

DISTRIBUTION SOLUTIONS

# Indoor Air Switch-disconnector, NAL/NALF/VR

Installation and operating instructions  
4.16 ... 38 kV / 200...1250 A





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# 1.0 Your safety first – always!

That's why our manual begins with these recommendations: comply in full with the legally recognized standards (ANSI / IEC) and the applicable safety regulations at work.



## WARNING!

- Pay special attention to the hazard notes in the manual marked with this warning symbol.
- Make sure that under operation condition of the switchgear or switchboard the specified data is not exceeded.
- Keep the manual accessible to all persons concerned with installation, operation and maintenance.
- The user's personnel are to act responsibly in all matters affecting safety at work and the correct handling of the switchgear.
- There are hazards of electrical shock and burns whenever working in or around electrical equipment. Turn off power before performing any inspection or maintenance operations.



## – WARNING

Always observe the manual and follow the rules of good engineering practice! Hazardous voltage can cause electrical shock and burns. Disconnect power, then earth and short-circuit before proceeding with any work on this equipment.

Check line terminals to verify that the equipment is de-energized and earthed.

- Check terminals to ensure that no back-feed condition exists.

If you have any further questions on this manual, the members of our field organization will be pleased to provide the required information.

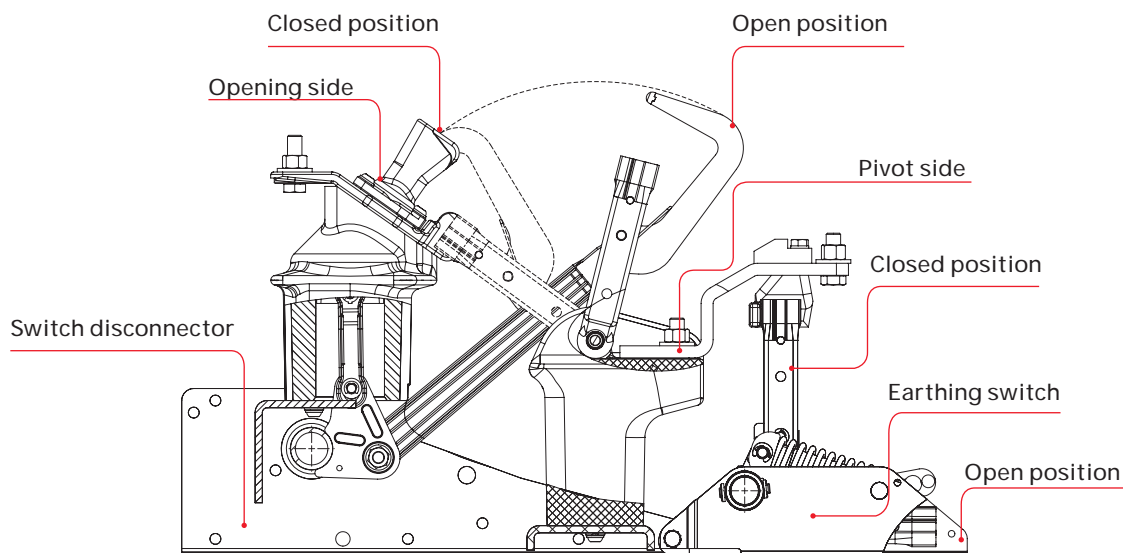
In case of any uncertainty or questions related to mounting and/or operation which are not described in the manual please contact ABB.

## 1.1 General notes:

1. Regular equipment designed for normal indoor service condition (Class 0 acc. to IEC/ TS 62271-304: 2008-05) to be used in

locations with humidity/temperature control (i.e. sufficient heating source, humidity absorbers, etc.) and/or buildings with special thermal design to prevent negative influence of rapid outside temperature change to avoid condensation.

2. For the normal indoor service condition (water condensation max 2 times a year and low pollution level) there is no need to do any special test of indoor switch-disconnectors. For more severe conditions, the substation with applicable components, needs to be classified and tested according to IEC/TS 62271-304: 2008-05.
3. The regular NAL/F and VR with BMC (Bulk (Dough) Moulding Compounds) insulators is designed to class 0 ( $C_0P_L$ ) that corresponds to normal indoor service conditions. The standard NAL/VR works fine everywhere these operating conditions are provided.
4. Wherever we observe harsh operating conditions, special type of the switch-disconnector NAL/F-H is recommended that has been type tested according to IEC/TS 62271-304: 2008-05 design class 2 for severe operating conditions.
5. Regardless of the type of switch-disconnector in use, all installation work, station design, location selection, ground preparation, and maintenance must be done in a professional way to keep the installation in good condition throughout its assumed lifetime.
6. Correct installation is of primary importance. The manufacturer's instructions must be carefully studied and followed. It is good practice to use gloves for handling the pieces during installation.
7. Operations describe in this manual shall be carried out by specialists only.
8. According to IEC 62271-1:2007-10 p. 5.12 and IEC 62271-102: 2018 p. 6.13 position of switch-disconnector has to be clearly indicated. NAL/NALF/VR air insulated switch-disconnector allows 100% certainty to determine the position of the main contacts



which is a big advantage.

9. Please place attached sticker with drawing



#### – WARNING

ABB recommends to verify the position of the main knives before and after each operation. ABB recommends to install air-insulated switch-disconnectors in applications where it is possible to visually check main knives position eg. through an inspection window.

close to inspection window. Before any operation please check switch position.

### 1.2 Application highlights

Important factors that influence life time of prefabricated substation:

- Placement of substations and proximity to harsh environments (polluted areas and roads, road salt, farming land and fertilizing areas, coast areas, salty water, cable ditch and penetration of ground water and surface water, removing of snow etc).
- Materials of the substation and possibility of condensation forming from quick temperature variations.
- Draining of the ground around the substation and preparation of the foundation including backfilling of cable trench.
- Elimination of pollution and humidity.
- Placement of kiosks in terrains.
- Elimination of potential sources of corona in design and installation: cable terminations, busbars, sharp edges...
- Heating, better utilization of the heating from the transformer and ventilation. Whenever the utilization of heating from installed distribution transformer is not sufficient to avoid water dropping

condensation, it is recommended to use other solutions like heaters, humidity absorbers, thermal insulation of walls etc. to keep working environment according to installed apparatus and equipment class.

- Respect of maintenance plan, to be done as per manufacturer instructions. Reduction of space and installation requirements has already influenced the design of kiosks and stations however the proper maintenance is still required.
- In case it would not be possible to avoid condensation inside the compartment, the prefabricated substation must be treated as class 1 or class 2 as per IEC/TS 62271-304: 2008-05 and all the products installed inside shall be upgraded accordingly.
- Regardless of the type of switch-disconnector, all installation work, station design, location selection, ground preparation, and maintenance must be done in a professional way to keep the installation in good condition throughout it's assumed lifetime.
- Final product performance needs to be tested in final application.

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## 2.0 Indoor Air Switch-disconnector

NAL/NALF/VR

Rated voltage: 4.16 - 38 kV

Rated current: 200 -1250 A

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The NAL/NALF/VR family of switch-disconnectors is characterized by its compact, modular design and broad functionality. With their unique design for extinguishing the electric arc and high switching capacity, they represent an attractive solution as the main switching apparatus for applications in enclosed switchgear and compact transformer stations. In combination with ABB CEF current limiting fuses, they provide reliable control over the full range of overload currents.

Main areas of application NAL/NALF/VR switch-disconnector:

- as line and transformer switches within distribution networks,
- as motor switches.



## 3.0 Introduction

The NAL/NALF/VR switch-disconnector system is based on a modular principle. The basic unit consists of a frame with insulators and current carrying elements. Two different types of operating mechanisms: snap action mechanism type K or stored spring energy mechanism type A, can be mounted on the frame. Fuse-bases type F with or without fuse tripping mechanism, and earthing switch type E/EB, suitable for both direct mounting and free standing components, complete the basic switch-disconnector equipment. These modules can be easily configured, according to customer requirements. Accessories such as shunt trip, auxiliary switches, motor operation and various systems for manual operation can easily be added.

The NAL/NALF/VR brand is recognized globally and over 600,000 switches have been produced so far. The design is subject to continuous development to meet changing customer needs.

### 3.1 Main Product Features

NALF/VR is the ideal solution for the protection of the majority of faults in modern electrical networks. It combines NAL/VR, which interrupts load currents (up to 1250A) and small fault currents, with the fuse-base (F) for breaking large short-circuit currents. The NAL switch-disconnector family meets the following standards (depends on the product variant and voltage level):

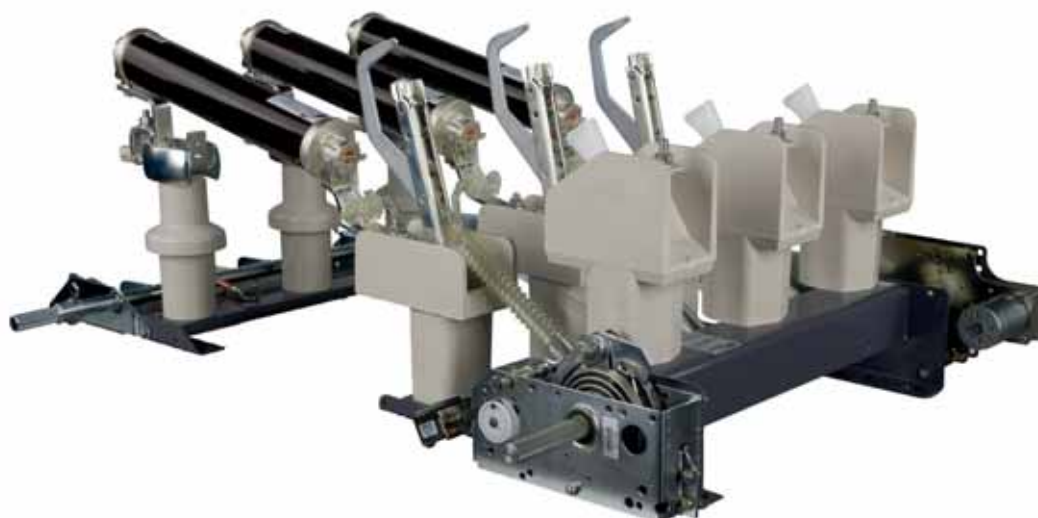
IEC 62271-1: 2017-07, IEC 62271-102: 2018-05, IEC 62271-103: 2011-06, IEC 62271-105: 2012-09, IEC/TS 62271-304: 2008-05,

regarding indoor switches for general use and for safe switching coordination between switch-disconnectors and a current limiting fuse.

NAL meets requirements of IEC 62271-1: 2017-07 p. 2.1 Normal service conditions.

The NAL version for IEEE applications is called VersaRupter. It meets IEEE Standard No. C37.20.4. The specified NAL/NALF switch-disconnectors are listed as certified by the Canadian Standard Association.

Some VersaRupter styles are UL listed, in terms of compliance with relevant safety requirements, in order of their release for use in each region of the US and installations carried out in accordance with the UL standard.



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## 4.0 Environmental protection program

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The NAL/NALF/VR switch-disconnectors are manufactured in accordance with the ISO 14001 Standard (Guidelines for environmental management). The production processes are carried out in compliance with the Standards for environmental protection in terms of reduction in energy consumption as well as in raw materials and production of waste materials. All this is thanks to the medium voltage apparatus manufacturing facility environmental management system.

## 5.0 Safety instructions



### — WARNING

Careless handling of high voltage can result in serious injury or death. Before carrying out of any maintenance/installation of apparatus, read these instructions carefully.

- Comply all general safety rules during any activities related to the electrical apparatus under high voltage.
- Use switch-disconnector in working condition aligned to product design class only.
- Operate switch-disconnector when rated performance of the apparatus is not exceeded during apparatus maneuvering, service and its application remain in healthy condition only.
- Make sure that all the installation, service and maintenance operations comply with the applicable standards and laws to ensure safety of operation.
- Make sure that the apparatus will be installed in proper place.
- All maintenance and application panel on site installation activities shall be performed by specialists comply with local safety requirements.
- Always follow these instructions closely.
- If you have any questions or doubts, please contact the proper ABB personnel.
- Only original parts provided by PLABB should be used.

## 6.0 Recommendations for receipt, handling and storage of equipment

Unload the switch-disconnectors from the vehicle with the utmost care. Immediately check the condition of the packaging as soon as the switch-disconnectors arrive. Make sure that the apparatus is undamaged and that the data on the nameplate on the outside of the packaging corresponds to the information on the order confirmation and shipping note. If damage or discrepancies are discovered, or the documents supplied with the goods fail to correspond, immediately inform ABB (either directly, or through your representative or supplier) and the haulage contractor that made the delivery. The switch-disconnectors are supplied solely with the accessories specified at the time of order and validated in the order confirmation by ABB. If immediate installation is not possible, please store covered indoors, in a well-ventilated, dry, dust-free, non-corrosive atmosphere, away from any easily flammable materials and at a temperature between  $-5\text{ °C}$  and  $+45\text{ °C}$ . Please consult us if special requirements are involved.

- In any case, avoid any accidental impacts or positioning which stresses the structure of the apparatus.
- Check the apparatus condition directly after receipt. Any damages should be reported to the transporter forwarder and manufacturer,
- Make sure that the product is complete and complies with the order.
- Be careful during transportation of apparatus.
- Never lift apparatus by grabbing current knives, main shaft or insulators, because it may cause switch damage.
- Before installing, keep switches only in original boxes and store it as it indicated on the boxes.
- In order to unpack the switch, remove all the packaging elements first. After that remove the switch from the box using straps fixed to upper frame plate. Do not use chains, because it may cause damage to the apparatus.

### 6.1 Switch-disconnector type NAL/NALF/VR, alternative assemblies

The switch-disconnector NAL/NALF/VR is supplied by the factory as follows:

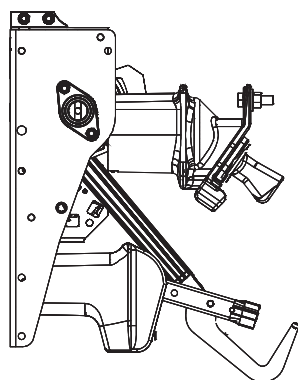
- Fully assembled with mechanism and auxiliaries. See item "Installation"
- The following versions are available:
  - NAL – IEC/CSA standards as line switch-disconnectors
  - NALF – IEC standard as switch-fuse combination
  - NALFO- IEC standard as switch-fuse combination with fuse base above hollow insulators
  - NAL-H – IEC standard as line switch-disconnectors for harsh operating conditions.
  - NALF-H – IEC standard as switch-fuse combination for harsh operating conditions.
  - VR – VersaRupter the NAL version for IEEE standard

## 7.0 Installation

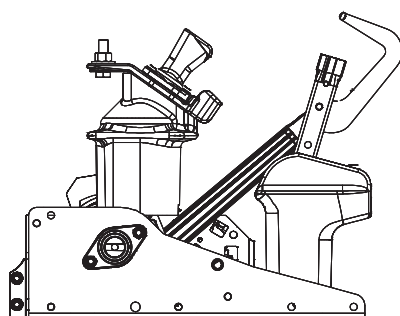


### CAUTION!

The apparatus should be protected against the water dripping or runoff on its insulating parts. In addition to this, as the apparatus shall work under indoor conditions, possible rare episodes of condensations shall not get deposited on insulations parts and especially into the hollow insulators. To prevent it, the apparatus shall only be installed horizontally or vertically, but ensuring having the hollow insulators on the upper side and blades located down, as shown on the pictures below.



Vertical correct installation position with hollow insulator with arch chute on upper side.



Horizontal correct installation position.



### WARNING

Current knives rotate with great speed and force. Always keep a safe distance from moving parts of the switch. Be careful with type A (double spring) mechanism. This kind of drive stores great energy and can release it by small rotation of shaft.

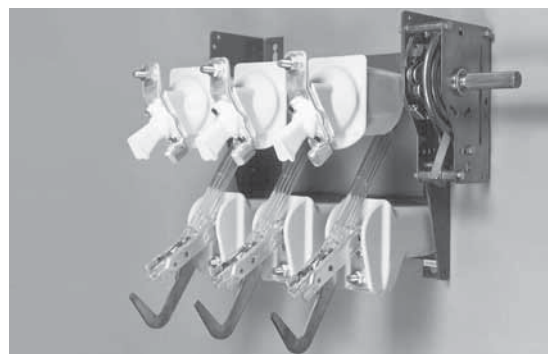
### 7.1 Before installation

Before installing, carry out visual check of switch. Make sure that main contacts are greased with Isoflex Topas NCA 52. In case of NAL 12/17/24/36 with A mechanisms, make sure that the push rods are removed from the main shaft.

### 7.2 Preparation of the switch for installation.

#### Fig. 1

For switches with A-mechanisms, the contact knives must be fully opened by hand and the draw bars connected to the cranks. Before the switch is test operated, it should be checked that the surfaces of the main contact are covered by contact grease (recommended grease: ISOFLEX TOPAS NCA 52). ABB recommends to install this switch-disconnector in applications where it is possible to visually check main knives position e.g. through inspection window.



1 Switch-disconnector type NAL/NALF/VR

### 7.3 Test operations

Switches with K-mechanism will close when the operating shaft is turned anti-clockwise. The switch will open when the operation shaft is turned clockwise. (Clockwise/anti-clockwise as seen from the mechanism side of the switch). When operating switches are equipped with A-mechanism, the opening spring is first charged and latched by turning the operating shaft clockwise. Turning the shaft anti-clockwise charges the closing spring and the switch closes. The switches open when the operating shaft is turned clockwise.



#### CAUTION!

In case of A mechanism, after switch closing or opening (without opening spring charged) do not turn the mechanism shaft in the closing direction. It can cause damage of mechanism. Keep well clear of contact knives when operating the switches. During installation on non-flat surfaces, use shims correcting inequalities. This will prevent the stress forces in the switch frame. When inequalities of surface are significant, use a rigid support structure, e.g. made by ABB.

### 7.4 Preparation of the supporting structure

The switch-disconnector is intended for vertical or horizontal operations. The design of a supporting structure shall consider the geometrical configuration of the apparatus (vertical or horizontal) and minimal clearances to both earthed and live parts. The supporting structure shall be rigid enough to avoid some deformation of the apparatus base. All the touching points of the supporting structure and the apparatus base shall lay in the same plane.

### 7.5 Installation of the switch-disconnector

In the course of installation of the switch-disconnector particular attention should be paid not to deform the base of the apparatus, otherwise some defects will occur such as the following:

1. Excessive rise of the starting moment of a force on the switch-disconnector shaft,
2. Non-simultaneity of the contacts which should not exceed 3 mm in normal conditions,
3. Deterioration of contact surface area in the closed opposition,
4. Displacement of the symmetry plane of moving contacts in relation to the pole symmetry plane which results in asymmetrical touching of the fixed and moving contacts. In addition, the operating lever will hit the lock.

To avoid these defects coming from deformations of the supporting structure it is recommended to tighten initially three bolts only when fixing the base. Some additional washers shall be placed under the fourth bolt to prevent deformations of the switch base when tightening the fourth bolt. During installation be careful and do not apply high (should be 40 Nm +/-10%), torque on the insulators. When tightening nuts of the rail mounting bolts, the bolts must be countered.

Whenever special operating conditions apply the only recommended type of switch-disconnector is H version that has been designed for application in harsh operating conditions (design class 2 according to IEC/TS 62271-304: 2008-05).

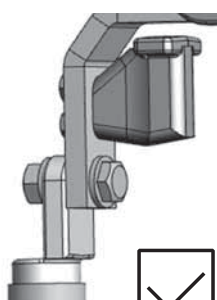
## 8.0 Cable connections to NAL/F terminals



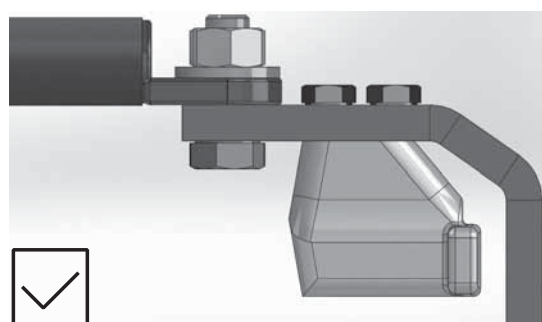
### WARNING

Improper installation of cable connections to the switch-disconnector terminals cause an operational hazard.

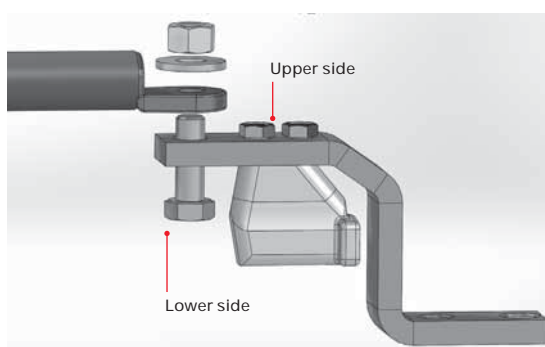
### 8.1 How to install the medium voltage cable lug?



2 Proper cable lug connection

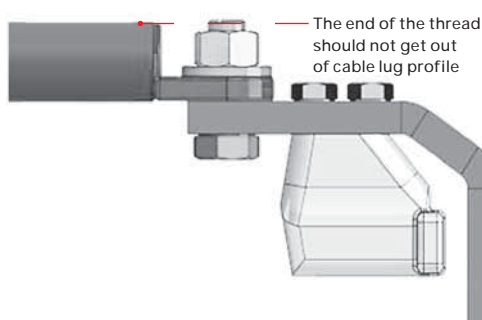


3 Proper cable lug connection



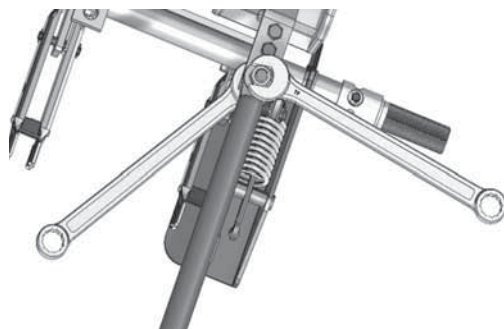
Cable lugs should always be placed on the upper side of the switch terminal and face up (Fig.4). It is recommended to use a is conical spring washer DIN 6796 mechanical zinc plated.

4 Recommended assembly method of medium voltage cable lug



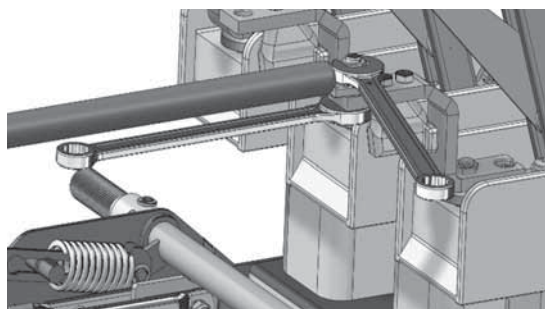
The length of the fastening bolts used for the cable lug connections should not protrude beyond the nut by more than 2-3 threads after tightening. (Fig.5).

5 Proper connection with the switch-disconnector terminal

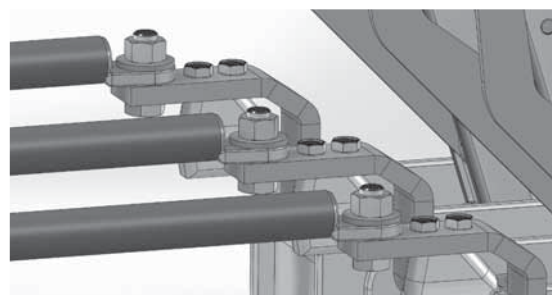


The connection bolt should be arranged such that one wrench can be used to hold the bolt head on the bottom and another can be used to tighten the nut in the direction of the threads. (Fig. 6,7.)

6 Direction of the screw thread



7 Recommended method of screwing connection.



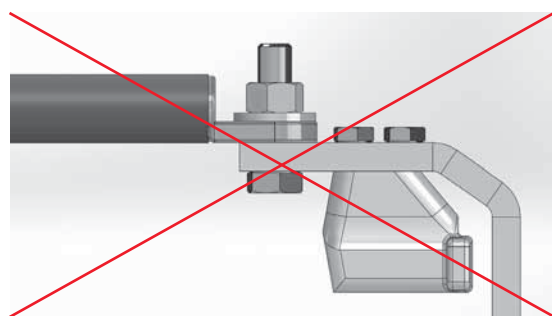
Proper connection to the switch-disconnector terminal.



#### **WARNING!**

Improper installation of cable connections to the switch-disconnector terminals cause an operational hazard.

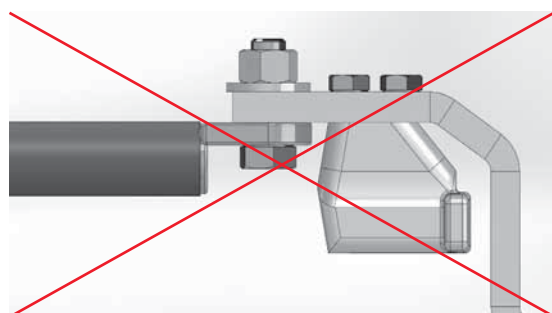
8 Cable lugs properly connected to the switch-disconnector terminal



### **12.0 Improper installation of cable connections**

The connection bolt used is too long. The bolt should have sufficient length. See Fig. 3.

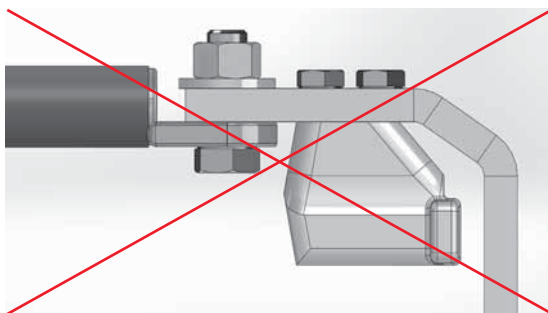
9 Example of mounting with too long screw



Cable lug installation on the incorrect side of the switch terminal. Cable lug cannot be fixed from the terminal lower side. Fix it as shown on Fig.3.

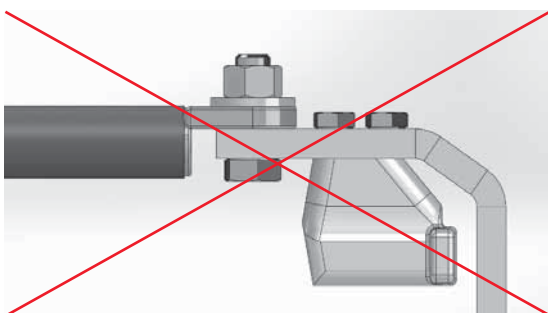
10 Example of incorrect cable lug side installation.





Cable lug installation on the incorrect side of the switch terminal. Cable lug cannot be fixed from the terminal lower side. Fix it as shown on Fig.3.

— 11 Example of incorrect cable lug side installation



Cable lug installation on the incorrect side of the switch terminal. Cable lug cannot face down. Fix it as shown on Fig.3.

— 12 Example of incorrect cable lug side installation



#### — **WARNING!**

Ignoring these instructions can cause damage to the equipment:

1. Ensure proper installation of the cable lugs on the terminals
  - Do not install cable terminal on the side of the earthing switch
  - Do not install cable terminal in reverse way.
  - Utilize proper length of bolts in such a way that bolt thread does not excessively protrude from the cable lug.

In the case, a double cable connection, is to be made, a spacer shall be used for this purpose. Both cable lugs are to be connected to the end of the spacer.

2. Ensure good quality work on cable terminations.
3. Ensure that clearances are in accordance to the required voltage level.

For NAL/F installation in the pre-fabricated substations or CSS please refer to manufacturer manuals. The pre-fabricated substations or CSS manufacturer is responsible for ensuring the operating conditions in the station according to the design class of installed devices (see IEC/TS 62271-304: 2008-05).

The regular NAL/F with BMC (Bulk (Dough) Moulding Compounds) insulators is designed to class 0 ( $C_0P_L$ ) that corresponds to normal service conditions. The standard NAL works fine everywhere these operating conditions are provided. Wherever we observe harsh operating conditions, special type of the switch-disconnector NAL/F-H is recommended that has been type tested according to IEC/TS 62271-304: 2008-05 design class 2 for severe operating conditions.

Regardless of the type of the switch-disconnector in use, all installation work, station design, location selection, ground preparation, and maintenance must be done in a professional way to keep the installation in good condition throughout it's lifetime.

## 9.0 Mounting the hand operating mechanism type HE

The bevel gears should be mounted with the switch-disconnector in open position (see Fig. 13) and should be placed at the end of the shaft to achieve maximum distance between apparatus and rod. Two set screws must be tightened after installing the bevel gears as visible on Fig. 16. The angle of the operating tube must not exceed 40°, see Fig. 17. Drilling of the operating tube, see Fig. 18.

**9.1 Instruction of installation and adjustment of switch-disconnector type NAL/NALF/VR with hand operation mechanism HE.**



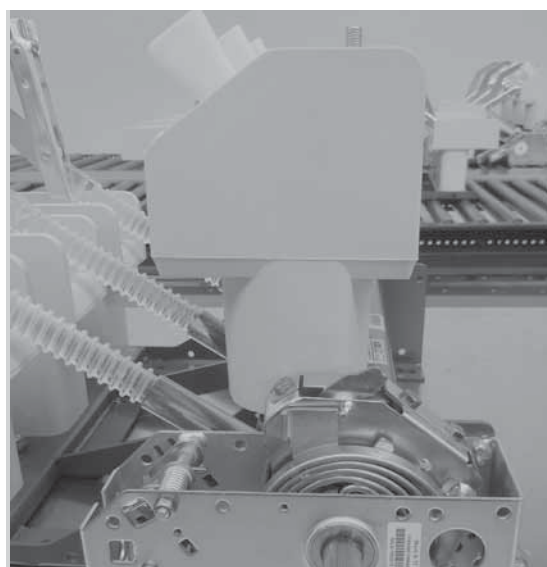
—  
**WARNING**

Always apply the information label supplied with the drive during installation. Stickers must be close to the drive so they can be easily viewed by personnel.



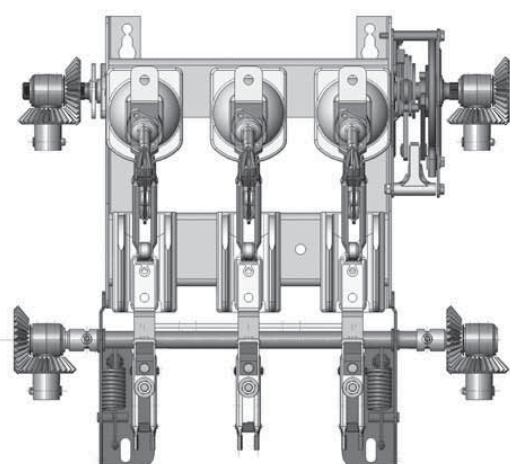
1. Take out the NAL/VR from the box. Open the contact knives to maximum position and connect the drawbars (disconnected for transport) with shaft. Install NAL/VR on support construction in open position, see Fig.13.

—  
13 NAL in open position



2. Opening spring is not charged (apply to NAL/ NALF/VR with A mechanism), see Fig. 14.

—  
14 A mechanism



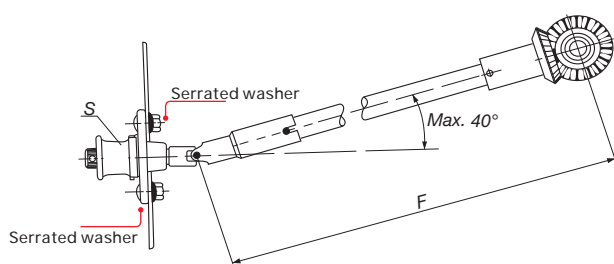
3. Install the bevel gear on the NAL/NALF/VR and earthing switch shaft. Be sure the orientation of the gear wheels has been properly assigned – the bigger wheel position is important. This position is clearly shown on Fig. 15. In case of earthing switch, the knurled end shaft on which the bevel gear is installed, must be mounted on the earthing switch shaft using the long-slotted hole.

—  
15 NAL/VR switch disconnecter with earthing switch



4. Secure the bevel gear with two screws located inside the housing with allen key (2,5 size) with torque 3 Nm (see Fig. 16).

16 Bevel gear - upper part



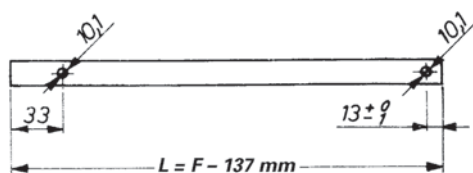
5. Install the hand operating mechanism HE. Put the connection rod (tube = 26.9 mm) between cardanic joint and bevel gear. Maximum angle is 40° - see Fig. 17.

17 Hand operating mechanism



Use serrated washers when mounting for additional improvement of continuous earthing connectivity (see picture 17a)

17a Front bearing HE



6. Mark the position of the hole for the safety pin hole and do not make a bigger hole than = 10.1 mm (see Fig.18).

18 Connecting rod



19 Front bearing of hand operating mechanism HE



20 Take out the Seegeer ring, spring and nut



21 Slide out the arrestor ring from the shaft



22 The shaft should loosely rotate loosely after taking out the arrestor ring



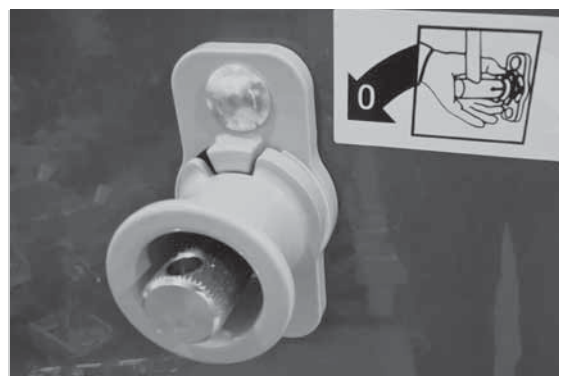
23 Put the operating handle on the splined end. Turn the handle anticlockwise to charge A mechanism opening spring (apply to A mechanism),



24 A mechanism opening spring is charged



—  
25 Turn the handle to the left and right for test



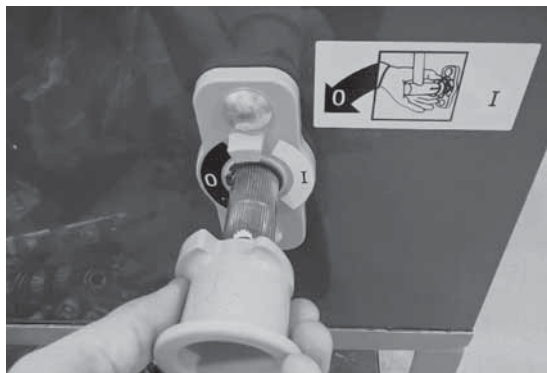
—  
26 Put the arrestor ring on the shaft



27 Slide out the arrester ring to the position where it is possible to turn the handle clockwise and close switch-disconnector



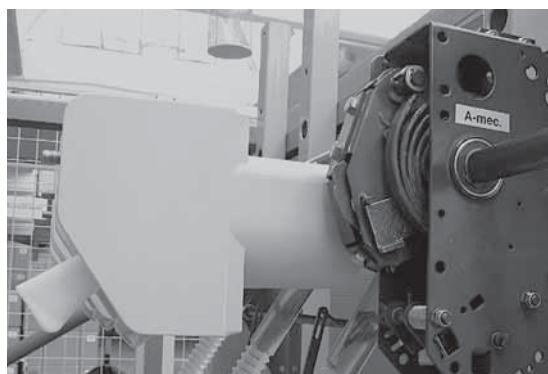
28 Check if the arrester ring and switch-disconnector are in locking position



29 If NOT (as in picture 22) slide out the arrester ring from the shaft and turn 2-3 teeth to the right



30 Correctly position the arrester ring in closed position



31 Check the opening spring is charged. After adjustment the Seeager ring, spring and nut should be put back on the HE shaft



## 10.0 Adjustment of the hand operating, mechanism type HE

### 10.1 Adjustment of the hand operating, mechanism type HE

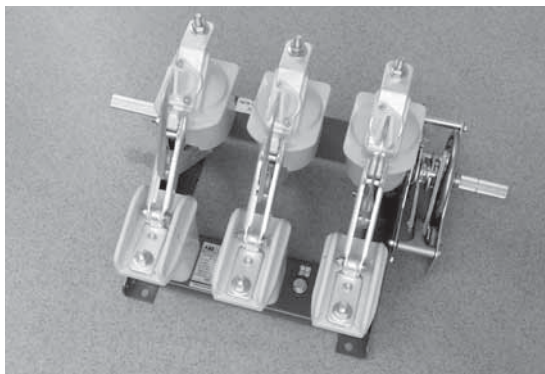
#### 10.2 K-mechanism. Fig.32

##### Closing

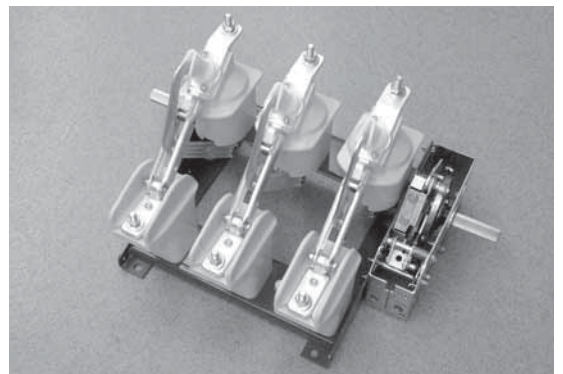
1. If the switch-disconnector is equipped with earthing switch, be sure that it is in the open position (Fig. 105)
2. Make sure that all doors of the station are closed.
3. Remove the padlock securing manual drive of the switch-disconnector (if used),
4. Apply lever on the knurled shaft of manual drive of the switch-disconnector.
5. Pull the locking ring S (Fig. 17.).
6. Turn the lever in the closing direction - according to the information shown on the information label; rotation should be performed until the end - until the locking ring snaps into the locked position of the manual drive.
7. Check whether all poles of the switch-disconnector have closed correctly (Fig.105).
8. Remove the lever from manual drive and secure it with a padlock (if used).

##### Opening

1. Make sure that all doors of station are closed.
2. Remove the padlock securing manual drive of switch-disconnector (if used),
3. Apply lever on the knurled shaft of manual drive of the switch-disconnector,
4. Pull the locking ring S (Fig.17)
5. Turn the lever in the opening direction - according to the information shown on the information label; rotation should be performed until the end, until the locking ring snaps into the locked position of the manual drive.
6. Check whether all poles of the switch-disconnector have opened correctly (Fig. 105).
7. Remove the lever from the manual drive and secure it with a padlock (if used).
8. If the switch-disconnector is equipped with earthing switch, closing of earthing switch can take place only after confirming that the switch-disconnector is in open position (Fig. 105).



32 Switch-disconnector type NAL/VR with Kmechanism



33 Switch-disconnector type NAL/VR with Amechanism



### 10.3 A-mechanism. Fig. 33

Current knives rotate with great speed and force. Always keep a safe distance from moving parts of the switch. Be careful especially with type A (double spring) mechanism. This kind of drive stores great energy and can release it by small rotation of shaft.

#### Closing

1. If the switch-disconnector is equipped with earthing switch, be sure that the earthing switch is in the open position (Fig.105),
2. If the switch-disconnector is equipped with a fuse tripping system, make sure that all fuse-links have no strikers in released position - in this case (striker is out) the closing of switch-disconnector is not possible,
3. Make sure that all station doors are closed.
4. Remove the padlock securing manual drive of the switch-disconnector (if used),
5. Apply lever on the knurled shaft of manual drive of switch-disconnector,
6. Remember that before switch-disconnector closing operation, the spring of the mechanism has to be charged (Fig.24)
7. If the spring is charged the switch-disconnector can be closed in following way:
  - a. Pull the locking ring S (Fig.17)
  - b. Turn the lever in the closing direction - according to the information on the information label of HE drive of the switch-disconnector; rotation should be performed until the end - until the locking ring snaps into the locked position the drive.
8. Check whether all poles of the switch-disconnector have closed properly.
9. Remove the lever from manual drive and secure it with a padlock (if used).

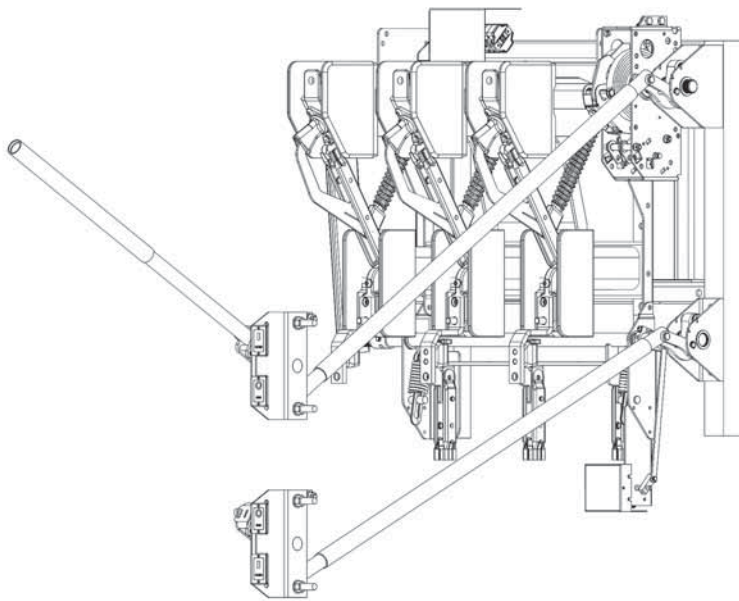
#### Opening

1. Make sure that all station doors are closed.
2. Remove the padlock securing manual drive of switch-disconnector (if used),
3. Apply lever on the knurled shaft of manual drive of the switch-disconnector,
4. Pull the locking ring S (Fig.17).
5. Turn the lever in the opening direction - according to the information shown on the information label of manual drive of the switch-disconnector; rotation should be performed until the end - until the locking ring snaps into the locked position of manual drive. In result of this operation the spring of the mechanism will be charged (Fig. 24). The switch opens before - after rotating the lever (about 20 degrees).
6. Check whether all poles of the switch-disconnector have opened correctly (Fig. 105),
7. Remove the lever from the manual drive and secure it with a padlock (if used),
8. If the switch-disconnector is equipped with earthing switch, closing of earthing switch can take place only after confirming that the switch-disconnector is open (Fig.105).

For step-by-step instructions for installation of the switch-disconnector with the HE hand operation mechanism, see item " Mounting the hand operating mechanism type HE" .

# 11.0 Hand operating mechanism

## NEMD



### 11.1 Application

The reciprocating drive is intended for operating indoor switch-disconnectors type NAL and E / EB earthing switches. The operation can be performed manually by operating the maneuvering lever in a reciprocating movement. It is designed for mounting on the front of the panel in tower type switchgears (drive installation below the level of the apparatus).

It is possible to use a mechanical lock, which increases the safety of the operator (locking of the drive is performed by installing padlock that prevents inserting the maneuvering lever and blocking the position of the front lever. Please specify the type of apparatus (NAL / F switch or E, EB earthing switch) to which the drive is required when placing order.

—  
34 Hand operating mechanism NEMD arrangement

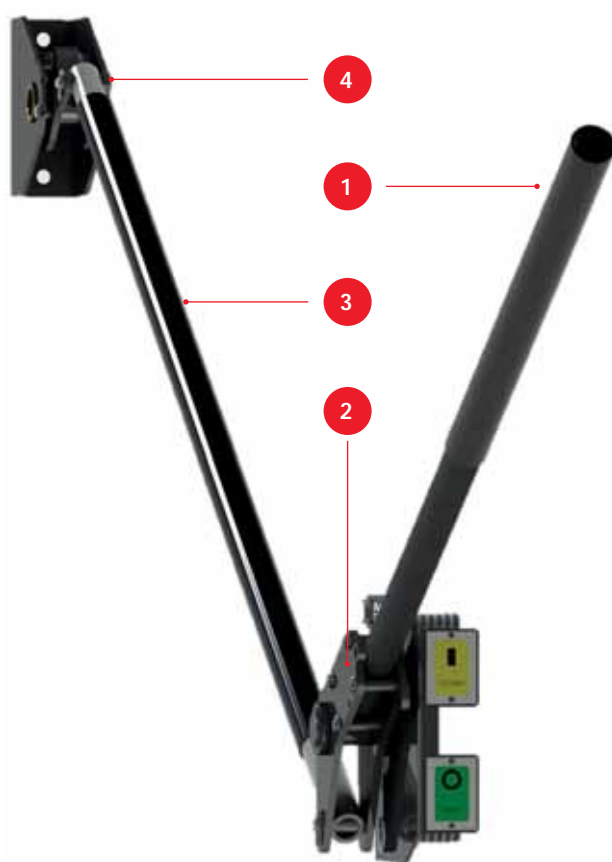
### 11.2 Rated data

- Fitter's lock with a padlock
- MAX 90° manoeuvring angle of rotation
- Mechanical performance of 2000 operations
- Hand operating mechanism (for NAL) - 1YMX888739M0001 (operating angle 10-35° measured from level),
- Hand operating mechanism (E, EB) - 1YMX888739M0002 (operating angle 10-30° measured from vertical)

### 11.3 Working conditions

The NEMD type drive is designed for operation in indoor switchgears in normal service conditions with:

- ambient temperature (-5°C + 40°C),
- maximum relative air humidity 95%



#### 11.4 Design and principle of operation

The NEMD drive consists of:

1. operating lever,
2. front lever,
3. insulated rod,
4. sliding mechanism.

#### 11.5 Versions available

- 1YMX888739M0001 - NEMD drive for NAL switch disconnector designed for mounting on the front wall of application panel.
- 1YMX888740M0001 - NEMD drive for E / EB earthing switches designed for mounting on the side wall of application panel.
- 1YMX888741M0001 - NEMD drive for NAL switch disconnectors intended for installation below the switch disconnector level.
- 1YMX888742M0001 - NEMD drive for E / EB earthing switches intended for installation below the switch-disconnector level.

## 12.0 Replacing the mechanism on the switch

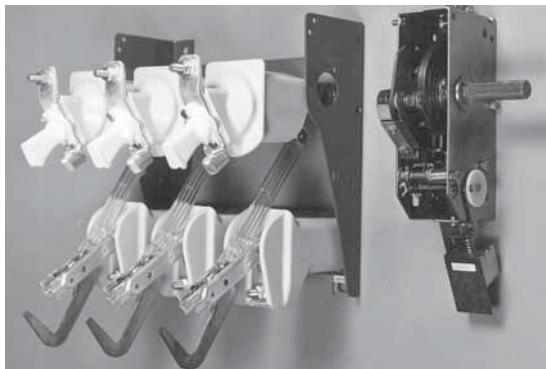
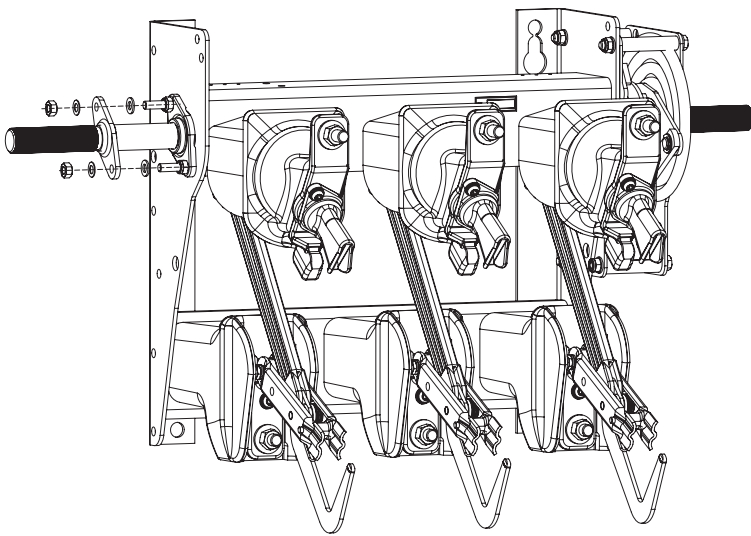
### 12.1 Replacing the mechanism on the switch.



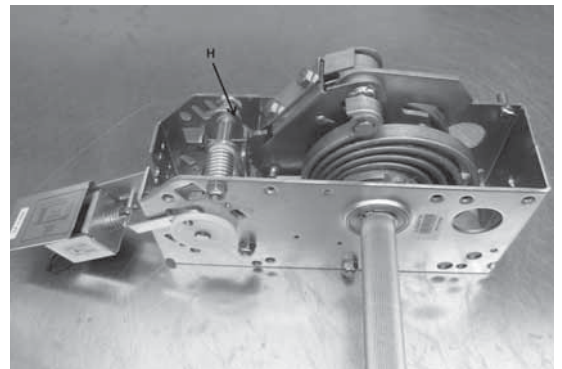
#### — WARNING!

These operations shall be carried out by authorised personnel only!

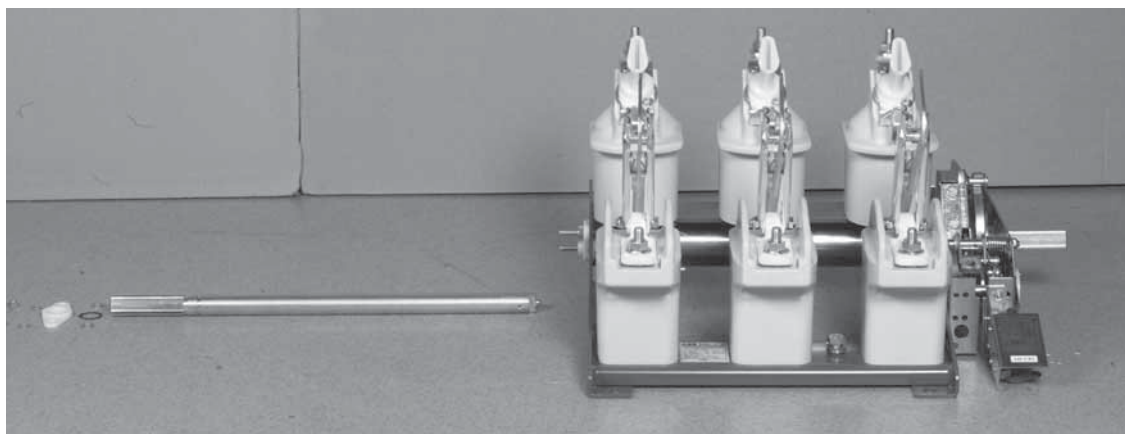
The mechanisms are mounted on the right hand side of the switch main frame and the switch is normally operated from the same side (mechanism-side). When the switches have to be operated from the opposite side, an operating shaft must be connected, see Fig. 38. The mechanism clutch is brought together with the clutch of the hollow main shaft and the mechanism is fixed to the switch frame. Usually the switch disconnecter is delivered without shaft extension for left hand side operation.



— 37 Shunt trip mounted on the A-mechanism



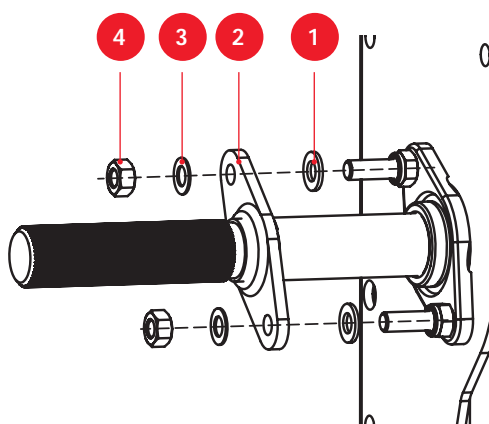
— 38 Mounting the mechanism on the switch



39 Shaft extension for the left-hand side operation

When the switches have to be operated from the left side, an operating shaft must be connected, see Fig. 36. The mechanism clutch is brought together with the clutch of the hollow main shaft and the mechanism is fixed to the frame. Tighten mounting screws with 15 [Nm] torque. Insert the shaft extension from the left side of the apparatus through the hollow shaft into the mechanism clutch. Secure the shaft extension as shown in figure below. Tighten the nuts with 9 [Nm] +/-10% torque.

**Note:** Contact knives in open position



40 Shaft extension.

## 12.2 Test operation of A-mechanism

Current knives rotate with great speed and force. Always keep a safe distance from moving parts of the switch. Be careful especially with type A (double spring) mechanism. This kind of drive stores great energy and can release it by small rotation of shaft.

After having mounted the mechanism to the switch frame, check that the latch H is in correct position by pulling it back to the outermost position, see Fig.38.

For test operation see item "Test operations".

1. Plain washer M8 DIN126 2 pcs.
2. Shaft secure (1YMX023808P0001) 1 pcs.
3. Wave washer DIN137A 2 psc.
4. Nut M8 DIN934 2 psc.

Check if the shaft extension works properly with a few operations.

## 13.0 Mounting of fuse-base



### CAUTION!

1. The switch-disconnector must be open and main springs not charged.
2. If contact plastic covers are added to box with apparatus (component „A“ Fig.41), these covers must be assembled at middle phase as shown in the Fig.41.

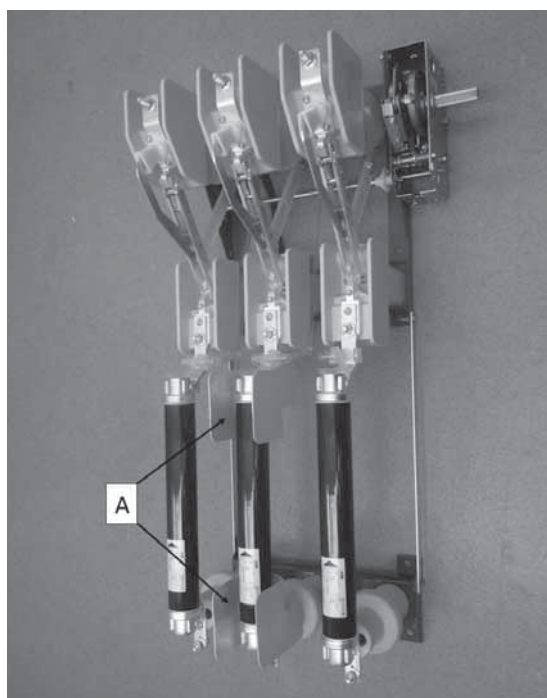


### WARNING!

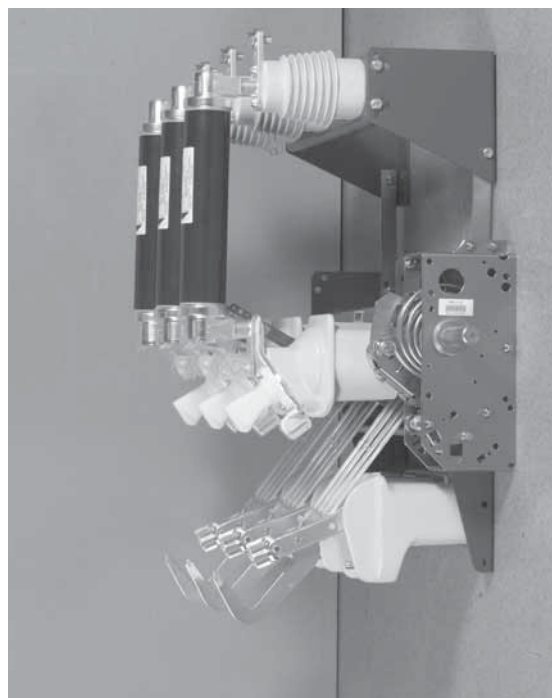
These operations shall be carried out by authorised personnel only!

### 13.1 Mounting of fuse-base

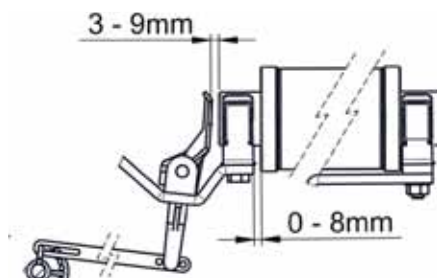
When mounting a fuse-base with three post insulators, one set of fuse contacts and possibly fuse trip accessories are mounted directly on the switch terminals, see Fig. 41 or 42.



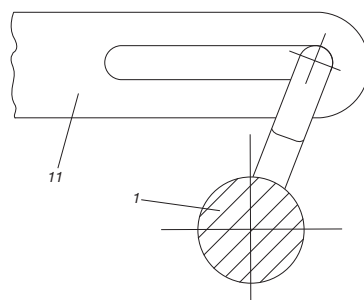
41 Switch-disconnector type NALF with fuse base mounted on the pivot side



42 Switch-disconnector type NALF with fuse-base mounted on the opening side

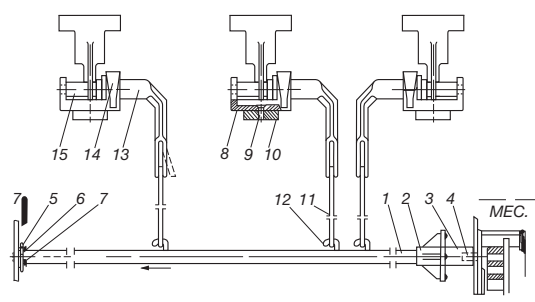


43 Fuse tripping



44 Tripping rod





—  
45 Fuse tripping completed

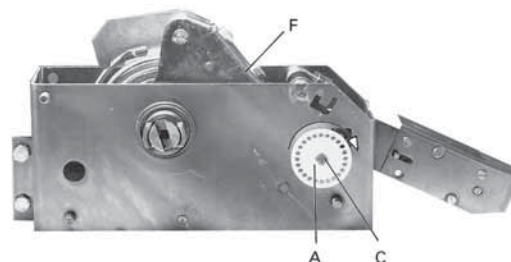
### 13.2 Mounting of the fuse tripping. Fig. 45

1. Lower part of bearing (8) is fixed to terminal (10) by one screw (9).
2. The lever (13) together with the fuse trip flap (15) are placed in the lower bearing (8) and locked by means of upper part of bearing (14).
3. The released rod (11) is mounted in the lever (13).
4. The drive ring (2) is mounted to the release shaft (1) on the RHS (right hand side).
5. The bearing (5) and washer (6) is mounted on the release shaft (1) on the LHS (left hand side) and secured by split-pin (7).
6. Disc (3) is mounted to the release shaft (4) of the mechanism.
7. The release rods (11) are mounted onto the hooks (12) on the release shaft (1).

### 13.3 Adjustment of the fuse tripping. Fig. 45.

1. The adjustment applies to switch-disconnectors with fuse-links and fuse tripping,
2. The adjustment must be made with both operating springs in the mechanism in uncharged position, but the releasing spring in the mechanism has to be charged as mentioned under control point 6.4 point
3. The split pin (7) is removed and the release shaft (1) together with the drive ring (2) is pushed in the direction of the arrow until the tapped connection is free from disc (3).
4. The release rod (1) with the drive ring (2) is turned and adjusted to a hole in the disc (3), while the adjustment of the fuse trip flap (15) and its distance to the strike pin of the fuse-link must be checked, see Fig. 43.

—  
**Remark:** Following adjustment according to above the fuse switch-disconnector must open when tested in all phases. After fuse interruption the mechanism shall be blocked against another operation until the fuselink has been replaced.



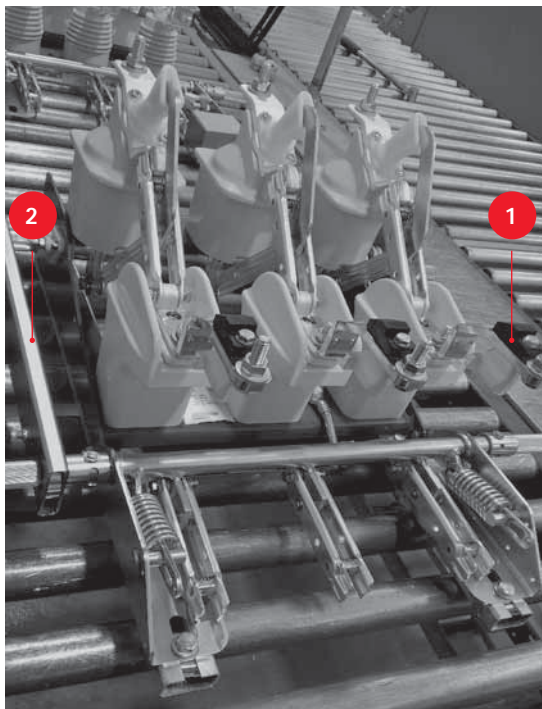
—  
46 A-mechanism

### 13.4 Fuse tripping

1. Turn the operating mechanism shaft clockwise, max 60°, and return the operating handle back to the neutral position (opening spring housing F, see Fig. 46, must not be latched),
2. Mount a new fuse-link, or a test fuse which is in accordance with DIN 43625, in one of the phases. The fuse-links for switch-fuse combination with fuse tripping system, must come from NALF reference list of fuse-links to ensure proper coordination between switch-disconnector and current limiting fuse-link breaking performance characteristic, according to IEC 62271-105: 2012-09.
3. If the distance between the fuse clips of fuse-bases (see Fig. 43) is longer than described – max  $e + 8$  mm, the adjustment (point 13.3) must be made with the fuse-link mounted on the fuse-base,
4. The distance between the striker pin and the fuse trip flap (position 15 Fig. 45) must be from 3-6 mm (see Fig. 43). By this adjustment the fuse-link is allowed to sag, but the distance between the striker pin and the fuse trip flag must not exceed 12 mm,
5. If the fuse switch-disconnector does not open when adjusted as mentioned above, the adjustment has to be checked and repeated.

—  
**Remark:** The hooks (12) on the release rod (1) ought to have the same position as shown on Fig. 45 - when the fuse-switch disconnector is in open position with both operating springs uncharged, but with the releasing spring charged.

## 14.0 Mounting of earthing switch type E



47 Earthing switch type E mounted on the NAL/VR switch-disconnector

### 14.1 Mounting of earthing switch type E/EB (Fig.47)

The switch will normally be delivered for connection of the hand operating mechanism on the right hand side and any mechanical interlock on the left side. The splined extension intended for connection to the hand operating mechanism will have free travel. The extension for the interlock will be bolted to the shaft, see Fig.47.

**Note:** From the operating side of the earthing switch, the earthing switch shaft extension must be mounted on the oblong hole. From the mechanical interlock side, the earthing switch shaft extension must be mounted on the round hole. For more information and shaft extension adjustment see point "Shaft extension adjustment".



47a Tighten the earthing link to the frame of switch-disconnector with torque 40 Nm. Between link's head and switch-disconnector frame must be only toothed washer (excluding frames dedicated to Czech market, where toothed washer is not applicable). Rest of washers must be above link's head

### 14.2 Mounting the earthing switch to the switch-disconnector type NAL/VR

The contacts (see pos. 1, Fig.47) are mounted on the terminals of the switch-disconnector, and the surfaces of the main contacts are then covered by contact grease. (Recommended grease: ISOFLEX TOPAS NCA 52).

Close the earthing switch slowly (operate the earthing switch using a handle placed on knurled end shaft installed on short hole) and adjust the fixed contacts to line up correctly with moving contacts. Tighten the contacts screws.

Contact knife with draw bar should be tightened in two steps:

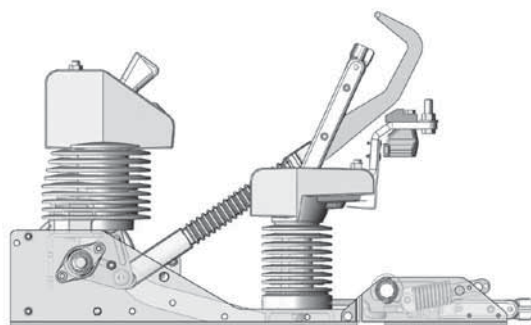
- initial torque 32 Nm +/-10%,
- final torque 40 Nm +/- 10%.





#### — WARNING!

By default earthing switch is configured to be operated on the right hand operating side. Changing side of operation require shaft extension adjustment – see point “Shaft extension adjustment”

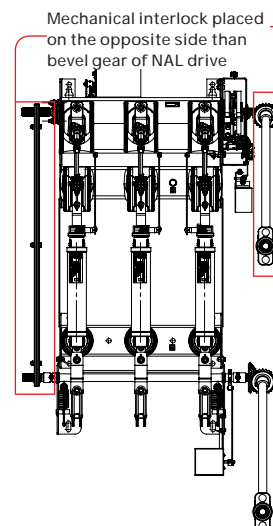


— 48 The switch-disconnector and earthing switch must be in the open position. In case of switch-disconnectors with mechanism A, the opening spring must be charged before assembly of the interlock, (see item “Preparation of the switch for installation.”).

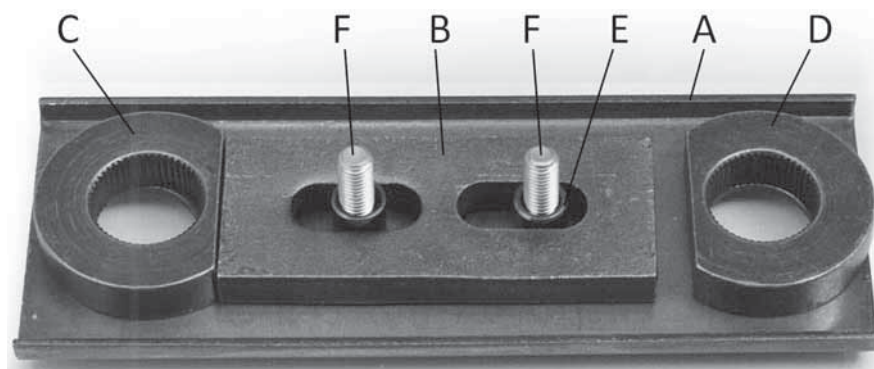
### 14.3 Mounting the earthing switch to the fuse-switch disconnector type NALF/VR

Proceed according to item “Mounting the earthing switch to the switch- disconnector type NAL/VR”. The contacts A must be mounted on the terminals of the fuse-base, and secured in position with tension.

### 14.4 Mounting the mechanical interlock between switch-disconnector and earthing switch. Fig. 47, 49, 50.



— 49 Mechanical interlock must be placed on the opposite side than bevel gear of NAL drive



— 50 Mechanical interlock

In case of earthing switch, the knurled end shaft on which the mechanical interlock is installed, must be mounted on the earthing switch shaft using the short hole. Put one half of the guide A (side plate) on the operating shafts of the switches.

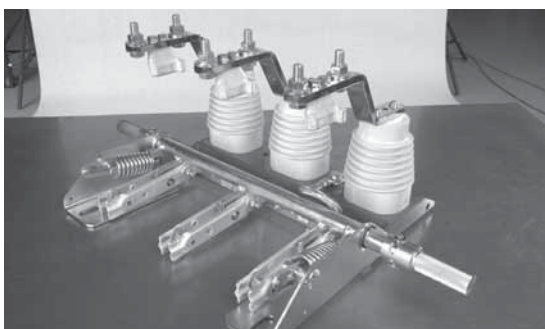
Do not forget to mount the two distance rings E on the two screws F.

Mount the interlock connection B. Mount the interlock rings C and D on the shafts with the flat part of the ring facing towards the interlock connection B, see Fig.50.

Do not forget to mount the two distance rings E on the two screws F.

### 14.5 Testing the interlock

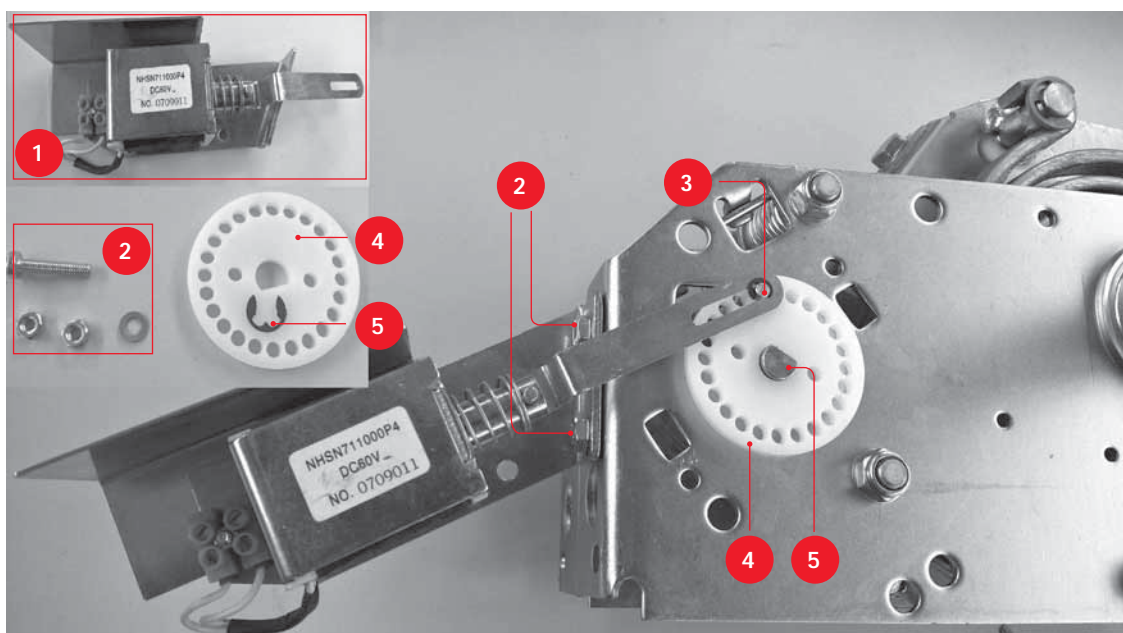
It shall not be possible to close the switch-disconnector when the earth switch is closed. It shall not be possible to close the earth switch-disconnector when the switch is closed.



— 51 Earthing switch type EB12

## 15.0 Mounting the shunt release

Allows opening command of switch-disconnector to be enabled by remote control. Shunt release is only available for stored spring energy mechanism type A. It shall always be connected in series with an auxiliary switch Fig. 53, (5% duty cycle solenoid) which disconnects the shunt trip coil when the switch is open in order to break a continuous operation command which may also cause a dangerous situation when closing.



52 Shunt trip parts component A-mechanism

### Mounting the shunt release Fig. 52

1. Turn the operating mechanism shaft to a maximum angle of 60° clockwise.
2. Opening spring housing F, see Fig. 46, must not be latched.
3. Return the shaft to its neutral position.
4. Install shunt release coil to the mechanism using two bolts 2.
5. Insert the perforated disc into the A-mechanism pin.
6. Connect the bar 3 to the perforated disc 4 in such a way that it does not block the mechanism and work properly.
7. Secure connection by locking ring with pin 3.
8. Insert a locking ring into the A-mechanism pin to secure the perforated disc 5.
9. After installation, check the operation of the shunt trip and its cooperation with the mechanism. Turn the operating mechanism shaft to a maximum angle of 60° clockwise and tighten mounting screws 2 with 25 [Nm] torque.

# 16.0 Mounting the auxiliary switch

–  
**Note:** The minimum cross-section of the wires used for the auxiliary circuits must not be less than the one used for the external cabling. Furthermore, they must be insulated for 3 kV of test.

## 16.1 Auxiliary switch for switch-disconnector.

Electrical signalling of switch-disconnector open/closed can be obtained with a group of 2NO+2NC, 4NO+4NC, 8NO+8NC auxiliary contacts.

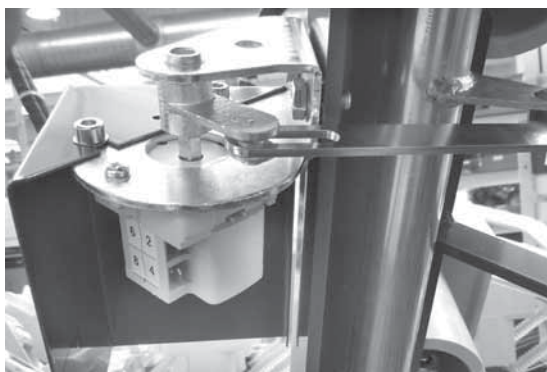
### Connection of the auxiliary circuits.

The auxiliary switch is mounted to the frame on the opening side of the switch disconnector and connected to the crank on the hollow shaft by steel arm - bent end of the arm must be mounted on the hollow shaft side (see Fig.54).

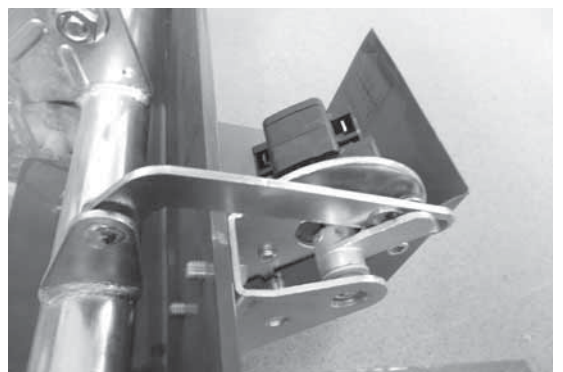
Electric scheme of auxiliary switch is shown in Fig. 58. In cases where a shunt trip coil is installed, it should be connected to the auxiliary switch as shown on Fig.59. Tighten mounting screws with 25 [Nm] torque.

General characteristics	
Insulation voltage to standard VDE 0110, Group C	660 V AC 800 V DC
Rated voltage	24V ... 660 V
Test voltage	2 kV for 1 min
Maximum rated current	10 A - 50/60 Hz
Breaking capacity	Class 1 (IEC 62271-1)
Number of contacts	5
Groups of contacts	10 / 16 / 20
Contact travel	90 °
Actuating force	0.66 Nm
Resistance	<6.5 mΩ
Storage temperature	–30 °C ... +120 °C
Operating temperature	–30 °C ... +70 °C (–30° ref. ANSI 37.09)
Contact overtemperature	10 K
Mechanical life	30,000 mechanical operations
Protection class	IP20
Cable section	1 mm <sup>2</sup>

Auxiliary contacts conform to the following standards/regulations/directives: EN 60947 (DC-21A DC-22A DC 23A AC-21A) RoHS Directive



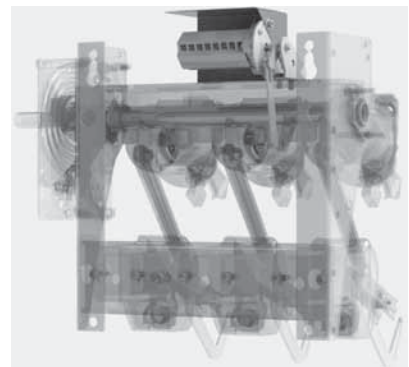
53 Auxiliary switch mounted on NAL



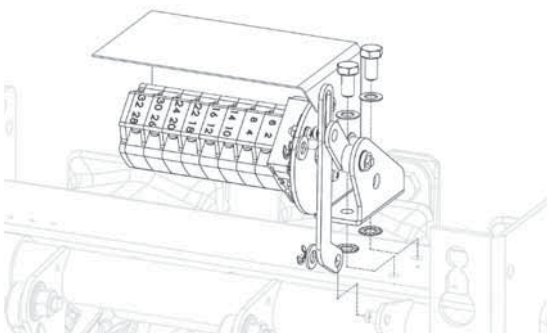
54 Auxiliary switch mounted on NAL



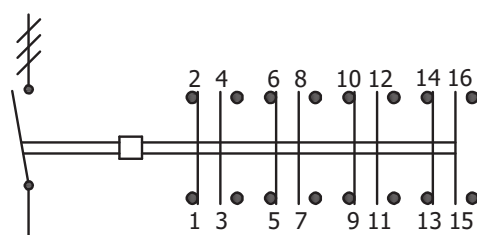
55 Auxiliary switch



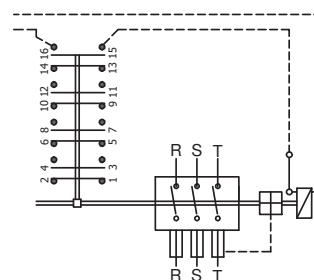
56 Auxiliary switch position



57 Auxiliary switch position



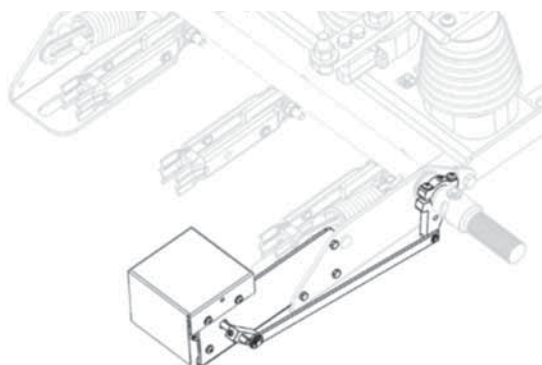
58 Wiring diagram auxiliary switch



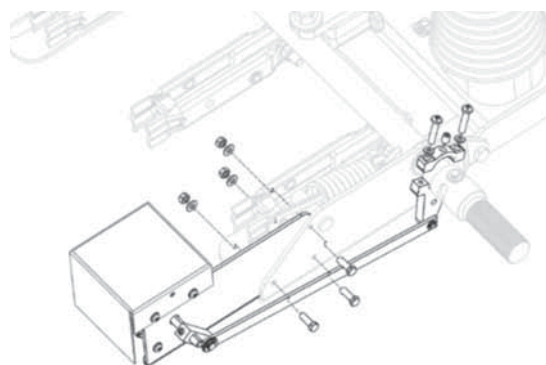
59 Wiring diagram tripping coil

## 16.2 Mounting the auxiliary switch for E-EB earthing switch Fig. 60-71.

Electrical signalling of earthing switch open/closed can be obtained with a group of 2NO+2NC, 4NO+4NC auxiliary contacts. The auxiliary switch is mounted to the frame on the right side of the earthing switch and connected to the main shaft.

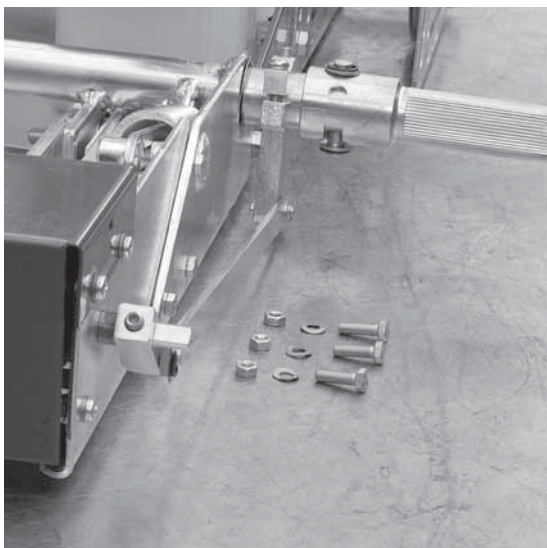


60 Auxiliary switch mounted on earthing switch

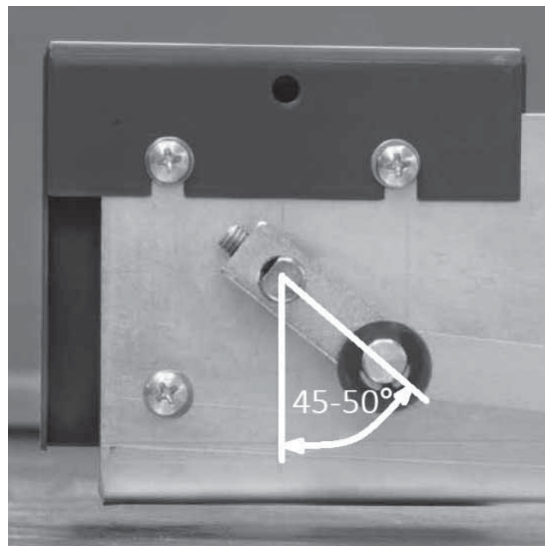


61 Connecting point of auxiliary switch

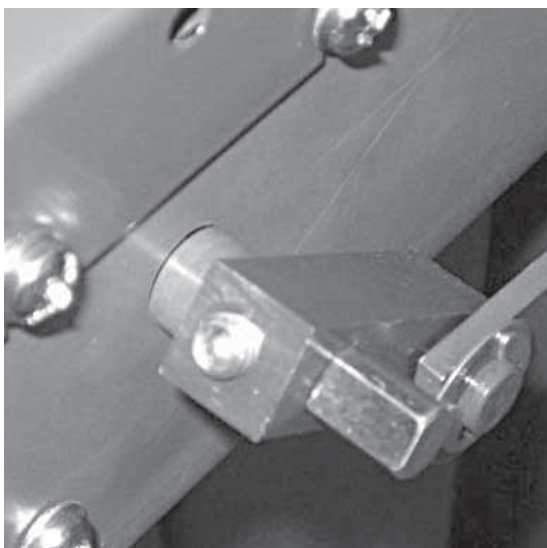




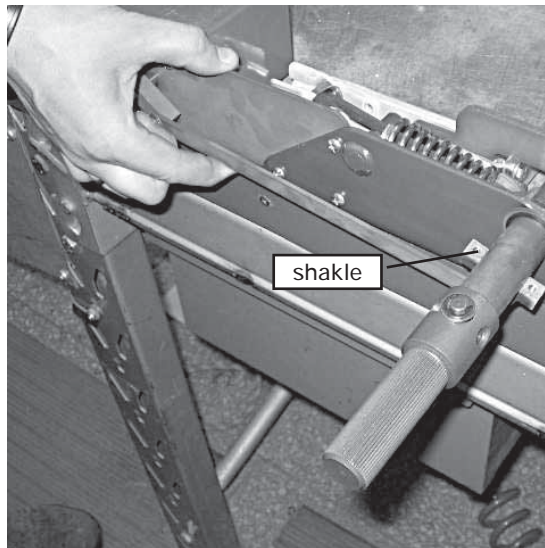
62 The installation starts with the earthing switch in open position.



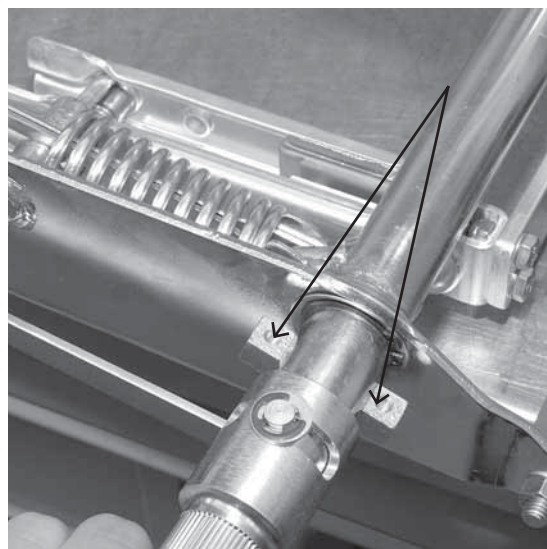
63 The arm of auxiliary switch should be at an angle 45-50 degrees in direction of earthing switch



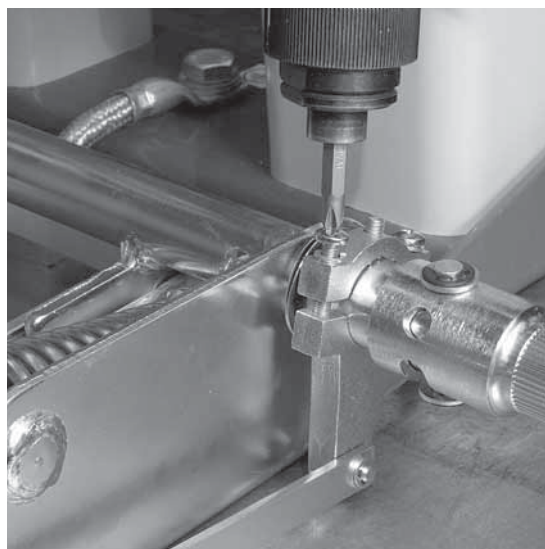
64 Holdfast screw must be tightened from the flat side of auxiliary switch shaft.



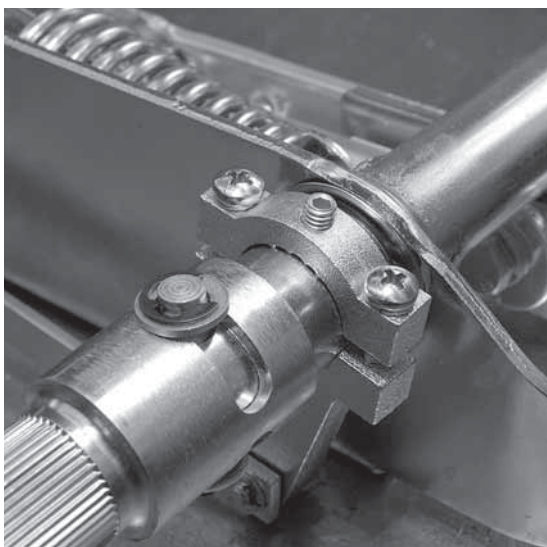
65 The shackle (connecting part with a hole) is mounted on the extension shaft of earthing switch so that the rod connecting the arm of auxiliary switch with shackle is slightly strained



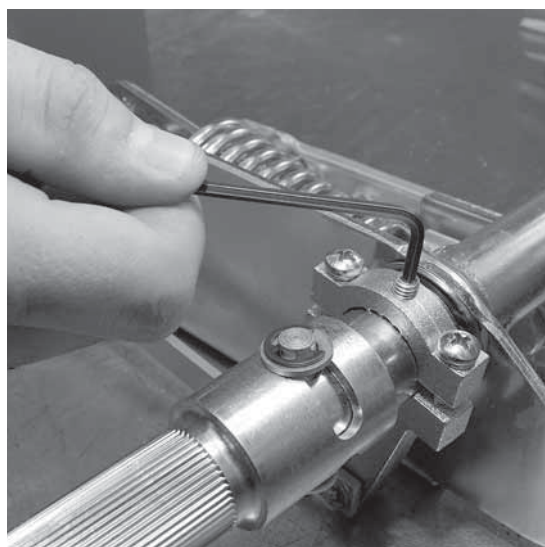
66 Tighten the screws (M5) that mount the shackle on extension shaft of earthing switch



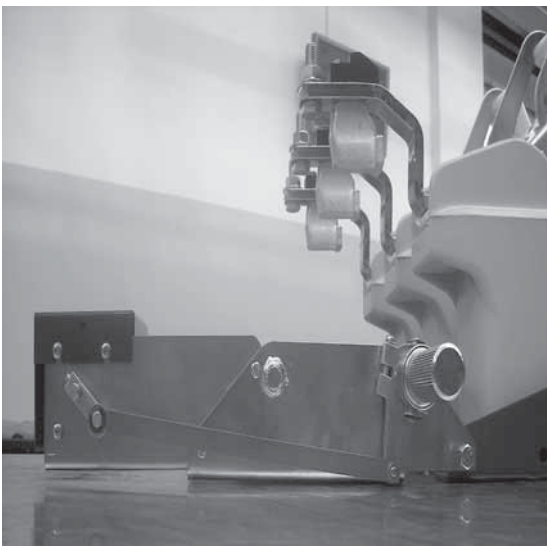
67 Tighten the screws (M5) that mount the shackle on extension shaft of earthing switch



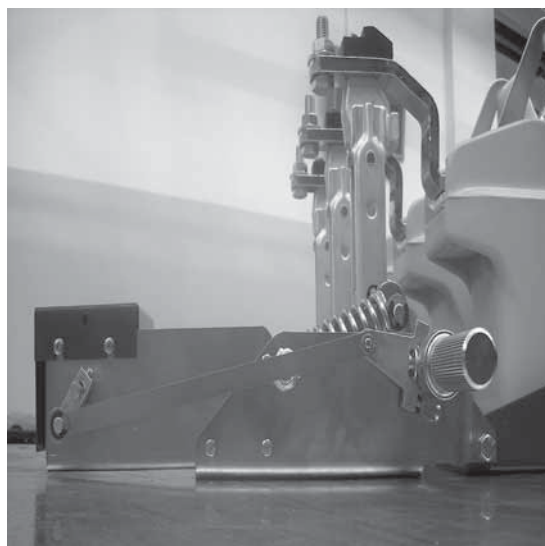
68 Tighten the holdfast screw rather firmly



69 Verify the correct operation of auxiliary switch



70 Earthing switch in open position



71 Earthing switch in closed position

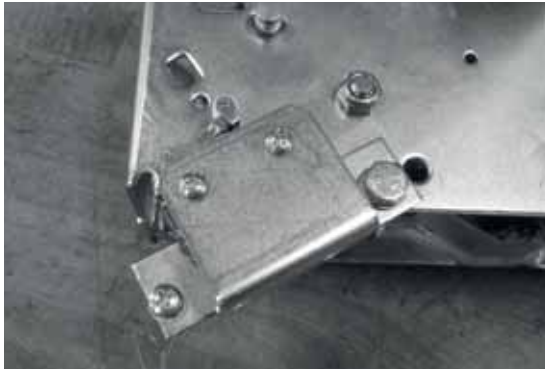
### 16.3 Mounting the auxiliary switch for fuse interruption

The open fuse auxiliary switch can only be installed on the A-mechanism and a fuse base equipped with fuse tripping. This switch has two contacts, one normally open and one normally closed. It is actuated by the fuse tripping tie rod linkage connected to the type CEF fuse base.

Locate the mounting hole and slot on the side of the A-mechanism with the operating shaft shown in figure 72.

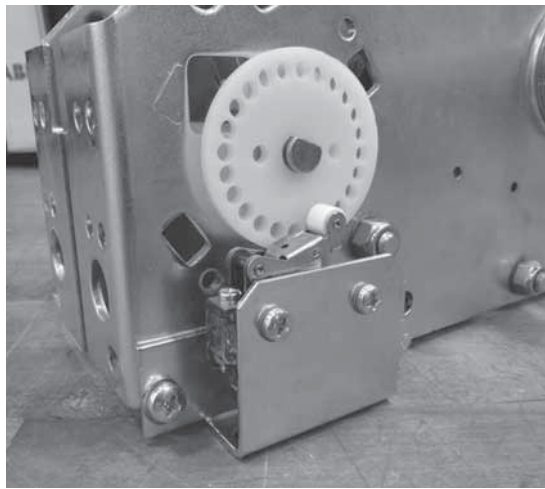


72



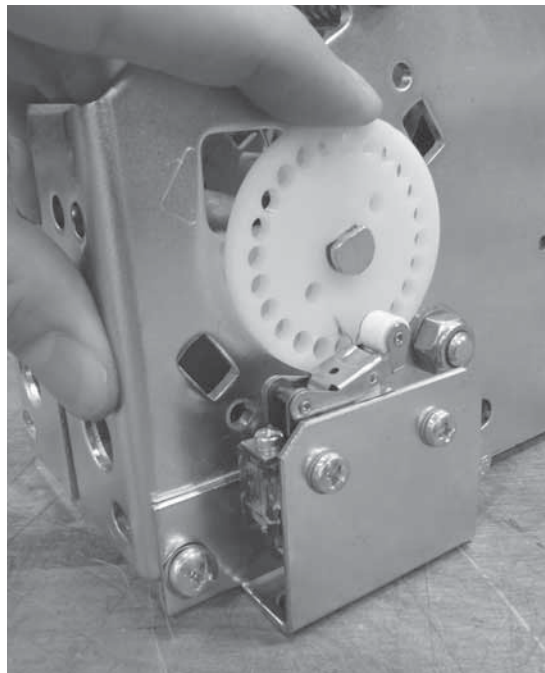
Bolt the open fuse auxiliary switch to the mounting hole on the A-mechanism and loosely install the screw hardware to allow the switch to rotate into the slot, pictured in figure 73.

73



Place the white disk onto the half-moon shaft and rotate the switch into place as shown in figure 74.

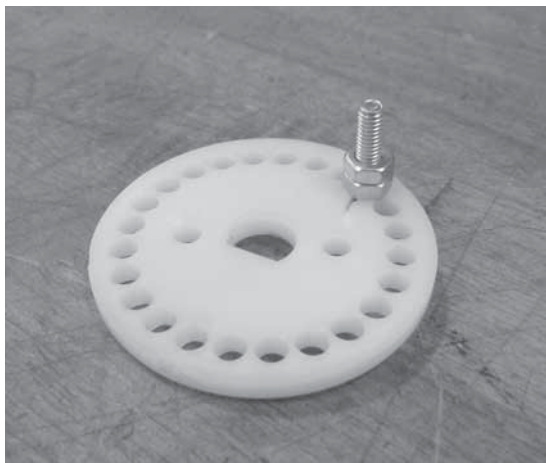
74



Rotate the white disk with your finger and mark the hole directly adjacent to the white roller on the switch as shown in figure 75.

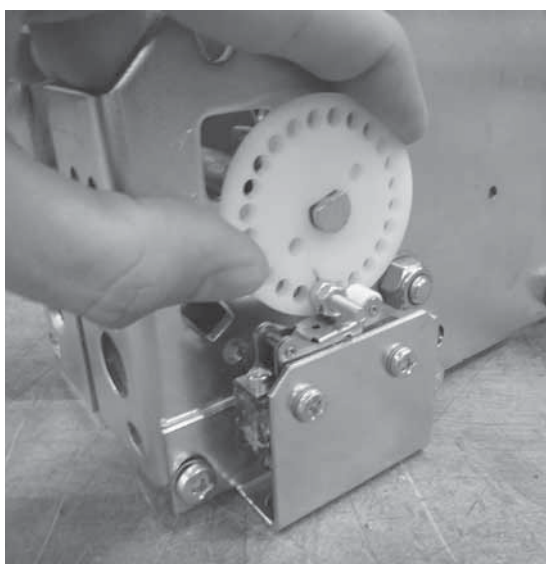
75





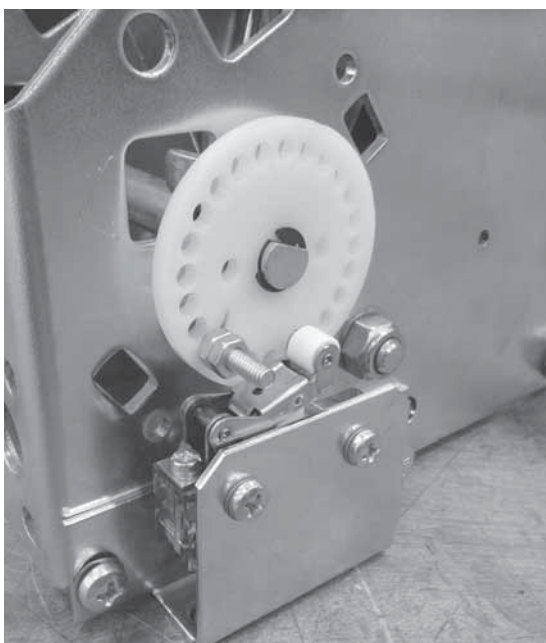
Rotate the switch out of position and remove the white disk. Install the long bolt and two nuts into the marked hole from the previous step as in figure 76.

76



Re-install the white disk and switch back onto the A-mechanism. Rotate the white disk until it reaches its maximum rotation and contacts the switch as in figure 77. An audible click should be heard. If not, remove the white disk and move the long bolt and nuts to the appropriate hole. Once adjusted properly, secure the switch with a 13 mm socket and Phillips screw driver.

77

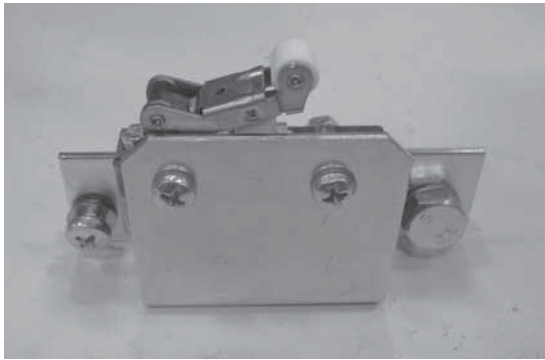


Install the circlip onto the half-moon shaft to secure the white disk as shown in figure 78.

78

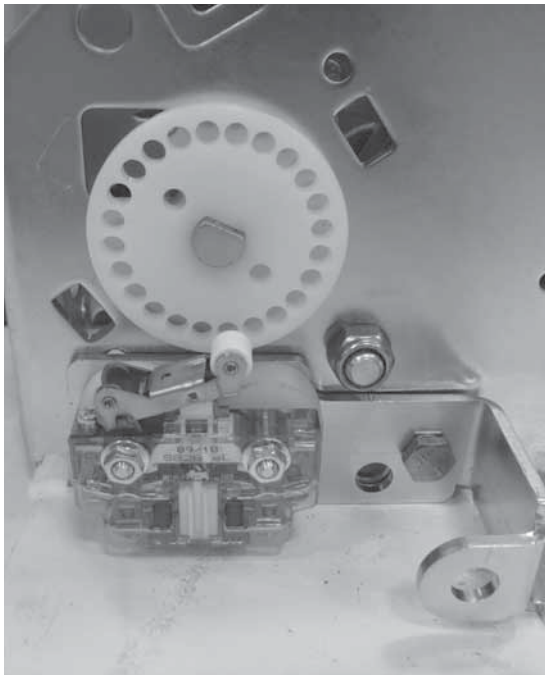
#### 16.4 Mounting the open fuse auxiliary switch on motor bracket

Remove the two screws that secure the switch to the mounting bracket with a Phillips screw driver as seen in figure 79.



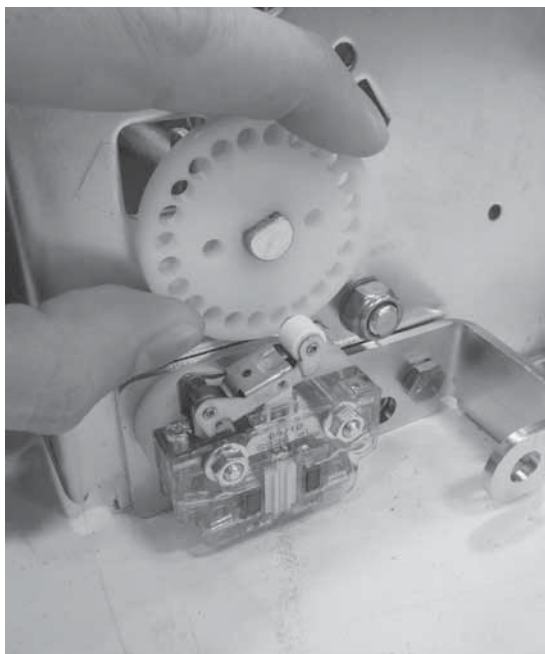
—  
79

Slide the switch onto the studs located on the motor bracket and secure with the provided nuts. Place the white plastic disc onto the half-moon shaft as shown in figure 80.

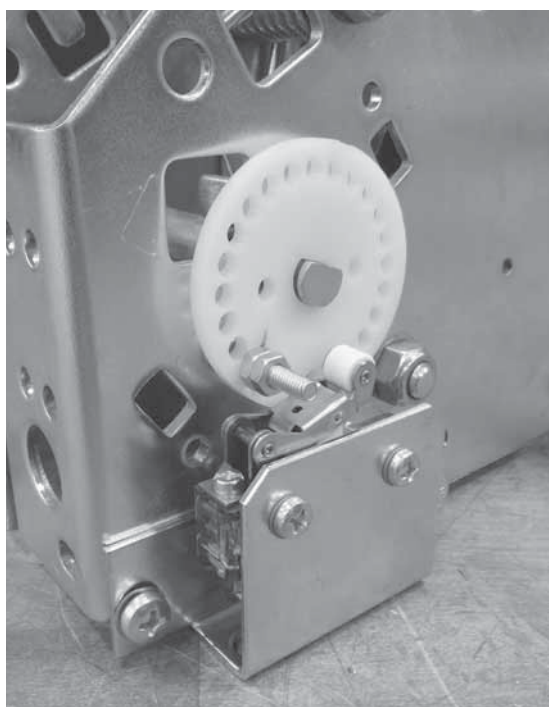


—  
80

Rotate the white plastic disc to its maximum rotation and mark the hole adjacent to the white roller on the open fuse auxiliary switch as shown in figure 81.

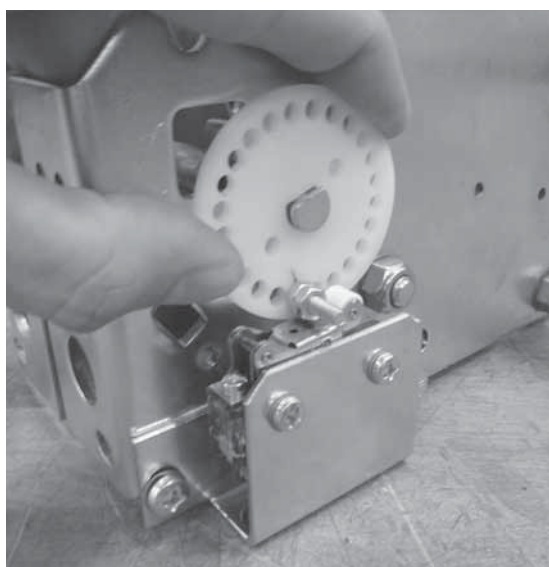


—  
81



Install the provided screw and nuts into the marked hole from the previous step as shown in figure 82.

—  
82



Rotate the white plastic disc, shown in figure 83, to its maximum displacement and listen for a "click". This indicates that the switch will make contact. If a "click" is not heard, relocate the screw to a closer hole. Ensure the white disc reaches its maximum rotation just as the click is heard to prevent over rotation. If the setup is correct, secure the white disc with the provided cir-clip onto the half-moon shaft.

—  
83

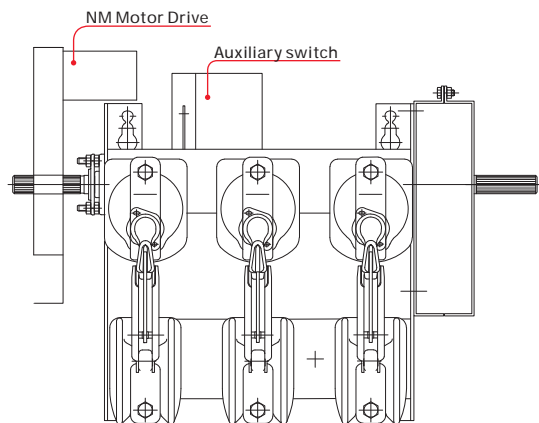
## 17.0 Motor drive

There are two types of drives which can be used together with NAL/NALF/VR:

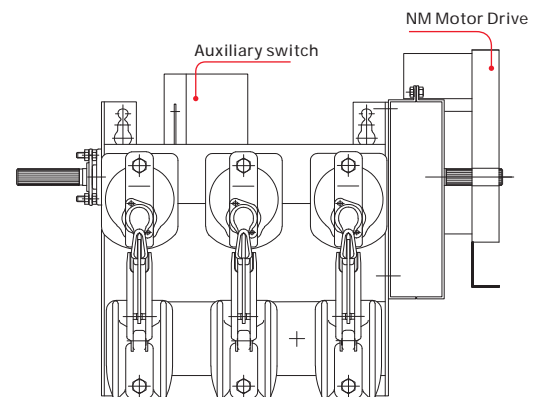
- NM/MU,
- UEMC 41.

NM/MU drive can be mounted on the NAL/NALF/VR mechanism shaft where UEMC 41 can have more possibilities to be connected to switch-disconnector.

### 17.1 Mounting of NM/MU motor drive



84 NM mounted on the left hand side



85 NM mounted on the right hand side



#### CAUTION!

In case of any installation/maintenance of switch-disconnector NAL/VR equipped with NM/ MU drive, disconnect power source of control board first.

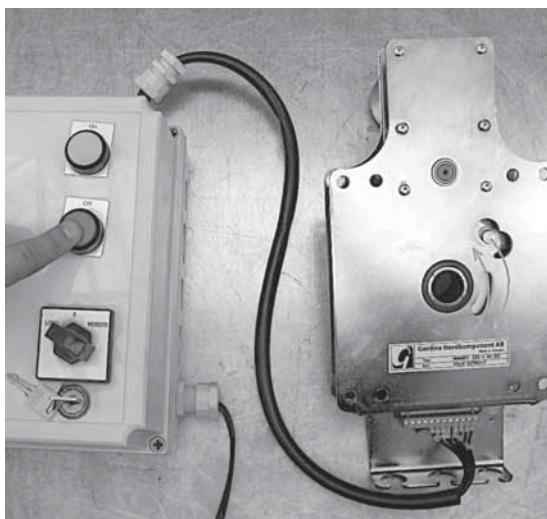


#### CAUTION!

The pushbuttons on the box must not be held for more than 5-6 seconds. The button only initiates the closing or opening process. It has its own support and there is no need to keep pressed.

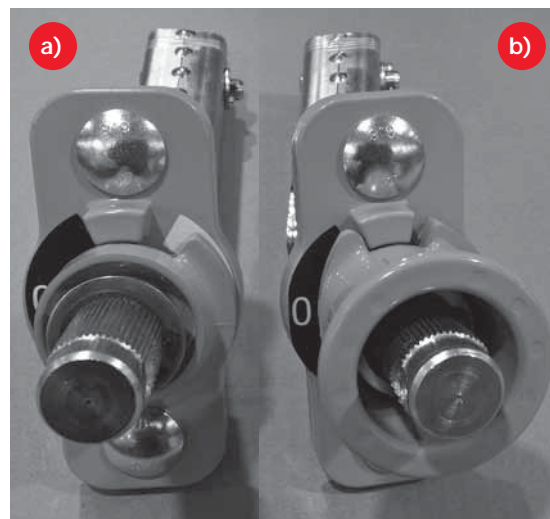


## 17.2 Motor drive settings for A-mechanism

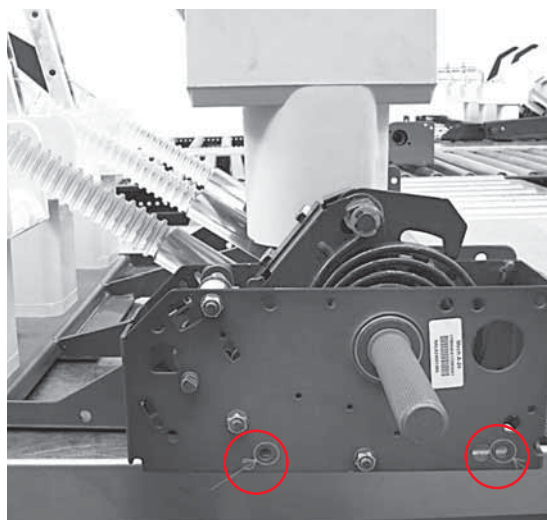


86 Installation NM/MU drive

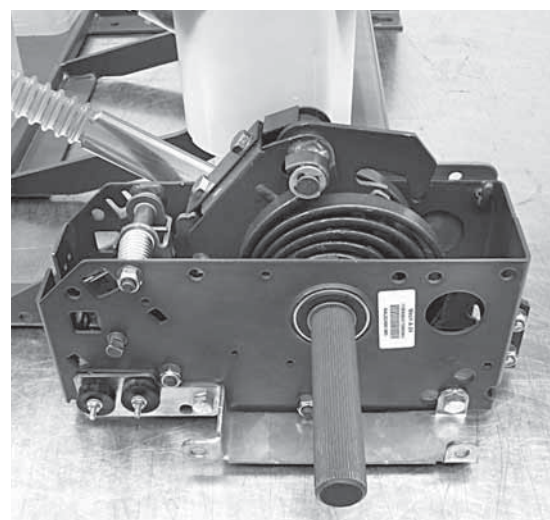
1. Check that the motor drive is working correctly



87 HE lower part for motor operation (a) and manual operation (b). There is also possibility to add blocking coil (b).

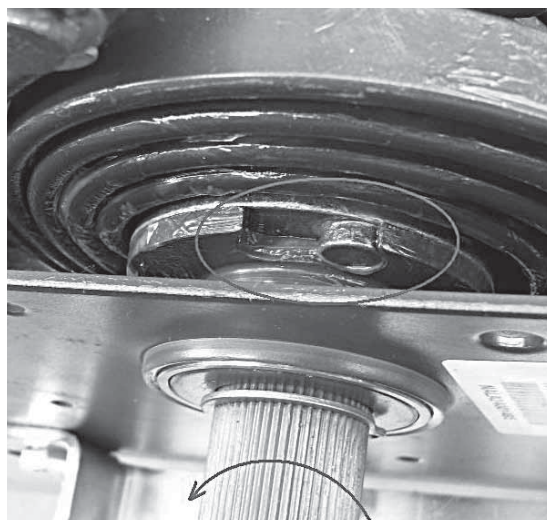


88 Locate the spacer bracket mounting holes

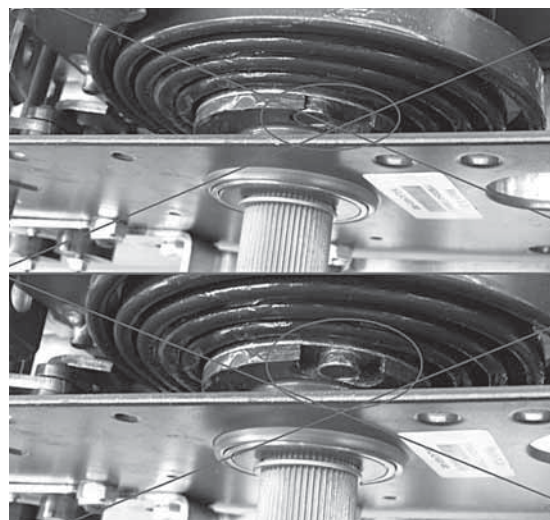


89 Tighten mounting screws with 25 [Nm] torque

2. NAL/NALF/VR must be in open position and discharge both springs. Locate the spacer bracket mounting holes on the A-mechanism, see Fig. 88, 89. Tighten mounting screws with 25 [Nm] torque



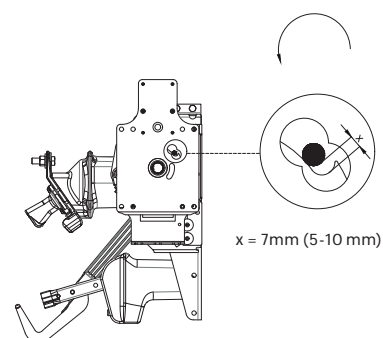
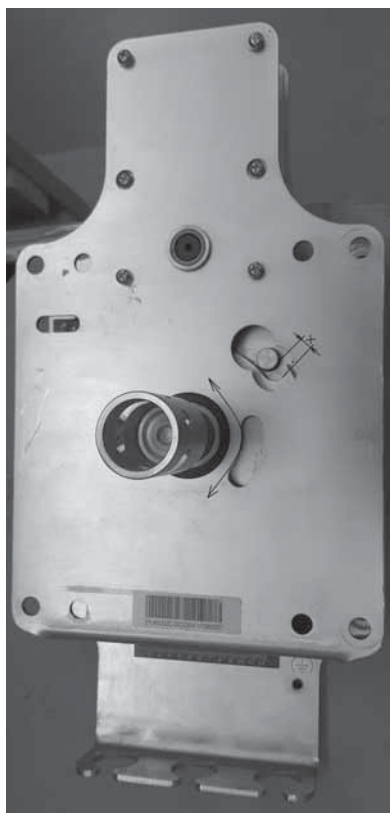
90 Mounting of NM/MU motor drive on A-mechanism



91 Mounting of NM/MU motor drive on A-mechanism

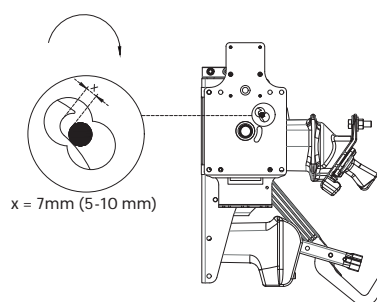
3. To reduce side shake, turn the operating shaft anticlockwise, see Fig. 90, 91.

## Setting of shaft and drive coupling



92b Alternative A - A-mech  
Both springs uncharged

Turn the operating shaft of the disconnector anti-clockwise to set the tolerance to zero before mounting the motor device. Distance X adjusted to ~7 mm (5-10 mm) before mounting to the shaft.

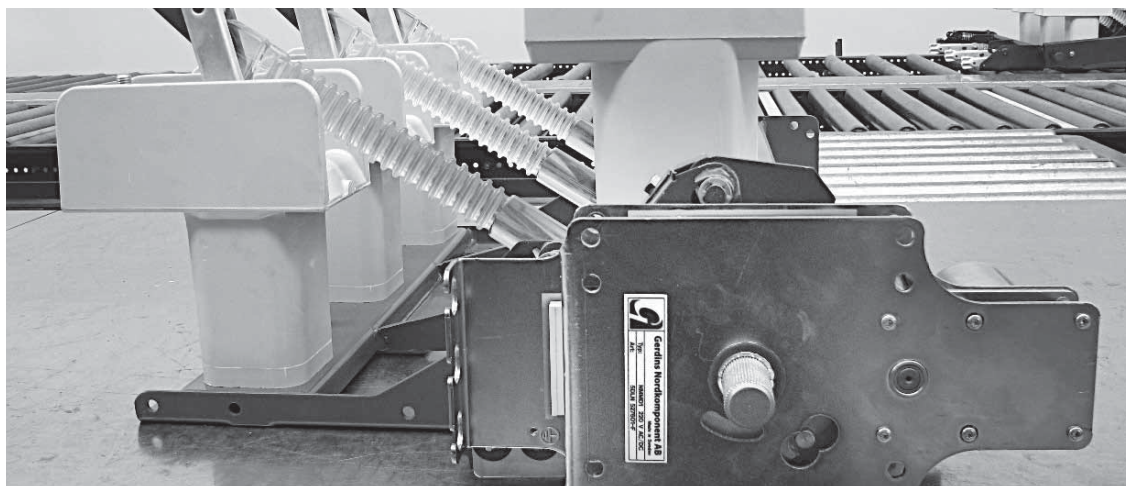


92c Alternative B - A-mech  
Both springs uncharged

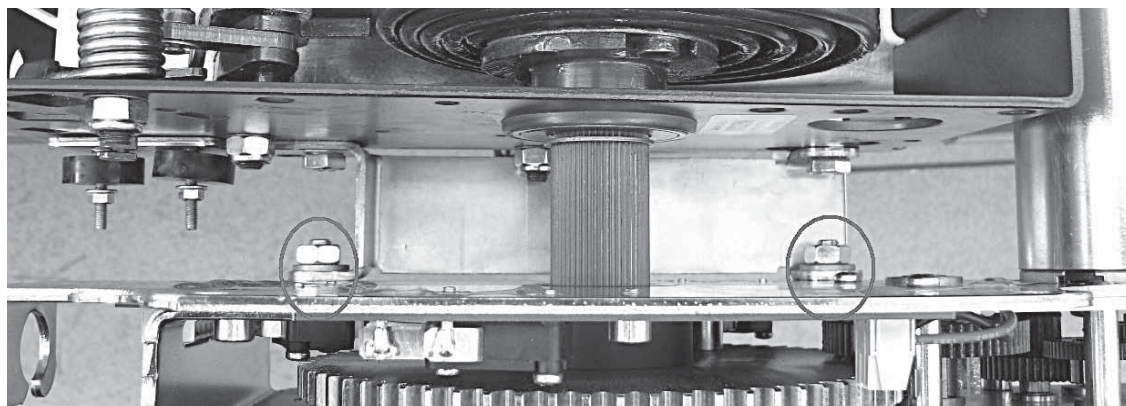
Turn the operating shaft of the disconnector clockwise to set the tolerance to zero before mounting the motor device. Distance X adjusted to ~7 mm (5-10 mm) before mounting to the shaft.

92a Before mounting on the A-mechanism shaft, set up distance

**Note:** When both springs of A mechanism are uncharged, start open operation to set the switch cycle, then close/open operation cycle is ready to work."

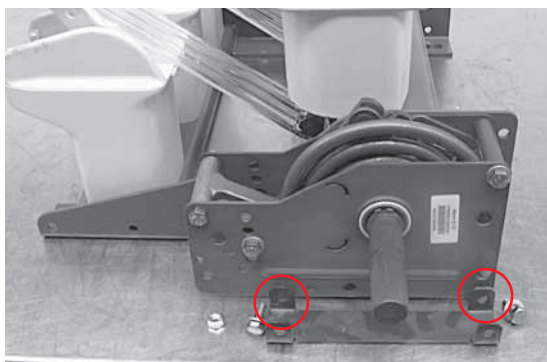


93 Mounting of standard motor drive for NAL/NALF/VR on A-mechanism

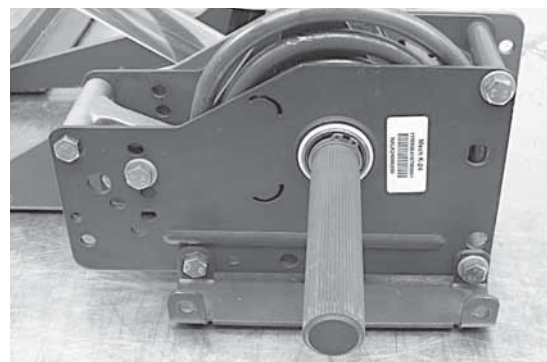


94 Mount the standard motor drive for NAL/NALF/VR on the shaft and tighten mounting screws with 25 [Nm] torque.





95 NAL 12 in open position

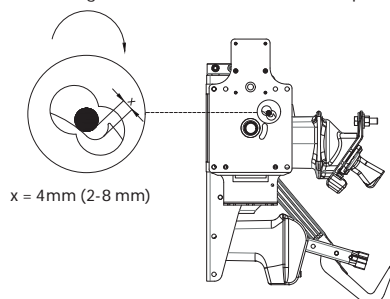


96 NAL 12 in open position

NAL/NALF/VR must be in open position. Locate the spacer bracket mounting holes on the K-mechanism. Fully tighten mounting screws. See Fig. 95, 96.



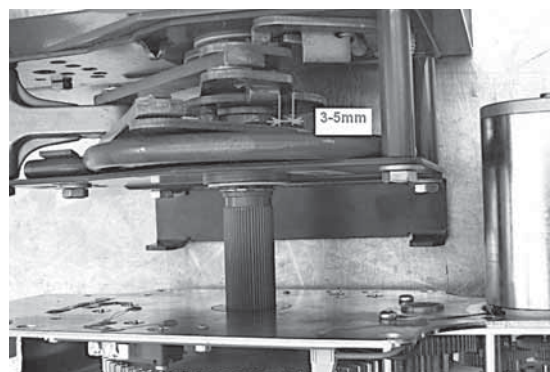
97a Before mounting on the K-mechanism shaft, set up distance



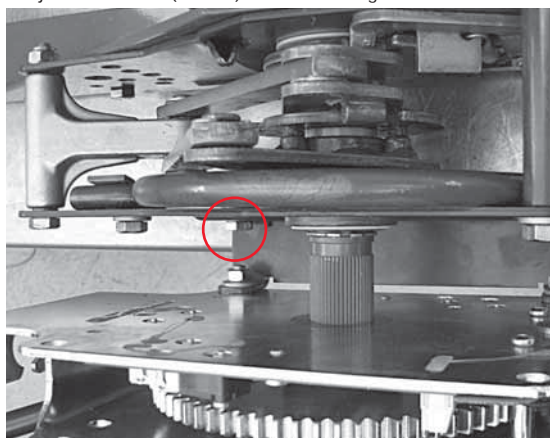
97b Alternative A K-mech

#### The disconnecter in open position

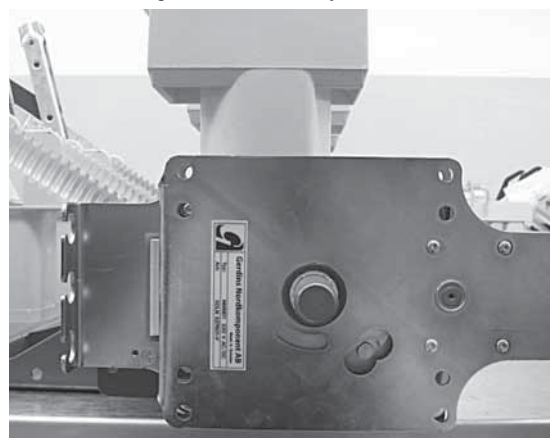
Turn the operating shaft of the disconnecter anti-clockwise to set the tolerance to zero before mounting the motor device. Distance X adjusted to ~4 mm (2-8 mm) before mounting to the shaft.



98 Before mounting the motor device, adjust distance ~3-5 mm



99 Mounting of standard motor drive for NAL/NALF/VR on Kmechanism



100 Mounting of standard motor drive for NAL/NALF/VR on Kmechanism

Mount the standard motor drive for NAL/NALF/ VR/F on the shaft and tighten mounting screws with 25 [Nm] torque. See Fig. 99, 100.



### 17.4 UEMC 41

The UEMC 41 - motor operating devices are intended for indoor mounting on medium voltage disconnectors and earthing switches. The operating device is reliable in changing temperature and humidity conditions. Operation can be performed both electrically and manually by operating lever. Operating time is from 4 to 10 s depending on the type of device and loading conditions.

There are three versions of UEMC 41 drives:



101 UEMC 41 drive with internal control box



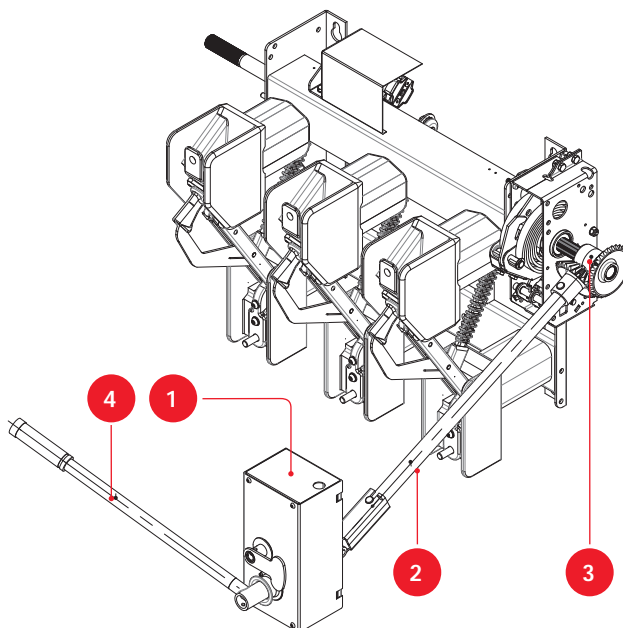
102 UEMC 41 drive with external control box



103 UEMC 41 drive with control components

For detailed instruction of installation and maintenance please refer UEMC 41 manual.

- 1 UEMC 41 drive
- 2 Connecting rod\*
- 3 Bevel gear
- 4 Manual operating handle
- \*) Length depends on client needs



104 Typical UEMC 41 installation with NAL switch-disconnector

# 18.0 Service and maintenance



## – WARNING!

The use of any type of alcohol-based cleaners is strictly forbidden. This results in weakening of the mechanical properties of tension rods and can cause cracking of them. For more info – see last pages!

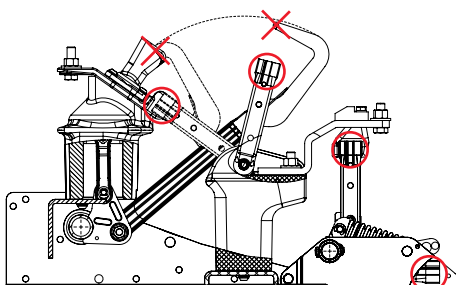
### 18.1 Cleaning

After maintenance the switch-disconnector must be cleaned before being put into service. Strong solvents and alcoholic fluids must not be used. For cleaning, water with soap can only be used. After cleaning, the contact area of the main blades and the fixed contacts must be greased, type ISOFLEX TOPAS NCA 52. If the switch-disconnector is placed in a very humid and polluted area, which will reduce the tracking resistance, it is recommended to polish the insulators and insulated components with Silicon Type DC200 Fluid 100 cst.



## – WARNING!

For any reasons nozzle or arcing knife mustn't be lubricated (see below picture where needed lubrication is indicated by circle).



### 18.2 Switch-disconnector in service

The switch-disconnector's real maintenance interval depends on both environmental conditions and on number and characteristic of on/off operations. The proceeding specified maintenance schemes refer to normal indoor operating conditions only.

All installation work with full respect to requirements of proper installation of switch-disconnector in substation/panel and cable/busbar connection to switch-disconnector terminals, station design, location selection, ground preparation and maintenance, must be performed in a professional way to keep the installation in good condition throughout its lifetime.

When special operating conditions occur the service intervals and service scope should be adjusted individually preventing the switch to be stressed over its performance limits. The switch-disconnectors with design class suitable for special operating conditions (like NAL -H) should be used.

After a possible short-circuit, overall quality checks (mechanical and electrical) is requested. The replacement of damaged parts or complete replacement should be done in line with the NAL conditions observed. Special attention needs to be focused on the main contacts. The quality of the silver coated contacts shall be such that a continuous layer of coating material remains on the contact area. Otherwise affected components need to be replaced for new ones. If fuses were applied to the switch they must be replaced. The proper coordination with the NALF switch-fuse combination requires fuse selection from Reference list of fuses (see 24.0) according to ABB instruction.

### 18.3 Mechanical overhaul

For presently manufactured NAL switches if below specified service conditions are met, maintenance can be extended up to 15-years intervals:

1. Apparatus must be transported and stored in a genuine box.
2. Service conditions – installation:
  - a) apparatus must work in indoor application under normal service conditions – according to IEC 62271-1: 2017-07 – p. 2.1,
  - b) apparatus must be installed by qualified staff according to manufacturer's recommendation,
  - c) maximum values and numbers of the making and breaking capacity as well as 1000 mechanical operations must not be exceeded,
  - d) safe distances to earthed parts or to other live parts or to other parts that may become conductive in operating conditions must be kept,
  - e) in special cases (e.g.: fault in the circuit where the NAL/VR is installed or the apparatus has been overloaded) apparatus should be inspected,
  - f) apparatus must not be installed vertically with the hollow insulators at the bottom which may cause water condensation in hollow insulators and arc extinguishing system,

Mechanical overhaul of the switch-disconnector should be carried out after max. 1000 operations or 15 years in service, (preferably by ABB's staff).

### 18.4 Electrical overhaul in service

The frequency of overhaul depends also on the number of operations and the magnitude of the breaking current. After 100 operations at rated current the main contacts, the arcing contacts and the arc extinguishing chamber should be inspected and replaced if one of below conditions took place

- the tip of the arcing contact knives has diminished approx. 3 mm (minor damage might only require polishing of the arcing tip),
- the fixed arcing fingers are burned or do not make any contact,
- the width of the slot in the arcing chamber is more than 8 mm.

If the copper is visible on any current bus part, then this part should be replaced by new one.



#### – CAUTION!

Eccentric bolt always must be perfectly fitted inside the extruded socket on shaft arm – it is not allowed to screw eccentric bolt in middle position between teeth of extruded socket. It is recommended to rotate the eccentric bolt no more than one "teeth" at one regulation operation.

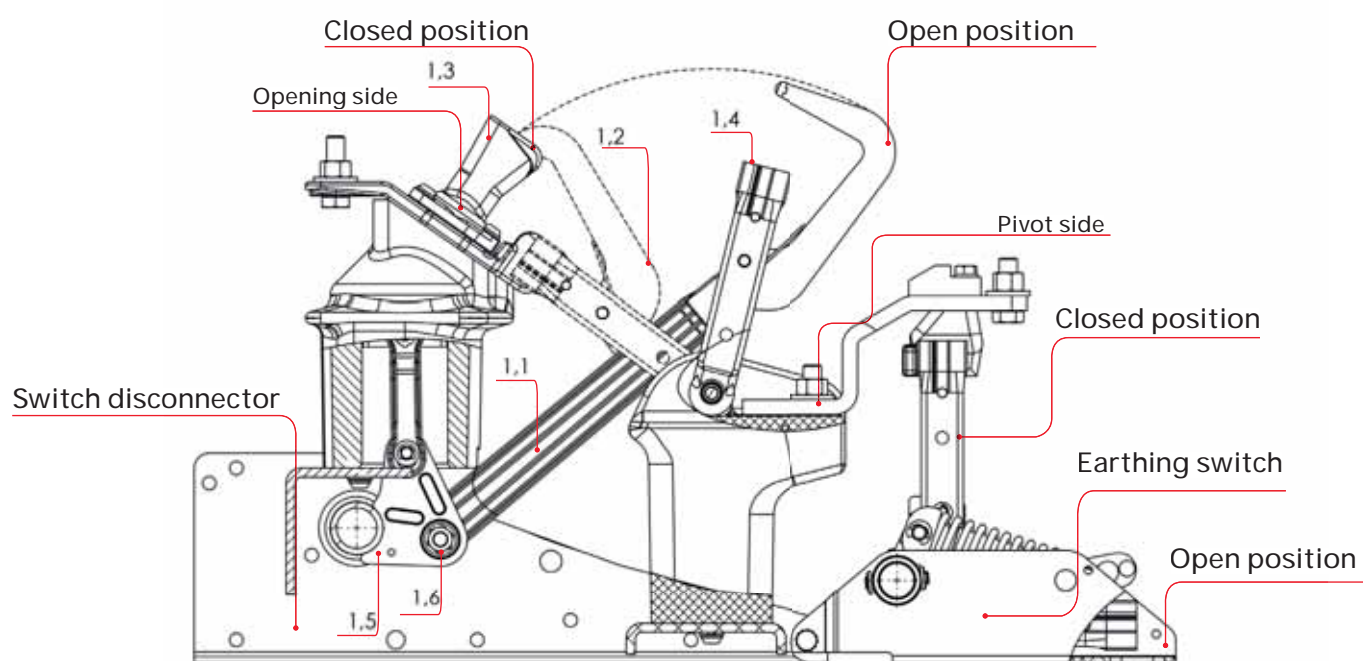


#### – CAUTION!

During switch-disconnector exploitation, position of main contact may change (parts wear) but it cannot be simultaneously outside the operational specification - maximum range of main contact position is shown on Fig. 68b. All four contact points on the main contacts must be in touch with the fixed contacts.

**18.5 Control of NAL/VR knives after mounting.  
Fig. 105-108**

Due to possible differences in the flatness of the wall and support frame, it is necessary to check the position of the main knives on the fixed contact.



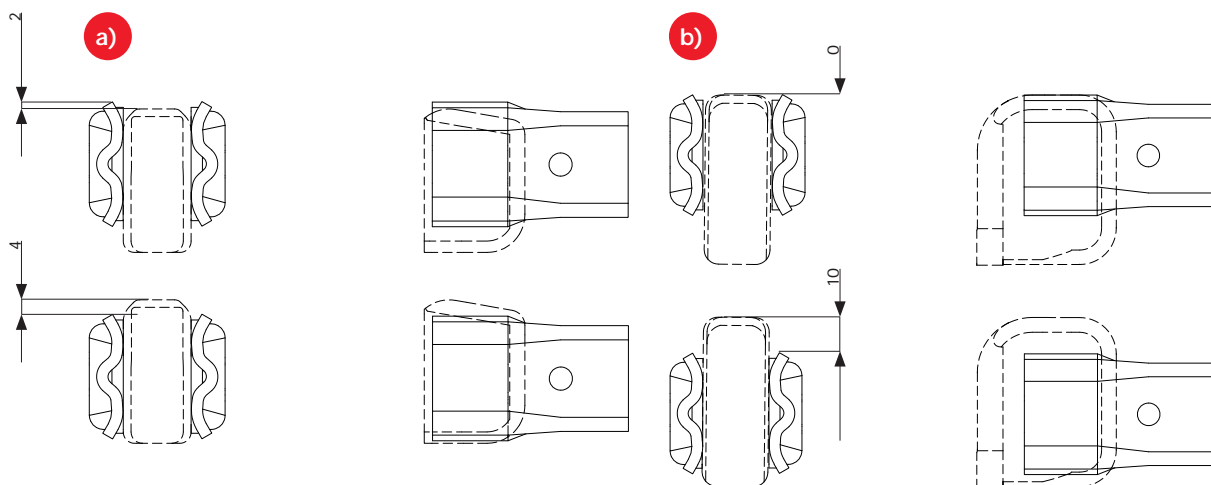
105 Open and close position of switch-disconnector with earthing switch



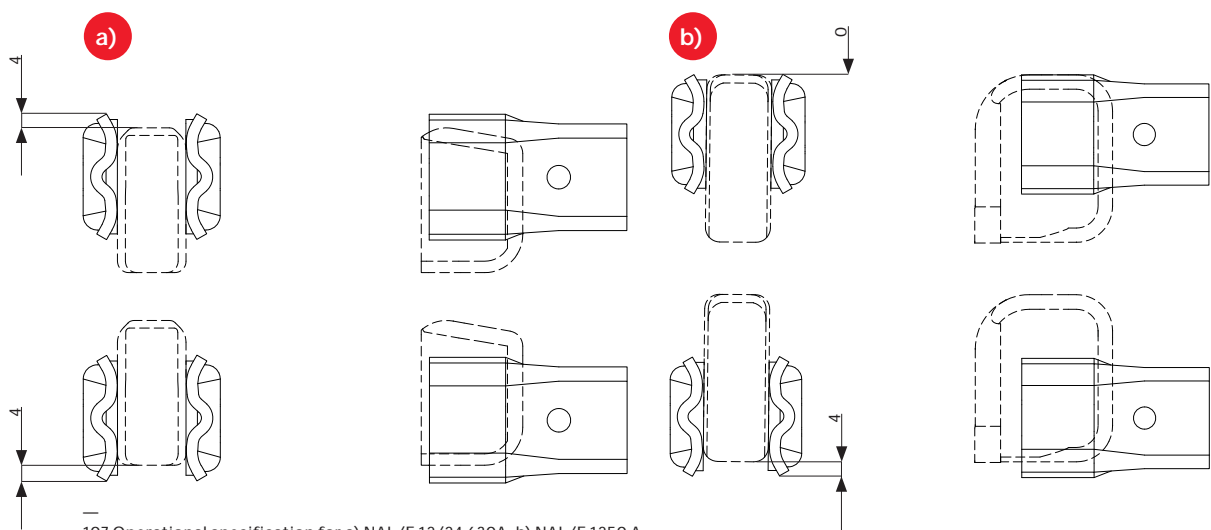
– **WARNING!**

In case of A mechanism pay extreme caution during adjusting the position of the main contacts because this kind of mechanism can unexpectedly open the switch-disconnector.

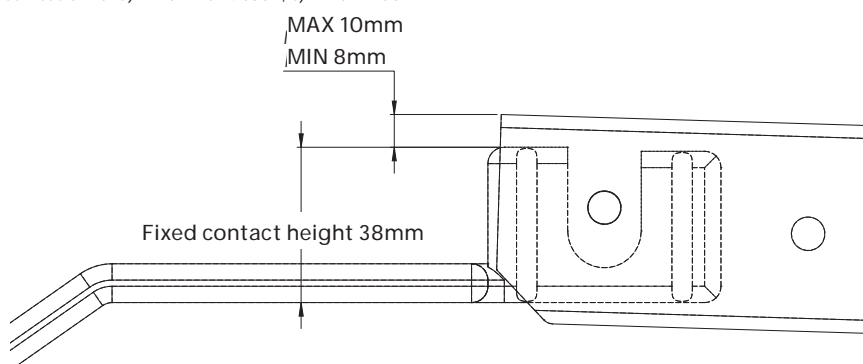
1. Switch with A-mechanism. On delivery the draw bars (1.1) are detached,
  - a) test by hand that each arcing knife (1.2) moves freely in the arc chamber (1.3),
  - b) pull the main contacts by hand (1.4) to open position, see Fig.105. Attach the draw bars to the main shaft (1.5) by the eccentric bolt (1.6), and secure with washer and circlip.
2. Switch with K-mechanism. On delivery the draw bars are connected.
3. Before operating the switch, check that the surfaces of the main contacts are covered by contact grease in the contact area. The grease type Isoflex Topas NCA 52 must be used if additional grease is required.
4. Operate the switch five times.
5. Check the main contact position at closed switch- disconnector.
6. After all adjustments this position must be in accordance with adjusting specification shown on Fig. 106- in case of fixed contact with a height of approximately 38 mm, main contact in closed position should be between two extreme positions: 2 mm above and 4 mm below the fixed contact. In case of fixed contact with a height of approximately 46 mm, main contact in closed position should not be below the fixed contact more than 10 mm while not extending below the lower edge of the fixed contact. If this position is different then it must be adjusted by the eccentric bolt (see Fig.110). To do this, change positions of eccentric bolts placed on the shaft arms (unscrew the M10 nut by wrench first to make possible rotation of eccentric bolt, rotate the eccentric bolt by second flat wrench, then tighten the nut with 32 [Nm] +/-10% torque) to achieve proper position of main knives.



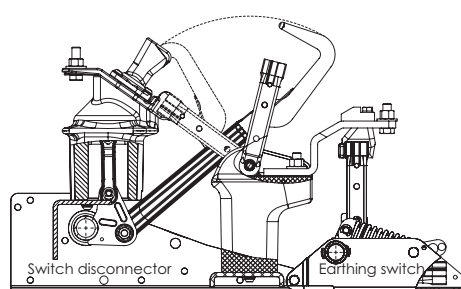
106 Adjusting specification for a) NAL/F 12/24 630A, b) NAL/F 1250 A



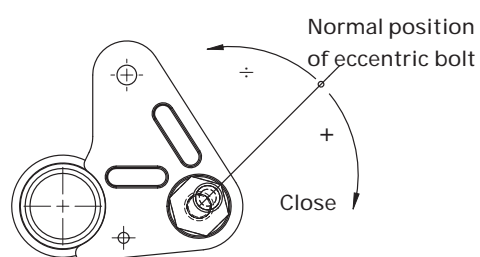
107 Operational specification for a) NAL/F 12/24 630A, b) NAL/F 1250 A



108 Adjusting specification for VR 61 kA



109 Control of NAL/VR knives after mounting



110 Illustrative drawing of eccentric bolt adjustment.

## 19.0 Replacement of parts (12-24 kV)



– **WARNING!**

These operations shall be carried out by specialists only!

The switch-disconnector type NAL/VR is equipped with DMC (BMC) (glassfibre-reinforced polyester) or epoxy insulators. In case of DMC (BMC) insulators all mounting is realized by self-tapping screws. The epoxy insulators are fixed by metric screws. DMC (BMC) insulator's replacement procedure: if the same insulator and screws are to be used after exchange of parts, the following procedure must be followed:

- unscrew the self-tapping screws carefully,
- brush them clean,
- blow out the small particles in the threaded hole (use eye protection).

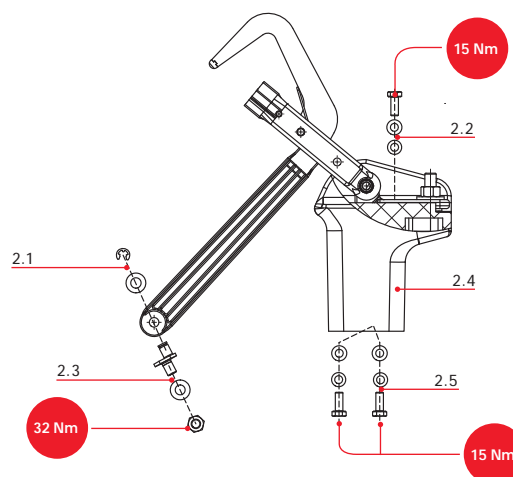
When mounting, the screws must be inserted carefully into the threads in the insulator and tightened with care. correct torque, see Fig. 114. If using a new insulator, the holes should be threaded to about 10 mm deep by the self-tapping screw before mounting. Remove the screw and blow the holes clean.

The mounting takes place according to the following procedures.

Epoxy insulator's replacement procedure:

The epoxy insulators can be unscrewed and screwed again several times. The screws should be tightened with special glue for thread, eg LOCTITE 243. Please follow glue manufacturer instruction for application.





111 Support insulator with knife complete

### 19.1 Replacement of contact knife with draw bar Fig.111.



#### — WARNING!

These operations shall be carried out by authorised ABB service only!

Switch-disconnector in open position with both the operating springs uncharged:

1. Remove the circlips 2.1 attaching the draw bar to the main shaft (eccentric bolt not to be loosened).
2. Unscrew the screw(s) 2.2 attaching the main contact to the insulator. Remove the fixed contact with the contact knife and draw bar (1 pc screw on 12 kV and 2 pcs screws on 24 kV).
3. Attach the new main contact with the contact knife and draw bar to the insulator.
4. Grease the new contact knife with ISOFLEX TOPAS NCA 52 and check carefully that it enters the fixed main contact correctly, and also that the arcing knife moves freely in the arcing chamber when closing and opening (the arcing knife does not have the same position related to the contact knife during the closing and opening movement). The contact knife must rotate firmly at the pivot point, but without jerking.
5. Attach the draw bar to the main shaft by the eccentric bolt 2.3 and secure with washer and circlips 2.1.
6. The depth of the engagement between the fixed and the moving contact can be adjusted by the eccentric bolt 2.3 or by moving the insulator 2.4

### 19.2 Pivot side support insulator. Fig. 111



#### — WARNING!

These operations shall be carried out by authorised ABB service only!

Detach the main contact with contact knives according to item 46.0 point 2.

1. Unscrew 2.5 and detach the insulator,
2. Attach the new insulator to the frame by the two self-tapping screws in case of DMC (BMC) insulators or standard metric screws in case of epoxy insulators (2.5).

For correct torque see Fig. 111.

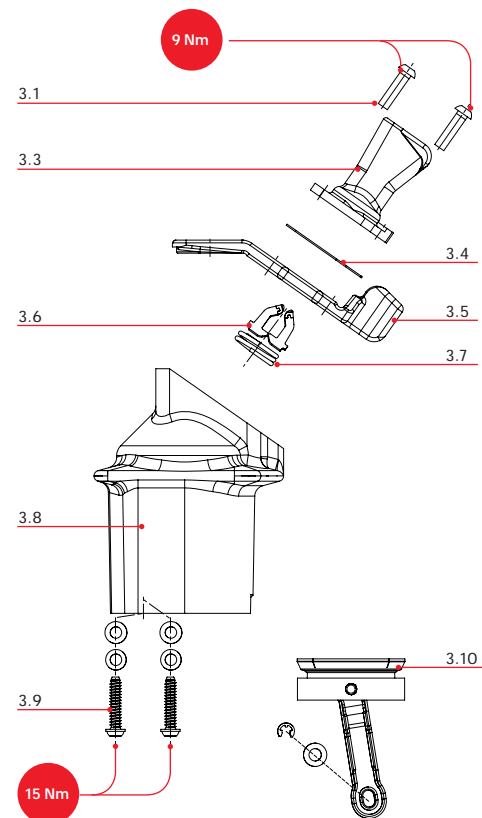
Note the washer and spring washer for the screws.

Attach the main contact with the contact knife to the top of the insulator and adjust according to item "Replacement of contact knife with draw bar".



#### — CAUTION!

In case of complete contact (with current knife) mounted to the support insulator with inserts, screw shall be tightened to 15 Nm torque (Fig. 111), additionally lubricate using glue eg LOCTITE 243.



112 Hollow insulator complete

### 19.3 Replacement of fixed contact on the opening side Fig. 112



#### – WARNING!

These operations shall be carried out by authorised ABB service only!

Switch-disconnector in open position:

1. Unscrew the two screws 3.1 and lift up the arcing chamber and the thermal disc 3.4 (for 630 A) while pressing the main contact 3.5 firmly against the hollow insulator 3.8.
2. Lift up the main contact 3.5 by the arcing contacts 3.6 which penetrate the main contact. Remove the pressure spring 3.7 and clean the top of the insulator and the hole, and blow out the threaded holes (use eye protection).
3. Attach the new main contact in reverse order as described above. In case of NAL 12 epoxy insulators put silicone rubber bumper 3.11 between main contact and insulator as it is indicated in the drawing.
4. Damaged parts must be replaced:
  - take care that the arcing contacts 3.6 are correctly placed in the pressure spring 3.7,
  - by mounting the thermal disc 3.4 and the arcing chamber 3.3, the main contact 3.5 must be pressed firmly against the hollow insulator 3.8. Attach the whole assembly by the screws 3.1. For correct torque see Fig. 112.

- Check correct position of the arcing contact and test correct function. Grease the contact area with ISOFLEX TOPAS NCA 52.

### 19.4 Replacement of the arcing chamber. Fig. 112

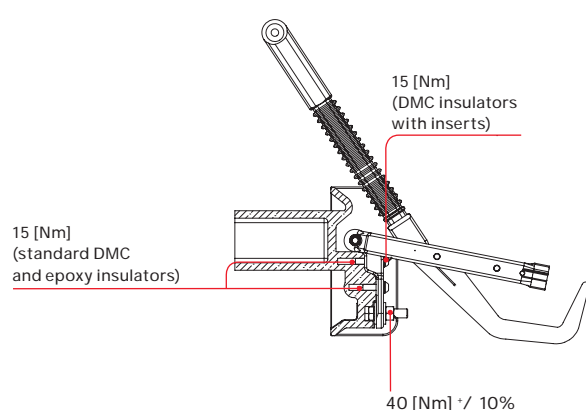
Follow instructions under item „Replacement of fixed contact on the opening side“.



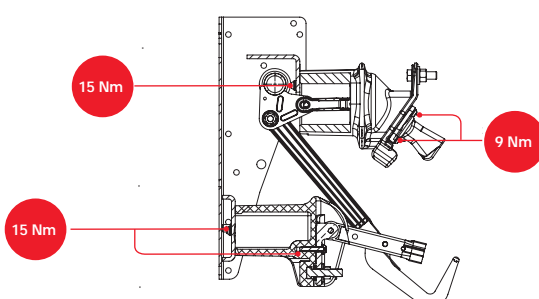
#### – WARNING!

These operations shall be carried out by specialists only!

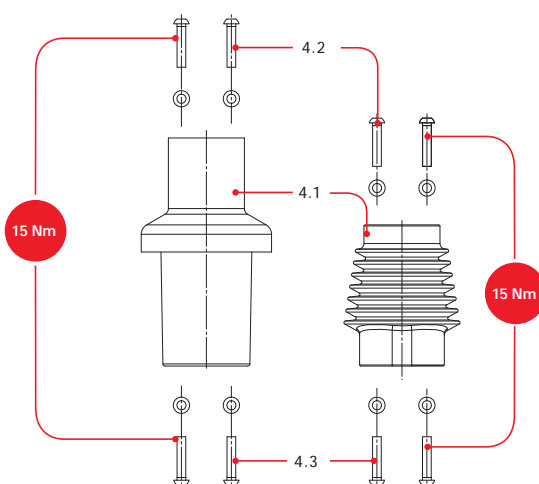
## 20.0 Replacement of insulators



113 Tightening torque for screws NAL/VR 12/17,5/24



114 Tightening torque for screws NAL/VR 12/17,5/24



115 Support insulators

### 20.1 Hollow insulators with arcing chamber. Fig. 113



#### WARNING!

These operations shall be carried out by authorised ABB service only!

1. Unscrew 3.9 and detach the insulator.
2. Attach the new insulator to the frame by the two self-tapping screws in case of DMC (BMC) insulators or standard metric screws in case of epoxy insulators. Remember to mount the piston with piston rod 3.10. For correct torque see Fig. 114. Note the washer and spring washer for the screws.

### 20.2 Insulator for fuse-base and quick make earthing switch

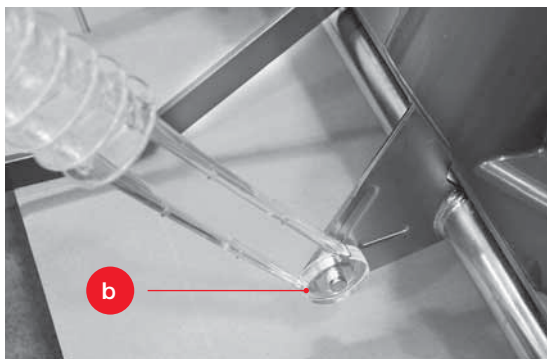


#### WARNING!

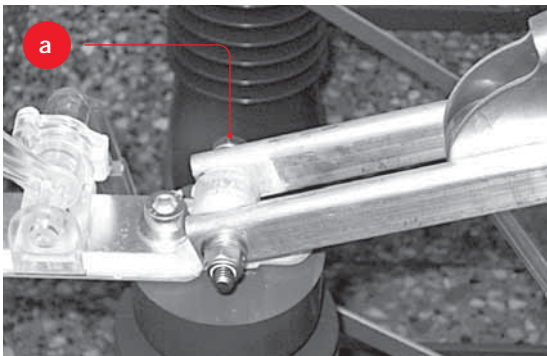
These operations shall be carried out by authorised ABB service only!

1. Unscrew 4.2 and detach the fuse clips and contact block respectively.
2. Unscrew 4.3 at the base of the insulator and detach the insulator.
3. Attach the new insulator to the frame by the two self-tapping screws in case of DMC (BMC) insulators or standard metric screws in case of epoxy insulators 4.3. For correct torque see Fig. 115. Note the washer and spring washer for the screws.
4. Attach the fuse clips and contact block respectively to the top of the insulator by the screws 4.2. For correct torque see Fig. 115

## 21.0 Replacement of parts in NAL/VR 36 kV



116 Detached draw bar



117 Detached contact screw

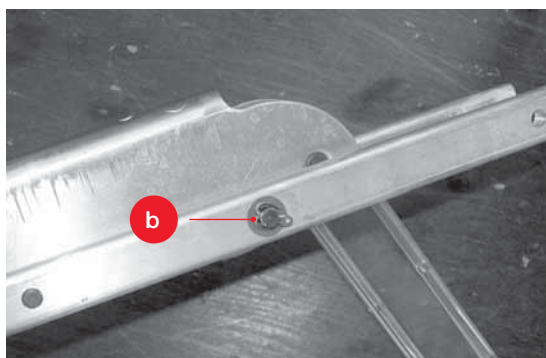
### 21.1 Replacement of contact knives



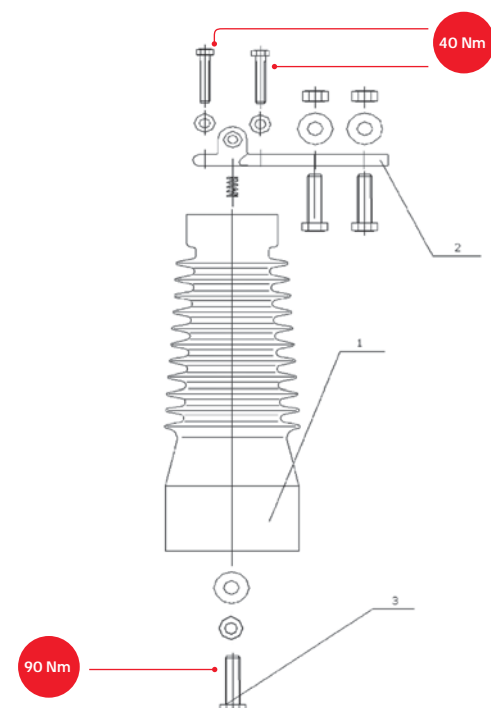
#### — WARNING!

These operations shall be carried out by authorised ABB service only!

1. Disconnect the switch-disconnector. When A-mechanism is fitted, the opening spring must NOT be charged.
2. The draw bar is detached from the crank arm of the operating shaft, see Fig. 116.
3. The contact screw is detached and the contact knives are removed, see Fig. 117.
4. Replacement contact knives are lubricated with ISOFLEX TOPAS NCA 52 and mounted to the contact block with the contact screw.
5. Check that the contact knives can move easily and operate correctly over the opposite contacts.
6. Before the drawbar is connected to the crank arm of the operating shaft, see Fig. 116 ensure that the auxiliary knives run easily in the individual arc extinguishing chambers, and that the main knives make proper contact.
7. Put contact grease on the main contacts before the first test operation. The contact position is adjusted by the eccentric bolt on the operating shaft. It can also be adjusted by adjusting the support insulator.



118 Contact knife



119 Replacement of the supporting insulator

## 21.2 Replacement of draw bar. Fig. 117



### WARNING!

These operations shall be carried out by authorised ABB service only!

1. Disconnect the switch-disconnector.
2. Pull out the bolt b.
3. Pull down the auxiliary knife such that the drawbar bolt (a) can be pushed out and upper hold for the drawbar is free.
4. The lower mounting for the drawbar is freed by removing circlips on eccentric bolt, see Fig.118.
5. New drawbar to be fitted in sequence a-b, see Fig.117.

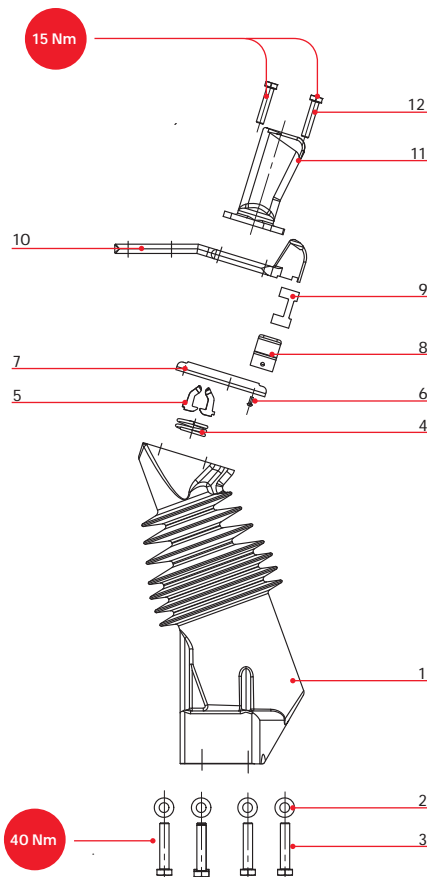
## 21.3 Replacement of the supporting insulator. Fig. 119



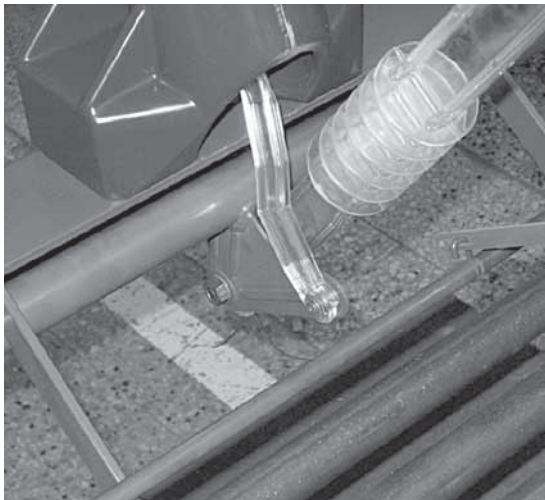
### WARNING!

These operations shall be carried out by authorised ABB service only!

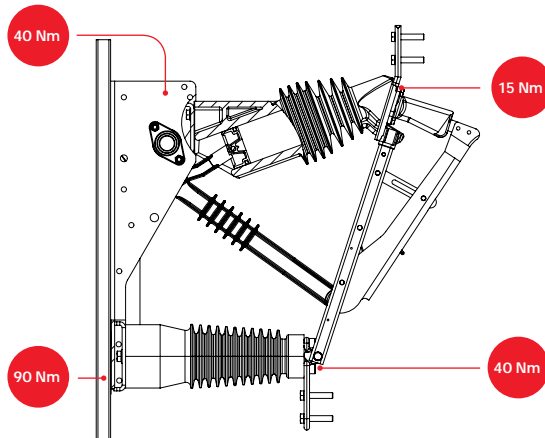
1. Disconnect the switch-disconnector.
2. Contact block with contact knives is dismantled (use spanner-gap 17).
3. The insulators are attached to the switch frame by a screw M12 (spanner-gap 19). The insulator is dismantled and a new insulator is mounted to the switch frame.
4. Contact block with contact knives is mounted to the insulator and adjusted as described in paragraph "Hollow insulator with arcing chamber".



120 Replacement of the hollow insulator.



121 Replacement of the piston with piston rod.



122 Tightening torque for screws NAL/VR 36-40,5

**WARNING!**

These operations shall be carried out by authorised ABB service only!

**21.4 Replacement of the hollow insulator. Fig. 120**

1. Disconnect the switch-disconnector.
2. The spring mechanism is removed from the frame.
3. All draw bars are detached from the crank arm of the operating shaft, see Fig.116.
4. Turn the operating shaft to one side.
5. Disconnect the piston rod from the operating shaft and piston can be taken out.
6. Undo the mounting screws on insulator.
7. The hollow insulator is attached to the frame by 4 screws M10 (spanner-gap 17). New insulator is mounted. If contact blocks and arc extinguishing chambers are to be used again, these must be mounted to the insulator BEFORE the insulator is fitted to the switch frame.
8. Add spring mechanism and connect all draw bars to the crank arms as described in paragraph "Hollow insulator with arcing chamber".
9. The position of the insulator is checked and adjusted as described in paragraph "Hollow insulator with arcing chamber".

**Note:** A certain degree of adjustment can be made by moving the hollow insulator.

**21.5 Replacement of the piston with piston rod. Fig. 121****WARNING!**

These operations shall be carried out by authorised ABB service only!

1. Remove spring mechanism before starting (if A mechanism is installed).
2. Close the switch-disconnector.
3. Disconnect the lower part of draw bar from the main shaft.
4. Disconnect the piston rod from the operating shaft and piston can be taken out.
5. New piston is installed the reverse way.
6. Connect the drawbar to the eccentric bolt on the main shaft.

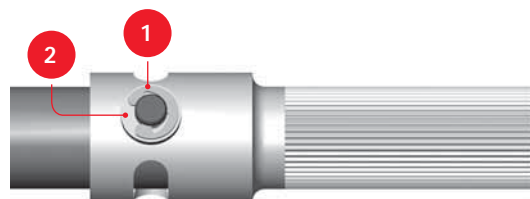
**Note:** Piston and cylinder MUST NOT be greased or lubricated.

## 22.0 Adjustment of splined shaft end for earthing switch. Fig. 123- 127.

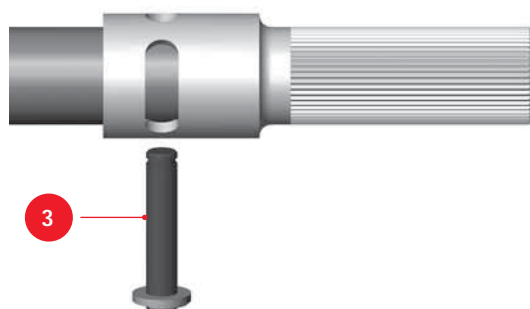


### CAUTION!

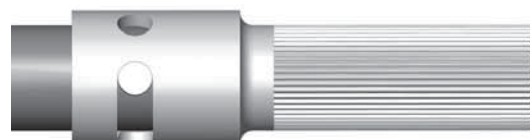
In case of changing the operating side of earthing switch (and mechanical interlocking), splined shaft end location should be updated accordingly.



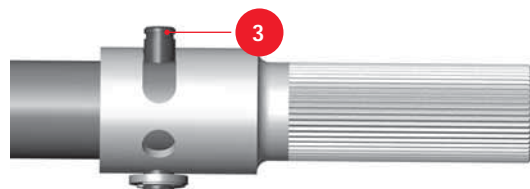
123 Remove the retaining ring [1] and washer [2]



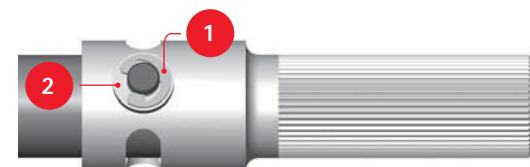
124 Remove the pin [3] from the hole



125 Turn the splined shaft to the position shown in the picture below



126 Insert pin [3] in the shaft hole



127 Put on washer [2] and safety ring [1]



## 23.0 Liabilities

The liability of ABB with respect to any and all claims arising out of the performance or non-performance of obligations connected with all NAL, NAL-H, NALF, NALF-H, VR design configurations shall not exceed in the aggregate the base delivered equipment price and shall in no event include damages for loss of profit, loss of revenues, loss of use, loss of production, costs of capital, costs of substitute equipment, facilities or services, downtime costs, delays and claims of customers of purchaser or costs connected with interruption of operation, loss of anticipated savings or for any special indirect or consequential damage or loss of any nature whatsoever. This limitation of liability provisions mentioned above shall prevail over any conflicting or inconsistent provisions contained in any of the documents connected with all NAL, NAL-H, NALF, NALF-H, VR design configurations, except to the extent such conflicting or inconsistent provisions further restrict the Supplier's liability. Final product performance needs to be tested in final application.

## 24.0 Reference list of fuses

The reference list of fuse -links for NALF/VR switch-fuse combinations according to IEC 62271-105: 2012-09  
ABB CEF/CEF-VT fuse-link selection for transformer protection with load 100% and 120%

Rated system voltage [kV]	Transformer				Fuse-link					Switch-fuse combination dedicated type
	Rated power $S_R$ [kVA]	Relative impedance voltage $u_k$ [%]	Rated current $I_R$ [A] 100%	Rated current $I_R$ [A] 120 %	Type	Rated voltage $U_R$ [kV]	Rated normal current $I_n$ [A]	Length e [mm]	Catalogue number	
6 - 7.2	50	4	4.8	6.1	CEF	3/7.2	10	192 292	1YMB710716M1512 1YMB710716M2512	NALF 12, NALF-H 12, NALFO-H 12
	75	4	7.2	9.1	CEF	3/7.2	16	192 292	1YMB710718M1512 1YMB710718M2512	
	100	4	9.6	12.1	CEF	3/7.2	20	192 292	1YMB710719M1512 1YMB710719M2512	
	125	4	12.0	15.2	CEF	3/7.2	20	192 292	1YMB710719M1512 1YMB710719M2512	
	160	4	15.4	19.4	CEF	3/7.2	25	192 292	1YMB710721M1512 1YMB710721M2512	
	200	4	19.2	24.9	CEF	3/7.2	31.5	192 292	1YMB710724M1512 1YMB710724M2512	
	250	4	24.1	30.3	CEF	3/7.2	40	192 292	1YMB710725M1512 1YMB710725M2512	
	315	4	30.3	38.2	CEF	3/7.2	50	192 292	1YMB710727M1512 1YMB710727M2512	
	400	4	38.5	48.5	CEF	3/7.2	50	192 292	1YMB710727M1512 1YMB710727M2512	
	500	4	48.1	60.6	CEF	3/7.2	63	192 292	1YMB710729M1612 1YMB710729M2612	
	630	4	60.6	76.4	CEF	3/7.2	100	192 292	1YMB710733M1612 1YMB710733M2612	
	800	5	77.0	97.0	CEF	3/7.2	100	192 292	1YMB710733M1612 1YMB710733M2612	
	1000	5	96.2	121.2	CEF	3/7.2	125	192 <sup>2)</sup> 292	1YMB710735M1812 <sup>2)</sup> 1YMB710735M2812	
10 - 12	50	4	2.9	3.6	CEF	6/12	10	292 442	1YMB711216M2512 1YMB711216M4512	NALF 12, NALF-H 12, NALFO-H 12
	75	4	4.3	5.5	CEF	6/12	10	292 442	1YMB711216M2512 1YMB711216M4512	
	100	4	5.8	7.3	CEF	6/12	16	292 442	1YMB711218M2512 1YMB711218M4512	
	125	4	7.2	9.1	CEF	6/12	16	292 442	1YMB711218M2512 1YMB711218M4512	
	160	4	9.2	11.6	CEF	6/12	20	292 442	1YMB711219M2512 1YMB711219M4512	
	200	4	11.5	14.5	CEF	6/12	20	292 442	1YMB711219M2512 1YMB711219M4512	
	250	4	14.4	18.2	CEF	6/12	25	292 442	1YMB711221M2512 1YMB711221M4512	
	315	4	18.2	22.9	CEF	6/12	31.5	292 442	1YMB711224M2512 1YMB711224M4512	
	400	4	23.1	29.1	CEF	6/12	31.5	292 442	1YMB711224M2512 1YMB711224M4512	
	500	4	28.9	36.4	CEF	6/12	50	292 442	1YMB711227M2612 1YMB711227M4612	
	630	4	36.4	45.8	CEF	6/12	50	292 442	1YMB711227M2612 1YMB711227M4612	
	800	5	46.2	58.2	CEF	6/12	63	292 442	1YMB711229M2612 1YMB711229M4612	
	1000	5	57.7	72.7	CEF	6/12	80	292 442	1YMB711231M2612 1YMB711231M4612	
	1250	5	72.2	90.9	CEF	6/12	100	292 442	1YMB711233M2612 1YMB711233M4612	
	1600	6	92.4	116.4	CEF	6/12	125	292 442	1YMB711235M2812 <sup>2)</sup> 1YMB711235M4612	

<sup>1)</sup> Fuse link is not able to clear independently transformer secondary side terminals short circuit current

<sup>2)</sup> Available for 100% load only

Rated system voltage [kV]	Transformer				Fuse-link					Switch-fuse combination dedicated type
	Rated power $S_R$ [kVA]	Relative impedance voltage $u_k$ [%]	Rated current $I_R$ [A] 100%	Rated current $I_R$ [A] 120 %	Type	Rated voltage $U_R$ [kV]	Rated normal current $I_R$ [A]	Length $e$ [mm]	Catalogue number	
15 - 17.5	50	4	1.9	2.4	CEF	10/17.5	6.3	292 367 442	1YMB711713M2512 1YMB711713M3512 1YMB711713M4512	NALF 17, NALF-H 17
	75	4	2.9	3.6	CEF	10/17.5	10	292 367 442	1YMB711716M2512 1YMB711716M3512 1YMB711716M4512	
	100	4	3.8	4.8	CEF	10/17.5	10	292 367 442	1YMB711716M2512 1YMB711716M3512 1YMB711716M4512	
	125	4	4.8	6.1	CEF	10/17.5	10	292 367 442	1YMB711716M2512 1YMB711716M3512 1YMB711716M4512	
	160	4	6.2	7.8	CEF	10/17.5	16	292 367 442	1YMB711718M2512 1YMB711718M3512 1YMB711718M4512	
	200	4	7.7	9.7	CEF	10/17.5	16	292 367 442	1YMB711718M2512 1YMB711718M3512 1YMB711718M4512	
	250	4	9.6	12.1	CEF	10/17.5	20	292 367 442	1YMB711719M2512 1YMB711719M3512 1YMB711719M4512	
	315	4	12.1	15.3	CEF	10/17.5	20	292 367 442	1YMB711719M2512 1YMB711719M3512 1YMB711719M4512	
	400	4	15.4	19.4	CEF	10/17.5	25	292 367 442	1YMB711721M2512 1YMB711721M3512 1YMB711721M4512	
	500	4	19.2	24.2	CEF	10/17.5	31.5	292 367 442	1YMB711724M2612 1YMB711724M3512 1YMB711724M4512	
	630	4	24.2	30.6	CEF	10/17.5	40	292 367 442	1YMB711725M2612 1YMB711725M3512 1YMB711725M4512	
	800	5	30.8	38.8	CEF	10/17.5	40	292 367 442	1YMB711725M2612 1YMB711725M3512 1YMB711725M4512	
	1000	5	38.5	48.5	CEF	10/17.5	50	292 <sup>2)</sup> 367 442	1YMB711727M2812 <sup>2)</sup> 1YMB711727M3612 1YMB711727M4612	
	1250	5	48.1	60.6	CEF	10/17.5	63	292 <sup>2)</sup> 367 442	1YMB711729M2812 <sup>2)</sup> 1YMB711729M3612 1YMB711729M4612	
	1600	6	61.6	77.6	CEF	10/17.5	80	292 <sup>2)</sup> 367 442	1YMB711731M2812 <sup>2)</sup> 1YMB711731M3612 1YMB711731M4612	
	2000	6	77.0	97.0	CEF	10/17.5	100	292 <sup>2)</sup> 367 442	1YMB711733M2812 <sup>2)</sup> 1YMB711733M3812 1YMB711733M4612	

<sup>1)</sup> Fuse link is not able to clear independently transformer secondary side terminals short circuit current

<sup>2)</sup> Available for 100% load only

Rated system voltage [kV]	Transformer					Fuse-link				Switch-fuse combination dedicated type
	Rated power $S_R$ [kVA]	Relative impedance voltage uk [%]	Rated current $I_R$ [A] 100%	Rated current $I_R$ [A] 120 %	Type	Rated voltage $U_R$ [kV]	Rated normal current $I_R$ [A]	Length e [mm]	Catalogue number	
20 - 24	50 <sup>1)</sup>	4	1.4	1.8	CEF-VT	10/24	4	442	1YMB752411M4512	NALF 24; NALFO 24; NALF-H 24; NALFO-H 24
	75	4	2.2	2.7	CEF	10/24	6.3	442 537	1YMB712413M5512 1YMB712413M5512	
	100	4	2.9	3.6	CEF	10/24	10	442 537	1YMB712416M5512 1YMB712416M5512	
	125	4	3.6	4.5	CEF	10/24	10	442 537	1YMB712416M5512 1YMB712416M5512	
	160	4	4.6	5.8	CEF	10/24	10	442 537	1YMB712416M5512 1YMB712416M5512	
	200	4	5.8	7.3	CEF	10/24	16	442 537	1YMB712418M5512 1YMB712418M5512	
	250	4	7.2	9.1	CEF	10/24	16	442 537	1YMB712418M5512 1YMB712418M5512	
	315	4	9.1	11.5	CEF	10/24	20	442 537	1YMB712419M5512 1YMB712419M5512	
	400	4	11.5	14.5	CEF	10/24	20	442 537	1YMB712419M5512 1YMB712419M5512	
	500	4	14.4	18.2	CEF	10/24	25	442 537	1YMB712421M5512 1YMB712421M5512	
	630	4	18.2	22.9	CEF	10/24	31.5	442 537	1YMB712424M5512 1YMB712424M5512	
	800	5	23.1	29.1	CEF	10/24	31.5	442 537	1YMB712424M5512 1YMB712424M5512	
	1000	5	28.9	36.4	CEF	10/24	40	442 537	1YMB712425M5512 1YMB712425M5512	
	1250	5	36.1	45.5	CEF	10/24	50	442 537	1YMB712427M5612 1YMB712427M5612	
	1600	6	46.2	58.2	CEF	10/24	63	442 537	1YMB712429M5612 1YMB712429M5612	
	2000	6	57.7	72.7	CEF	10/24	80	442 537	1YMB712431M5612 1YMB712431M5612	

<sup>1)</sup> Fuse link is not able to clear independently transformer secondary side terminals short circuit current

<sup>2)</sup> Available for 100% load only

The table was calculated according to standards IEC/TR 62655: 2013-05 and IEC 62271-105: 2012-09 with following assumptions:

- Maximum long lasting transformer current overload – 120%
- Magnetizing transformer inrush current – 12 x  $I_R$  during 100ms (up to 800 kVA) or 10 x  $I_R$  during 100ms (800 kVA and above)
- Transformer short-circuit voltage according to IEC 60076-5: 2006-02
- No fuse derating due to small enclosures assumed

For different working conditions fuse selection has to be recalculated

## Reference list for ABB CEF-S fuse-link selection for transformer protection with 100% and 120 % load

Rated system voltage [kV]	Transformer				Fuse-link					Switch-fuse combination dedicated type
	Rated power $S_R$ [kVA]	Relative impedance voltage $u_k$ [%]	Rated current $I_R$ [A] 100%	Rated current $I_R$ [A] 120 %	Type	Rated voltage $U_R$ [kV]	Rated normal current $I_R$ [A]	Length e [mm]	Catalogue number	
10-12	50	4	2.9	3.6	CEF-S	6/12	10	292	1YMB741216M2611	NALF 12; NALF-H 12, NALFO-H 12
	75	4	4.3	5.5	CEF-S	6/12	16	292	1YMB741218M2611	
	100	4	5.8	7.3	CEF-S	6/12	20	292	1YMB741219M2611	
	125	4	7.2	9.1	CEF-S	6/12	20	292	1YMB741219M2611	
	160	4	9.2	11.6	CEF-S	6/12	25	292	1YMB741221M2611	
	200	4	11.5	14.5	CEF-S	6/12	40	292	1YMB741225M2611	
	250	4	14.4	18.2	CEF-S	6/12	40	292	1YMB741225M2611	
	315	4	18.2	22.9	CEF-S	6/12	50	292	1YMB741227M2611	
	400	4	23.1	29.1	CEF-S	6/12	63	292	1YMB741229M2611	
	500	4	28.9	36.4	CEF-S	6/12	63	292	1YMB741229M2611	
20-24	630 <sup>1)</sup>	4	30.3	38.2	CEF-S	6/12	63	292	1YMB741229M2611	NALF 24; NALFO 24, NALF-H 24; NALFO-H 24
	75 <sup>4)</sup>	4	2.2	2.7	CEF-S	10/24	10	442	1YMB742416M4611	
	100	4	2.9	3.6	CEF-S	10/24	10	442	1YMB742416M4611	
	125	4	3.6	4.5	CEF-S	10/24	16	442	1YMB742418M4611	
	160	4	4.6	5.8	CEF-S	10/24	16	442	1YMB742418M4611	
	200	4	5.8	7.3	CEF-S	10/24	20	442	1YMB742419M4611	
	250	4	7.2	9.1	CEF-S	10/24	20	442	1YMB742419M4611	
	315	4	9.1	11.5	CEF-S	10/24	25	442	1YMB742421M4611	
	400	4	11.5	14.5	CEF-S	10/24	40	442	1YMB742425M4611	
	500	4	14.4	18.2	CEF-S	10/24	40	442	1YMB742425M4611	
30-36	630	4	18.2	22.9	CEF-S	10/24	50	442	1YMB742425M4611	NALF 36, NALFO 36
	800	5	23.1	29.1	CEF-S	10/24	50	442	1YMB742425M4611	
	1000 <sup>2)</sup>	5	24.1	30.3	CEF-S	10/24	50	442	1YMB742425M4611	
	25 <sup>4)</sup>	4	0.5	0.6	CEF-S	30/40.5	6.3	537	1YMB744014M5611	
	50 <sup>4)</sup>	4	1.0	1.2	CEF-S	30/40.5	6.3	537	1YMB744014M5611	
	75 <sup>4)</sup>	4	1.4	1.8	CEF-S	30/40.5	6.3	537	1YMB744014M5611	
	100	4	1.9	2.4	CEF-S	30/40.5	6.3	537	1YMB744014M5611	
	125	4	2.4	3.0	CEF-S	30/40.5	6.3	537	1YMB744014M5611	
	160	4	3.1	3.9	CEF-S	30/40.5	10	537	1YMB744016M5611	
	200	4	3.8	4.8	CEF-S	30/40.5	16	537	1YMB744018M5611	
	250	4	4.8	6.1	CEF-S	30/40.5	16	537	1YMB744018M5611	
	315	4	6.1	7.6	CEF-S	30/40.5	20	537	1YMB744019M5611	
	400	4	7.7	9.7	CEF-S	30/40.5	25	537	1YMB744021M5611	
	500 <sup>5)</sup>	5	9.6	10.1	CEF-S	30/40.5	25	537	1YMB744021M5611	

<sup>1)</sup> - rated voltage 12 kV,

<sup>2)</sup> - rated voltage 24 kV,

<sup>3)</sup> - rated voltage 36 kV,

<sup>4)</sup> Fuse link is not able to clear independently transformer secondary side terminals short circuit current

<sup>5)</sup> Solution is valid for rated system voltage 36 kV only.

Recommended fuse rating is on the crossing of transformer rating and line voltage. For different line voltage level, please use closest smaller value from the table. The table was calculated according to standards IEC/TR 62655: 2013-05 and IEC 62271-105: 2012-09 with following assumptions:

- Maximum long lasting transformer current overload – 120%
- Magnetizing transformer inrush current – 12 x  $I_R$  during 100ms (up to 800 kVA) or 10 x  $I_R$  during 100ms (800 kVA and above)
- Transformer short-circuit voltage according to IEC 60076-5: 2006-02
- No fuse derating due to small enclosures assumed

For different working conditions fuse selection has to be recalculated. The CEF-S fuse-links can be selected in reference to § 17 STEV-FS requirement that ensure very good protection and prevents many faults in low voltage switchgears. The selection table according to that is available on request.

Reference list for fuse-link CEF-S/CEF selection for the transformer protection for Swedish market with 100% and 120 % load (§17; fuse with cut off time within 0,1 seconds "Sverigesäkring")

Rated system voltage [kV]	Transformer				Fuse-link					Switch-fuse combination dedicated type
	Rated power $S_R$ [kVA]	Relative impedance voltage $u_k$ [%]	Rated current $I_R$ [A] 100%	Rated current $I_R$ [A] 120 %	Type	Rated voltage $U_R$ [kV]	Rated normal current $I_R$ [A]	Length e [mm]	Catalogue number	
6.6-7.2	50	4	4.4	5.2	CEF	3/7.2	10	192 292	1YMB710716M1512 1YMB710716M2512	NALF 12, NALF-H 12, NALFO-H 12
	100	4	8.8	10.5	CEF	3/7.2	20	192 292	1YMB710719M1512 1YMB710719M2512	
	200	4	17.5	21.0	CEF	3/7.2	31.5	192 292	1YMB710724M1512 1YMB710724M2512	
	315	4	27.6	33.1	CEF	3/7.2	50	192 292	1YMB710727M1512 1YMB710727M2512	
	500	4	43.7	52.5	CEF	3/7.2	63	192 292	1YMB710729M1612 1YMB710729M2612	
	630	4	55.1	66.1	CEF	3/7.2	100	192 292	1YMB710733M1612 1YMB710733M2612	
	800	5	70.0	84.0	CEF	3/7.2	100	192 292	1YMB710733M1612 1YMB710733M2612	
	1000	5	87.5	104.9	CEF	3/7.2	125	192 <sup>1)</sup>	1YMB710735M1812 <sup>1)</sup>	
11-12	50	4	2.6	3.1	CEF	6/12	6.3	292	1YMB711216M2512	NALF 12, NALF-H 12, NALFO-H 12
	100	4	5.2	6.3	CEF-S	6/12	16	292	1YMB741218M2611	
	200	4	10.5	12.6	CEF-S	6/12	20	292	1YMB741219M2611	
	315	4	16.5	19.8	CEF-S	6/12	25	292	1YMB741221M2611	
	500	4	26.2	31.5	CEF-S	6/12	40	292	1YMB741225M2611	
	630	4	33.1	39.7	CEF-S	6/12	50	292	1YMB741227M2611	
	800	5	42.0	50.4	CEF-S	6/12	50	292	1YMB741227M2611	
22-24	1000	5	52.5	63.0	CEF-S	6/12	63	292	1YMB741229M2611	NALF 24; NALFO 24, NALF-H 24; NALFO-H 24
	50	4	1.3	1.6	CEF	10/24	6.3	442	1YMB711713M4512	
	100	4	2.6	3.1	CEF-S	10/24	10	442	1YMB742416M4611	
	200	4	5.2	6.3	CEF-S	10/24	16	442	1YMB742418M4611	
	315	4	8.3	9.9	CEF-S	10/24	16	442	1YMB742418M4611	
	500	4	13.1	15.7	CEF-S	10/24	20	442	1YMB742419M4611	
	630	4	16.5	19.8	CEF-S	10/24	25	442	1YMB742421M4611	
	800	5	21.0	25.2	CEF-S	10/24	25	442	1YMB742421M4611	
	1000	5	26.2	31.5	CEF-S	10/24	40	442	1YMB742425M4611	
	1250	5	32.8	39.4	CEF-S	10/25	50	442	1YMB742427M4611	

<sup>1)</sup> Available for 100% load only

Final product performance needs to be tested in final application.



## 25.0 Environmental declaration

### 25.1 Environmental Certification Life expectancy of product

The product is developed in compliance with the requirements denoted by IEC 62271-200: 2021-05. The design incorporates a life span under indoor service conditions exceeding 25 years (IEC 62271-200: 2021-05).

### 25.2 End-of-life

ABB is committed to the protection of the environment and adheres to ISO 14001:2015 standards. It is our obligation to facilitate end-of-life-recycling for our products.

#### Recycling capability

Weight:

NAL12-6A150 (VR) – 32 kg

NAL17-6A170 (VR) – 34 kg

NAL24-6A235 (VR) – 42 kg

NAL36-6A360 (VR) – 72 kg

Raw Material	% of total weight (weight)	Recycle	Environmental effects & recycle/reuse processes
Steel	60.59%	Yes	Separate, utilize in favor of new source
Copper	11.26%	Yes	Separate, utilize in favor of new source
Zinc	0.025%	Yes	Electrolysis, utilize in favor of new source
Silver	0.012%	Yes	Electrolysis, utilize in favor of new source
Thermoplastic	2.11%	Yes	Make granulate, re-use or apply as energy superior additive in refuse incineration; partial material can be reused in production process
Polyester with glass fiber*	24.64%	Yes	Grind to powder and use as high-grade energy additive in cement mill
Total for recycling	98.64%		
Not specified	1.34%		Powder coating, grease, etc.
Total	100%		Complete apparatus without packaging
Carton box**	6 kg	Yes	Re-use or use as energy additive in refuse incineration
Wooden pallet**	7.5 kg	Yes	Re-use or use as energy additive in refuse incineration
Epoxy***	33%	No	Store in appropriate places, indented for this purpose

\*Used for NAL12, NAL17, NAL24 (VR)

\*\*Packing depends on particular customer requirements, law and the kind of transportation. Example for NAL 24 (VR)

\*\*\*Used for NAL12 (VR) and NAL36 (VR). For NAL 24 total weight of epoxy is 43%.



– **WARNING!**

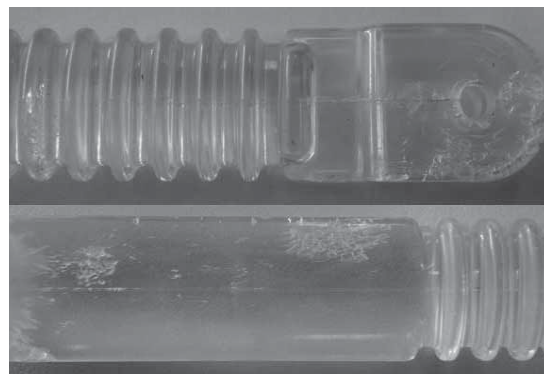
The apparatus can not work or have contact with hazardous chemicals for materials mentioned in table above.

Acetone	Ethylamine, 33%
Acrylonitrile	Ethylene diamine
Allyl alcohol	Ethylene glycol
Ammonium sulfide, 40%	Fluorodichloromethane
Amyl alcohol	Formic acid, concentrated
Aniline	Furfuralcohol
Benzaldehyde	Gasoline (5% methanol)
Benzoic acid	Glacial acetic acid
Bromine, liquid	Hydrazine hydrate, 80%
1,3-butanediol	Hydrochloric acid, concentrated
1,4-butanediol	Isoamyl alcohol
2,3-butanediol	Isopropanol
N-butyl alcohol	Methylene chloride
T-butyl alcohol	Methyl ethyl ketone
Butylene glycol	Nitric acid, 2%
Chloroform	Nitric acid, 10%
Chlorosulfuric acid	Nitric acid, 30%
Crotonaldehyde	Potassium chlorate
Cyclohexane	N-propanol
1,2-dichloroethane	Propylene glycol
1,2-dichloroethylene	Sulfuric acid, concentrated
Difluoromono-chloromethane	Sodium hydroxide solution
Dimethylformamide	5%, 10%, 50%
1,4-dioxane	Tartaric acid
Ethyl alcohol	



– **WARNING!**

All plastic parts of the apparatus can not work or have contact with chemicals mentioned above. Apparatus intended for indoor use. Therefore, all plastic parts are not resistant to solar radiation



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Usage of these chemicals can result in damage or a significant quality deterioration of plastic parts of the apparatus – eg. see picture above.

**Additional information**

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For more information please contact:

**ABB Contact Center**

tel.: +48 22 22 37 777

e-mail: [contact.center@pl.abb.com](mailto:contact.center@pl.abb.com)

**ABB Sp. z o.o.**

**Branch in Przasnysz**

59 Leszno Str.

06-300 Przasnysz, Poland

Phone: +48 22 22 38 900

Fax: +48 22 22 38 953

[www.abb.pl](http://www.abb.pl)

