is tight enough (see Fig. 10). If tightening is required, adjust the motor support. The tightness of the belt can be checked by a spring balance attached to the belt, halfway between the pulleys. At a 10 N load the belt should yield about 5 mm.

![Fig. 10. Checking of the V-belt.](image)

3.11.6 Cable connections
Check that all cable connections within reach are secure.

3.11.7 Gland for the main shaft
Check that the gland is tight.

No signs of oil leakage into the motor drive cabinet should exist.
3.11.8 Disc brake
Check that the flywheel is free from grease. The flywheel shall stop in its middle position with a tolerance of ± 30°.

The middle position of the flywheel is marked with two conical holes and the tolerances of ± 30° are marked with single holes. The middle position of the brake is the centre of the brake roller.

The braking force can be adjusted by tightening the springs in the brake until the required tolerance is achieved. See Fig. 11. If adjustment is not sufficient and the driving roller runs too far and is on its way into the grooves of the geneva gear, oil or grease has probably entered into the brake linings and these must therefore be cleaned.

The cleaning should be done as follows:

Dismantle the springs on the brake. Dismantle the two screws holding the brake and remove the brake carefully together with the two brake blocks and the attached operating arm for the starting contact. The linings of the two brake blocks should be carefully cleaned by using toluol spirit or any degreasing agent.

When reassembling the brake, check that the flywheel is completely free from grease.

Adjust the brake until the flywheel stops in its right position, as described above.

When the brake is remounted adjust the starting contact according to section 3.11.9.

3.11.9 Starting contact
Check that the play between the operating arm and the starting contact plunge is 0.5 ± 0.3 mm when not affected. Adjustment can be made by moving the starting contact. See Fig. 11.
3.11.10 Position transmitter and other position switches

Clean the contact plates and arms from dust and dirt with a dry cloth.

Check and adjust the resilience of the moving contacts in the multi-position switches.

The moving contacts in all positions must have a clearance between the nut and the contact arm of 0.4–1.2 mm. Adjustment is made with the nuts on the moving contact. See Fig. 12.

Fig. 12. Contact arm play.

0.8±0.4 mm
3.11.11 Lubrication

A. This point should be sparingly lubricated with oil. Use oil for plain ball and roller bearings.

B. The spur gears and the geneva wheel with the limit stops are sparingly lubricated with grease when necessary. Use Lithium grease for ball and roller bearings in low temperatures (–50 to +80 °C, -58 to 176 °F).

Other bearing points do not need lubrication.

Protect the flywheel and the brake linings against lubricants. Wipe off excess lubricant.

Close the control panel and reconnect the incoming auxiliary power. Turn the selector-switch to LOCAL position and make the operation test according to section 3.12.
3.12 Operation test
The rotary motion is transmitted from the motor-drive mechanism to the selector-switch through the gland box in the tank. A mechanical position indicator is provided in the motor-drive mechanism and the position is given by the geneva gear.

The contact arms of each phase are fixed to the shaft by taper-pins and no adjustment between contact arms and driving shaft is needed after mounting.

Operate the driving mechanism, first by manual operation and then electrically between the limit positions. Check the limit stops by operating the tap-changer to one of the end positions. When trying to operate it electrically beyond the end position, the motor should not start. Check the mechanical end stop by trying to hand crank it beyond the end position. After a couple of turns on the handcrank it should be mechanically stopped. Hand crank back to the end position (where the tap-changer in progress indicator is white). Operate the tap-changer electrically to the other end position and repeat the test procedure above. Make sure that the tap-changer operates with spring force.

WARNING
The hands or tools must be kept away from the contacts when making a manual or electrical operation. The contact arm is operated by a spring battery and can cause severe damage.

Check the emergency stop by giving a RAISE or LOWER impulse and after about one second press the emergency stop. The operation should be interrupted. Reset the emergency stop by turning the knob clockwise and switch on the protective motor switch. The started operation should now be completed.

Check the running-through protection with the step-by-step function disengaged. This is done by first removing the connection between terminals X4:1 and X4:2 and then keep the RAISE/LOWER switch engaged. The motor-drive mechanism should stop before the fourth operation is completed. This checking must be done at least five steps from the end position. After the test reset the time relay by putting the LOCAL/REMOTE switch to "0" and then back.

Reset the protective motor switch to ON. Remount the connection between X4:1 and X4:2.

Check the step-by-step relay by keeping the RAISE/LOWER switch engaged in RAISE. The tap-changer shall make only one step. Repeat the check in LOWER.

Check the function of the position transmitter and other multi position switches in all positions.

3.13 Closing
Before closing the front cover of the tap-changer, make sure that no foreign objects, tools, wires, rags, etc., are left in the tank. The surface of the gasket towards the front cover might be greased to simplify future opening.

Check the running-through protection with the step-by-step function disengaged. This is done by first removing the connection between terminals X4:1 and X4:2 and then keep the RAISE/LOWER switch engaged. The motor-drive mechanism should stop before the fourth operation is completed. This checking must be done at least five steps from the end position. After the test reset the time relay by putting the LOCAL/REMOTE switch to "0" and then back.

Reset the protective motor switch to ON. Remount the connection between X4:1 and X4:2.

Check the step-by-step relay by keeping the RAISE/LOWER switch engaged in RAISE. The tap-changer shall make only one step. Repeat the check in LOWER.

Check the function of the position transmitter and other multi position switches in all positions.

3.13 Closing
Before closing the front cover of the tap-changer, make sure that no foreign objects, tools, wires, rags, etc., are left in the tank. The surface of the gasket towards the front cover might be greased to simplify future opening.

Close the front cover. Tightening torque for the dome nuts should be approximately 42 Nm.

3.14 Oil filling
3.14.1 Filling methods and restrictions
Oil filling can be carried out at atmospheric pressure or under vacuum. The wall between the tap-changer and the transformer tank is designed to withstand vacuum on one side and atmospheric pressure on the other side. It is not permissible to have vacuum on one side and the pressure of an oil column on the other side.

After maintenance, oil is normally filled at atmospheric pressure. This procedure is described in section 3.14.2. If filling is to be done under vacuum see the Installation and commissioning guide 1ZSE 5492-115.
3.14.2 Filling at atmospheric pressure
1. Open the conservator valve, if any.
2. Dismantle the pipe to the breather. Or, if simpler, take away the air relief valve or the dehydrating breather.
3. Connect the pump to the oil valve on the tap-changer tank. Open the valve and pump in oil to the correct level shown on the oil level indicator. For correct oil level see section 3.14.3.
4. Shut the oil valve and disconnect the pump.
5. Reassemble the pipe or the breather. The connections must be airtight, so use sealing tape on the threads and O-rings in the flanges.

When the transformer and the tap-changer have a common oil conservator, you should carry out oil filling as described in the instructions from the transformer manufacturer.

3.14.3 Correct oil level
(For installations where tap-changer and the transformer tank have a common oil conservator, see the instructions for the transformer).

At +20 °C (68 °F), oil is filled to the level where the pointer of the oil level indicator points half-way between MIN and MAX.

For other temperatures than +20 °C (68 °F), proceed as follows:
- For every 10 °C (18 °F) increase of temperature, adjust the oil level upwards a tenth of the scale range of the oil level indicator.
- For every 10 °C (18 °F) decrease of temperature, adjust the oil level downwards a tenth of the scale range of the oil level indicator.

3.15 Waiting period

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.

3.16 Putting into operation

Operate the tap-changer to the position noted in section 3.3.1. Put the LOCAL/REMOTE switch to REMOTE. Reset the draghands. Make sure that no tools or foreign objects are left in the motor-drive cabinet. Close the door. Sign the revision protocol and give it to the engineer in charge and inform him that the tap-changer is ready for energizing.
4. Tap-changer on the transformer

4.1 Resistance measurement
If there are problems with too high resistance during measurement of the transformer, the tap-changer should be operated 10 cycles over all positions to clean the contacts.

Another cause for problems at resistance measurement may be too low measuring current. We recommend a measuring current of at least 50 A.
5. Specification of materials

5.1 General
This chapter specifies the materials used in the tap-changer. On disposal of this product, it is recommended that local environmental regulations in each country are met. For environmental reasons, materials used are specified.

5.2 Tap-changer tank

<table>
<thead>
<tr>
<th>Material</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Steel</td>
<td>400–600 kg</td>
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<tr>
<td>Transformer oil</td>
<td>400–1100 kg</td>
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5.3 Active part

<table>
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<th>Material</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>10–75 kg</td>
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<tr>
<td>Aluminium</td>
<td>5 kg</td>
</tr>
<tr>
<td>Copper and alloys</td>
<td>40–75 kg</td>
</tr>
<tr>
<td>Silver</td>
<td>25–50 g</td>
</tr>
<tr>
<td>Tungsten</td>
<td>0–1.5 kg</td>
</tr>
<tr>
<td>Epoxy resin</td>
<td>25–50 kg</td>
</tr>
<tr>
<td>Polyester resin</td>
<td>2 kg</td>
</tr>
<tr>
<td>Phenol resin laminate</td>
<td>0–100 kg</td>
</tr>
<tr>
<td>Siliceous flux</td>
<td>50–100 kg</td>
</tr>
<tr>
<td>Resistor wire (mainly copper and nickel alloys with small amounts of aluminium and manganese)</td>
<td>0.5–5 kg</td>
</tr>
</tbody>
</table>

5.4 Motor-drive mechanism

<table>
<thead>
<tr>
<th>Material</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Steel</td>
<td>100 kg</td>
</tr>
<tr>
<td>Copper and alloys</td>
<td>5–10 kg</td>
</tr>
<tr>
<td>Silver</td>
<td>10–20 g</td>
</tr>
<tr>
<td>Plastics:</td>
<td></td>
</tr>
<tr>
<td>chlorsulphoned polyethylene</td>
<td></td>
</tr>
<tr>
<td>polyamide</td>
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<td>phenol resin laminate</td>
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</tr>
<tr>
<td>carbonate plastic</td>
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</tr>
<tr>
<td>Rubber:</td>
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<tr>
<td>nitrile rubber</td>
<td></td>
</tr>
<tr>
<td>fluorine rubber</td>
<td></td>
</tr>
</tbody>
</table>

CAUTION

Materials listed in the table above without any specification of amount are included because they may cause pollution problems during decommissioning, even in the small quantities used.
ABB AB
Components
SE-771 80 Ludvika, Sweden
Phone: +46 240 78 20 00
Fax: +46 240 121 57
E-Mail: sales@se.abb.com

www.abb.com/electricalcomponents