

Service Manual

# Outdoor Disconnectors ONIII (ONI) for 24 and 36 kV



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# ON

## Medium Voltage Outdoor Disconnectors



### WARNING

HAZARDUS VOLTAGE CAN SHOCK, BURN, OR CAUSE DEATH.

Do not attempt to handle, install, use or service this product before reading this installation guide.

### 1. Safety

Must always follow the directions in the manual and good engineering practice.

Dangerous voltage can cause electric shock and burns.

- Do not perform any activity described in this document with the switch energized.
- ALWAYS follow your company's or country's Safety procedures before performing any work on this equipment.
- ON outdoor switch disconnector should be installed only within the design limitation.
- All the activities listed on this document it must be performed with the switch completely de-energized, isolated, grounded and out of service.
- Must be observed appropriate guidance given in the manuals for all operations performed on the apparatus.
- This product is intended to be installed, operated and maintained by qualified personnel, thoroughly trained and knowledgeable with the regards of the hazards involved. This publication is written only for such qualified persons and is not intended to be a substitute for adequate training and experience in the safety procedures for this device.

### Warning

**Detailed descriptions of standard repair procedures, safety principles, and service operations are not included. It is important to note that this document contains some warnings and cautions against some specific service methods that could cause personal injury to service personnel, or could damage equipment or render it unsafe. These warnings do not cover every conceivable method in which service (whether or not recommended by ABB) may be performed. Secondly, ABB cannot predict or investigate all potential hazards resulting from all conceivable service methods**

Anyone using service procedures or tools, whether or not recommended by ABB, must satisfy himself thoroughly that neither personal safety nor equipment safety will be jeopardized by the service method or tools selected.

All information contained in this manual is based on the latest product information available at the time of printing.

The right is reserved to make changes at any time without notice.

### 2 Introduction

The subject of this Manual is installation and usage of 3-pole and 1 pole outdoor disconnectors type ONIII and ONI. It contains information about these disconnectors such as technical data, description of construction and principles of operation and also directives and recommendations on their servicing and maintenance.

The Manual is intended to be a help in the process of installation, maintenance and usage of these apparatuses.

The manufacturer do not bear responsibility for any direct or indirect loses or damages caused by improper usage of these apparatuses.

The contents of this Manual is can be changed without notice.

### 3 Functions

#### 3.1 Disconnector

Medium voltage disconnectors are designed for galvanic separation of electrical circuits and sections of medium voltage networks. In open position they create visible, safe isolating break. Opening and closing of medium voltage disconnector is done in loadless state.

Disconnectors type ONIII (ONI) 20, 30..., described in this Manual are 3-pole (1-pole) disconnectors for outdoor installation.

Disconnectors type ONIII (ONI) 20, 30..., fulfil the requirements of following standards:

- PN-EN 62271-1:2009 High-voltage switchgear and controlgear – Part 1: Common specifications
- PN-EN 62271-102:2005 + AC:2005(U) High-voltage switchgear and controlgear – Part 102: Alternating current disconnectors and earthing switches

#### 3.2 Earthing switch

At each disconnector it is possible to install an earthing switch. Earthing switches can be located either from fixed contact side or disconnectable side of disconnector.

### 4 Construction and operation

#### 4.1 Disconnector

The outdoor disconnectors type ONI...-2 i ONIII... 2 are vertical break switches. The base of disconnector is a steel frame in which there is installed (in bearings) the operating shaft ended with operating lever. Disconnector's shaft from

both sides is ended with the knurling, which allows easy connection of lever with the drive. The operating lever can be rotated every 10 degrees within full turn. Support porcelain insulators with moving and unmoving contacts are fixed into the base. Between moving and unmoving contacts there is a line contact and its proper pressure is achieved via the pressure springs. Contacts and terminal are silvered. The disconnector's moving contacts are connected via isolating rods to operating shaft. Rotation move of shaft is carried over via rods on moving contacts putting them in motion within perpendicular to a base plane. Full operating angle of shaft is 102°.

The construction of disconnectors type ONIII...-2 allowed mounting up earthing switches which can be mounted on moving contact side (the up earthing switches) or on unmoving contact side (the down earthing switches). Between operating shaft of disconnector and operating shaft of earthing switch there is mechanical interlocking ensuring proper sequence of connection.

Disconnectors are suitable for working in horizontal or vertical position and have clamps suitable for connect flat buses mounted in parallel to the base.

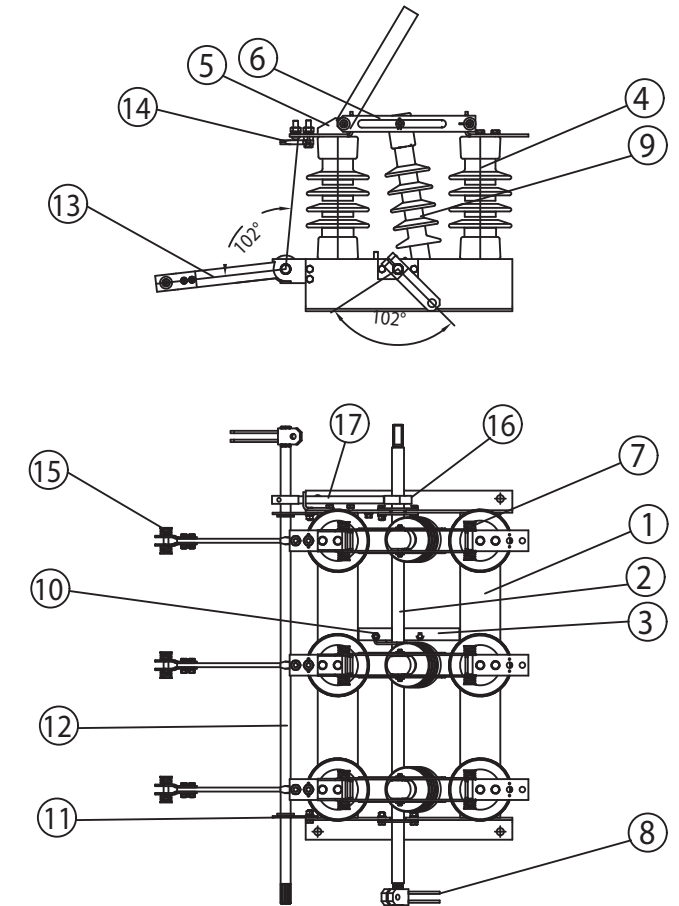
Disconnectors and earthing switches can be controlled by separate manual operating devices type NN or motor type UEMC50 Operating devices are coupled with disconnector by adjustable pipe rod.

#### 4.2 Earthing switch

Construction of earthing switches enables building-on the earthing switches without making any changes even when the disconnector is already installed at site. Earthing switches can be located from the fixed non-disconnectable contact side (lower earthing switches) or from disconnectable fixed contact side (upper earthing switches). Disconnector bearings [drawing. 1 pos. 11], which are simultaneously the rotation limiters are fixed to the supporting base of the disconnector. Supported in the bearings is the driving shaft of the disconnector [drawing. 1 pos. 12] together with welded to it movable contacts [drawing 1 pos. 13]; on the ends of these contacts are fixed copper, silver-plated contact. The correct contact pressure for contacts is ensured by springs. The full angle of rotation for earthing knives shaft - like for the disconnector switch is 102 degrees. Transfer of current from movable contacts of the earthing switch to the supporting base is ensured by using flexible earthing stranded conductor. On the supporting base are located the earthing terminals with screws M12 x 25.

#### 4.3 Interlocking

Disconnector switch and earthing switch can be interlocked with one another in the following manner:



**Drawing. 1: Disconnector with lower earthing switch**

- |                               |                                |
|-------------------------------|--------------------------------|
| 1-Supporting base,            | 9-Driving insulator,           |
| 2- Disconnector switch shaft, | 10-Rotation limiters,          |
| 3-Bracket,                    | 11-Bearing / rotation limiter, |
| 4-Supporting insulator,       | 12-Earthing switch shaft,      |
| 5-Fixed contact,              | 13-Earthing switch knife,      |
| 6-Movable contact,            | 14-Earthing contact,           |
| 7,15-Pressure springs,        | 16-Locking disc,               |
| 8-Lever,                      | 17-Lock                        |

- Disconnector switch can be CLOSED only when earthing switch is OPEN
- Earthing switch can be CLOSED only when disconnector switch is OPEN The interlocking can be realised in mechanical way.

Mechanical interlocking between the disconnector switch and the earthing switch is installed in the factory.

## 5. Designation of switch

Designation of disconnectors type.

<b>ON</b>	<b>III</b>	<b>30</b>	<b>W</b>	/	<b>8</b>	<b>UD</b>	-	<b>2</b>
Disconnector's type	Number of poles  I – 1 pole III -3 poles	Rated voltage  20 - 24 kV 30 - 36 kV	Creepage distance of insulators  – 460 mm (24 kV) – 610 mm (36 kV) W – 900 mm (36 kV) L – 1116 mm (36 kV)		Rated current  4 – 400 A 8 – 800 A 12 –1250 A 16 –1600 A 20 – 2000 A	Earthing switch type  UD – lower earthing switch UG – upper earthing switch		Construction version

## 6. Technical data

### Electrical parameters

Table 1: Three poles disconnector's parameters

Parameter	Switch type															
		ONIII 20/4-2	ONIII 20/8-2	ONIII 20/12-2	ONIII 30/4-2	ONIII 30/8-2	ONIII 30W/4-2	ONIII 30W/8-2	ONIII 30W/16-2	ONIII 30W/20-2	ONIII 30L/4-2	ONIII 30L/8-2	ONIII 30L/16-2	ONIII 30L/20-2		
Rated Voltage [kV]		24						36								
Rated power frequency withstand voltage to earth and between phases. [kV]		55						75								
Rated power frequency withstand voltage across the isolating distance [kV]		75						100								
Rated lighting impulse withstand voltage to earth end between phases. [kV]		125						170								
Rated lighting impulse withstand voltage across the isolating distance [kV]		145						195								
Creepage distance [mm]		460			610		900			1116**						
Rated current [A]		400	800	1250	400	800	400	800	1600	2000	400	800	1600	2000		
Disconnector rated peak withstand current [kA]		50			50			63			50		63			
Disconnector rated short-time withstand current 1 s [kA]		20			20			25			20		25			
Earthing switch		UD – lower earthing switch; or UG – upper earthing switch *														
Earthing switch rated peak withstand current [kA]		40			50			63			50		63			
Earthing switch rated short-time withstand current 1 s [kA]		16			20			25			20		25			
Rated frequency [Hz]		50/60														
Mechanical endurance [close /open]		1000														
Weight [kg]	Without earthing switch	80			105		125			130			173		178	
	With earthing switch	90			120		140			150			188		198	

\* earthing switch from both side on request

\*\* on request

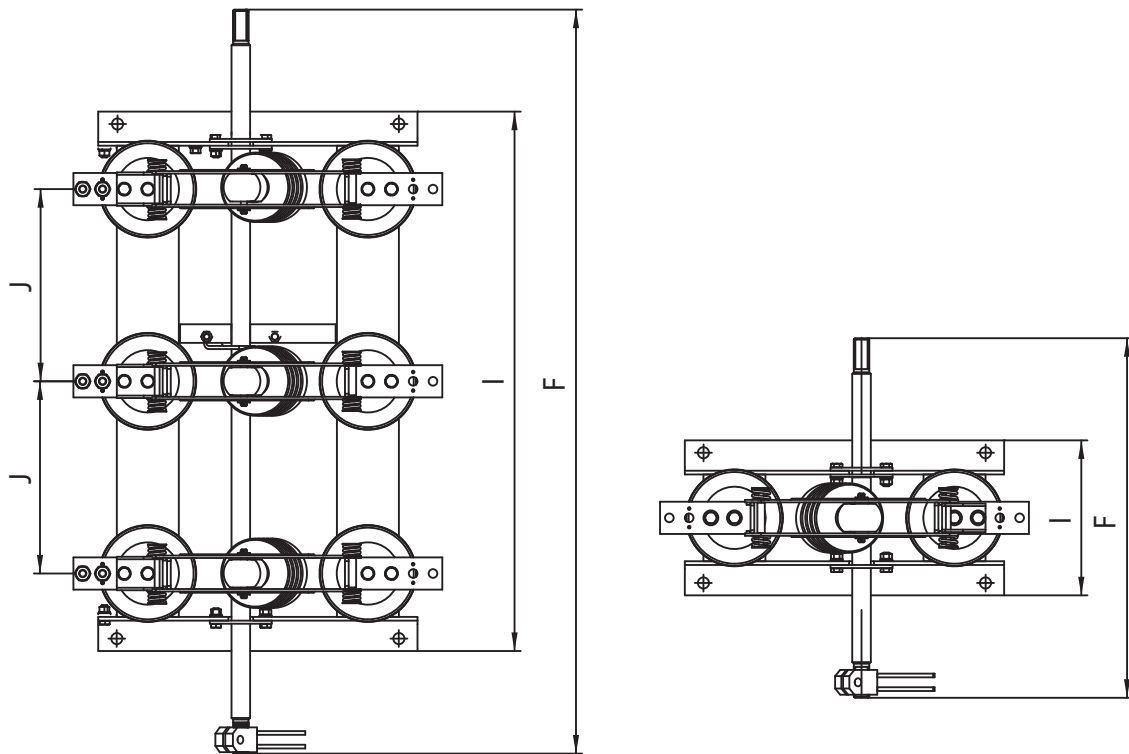
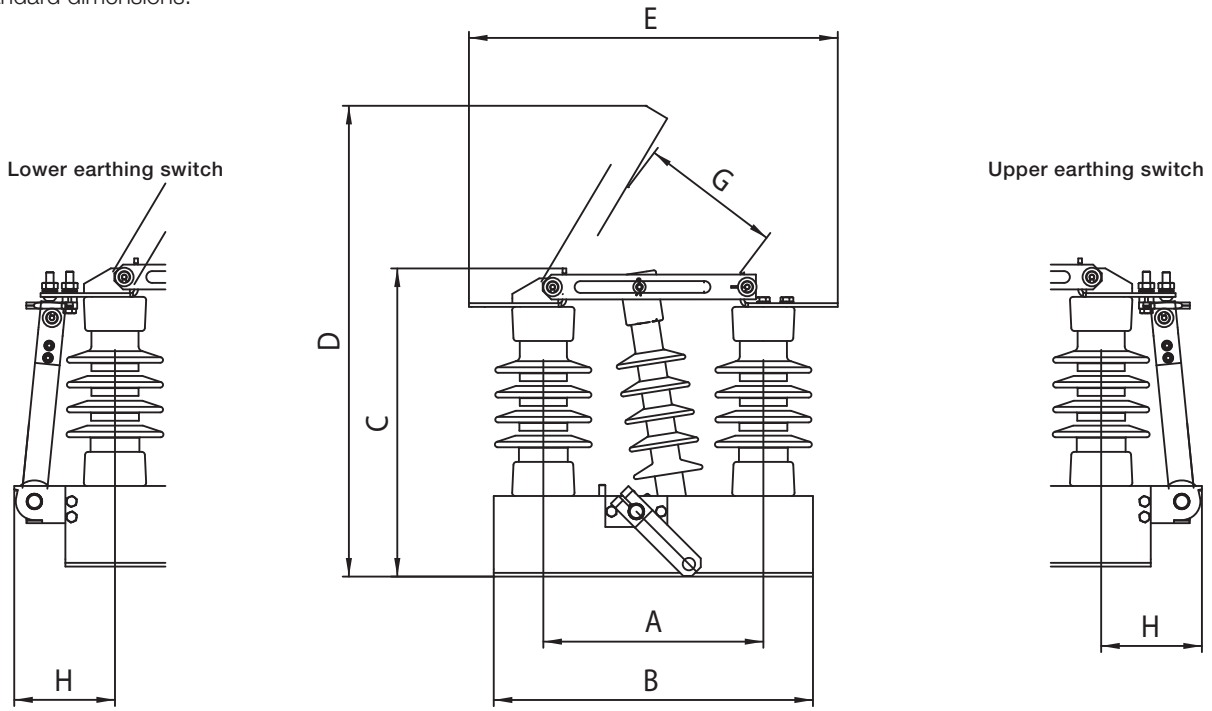
Table 2: Single pole disconnector's parameters

Parameter	Switch type																													
	ONI 20/4-2			ONI 20/8-2			ONI 20/12-2			ONI 30/4-2		ONI 30/8-2		ONI 30W/4-2		ONI 30W/8-2		ONI 30W/16-2		ONI 30W/20-2		ONI 30L/4-2		ONI 30L/8-2		ONI 30L/16-2		ONI 30L/20-2		
Rated Voltage [kV]	24						36																							
Rated power frequency withstand voltage to earth and between phases. [kV]	55						75																							
Rated power frequency withstand voltage across the isolating distance [kV]	75						100																							
Rated lighting impulse withstand voltage to earth end between phases. [kV]	125						170																							
Rated lighting impulse withstand voltage across the isolating distance [kV]	145						195																							
Creepage distance [mm]	460						610						900						1116*											
Rated current [A]	400	800	1250	400	800	1250	400	800	1250	400	800	1250	1600	2000	400	800	1250	1600	2000	400	800	1250	1600	2000						
Disconnecter rated peak withstand current [kA]	50						50						63						50						63					
Disconnecter rated short-time withstand current 1 s [kA]	20						20						25						20						25					
Earthing switch															NO															
Rated frequency [Hz]															50/60															
Mechanical endurance [close /open]															1000															
Weight [kg]	27						35						45																	

\* on request

### 6.1 Basic dimensions

Full specification of dimensions is given in dimensional technical drawings in the catalogue. In Table 3 are given only the standard dimensions.



Drawing. 2: Basic dimensions of disconnectors type ONIII... and ONI...



Table 3: Basic dimensions of disconnectors type ONIII... and ONI... (standard dimensions)

	A	ONIII 20	ONIII 30 (ONI 30)				
		(ONI 20)	400/800	400/800	1600/2000	400/800	1600/2000
Rated current		400/800/1200	400/800	400/800	1600/2000	400/800	1600/2000
insulators creepage distance	mm	460	610	900	900	1116	1116
A Distance between insulators	mm	355	485	485	485	505	505
B Length of supporting frame	mm	515	694	694	694	714	714
C Height of disconnector (open)	mm	783	981	1000	1020	1000	1020
D Height of disconnector (closed)	mm	497	583	602	626	602	626
E Overall disconnector length	mm	595	725	725	725	745	745
F Overall disconnector width	mm	1200 (580)			1470 (670)		
G Open gap distance	mm	250			360		
H Length with built-on earthing switch	mm	165			190		
I Disconnector frame width	mm	870 (250)			1110 (310)		
J Pole distance	mm	310 (-)			400 (-)		

## 7 Despatch / storage

### 7.1 Despatch

Apparatuses are despatched in cases. Directly after unpacking one shall check all the delivered equipment regarding possible damages occurred during transportation. If such damages have been found, one shall immediately inform about it the supplier.

### 7.2 Storage

In case of improper storage of disconnector components there is a danger that they can get damp. Due to that components of disconnector and operating mechanisms shall be always stored in the position of their normal operation.

**In order to protect the stored semi-assemblies against getting dirty or damaged it is recommended to leave them in their original packages until the moment when they are to be installed at site.**

Operating mechanisms are delivered in special packing. This packing protects them for some period of storage in dry environment against corrosion. Therefore it is not recommended to open these original packing earlier than immediately before starting installation these operating mechanisms at site.

**In case of need for prolonged storage and/or damp environment there can occur undesirable condensation of water vapor in the operating mechanisms. If the total time of transportation and storage exceeds 6 months or if operating mechanisms are stored in damp environment, their special packing shall be immediately removed and their electrical heating system shall be connected to the supply. Before supplying heating system of operating mechanism, one must remove from it the desiccant packages put there in the factory.**

## 8 Installation

### 8.1 General information

Disconnectors type ONIII (ONI) 20, 30 can be installed in two optional positions:

- Horizontal
- Vertical

Internal components of an operating mechanism (e.g. auxiliary connecting links or contactors) are not resistant to the effects of adverse climatic factors. Due to that reason access of dampness inside the operating mechanism during its installation shall not be permitted.

One shall remember, that the delivery do not include the connecting elements necessary for fixing the disconnector base to the supporting structure.

### 8.2 Visual inspection and preparation for installation

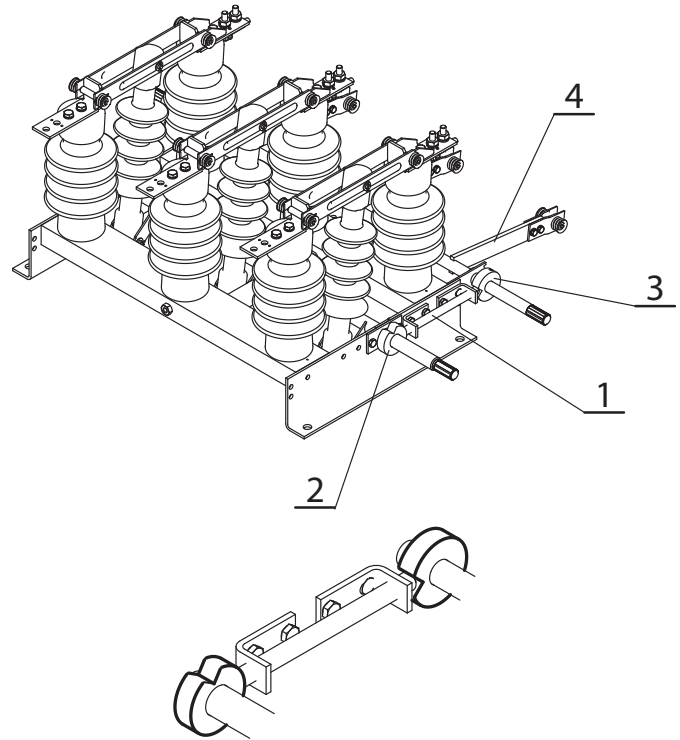
Before installation following points should be checked:

- Contents of rating plate and compare it with the requirements from the order.
- General state of parts and components and particularly the insulators.
- State of protective coatings.
- State of grease on the disconnector contacts.

In case of finding damages occurred during transportation which make impossible normal usage of the disconnector one shall immediately inform about it the insurer and the supplier. The contact parts of the disconnector shall be thoroughly cleaned and covered with the layer of grease (approximately 1 mm thick). Then one shall screw together surfaces prepared in above described way, greasing also the connecting screws.

### 8.3 Adjusting mechanical interlocking

Disconnectors equipped with earthing switches are transported with closed movable contacts both of disconnector switch and of earthing switch. Therefore before installing the apparatus onto the supporting structure one shall adjust mechanical interlocking between the disconnector switch shaft and the earthing switch shaft by opening movable contacts of the earthing switch [drawing 3; pos 4] and then setting the locking disc [drawing 3; pos 3] located on the earthing switch shaft in accordance with Drawing. 3 and fixing it in this position using screws located on the disc.



**Drawing. 3: Mechanical interlocking disconnector earthing switch**

1-Lock, 2-Locking disc on disconnector shaft, 3-Locking disc on earthing switch shaft, 4-Movable contacts of earthing switch

### 8.4 Supporting structure

Supporting structure on which the disconnector is to be installed shall be appropriately rigid and its points where it comes into contact with the supporting base of the disconnector must lay in the same plane. The disconnector shall be fixed to the supporting structure with M16 bolts through 4 holes in the disconnector base. When installing the disconnector onto the supporting structure one shall first of all pay attention in order not to warp its supporting base. This may occur when points where supporting structure comes into contact with the supporting base of the disconnector do not lay in the same plane. If this is not compensated with the equalising pads, it may lead to incorrect co-operation of contacts and to increase in the torque needed on the disconnector shaft.

### 8.5 Coupling disconnector switch with operating mechanism

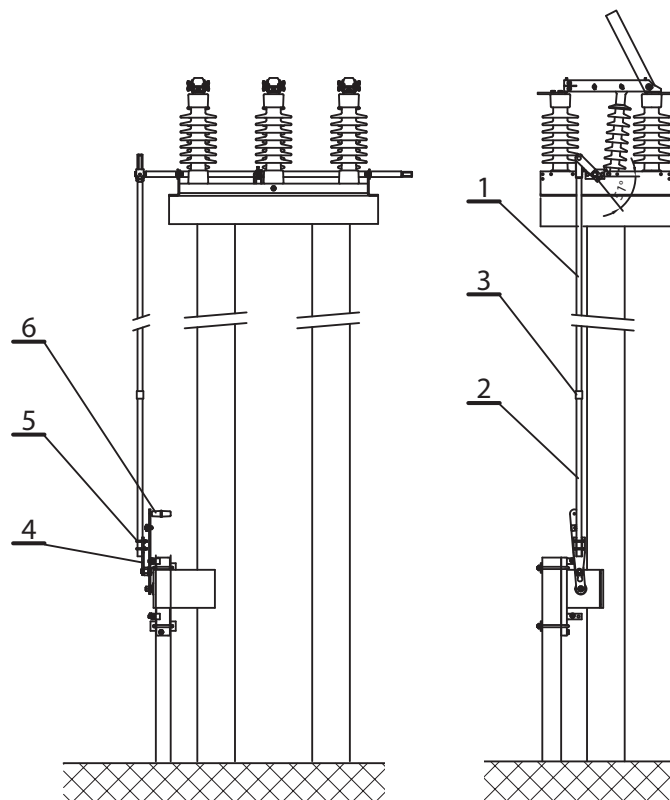
Coupling the disconnector with its operating mechanism is done after the disconnector has been fixed to the supporting structure according to the procedure as below:

1. In closed position of disconnector switch the lever [drawing 1 pos.8] set on the shaft [drawing 1 pos.2] shall be put into position as shown on Drawing. 4.

2. Install the operating mechanism. The operating mechanism shall be set in state „closed”.
3. Prepare the connecting pull rod (consisting of pipe [drawing 4 pos.2] and connecting elements [drawing 4 pos.3]).
4. Connect the upper part of the pull rod with the lever [drawing 1 pos.8] set on the disconnector shaft using the pin.
5. If the disconnector is mounted at the height exceeding 6 m: mount the rod support for pulling rods using the clamps.
6. Cut the lower part of the pull rod to the required length.
7. The front surface of pull rod after cutting shall be protected against corrosion with the anti-corrosion paint or the zinc spray.
8. The end of the pull rod set in clamp [drawing 4 pos.4] of the operating mechanism and tighten the nuts of the clamping rings [drawing 4 pos. 5].
9. Carry out opening and closing of the disconnector in order to check the correctness of the coupling. After opening the disconnector check the distance „G” between the contacts (Drawing 2). It shall be as in Table 4:

Rated voltage of disconnector [kV]	Minimum required distance between contacts in open position „a” [mm]
24	250
36	360

10. In case when the disconnector contacts do not reach in correct way their end positions one shall adjust the disconnector by changing the position of the lever [drawing 1 pos.8] set on the disconnector shaft or by changing the position of the pull rod in the clamp [drawing 4 pos.4] of the operating mechanism.
11. Carry out manually several test operations of opening and closing the disconnector (it is recommended to carry out 3 opening and 3 closing operations).



Drawing. 4: Coupling disconnector with its operating mechanism

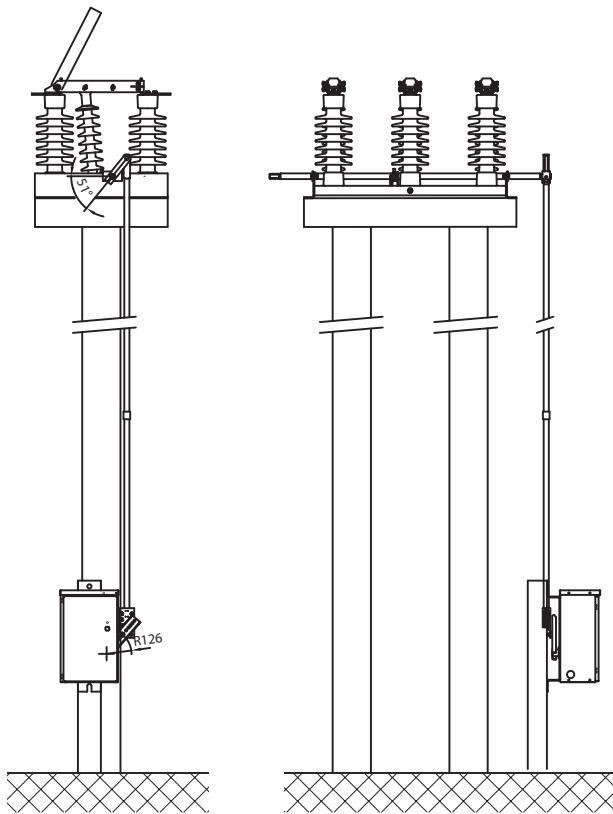
1-Lever, 2-Pipe, 3-Connecting element, 4-Clamp, 5-Clamping ring, 6-Handle for manual operation

Principles for coupling earthing switch with its operating mechanism are the same as these described above for disconnector.

## 8.6 Additional information

### Coupling disconnector with motor operating mechanism type UEMC50

In case of using motor operating mechanism type UEMC50 as the disconnector drive, its coupling is carried out in the similar way as that described earlier for manual operating mechanism type NN1. The coupling pulling rod with the fixing element shall be mounted with the lever coming out from the operating mechanism, using the hole on R126 mm (see Drg. 5).



Drawing 5: Coupling disconnector ONIII (ONI) with motor operating mechanism type UEMC50

## 8.7 Connecting the busbars or line conduits to disconnector terminals

Before connecting the busbars or station terminals of line conduits to the terminals of disconnector, these terminals have to be thoroughly cleaned from the oxidation and covered with the layer of grease. The same procedure shall be carried out before connecting the lead of protective earthing to the earthing terminal located on the supporting base of the disconnector.

## 9 Commissioning and taking out of usage

### 9.1 Commissioning of disconnector

Steps of disconnector commissioning

1. Carry out manually test opening and closing of the disconnector, checking whether the main contacts of the disconnector correctly reach their end positions in open and closed state.
2. If it turns out necessary, one shall once more carry out the adjustment regarding the moment of coming together the main contacts of disconnector.
3. manually test opening and closing of the earthing switch, checking whether movable contacts of the earthing switch enter in correct way its fixed contacts and whether the end positions are reached correctly.
4. If it turns out necessary, one shall once more carry out adjustment procedure for the earthing switch.

### 9.2 Commissioning of disconnector operating mechanism

Steps of operating mechanism commissioning

1. Check disconnector operating mechanism in the way described in the relevant Service Manual delivered together with the apparatus.
2. If the operating mechanism has got the housing, remove from inside of the operating mechanism housing the bag with desiccant and connect the supply to the heating system (if operating mechanism is equipped with it).

### 9.3 Taking out of usage

Outdoor disconnectors type ONIII (ONI) 20 ...30 .... are the apparatuses which have no harmful effects for natural environment.

If the apparatus described in this Manual is taken out of usage, all kinds of materials used for its manufacture can undergo the recycling. In other words, it means that all parts and components of the disconnector can be utilised in the way which is not harmful for natural environment, following all relevant currently binding low regulations.

One of the ways to utilise mixed materials is the recycling. The apparatus is manufactured from the following materials:

- Steel
- Copper
- Aluminium
- Cast iron
- Plastics
- Rubber (all kind of seals)
- Porcelain (insulators)
- Greases

The environment regulation varies from country to country and develops fast. Due to this it is recommended to contact the local waste handler who is authorized and specialized in disposing electronic waste including lead-acid batteries. These handlers can sort the material by using dedicated sorting processes and dispose of the product according to the local requirements

## 10 Maintenance and service

In Table 5 are given service intervals both for normal working conditions and for particularly heavy working conditions. Servicing disconnectors in accordance with below given recommendations is the condition of correct and failure-free operation of these apparatuses.

**During carrying out all kind of works nearby live high voltage apparatuses one must strictly follow all relevant safety regulations. Not following these regulations may lead to serious injuries or death.**

Table 5: Service intervals for normal ambient conditions and for particularly heavy ambient conditions

Ambient conditions	Service interval	Year of commissioning
Normal	After each 5 years of usage or after 1000 operations „open” / „close”.	
Heavy	After each 30 months of usage or after 50 operations „open” / „close”.	

### Heavy ambient conditions

Listed below examples of heavy ambient conditions are based on the experience coming from usage ;

- Special climatic conditions (arctic or tropical climate).
- Heavy air pollution (dust, salt, sulphur compounds or other corrosive factors).

### Special tools and materials

For all kind of repairs, apart from standard tool set, all necessary the following special tools and materials:

- Brass wire brush for cleaning copper surfaces.
- Steel wire brush for cleaning aluminium surfaces.
- Contact grease Mobil 28.
- Cleaning agent for silver plated surfaces (Rivolta MTX forte).
- Fluff-free cloths

### Allowed tightening torque

If in this Manual has not been stated differently, during tightening all screw connections and joints one shall apply standard values of tightening torque, as given in the Table 6 below:

Table 6: Allowed tightening torque for screw connections and joints (standard values)

Thread size	Tightening torque in Nm		
	Threads in steel, galvanised	Threads in stainless steel	Threads in aluminium
Strength	8,8	A2-70, A4-70	-
M6	-	7	5,5
M8	-	16	14
M10	42	33	26
M12	72	56	45
M16	174	122	100

### 10.1 Maintenance of contact surfaces and machine-tooled surfaces

**Screwed or sliding contact surfaces conducting current effect the electrical resistance of the disconnector current path. Soiled or oxidised contact surfaces result in increase of electrical resistance, which may lead to irreparable damage of the apparatus.**

Regarding the maintenance of contact surfaces and machine tooled surfaces one shall follow principles listed below:

### **Screwed contact surfaces**

#### **Aluminium contact surfaces**

1. Lightly grease.
2. Using steel wire brush remove the oxidation so that the surface become dull- grey (do not use abrasive paper).
3. Immediately after cleaning the oxidation remove the residue of grease using fluff-free cloth.
4. Next cover the contact surfaces with fresh grease layer (approximately 1 mm thick).
5. Screw together contact surfaces prepared in the above described way, greasing also the connecting screw.

#### **Sliding contact surfaces**

##### **Silver plated contact surfaces**

1. Clean using the cleaning agent for silver surfaces (do not damage the silver layer).
2. Cover the contact surfaces with grease layer (approximately 1 mm thick).
3. Screw together contact surfaces prepared in the above described way, greasing also the connecting screw.

##### **Galvanised contact surfaces.**

1. Using steel wire brush clean the surfaces.
2. Immediately after cleaning cover the contact surfaces with grease layer (approximately 1 mm thick).
3. Screw together contact surfaces prepared in the above described way, greasing also the connecting screw.

##### **Silver plated contact surfaces**

1. Clean using the cleaning agent for silver surfaces (do not damage the silver layer).
2. Cover the contact surfaces with grease layer (approximately 1 mm thick).

#### **Machine tooled surfaces**

##### **Steel parts**

1. Protect against corrosion with the layer of zinc spray.

### **10.2 Disconnecter (disconnecter with earthing switch)**

**During carrying out all kind of works nearby live high voltage apparatuses one must strictly follow all relevant safety regulations. Not following these regulations may lead to serious injuries or death.**

The actions described below must be carried out during each periodical service inspection.

Procedure for periodical service inspection

1. Follow relevant safety regulations when working nearby live high voltage equipment and carry out the required preparatory actions

2. Switch off the electrical supply, disconnect the control voltage and take steps to safeguard the site of work against accidental switching on the supply voltage.
3. Clean contact elements/surfaces and check whether there is no damage to the silver layer on these surfaces; if necessary, replace the damaged contact element with the new one.
4. Grease the contact elements.
5. Clean the supporting insulators and check whether they are not damaged; if necessary, replace the damaged insulator with the new one.
6. Carry out visual inspection of points which do not require maintenance, where the pulling rods and coupling levers are jointed or supported.
7. Check all screwed joints and connections; if necessary, tighten them.
8. Carry out several manual test opening and closing operations (it is recommended to carry out three of each).
9. Maintenance and periodical service inspection of disconnecter operating mechanism shall be carried out in accordance with relevant Service Manual, delivered together with the operating mechanism.

### **11 Spare parts**

In normal usage no spare parts are needed. All accessories and additional equipment ordered not in set with disconnecter are treated as spare parts. These orders are served by Service department.

When ordering following data has to be delivered:

Disconnecter type and serial number

Type of the pole/installation

Available spare parts:

- Accessories from point 8 catalogue
- Manual drives
- Insulators
- Operating levers
- Earthing switches.



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