



1ZSC000498-ABH en, Rev. 1

Motor-drive mechanisms, types BUE and BUL2 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.

WARNING, CAUTION and INFO



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 against 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 the document should be followed at all times.



WARNING

Before starting any work inside the motor-drive mechanism, the auxiliary power must be switched off. N.B. The motor, the contactors and the heating element may be energized from separate sources.

During service



WARNING

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



WARNING

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



WARNING

The hand crank must not be inserted during electrical operation.



WARNING

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

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1. Introduction

1.1 General

The motor-drive mechanisms, types BUE and BUL2, manufactured by ABB, have been developed over many years to provide maximum reliability. The simple and robust design gives a service life equal to the service life of the transformer. Minimum maintenance is required for trouble-free operations.

The motor-drive mechanism is attached to the transformer tank and connected to the on-load tap-changer by means of drive shafts and a bevel gear.

1.2 Design

The design and layout of the motor-drive mechanisms are shown in Figs. 1 and 2 (BUE) and Figs. 3 and 4 (BUL2).

1.3 Legend





	Towards motor-drive upper limit
	Towards motor-drive lower limit
	LOCAL control
	REMOTE control



Fig. 1. Cabinet layout of motor-drive mechanism, type BUE.

- | | |
|--|---|
| 1. Locking device prepared for padlock | 10. Tap-change in progress indicator |
| 2. Emergency stop | 11. Position indicator with drag hands for max. and min. position |
| 3. Air vent | 12. Shaft for hand crank |
| 4. LOCAL/REMOTE switch | 13. Protective motor switch |
| 5. RAISE/LOWER switch | 14. Door-operated switch for lamp |
| 6. Outgoing shaft | 15. Hand crank |
| 7. Lamp (40 W socket E27) | 16. Descriptions and circuit diagram |
| 8. Lifting eye | |
| 9. Counter | |

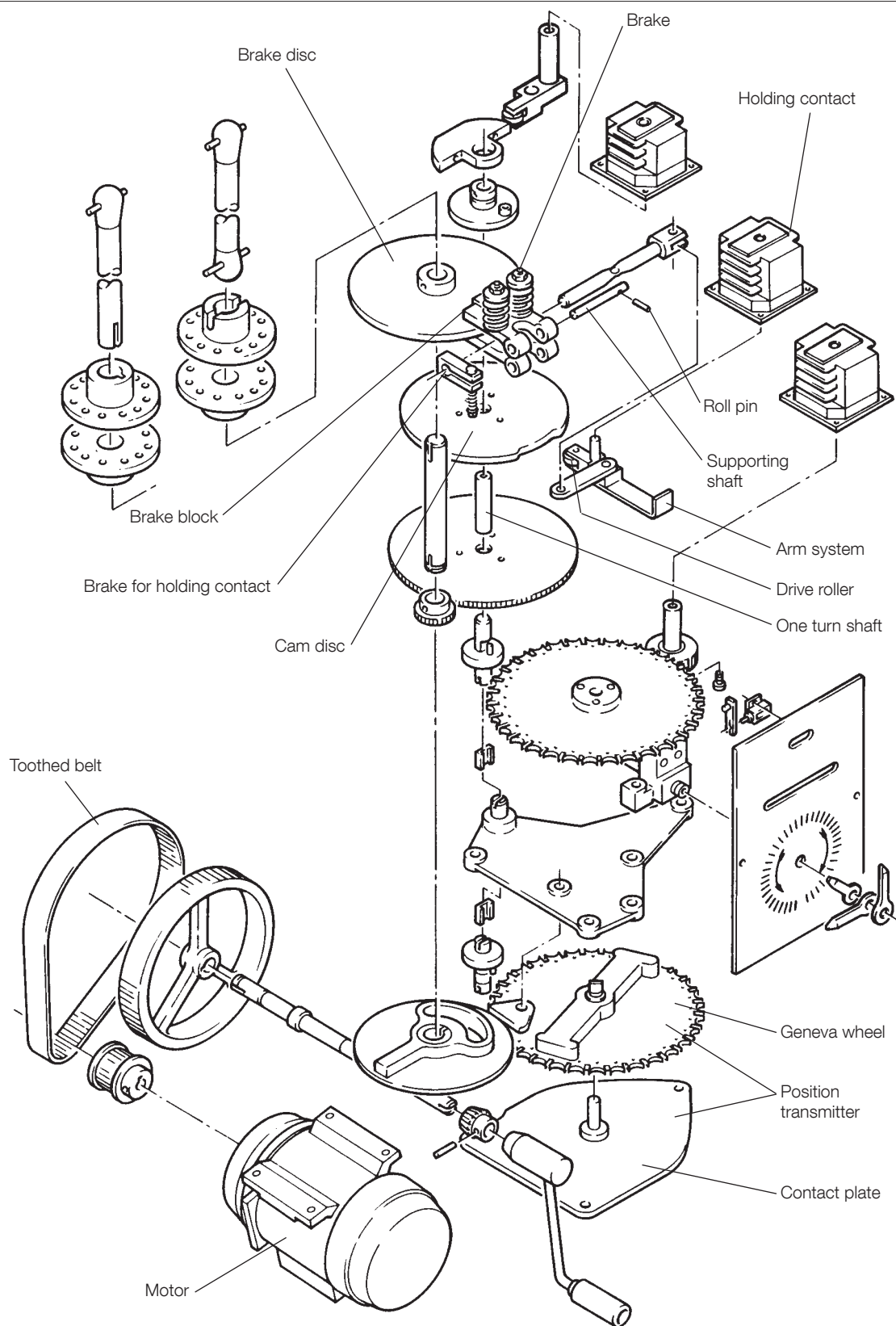


Fig. 2. Mechanical design of motor-drive mechanism, type BUE.



Fig. 3. Cabinet layout of motor-drive mechanism, type BUL2.

- | | |
|---|--------------------------------------|
| 1. Position indicator with drag hands for max. and min. position | 8. Emergency stop |
| 2. Tap-change in progress indicator
(Red: in progress, White: in position) | 9. RAISE/LOWER switch |
| 3. Counter | 10. LOCAL/REMOTE switch |
| 4. Outgoing shaft with multi-hole coupling half | 11. Protective motor switch |
| 5. Shaft for hand crank | 12. Air vent |
| 6. Locking device prepared for padlock | 13. Door-operated switch for lamp |
| 7. (Option) Outlet | 14. Lamp |
| | 15. Descriptions and circuit diagram |
| | 16. Hand crank |

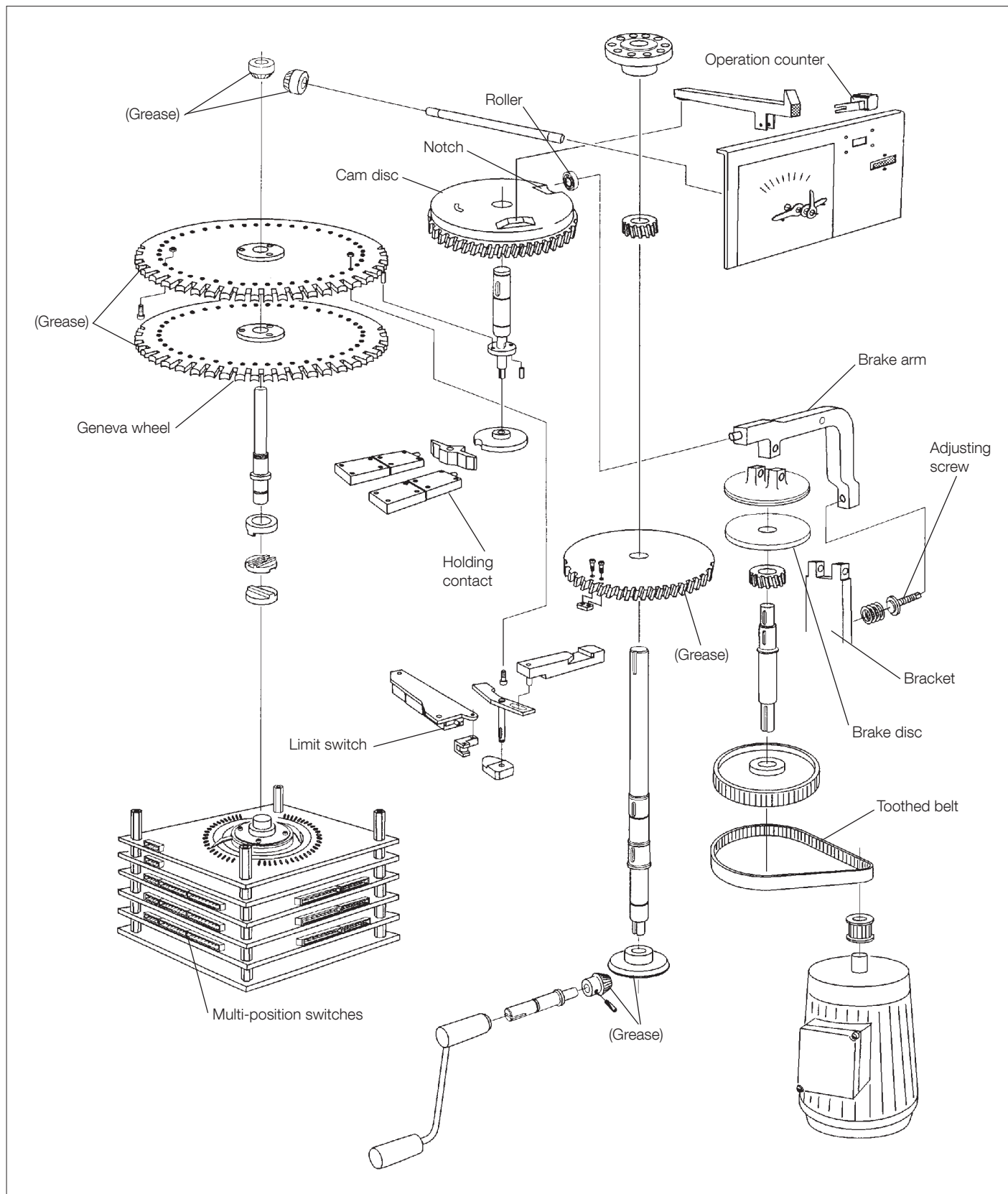


Fig. 4. Mechanical design of motor-drive mechanism, type BUL2.

2. Inspection

The inspection mainly consists of a visual check of the motor-drive mechanism once a year while the transformer is in service. It is recommended to perform the inspection of the motor-drive mechanism and the other parts of the tap-changer at the same time. See the respective maintenance guide.

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

- Motor and counter
- Heater
- The counter's value
- Visual check of toothed belt

2.1 Required tools and material

The following equipment is required for the inspection:

- Set of screw drivers

2.2 Procedure



WARNING

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



WARNING

Before starting any work inside the motor-drive mechanism, the auxiliary power must be switched off. N. B. The motor, contactors and heating element may be energized from separate sources.

1. Open the cabinet door of the motor-drive mechanism and turn the selector switch to the LOCAL position. Then turn the control switch to the RAISE (LOWER) position.
2. 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).
3. Turn the control switch to the LOWER (RAISE) position for 1-2 seconds. Check that the motor also works properly in that direction, the position indicator decreases (increases) one step and the counter advances one more step. Reset the drag hands.
4. Check the emergency stop. Trigger 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 the service position.
5. Check the ground fault protector (option). 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.
6. Disconnect the incoming auxiliary power.
7. Open the control panel.
8. Check by feeling with a finger that the elements have been functioning.
9. Close the control panel and reconnect the incoming auxiliary power.
10. Complete the inspection by turning the switch to the REMOTE position and closing the cabinet door.

3. Overhaul



WARNING

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

3.1 Required tools and materials

Necessary for the overhaul is the following equipment:

- Normal hand tools (wrench sizes up to 19 mm)
- Standard set of combination wrenches
- Sliding caliper
- Spring balance (10 N)
- Grease (GULF-718 EP synthetic grease, Mobilgrease 28, Shell-Aero Shell grease 22 or similar)
- Oil (for plain ball and roller bearings)

The motor-drive mechanism should normally be regularly overhauled at intervals of 300,000 operations. The number of operations must not exceed 1,500,000, which is the mechanical lifetime of the motor-drive mechanism.

It is recommended to perform the overhaul of the motor-drive mechanism and the other parts of the tap-changer at the same time. See the appropriate maintenance guide for the tap-changer.

The overhaul includes the following points:

Before disconnecting the power supply:

- Motor protection function (Section 3.2)
- Ground fault protector (option) (Section 3.3)
- Counter function (Section 3.4)

After disconnecting the power supply:

- Heater function (Section 3.5)
- Toothed belt (Section 3.6)
- Cable connections (Section 3.7)
- Disc brake function (Section 3.8.1 for BUE; Section 3.9.1 for BUL2)
- Position transmitter and other position switches (Section 3.8.3 for BUE; Section 3.9.2 for BUL2)
- Lubrication (Section 3.8.4 for BUE; Section 3.9.3 for BUL2)

Reconnect the power supply and carry out operation tests according to the instructions in the tap-changer installation guide.

3.2 Motor protection



WARNING

The motor power voltage is dangerous.

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.

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.

3.3 Ground fault protector (option)

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.

3.4 Counter

Check that the counter is functioning for 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 tap-changer.

3.5 Heater



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 elements have been functioning.

3.6 Toothed belt

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 (see Fig. 5). At a 10 N load the belt should yield about 5 mm on BUE, and at a 6 N load the belt should yield about 2 mm on BUL2.

3.7 Motor cable connections

Check that all cable connections within reach are secure.

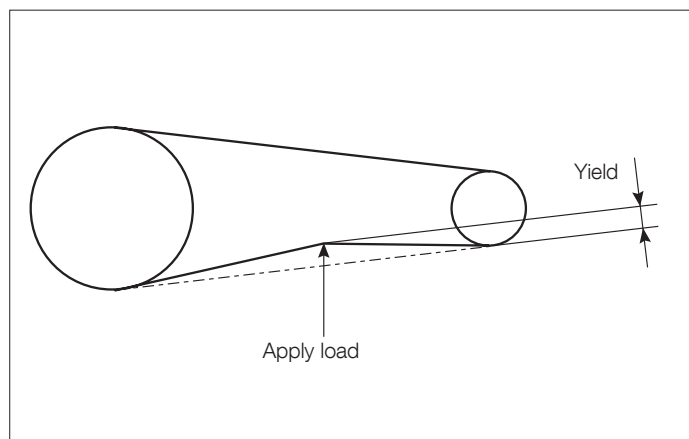


Fig. 5. Check of toothed belt.

3.8 Overhaul type BUE

3.8.1 Disc brake

Wipe the brake disc free from grease.

See Fig. 6. The kinetic energy in the motor and the toothed wheels should be absorbed by the brake, and the motor-drive mechanism should stop with a tolerance of $\pm 25^\circ$ as measured on the brake disc ($\pm 125^\circ$ measured on the hand crank).

This can be adjusted by tightening both of the spring bolts on the brake. Using the hand crank, operate the motor-drive mechanism until the brake is fully open. At this point the length of the springs must not be less than 35 mm. If the brake still does not function with that spring length, oil or grease has entered the brake linings, which will then need cleaning.

Clean as follows: Using a pair of tongs, remove the roll pins that hold the supporting shafts on the brake blocks; see Fig. 2. Then remove the shaft and the brake blocks. Clean the brake linings on the two brake blocks with degreasing agent.

When refitting the brake, check that the brake disc is completely free from grease. Adjust the spring force of the brake until the motor-drive mechanism stops within the tolerances given above.

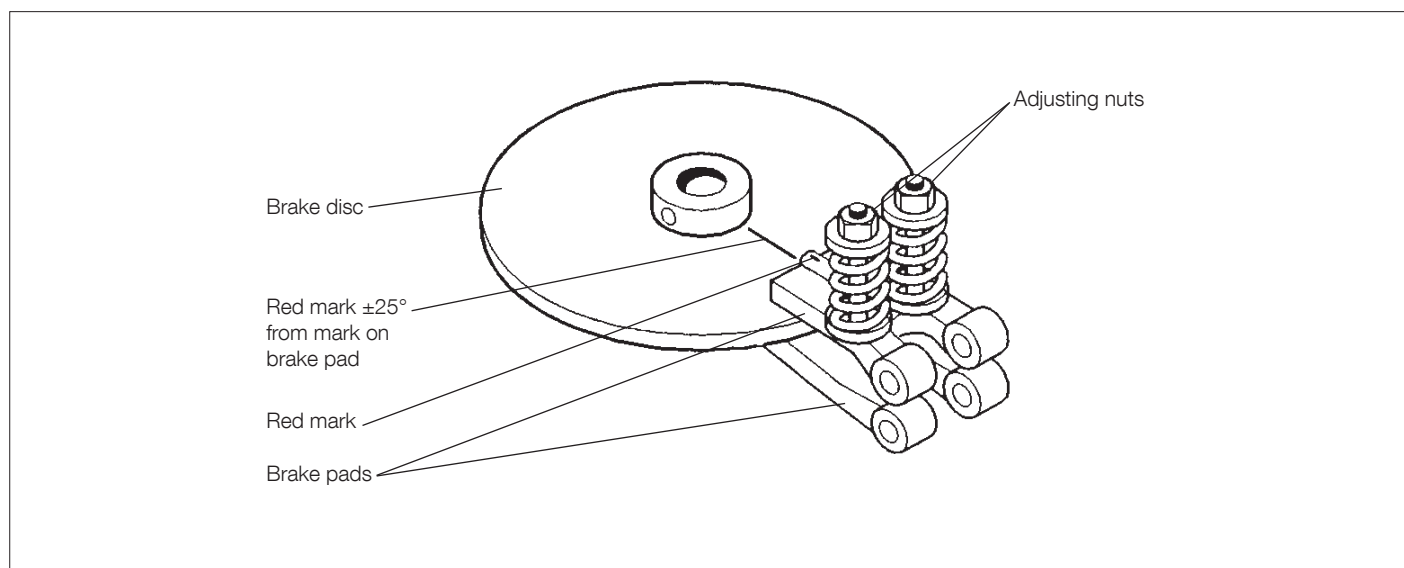


Fig. 6. Brake adjustment, type BUE.



CAUTION

If the motor-drive still does not stop when the brake is adjusted to a spring length of 35 mm when the brake is fully open, please contact ABB for advice.

3.8.2 Brake for the holding contact

Check that the brake for the holding contact prevents the arm system on the holding contact shaft from swinging beyond its normal position when the roller on the drive arm moves free from the cam disc; see Fig. 2. At the end of the operation, contacts for operation in the opposite direction should not move when the arm system swings back towards its normal position.

Unpermitted swinging should be prevented by raising the braking force, i. e. tightening the spring bolt.

An adjusted, increased spring force on the brake makes the holding contact arm swing back with a different speed, and the brake for the holding contact must be adjusted.

3.8.3 Position transmitter and other position switches

Clean the contact plates and arms (Fig. 7) from dust and dirt with a dry cloth.

Check and adjust the resilience of the moving contacts in the multi-position switches. The moving contact shall in all positions, have a clearance between the nut and the contact arm of 0.5–1.1 mm. Adjustment is made with the nuts on the contact.

3.8.4 Lubrication

See Fig. 8. The bearing points of the brake blocks and the links should be sparingly lubricated with oil. (Use oil for plain ball and roller bearings.)

The spur gears, the Geneva wheel with the limit-stop, the cam discs, the cam bar and the big wheel attached on the outgoing shaft, are sparingly lubricated with the same type of grease as for the shaft system when necessary.

Other bearing points do not need lubrication.



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

Reconnect the power supplies.

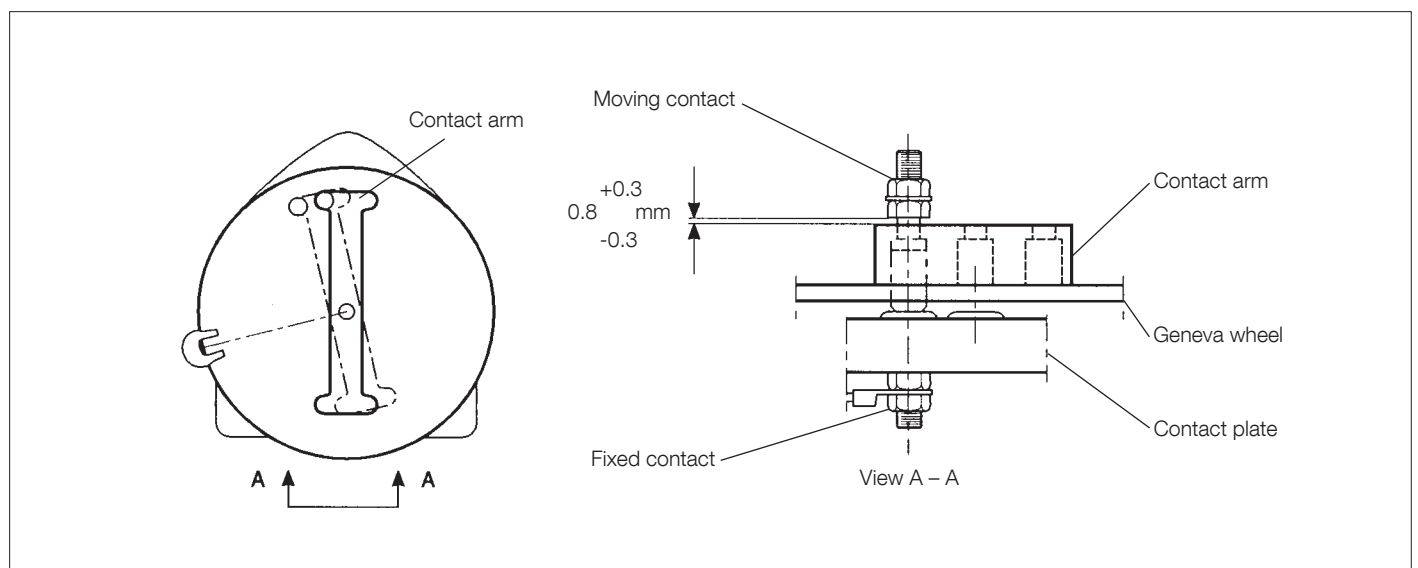


Fig. 7. Contact arm play.

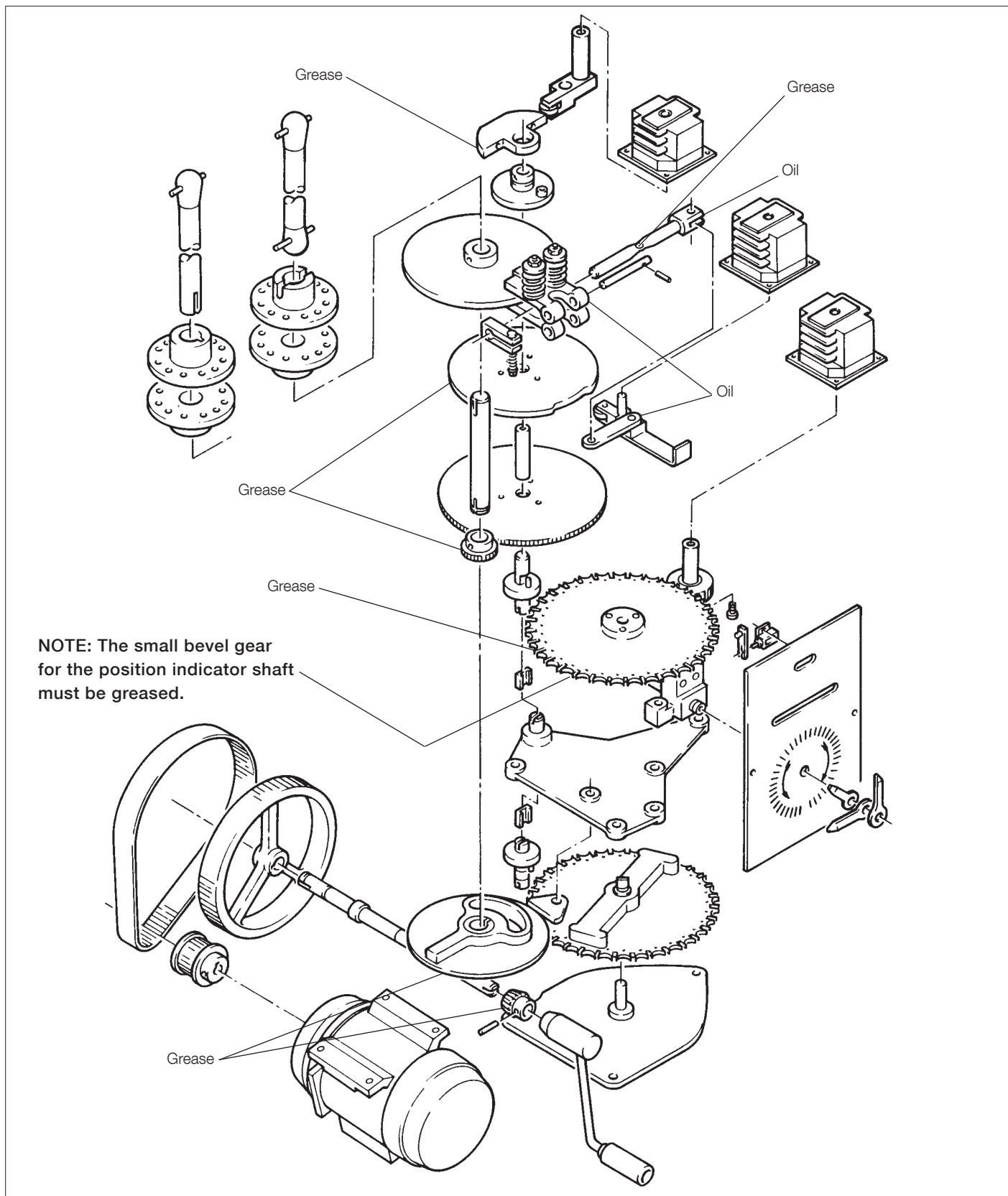


Fig. 8. Lubrication points, type BUE.

3.9 Overhaul type BUL2

3.9.1 Disc brake

Run the motor-drive mechanism and check that the center of the notch in the cam disc stops within ± 2 mm from the center of the roller on the brake arm, see Fig. 9. If it does not stop within the tolerances, adjust the braking force with the adjusting screw at the lower end of the brake arm. Loosen the contra nut. Tightening the screw (clockwise) makes the stop occur earlier and loosening the screw (counterclockwise) makes the stop occur later. Tighten the contra nut after the adjustment.



CAUTION

If the motor-drive still does not stop when the brake is adjusted to min. 15 mm according to Fig. 9, please contact ABB for advice.

3.9.2 Position the transmitter and other position switches

Check the contact function in all positions for both RAISE and LOWER operations.

No adjustment of the contacts should be made.

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

3.9.3 Lubrication

Lubrication is not needed under normal operating conditions. All ball bearings have rubber seals and are permanently lubricated. All cam discs and some gears are made of self-lubricating material.

If needed, the gear for the outgoing shaft, the bevel gears for the hand crank, the Geneva wheels and the bevel gears for the position indicator can be sparingly lubricated with the same grease as for the shaft system. (GULF-718EP Synthetic Grease, Mobilgrease 28, Shell-Aero Shell Grease 22 or similar). See Fig. 4.

Reconnect the power supplies.

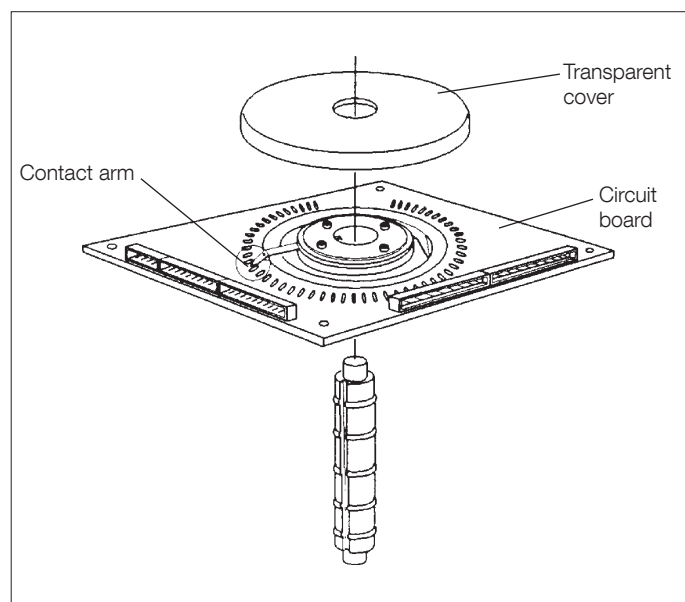


Fig. 10. Check of position transmitter.

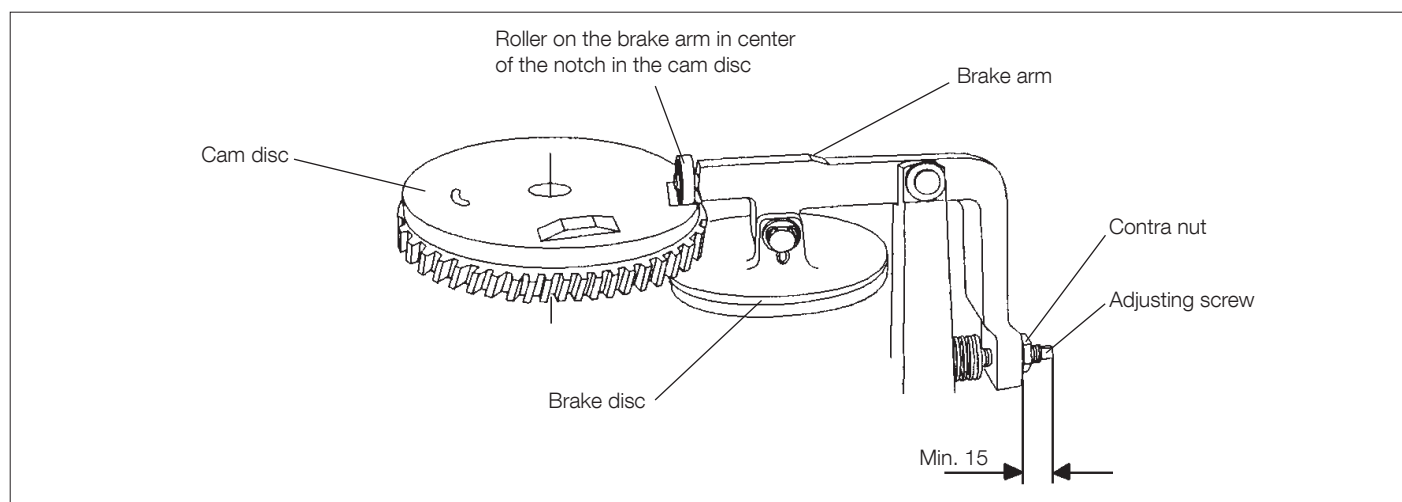


Fig. 9. Brake adjustment, type BUL2.

3.10 Operation test

Operate the motor-drive mechanism, first with manual operation and then electrically between the limit-positions. Check the limit-stops by operating the tap-changer to one of the end-positions. When trying to operate it electrically beyond the end-position, the motor should not start. Check the mechanical end-stop by trying to hand crank it beyond the end-position. After a couple of turns on the hand crank, it should be mechanically stopped. Hand crank back to the end-position (where the indicator flag is positioned in the middle for the BUE, and when the indicator flag shows white color for the BUL2). Operate the tap-changer electrically to the other end-position and carry out the same test procedure as above.

Check the emergency stop by triggering 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 run-through protection with the step-by-step function disengaged. This is done by first removing the connection between terminals X4:1 and X4:2 and then keeping the RAISE/LOWER switch engaged. The motor-drive mechanism should stop before the fourth operation is completed. This check must be performed at least five steps from the end-position. After the test, reset the time relay by setting the LOCAL/REMOTE switch to 0 and then back. Reset the protective motor switch to ON. Reconnect the connection between X4:1 and X4:2.

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

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

4. Specification of materials

Material	BUE Approx. amount	BUL Approx. amount	BUL2 Approx. amount
Steel	100–120 kg	55 kg	25 kg
Aluminium and alloys	–	10 kg	5 kg
Copper and alloys	5–10 kg	5 kg	65 kg
Silver	10 g	10 g	x
Plastics:			
chlorsulphonated polyethylene	x	x	x
polyamide with MoS ₂		x	x
phenol resin laminate	x		
polyester	x	x	x
PVC	x	x	x
carbonate plastic	x	x	x
Rubbers:			
nitrile rubber	x	x	x
fluorine rubber	x	x	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.

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