Indoor Air Switch-disconnector, NAL/NALF/VR
Rated voltage: 12, 17.5, 24 and 36 kV
Rated current: 400/630, 800 and 1250 A

The NAL/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 main switching apparatus for applications in enclosed switchgear and compact transformer stations. In combination with CEF current limiting fuses, they provide reliable control over the full range of overload currents.

Main areas of application NAL/VR switch disconnectors:
– as line and transformer switches within distribution networks,
– as motor switches,
– as capacitor switches.

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 monting 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 recognised globally and more than 600,000 switches have been produced so far. The design is subject to continuous development to meet changing customer needs.

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. This switch-disconnector range meets IEC Publication 60129, 60265, 60694, GOST 1516.3-96, GOST 17717-79, and CSA Standard No. C22.2, No. 193, and IEC 62271-105, regarding switches for general use and for safe switching coordination between switch-disconnectors and a current limiting fuse.
The NAL version for ANSI standard is called VersaRupter. It meets ANSI 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.

Power and productivity for a better world™ ABB
That’s why our instruction manual begins with these recommendations:

– Comply in full with the legally recognized standards (ANSI / IEC), the connection conditions of the local electrical utility and the applicable safety at work regulations.

⚠️ WARNING!

– Pay special attention to the hazard notes in the instruction manual marked with this warning symbol.

– Make sure that under operation condition of the switchgear or switchboard the specified data are not exceeded.

– Keep the instruction 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 shocks and burns whenever working in or around electrical equipment. Turn off power before performing any inspection or maintenance operations. Check line terminals to verify that the equipment is de-energized and grounded. Check terminals to ensure that no back-feed condition exists.

⚠️ WARNING

Always observe the instruction 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.

If you have any further questions on this instruction 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.

According to IEC 62271-1 p. 5.12 and IEC 62271-102 p. 5.104.3.1 position of switch disconnector has to be clearly indicated. NAL switch disconnector allows 100% certainty to determine the position of the main contacts which is a big advantage.

ABB recommends to verify the position of the main knives before and after each operation.

ABB recommends installing switch disconnectors in applications where it is possible to visually check main knives position eg. through inspection window.

Please place attached sticker with drawing close to inspection window. Before any operation please check switch position.
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1.0 Safety instructions

**WARNING**
Careless handling of high voltage can result in serious injury or death. Before carrying out 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.
- Make sure that the apparatus will be installed in proper place.
- All maintenance and installation activities can be performed by specialists with valid licenses only.
- Always follow these instructions closely.
- If you have any questions or doubts, please contact with proper ABB personnel.

2.0 Recommendations for receipt, handling and storage of equipment.

- Check the apparatus condition directly after receipt. Any damages should be reported to the transporter.
- 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 and 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 with using belts fixed to upper frame plate. Do not use chains, because it may cause damage of the apparatus.

3.0 Switch-disconnector type NAL/VR, alternative assemblies

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

3.1 Fully assembled with mechanism and auxiliaries. See item 4.0
3.2 Switch main frame, mechanism and auxiliaries as separate components, see item 6.0 i 7.0

4.0 Installation

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

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

4.1 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 installing switch disconnectors in applications where it is possible to visually check main knives position eg. through inspection window.

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 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 charging) do not turn further the mechanism shaft in the closing direction. It can cause damage of mechanism.

Caution!

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, eg made by ABB.

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**Fig. 1 Switch-disconnector type NAL/VR**
5.0 Adjustment of the hand operating, mechanism type HE

5.1 K-mechanism. Fig. 2

Closing
- If the switch disconnector is equipped with earthing switch, be sure that it is in the open position (Fig. 66).
- Make sure that all doors of the station are closed.
- Remove the padlock securing manual drive of the switch disconnector (if used).
- Apply lever on the knurled shaft of manual drive of the switch disconnector.
- Pull the locking ring S (Fig. 8).
- 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.
- Check whether all poles of the switch disconnector have closed correctly (Fig 66).
- Remove the lever from manual drive and secure it with a pad-lock (if used).

During installation be careful and do not apply too big torque on the insulators.

Caution!
If the apparatus will work under conditions which allow the water deposition or condensation on apparatus parts or on elements (busbars) directly connected to it, the apparatus should not be installed vertically with hollow insulators at the bottom. In addition, the apparatus should be protected against the water dripping or runoff on its insulating parts. This situation may cause a dielectric strength deterioration of apparatus.
Opening

– Make sure that all doors of station are closed.
– Remove the padlock securing manual drive of switch disconnector (if used),
– Apply lever on the knurled shaft of manual drive of the switch disconnector,
– Pull the locking ring S (Fig. 2)
– 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.
– Check whether all poles of the switch disconnector have opened correctly (Fig. 66)
– Remove the lever from the manual drive and secure it with a padlock (if used).
– 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. 66).

5.2 A-mechanism. Fig. 3

Closing

– If the switch-disconnector is equipped with earthing switch, be sure that the earthing switch is in the open position (Fig. 66),
– If the switch disconnector is equipped with a fuse tripping system, make sure that all fuse links have no strikers in out position - in this case (striker is out) the closing of switch disconnector is not possible,
– Make sure that all station doors are closed.
– Remove the padlock securing manual drive of the switch disconnector (if used),
– Apply lever on the knurled shaft of manual drive of switch disconnector,
– Remember that before switch disconnector closing operation, the spring of the mechanism has to be charged (Fig. 18)
– If the spring is charged the switch disconnector can be closed in following way:
  – Pull the locking ring S (Fig. 8)
  – 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 of the drive.
– Check whether all poles of the switch disconnector have closed properly.
– Remove the lever from manual drive and secure it with a padlock (if used).

Opening

– Make sure that all station doors are closed.
– Remove the padlock securing manual drive of switch disconnector (if used),
– Apply lever on the knurled shaft of manual drive of the switch disconnector,
– Pull the locking ring S (Fig. 8).
– 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. 18). The switch opens before - after rotating the lever about 20 degrees).
– Check whether all poles of the switch disconnector have opened correctly (Fig. 66),
– Remove the lever from the manual drive and secure it with a padlock (if used),
– 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.66).

For step-by-step instructions for installation of the switch-disconnector with the HE hand operation mechanism, see item 7.1.
6.0 Mounting the mechanism on the switch. Fig. 4

**WARNING**
These operations can be carried out by specialists 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. 6. The mechanism clutch is brought together with the clutch of the hollow main shaft and the mechanism is fixed to the switch frame.

Note: Contact knives in open position

Normally the switch disconnector is delivered without shaft extension for left hand side operation.
6.1. Test operation of A-mechanism
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. 5. Test operation see item 4.1.

7.0 Mounting the hand operating mechanism type HE
The bevel gears are mounted with the switch in open position as shown in Fig. 7. The inclination of the operating tube must not exceed 40°, see Fig. 8. Drilling of the operating tube, see Fig. 9.

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

Step by step.
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. 10.
2. Opening spring is not charged (apply to NAL/NALF/VR with A mechanism), see Fig. 11.
3. Install the bevel gear on the NAL/NALF/VR and earthing switch shaft. Be sure the toothed wheels are properly installed - the bigger wheel position is important. This position is clearly shown on Fig. 7. In case of earthing switch, knurled end shaft on which the bevel gear is installed, must be mounted on the earthing switch shaft on long-slotted hole.

Fig. 7 NAL/VR switch disconnector with earthing switch | Fig. 8 Hand operating mechanism | Fig. 9 Connection rod | Fig. 10-11 Mounting of hand operating mechanism HE
4. Install the hand operating mechanism HE
WARNING ! Always stick the information label supplied with the drive during installation. Stickers must be close to the body of the drive, so that service explicitly tied him with that label - preferably in a conspicuous place for the service.
Put the connection rod (tube = 26.9 mm) between cardanic joint and bevel gear. Mark the position of the hole for the safety pin hole and do not greater than = 10.1 mm (see Fig. 13).

5. Take out the Seeger ring, spring and nut, see Fig. 14.
6. Slide out the arrestor ring from the shaft, see Fig. 15.
7. The shaft should loosely rotate loosely after taking out the arrestor ring, see Fig. 16.
8. Put the operating handle on the splined end. Turn the handle anticlockwise to charge A mechanism opening spring (apply to A mechanism), see Fig. 17.

Fig. 12-17 Mounting of hand operating mechanism HE
9. A mechanism opening spring is charged, see Fig. 18.
10. Turn the handle to the left and right for test, see Fig. 19.

11. Put the arrestor ring on the shaft, see Fig. 20.
12. Slide out the arrestor ring to the position where it is possible to turn the handle clockwise and close switch disconnector, see Fig. 21.
13. Check if the arrestor ring and switch disconnector are in locking position, see Fig. 22.
14. If NOT (as in picture 22) slide out the arrestor ring from the shaft and turn 2-3 teeth to the right, see Fig. 23.
15. Correctly position the arrestor ring in closed position, see Fig. 24.

16. Check the opening spring is charged. After adjustment the Seeger ring, spring and nut should be put back on the HE shaft, see Fig. 25.
8.0 Mounting of fuse base

**WARNING**
These operations can be carried out by specialists only!

**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. 26), these covers must be assembled at middle phase as shown in the fig. 26.

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. 26 or 27.

**8.1 Mounting of the fuse tripping. Fig. 30**
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.
5. The bearing (5) and washer (6) is mounted on the release shaft (1) on the LHS 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).

**8.2 Adjustment of the fuse tripping. Fig. 30.**
– the adjustment applies to switch disconnectors with fuse links and fuse tripping,
– 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 1.
1. 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).

2. 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. 28.

Remark:
– Following adjustment according to above the fuse switch disconnector must open by when tested in all phases,

– after fuse interruption the mechanism shall be blocked against another operation until the fuse link has been replaced.

8.3 Fuse tripping. Control
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. 31, 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. Dimensionally the fuse link then will have the same dimensions as ABB-CEF fuse-links,

3. If the distance between the fuse clips is longer than described – max e + 8 mm, the adjustment (point 6.3) must be made with the fuse link resting on the fuse clips on the fuse base,

4. The distance between the striker pin and the fuse trip flag (15) must be from 3-6 mm. 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. 29 - when the fuse switch disconnector is in open position with both operating springs uncharged, but with the releasing spring charged (ref. point 1).
9.0 Mounting of earth switch type E (Fig. 32) and earth switch type LCES (Fig. 33)
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 interlook will be bolted to the shaft, see Fig. 32.

9.1. Mounting the earth switch to the switch-disconnector type NAL/VR
The contacts (see pos. 1, Fig. 32) 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 earth switch slowly (operate the earthing switch using a handle putted on knurled end shaft installed on short hole) and adjust the fixed contacts to line up correctly with moving contacts. Tighten the contacts screws.

9.2 Mounting the earth switch to the fuse-switch disconnector type NALF/VR
Proceed as under item 7.1. The contacts A must be mounted on the terminals of the fuse base, and secured in position with tension bushes.

10.0 Mounting the mechanical interlock between switch disconnector and earth switch. Fig. 32-34
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 4.1).
Mechanical interlock must be installed on opposite site than drive site. In case of earthing switch, knurled end shaft on which the mechanical interlock is installed, must be mounted on the earthing switch shaft on short hole. Put one half of the guide A (side plate) on the operating shafts of the switches. 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. 34.
Do not forget to mounting the two distance rings E on the two screws F.

Fig. 32 Earthing switch type E mounted on the NAL/VR switch disconnector | Fig. 33 Earthing switch type LCES | Fig. 34 Mechanical interlock for earthing switch
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.

11.0 Mounting the shunt release. Fig. 38
Turn the operating mechanism shaft of maximum angle of 60° clockwise.
Opening spring housing F, see Fig. 31, must not be latched.

Return the shaft to its neutral position. Connect the bar to the perforated disc (see Fig 38) in such a way that it does not block the mechanism and work properly. After installation, check the operation of the shunt trip and its cooperation with the mechanism.

12.0 Mounting the auxiliary switch. Fig. 35 and 39
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 - bended end of the arm must be mounted on the hollow shaft side (see fig. 39.). Electric scheme of auxiliary switch is shown on fig. 36. In case of shunt trip coil installed, it should be connected to auxiliary switch as shown on fig. 37.
13.0 Mounting the auxiliary switch for E-EB earthing switch, excluding LCES, Fig. 40-50.

1. The installation starts with the earthing switch in open position, see Fig. 40.

2. The arm of auxiliary switch should be at an angle 45-50 degrees in direction of earthing switch, see Fig. 41.

3. Holdfast screw must be tightened from the flat side of auxiliary switch shaft, see Fig. 42.
4. 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, see Fig. 43.

5-7. Tighten the screws (M5) that mount the shackle on extension shaft of earthing switch, see Fig. 44-46.
8-9. Tighten the holdfast screw rather firmly, see Fig. 47-48. Verify the correct operation of auxiliary switch.
10. Earthing switch in open position, see Fig. 49.
11. Earthing switch in closed position, see Fig. 50.

Fig. 47-50 Mounting the auxiliary switch for E-EB earthing switch
14.0 Mounting of NM/MU motor drive

1. Check that the motor drive is working correctly according to Fig. 51 and 52.

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

Motor drive settings for A-mechanism

2. NAL/VR/F must be in open position and discharge both springs. Locate the spacer bracket mounting holes on the A-mechanism, see Fig. 53-54. Tighten mounting screws with 25 [Nm] torque.
3. To reduce side shake, turn the operating shaft anticlockwise, see Fig. 55-56.
4. Before mounting on the A-mechanism shaft, set up distance to ~4-8 mm, see Fig. 57.
5. Mount the standard motor drive for NAL/VR/F on the shaft and tighten mounting screws with 25 [Nm] torque. see Fig. 58-59.

Fig. 58-59 Mounting of standard motor drive for NAL/VR/F on A-mechanism
Motor drive settings for K-mechanism.

6. NAL/VR/F must be in open position. Locate the spacer bracket mounting holes on the K-mechanism, see Fig. 60-61. Fully tighten mounting screws.

7. Before mounting on the K-mechanism shaft, set up distance to ~4-8 mm, see Fig. 62.

8. Before mounting the motor device, adjust distance ~3-5 mm in K-mechanism, see Fig. 63.

9. Mount the standard motor drive for NAL/VR/F on the shaft and tighten mounting screws with 25 [Nm] torque. see Fig. 64-65.
15.0 Service and maintenance

**WARNING**
Do not use any type of alcohol-based cleaners. This results in weakening of the mechanical properties of tension rods and can cause cracking of them. For more info – see last pages!

**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 be used only. 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.

**Switch disconnectors in service**
The switch disconnector’s real maintenance frequency depends on both environmental conditions and on number and characteristic of on/off operations. The furthermore specified maintenance schemes refer to normal indoor operating conditions. When special operating conditions occur the service frequency and service scope should be adjusted individually preventing the switch to be stressed over its performance limits.

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 need to be focused on main contacts. The quality of the silver coated contacts shall be such that a continuous layer of coating material remains in the contact area. Otherwise affected components need to be replaced for a new ones.

If fuses were applied to the switch they must be replaced.

The proper coordination with the NALF switch-fuse combination required fuse selection from Reference list of fuses (see 22.0) according to ABB instruction.

**Mechanical overhaul**
For presently manufactured NAL switches if below specified service conditions are met, maintenance can be done even extended up to 15-year-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 62271:2007 – 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 lived parts 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 what 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.

**Electrical overhaul**
The frequency of overhaul depends also one 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 (by minor damage might only cause 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 cooper is visible on any current bus part, then this part should be replaced by new one.
Control of NAL/VR knives after mounting Fig. 66-68

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.

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. 66. 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 several times. Check the main contact position at closed switch disconnector. After all adjustments this position must be in accordance with adjusting specification shown on Fig. 68a - 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 be below the fixed contact maximum 10 mm - lower edge of main contact cannot be below the lower edge of fixed contact. If this position is different then must be adjusted by the eccentric bolt (see Fig. 67). 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.

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.

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.

Fig. 66 Control of NAL/VR knives after mounting
Fig. 67 Adjustment of eccentric bolt
16.0 Replacement of parts (12-24 kV)

**WARNING**
These operations can be carried out by specialists only!

The switch disconnector type NAL/VR is equipped with DMC (glassfibre-reinforced polyester) or epoxy insulators. In case of DMC insulators all fixing is realized by selftapping screws. The epoxy insulators are fixed by metric screws.

**DMC 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 and brush them clean, and blow out the small particles in the threaded hole (use eye protection).
When mounting, the screws must be entered carefully into the threads in the insulator and tightened with care.
– correct torque, see page 28.
If using a new insulator, the holes should be threaded to about 10 m 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:**
In that case the epoxy insulators can be unscrewed and screwed again several times. In 24 kV design, the screws should be tighten with special glue for thread, eg LOCTITE 2701.

---

16.1 Replacement of contact knife with draw bar Fig. 69.
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.

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Fig. 68 a) Adjusting specification, b) Operational specification

Fig. 69 Support insulator with knife complete
16.2 Replacement of fixed contact on the opening side  
Fig. 70
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.
Demaged parts must be replaced:
– take care that the arcing contacts 3.6 are correctly placed in the pressure spring 3.7,
– by mounting the termal 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. 71.
Check correct position of the arcing contact and test correct function. Grease the contact area with ISOFLEX TOPAS NCA 52.

17.0 Replacement of the arcing chamber. Fig. 70
Follow instructions under item 16.2.

18.0 Replacement of insulators

**WARNING**
These operations can be carried out by specialists only!

18.1 Hollow insulators with arcing chamber. Fig. 70
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 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. 71.
Note the washer and spring washer for the screws.

18.2 Pivot side support insulator. Fig. 69
Detach the main contact with contact knives according to item 16.1 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 insulators or standard metric screws in case of epoxy insulators (2.5).
For correct torque see Fig. 71.
Note the washer and spring washer for the screws.

3. Attach the main contact with the contact knife to the top of the insulator and adjust according to item 16.1.

**Caution!**
In case of complete contact (with current knife) fixing to the support insulator with inserts, screw tightened with 15 Nm torque (Fig. 71) should be additionally lubricate using glue eg LOCTITE 2701.
19.0 Insulator for fuse base and quick make earthing switch Fig. 72
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 insulators or standard metric screws in case of epoxy insulators 4.3. For correct torque see page 29.
4. Attach the fuse clips and contact block respectively to the top of the insulator by the screws 4.2.
For correct torque see page 29.

20.0 Changing parts in NAL/VR 36 kV

WARNING
These operations can be carried out by specialists only!

20.1 Changing contact knives
Disconnect the switch-disconnector. When A-mechanism is fitted, the opening spring must NOT be charged.
1. The draw bar is detached from the crank arm of the operating shaft, see Fig. 73.
2. The contact screw is detached and the contact knives are removed, see Fig. 74.
3. Replacement contact knives are lubricated with ISOFLEX TO-PAS NCA 52 and fitted to the contact block with the contact screw.
4. Check that the contact knives can move easily and operate correctly over the opposite contacts.
5. Before the drawbar is connected to the crank arm of the operating shaft, see Fig. 73 ensure that the auxiliary knives run easily in the individual arc extinguishing chambers, and that the main knives make proper contact.
6. 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.

20.2 Changing draw bar. Fig. 75
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. 73.
5. New drawbar to be fitted in sequence a-b, see Fig. 75.
20.3 Changing the supporting insulator. Fig. 76
1. Disconnect the switch-disconnector.
2. Contact block with contact knives is dismounted (use spanner gap 17).
3. The insulators are attached to the switch frame by a screw M12 (spanner gap 19).
The insulator is dismounted and a new insulator is fitted to the switch frame.
4. Contact block with contact knives is fitted to the insulator and adjusted as described in paragraph 18.1.

20.4 Changing the hollow insulator. Fig. 77
1. Disconnect the switch-disconnector.
2. The spring mechanism is dismounted from the frame.
3. All draw bars are detached from the crank arm of the operating shaft, see Fig. 73.
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 fixing screws on insulator.
7. The hollow insulator is attached to the frame by 4 screws M10 (spanner gap 17). New Insulator is fitted. If contact blocks and arc extinguishing chambers are to be used again, these must be fitted 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 18.1.
9. The position of the insulator is checked and adjusted as described in paragraph 18.5. (NB! A certain degree of adjustment can be made by moving the hollow insulator).
20.5 Changing the piston with piston rod. Fig. 78
NB! Remove spring mechanism before starting. If a mechanism is installed.
1. Close the switch-disconnector.
2. Disconnect the lower part of draw bar from the main shaft.
3. Disconnect the piston rod from the operating shaft and piston can be taken out.
4. New piston is fitted the same way.
   NB! Piston and cylinder MUST NOT be greased or lubricated.
5. Connect the drawbar to the eccentric bolt on the main shaft.

21.0 Liabilities
The liability of ABB with respect to any and all claims arising out of the performance or non-performance of obligations connected with NAL New Design 2008 or NAL/VR 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 NAL New Design 2008 or NAL/VR, except to the extent such conflicting or inconsistent provisions further restrict the Supplier’s liability.
### 22.0 Reference list of fuses

These fuse links has been tested, according to IEC 62271-105 with air switch-disconnector Type NALF/VR

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**WARNING**

Switch disconnector during fuse replacement must be open!
23.0 Environmental declaration

Environmental Certification
Life expectancy of product

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

End-of-life

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

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</thead>
<tbody>
<tr>
<td>Steel</td>
<td>60.59%</td>
<td>Yes</td>
<td>Separate, utilize in favor of new source</td>
</tr>
<tr>
<td>Cooper</td>
<td>11.26%</td>
<td>Yes</td>
<td>Separate, utilize in favor of new source</td>
</tr>
<tr>
<td>Zinc</td>
<td>0.025%</td>
<td>Yes</td>
<td>Electrolysis, utilize in favor of new source</td>
</tr>
<tr>
<td>Silver</td>
<td>0.012%</td>
<td>Yes</td>
<td>Electrolysis, utilize in favor of new source</td>
</tr>
<tr>
<td>Thermoplastic</td>
<td>2.11%</td>
<td>Yes</td>
<td>Make granulate, re-use or apply as energy superior additive in refuse incineration; partial material can be reused in production process</td>
</tr>
<tr>
<td>Polyester with glass fiber*</td>
<td>24.64%</td>
<td>Yes</td>
<td>Grind to powder and use as high-grade energy additive in cement mill</td>
</tr>
<tr>
<td>Total for recycling</td>
<td>98.64%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Not specified</td>
<td>1.34%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carton box**</td>
<td>6 kg</td>
<td>Yes</td>
<td>Powder coating, grease, etc.</td>
</tr>
<tr>
<td>Wooden pallet**</td>
<td>7.5 kg</td>
<td>Yes</td>
<td>Complete apparatus without packaging</td>
</tr>
<tr>
<td>Epoxy***</td>
<td>33%</td>
<td>No</td>
<td>Store in appropriate places, indented for this purpose</td>
</tr>
</tbody>
</table>

*Used for NAL/VR12, NAL/VR17, NAL/VR24

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

***Used for NAL/VR36 and NAL12–24 with long creepage distance.

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

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