

MG 44-504
Maintenance Guide
June 30, 1998
New Information

Maintenance Guide

*Load Tap Changers, Types UZE and UZF
with Motor-Drive Mechanism, Type BUF3
Load tap changer, Type UZG with
Motor-Drive Mechanism, Type BUL*

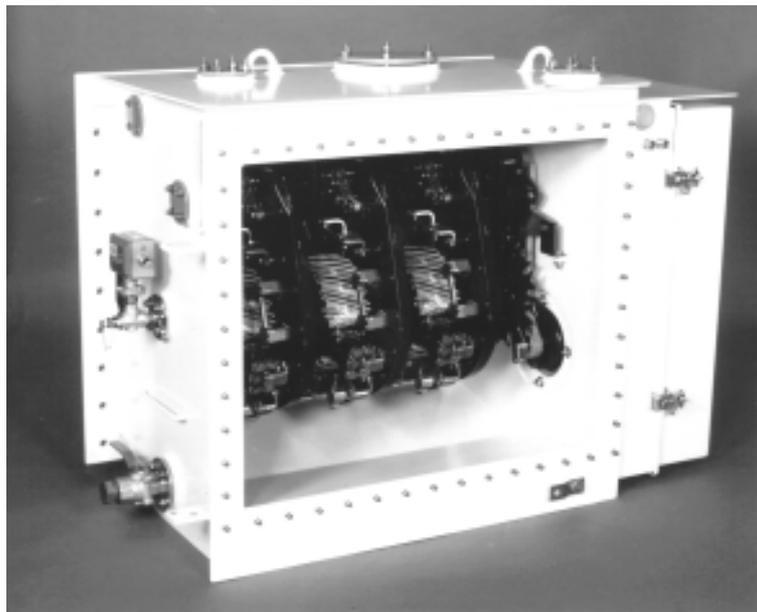


ABB Power T&D Company Inc.
Components Division

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If renewal parts are required, order them through the nearest ABB Power T&D Company Inc. representative. Please provide the item description and the identification numbers (model, style, catalog) from the unit's nameplate.

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Recommended Practices

ABB Power T&D Company recommends careful consideration of the following factors for maintenance work on load tap changers.

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

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

WARNING

Before any work is carried out on the 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.

WARNING

Before starting any work in the load tap changer the protective motor switch and the LOCAL/REMOTE switch shall be set at "0".

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 load tap changer.

CAUTION

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

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 occurs in the immediate surroundings of the breathing devices.

WARNING

If a power 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

The motor drive can move suddenly when power is restored after a power failure.

CAUTION

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

During Oil Handling

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 the skin becomes very dry.

Used 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 oil tight protective gloves when handling the oil.

First aid:

Skin contact: Wash the hands. Use skin cream to counteract the 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.

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

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

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 for explosion due to the gases produced by the 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 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.

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 oil into the load tap changer if the transformer tank is under vacuum and the load tap changer is not.

CAUTION

Do not fill oil into the transformer tank if the load 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 in atmospheric pressure. This waiting period is needed to allow air bubbles to disappear.

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1 Introduction

1.1 General

The UZ range of Load Tap Changers manufactured by ABB Components Sweden 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 load tap changer type UZE/UZF/UZG is placed in a tank separated from the transformer tank, see fig. 1. The motor-drive mechanism is attached to the side of the load tap changer tank for UZE/UZF. It is separate for UZG.

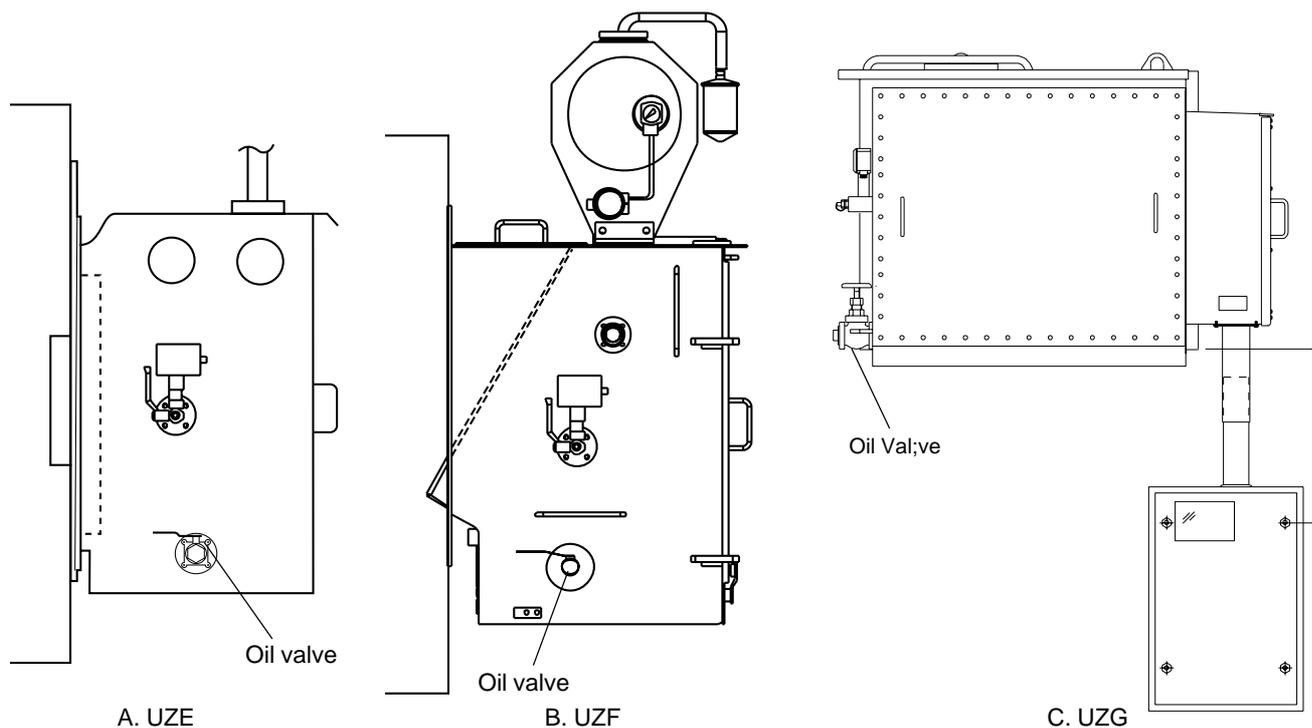


Figure 1. UZE, UZF, and UZG models

Fig. 2 shows the general arrangement of a UZ-type load 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.

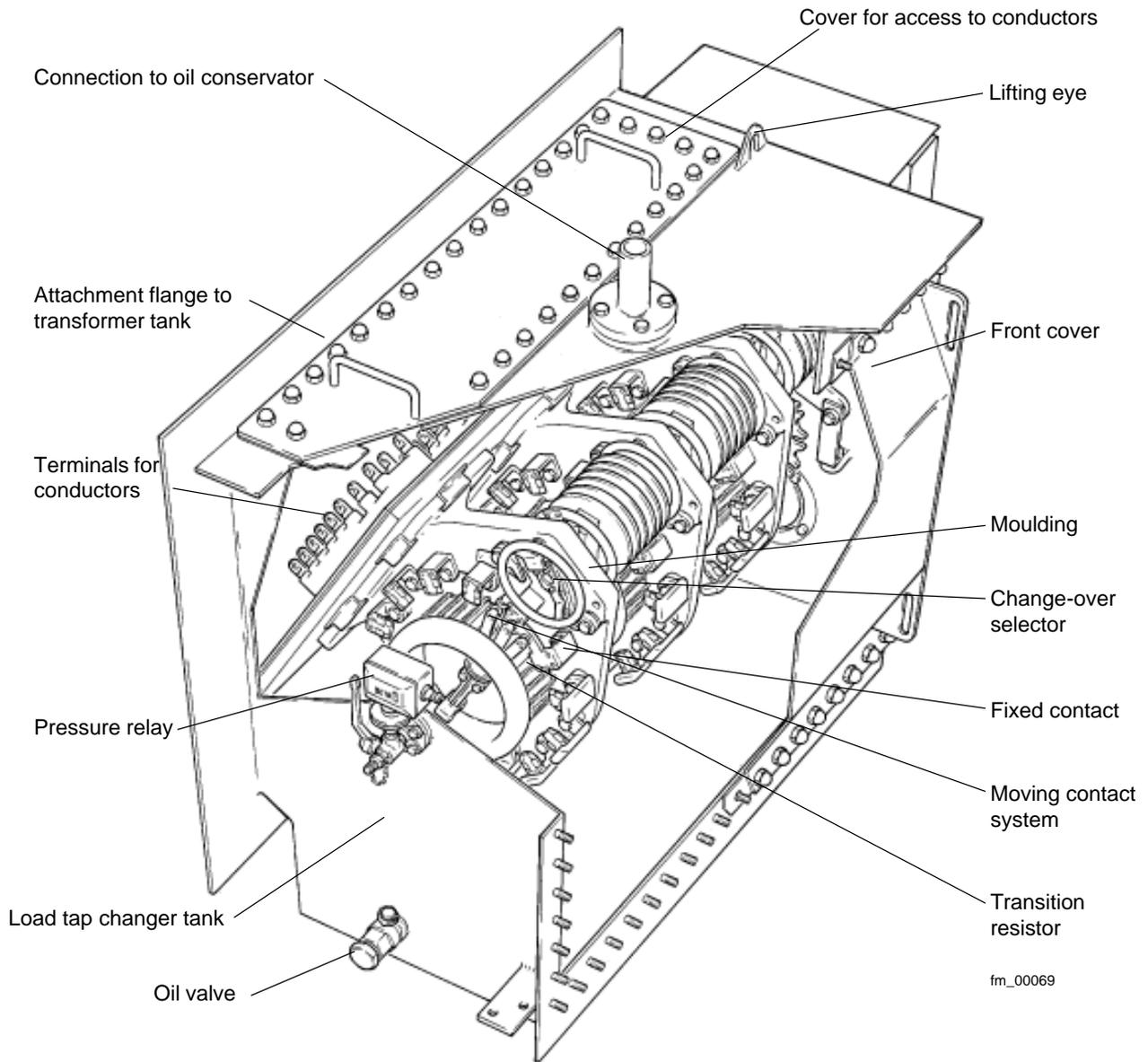


Figure 2. General arrangement of load tap changer, type UZF

The separate load tap changer tank keeps the oil of the load tap changer separated from the oil in the transformer. This is required since the oil of the load tap changer deteriorates as a result of the operation 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.

The load 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 load tap changer inside at regular intervals.

Besides the maintenance of the load tap changer and cleaning of the oil, the motor-drive mechanism should be checked and lubricated.

The pressure relay should also be checked.

1.2 Maintenance Schedule

Maintenance of the load 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 motor 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 load 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.

WARNING

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

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

The load 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).

1.2.3 Contact Replacement

On the rating plate of the load 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 load 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

Following tightening torques are recommended:

M6,	10 Nm	±10 %
M8,	24.5 Nm	±10 %
M10,	49 Nm	±10 %
M12,	84 Nm	±10 %

unless otherwise stated in this guide.

2 Inspection

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

WARNING

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

In the motor-drive mechanism the following points are to be checked:

- Motor and counter
- Heater
- The counter's value

On the load tap changer tank and the conservator the following are to be checked where applicable:

- Oil level
- Breather.

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

CAUTION

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

WARNING

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

1. Check the breather, see section 3.6.
2. Check the oil level. The oil level should be according to section 3.16 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 load tap changer (the overhaul-schedule can be determined with the help of this information).

2 Inspection

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.
6. Check the emergency stop. (BUL) See figure 3.

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 and by switching on the protective motor switch. The started operation should now be completed. Operate back to service position.

7. Check the ground fault protector (option BUL). See figure 3.

If the motor-drive mechanism is equipped with an outlet, the ground fault protector should be tested by pressing the test knob on the separate earth fault protector on BUL.

8. 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.

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.

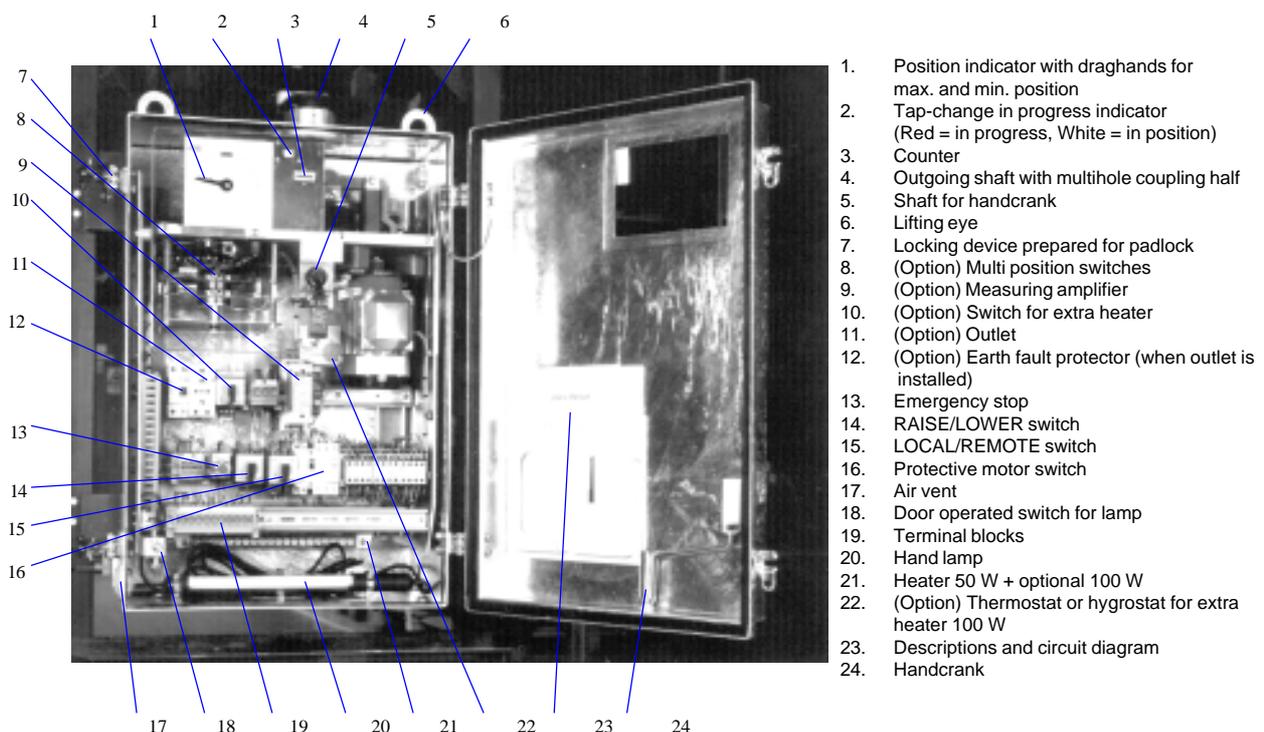


Fig. 3. Motor-drive mechanism, type BUL

3 Overhaul

WARNING

The transformer must be disconnected and effectively earthed.

3.1 Required Tools and Materials

The following equipment is necessary for the overhaul:

- Normal set of Allen sockets (metric)
- Normal set of hexagon wrenches (metric)
- Normal set of sockets (metric)
- Ratchet wrench handle with extension
- Normal set of screwdrivers
- Hammer and wedges or parting tool (for loosening of the front cover)
- Polygrip
- Toluol spirit
- Oil can with oil for plain ball and roller bearings
- Lubricating grease, Lithium grease for ball and roller bearings in low temperature (–50 to +80 °C) (–58 to +176 °F)
- Oil test equipment (for dielectric test according to IEC 156)
- Pure oil, approx. 100 litres (class II according to IEC 296)
- Clean and empty drums
- Bucket
- Rags
- Hoses and connections for oil filling
- Nylon brush
- Ohmmeter (0–50 Ohm)
- Air pump with pressure gauge and connection to male thread R 1/8" (0–100 kPa)
- Hand lamp
- Spare parts set (see Spare Parts List)
- Protective gloves, oil-proof
- Overhaul report form
- Overhaul instructions

- Pliers for retaining ring (for oil filter)
- Pen
- Slide calliper
- Watch (with hand for seconds)
- Feeler gauge (0.4–1.2 mm)
- Small mirror
- Sealing tape.

3.2 Procedure

The overhaul procedure includes the following points:

- Oil testing and oil draining
- Cleaning the load tap changer
- Oil filtration
- Checking contacts
- Checking the transition resistors
- Checking the pressure relay
- Checking the motor-drive mechanism
- Operation test
- Checking gear box and shafts (UZG)
- Checking before closing
- Oil filling
- Putting into operation.

3.3 Preparations

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

3.3.1 Load Tap Changer Position

Note the position of the load 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 load tap changer:

Make sure that the transformer is disconnected on both sides and the earthing is properly carried out. Obtain a signed certificate from the engineer in charge.

WARNING

Before starting any work in the load tap changer the protective motor switch and the LOCAL/REMOTE switch shall be set at "0".

3.3.3 Oil Volumes

The necessary number of empty drums or suitable barrels for collecting and filtering of the oil in the load tap changer should be kept ready. The drums must be carefully cleaned and free from water. New oil should be Class II according to IEC 296.

NOTE: The volume of the oil conservator is not included.

UZE/UZG: 3-phase tank (fig. 1):

UZE.. 200–250/...	about 160 gallons (about 600 Litres)
UZE.. 380/...	about 300 gallons (about 1100 Litres)
UZE.. 550–650/...	about 400 gallons (about 1450 Litres)

UZF: 3-phase tank, (fig. 1) excl. oil conservator:

UZF.. 200–250/...	about 140 gallons (about 500 Litres)
UZF.. 380/...	about 250 gallons (about 900 Litres)
UZF.. 550–650/...	about 350 gallons (about 1250 Litres)

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

UZF.. 200–250/...	about 10 gallons (about 30 Litres)
UZF.. 380/...	about 20 gallons (about 60 Litres)
UZF.. 550–650/...	about 25 gallons (about 80 Litres)

Alternatively, the oil may be replaced by new oil and the used oil filtered at some later date. A certain quantity of new oil, say 30 gallons (about 100 litres), should be kept ready to replace waste oil.

CAUTION

Do not energize the transformer until oil has been filled as per section 3.16.

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.

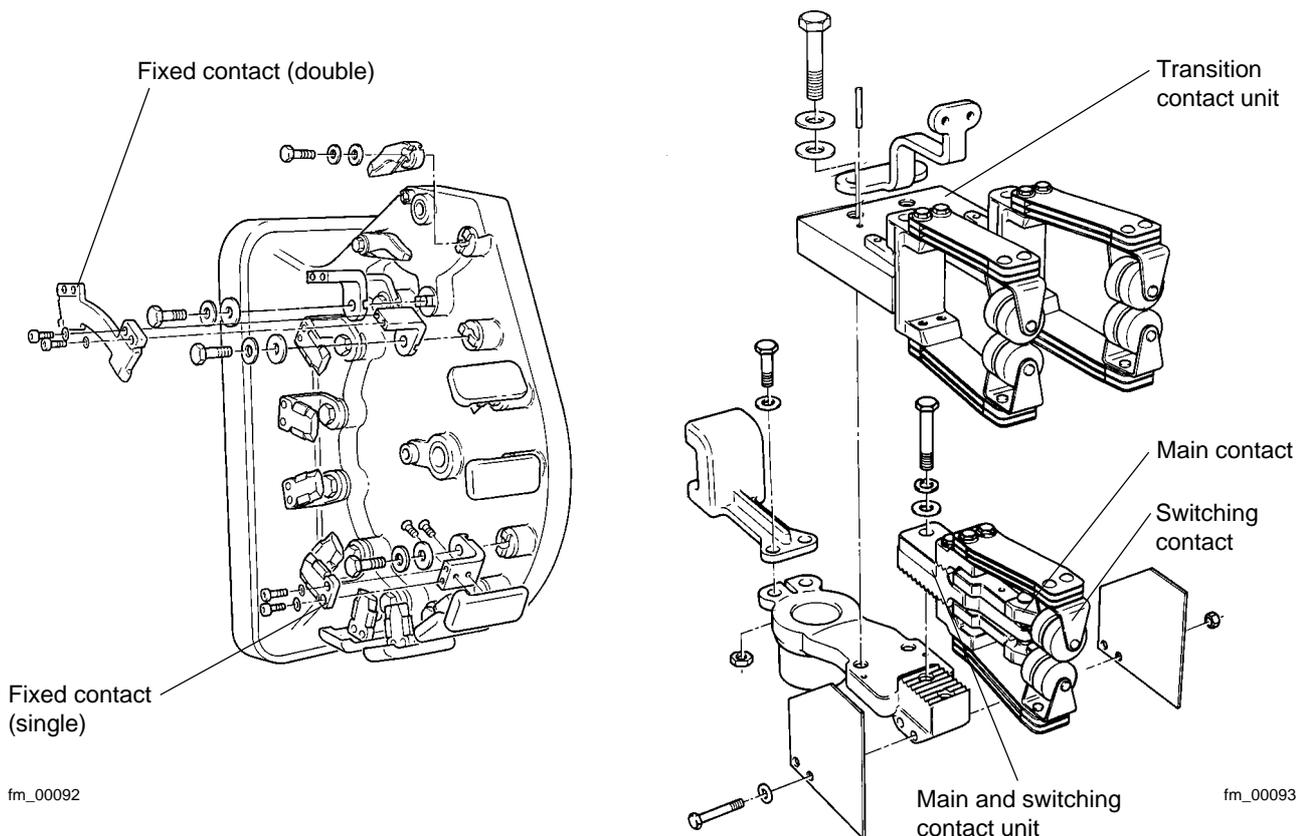


Figure 4. Contact spare parts

3.4 Oil Testing and Oil Draining

The tank of the load tap changer is equipped with an oil valve placed on the side plate. For connection dimension, see the dimension drawing for the load 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 156 (between spherical calottes, distance 2.5 mm).

The dielectric strength of the oil should not be allowed to be less than 120 kV/cm for a load tap changer in service.

NOTE: 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 load tap changer into a carefully cleaned oil drum. Connect the pump to the oil valve and drain the oil from the load tap changer tank and the conservator. Draining will be more efficient if the filtering equipment is used since all the oil will be filtered, at once.

If the oil conservator of the load 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 vent.

3.5 Cleaning

3.5.1 Cleaning the load tap changer

WARNING

There is always a cushion of explosive gases over the oil surface. This is sucked into the 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.

After draining, open the front cover of the tank of the load 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 load tap changer clean with rags (not cotton waste). Carefully wipe off carbon residues from the epoxy mouldings.

3.5.2 Cleaning the Oil Filter (if any)

The filter, which is mounted in a flange pipe on the top of the tap changer tank, is screwed from the inside. It can easily be screwed out for inspection or cleaning. A retaining ring must be removed before the oil filter is screwed out. The oil filter does not need to be exchanged nor cleaned in any other way than by washing with oil. Alternatively the filter housing can be dismantled and the complete housing with filter washed with oil.

3.5.3 Oil Filtration

The drained oil should be filtered until it is cleaned and has regained the high dielectric strength required. The break-down value for purified oil should be at least 160 kV/cm according to IEC 156.

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

3.6 Checking of Breather

If the oil conservator has a dehydrating breather, the silica gel should be blue. The gel may have turned pink at the bottom.

If more than half of the silica gel has turned pink, it must be dried or replaced. For drying see section 3.6.1.

The silica gel normally starts turning pink from the bottom of the breather. If it has started turning pink also from the top, there is a leakage in the connections to the conservator. Localize 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 load 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 Silica Gel

To replace the silica gel, proceed as follows:

Dismantle the breather and empty the gel.

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

Fill the breather with gel. Clean the threads and apply sealing tape. Remount the breather.

3.7 Checking Contacts

3.7.1 Contact Alignment

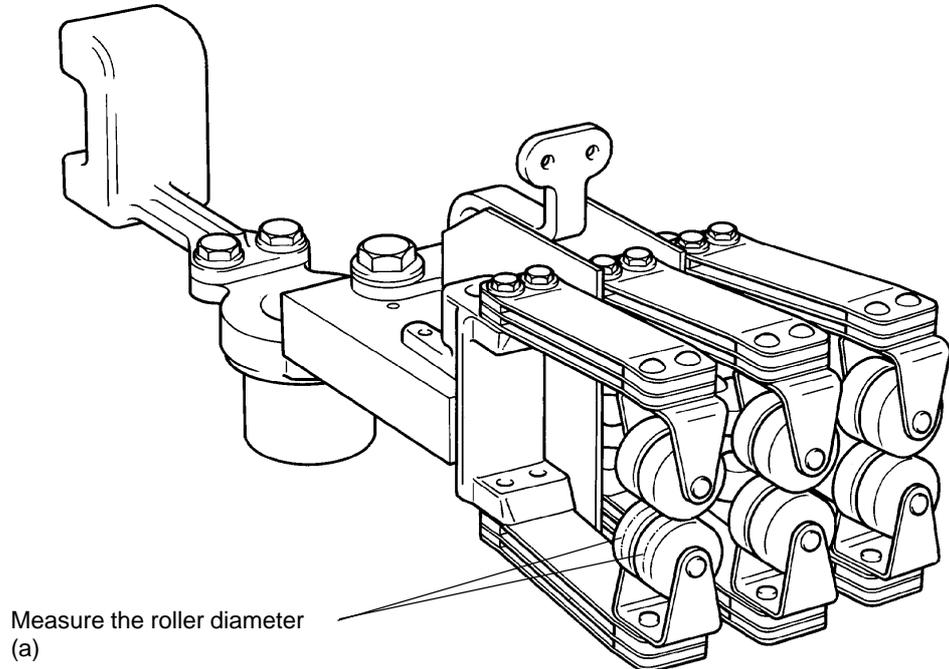
Operate the load tap changer by normal spring operation. Check that the moving main contact goes up on the flat part of the fixed contact. The centre of the main contact tip must be at least 1 mm in on the flat part after finished operation, see fig. 20. If not the shaft couplings have too much play and the worn details must be replaced. Make this inspection both with falling and lifting contact arm.

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

3.7.2 Moving Contact

NOTE: 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.

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 figure 5. For contact replacement, see section 4.1.



fm_00095

Figure 5. Moving contact arm

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 door and operate the load tap changer to this position. Now all the rollers can be measured.

When the measurement is done, operate the load tap changer to another position and remount all the fixed contacts, see section 4.2.

Table 1. Contact minimum dimensions

Maintenance Interval ¹⁾	Measure a (mm)
1	≤ 18.5
2	≤ 18
3	≤ 17.5
4	≤ 17
5	≤ 17

1) According to recommendations on the rating plate.

CAUTION

If the load 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.

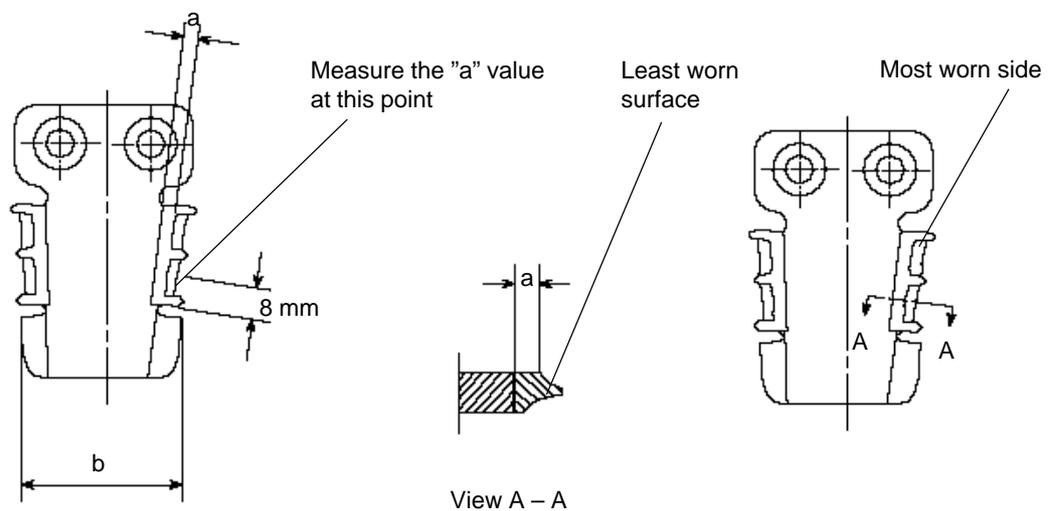


Figure 6.

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

Table 2. Contact minimum dimensions

Manitenance Interval ¹⁾	b=32 mm Measure a (mm)	b=26 mm Measure a (mm)
1	≤ 3.0 (2.5)	≤ 3.5 (3.0)
2	≤ 2.5 (2.0)	≤ 3.5 (3.0)
3	≤ 2.5 (2.0)	≤ 2.5 (2.5)
4	≤ 2.0 (1.5)	≤ 2.0 (2.5)
5	≤ 1.5 (1.5)	≤ 1.5 (2.5)

1) According to recommendations on the rating plate.

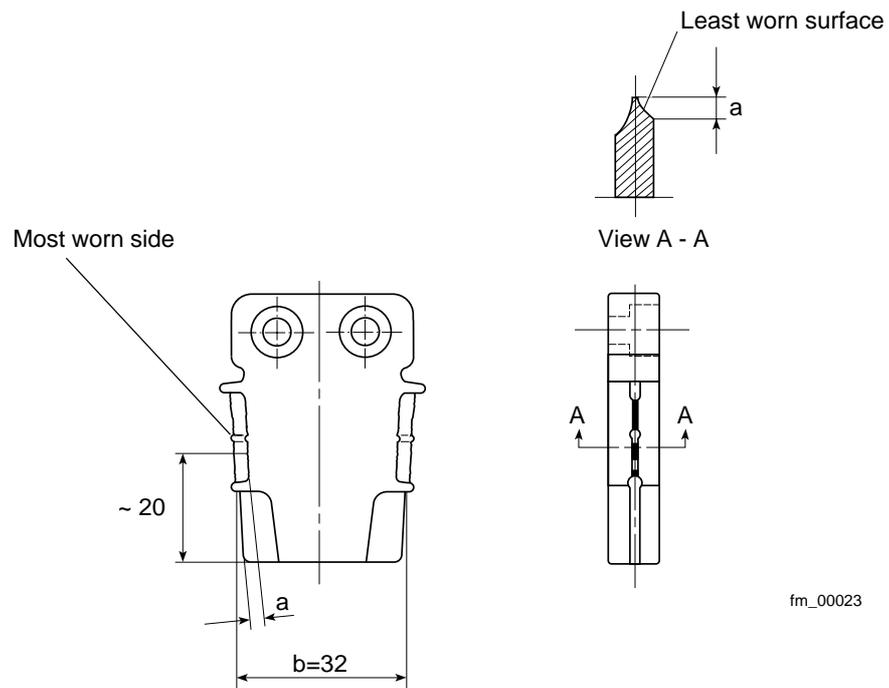
The values within brackets apply to situations of equal wear of the contact's upper and lower surfaces (within ± 0.5 mm).

As applicable, reinstall the old contacts or install new ones, according to instructions in section 4.2 Fixed Contacts.

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 or fig. 8. The contact may have to be loosened to make the measurement possible.

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



fm_00023

Figure 7.

Table 3.

Maintenance Interval ¹⁾	b=32 mm Measure a (mm)	b=26 mm Measure a (mm)
1	≥ 2.0 (2.5)	≥ 4.5 (5.0)
2	≥ 2.5 (3.0)	≥ 5.5 (6.0)
3	≥ 3.0 (3.5)	≥ 5.5 (6.0)
4	≥ 3.5 (4.0)	≥ 6.0 (6.5)
5	≥ 3.5 (4.0)	≥ 6.0 (6.5)

1) According to recommendations on the rating plate.

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.

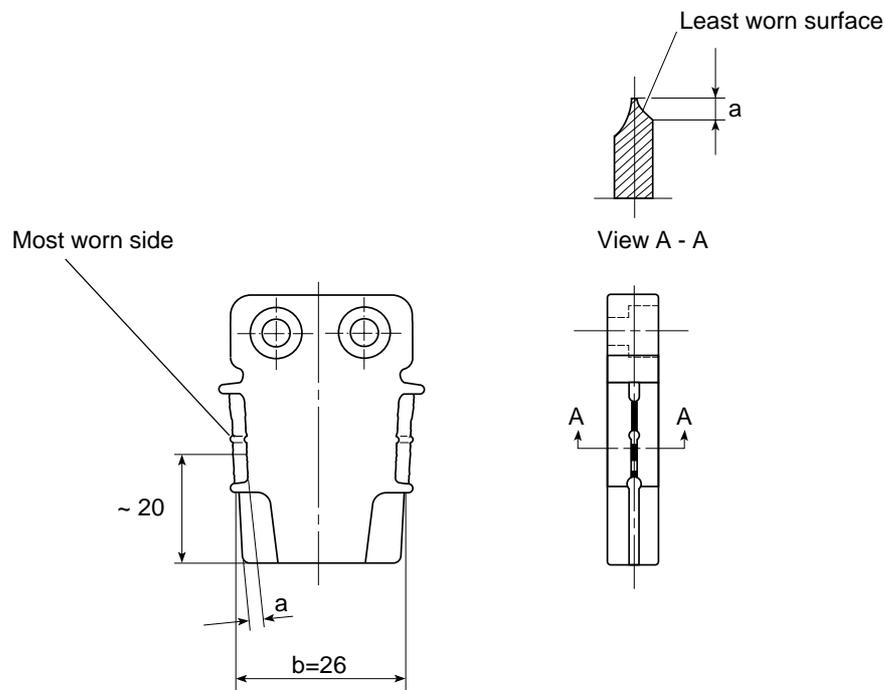


Figure 8.

3.8 Checking the Transition Resistors

Operate the load 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 figure 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.

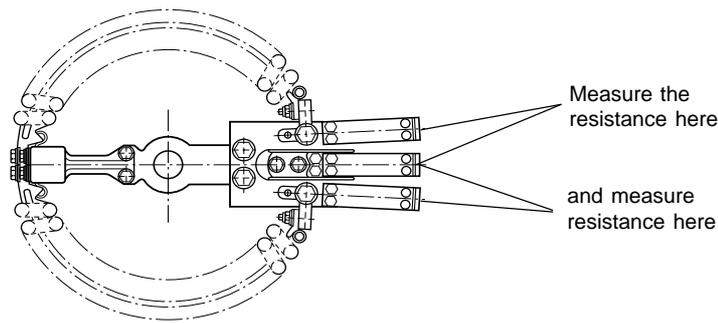


Figure 9

3.9 Checking the Pressure Relay

3.9.1 Functional Check of the Pressure Relay

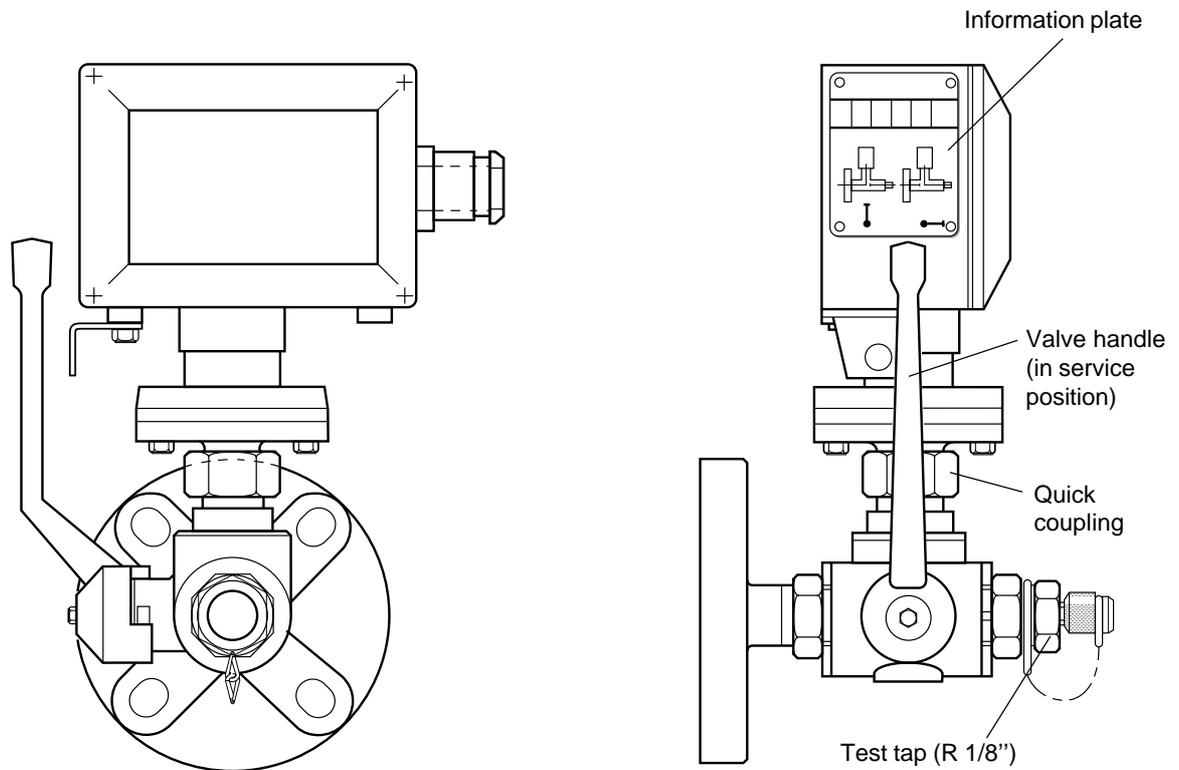


Figure 10. Pressure relay

1. Set the valve handle to 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. (Thread R 1/8").
3. Raise the pressure until the pressure relay trips the circuit breakers of the transformer.
4. Read the pressure on the manometer and check against the pressure stated on the information plate. Max. permitted deviation is $\pm 10\%$. If the deviation is greater, the pressure relay should be replaced.
5. Check that the signal disappears when the pressure is released.
6. After finishing the check, turn back the valve handle to service position.

3.9.2 Replacing the Pressure Relay

If replacement of the pressure relay is necessary, it is carried out according to the instruction in 1ZSE5492-128 *Repair Guide for UZE and UZF*.

3.10 Checking of Motor-Drive Mechanism type BUF3

The motor-drive mechanism should be checked and lubricated at the same time as the load tap changer.

The overhaul includes the following points:

Before disconnecting the power supply.

- Motor protection function
- Ground fault protection (option)
- Counter function

After disconnecting the power supply.

- Heater function
- V-belt tightness
- Motor contactors 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 3.11.

3.10.1 Motor Protection, BUF3

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 does 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 necessary to test.

3.10.2 Ground Fault Protection (option)

If the motor-drive mechanism is equipped with an outlet, the ground fault relay should be tested by pressing the test knob on the outlet.

3.10.3 Counter, BUF3

Check that the counter is functioning at RAISE and LOWER operations.

3.10.4 Heater, BUF3

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 your hand that the heating element has been functioning.

3.10.5 V-belt, BUF3

Check that the V-belt is tight enough. 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.

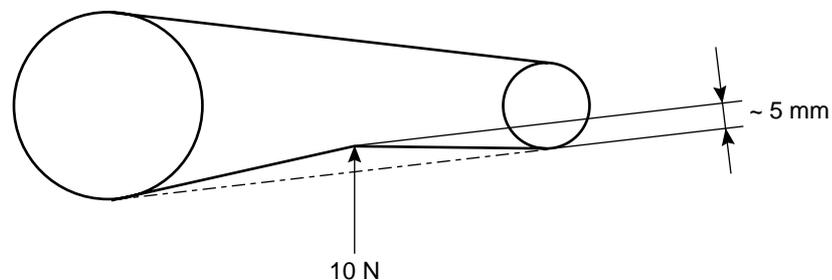


Figure 11.

3.10.6 Cable Connections, BUF3

Check that all cable connections within reach are secure.

3.10.7 Gland for the Main Shaft, BUF3

Check that the gland is tight. (It is not likely that the gland must be exchanged).

No signs of oil leakage into the motor drive cabinet should exist.

3.10.8 Disc Brake, BUF3

Check that the flywheel is free from grease. The flywheel shall stop in its middle position with a tolerance of ± 30 degrees.

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

The braking force can be adjusted by tightening the springs in the brake until the required tolerance is achieved, see figure 12. If adjustment is not sufficient and the driving roller runs too far and is on its way into the grooves of the flywheel, 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.

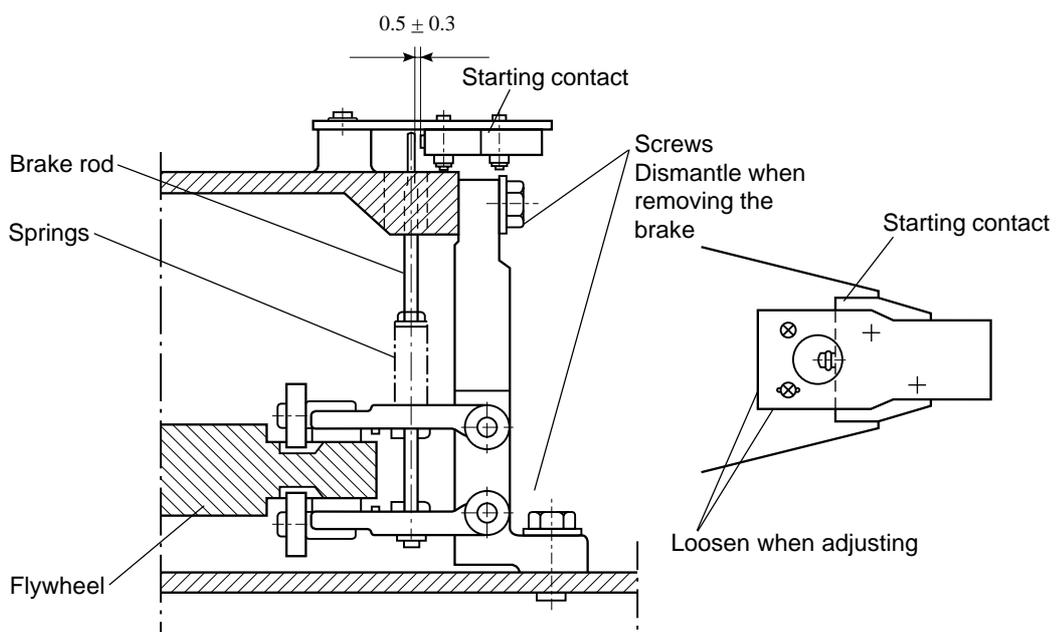
When reassembling the brake, check that the flywheel is completely free from grease.

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 the next paragraph.

3.10.9 Starting Contact, BUF3

Check that the play between the operating arm and the starting contact plunge is $0,5 \pm 0,3$ mm when not affected. Adjustment can be made by moving the starting contact (fig. 12).



fm_00098

Figure 12. Starting contact

3.10.10 Position Transmitter and other Position Switches, BUF3

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 shall, in all positions, 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 (fig. 13).

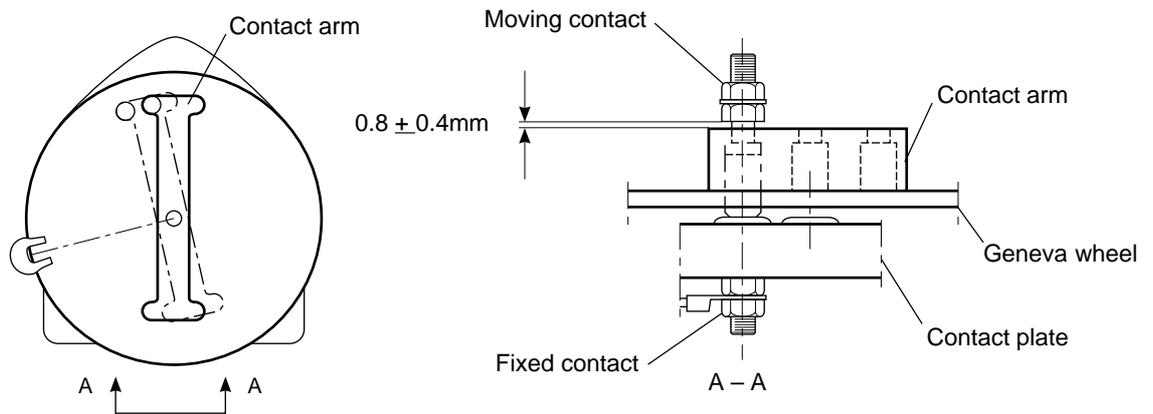


Figure 13. Contact arm play

3.10.11 Lubrication, BUF3

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 stop are sparingly lubricated with grease when necessary. Use Lithium grease for ball and roller bearings in low temperatures (-50 to +80 °C).

Other bearing points do not need lubrication.

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

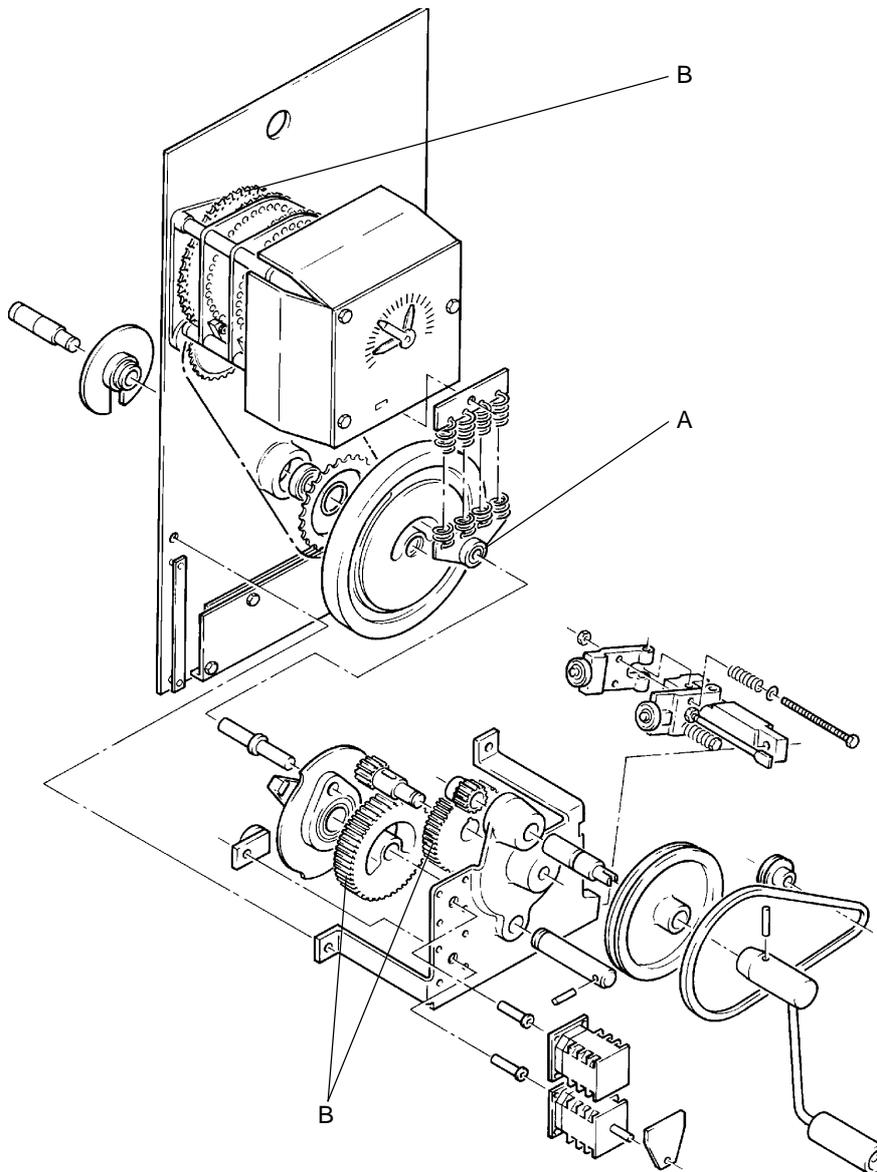


Figure 14. Motor-Drive Mechanism BUF3, lubrication points

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 3.11.

3.11 Operation Test, BUF3

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 load 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 hand crank it should be mechanically stopped. Operate the load tap changer electrically to the other end position and repeat the test procedure above. Make sure that the load 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 damages.

Check the step-by-step relay, if applicable, by keeping the RAISE/LOWER switch engaged in RAISE. The load 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.

3.12 Checking of Motor-Drive Mechanism type BUL

The motor-drive mechanism should be checked and lubricated at the same time as the load tap changer.

The overhaul includes the following points:

Before disconnecting the power supply:

- Motor protection function
- Ground fault protector (option)
- Counter function

After disconnecting the power supply:

- Heater function
- Toothed belt
- Cable connections
- Disc brake function
- Position transmitter and other position switches
- Lubrication

Reconnect the power supply and make operation tests according to section 3.13.

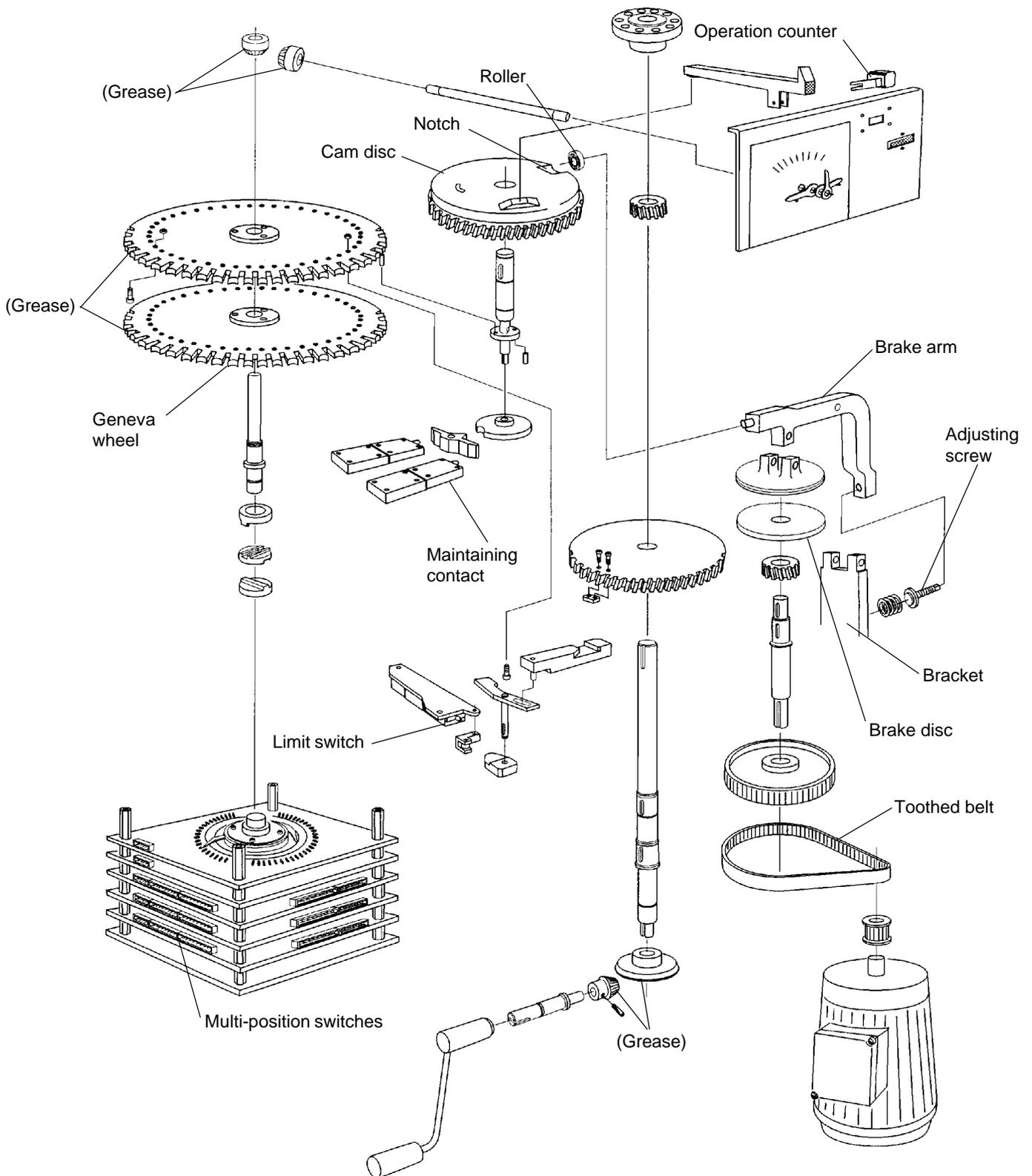


Fig. 15. Motor-drive mechanism, type BUL

3.12.1 Motor Protection, BUL

Open the motor-drive cabinet door and turn the selector-switch to the LOCAL position. 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 shall release within 60 seconds at a current setting equal to the rated current of the motor at actual voltage.

WARNING

The motor power voltage is dangerous.

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

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

3.12.2 Ground Fault Protector (option), BUL

If the motor-drive mechanism is equipped with an outlet, the ground fault protector should be tested by pressing the test knob on the outlet. (On BUL, the ground fault protector is separated from the outlet and the knob is on the protector).

3.12.3 Counter, BUL

Check that the counter is functioning at RAISE and LOWER operations. Check that the position indicator increases (decreases) 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 load tap changer.

3.12.4 Heater, BUL

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.

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

3.12.5 Toothed Belt, BUL

Check that the toothed belt is sufficiently tight. 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 6 N load the belt should yield about 2 mm on BUL.

3.12.6 Cable Connections, BUL

Check that all cable connections within reach are secure.

3.12.7 Disc Brake, BUL

Run the motor-drive mechanism and check that the centre of the notch in the cam disc stops within ± 2 mm from the centre of the roller on the brake arm, see Fig. 16. If it does not stop within the tolerances, adjust the breaking force with the adjusting screw in the lower end of the brake arm. Loosen the lock nut. Tightening the screw (clockwise) makes the stop earlier and loosening the screw (anticlockwise) makes the stop later. Tighten the lock nut after the adjustment.

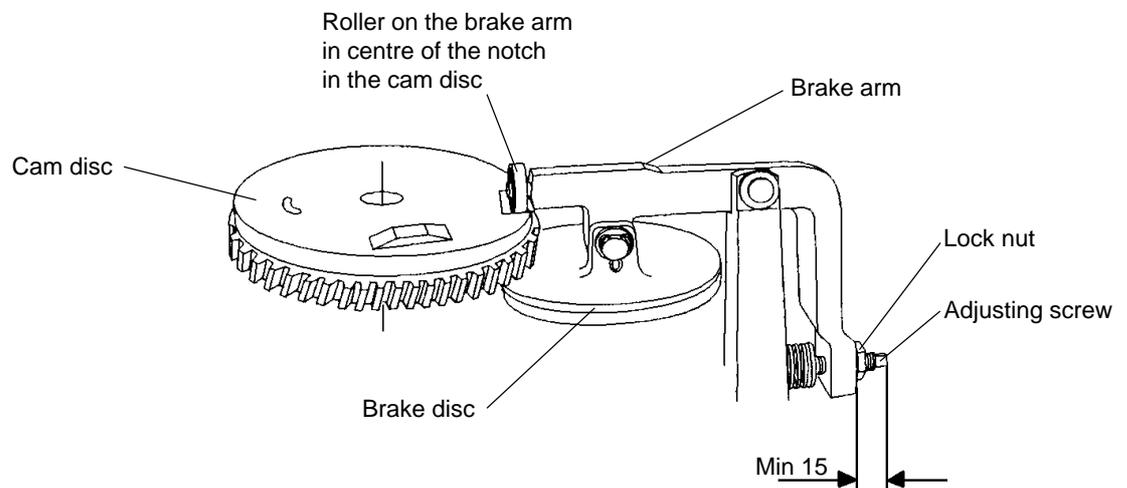


Fig. 16. Brake adjustment, type BUL

CAUTION

If the motor-drive still does not stop when the brake is adjusted to min. 15 mm according to Fig. 16 please contact ABB for advisory.

3.12.8 Position Transmitter and other Position Switches, BUL

Check the contact function in all positions at both RAISE and LOWER operations. No adjustment of the contacts should be made. For replacement of a Position Switch see IZSE 5492-129, *Repair Guide, On-Load Tap-Changers, types UCG, UCL, UCC and UCD*.

If there is a lot of dust, it can be removed from the circuit cards and the transparent covers with a vacuum cleaner, without disassembling the multi-position switch.

3.12.9 Lubrication, BUL

Lubrication is not needed at normal working conditions. All ball bearings have rubber seals and are permanently greased. All cam discs and some gears are made of self lubricating material.

If needed, the bevel gears for the hand crank, the geneva wheels, and the bevel gears for the position indicator might be sparingly lubricated with the same grease as the shaft system. (GULF-718EP Synthetic Grease, Mobilgrease 28, Shell-Aero Shell Grease 22 or similar). See figure 15.

Reconnect power supplies.

3.13 Operation Test, BUL

Operate the motor-drive mechanism, first by manual operation and then electrically between the limit positions. Check the limit stops by operating the load 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 hand crank it should be mechanically stopped. Handcrank back to the end position (the indicator flag shows white colour for BUL). Operate the load tap changer electrically to the other end position and carry out the same test procedure as above.

Check the emergency stop, when applicable, 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, when applicable 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, where applicable, by keeping the RAISE/LOWER switch engaged in RAISE. The load 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.

3.14 Closing

Before closing the front cover of the load tap changer, make sure that no foreign objects, tools, wires, rags etc. are left in the tank.

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

3.15 Checking of Disc Brake in Gear Box and Drive Shaft System for UZG

3.15.1 Disc Brake (Gear Box), UZG

Remove the cover of the gear box.

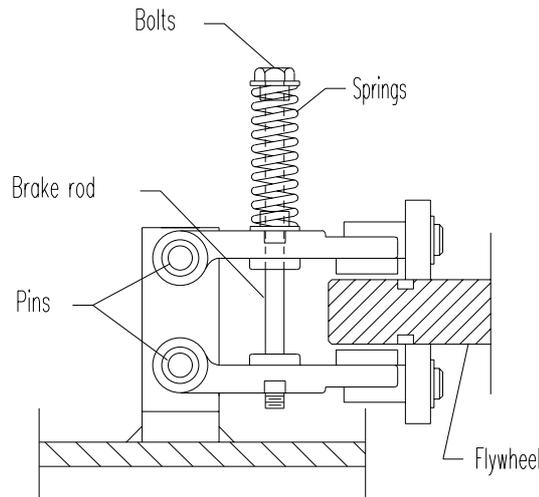


Figure 17

Check that the flywheel is free from grease. The flywheel shall stop in its middle position with a tolerance of ± 30 degrees.

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

The braking force can be adjusted by tightening the springs in the brake until the required tolerance is achieved. If adjustment is not sufficient and the driving roller runs too far and is on its way into the grooves of the flywheel, 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 pins and two bolts holding the brake and remove the brake carefully together with the two brake blocks (fig. 17). 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.

Check and lubricate the gears with grease if necessary. Use the same grease as for the drive shaft system.

Lubricate the bearing for the spring battery with oil. Use oil for plain ball and roller bearings.

Replace the cover of the gearbox

3.15.2 Lubrication of the Drive Shaft System UZG

For access to couplings, loosen the hose clips and push the protective tubes together.

WARNING

Rotating Shafts. Be Cautious!

Check and lubricate with grease if necessary. Recommended types of grease are GULF-718 EP Synthetic Grease, Mobilgrease 28, Shell-Aero Shell Grease 22, or similar.

Remount covers (make sure the gaskets are properly in place).

3.16 Oil Filling

3.16.1 Filling Methods and Restrictions

Oil filling can be carried out at atmospheric pressure or under vacuum. The wall between the load 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 3.16.2. If filling is to be done under vacuum see *Installation and Commissioning Guide for UZE, UZF, and UZG*.

3.16.2 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 load 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 3.16.3.
4. Shut the oil valve and disconnect the pump.
5. Reassemble the pipe or the breather. The connections must be airtight, use sealing tape on the threads and O-rings in the flanges.

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

3.16.3 Correct Oil Level

(For installations where load tap changer and the transformer tank have a common oil conservator the instructions for the transformer should be used.)

Oil Level Indicator delivered by ABB Components

At +25 °C (77 °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 +25 °C (77 °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.

3.17 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.

3.18 Putting into Operation

Operate the load 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 maintenance protocol and give it to the engineer in charge and inform him that the load tap changer is ready for energizing.

4 Contact Replacement

CAUTION

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

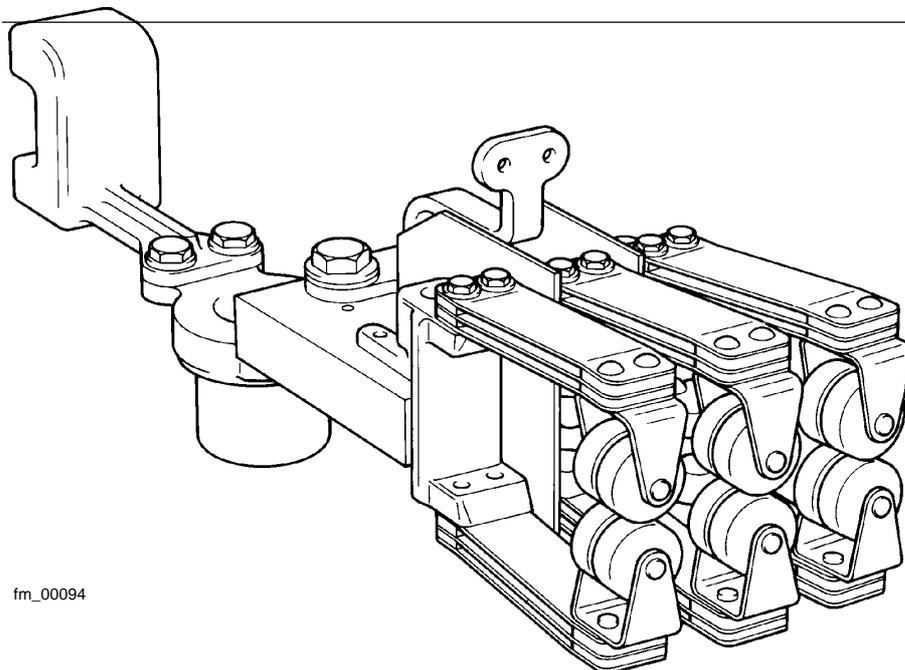


Figure 18. Moving contact system design

4.1 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 shall be replaced.

First the transition resistors must be removed by loosening 2 bolts (A) (fig. 19). Also remove 4 bolts (B) at the other end of the contact arm. Then remove the complete transition contact unit by unbolting the 2 bolts (C). The removal is 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.

NOTE: *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.*

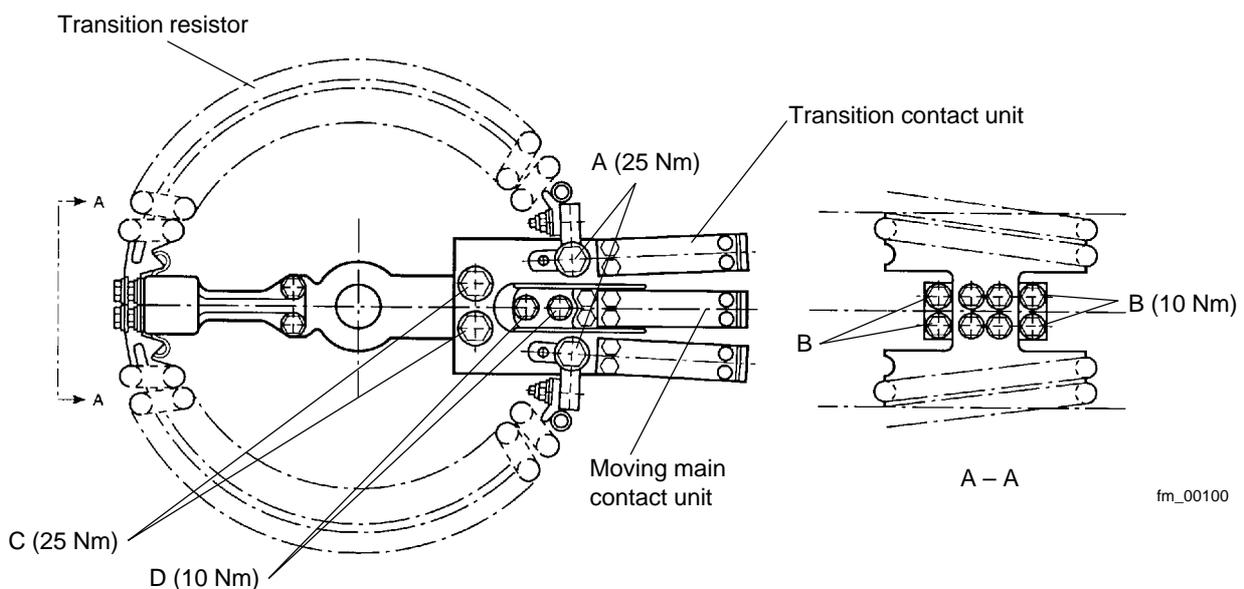


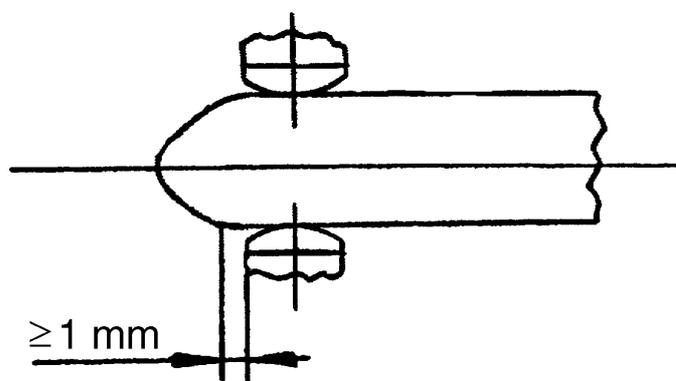
Figure 19. Transition resistor and contacts

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. 19. It is not necessary to use a torque wrench. The stated torques (in brackets) are guide values only.

4.2 Fixed Contacts

To remove the fixed contact blades you have to loosen the two socket screws. On UZE/ UZF/UZG 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 12 Nm. Make sure the serrated lock washers are mounted.



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Figure 20. Main contact placement

After replacing the contacts, operate the load 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. This inspection should be made in all positions on all three phases and operation in both directions. If the 1 mm 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 damages.

5 Specification of Materials

5.1 General

This chapter specifies the materials used in the load tap changer.

5.2 Load Tap Changer Tank

Material	Amount
Steel	400–600 kg
Transformer oil	400–1100 kg

5.3 Active Part

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

5.4 Motor-Drive Mechanism BUF3

Material	Amount
Steel	100 kg
Copper and alloys	5–10 kg
Silver	10 g
Plastics:	
chlorsulphoned polyethylene	
polyamide	
phenol resin laminate	
polyester	
PVC	
carbonate plastic	
Rubbers:	
nitrile rubber	
fluorine rubber	

CAUTION

Materials listed in the table above without any specification of amount are included because they may cause pollution problems during de-commissioning, even in the small quantities used.

5.5 Motor-Drive Mechanism BUL

Material	BUL Amount
Steel	55 kg
Copper and alloys	5 kg
Aluminium and alloys	10 kg
Silver	10 g
Plastics:	
chlorsulphonated polyethylene	x
polyamide with MoS ₂	x
phenol resin laminate	
polyester	x
PVC	x
carbonate plastic	x
Rubbers:	
nitrile rubber	x
fluorine rubber	x

CAUTION

Materials listed in the table above without any specification of amount are included because they may cause pollution problems during de-commissioning, even in the small quantities used.