

1ZSE 5492-127 en, Rev. 6

On-load tap-changers, type UBB

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 install or commission a unit, make sure that the personnel doing the job have read and fully understood the installation and commissioning guide provided with the unit.

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

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

Follow local and international wiring regulations at all times.

Use only factory authorized replacement parts and procedures.

Safety warnings

The following warnings and notes are used in the manual:



WARNING

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

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

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



WARNING

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

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



CAUTION

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 "Pressure relay" in the Repair guide.

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 tap-changer 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 tap-changer may be hot. Be cautious!



WARNING

There is always a cushion of explosive gases in the top of the on-load tap-changer. 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 minutes before any work is started.

**WARNING**

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

**CAUTION**

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

**CAUTION**

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

**CAUTION**

Leave a gas cushion on top of the oil in the tap-changer.

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.

Mounting of gaskets**CAUTION**

Sealing surfaces and gaskets must be clean and undamaged. Diametrically opposed bolts in sealing joints must be tightened alternately several times, beginning with a low tightening torque and finally with the recommended tightening torque as described in section 1.3 Tightening Torque, in this guide.

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1. Introduction

1.1 General

The UB range of on-load tap-changers manufactured by ABB has been developed to provide maximum reliability. The simple and rugged design gives a service life equal to the service life of the transformer. A minimum of 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 UBB, is housed in the transformer tank. The motor-drive mechanism is attached to the transformer tank and connected to the tap-changer by means of drive shafts and a bevel gear, see Fig. 1.

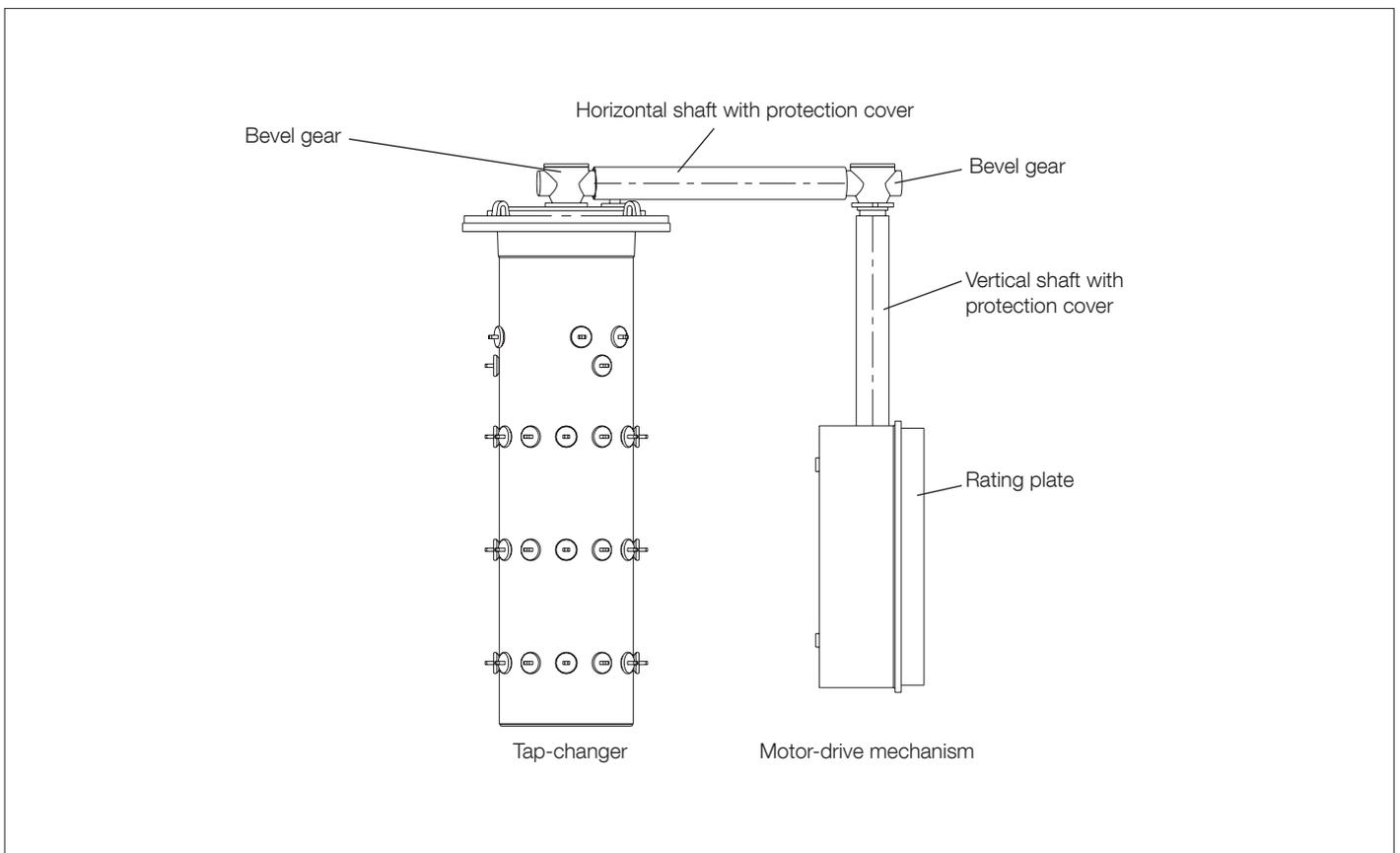


Fig. 1. On-load tap-changer system.

Fig. 2 shows the general arrangement of a UB-type tap-changer. The main components are the selector switch (combined tap selector and diverter switch), the change-over selector, the selector switch housing and the gearing mechanism. For maintenance the top cover and the gear base plate (Fig. 4) are removed before lifting the selector switch insert. The contacts are then immediately accessible and can be inspected for wear.

The selector switch housing has its own oil separated from the transformer oil. This is to prevent contamination of the transformer oil since the oil of the tap-changer deteriorates due to the switching operations. The oil needs to be changed at regular intervals to maintain adequate dielectric strength as well as to prevent mechanical wear.

The selector switch comprises three phases, each consisting of:

- Selector switch (with replaceable fixed and moving contacts)
- Transition resistors.

It is necessary to inspect and clean the contacts and insulation parts of the selector switch, as well as to clean the housing inside at regular intervals.

Besides the maintenance of the selector switch and changing of the oil, the motor-drive mechanism should be checked and lubricated.

The pressure-relay, the device that protects the transformer from excessive pressure in the selector switch housing, should also be checked.

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 principally concerns the motor-drive mechanism and refers to a visual inspection inside the motor-drive cabinet, the heater is functioning, etc.

In the motor-drive mechanism a counter registers every tap-change 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 are checked according to the instructions from the transformer manufacturer.

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

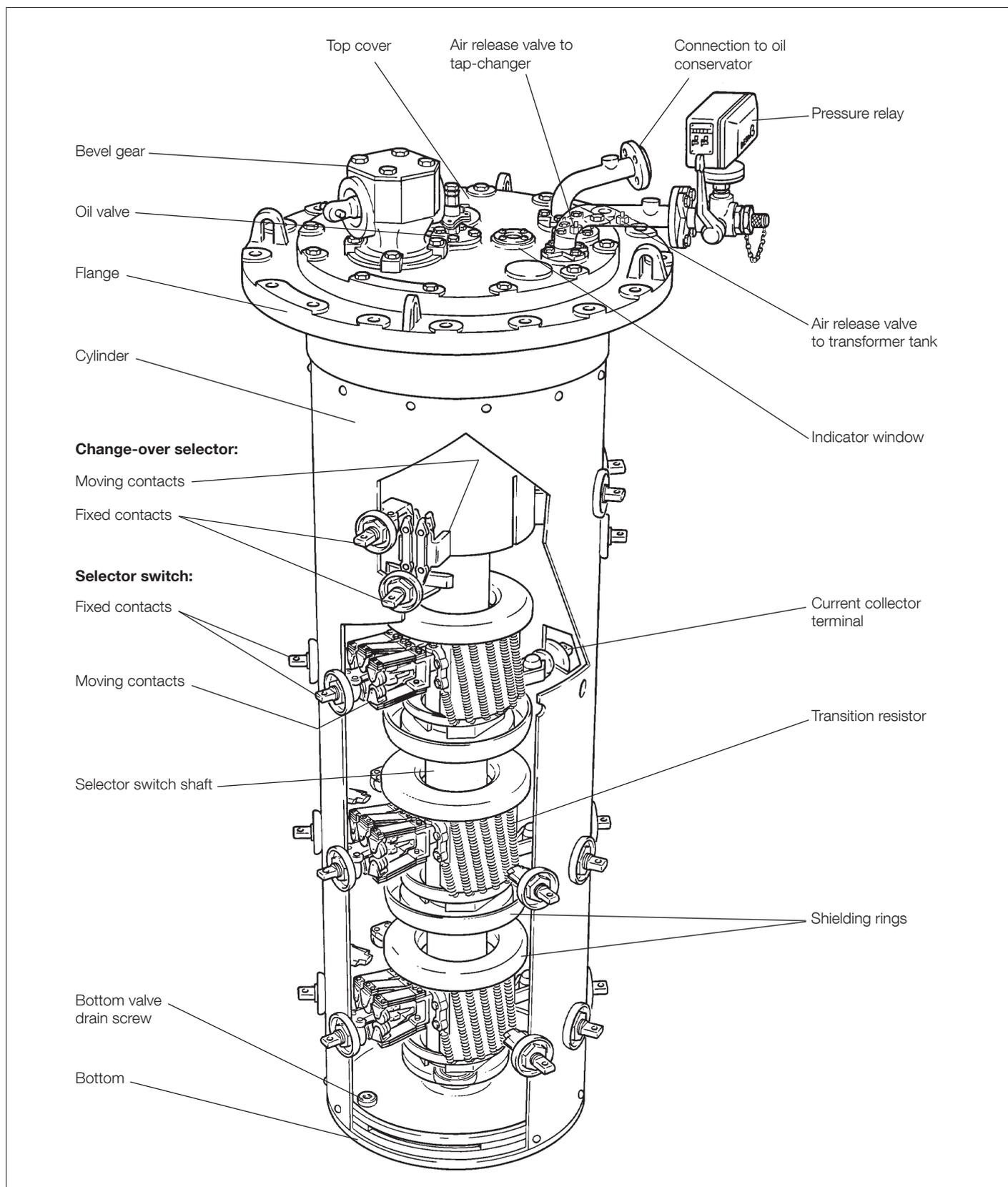


Fig. 2. General arrangement of on-load tap-changer, type UBB.

1.2.2 Overhaul

The contact life and the frequency of operations or the time in service determine the interval between overhauls.

The number of operations run by the tap-changer is recorded by a counter, housed in the motor-drive mechanism cabinet. 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 contact life, the interval between overhauls should be limited to the time stated on the rating plate (normally 5 years).

The overhaul will normally take at least 8 hours, including the 3 hours waiting period after oil filling, even if it is made by trained personnel. We recommend that the overhaul is carried out under supervision of a service engineer trained by ABB.

1.2.3 Contact replacement

On the rating plate of the tap-changer the estimated contact life of the breaking contacts in the selector switch 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 is not normally 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:

For metallic bolt joints:	M6	10 Nm	±10 %
	M8	24.5 Nm	±10 %
	M10.....	49 Nm	±10 %
	M12.....	84 Nm	±10 %

if not otherwise stated in this guide.

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 unit manual.

2.1 Required tools

The following equipment is required for the inspection:

- Set of screwdrivers
- Pen and note pad

2.2 Procedure



WARNING

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



CAUTION

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

2.2.1 Checking of the breather

Check the breather according to the instructions for the transformer.



WARNING

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

If more than half of the drying agent has changed colour, it must be dried or replaced.

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

2.2.2 Checking of the oil level in the conservator

The oil level in the conservator should be according to the instructions in the transformer documentation.

2.2.3 Checking of the motor and the counter

Open the motor-drive cabinet door and turn the selector-switch to the LOCAL position. Then turn the control switch to the RAISE (LOWER) position.

Check that the motor works properly, 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 tap-changer (the overhaul-schedule can be determined with the help of this information).

Turn the control switch to the LOWER (RAISE) position. Check that the motor also works properly in that direction, the position indicator decreases (increases) one step and the counter advances one step more.

Reset the draghands.

2.2.4 Checking of 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 and set the protective motorswitch to ON. The started operation should now be completed. Operate back to service position.

2.2.5 Checking of 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 on BUE or on the separate earth fault protector on BUL2.

2.2.6 Checking of the 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. (BUE only).

Check by feeling with a finger on the protection plate that the heater has been functioning.

Close the control panel. (BUE only). Reconnect the incoming auxiliary power.

Complete the inspection by turning the selector-switch to the REMOTE position and close the cabinet door.

3. Overhaul

The overhaul mainly consists of lifting and cleaning of the selector switch insert, checking of the selector switch and change-over selector (if any), checking of the transition resistors, checking of contacts and the motor-drive mechanism.



WARNING

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

3.1 Required tools and materials

Necessary for the overhaul, besides common hand tools, is the following equipment:

- Standard set of open-end wrenches (up to 18 mm)
- Standard set of sockets (up to 18 mm)
- Allen socket, 5 and 6 mm
- Ratchet wrench handle with extension
- Standard set of screwdrivers
- Oil test equipment (for dielectric strength testing according to IEC 60156, 1995-08),
- New transformer oil, volume according to section 3.3.3. The oil quality should be IEC 60296, 2012-02, -LCSET -30° (former Class II). The oil should have an electrical withstand of at least 40 kV, measured in a 2.5 mm gap, according to IEC 60156, 1995-08.
- Clean and empty drums (for approximately 200 l)
- Bucket (10 l)
- Rags (lint-free)
- Brush with extensible shaft (for cleaning of cylinder and selector switch shaft), see Appendix, Fig. A1
- Spring balance (10 N) for checking of belt tension
- Megger (500 V)
- Set of spare contacts
- Guide for rollers, see Appendix, Fig. A6
- Holding tool (for remounting of fixed contact blade and guiding when lowering the insert), see Appendix, Fig. A2
- Screwing tool (for remounting of fixed contact blade), see Appendix, Fig. A3

- Lifting and operating tool, see Appendix, Fig. A4
- Lifting rig, see Appendix, Fig. A5
- Lifting jack (about 40 kg, 1.6 m lifting height)
- Protective gloves, oil-proof
- Hand lamp
- Ohmmeter (0.5-50 Ohm)
- Slide calliper
- Air pump with pressure gauge (0-200 kPa), connection to thread R1/8" male
- Oil for bearings
- Grease: GULF-718EP Synthetic grease, Mobilgrease 28, SHELL-Aero Shell Grease 22 or similar
- Watch, with hand for seconds
- Pen and paper and revision protocol

3.2 Procedure

The overhaul procedure includes the following points:

- Oil draining and filtering
- Lifting and cleaning the selector switch housing and insert
- Checking fixed and moving contacts of the selector switch and change-over selector (if any)
- Checking the transition resistors
- Lowering the selector switch insert
- Checking the pressure-relay
- Lubrication of the drive shaft system
- Checking the motor-drive mechanism
- 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 outage time of the transformer, carry out all work on the tap-changer and 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 tap position.

3.3.2 Disconnection and earthing of the transformer

WARNING



Before carrying out work on the tap-changer, put the LOCAL/REMOTE in position LOCAL or 0, and the protective motor switch on the motor-drive mechanism to position 0.

WARNING



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

Operate the tap-changer by the hand crank until the maintenance position is reached.



The maintenance position is marked on the rating plate.

3.3.3 Oil volumes and lifting heights

The necessary number of empty drums for collecting and filtering of the oil in the diverter switch housing should be kept ready. The drums must be carefully cleaned and free from water. New oil needed should be IEC 60296, 2012-02, -LCSET -30° (former Class II). The oil should have an electrical withstand of at least 40 kV, measured in a 2.5 mm gap, according to IEC 60156, 1995-08. The oil should have a water content below 15 ppm and have been handled and stored according to IEC 60422 point 10.

Quantity of oil in the tap-changer and lifting height for insert

UBB.N 200/...	Approx. 100 kg	(lifting height 1.3 m)
UBB.N 350/...		
UBB.T 200/...	Approx. 125 kg	(lifting height 1.6 m)
UBB.T 350/...		



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, approximately 40 kg, should be kept ready to replace waste oil and for cleaning.



CAUTION

Do not energize the transformer until oil has been filled as per section 3.18 in this guide.

3.3.4 Recommended set of standard spare parts

It is recommended to have a set of contacts for the selector switch available at the overhaul. See Fig. 3.

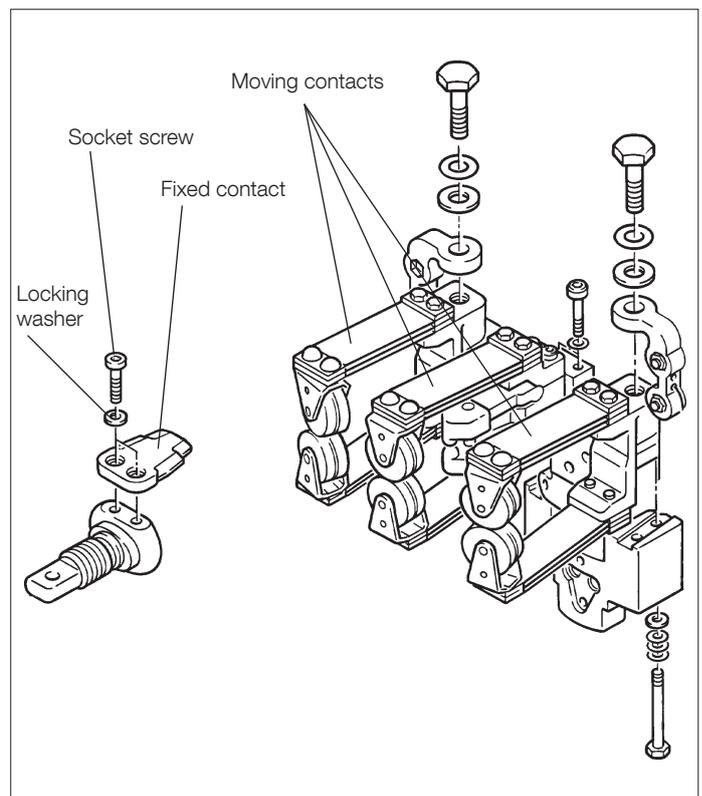


Fig. 3.

3.4 Oil testing and oil draining

The tap-changer housing is equipped with an oil valve placed on the top section. For connection dimensions, see the dimension drawing for the tap-changer.



WARNING

The oil in the tap-changer may be hot. Be cautious!

Take an oil-sample from the oil valve and carry out the dielectric strength test according to IEC 60156, 1995-08 (between spherical calottes, distance 2.5 mm). This test is carried out for deciding whether the oil can be filtered or must be exchanged.

The dielectric strength of the oil should not be allowed to be less than 30 kV in the test above for an tap-changer in service. For new oil or after filtering of the old oil, the dielectric strength must be at least 40 kV to be allowed for filling the tap-changer.



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



If the tap-changer is equipped with an oil filter unit for continuous oil filtration from ABB and it is maintained and operated according to our instructions, oil draining and filtering is not needed, provided that the dielectric strength is at least 40 kV measured in a gap according to IEC 60156, 1995-08.

Use the filtering equipment or the pump to drain oil from the tap-changer into carefully cleaned oil drum. Connect the pump to the oil valve and drain the oil from the tap-changer housing and the conservator. (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 to the tap-changer, see Fig. 2.) Pump until the oil flow stops. The oil level will then be about 300 mm below the cover. Draining can be effected quickly if filtering equipment is used and at the same time the whole oil quantity will be filtered once.



WARNING

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



WARNING

When oil that has been used in a tap-changer 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.

Remove the top cover of the selector switch housing. See section 3.5.1. Put the hose from the pump down to the bottom of the tap-changer housing and pump out the remaining oil.

3.5 Lifting and cleaning the selector switch insert

3.5.1 Dismantling the top cover of the tap-changer

See Fig. 4.

1. Remove the connection to the oil conservator and pressure relay and other connections made.
2. Loosen the hose clips for the protective tubes on the bevel gears and push the tube from the bevel gear so that the coupling halves for the square shaft can be be seen.
3. Loosen the bolts for the top cover.
4. Lift the cover carefully min 100 mm straight upwards before moving it in horizontal direction. Hold the shaft so it not will fall when the cover is lifted. Take away the shaft and store it temporary. Check that the driving disc on the lower side of the cover and the tightening surface not become damaged when storing the cover temporary.

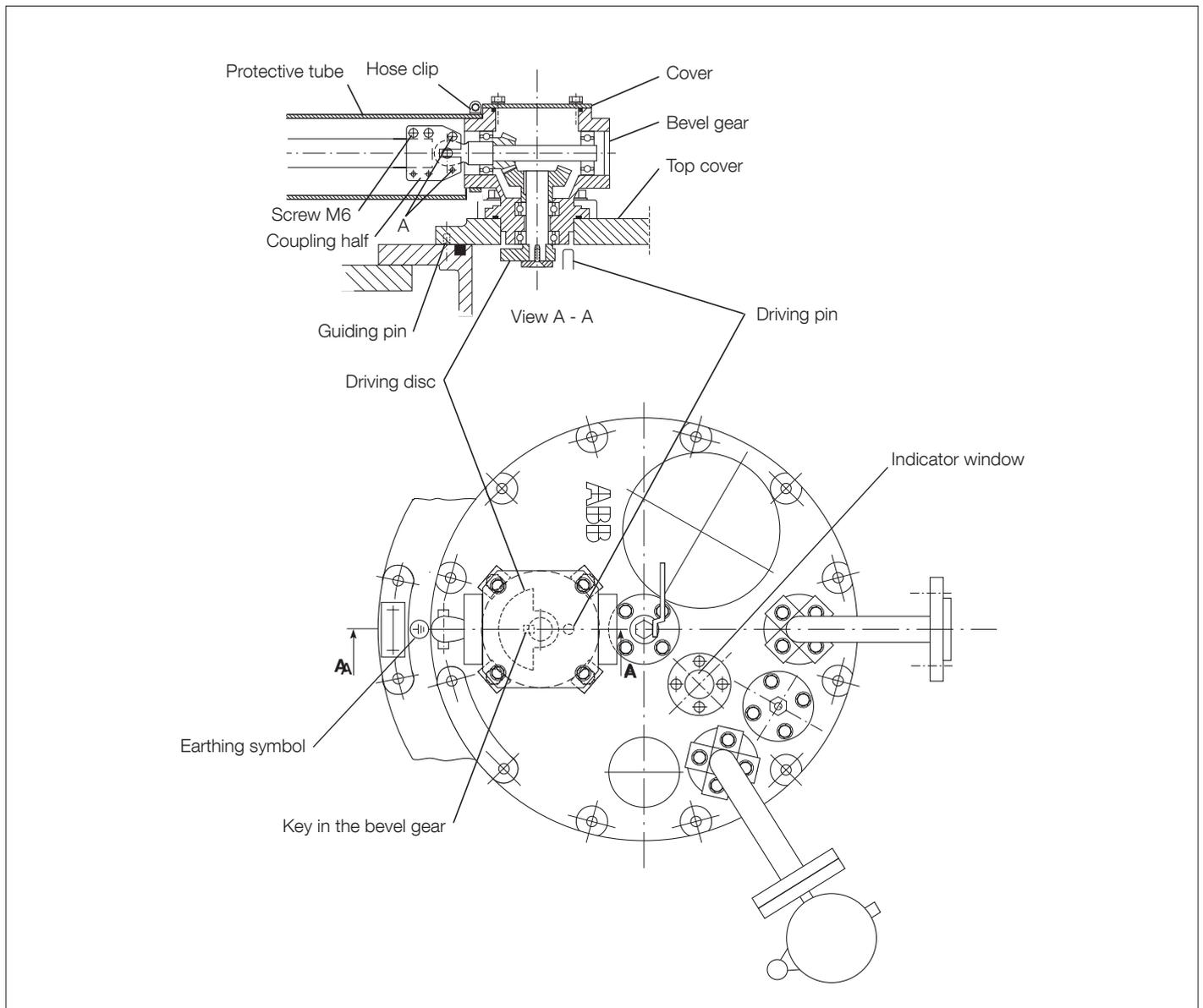


Fig. 4.

3.5.2 Removal of the mechanism and fixed contact blades

Loosen the four M8-screws in the corners of the base plate and remove the mechanism, see Fig. 5.

If the base plate is hard fitted it can be loosened by means of two M10x50 (or longer) screws. Mount the screws through the two clearance holes in the upper part of the selector switch, see Fig. 5. Tighten the screws and the base plate will be pressed upwards. Remove the screws immediately when the base plate with selector mechanism is removed.

At 10-pitch, (the number of fixed contacts in one phase of the selector switch), remove the contact blade next to the current collector in each phase, see Fig. 6, if 12- or 14-pitch removing of two contact blades in each phase is recommended.

Proceed as follows:

1. Adjust the contact holder of the holding tool, for the actual contact (different contacts for 10-, 12-, 14-pitches). See 3.5.3 and Fig. A2.
2. Attach the holding tool on the contact blade in the upper phase.
3. Loosen the two M6-screws completely in the contact blade by using the screwing tool, see Fig. A3.
4. Lift both tools and the contact blade and the M6-screws. Store the blade and screws temporarily.
5. For the blades in the lower phases, repeat the steps 2-4 above.

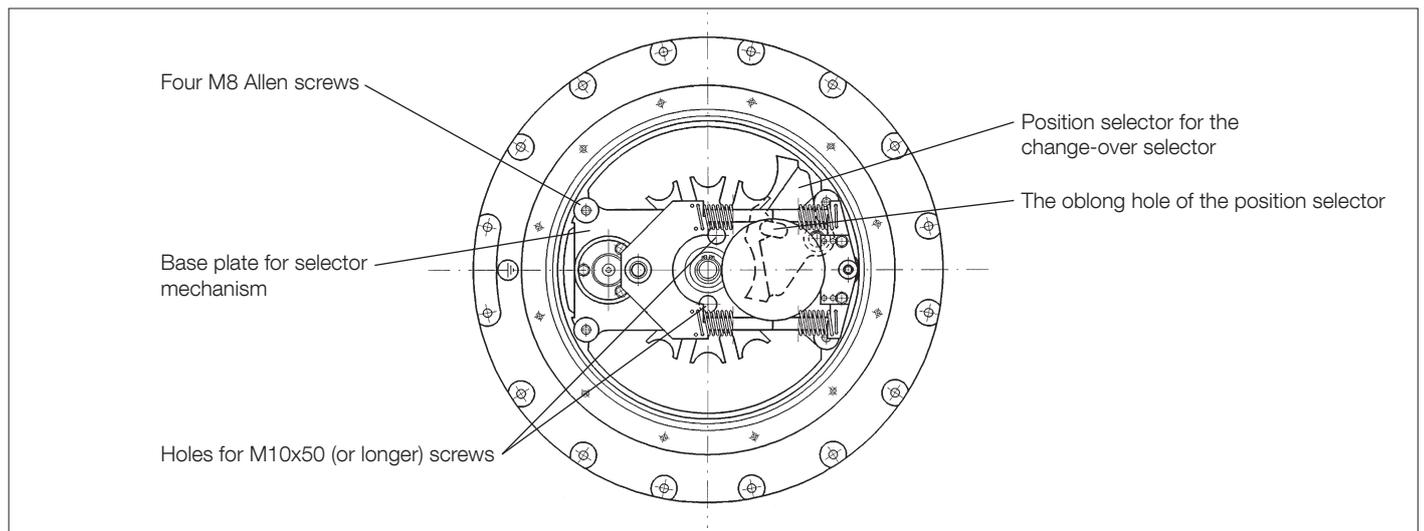


Fig. 5

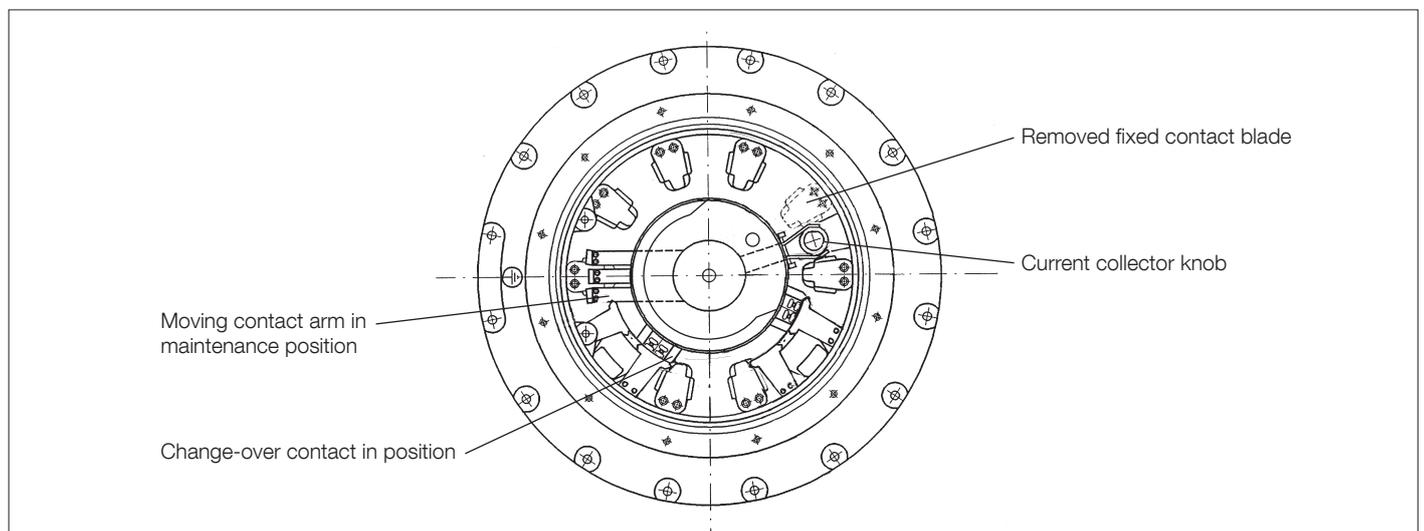


Fig. 6. UBB in position before removal of the switch insert.

3.5.3 Adjustment of the holding tool for removal of fixed contacts

See Fig 7. The plate spring must be adjusted to dimension B for the fixed contacts respectively (see the table below). Turn the adjusting screw clockwise to reduce and anticlockwise to increase the dimension B. If the adjusting according to above not is enough, bend carefully the plate spring to the right dimension. Use a spare contact blade to check the adjustment.

Fixed contact for	Dimension B
10-pitches	41 +1/-0
12-pitches	36 +1/-0
14-pitches	31 +1/-0

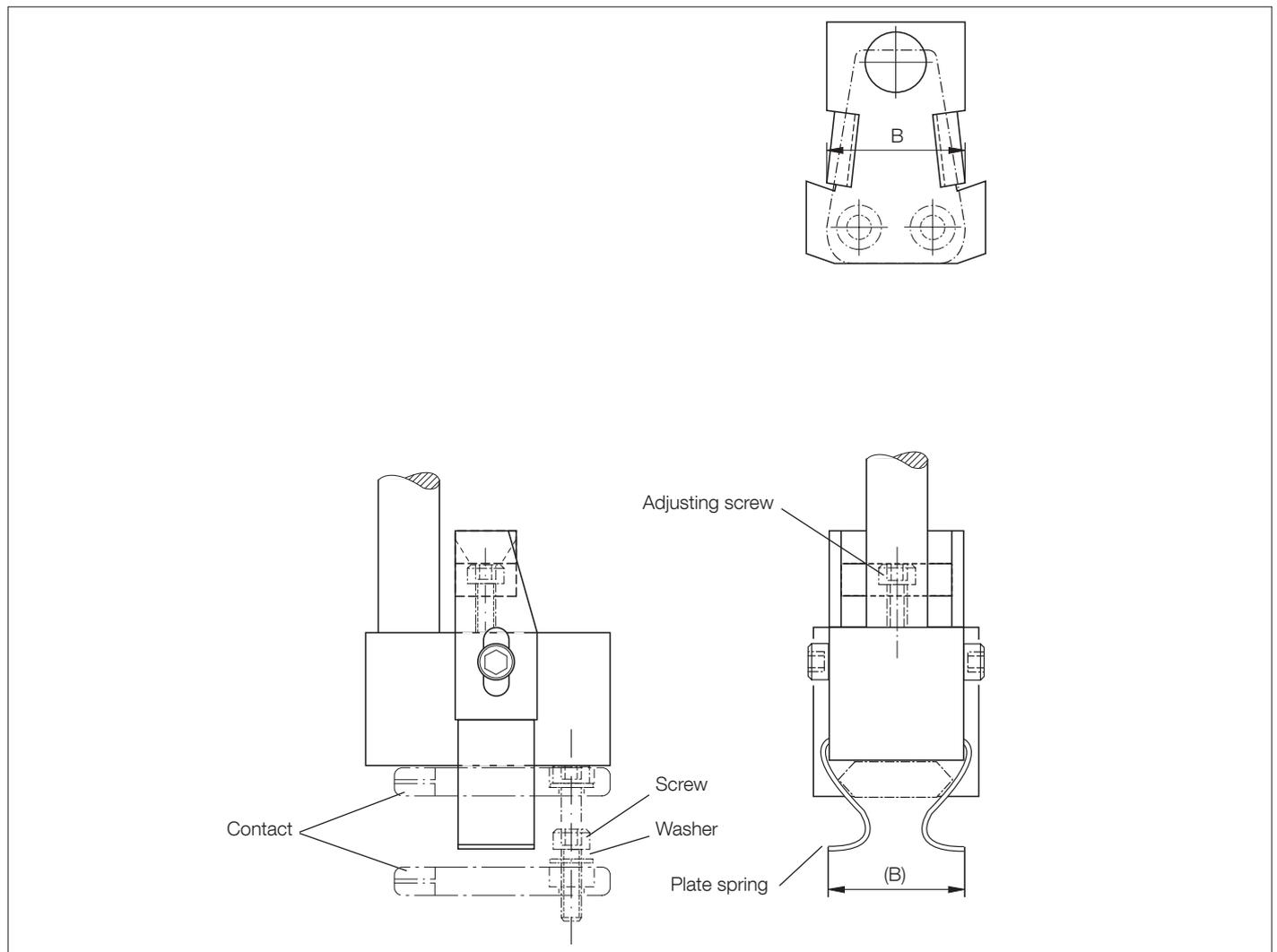


Fig. 7.

3.5.4 Positioning of selector switch and change-over selector before lifting

See Fig. 6.

1. Attach the lifting and operating tool, see Fig. A4, to the two M8-holes on the upper end of the selector switch.
2. Twist the tool clockwise until the moving contacts of the selector switch shaft have reached the position for the removed fixed contact blades and close to the current collectors. See Fig. 6.
3. Place the slot in the outer arm of the tool over the roller on the change over selector.
4. Twist the moving contacts of the change-over selector by means of the arm until they are between two fixed long contacts.

3.5.5 Lifting

The selector switch insert (mass approximately 30 kg) can be lifted out of the cylinder by means of a lifting jack. As a holder for the lifting jack it is recommended to use a "rig" similar to the one shown in Appendix, Fig. A5.

1. Couple the hook of the lifting jack to the lifting and operating tool and lift the insert carefully until the current collectors just leave their knobs.
2. Twist the shaft so both the moving contacts and the current collectors are in the position for the removed fixed contact blades, see Fig. 8.
3. Lift carefully until the selector switch insert is completely removed from the selector switch cylinder.
4. The insert can be put down on two non-metallic (wood) supports.



CAUTION

Make sure that there always is clearance between the insert and the fixed contact blades, so no parts will be deformed or damaged.

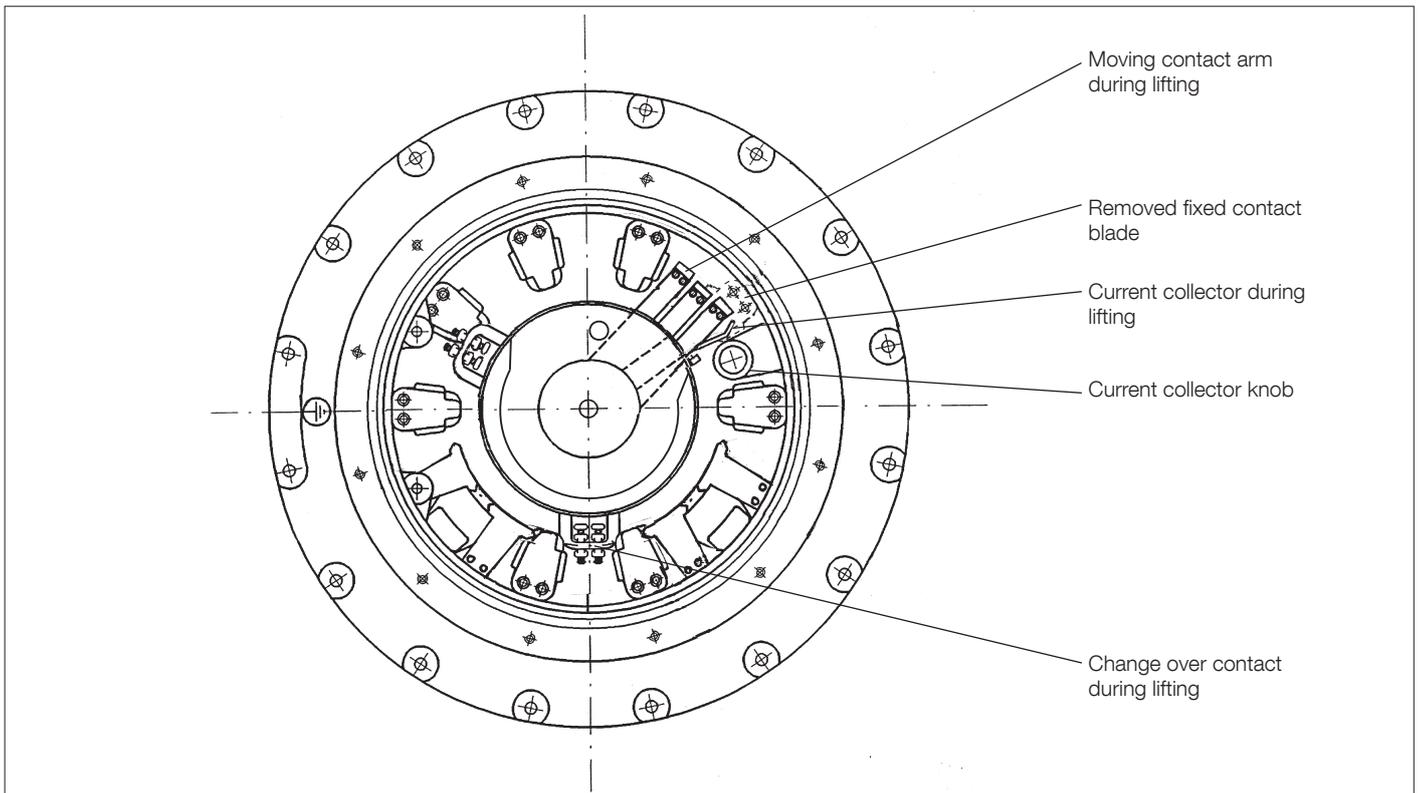


Fig. 8. UBB in position for lifting of the switch insert.

3.5.6 Cleaning

Clean the selector switch insert as follows:

1. Remove all carbon deposits on the outside by brushing. Flush with clean oil.
2. Clean the inside of the selector switch shaft by putting in the brush from the bottom and moving it up and down during turning. Flush the inside with clean oil.

Clean the selector switch cylinder:

1. Remove all carbon deposits with the brush moved up and down during turning. Flush with clean oil.
2. Remove the remaining oil on the cylinder bottom by using a lint-free rag. Pick up rags from the bottom.



If the tap-changer is equipped with an oil filter unit for continuous oil filtration from ABB and it is maintained and operated according to our instructions, the cleaning of the selector switch housing is very easy.

3.6 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 40 kV measured in a 2.5 mm gap according to IEC 60156, 1995-08.

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



If the tap-changer is equipped with an oil filter unit for continuous oil filtration from ABB and it is maintained and operated according to our instructions, no further oil filtration should be necessary. Only take a sample and measure the dielectric strength of the oil, see section "Oil Testing and Oil Draining" in this guide.

3.7 Checking of the breather

Check the breather according to the instructions for the transformer.



WARNING

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

If more than half of the drying agent has changed colour, it must be dried or replaced.

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

3.8 Checking contacts

3.8.1 Moving contacts

i 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 less than the diameters given in the table 1. Measure the diameter of each roller halfway between the roller ends.

Compare the measurements of the most worn roller with the diameters given in table 1. See Fig. 9.

i If a contact is replaced, the comparison at the next revision shall start again with the value for Revision 1.

Table 1. Contact minimum dimensions.

Revision (According to recommendations on the rating plate)	Measure d (mm)
1	≤ 18.5
2	≤ 18
3	≤ 17.5
4	≤ 17
5	≤ 17

The base for the dimensions are, 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.

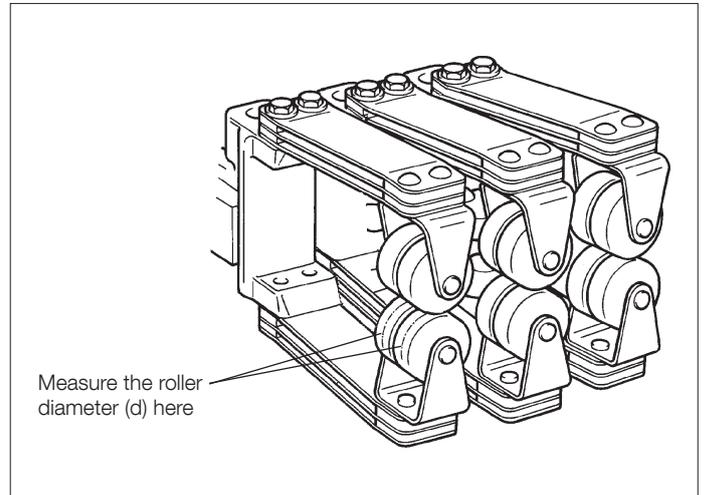


Fig. 9. Moving contact arm.

3.8.2 Fixed contacts 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, which surface (upper or lower part) is least worn. Measure the wear on this surface 6 mm up on the tip, according to Fig. 10. The contact has to be loosened to make the measurement possible.

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

i If a contact is replaced, the comparison at next revision shall start again with the value for Revision 1.

Table 2. Contact minimum dimensions.

Revision (According to recommendations on the rating plate)	b=30 Measure a (mm)	b=24.5 Measure a (mm)	b=21.5 Measure a (mm)
1	≤ 3.5 (3.0)	≤ 3.5 (3.0)	≤ 4.0 (3.5)
2	≤ 3.5 (3.0)	≤ 3.5 (3.0)	≤ 4.0 (3.5)
3	≤ 2.5 (2.5)	≤ 2.5 (2.5)	≤ 3.0 (3.0)
4	≤ 2.0 (1.5)	≤ 2.0 (1.5)	≤ 2.5 (2.0)
5	≤ 1.5 (1.5)	≤ 1.5 (1.5)	≤ 2.0 (2.0)

The base for the dimensions are, 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.

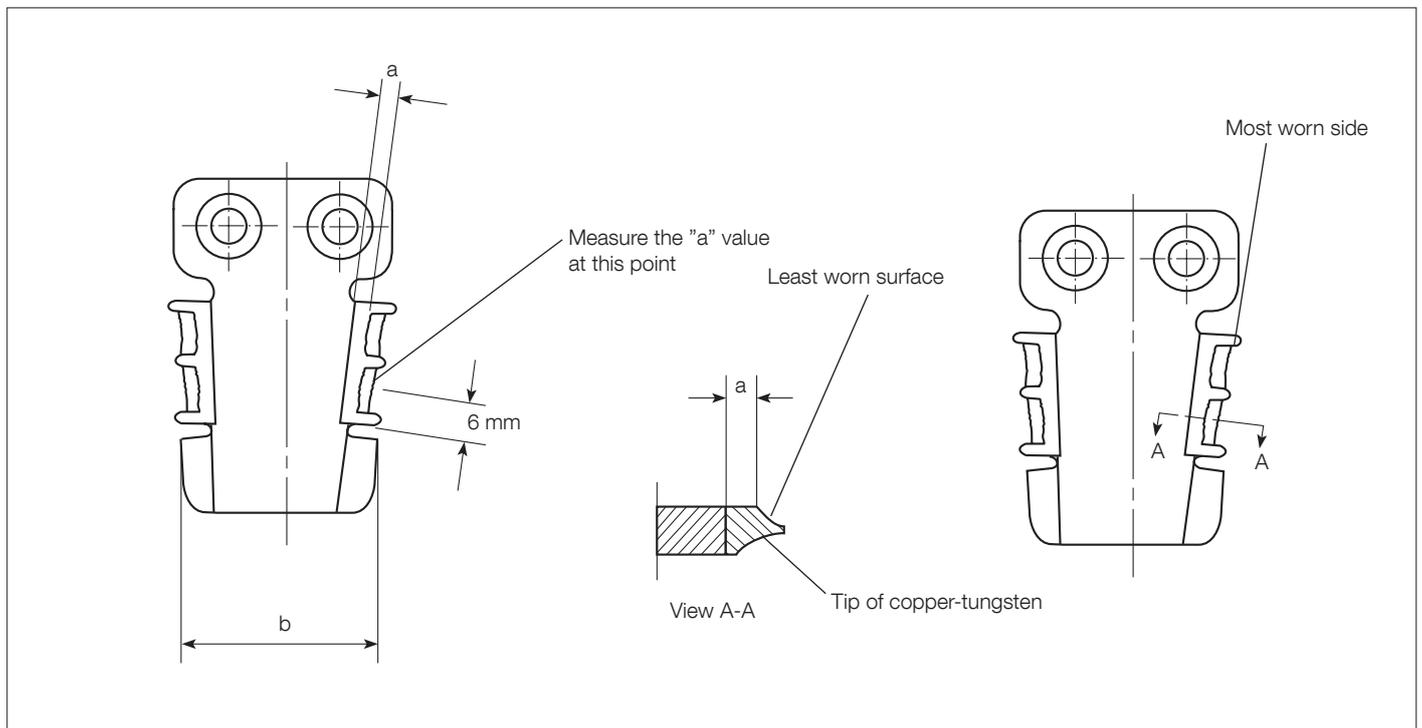


Fig. 10. Measure the wear of the contacts.

3.8.3 Fixed contacts 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, which surface (upper or lower part) is least worn. Measure the wear on this surface 18 mm up on the tip, according to Fig. 11. The contact has to be loosened to make the measurement possible.

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

i If a contact is replaced, the comparison at next revision shall start again with the value for Revision 1.

Table 3. Contact minimum dimensions.

Revision (According to recommendations on the rating plate)	b=30.5 Measure a (mm)	b=25 Measure a (mm)	b=22 Measure a (mm)
1	≥ 5.5 (6.0)	≥ 5.5 (6.0)	≥ 4.0 (4.5)
2	≥ 6.0 (6.5)	≥ 6.0 (6.5)	≥ 4.5 (5.0)
3	≥ 6.5 (7.0)	≥ 6.5 (7.0)	≥ 5.0 (5.5)
4	≥ 7.0 (7.5)	≥ 7.0 (7.5)	≥ 5.5 (6.0)
5	≥ 7.5 (8.0)	≥ 7.5 (8.0)	≥ 6.0 (6.5)

The base for the dimensions are, 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.

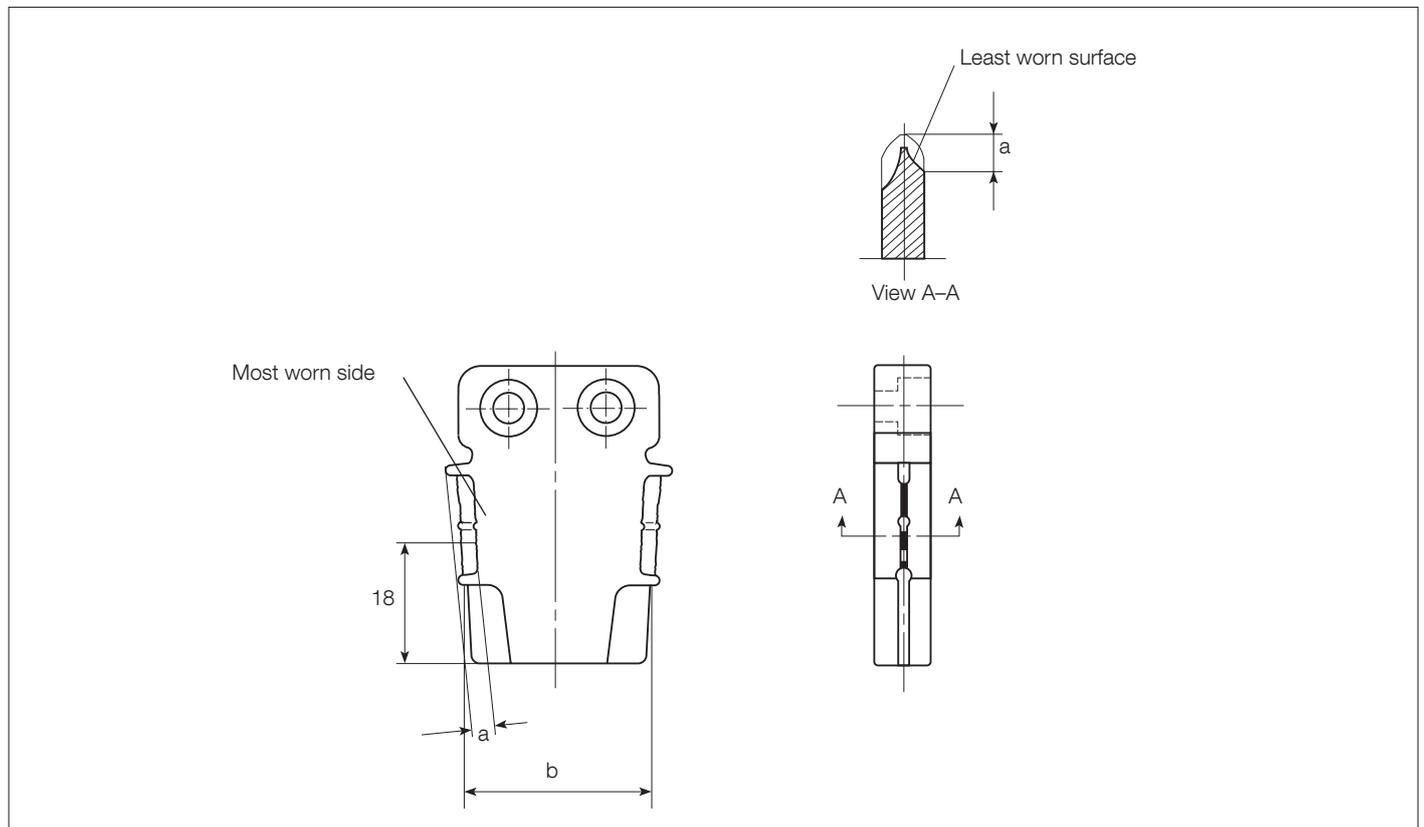


Fig. 11. Measure the wear of the contacts.

3.9 Checking the transition resistors

Connect one of the cables from the ohmmeter to one transition contact and the other cable to the moving main contact, in all phases as described above, then measure the resistance.

Measure the resistance of each resistor and compare with values given on the rating plate. Check that the resistors are undamaged. The values may not differ by more than 10 percent.

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

3.10 Lowering the selector switch insert

See Fig. 8.

1. Check that no foreign objects, tools, rags etc. are left in the selector switch housing.
2. Put the guiding round-bar, see Fig. A2, carefully in the centre hole in the bottom of the selector switch housing.

i The total length should be 1200 mm for UBB.N and 1500 mm for UBB.T. See also Fig. A2.

3. Attach the lifting and operating tool, (if removed), to the two M8 holes on the upper end of the selector switch.
4. Attach the lifting rig, see Fig. A5, on the flange of the selector switch housing.
5. Couple the lifting jack hook to the lifting and operating tool.
6. Before lowering, the moving contacts and the current collectors shall be positioned over the gap where the contact blades are removed and the moving contacts of change-over selector between two long fixed contacts.
7. Lower the insert carefully until the current collectors are a little bit above the current collector knobs.
8. Twist the insert carefully to the position with the current collectors exactly above the current collector knobs respectively.
9. Lower the insert carefully and check that all the current collectors have entered the knobs. If necessary push the current collectors with the screwing tool or similar. Check that the bottom part of the insert enters the bearing, if not adjust by lifting it.
10. Remove the lifting jack and lifting rig.
11. By means of the lifting and operating tool position the moving contacts of the change-over selector to the contact blades respectively. See Fig. 6.



The position of the roller.

12. Position, by means of the same tool, the moving contacts of the selector switch to the contact blades representing the maintenance position, see Fig. 6.
13. Remove the lifting and operating tool.
14. Remove the guiding round bar.
15. Remount the contact blades in each phase using the two tools according to sections 3.5.2 and 3.5.3. Tightening torque 15 Nm.
16. Make sure that the sealing underneath and on top of the mechanism are in place, see Fig. 12. Remount the mechanism and tighten the four M8-screws in the corners of the base plate, see Fig. 5.



The driving pins in the top of the selector switch shall enter in the corresponding holes in the driving mechanism.



If it is an tap-changer with change-over device, make sure that the roller on top of the change-over ring is engaged in the slot of the position selector under the gear base plate.

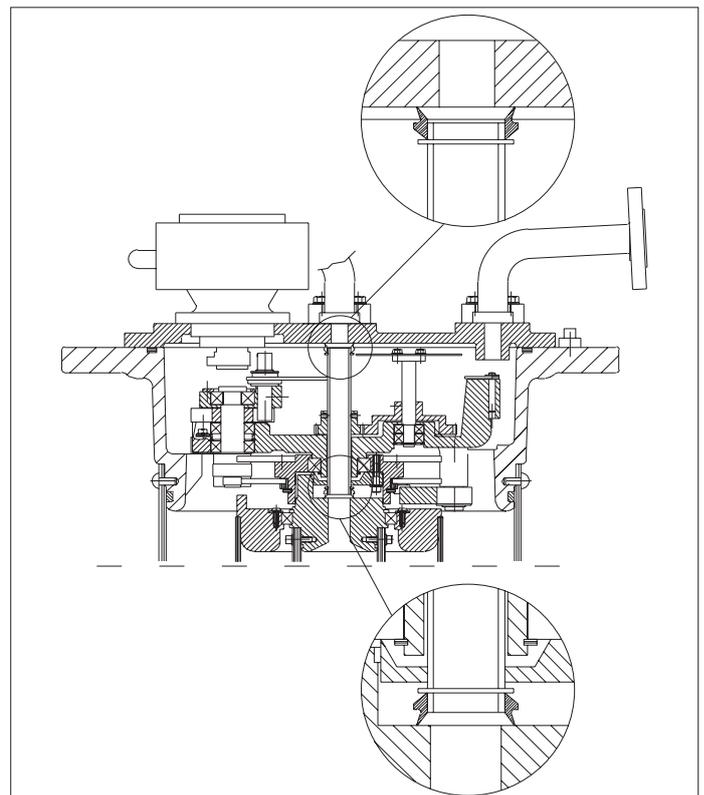


Fig. 12. Sealings.

3.11 Mounting the top cover on the tap-changer

See Fig. 4.

1. Check the O-ring in the groove in the flange. Grease the shaft ends of the bevel gears. See section 3.12.
2. Before mounting the top cover check that the position of the driving disc on the lower side of the cover is according to Fig. 4. Remove the cover of the bevel gear on the tap-changer top cover.
3. Lower the top cover straight down towards the flange. The guiding pin in the flange shall clear the hole in the cover. The horizontal shaft with the protective tube shall be remounted during the lowering.
Open the cover of the gear box on the top cover of the tap-changer. Check that the key on the vertical shaft in the bevel gear is facing the earthing symbol on the flange of the tap-changer. See Fig. 4.



CAUTION

The position of the driving disc must be according to Fig. 4 and the guiding pin must fit in the hole.

4. Check that the number, readable through the indicator window in the top cover, is the same as maintenance position and that the motor-drive mechanism has the same indicated position.
5. Mount the bolts for the top cover and tighten.
6. If drive shaft coupling has been dismantled:
Mount the coupling halves to the square shaft and the shaft of the bevel gear. Tighten the screws lightly and check that the shaft not can be moved more than 2 mm in axial direction (axial play). Tighten the two screws A, (see Fig. 4) first and then the others.
7. Reconnect the pipe-hooks on the top cover to the flanges of the pipe to the oil conservator and the pressure relay.
8. Lubricate the bevel gear, see section 3.12 and reassemble the cover.
9. Reassemble the protective tubes with the hose clips.



CAUTION

The motor-drive mechanism and tap-changer shall have the same indicated tap-position. Check in the indicator window and the motor-drive mechanism.

3.12 Lubrication of the tap-changer and the drive shaft system

The bevel gears are greased at delivery and the same type of grease is used for the couplings of the outer shaft system.

For access to the couplings, loosen the hose-clips and push the protective tubes together. For access to the bevel gears, dismount the covers.



WARNING

The bevel gear contains moving gears. Be cautious!



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).

3.13 Checking the pressure relay

See the accessories and protection devices guide, 1ZSC000562-AAD.

3.14 Checking of motor-drive mechanisms

See the maintenance guide for motor-drive mechanisms, 1ZSC000498-ABH.

3.15 Oil filling

3.15.1 Filling methods and restrictions

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

The oil quality should be IEC 60296, 2012-02, -LCSET -30° (former Class II). The oil must have an electrical withstand of at least 40 kV, measured in a 2.5 mm gap, according to IEC 60156, 1995-08. New oil should have a water content below 15 ppm and have been handled and stored according to IEC 60422 point 10.

After maintenance oil is normally filled at atmospheric pressure. This procedure is described in section 3.15.3. If filling is to be carried out under vacuum, see the installation and commissioning guide 1ZSE 5492-118.

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

The connection to the oil conservator is designed to automatically give a gas cushion when filling at atmospheric pressure.



If new oil, especially degassed oil, is filled into the selector switch housing and the number of operations is low, the gas cushion may be dissolved in the oil. The gas cushion should be restored according to section 3.16.5 "Restoring the Gas Cushion" in this guide.

3.16.2 Before filling



Oil filling may be carried out in different ways depending on what is convenient as long as the rules above are fulfilled and the tap-changer is filled with oil to the correct level with a gas cushion on the top. The method below is recommended and if it is followed in detail no pressure limits are exceeded and oil levels and gas cushion will be correct.

3.15.3 Filling at atmospheric pressure

See Fig. 2.

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

3.15.4 Oil level

For correct oil level in the oil conservator, see the transformer documentation.

3.15.5 Restoring the gas cushion

WARNING



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

If the tap-changer has been filled with degassed oil and has a very low frequency of operation, the gas cushion may have been absorbed by the oil. To avoid fault trip by the pressure relay, the gas cushion should be restored.

Proceed as follows:

1. Shut the conservator valve.
2. Connect a pump to the oil valve and start to suck out oil. Open the air vent to the tap-changer and let air in. Stop the pumping after about 2 litres of oil has been sucked out from the tap-changer.

WARNING



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

3. Shut the air vent and the oil valve and disconnect the pump.
4. Open the conservator valve and an appropriate gas cushion will be formed.

CAUTION

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

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

CAUTION

Avoid to do the restoring in damp weather since moisture will get into the selector switch housing. If the restoring has to be done in such weather, the incoming air has to be dehydrated.

3.15.6 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 airbubbles 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 drag hands. Make sure that no tools or foreign objects are left in the motor-drive mechanism cabinet. Close the door. Make sure that nothing is left on the transformer cover.

Sign the revision protocol and give it to the engineer in charge and inform that the tap-changer is ready for energizing.

4. Contact replacement

CAUTION

ABB recommends that only maintenance engineers with appropriate knowledge about the UBB selector switch carry out contact replacement.

Check the wearing of the contacts as described in section 3.8. Replace worn out contacts.

Replacing of contacts is described in the following sections.

4.1 Moving contacts

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

At first the transition resistors shall be loosened, but not removed, by loosening two bolts (B), see Fig. 22.

Remove the complete transition contact unit 1 and 3 by unbolting the four bolts (C). The moving main contact unit 2 is removed by unbolting the two bolts (D).

The new main contact unit and transition contact units are then remounted. Begin with the main contact. The transition contact units will be correctly positioned when the guide for the rollers according to Figs. 22 and A6 is used. All bolts should be tightened according to Fig. 22. It is not necessary to use a torque wrench. The torques (in brackets) are only guide values.

4.2 Fixed contacts

To remove the fixed contact blades you have to loosen the two socket screws. Use the holding tool to hold the blade and screws and the screwing tool to loosen screws.

When mounting the new contact blades, the socket screws should be tightened with a torque of 15 Nm.

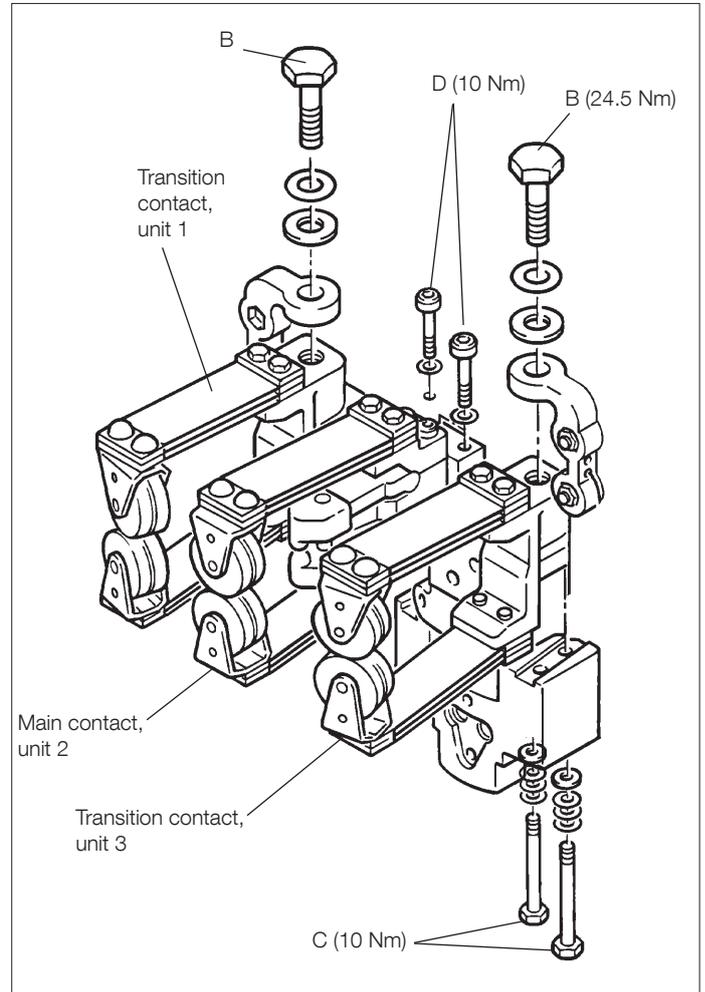


Fig. 22. Moving contact system design.

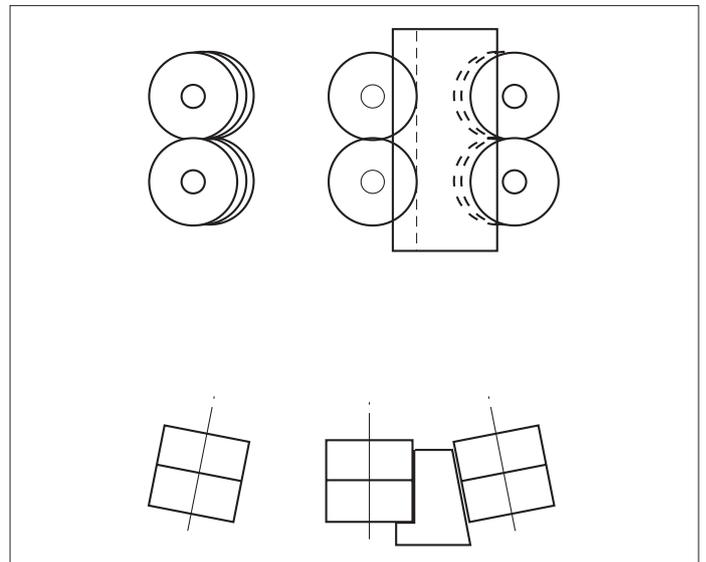


Fig. 23. Guide for the rollers.

5. Tap-changer in the transformer

5.1 Resistance measurement

If there are any 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.

6. Specification of materials

6.1 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.

6.2 Selector switch housing

Material	Amount
Steel	5 kg
Aluminium	45 kg
Copper and alloys	5 kg
Epoxy resin	30 kg
Epoxy resin	100-125 kg

6.3 Selector switch insert

Material	Amount
Steel	5 kg
Aluminium	5 kg
Copper and alloys	10 kg
Silver	25-50 g
Tungsten	0-1.5 kg
Epoxy resin	12 kg
Polyphenylene sulfide resin	2 kg
Resistor wire (mainly copper and nickel alloys with lesser amounts of aluminium and manganese)	2 kg

6.4 Gearing mechanism

Material	Amount
Steel	8 kg
Aluminium	2.5 kg
Copper and alloys	2 kg

6.5 Drive shaft systems

Material	Amount
Steel	8 kg
Aluminium	2 kg
Brass	2 kg
Polyethylene	2 kg



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.

Appendix. Tools

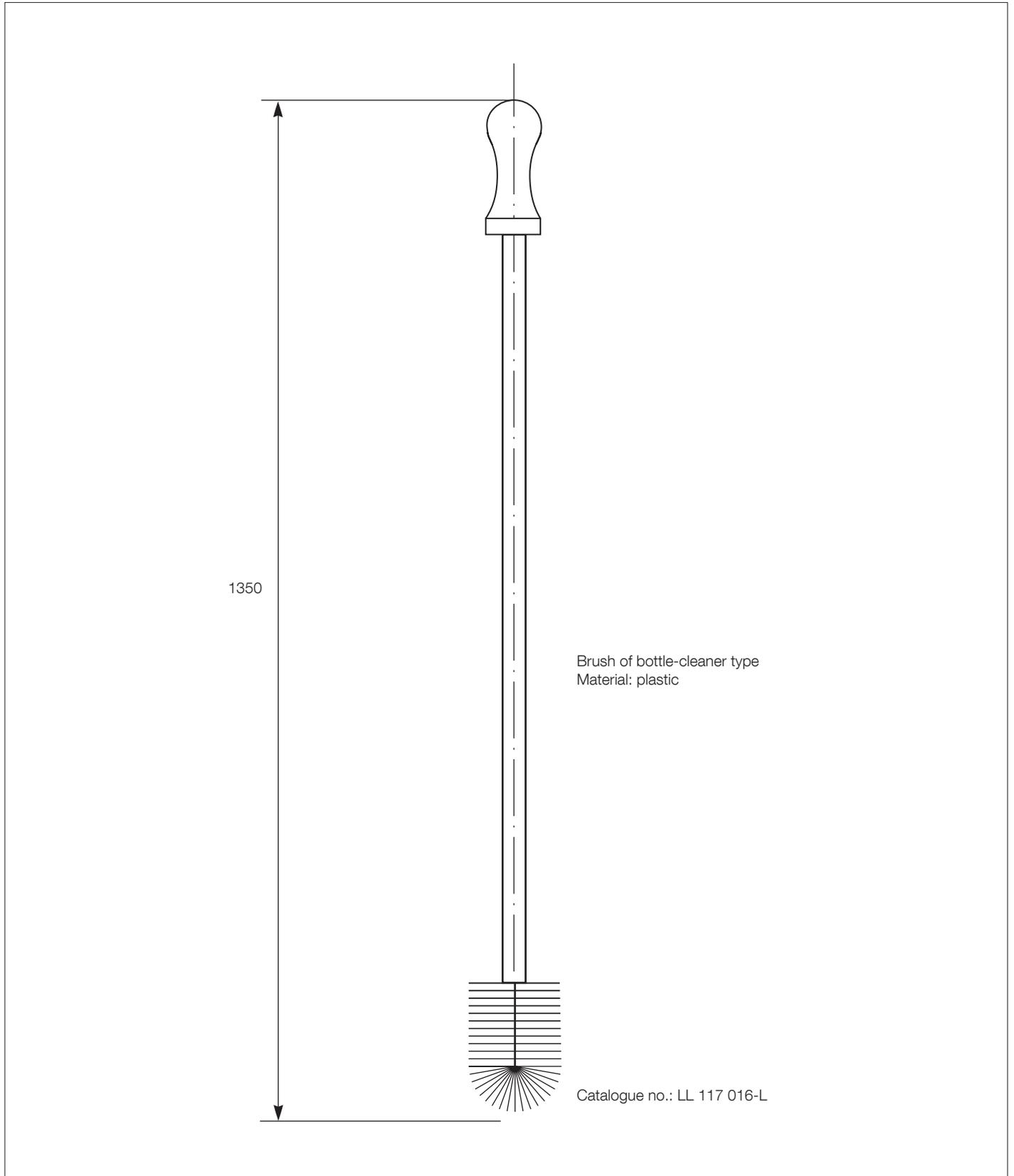


Fig. A1. Brush.

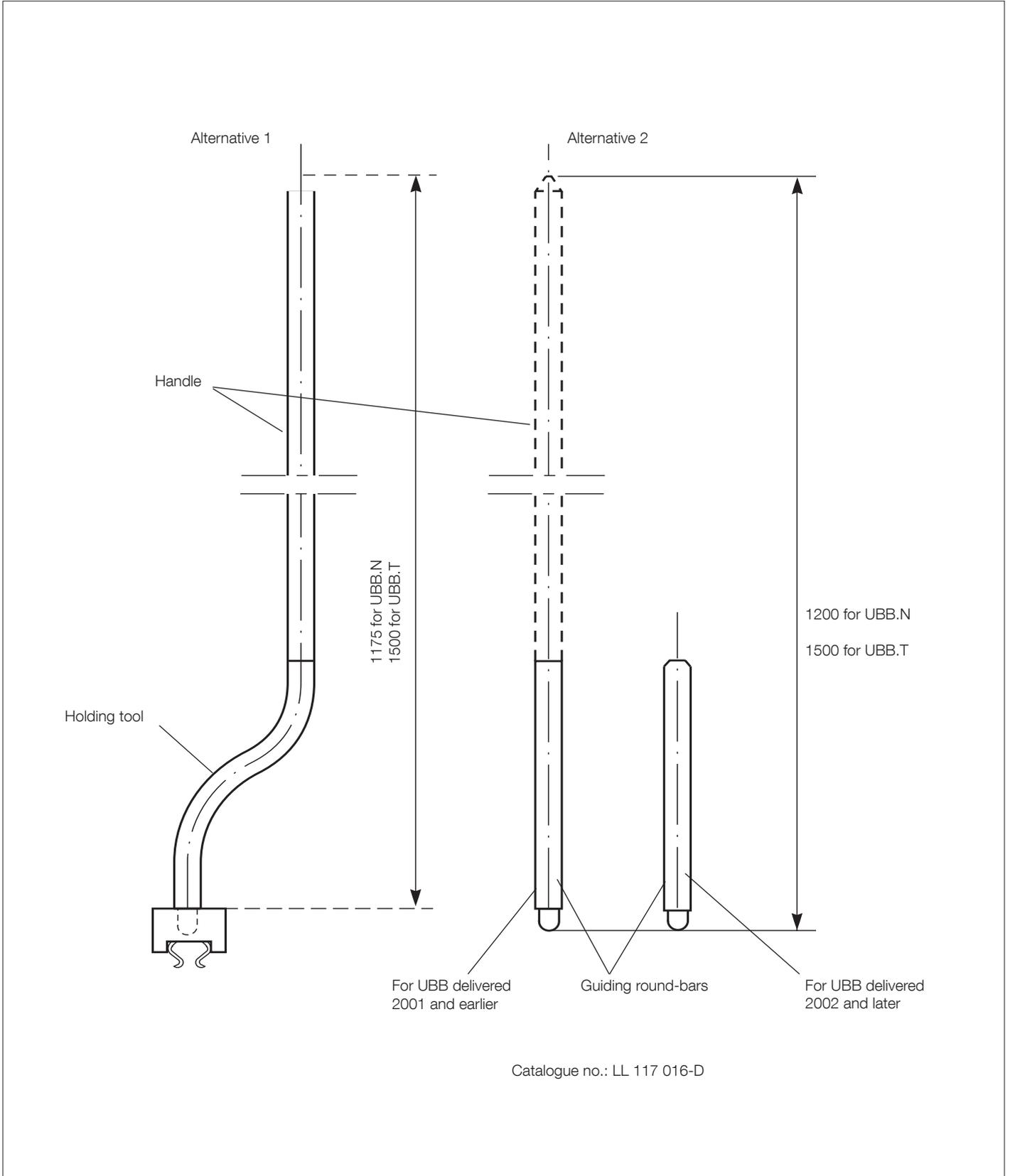


Fig. A2. Holding tool and guiding round-bar.

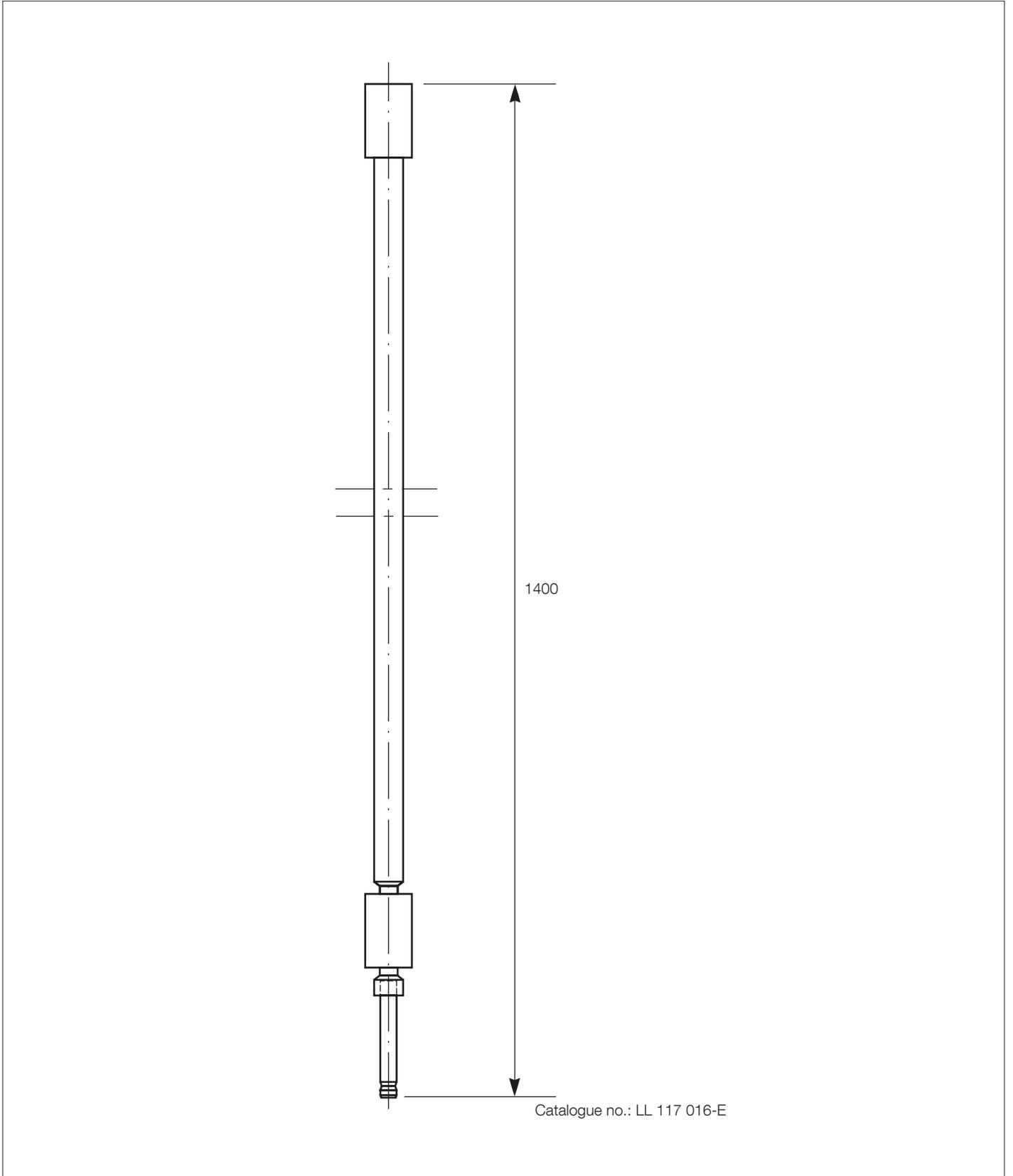


Fig. A3. Screwing tool.

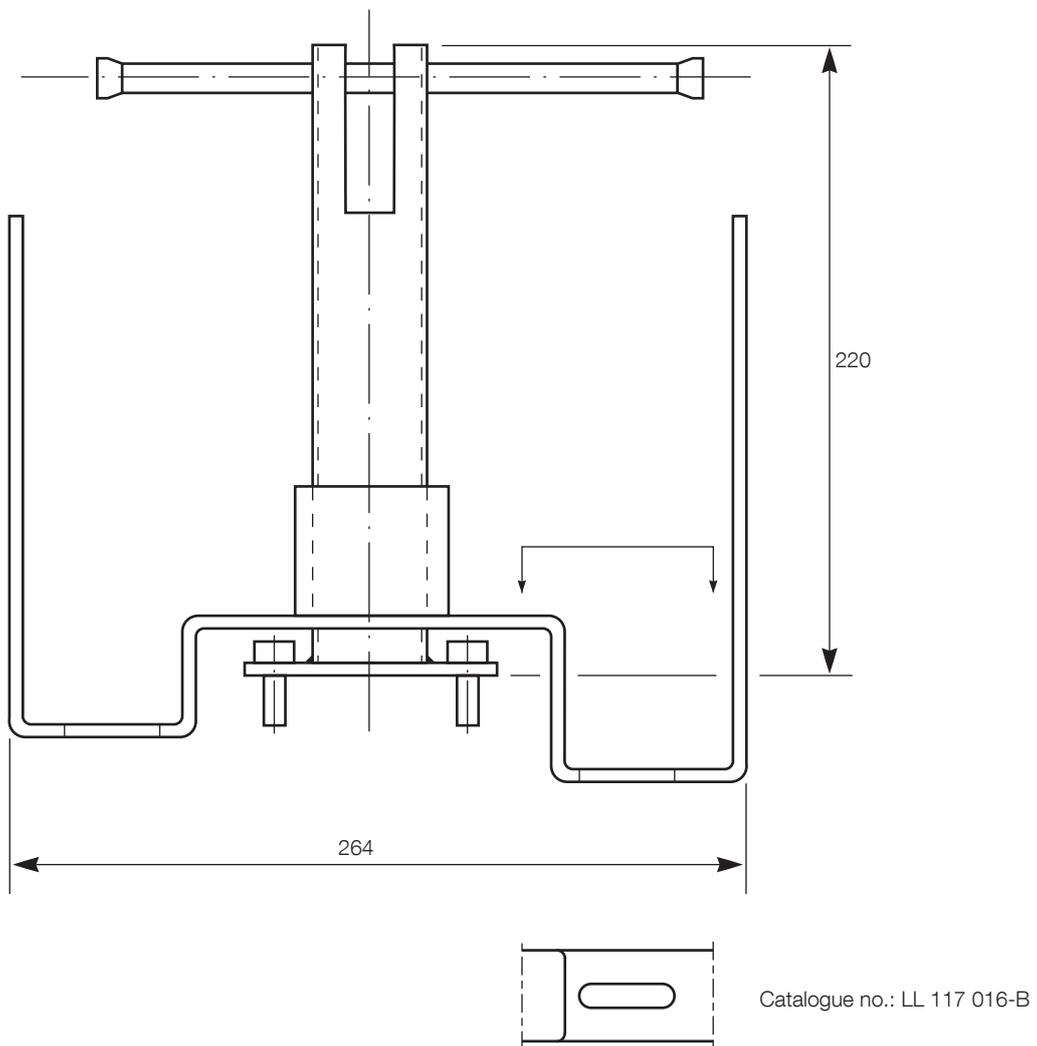


Fig. A4. Lifting and operating tool.

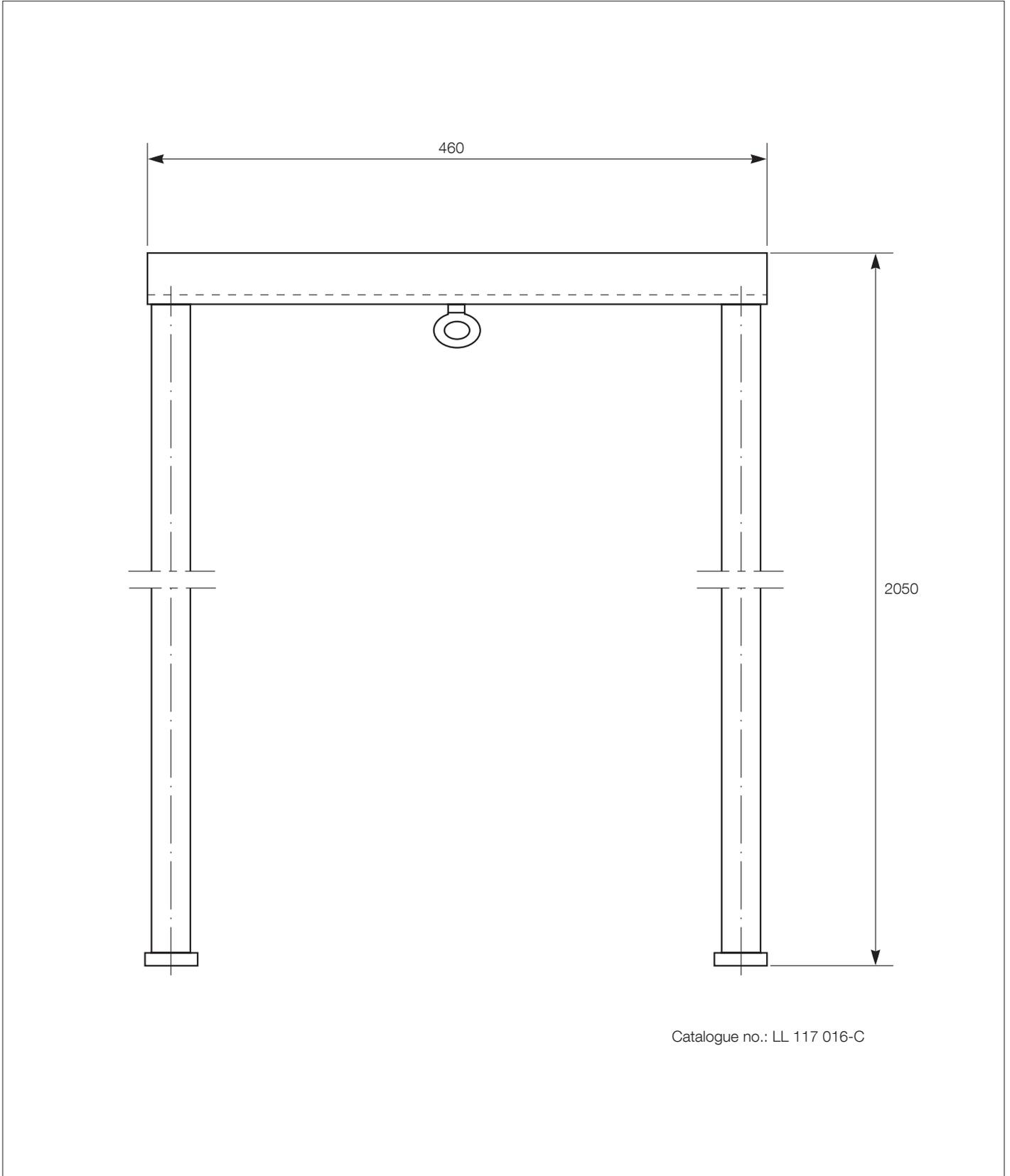
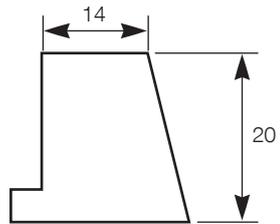
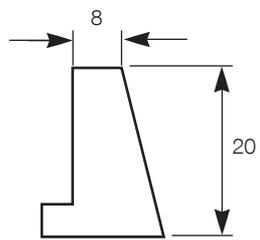


Fig. A5. Lifting rig.



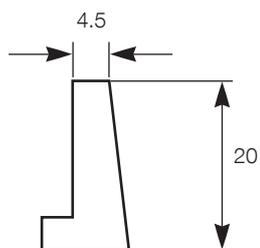
10-pitches

Catalogue no.: LL 117 016-F



12-pitches

Catalogue no.: LL 117 016-G



14-pitches

Catalogue no.: LL 117 016-H

Fig. A6. Guide for the rollers.

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