IZOELEKTRO

PRODUCT CATALOGUE 2023

About us

Overview

Our company specializes in the development, manufacturing, and commercialization of power distribution equipment designed for power systems up to 52 kV. As part of our company's new focus, we have expanded into the realm of remote monitoring for power grids and their components, reaching up to 1150 kV. Our key products include:

- devices for real time remote monitoring of surge arresters and power grids,
- surge arresters,
- tension and post composite insulators,
- overhead power line construction systems,
- junction and suspension equipment,
- connecting sleeves.

In addition to providing our own line of products, we also fulfil customer demands by supplying a comprehensive range of other requested equipment.

High voltage laboratory

Our company boasts a dedicated high voltage laboratory that is consistently upgraded to adhere to the most recent standard specifications. It enables us to conduct a wide range of tests in accordance with the IEC 60099-4 standard for medium voltage surge arresters. Moreover, we utilize this laboratory for testing insulators with operational voltages of up to 60 kV during the development and production phases. Additionally, we offer testing services to our customers.

Certificates

We recognize that our customers prioritize product quality above all else. Since 2000, we have implemented and diligently upheld a guidance system that meets all the requirements of the ISO 9001 standard. The ISO 14001 certification obtained in 2007 validates our commitment to responsible product development and eco-environmental management.

Innovativeness

Our product line showcases the integration of nine patents, all developed by our dedicated Research and Development Institute. Notably, Izoelektro pioneered the creation, patenting, and commercialization of post composite insulators featuring an insulated top fitting and a ground breaking wire conductor attachment method in 2004. Furthermore, in 2019, we patented the RAM-1, a device capable of remote monitoring of the resistive component of a surge arrester during operation in real time.

Innovations

SNO (2016) - class DH surge arrester certified in accordance with the latest edition of the IEC 60099-4 standard. PKI E (2018) – a new version of the post insulator PA6 top fitting with spring clamp for conductors with cross sections from Ø15 to Ø30. RAM-1 (2020) - a device for remote monitoring of the condition of surge arresters from 1 kV to 1150 kV. iRAM (2024) - a smart surge arrester featuring an integrated remote condition monitoring system, seamlessly built into the arrester itself.

Goals

Our goal is to consistently develop and secure patents, aiming for a minimum of two per year. By doing so, we aspire to establish ourselves as an internationally recognized producer of innovative products with our own patented technologies.

Vision

Our company will be at the forefront of advancing power grid protection and insulation solutions. We will focus on developing smart surge arresters ranging from 1 to 1150 kV, featuring cutting-edge remote indication of leakage current. Our innovative efforts will also extend to post composite insulators with end fittings made of insulating material and composite insulators with capacitive indicators and remote display capabilities. By harnessing emerging technologies, we will empower the electrical infrastructure with even smarter, more reliable, and sustainable solutions, shaping a smart energy future for all.

IZOELEKTRO - AHEAD OF IT'S TIME

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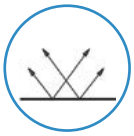
List of icons


Silicone hydrophobic


UV resistance


Self-cleaning

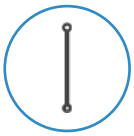
IP protection


Disconnecting Device

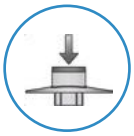

Earthing conductor H07V-K

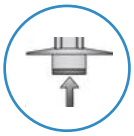

Cable lug


Terminal tube

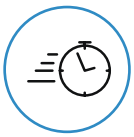

Safety tie

100% control


Mounting: top


Mounting: bottom


Insulated top fitting


Short delivery time

Made in Slovenia

Conformité Européenne


Recyclable

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List of abbreviations

AD	arcing distance
AgL	fuse type
Al	aluminium
°C	degrees celsius
CC	covered conductor
CD	creepage distance
d	diameter
D_{min}	minimum distance
DOPPS	Association for the observation and study of birds
E	electric field strength
F_h	horizontal load
F_v	vertical load
GF	glass fibre
H	height
HV	high voltage
I	length
IEC	International Electrotechnical Commimisson
I_{imp}	discharge current
I_{max}	maximum discharge current
I_n	nominal discharge current
IP	ingress protection level
kg	kilogram
kJ	kilojoule
kV	kilovolt
L	line
LV	low voltage
m	meter
mA	milliampere
mm	millimetre (unit of technical drawings)
mm^2	square millimetre
M	torque
M_t	terminal torque
M_u	cantilever strength
MV	medium voltage
N	newton
N_m	newton metre
ns	nanosecond
PA6	polyamide 6
PL	power line
s	second
SCL	specified cantilever load
ST	steel
t	time
T	temperature
tA	response time
U_c	continuous operating voltage
UL 94	flammability standard
U_{max}	maximum voltage
U_p	voltage protection level
U_r	rated voltage
U_{res}	residual voltage
UV	ultra-violet protection
v	speed of shock wave
V-0	burning rate by UL 94
W	energy absorption
µs	microsecond

Smart solutions for remote monitoring

1.1 Smart IoT Device RAM-1: Overview

RAM-1 is an intelligent IoT device specially designed for real time remote monitoring and advanced analysis of surge arresters and power grids. By incorporating the RAM-1 device in to the power grids, they are elevated to a smart level, resulting in enhanced operational processes, improved reliability, and increased stability of electricity transmission and distribution networks.

When connected to a gapless surge arrester with a continuous operating voltage above 1 kV, regardless of the manufacturer, the RAM-1 device will be able to extract the resistive component of the leakage current. This ground breaking method of extracting the resistive component of the leakage current conforms to the IEC 60099-5 standard. Measurement data can be conveniently accessed through a web interface, mobile application, or seamlessly integrated into SCADA system.

1.1.1 Prioritizing Sustainability in Development

Izoelektro places great importance on sustainability, striving to fulfil the electricity needs of consumers while safeguarding the ability of future generations to meet their own requirements. Our approach involves restructuring our product portfolio to emphasize responsible consumption and production. By enhancing the quality of working conditions and overall product performance, we ensure a more dependable electrical system operation, thus maximizing the utilization of our natural resources.

The battery incorporated into the smart IoT device RAM-1 is designed to operate for an exceptional 20 year lifespan, a rarity in today's electronic device industry. Meticulous selection of top-tier components, including the renowned Saft batteries that are certified to endure temperatures as low as -40 °C, further enhances the device's reliability and longevity.

1.1.2 Predictive Maintenance

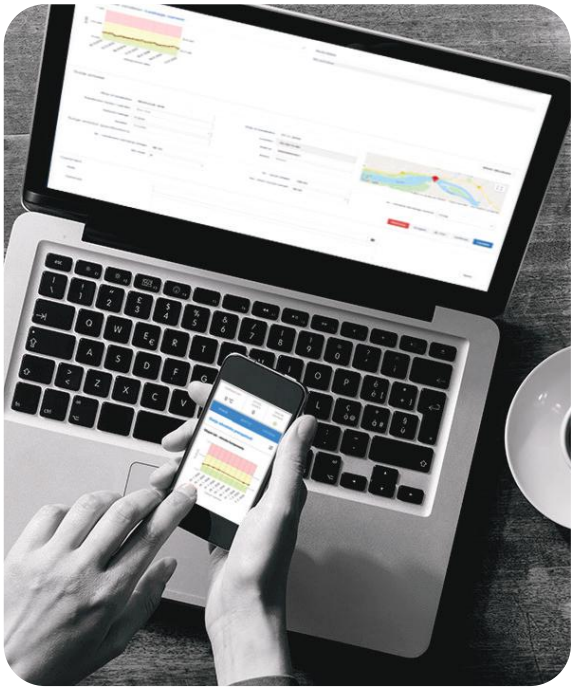
Predictive maintenance is made possible through the automatic monitoring of the power grid's state of health using RAM-1. This technology empowers grid operators to accurately forecast the timing and extent of equipment replacements, eliminating the need for physical inspections.

By utilizing our device, grid operators can effectively minimize costs. In some cases, equipment that would traditionally be replaced during preventive maintenance can now remain in operation within the grid.

1.2 RAM-Center Application

The authorized RAM-Center app by Izoelektro provides a comprehensive overview of installed RAM-1 devices, allowing for effective monitoring of surge arresters within power grids.

RAM-Center presents in-depth graphical monitoring of measurements, an extensive log of previous measurements, and instant push notifications for alerts (such as fire, sudden tilt, damage or failure of the surge arrester) as well as predefined events (such as surpassing the leakage current threshold). The app also offers GPS coordinates for installed RAM-1 devices and facilitates direct navigation to the place of installation.



Tracked Parameters

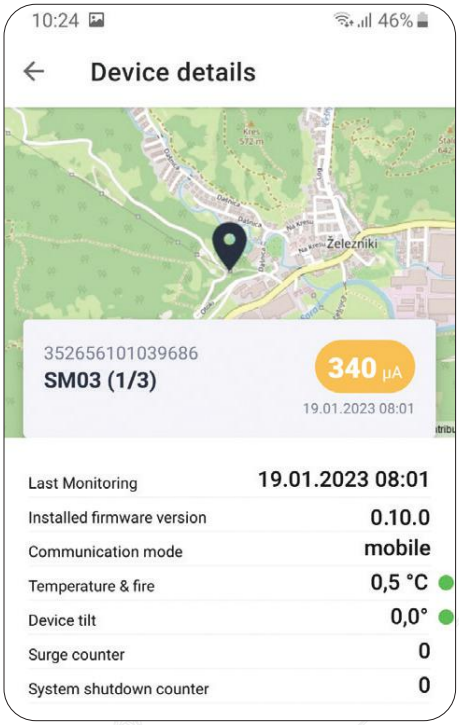
- The resistive component of leakage current
- Instantaneous faults
- Surge count
- Temperature
- Inclination
- Location

Features

- Surveillance of surge arrester's health
- Navigation to the place of installation
- Adding photos and specifications of the place of installation

Status and administration

- Get real time information about installed surge arresters
- Receive instant push notifications when the surge arrester leakage current threshold is exceeded or when alerts such as fire, malfunction, sudden tilt, etc. occur
- Take control of the settings for the RAM-1 device
- Wirelessly update the RAM-1 firmware to incorporate new features (FOTA)



1.3 RAM-1 Characteristics

The RAM-1 Smart IoT device provides:

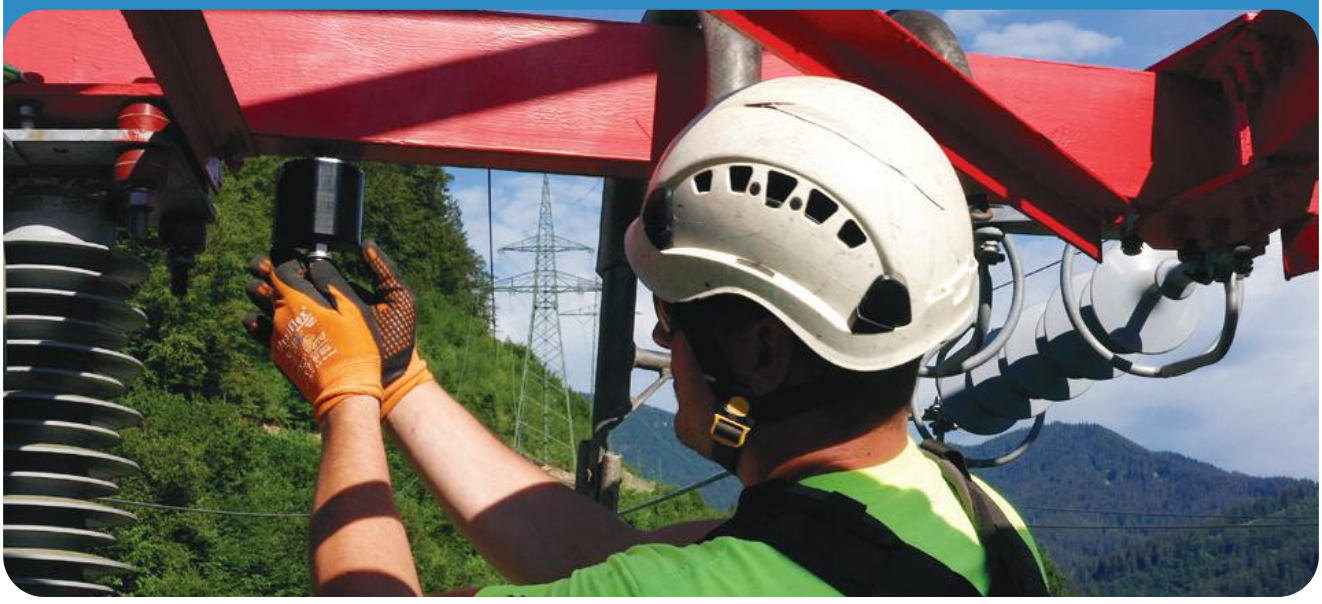
- advanced machine learning capabilities,
- simple and easy installation,
- wireless communication: 4G, 5G, or LoRaWAN,
- on-site reading and configuration function via the RAM-Center app (Bluetooth).

RAM-1 reports the following parameters:

- the resistive component of leakage current,
- excessive ambient temperature (fire detection),
- inclination/tilt or collapse detection,
- power outage detection (presence of voltage),
- lightning counter and detection of surge manipulations in the power grid,
- surge arrester destruction detection,
- activation of disconnecting device,
- event or fault location (provides navigation to the place of installation.

Competitive advantages

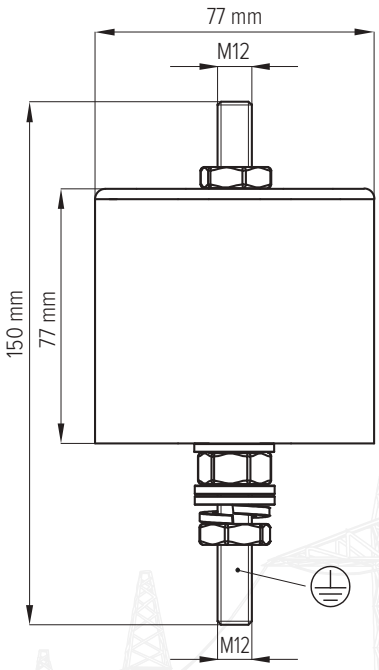
- Remote monitoring and advanced analysis of surge arresters and transmission and distribution power grids
- Real time measurement of resistive component of leakage current of surge arrester
- Surge counter, temperature sensor
- Detection of collapse or inclination/tilt, micro location, navigation to the place of installation
- Instant notifications of critical information, autonomous operation
- Machine learning capabilities based on collected data
- Compatibility with all existing and new gapless surge arresters above 1 kV, regardless of the manufacturer



1.4 RAM-1 Technical Data

Name	Description
Intended use	remote monitoring and advanced analysis of gapless surge arresters (regardless of the manufacturer) with a continuous operating voltage above 1 kV and power grids
Basic measurement	resistive component of leakage current <0.03...3 mA (± 10%)
Standard for basic measurement	IEC 60099-5
Other measurements	failure, wildfire, live line indicator, surge counter, device temperature, ambient temperature, inclination/tilt, location
Temperature range	from -40 °C up to +85 °C
Ingress protection IP	IP 67
Tested according to standards	EN 60529:1991 + A1:2000 + A2:2013 IEC/EN 62368-1:2014+A11:2017 EN 303 446-1 (EN 55032, EN 55024, EN 301 489-1/-3/-17/-19/52)
Frequency	from 48 Hz up to 62 Hz
User interface	web and mobile application (Android, iOS)
Measurement cycle	1 hour
Communication cycle	in real time: all significant faults (fire, destruction of the arrester, exceeding the recommended values) once a day – UDP package; for other measurements (with default settings) once every seven days – MQTT package; for other measurements (with default settings)
Communication	4G/5G (LTE-M/NB-IoT with PSM) or LoRaWAN; bluetooth (for on-site device configuratio and reading of measurements)
Battery autonomy	20 years*
Housing material	PA6 GF30 (UV UL 94 V-0), stainless steel A2 or A4
Connection material	stainless steel A2 or A4
Installation	on grounding side of surge arrester or in the top third of the pole/tower
Mass	0,580 kg

RAM-1 (black housing)
for medium voltage
< 110 kV



RAM-1 (light grey housing)
for high voltage
≥ 110 kV

1.5 Ordering the RAM-1 Device

Basic device versions

RAM-1 MV A2
RAM-1 HV A2

Possible device modifications - optional

A4 steel protection
External LoRaWAN antenna
AC/DC power supply
AC/DC power supply and external LoRaWAN antenna
RAM-1 with a SIM card provided by the customer

Monthly usage fee

covers: MFF2 eSIM card monthly subscription, all costs of mobile communications, AWS cloud services, unlimited use of the RAM-Center platform (web, Android, iOS), firmware and software maintenance and upgrades (functionality upgrades, upgrades of solutions obtained on the basis of machine learning) and monthly reports.

Warranty 20 years*

for battery (*using the device's default factory settings and with a stable mobile network that has the Power Saving Mode service enabled).
Built-in electronic components are covered by the electronic component manufacturer's warranty.

Explanation of the Name

RAM-1	Smart IoT device for remote monitoring and advanced analysis of surge arresters and power grids
A2 or A4	Quality of steel material
MV	black housing; for medium voltage use < 110 kV
4G/5G	Wireless communication
LoRaWAN	Wireless communication with External LoRaWAN antenna

LV Surge Arresters

2.1 NNO and MOSIPO: Overview

Low voltage metal oxide surge arresters with a silicone housing NNO and MOSPO are designed for installation in low voltage power lines or junction boxes with voltages up to 1 kV. They serve as the initial level of protection against surges and other transients. The varistors of low voltage surge arresters NNO and MOSIPO are directly moulded by silicone rubber, providing them with a high level of ingress protection rated at IP 67.

Characteristics

The disconnecting device reacts:

- after a certain number of surges when the current passing through the arrester during normal operation exceeds 1 mA
- in case of atmospheric discharge when the current exceeds 65 kA

Once the disconnecting device is activated, the surge arrester and earthing conductor are visibly separated. Subsequently, it becomes necessary to replace the surge arrester.

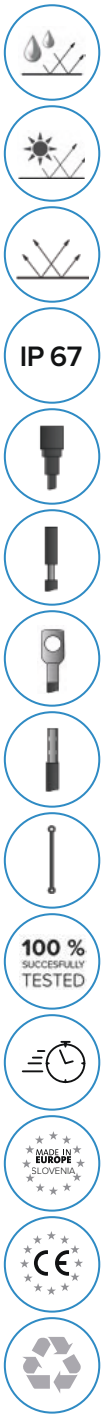
Installation

The position for installing type NNO and MOSIPO surge arresters is determined by directives and technical regulations. They must be installed:

- on all branches and terminations of LV overhead power lines,
- at a maximum mutual distance up to 1000m,
- at a distance of less than 500m in areas where, storms are more frequent,
- at all transitions from overhead lines to cables and vice versa.

General data

- Voltage levels: 275 V, 280 V, 360 V, 440 V, 690 V
- Earthing conductor: H07V-K 6 mm²
- Ambient temperature range: T = -60 °C ... +85 °C
- Ingress protection level: IP 67
- Response time: tA < 25 ns
- Housing: silicone rubber
- Silicone colour: grey
- IEC class: II
- Tested according to standards: IEC 61643-1 and IEC 61643-11a



Competitive advantages

LV surge arresters NNO and MOSIPO have:

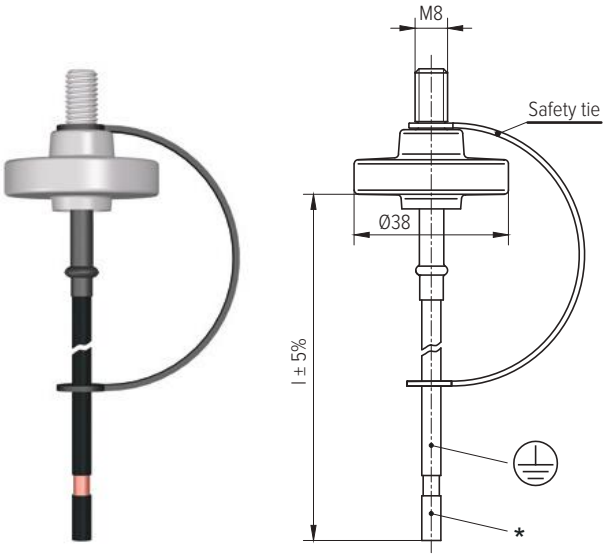
- silicone rubber housing for enhanced durability and protection,
- integrated earthing conductor for convenient installation,
- clearly visible separated conductor after disconnecting device operation.

Additionally, we offer customization options for NNO and MOSIPO surge arresters based on customer requirements:

- surge arresters without an integrated earthing conductor,
- flexibility in selecting the length, colour, and end fitting of the earthing conductor,
- factory set adjusted according to customer's specific demands.

2.2 **NNO**

At the customer's request we produce LV surge arrester NNO with any earthing conductor length, colour and end fitting.



General data

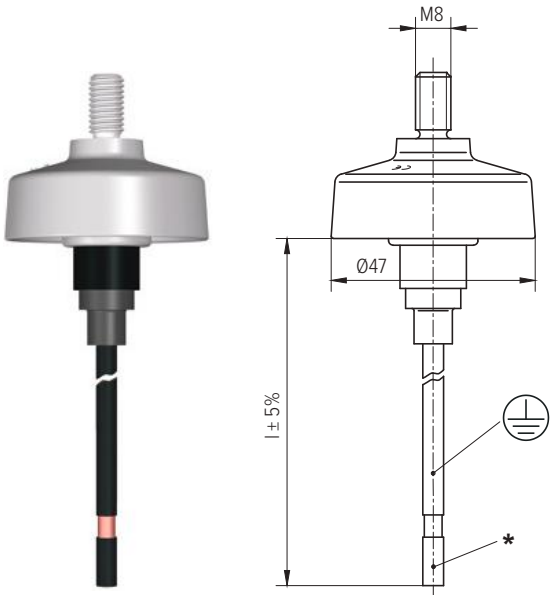
- Voltage levels: 280 V, 440 V, 690 V
- Earthing conductor: H07V-K 6 mm²
- Ambient temperature range: T = -60 °C ... +85 °C
- Ingress protection level: IP 67
- Housing: silicone rubber
- Silicone colour: grey
- IEC class: II
- Tested according to standard: IEC 61643-11

Name	I_n [kA]	Uc (AC/DC) [V]	U_p [kV]	W [J]
NNO 5/280	5	280/350	1,00	2450
NNO 5/440	5	440/585	1,50	3200
NNO 10/280	10	280/350	1,20	2450
NNO 10/440	10	440/585	1,80	3200

* End fittings of earthing conductor

2.3 **MOSIPO**

At the customer's request we produce LV surge arrester MOSIPO with any earthing conductor length, colour and end fitting.



General data

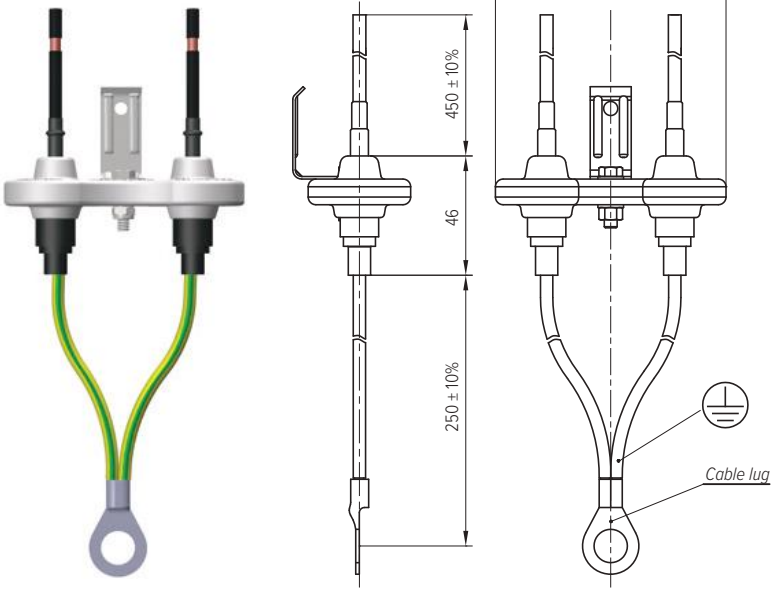
- Voltage levels: 275 V, 440 V, 690 V
- Earthing conductor: H07V-K 6 mm²
- Ambient temperature range: T = -60 °C ... +85 °C
- Ingress protection level: IP 67
- Housing: silicone rubber
- Silicone colour: grey
- IEC class: II
- Tested according to standard: IEC 61643-1, IEC 61643-11

Name	I_n [kA]	Uc (AC/DC) [V]	U_p [kV]	W [J]
MOSIPO 10/275	10	275/350	1,20	2450
MOSIPO 10/440	10	440/585	1,80	3200
MOSIPO 10/690	10	690/910	2,50	3960
MOSIPO 15/275	15	275/350	1,50	2450
MOSIPO 15/440	15	440/585	2,00	3200
MOSIPO 15/690	15	690/910	3,00	3960

* End fittings of earthing conductor

2.4 **NNO Double**

Earthing conductor: H07V-K 6 mm²
Cable lug: Cu 16/12 mm



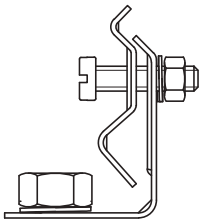
Name	I_n [kA]	U_c (AC/DC) [V]	U_p [kV]	W [J]
NNO 15/275 x 2	15	275/350	1,50	2450
NNO 15/360 x 2	15	360/465	1,80	2450
NNO 15/440 x 2	15	440/585	2,00	3200

2.5 **Most Used LV Surge Arresters**

Name	I_n [kA]	U_c (AC/DC) [V]	U_p [kV]	W [J]	Mass [kg]	l [m]
NNO 5/280 - 0,5m	5	280/350	1,00	2450	0,061	0,5
NNO 5/280 - 1,0m	5	280/350	1,00	2450	0,097	1,0
NNO 5/440 - 0,5m	5	440/585	1,50	3200	0,097	0,5
NNO 5/440 - 1,0m	5	440/585	1,50	3200	0,104	1,0
NNO 10/280 - 0,5m	10	280/350	1,20	2450	0,061	0,5
NNO 10/280 - 1,0m	10	280/350	1,20	2450	0,097	1,0
NNO 10/440 - 0,5m	10	440/585	1,80	3200	0,097	0,5
NNO 10/440 - 1,0m	10	440/585	1,80	3200	0,104	1,0
MOSIPO 10/275 - 0,5m	10	275/350	1,20	2450	0,087	0,5
MOSIPO 10/275 - 1,0m	10	275/350	1,20	2450	0,117	1,0
MOSIPO 10/440 - 0,5m	10	440/585	1,80	3200	0,095	0,5
MOSIPO 10/440 - 1,0m	10	440/585	1,80	3200	0,123	1,0
MOSIPO 10/690 - 0,5m	10	690/910	2,50	3960	0,100	0,5
MOSIPO 10/690 - 1,0m	10	690/910	2,50	3960	0,300	1,0
MOSIPO 15/275 - 0,5m	15	275/350	1,50	2450	0,087	0,5
MOSIPO 15/275 - 1,0m	15	275/350	1,50	2450	0,117	1,0
MOSIPO 15/440 - 0,5m	15	440/585	2,00	3200	0,095	0,5
MOSIPO 15/440 - 1,0m	15	440/585	2,00	3200	0,123	1,0
MOSIPO 15/690 - 0,5m	15	690/910	3,00	3960	0,100	0,5
MOSIPO 15/690 - 1,0m	15	690/910	3,00	3960	0,300	1,0

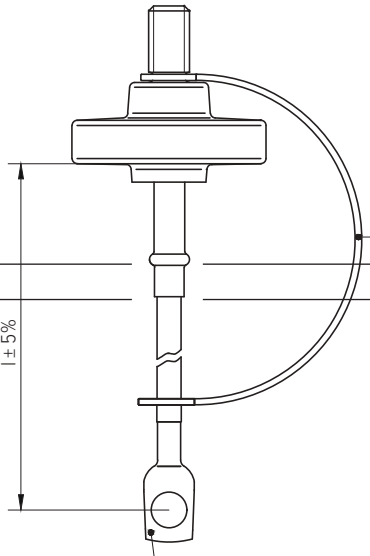
2.6 **LV Surge Arrester - Order Example**

Connector P1



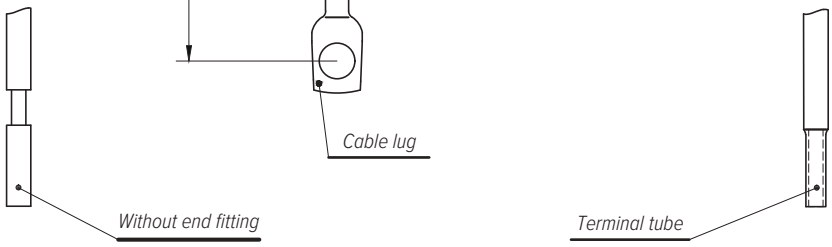
Connector P1 or P2, P3, P4, P5, P6

Surge arrester NNO



Option: NNO, MOSIPO

End fittings of earthing conductor



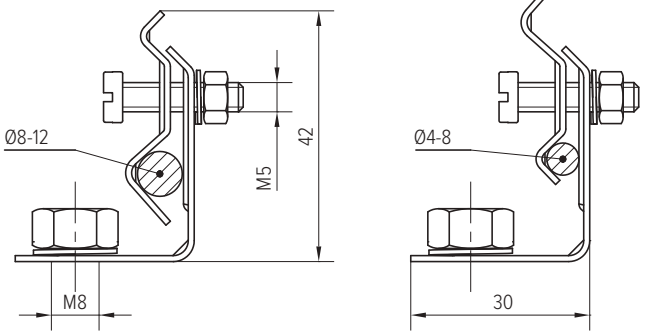
Name: **NNO 10/440 - 1,0 m + CL 6/8 + Connector P1**

Explanation of the Name

NNO	Type of LV surge arrester
10	Nominal discharge current I_n (kA)
440	Continuous operating voltage U_c (V)
1,0	Length of earthing conductor l (m)
CL 6/8	Mark of end fitting of earthing conductor
P1	Connector

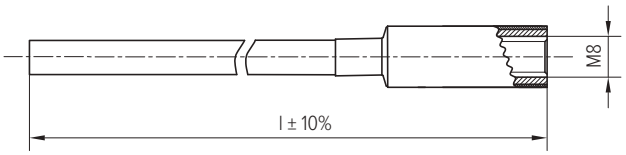
2.7 **Connector P1**

Purpose: connector for bare conductor Ø4-12 mm
Material: stainless steel A2/A4
Tightening torque M8: 5 Nm
Tightening torque M5: 6 Nm



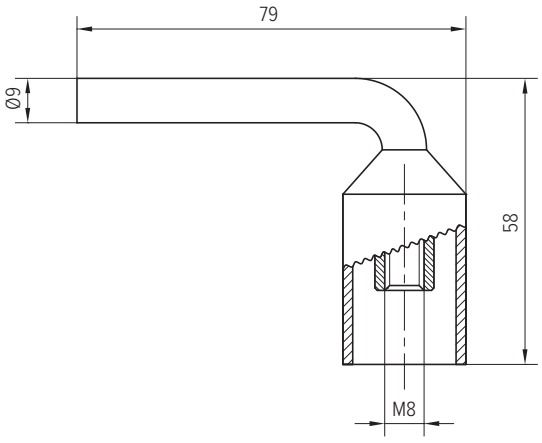
2.8 **Connector P2**

Purpose: connector for covered conductor
Material: conductor H07V-K 6 mm², tube Al
Tightening torque M8: 5 Nm - tighten by hand
Note: the length of connector P2 is customizable



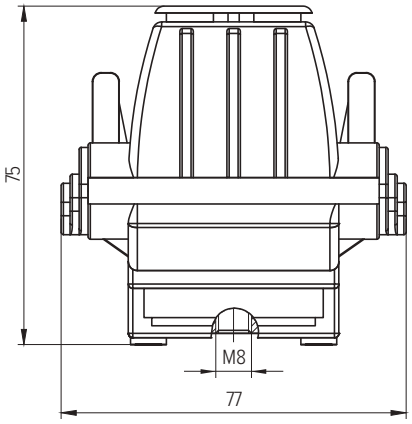
2.9 **Connector P3**

Purpose: connector for covered conductor
Material: Al, polyamide PA6 GF UV



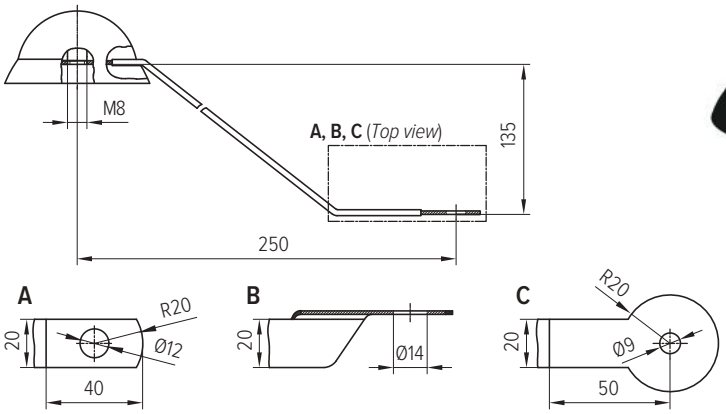
2.10 **Connector P4**

Purpose: connector for covered conductor Ø16-95
Material: Al, polyamide PA6 GF UV
Tightening torque M8: 5 Nm - tighten by hand



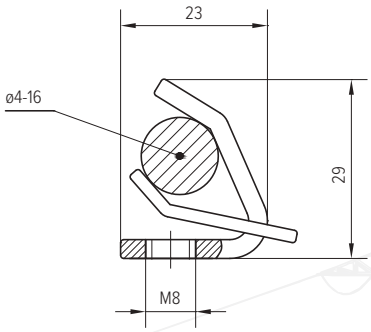
2.11 **Connector P5**

Purpose: insulated connector
Material: stainless steel A2/A4 polyamide PA6 GF UV
A - flat
B - 90°
C - round



2.12 **Connector P6**

Purpose: connector for bare conductor Ø4-16
Material: stainless steel A2/A4
Tightening torque M8: 5 Nm - tighten by hand



2.13 TY1 and TY1-F: Overview

TY1 are metal oxide surge arresters in a modular housing. TY1-F are compact metal oxide surge arresters with an integrated backup fuse. Both types are designed to be installed in the main junction box, serving as the initial level of protection against surges.

Characteristics

The disconnecting device reacts:

- when the current passing through the arrester during normal operation exceeds 1 mA,
- in case of an atmospheric discharge (when the current exceeds 100 kA).

Once the disconnecting device is activated, the visual indicator turns red. In such instances, it is necessary to replace the TY1 module. For TY1-F surge arresters, the complete surge arrester should be replaced in similar cases.

Installation

The position for installing TY1 and TY1-F surge arresters is determined on directives and technical regulations. They must be installed into junction boxes.

General data

- Response time: tA < 25 ns
- Main Backup fuse: 100 AgL
- Ambient temperature range: T = -40 °C ... +80 °C
- Ingress protection level: IP 20
- Housing: thermoplastic V-0 (UL 94)
- Possibility of remote control
- Mounting on top hat rail 35 mm
- Connection conductor cross-section
  - single-strand 35 mm^2
  - multi-strand 25 mm^2
- IEC class: I, II
- Tested according to standard: IEC 61643-11

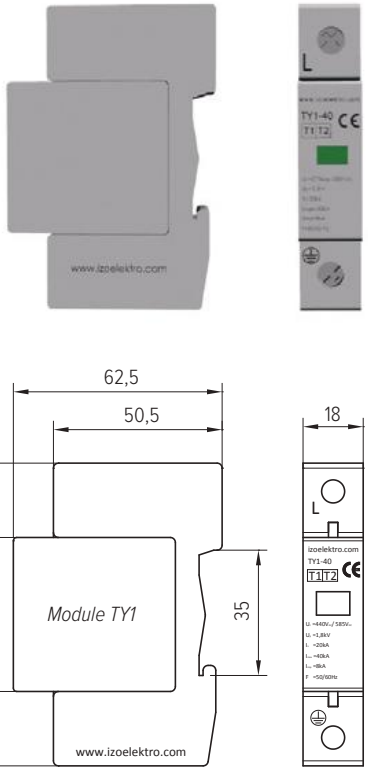
Competitive advantages

TY1-F surge arresters for indoor installation have an integrated backup fuse. Therefore the installation of a backup fuse (if main > 100 A) 100 AgL is not necessary.

TY1 and TY1-F surge arresters for indoor installation have:

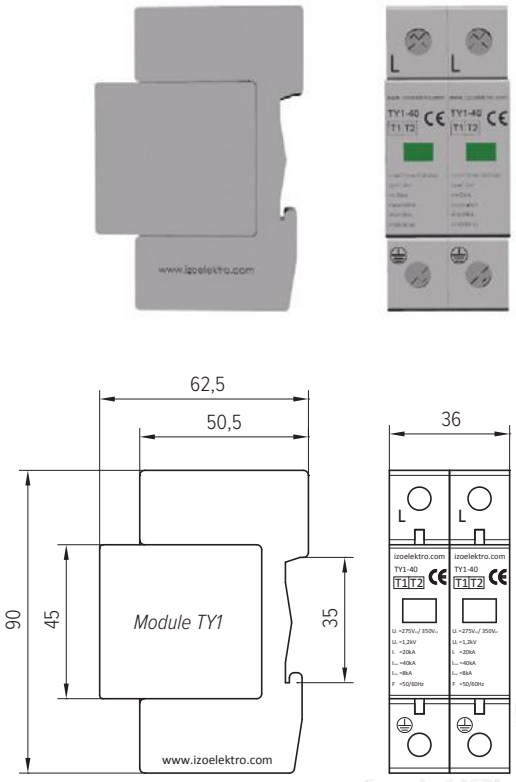
- a favourable price,
- a modular housing,
- reliable performance.

2.14 **TY1 Single Pole**



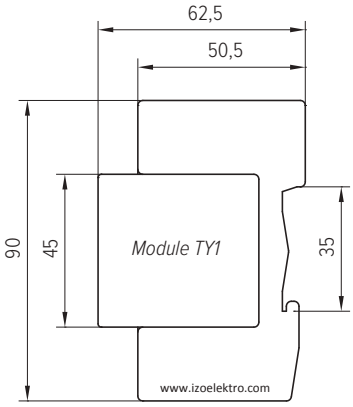
Set name	TY1 module	U_c (V)	I_n (kA)	I_{imp} (kA)	I_{max} (kA)	U_p (kV)
TY1-1-275-40	M1-275-40	275	20	8	40	< 1,2
TY1-1-320-40	M1-320-40	320	20	8	40	< 1,5
TY1-1-385-40	M1-385-40	385	20	8	40	< 1,8
TY1-1-440-40	M1-440-40	440	20	8	40	< 1,8
TY1-1-275-60	M1-275-60	275	30	12,5	60	< 1,5
TY1-1-320-60	M1-320-60	320	30	12,5	60	< 1,8
TY1-1-385-60	M1-385-60	385	30	12,5	60	< 2,0
TY1-1-440-60	M1-440-60	440	30	12,5	60	< 2,0
TY1-1-275-80	M1-275-80	275	40	20	80	< 2,0
TY1-1-320-80	M1-320-80	320	40	20	80	< 2,2
TY1-1-385-80	M1-385-80	385	40	20	80	< 2,4
TY1-1-440-80	M1-440-80	440	40	20	80	< 2,5
TY1-1-275-100	M1-275-100	275	50	25	100	< 2,4
TY1-1-320-100	M1-320-100	320	50	25	100	< 2,8
TY1-1-385-100	M1-385-100	385	50	25	100	< 3,0
TY1-1-440-100	M1-440-100	440	50	25	100	< 3,2
TY1-1-320-140	M1-320-140	320	80	25	140	< 3,0
TY1-1-385-140	M1-385-140	385	80	25	140	< 3,3
TY1-1-440-140	M1-440-140	440	80	25	140	< 3,5

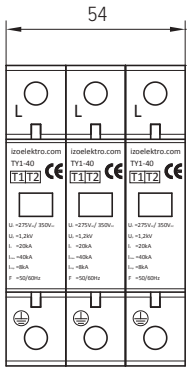
2.15 **TY1 Double Pole**



Set name	TY1 module	U_c (V)	I_n (kA)	I_{imp} (kA)	I_{max} (kA)	U_p (kV)
TY1-2-275-40	M2-275-40	275	20	8	40	< 1,2
TY1-2-320-40	M2-320-40	320	20	8	40	< 1,5
TY1-2-385-40	M2-385-40	385	20	8	40	< 1,8
TY1-2-440-40	M2-440-40	440	20	8	40	< 1,8
TY1-2-275-60	M2-275-60	275	30	12,5	60	< 1,5
TY1-2-320-60	M2-320-60	320	30	12,5	60	< 1,8
TY1-2-385-60	M2-385-60	385	30	12,5	60	< 2,0
TY1-2-440-60	M2-440-60	440	30	12,5	60	< 2,0
TY1-2-275-80	M2-275-80	275	40	20	80	< 2,0
TY1-2-320-80	M2-320-80	320	40	20	80	< 2,2
TY1-2-385-80	M2-385-80	385	40	20	80	< 2,4
TY1-2-440-80	M2-440-80	440	40	20	80	< 2,5
TY1-2-275-100	M2-275-100	275	50	25	100	< 2,4
TY1-2-320-100	M2-320-100	320	50	25	100	< 2,8
TY1-2-385-100	M2-385-100	385	50	25	100	< 3,0
TY1-2-440-100	M2-440-100	440	50	25	100	< 3,2
TY1-2-320-140	M2-320-140	320	80	25	140	< 3,0
TY1-2-385-140	M2-385-140	385	80	25	140	< 3,3
TY1-2-440-140	M2-440-140	440	80	25	140	< 3,5

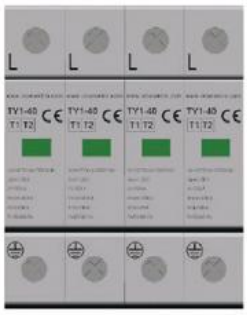
2.16 **TY1 Triple Pole**

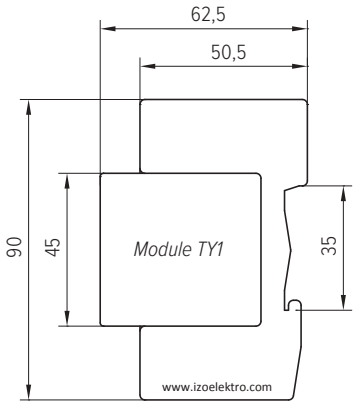


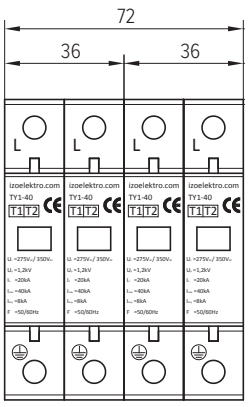


Set name	TY1 module	U_c (V)	I_n (kA)	I_{imp} (kA)	I_{max} (kA)	U_p (kV)
TY1-3-275-40	M3-275-40	275	20	8	40	< 1,2
TY1-3-320-40	M3-320-40	320	20	8	40	< 1,5
TY1-3-385-40	M3-385-40	385	20	8	40	< 1,8
TY1-3-440-40	M3-440-40	440	20	8	40	< 1,8
TY1-3-275-60	M3-275-60	275	30	12,5	60	< 1,5
TY1-3-320-60	M3-320-60	320	30	12,5	60	< 1,8
TY1-3-385-60	M3-385-60	385	30	12,5	60	< 2,0
TY1-3-440-60	M3-440-60	440	30	12,5	60	< 2,0
TY1-3-275-80	M3-275-80	275	40	20	80	< 2,0
TY1-3-320-80	M3-320-80	320	40	20	80	< 2,2
TY1-3-385-80	M3-385-80	385	40	20	80	< 2,4
TY1-3-440-80	M3-440-80	440	40	20	80	< 2,5
TY1-3-275-100	M3-275-100	275	50	25	100	< 2,4
TY1-3-320-100	M3-320-100	320	50	25	100	< 2,8
TY1-3-385-100	M3-385-100	385	50	25	100	< 3,0
TY1-3-440-100	M3-440-100	440	50	25	100	< 3,2
TY1-3-320-140	M3-320-140	320	80	25	140	< 3,0
TY1-3-385-140	M3-385-140	385	80	25	140	< 3,3
TY1-3-440-140	M3-440-140	440	80	25	140	< 3,5

2.17 **TY1 Quadruple Pole**

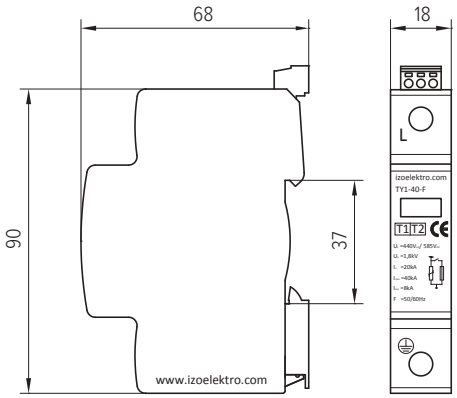






Set name	TY1 module	U_c (V)	I_n (kA)	I_{imp} (kA)	I_{max} (kA)	U_p (kV)
TY1-4-275-40	M4-275-40	275	20	8	40	< 1,2
TY1-4-320-40	M4-320-40	320	20	8	40	< 1,5
TY1-4-385-40	M4-385-40	385	20	8	40	< 1,8
TY1-4-440-40	M4-440-40	440	20	8	40	< 1,8
TY1-4-275-60	M4-275-60	275	30	12,5	60	< 1,5
TY1-4-320-60	M4-320-60	320	30	12,5	60	< 1,8
TY1-4-385-60	M4-385-60	385	30	12,5	60	< 2,0
TY1-4-440-60	M4-440-60	440	30	12,5	60	< 2,0
TY1-4-275-80	M4-275-80	275	40	20	80	< 2,0
TY1-4-320-80	M4-320-80	320	40	20	80	< 2,2
TY1-4-385-80	M4-385-80	385	40	20	80	< 2,4
TY1-4-440-80	M4-440-80	440	40	20	80	< 2,5
TY1-4-275-100	M4-275-100	275	50	25	100	< 2,4
TY1-4-320-100	M4-320-100	320	50	25	100	< 2,8
TY1-4-385-100	M4-385-100	385	50	25	100	< 3,0
TY1-4-440-100	M4-440-100	440	50	25	100	< 3,2
TY1-4-320-140	M4-320-140	320	80	25	140	< 3,0
TY1-4-385-140	M4-385-140	385	80	25	140	< 3,3
TY1-4-440-140	M4-440-140	440	80	25	140	< 3,5

2.18 TY1-F Single Pole

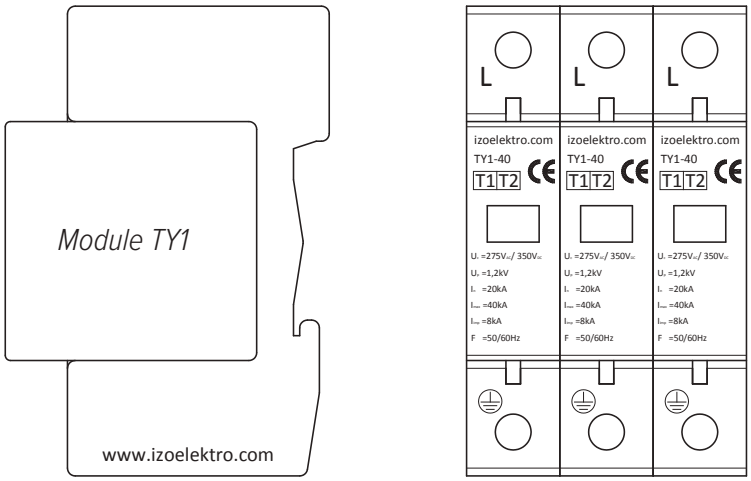


Set name	U_c (V)	I_n (kA)	I_{imp} (kA)	I_{max} (kA)	U_p (kV)
TY1-F-1-275-40	275	20	8	40	< 1,2
TY1-F-1-320-40	320	20	8	40	< 1,5
TY1-F-1-385-40	385	20	8	40	< 1,8
TY1-F-1-440-40	440	20	8	40	< 1,8
TY1-F-1-275-60	275	30	12,5	60	< 1,5
TY1-F-1-320-60	320	30	12,5	60	< 1,8
TY1-F-1-385-60	385	30	12,5	60	< 2,0
TY1-F-1-440-60	440	30	12,5	60	< 2,2
TY1-F-1-275-80	275	40	20	80	< 2,0
TY1-F-1-320-80	320	40	20	80	< 2,2
TY1-F-1-385-80	385	40	20	80	< 2,4
TY1-F-1-440-80	440	40	20	80	< 2,5
TY1-F-1-320-100	320	50	25	100	< 2,8
TY1-F-1-385-100	385	50	25	100	< 3,0
TY1-F-1-440-100	440	50	25	100	< 3,2
TY1-F-1-320-140	320	80	25	140	< 3,0
TY1-F-1-385-140	385	80	25	140	< 3,3
TY1-F-1-440-140	440	80	25	140	< 3,5

2.19 The Most Frequently Used Products in the Order TY1

Name	I_n (kA)	U_c (V)	I_{imp} (kA)	I_{max} (kA)	Mass (kg)	U_p (kV)	No. of poles
TY1-1-275-40	20	275	8	40	0,126	<1,2	1
TY1-1-440-40	20	440	8	40	0,129	<1,8	1
TY1-2-275-40	20	275	8	40	0,260	<1,2	2
TY1-2-440-40	20	440	8	40	0,266	<1,8	2
TY1-3-275-40	20	275	8	40	0,362	<1,2	3
TY1-3-440-40	20	440	8	40	0,390	<1,8	3
TY1-4-275-40	20	275	8	40	0,520	<1,2	4
TY1-4-440-40	20	440	8	40	0,540	<1,8	4

2.20 **TY1 and TY1-F - Order Example**



Name: **TY1-3-275-40**

Explanation of the Name

TY1	Type of LV surge arrester
3	Number of poles
275	Continuous operating voltage U_c (V)
40	Maximum discharge current I_{max} (kA)

MV Surge Arresters

3.1 SNO and 2SS15N: Overview

SNO and 2SS15N are medium voltage metal oxide surge arresters with directly moulded silicone rubber housing. They are designed to be installed in MV power grids up to 52 kV as protection against surges and other transients.

Characteristics

Their top quality is ensured by:

- a top quality varistor block,
- a rigid construction,
- housing resistant to UV radiation and chemical influences,
- all used materials are resistant to weathering and ageing,
- varistors that are directly moulded by silicone rubber.

Installation

The position for installing SNO and 2SS15N surge arresters is determinated by directives and technical regulations.

Surge arresters SNO and 2SS15N are used for:

- indoor and outdoor installation,
- protection of electric devices,
- protection of compensation devices,
- railways, mines, ...

General data

- Ambient temperature range T = -60 °C ... +85 °C
- Housing: silicone rubber
- Silicone colour: grey
- Connection thread: M12x27 mm

Type	SNO	2SS15N
Standard	IEC 60099-4:2014 and IEC 60099-5	IEC 60099-4:2004 and IEC 60099-5
IEC class	DH	1

Competitive advantages

MV surge arresters SNO and 2SS15N for outdoor and indoor installation have:

- certification from an accredited laboratory,
- varistors directly moulded by silicone rubber,
- a rigid housing construction,
- low residual voltage,
- high energy absorption capacity,
- excellent mechanical properties,
- 100% final inspection conducted in our own laboratory.

We offer customized production and delivery of SNO and 2SS15N surge arresters:

- as a factory set per customer's choice,
- with continuous operating voltage U_c from 1 to 44kV,
- with an indelible measurement number on each arrester.

3.2 Class 1 - Calculation and Selection

3.2.1 Calculation

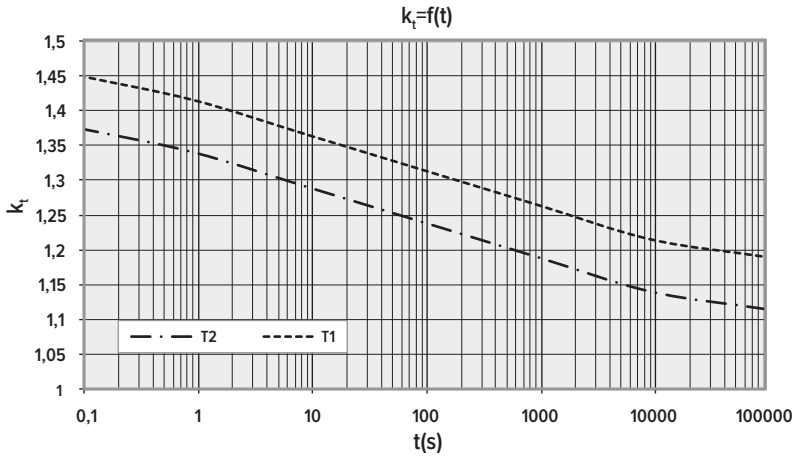
Data of electric network

- U_m – maximum voltage
- t – short circuit duration time
- k_z – factor of earthing
  - k_z = 1,40 – directly earthed
  - k_z = 1,40 – 1,7 with little resistance
  - k_z = 1,73 – 1,8 with a neutral insulated spot

Data for surge arresters type 2SS15N

- k_0 = 0,8
- k_t = factor of continious operating voltage for temporary over voltage duration time.

Characteristics diagram for type 2SS15N



Legend:
Curve T1:
without prior energy

Curve T2:
100 kA, 4/10 µs
prior energy

Calculation

- Continuous operating voltage of system:

$$U_{cs} = \frac{U_m}{\sqrt{3}} \; [kV]$$

- Preliminary operating voltage of surge arrester:

$$U_{c1} = \frac{U_{cs}}{k_0} \; [kV]$$

- Highest expected transient over voltage of surge arrester:

$$U_t = k_z \frac{U_m}{\sqrt{3}} \; [kV]$$

- Continuous operating voltage of surge arrester:

$$U_{c2} = \frac{U_t}{k_t} \; [kV]$$

3.2.2 Selection

We choose a suitable surge arrester from tables with data based on higher calculated value between U_{C1} and U_{C2} so, that we choose the first higher value of continuous operating voltage U_C specified in the table.

3.3 Determination of the Shielding Distance

Data of electric network

The level of protection provided to devices on power lines relies on the distance between the surge arrester and the protected device. The surge arrester protects within a specific distance from its installation point.

The calculations require the following data:

- l_z shielding distance of the surge arrester
- U_z allowed trigger voltage of insulating equipment.
- U_{res} maximum value of residual voltage for the chosen type of surge arresters
- v speed of shock wave spreading through power lines
  v = 300 m/μs – overhead line
  v = 150 m/μs – cable
- S anticipated steepness of high voltage surge
  S = 1550 kV/μs – wooden poles
  S = 800 kV/μs – earthed brackets

Calculation

Simplified formula for calculating the shielding distance:

$$l_z = \frac{U_z - U_{res}}{2S} v$$

As a general rule, the surge arrester should be installed as close as possible to the device it protects.

3.4 Parameters for Type 2SS15N - Class 1

Arrester class	1
Arrester type	2SS15N
Commercial designation	R, RP, RO, NO
Continuous operating voltage U_c	3 – 44 kV
Rated voltage U_r	3,7 – 55 kV
Nominal discharge current I_n (8/20μs)	10 kA
High impulse current (4/10μs)	100 kA
Short circuit current (I_{sc})	20 kA
Long-duration current (I_{2ms})	250 A
Energy absorption capability (long duration) (W_{2ms})	2,8 kJ/kVU_c
Energy absorption capability (impulse current) ($W_{4/10}$)	4,8 kJ/kVU_c
Cantilever strenght 24 kV (M_u)	300 Nm
Cantilever strenght 36 kV (M_u)	250 Nm
Vertical load (F_v)	625 N
Terminal torque at Ur= 45 kV (M_t)	80 Nm

3.5 Class DH - Calculation and Selection

3.5.1 Calculation

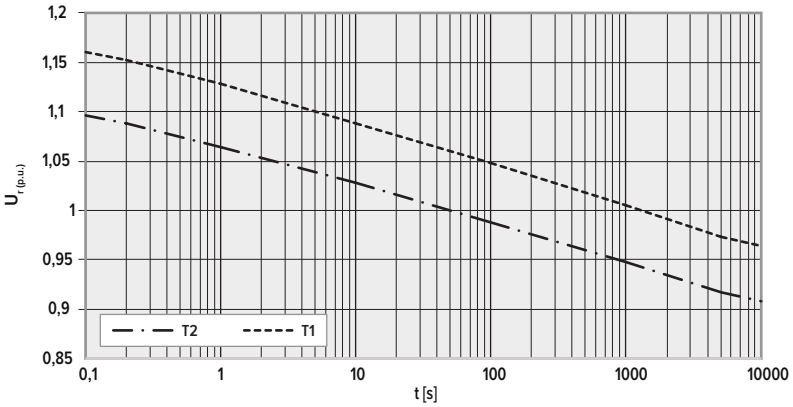
Data of electric network

- U_m – maximum voltage
- t – short circuit duration time
- k_z – factor of earthing
  - k_z = 1,40 – directly earthed
  - k_z = 1,40 – 1,7 with little resistance
  - k_z = 1,73 – 1,8 with a neutral insulated spot

Data for surge arresters types SNO

- k_0 = 0,8
- k_t = factor of rated voltage for temporary over voltage duration time.

Characteristics for type SNO



Legend:
Curve T1:
without prior energy

Curve T2:
2 x 34 kA, 8/20
prior energy

Calculation

- Rated voltage of system:

$$U_{rs} = \frac{U_m}{\sqrt{3}} \times 1{,}25\ [kV]$$

- Preliminary rated voltage of surge arrester:

$$U_{r1} = \frac{U_{rs}}{k_0}\ [kV]$$

- Highest expected transient over voltage of surge arrester:

$$U_t = k_z \frac{U_m}{\sqrt{3}}\ [kV]$$

- Rated voltage of surge arrester:

$$U_{r2} = \frac{U_t}{k_t}\ [kV]$$

3.5.2 Selection

We choose a suitable surge arrester from tables with data based on higher calculated value between U_{r1} and U_{r2} so, that we choose the first higher value of rated voltage U_r specified in the table.

3.6 Determination of the Shielding Distance

Data of electric network

The level of protection provided to devices on power lines relies on the distance between the surge arrester and the protected device. The surge arrester protects within a specific distance from its installation point.

The calculations require the following data:

- l_z shielding distance of the surge arrester
- U_z allowed trigger voltage of insulating equipment.
- U_{res} maximum value of residual voltage for the chosen type of surge arresters
- v speed of shock wave spreading through electric power lines
  v = 300 m/μs – overhead line
  v = 150 m/μs – cable
- S anticipated steepness of high voltage surge
  S = 1550 kV/μs – wooden poles
  S = 800 kV/μs – earthed brackets

Calculation

Simplified formula for calculating the shielding distance:

$$l_z = \frac{U_z - U_{res}}{2S} v$$

As a general rule, the surge arrester should be installed as close as possible to the device it protects.

3.7 Parameters for Type SNO - Class DH

Arrester class	DH
Arrester type	SNO
Commercial designation	RP, NO
Continuous operating voltage U_c	3 – 44 kV
Rated voltage U_r	4 – 55 kV
Nominal discharge current I_n (8/20μs)	10 kA
High impulse current (4/10μs)	100 kA
Short circuit current (I_{sc})	20 kA
Thermal charge transfer rating (Q_{th})	1,1 C
Repetitive charge transfer rating (Q_{rs})	0,4 C
Cantilever strenght at Ur=55 kV (M_u)	250 Nm
Vertical load (F_v)	800 N
Terminal torque at Ur= 55 kV (M_t)	50 Nm

3.8 The Comparison of Energy Absorption Between Class 1 and Class DH According to IEC 60099-4:2014 (Ed.3.0)

Comparision table from IEC 60099-4:2014 (Ed.3.0)

Table L.3 – comparision of the classification system according to IEC 60099-4:2009 (Ed.2.2) and to IEC 60099-4:2014 (Ed.3.0)

Old LDC	Required minimum test energy[a]	Corresponding new thermal energy rating as per 8.7.3 W_{th}	Estimated current at old LD test[b]	Charge calculated with the same current and duration as for old LDC to give the required minimum energy	Corresponding new repetitive charge transfer rating as per 8.5.4 Q_{rs}	Repetitive charge transfer test value (=1,1 x Q_{rs})
	kJ/kV	kJ/kV	A	C	C	C
1	1,0	2	277	0,56	0,5	0,55
2	2,1	4	538	1,10	1	1,10
3	3,3	7	721	1,78	1,6	1,76
4	5,0	10	962	2,75	2,4	2,64
5	6,9	14	1118	3,75	3,6	3,96

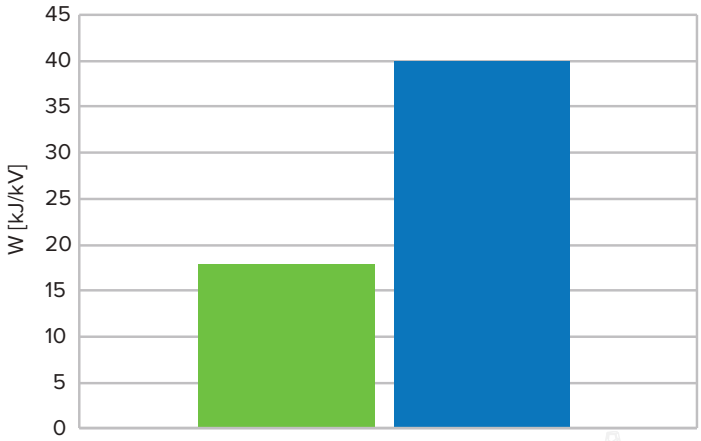
[a] Calculated with U_{resmin} (I_{min}) = 1,8 x U_r, [b] Estimated from LD parameters and b) and c) above.

Interpretation of the comparative diagram 1

Based on the comparison table L.3 a comparative diagram 1 was drawn where a graphical visualization between the hypothetical energy absorption of the Class 1 surge arrester and the actual energy absorption of the Class DH surge arrester is presented. Calculating the hypothetical energy absorption of the Class 1 surge arrester on the basis of the new standard edition shows that the Class 1 surge arrester would absorb a total of 18 kJ/kV of energy whereas the Class DH must absorb according to the new standard edition 40 kJ/kV.

Comparative diagram 1

Energy absorption



Legend:
W: energy [kJ/kV]

Class 1 ..... 2SS15N
Class DH ..... SNO

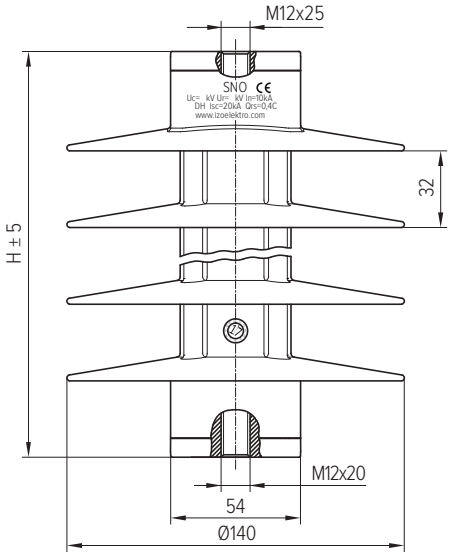
Abstract

The Class DH surge arresters, specifically the SNO type, have the ability to absorb and dissipate 122% more energy compared to Class 1 surge arresters. This enhanced energy absorption capability provides greater protection against electrical surges.

3.9 **Class DH**

3.9.1 **SNO - RP**

Surge arrester type: SNO
Commercial designation: RP



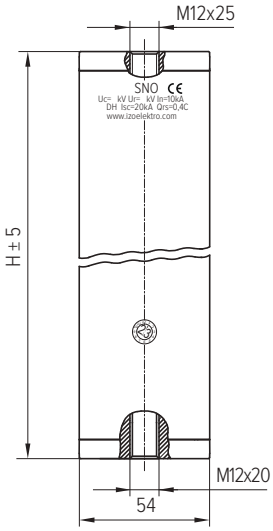
SNO - RP 12 kV

ELECTRICAL CHARACTERISTICS								*MEHANICAL CHARACTERISTICS*							
U_r	U_c	U_{res}				U_{peak}	U_{rms}	SSL	SLL	AD	CD	A	B	H	N
		1/2,5µs 10 kA	8/20µs 5 kA	8/20µs 10 kA	8/20µs 100 A	1,2/50µs	50 Hz, 1 min								
[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[N]	[N]	[mm]	[mm]	[mm]	[mm]	[mm]	
3,0	2,4	7,73	6,84	7,39	5,59							80	100		
6,0	4,8	15,47	13,69	14,77	11,17	90	35	1888	1437	154	343	100	120	136	3
9,0	7,2	23,20	20,53	22,16	16,76							120	140		
12,0	9,6	30,94	27,38	29,54	22,34	105	40	1528	1163	186	453	140	160	168	4
15,0	12,0	38,67	34,22	36,93	27,93							160	180		
18,0	14,4	46,40	41,06	44,32	33,52	120	45	1284	975	218	563	180	200	200	5
21,0	16,8	54,14	47,91	51,70	39,10							200	220		
24,0	19,2	61,87	54,75	59,09	44,69							220	240		
25,0	20,0	64,45	57,03	61,55	46,55	130	50	1106	841	250	674	240	260	232	6
27,0	21,6	69,61	61,60	66,47	50,27							260	280		
27,5	22,0	70,90	62,74	67,71	51,21	140	65	976	742	282	784	270	300	263	7
30,0	24,0	77,34	68,44	73,86	55,86							300	320		
33,0	26,4	85,07	75,28	81,25	61,45	150	75	870	662	314	894	320	340	295	8
36,0	28,8	92,81	82,13	88,63	67,03							340	360		
39,0	31,2	100,54	88,97	96,02	72,62	160	80	785	597	345	1004	380	400	327	9
42,0	33,6	108,28	95,82	103,40	78,20							400	420		
45,0	36,0	116,01	102,66	110,79	83,79	170	85	715	544	377	1114	420	440	359	10
48,0	38,4	123,74	109,50	118,18	89,38							440	460		
51,0	40,8	131,48	116,35	125,56	94,96	180	90	656	500	409	1234	460	480	391	11
55,0	44,0	141,79	125,47	135,41	102,41							470	490		

U_c Continuous operating voltage
U_r Rated voltage
U_{res} Residual voltages at different impulse currents
U_{peak} Lightning impulse withstand voltage 1,2/50µs in dry
U_{rms} Power frequency withstand voltage 1 min. 50Hz, wet
SSL Specific short-term load
SLL Specific long-term load
AD Arcing distance
CD Creepage distance
A Minimum distance to wall
B Minimum distance between phases
H Surge arrester height
N Number of sheds

3.9.2 **SNO - NO**

Surge arrester type: SNO
Commercial designation: NO



SNO - NO 12 kV

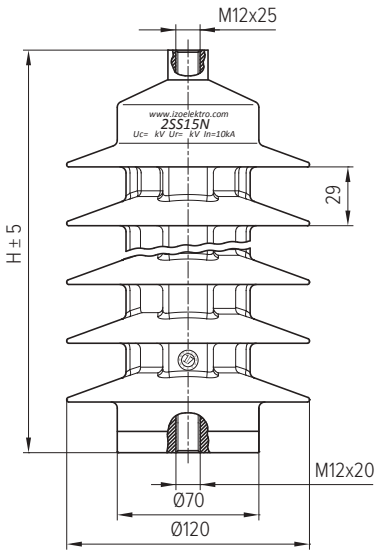
ELECTRICAL CHARACTERISTICS								*MEHANICAL CHARACTERISTICS*						
U_r	U_c	U_{res}				U_{peak}	U_{rms}	SSL	SLL	AD	CD	A	B	H
		1/2,5µs 10 kA	8/20µs 5 kA	8/20µs 10 kA	8/20µs 100 A	1,2/50µs	50 Hz, 1 min							
[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[N]	[N]	[mm]	[mm]	[mm]	[mm]	[mm]
3,0	2,4	7,73	6,84	7,39	5,59							80	100	
6,0	4,8	15,47	13,69	14,77	11,17	70	25	1888	1437	120	120	100	120	136
9,0	7,2	23,20	20,53	22,16	16,76							120	140	
12,0	9,6	30,94	27,38	29,54	22,34	85	30	1528	1163	152	152	140	160	168
15,0	12,0	38,67	34,22	36,93	27,93							160	180	
18,0	14,4	46,40	41,06	44,32	33,52	100	35	1284	975	184	184	180	200	200
21,0	16,8	54,14	47,91	51,70	39,10							200	220	
24,0	19,2	61,87	54,75	59,09	44,69							220	240	
25,0	20,0	64,45	57,03	61,55	46,55	110	40	1106	841	216	216	240	260	232
27,0	21,6	69,61	61,60	66,47	50,27							260	280	
27,5	22,0	70,90	62,74	67,71	51,21	120	55	976	742	247	247	270	300	263
30,0	24,0	77,34	68,44	73,86	55,86							300	320	
33,0	26,4	85,07	75,28	81,25	61,45	130	65	870	662	279	279	320	340	295
36,0	28,8	92,81	82,13	88,63	67,03							340	360	
39,0	31,2	100,54	88,97	96,02	72,62	140	70	785	597	311	311	380	400	327
42,0	33,6	108,28	95,82	103,40	78,20							400	420	
45,0	36,0	116,01	102,66	110,79	83,79	150	75	715	544	343	343	420	440	359
48,0	38,4	123,74	109,50	118,18	89,38							440	460	
51,0	40,8	131,48	116,35	125,56	94,96	165	80	656	500	375	375	460	480	391
55,0	44,0	141,79	125,47	135,41	102,41							470	490	

U_c Continuous operating voltage
U_r Rated voltage
U_{res} Residual voltages at different impulse currents
U_{peak} Lightning impulse withstand voltage 1,2/50µs in dry
U_{rms} Power frequency withstand voltage 1 min. 50Hz in dry
AD Arcing distance
CD Creepage distance
A Minimum distance to wall
B Minimum distance between phases
H Surge arrester height

3.10 **Class 1**

3.10.1 **2SS15N - R**

Surge arrester type: 2SS15N
Commercial designation: R



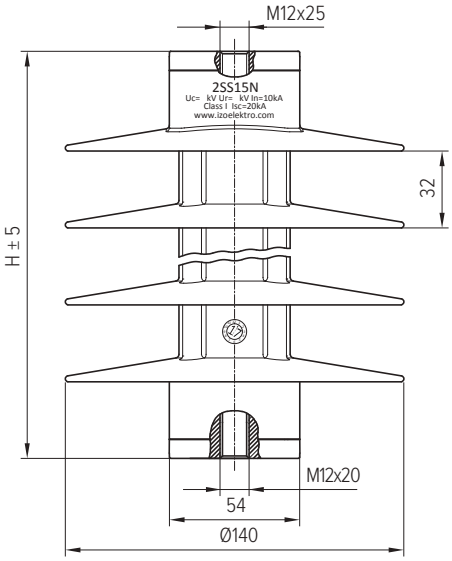
2SS15N - R 12 kV

ELECTRICAL CHARACTERISTICS											*MEHANICAL CHARACTERISTICS*					
U_r	U_c	U_{res}							U_{peak}	U_{rms}	AD	CD	A	B	H	N
		1/20µs 5 kA	1/20µs 10 kA	8/20µs 5 kA	8/20µs 10 kA	8/20µs 20 kA	30/60µs 125 A	30/60µs 500 A	1,2/50µs	50 Hz, 1 min						
[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[mm]	[mm]	[mm]	[mm	[mm]	
3,75	3	8,55	9,65	7,18	8,78	9,60	7,35	7,85					60	90		
5,00	4	12,8	14,20	11,25	12,92	14,15	9,63	10,16	62	25	139	360	80	100	147	3
7,50	6	21,35	23,85	17,95	21,70	23,75	16,98	18,01					100	120		
10,00	8	25,60	28,40	26,12	25,84	28,30	19,26	20,32					120	140		
12,50	10	34,15	38,05	29,00	34,62	37,90	26,61	28,17	98	35	185	520	140	160	193	5
15,00	12	38,40	42,60	33,15	38,96	42,45	28,89	30,48					160	180		
17,50	14	46,95	52,25	39,98	47,54	52,05	36,24	38,33					180	200		
20,00	16	51,20	56,80	44,10	51,68	56,60	38,52	40,64	125	55	235	600	200	220	243	6
22,50	18	59,75	66,45	51,26	60,46	66,20	45,87	48,49					220	240		
25,00	20	64,00	71,00	55,45	64,60	70,75	48,15	50,80					240	260		
26,25	21	67,55	77,10	58,93	67,95	76,25	52,15	54,55					260	280		
27,50	22	72,55	80,65	63,00	73,38	80,35	55,50	58,65	135	60	262	680	270	300	270	7
30,00	24	76,80	85,20	66,15	75,98	84,90	57,78	60,96					320	320		
30,00	24	76,80	85,20	66,15	75,95	84,90	57,78	60,96					320	320		
32,50	26	85,35	94,85	77,20	84,76	94,50	65,13	68,81	150	65	309	760	340	340	317	8
35,00	28	89,60	99,40	84,90	88,21	99,05	67,41	71,12					360	360		
37,50	30	98,15	109,05	88,00	96,99	108,65	74,76	78,97					295	380		
40,00	32	102,40	113,60	96,05	101,15	113,20	77,04	81,28					380	400		
43,75	35	112,30	125,50	97,86	112,81	125,15	85,16	90,12	170	70	362	1000	410	430	370	11
45,00	36	115,20	127,80	99,10	114,10	127,25	86,67	91,44					420	440		
42,50	34	110,95	123,25	96,05	109,93	122,80	84,39	89,13					400	420		
45,00	36	115,20	127,80	99,10	114,10	127,35	86,67	91,44	180	75	396	1080	420	440	404	12
50,60	40,5	125,76	136,35	114,89	129,78	146,25	96,12	101,35					450	470		

U_c Continuous operating voltage
U_r Rated voltage
U_{res} Residual voltages at different impulse currents
U_{peak} Lightning impulse withstand voltage 1,2/50µs in dry
U_{rms} Power frequency withstand voltage 1 min. 50Hz, wet
AD Arcing distance
CD Creepage distance
A Minimum distance to wall
B Minimum distance between phases
H Surge arrester height
N Number of sheds

3.10.2 **2SS15N - RP**

Surge arrester type: 2SS15N
Commercial designation: RP



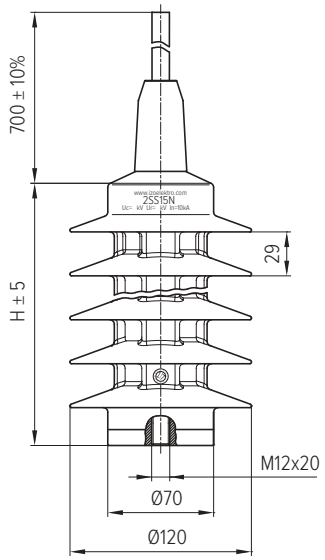
2SS15N-RP 12 kV

ELECTRICAL CHARACTERISTICS											*MEHANICAL CHARACTERISTICS*					
U_r	U_c	U_{res}							U_{peak}	U_{rms}	AD	CD	A	B	H	N
		1/20µs 5 kA	1/20µs 10 kA	8/20µs 5 kA	8/20µs 10 kA	8/20µs 100 A	30/60µs 125 A	30/60µs 500 A	1,2/50µs	50 Hz, 1 min						
[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[mm]	[mm]	[mm]	[mm]	[mm]	
3,75	3	8,55	9,65	7,18	8,78	6,20	7,35	7,85	90	35	154	343	60	90	136	3
5,00	4	12,80	14,20	11,25	12,92	8,93	9,63	10,16					80	100		
7,50	6	21,35	23,85	17,95	21,70	15,12	16,98	18,01					100	120		
10,00	8	25,60	28,40	26,12	25,84	17,85	19,26	20,32					120	140		
12,50	10	34,15	38,05	29,00	34,62	24,05	26,61	28,17	105	40	186	453	140	160	168	4
15,00	12	38,40	42,60	33,15	38,76	26,78	28,89	30,48					160	180		
17,50	14	46,95	52,25	39,98	47,54	32,97	36,24	38,33	120	45	218	563	180	200	200	5
20,00	16	51,20	56,80	44,10	51,68	35,70	38,52	40,64					200	220		
22,50	18	59,75	66,45	51,26	60,46	41,90	45,87	48,49	130	50	250	674	220	240	232	6
25,00	20	64,00	71,00	55,45	64,60	44,63	48,15	50,80					240	260		
26,25	21	67,55	77,10	58,93	67,95	48,09	52,15	54,55	140	65	282	784	260	280	263	7
27,50	22	72,55	80,65	63,00	73,38	50,82	55,50	58,65					270	300		
30,00	24	76,80	85,20	66,15	75,98	53,55	57,78	60,96					300	320		
32,50	26	85,35	94,85	74,39	84,76	59,75	65,13	68,81	150	75	314	894	320	340	295	8
35,00	28	89,60	99,40	77,20	88,21	62,48	67,41	71,12					340	360		
37,50	30	98,15	109,05	84,90	96,99	68,67	74,46	78,97	160	80	345	1004	360	380	327	9
40,00	32	102,40	113,60	88,00	101,15	71,40	77,04	81,28					380	400		
42,50	34	110,95	123,25	96,05	109,93	77,60	84,39	89,13	170	85	377	1114	400	420	359	10
45,00	36	115,20	127,80	99,10	114,10	80,33	86,67	91,44					420	440		
47,50	38	120,35	130,33	106,25	123,66	86,52	90,85	95,65	180	90	409	1234	440	460	391	11
50,00	40	124,87	135,63	114,33	129,78	89,25	95,50	100,75					450	470		
52,50	42	130,50	138,75	120,63	137,85	95,45	100,43	105,47					460	480		
55,00	44	136,75	143,25	127,55	142,68	98,18	103,58	108,35					470	490		

U_c Continuous operating voltage
U_r Rated voltage
U_{res} Residual voltages at different impulse currents
U_{peak} Lightning impulse withstand voltage 1,2/50µs in dry
U_{rms} Power frequency withstand voltage 1 min. 50Hz, wet
AD Arcing distance
CD Creepage distance
A Minimum distance to wall
B Minimum distance between phases
H Surge arrester height
N Number of sheds

3.10.3 **2SS15N - RO**

Surge arrester type: 2SS15N
Commercial designation: RO



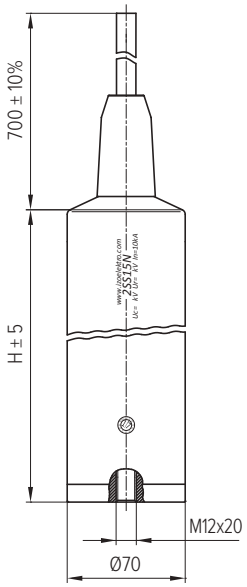
2SS15N - RO 12 kV

ELECTRICAL CHARACTERISTICS											*MEHANICAL CHARACTERISTICS*					
U_r	U_c	U_{res}							U_{peak}	U_{rms}	AD	CD	A	B	H	N
		1/20µs 5 kA	1/20µs 10 kA	8/20µs 5 kA	8/20µs 10 kA	8/20µs 20 kA	30/60µs 125 A	30/60µs 500 A	1,2/50µs	50 Hz, 1 min						
[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[mm]	[mm]	[mm]	[mm	[mm]	
3,75	3	8,55	9,65	7,18	8,78	9,60	7,35	7,85					60	90		
5,00	4	12,8	14,20	11,25	12,92	14,15	9,63	10,16	62	25	257	491	80	100	129	3
7,50	6	21,35	23,85	17,95	21,70	23,75	16,98	18,01					100	120		
10,00	8	25,60	28,40	26,12	25,84	28,30	19,26	20,32					120	140		
12,50	10	34,15	38,05	29,00	34,62	37,90	26,61	28,17	98	35	303	651	140	160	175	5
15,00	12	38,40	42,60	33,15	38,96	42,45	28,89	30,48					160	180		
17,50	14	46,95	52,25	39,98	47,54	52,05	36,24	38,33					180	200		
20,00	16	51,20	56,80	44,10	51,68	56,60	38,52	40,64	125	55	353	731	200	220	225	6
22,50	18	59,75	66,45	51,26	60,46	66,20	45,87	48,49					220	240		
25,00	20	64,00	71,00	55,45	64,60	70,75	48,15	50,80					240	260		
26,25	21	67,55	77,10	58,93	67,95	76,25	52,15	54,55					260	280		
27,50	22	72,55	80,65	63,00	73,38	80,35	55,50	58,65	135	60	380	811	270	300	252	7
30,00	24	76,80	85,20	66,15	75,98	84,90	57,78	60,96					320	320		
30,00	24	76,80	85,20	74,39	75,95	84,90	57,78	60,96					320	320		
32,50	26	85,35	94,85	77,20	84,76	94,50	65,13	68,81	150	65	427	891	340	340	299	8
35,00	28	89,60	99,40	84,90	88,21	99,05	67,41	71,12					360	360		
37,50	30	98,15	109,05	88,00	96,99	108,65	74,76	78,97					295	380		
40,00	32	102,40	113,60	96,05	101,15	113,20	77,04	81,28					380	400		
43,75	35	112,30	125,50	97,86	112,81	125,15	85,16	90,12	170	70	480	1131	410	430	352	11
45,00	36	115,20	127,80	99,10	114,10	127,25	86,67	91,44					420	440		
42,50	34	110,95	123,25	96,05	109,93	122,80	84,39	89,13					400	420		
45,00	36	115,20	127,80	99,10	114,10	127,35	86,67	91,44	180	75	517	1211	420	440	386	12
50,60	40,5	125,76	136,35	114,89	129,78	146,25	96,12	101,35					450	470		

U_c Continuous operating voltage
U_r Rated voltage
U_{res} Residual voltages at different impulse currents
U_{peak} Lightning impulse withstand voltage 1,2/50µs in dry
U_{rms} Power frequency withstand voltage 1 min. 50Hz, wet
AD Arcing distance
CD Creepage distance
A Minimum distance to wall
B Minimum distance between phases
H Surge arrester height
N Number of sheds

3.10.4 **2SS15N - NO**

Surge arrester type: 2SS15N
Commercial designation: NO

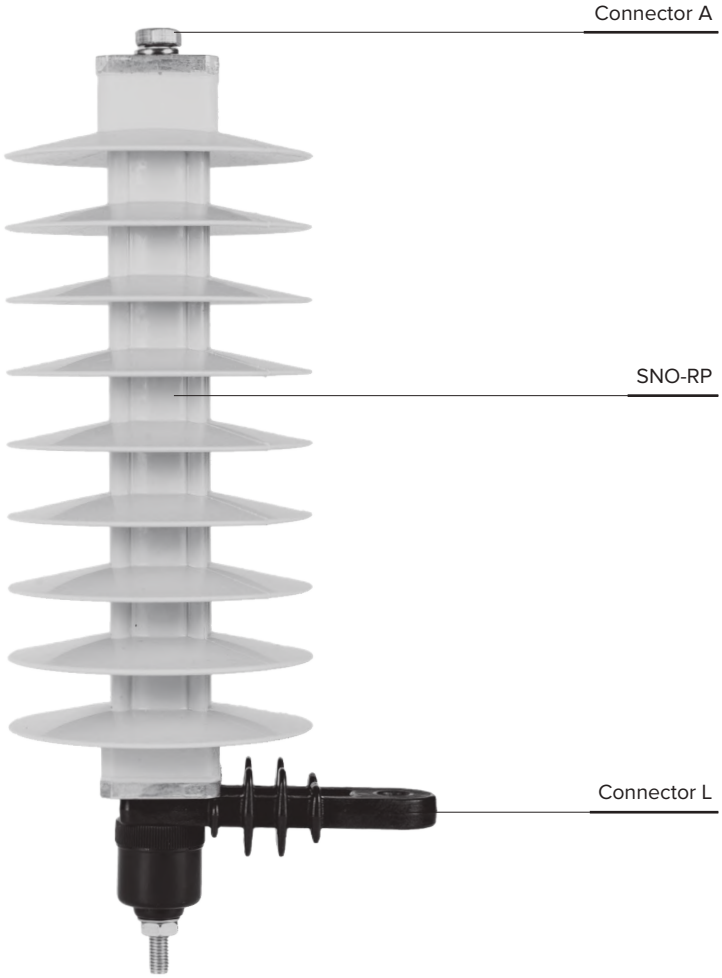


2SS15N-NO 22 kV

ELECTRICAL CHARACTERISTICS												*MEHANICAL CHARACTERISTICS*				
U_r	U_c	U_{res}							U_{peak}	U_{rms}	AD	CD	A	B	H
		1/20µs 5 kA	1/20µs 10 kA	8/20µs 5 kA	8/20µs 10 kA	8/20µs 20 kA	30/60µs 125 A	30/60µs 500 A	1,2/50µs	50 Hz, 1 min					
[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[kV]	[mm]	[mm]	[mm]	[mm	[mm]
3,75	3	8,55	9,65	7,18	8,78	9,60	7,35	7,85					60	90	
5,00	4	12,8	14,20	11,25	12,92	14,15	9,63	10,16	62	25	215	243	80	100	129
7,50	6	21,35	23,85	17,95	21,70	23,75	16,98	18,01					100	120	
10,00	8	25,60	28,40	26,12	25,84	28,30	19,26	20,32					120	140	
12,50	10	34,15	38,05	29,00	34,62	37,90	26,61	28,17	98	35	271	289	140	160	175
15,00	12	38,40	42,60	33,15	38,96	42,45	28,89	30,48					160	180	
17,50	14	46,95	52,25	39,98	47,54	52,05	36,24	38,33					180	200	
20,00	16	51,20	56,80	44,10	51,68	56,60	38,52	40,64	125	55	321	339	200	220	225
22,50	18	59,75	66,45	51,26	60,46	66,20	45,87	48,49					220	240	
25,00	20	64,00	71,00	55,45	64,60	70,75	48,15	50,80					240	260	
26,25	21	67,55	77,10	58,93	67,95	76,25	52,15	54,55	135	60	348	366	260	280	252
27,50	22	72,55	80,65	63,00	73,38	80,35	55,50	58,65					270	300	
30,00	24	76,80	85,20	66,15	75,98	84,90	57,78	60,96					320	320	
30,00	24	76,80	85,20	74,39	75,95	84,90	57,78	60,96					320	320	
32,50	26	85,35	94,85	77,20	84,76	94,50	65,13	68,81	150	65	395	413	340	340	299
35,00	28	89,60	99,40	84,90	88,21	99,05	67,41	71,12					360	360	
37,50	30	98,15	109,05	88,00	96,99	108,65	74,76	78,97					295	380	
40,00	32	102,40	113,60	96,05	101,15	113,20	77,04	81,28	170	70	418	466	380	400	352
43,75	35	112,30	125,50	97,86	112,81	125,15	85,16	90,12					410	430	
45,00	36	115,20	127,80	99,10	114,10	127,25	86,67	91,44					420	440	
42,50	34	110,95	123,25	96,05	109,93	122,80	84,39	89,13					400	420	
45,00	36	115,20	127,80	99,10	114,10	127,35	86,67	91,44	180	75	482	500	420	440	386
50,60	40,5	125,76	136,35	114,89	129,78	146,25	96,12	101,35					450	470	

U_c Continuous operating voltage
U_r Rated voltage
U_{res} Residual voltages at different impulse currents
U_{peak} Lightning impulse withstand voltage 1,2/50µs in dry
U_{rms} Power frequency withstand voltage 1 min. 50Hz, wet
AD Arcing distance
CD Creepage distance
A Minimum distance to wall
B Minimum distance between phases
H Surge arrester height

3.11 **MV Surge Arrester Order Example**



Name: **SNO - RP 34 kV + Connectors AL**

Explanation of the Name

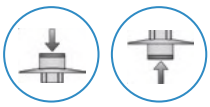
SNO	type
RP	commercial designation
34	continuous operating voltage (U_c)
kV	measuring unit
AL	connector markings

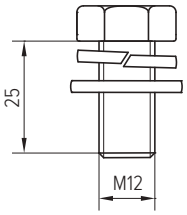
Marks on surge arrester

Izoelektro	manufacturer
SNO	type
M/Y	month and year of production
U_c ... (kV)	continuous operating voltage
U_r ... (kV)	rated voltage
I_n ... (kA)	nominal discharge current
I_{sc} ... (kA)	short-circuit current
DH	IEC class

3.12 **Connector A**

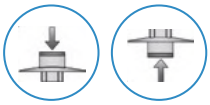
Description: screw connector for cable lug
Material: stainless steel A2/A4
Tightening torque M12: 20 Nm
Mass: 0,044 kg

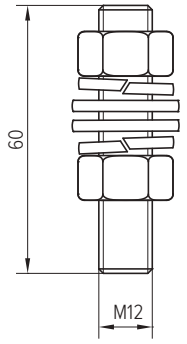




3.13 **Connector B**

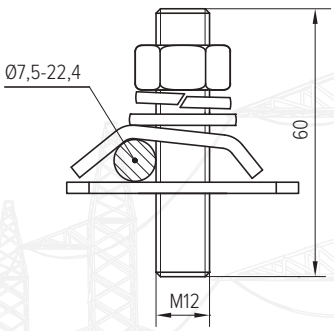
Description: screw connector for cable lug
Material: stainless steel A2/A4
Tightening torque M12: 20 Nm
Mass: 0,086 kg





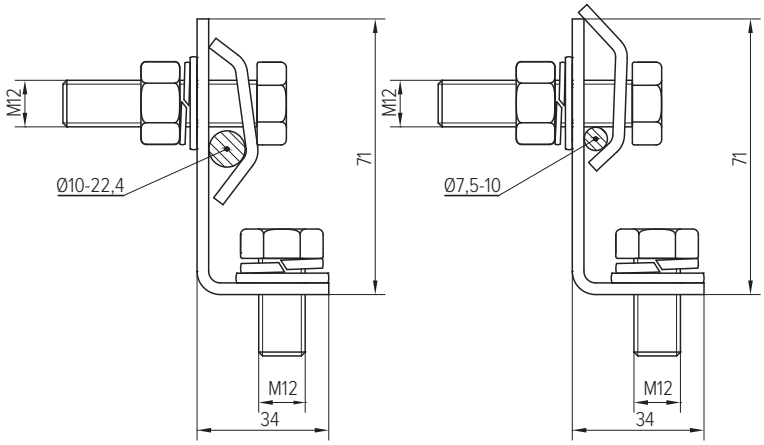
3.14 **Connector C**

Description: screw screw connector for AlFe Ø7,5-22,4 mm
Material: stainless steel A2/A4
Tightening torque M12: 60 Nm
Mass: 0,086 kg



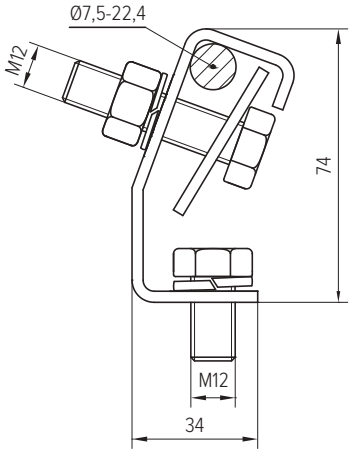
3.15 **Connector E**

Description: screw screw connector for AlFe Ø7,5-22,4 mm
Tightening torque M12: 20 Nm
Mass: 0,200 kg



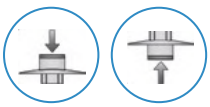
3.16 **Connector F**

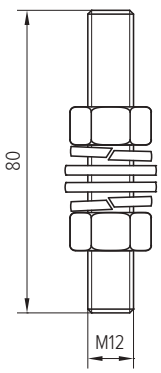
Description: screw screw connector for AlFe Ø7,5-22,4 mm
Material: stainless steel A2/A4
Tightening torque M12: 20 Nm
Mass: 0,210 kg



3.17 **Connector G**

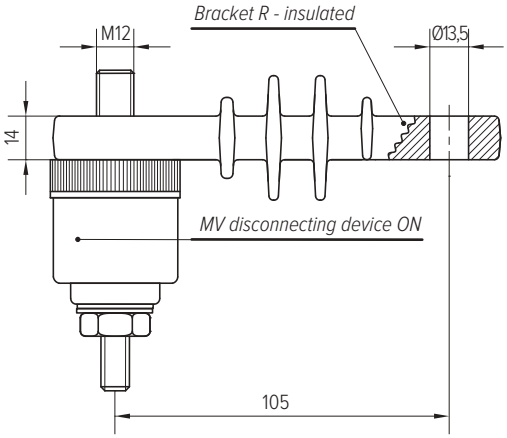
Description: screw connector for cable lug
Material: stainless steel A2/A4
Tightening torque M12: 20 Nm
Mass: 0,100 kg

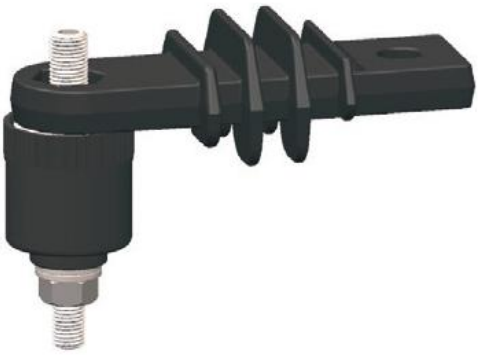




3.18 **Connector L**

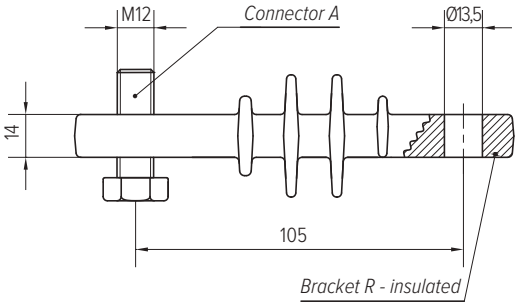
Description: insulative bracket R with disconnecting device ON
Material: polyamide PA6 GF UV and stainless steel A2/A4
Tightening torque M12: 20 Nm
Mass: 0,200 kg





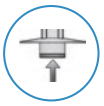
3.19 **Connector M**

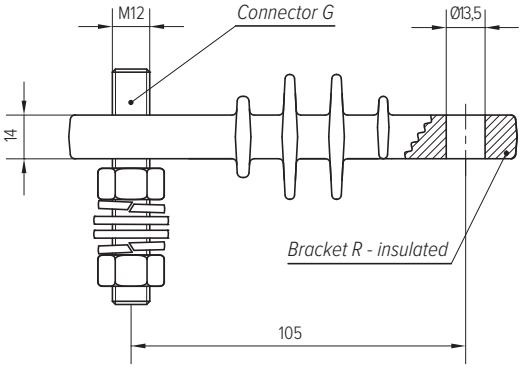
Description: insulative bracket R with screw M12x25
Material: polyamide PA6 GF UV and stainless steel A2/A4
Tightening torque M12: 20 Nm
Mass: 0,120 kg



3.20 **Connector N**

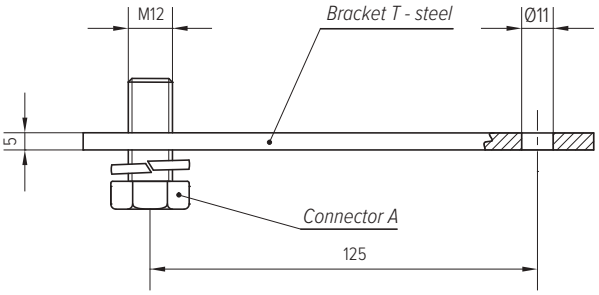
Description: insulative bracket R with MV connector G
Material: polyamide PA6 GF UV and stainless steel A2/A4
Tightening torque M12: 20 Nm
Mass: 0,160 kg





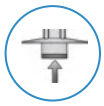
3.21 **Connector O**

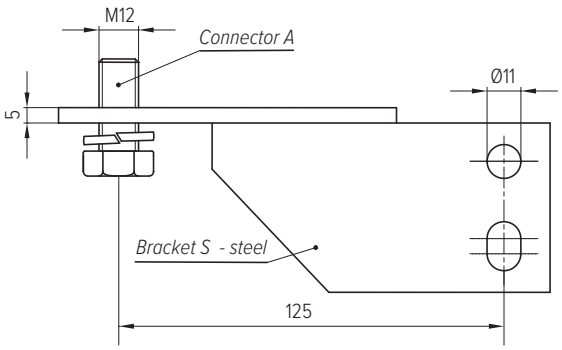
Description: steel bracket T with screw M12x25
Material: stainless steel A2/A4 or hot-dip galvanized steel
Tightening torque M12: 20 Nm
Mass: 0,120 kg

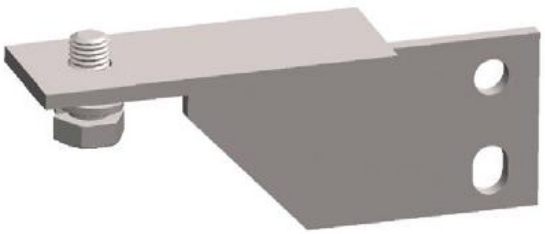


3.22 **Connector P**

Description: steel bracket S (90°) with screw M12x25
Material: stainless steel A2/A4 or hot dip galvanized
Tightening torque M12: 20 Nm
Mass: 0,220 kg

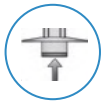


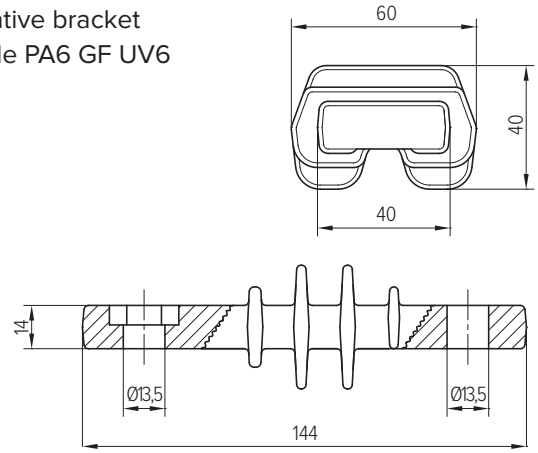




3.23 **Bracket R - Insulated**

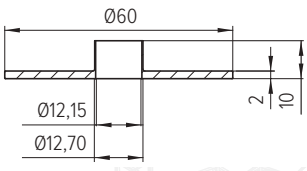
Description: insulative bracket
Material: polyamide PA6 GF UV6
Mass: 0,100 kg

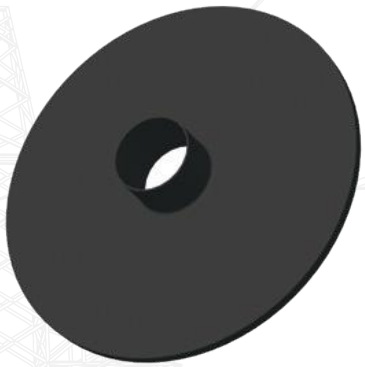




3.24 **RAM-1 Insulative Spacer**

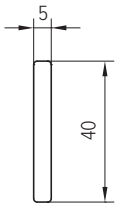
Description: insulative spacer Ø60 for metal bracket
Material: polyamide PA6 GF UV
Mass: 0,006 kg

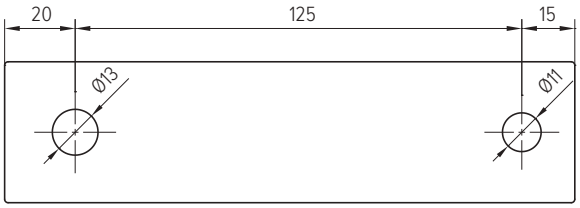




3.25 **Bracket T - Steel**

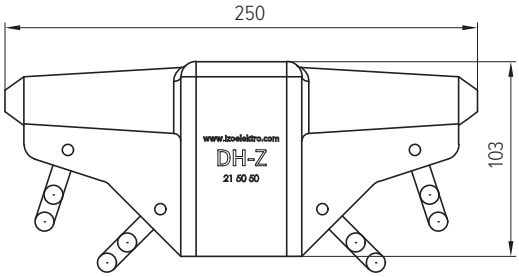
Description: steel bracket
Material: stainless steel A2/A4 or hot dip galvanized
Mass: 0,100 kg





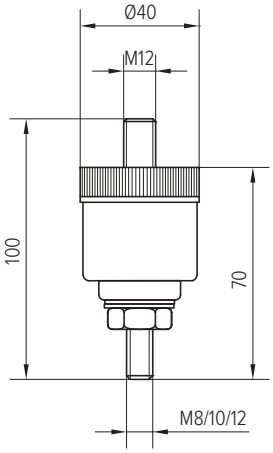
3.26 **Silicone Cover DH-Z**

Description: wildfire protection
Material: silicone
Mass: 0,183 kg



3.27 **MV Disconnecting Device ON**

Description: disconnects a destroyed surge arrester
Material: polyamide PA6 GF UV and stainless steel A2/A4
Tightening torque M12: 20 Nm



MV Tension/ Suspension Insulators

4.1 NKI: Overview

NKI are composite tension/suspension insulators with silicone housing. They are designed for installation on overhead power lines with rated voltages up to 52 kV.

Characteristics

NKI composite tension/suspension insulators offer the following features:

- UV radiation and chemical resistance,
- weathering and aging resistance,
- silicone rubber housing without additives,
- suitable for aggressive and polluted environments (industry, seaside, desert climate, etc.),
- impact insensitivity.

Installation

The installation of composite tension/suspension insulators NKI follows directives and technical regulations. They are typically installed in new constructions, reconstructions, and during maintenance. It is important to note that the installation of NKI insulators, regardless of the previously installed insulators, does not affect the insulation coordination in power system.

General data

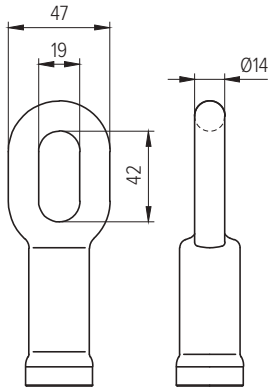
- Specified mechanical load (SML): 90 kN
- Maximum torsion load: 50 Nm
- Ambient temperature range: T = -60 °C ... +85 °C
- Housing: silicone rubber
- Silicone colour: grey
- Material of steel end fittings: ST 52-3
- Zinc coating: ≥ 70 µm
- Length tolerance: ±10 mm
- Tested according to standards:
  IEC 61109, IEC/TS 60815, IEC 62217, IEC 61466, IEC 61284

Competitive advantages

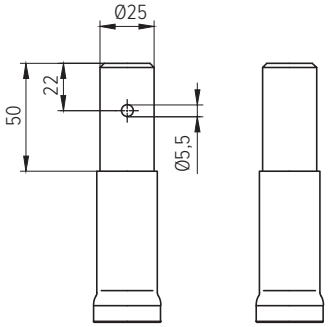
NKI tension composite insulators for indoor and outdoor installation feature:

- shape of coat and fittings manufactured according to standard IEC 61466,
- certified at accredited laboratory,
- suitable also for aggressive environments,
- our short and lightweight strings are made from NKI insulators and connecting material,
- a specified mechanical load SML 90 kN,
- 100% routine tested,
- production with end fittings by customer's request.

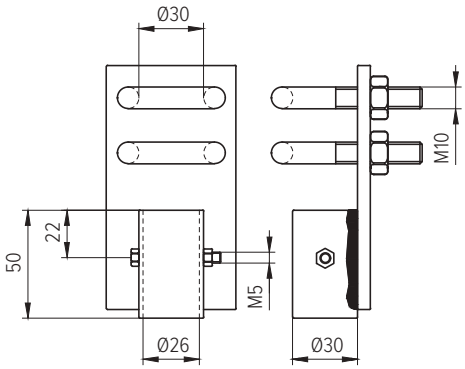
4.2 **Shape of End Fittings**



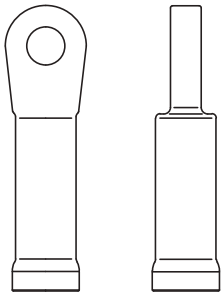
EYE
»U«



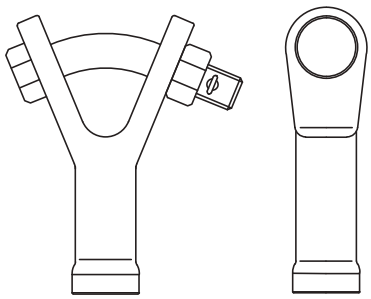
ROD
»I«



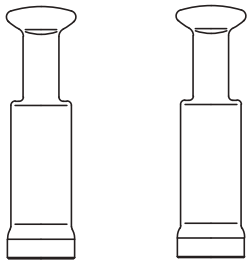
ROD 3/4
»I 3/4«



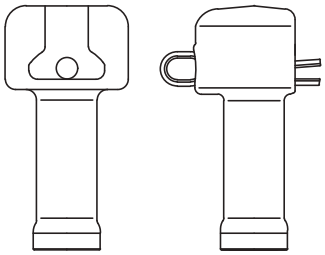
IEC 61466
TONGUE
»O«



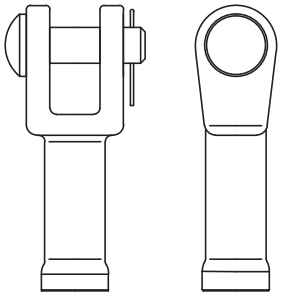
IEC 61466
Y CLEVIS
»Y«



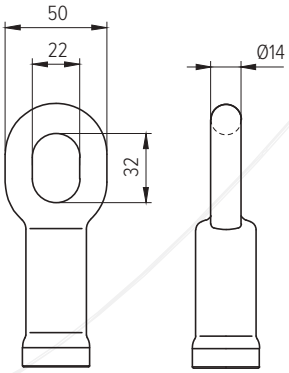
IEC 61466
BALL
»B«



IEC 61466
SOCKET
»P«



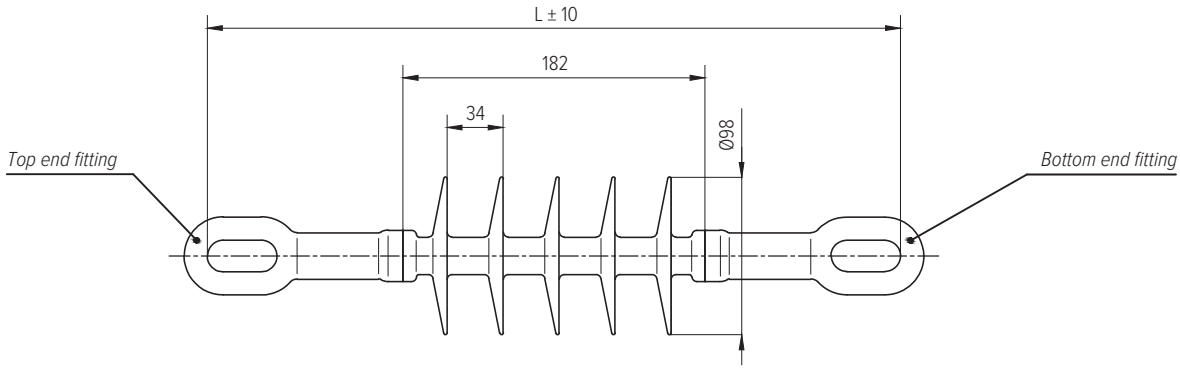
IEC 61466
CLEVIS
»V«

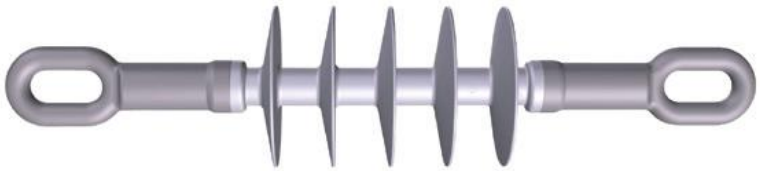


IEC 61466
EYE
»E«

4.3 **Silicone Coat N - Creepage Distance 520 mm**

Note: selection of insulator NKI N





NKI N/UU

Type	Commercial designation	Nominal operating voltage	Number of Sheds	Creepage distance	Arcing distance	Dry lighting impulse withstand voltage	Wet power frequency withstand voltage
NKI N	* *	24 kV	5	520 mm	215 mm	159 kV	66 kV

Most used NKI insulator

Top end fitting *	Bottom end fitting *	Commercial designation	Length (mm)	Mass (kg)
eye	eye	UU	418	1,0
eye	eye	UU 90°	418	1,0
tongue	tongue	OO	410	1,3
tongue	ongue	OO 90°	410	1,3
ball	ball	BB	389	0,9
socket	socket	PP	378	1,7
clevis	clevis	VV	395	1,2
eye	ball	UB	404	1,0
socket	eye	PU	398	1,4
eye	clevis	UV	407	1,1
socket	batič/ball	PB	384	1,4
clevis	ball	N/VB	392	1,1
socket	clevis	PV	387	1,7
clevis	clevis	VV 90°	395	1,2
rod	rod	II	424	1,1
rod	rod	II ¾''	424	2,3

Marks on insulator

Izoelektro Manufacturer

NKI N Type of MV composite insulator

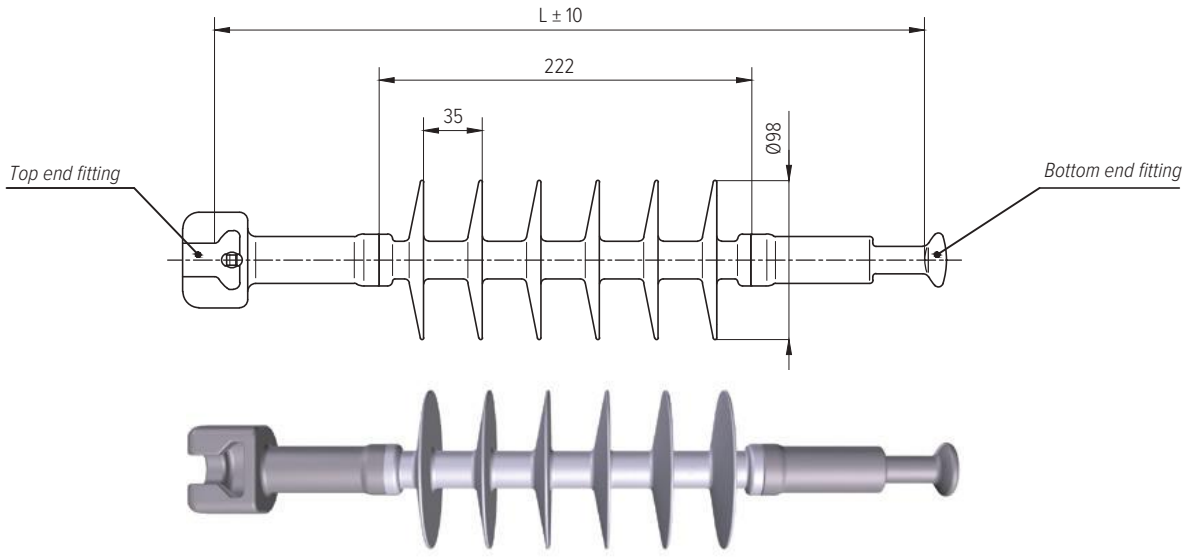
M/Y Month and year of production

≤90 kN Specified mechanical load (SML)

* Shape of end fittings in chapter 4.2
** Commercial designation consisting of top and bottom end fittings

4.4 Silicone Coat L - Creepage Distance 630 mm

Note: selection of insulator NKI L



NKI L/PB

Type	Commercial designation	Nominal operating voltage	Number of Sheds	Creepage distance	Arcing distance	Dry lighting impulse withstand voltage	Wet power frequency withstand voltage
NKI L	* *	36 kV	6	630 mm	250 mm	186 kV	76 kV

Most used NKI insulator

Top end fitting *	Bottom end fitting *	Commercial designation	Length (mm)	Mass (kg)
eye	eye	UU	458	1,1
eye	eye	UU 90°	458	1,1
tongue	tongue	OO	450	1,4
tongue	tongue	OO 90°	450	1,4
ball	ball	BB	429	1,0
socket	socket	PP	418	1,8
clevis	clevis	VV	435	1,3
eye	ball	UB	444	1,1
socket	eye	PU	438	1,5
eye	clevis	UV	447	1,2
socket	ball	PB	424	1,5
clevis	ball	N/VB	432	1,2
socket	clevis	PV	427	1,8
clevis	clevis	VV 90°	435	1,3
rod	rod	II	464	1,2
rod	rod	II ¾''	464	2,4

Marks on insulator

Izoelektro Manufacturer

NKI L Type of MV composite insulator

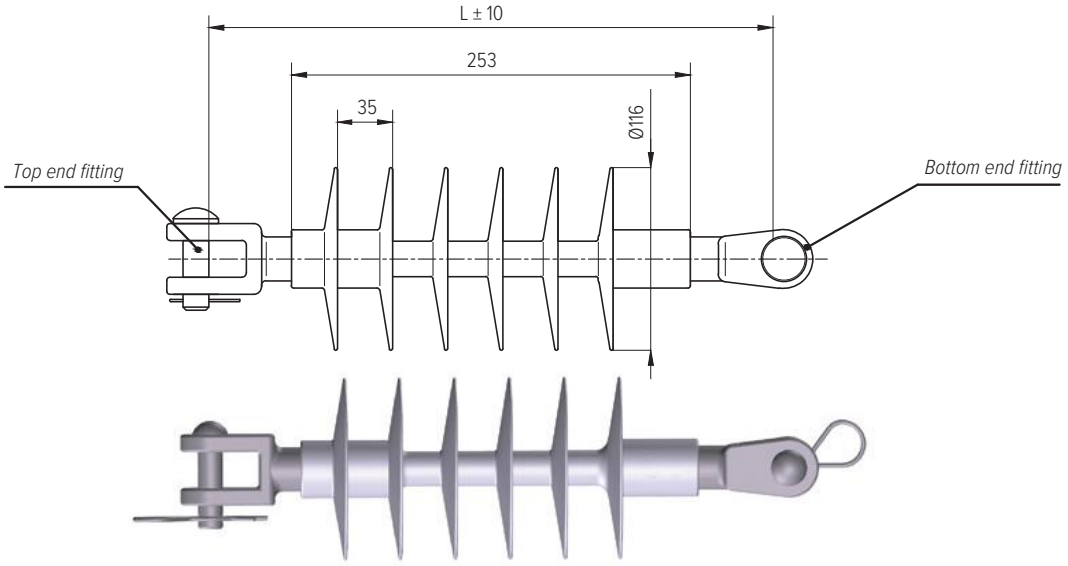
M/Y Month and year of production

≤90 kN Specified mechanical load (SML)

** Shape of end fittings in chapter 4.2*
*** Commercial designation consisting of top and bottom end fittings*

4.5 Silicone Coat M - Creepage Distance 783 mm

Note: selection of insulator NKI M



NKI M/VV 90°

Type	Commercial designation	Nominal operating voltage	Number of Sheds	Creepage distance	Arcing distance	Dry lighting impulse withstand voltage	Wet power frequency withstand voltage
NKI M	* *	36 kV	6	783 mm	290 mm	169 kV	91 kV

Most used NKI insulator

Top end fitting *	Bottom end fitting *	Commercial designation	Length (mm)	Mass (kg)
eye	eye	UU	385	1,1
eye	eye	UU 90°	385	1,1
tongue	tongue	OO	370	1,4
tongue	tongue	OO 90°	370	1,4
ball	ball	BB	352	1,0
socket	socket	PP	342	1,8
clevis	clevis	VV	358	1,3
eye	ball	UB	366	1,1
socket	eye	PU	362	1,5
eye	clevis	UV	369	1,2
socket	ball	PB	346	1,5
clevis	ball	N/VB	355	1,2
socket	clevis	PV	350	1,8
clevis	clevis	VV 90°	358	1,3
rod	rod	II	387	1,2
rod	rod	II ¾''	387	2,4

Marks on insulator

Izoelektro Manufacturer

NKI M Type of MV composite insulator

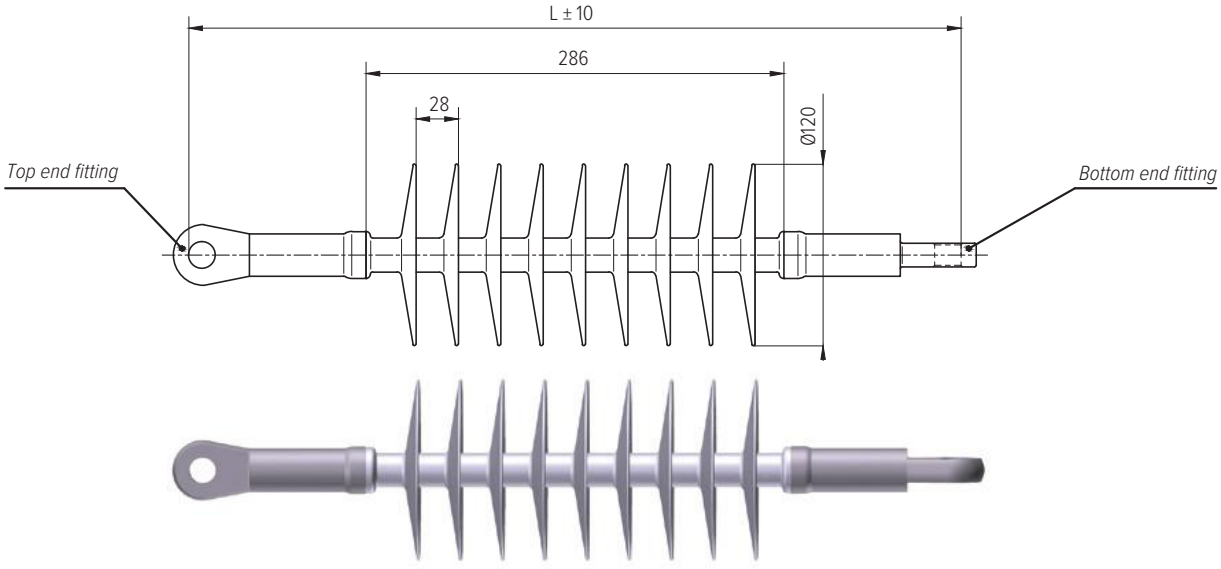
M/Y Month and year of production

≤90 kN Specified mechanical load (SML)

** Shape of end fittings in chapter 4.2*
*** Commercial designation consisting of top and bottom end fittings*

4.6 **Silicone Coat X - Creepage Distance 1120 mm**

Note: selection of insulator NKI X



NKI X/OO 90°

Type	Commercial designation	Nominal operating voltage	Number of Sheds	Creepage distance	Arcing distance	Dry lighting impulse withstand voltage	Wet power frequency withstand voltage
NKI X	* *	52 kV	9	1120 mm	335 mm	214 kV	106 kV

Most used NKI insulator

Top end fitting *	Bottom end fitting *	Commercial designation	Length (mm)	Mass (kg)
eye	eye	UU	522	1,3
eye	eye	UU 90°	522	1,3
tongue	tongue	OO	510	1,6
tongue	tongue	OO 90°	510	1,6
ball	ball	BB	493	1,2
socket	socket	PP	482	2,0
clevis	clevis	VV	499	1,5
eye	ball	UB	508	1,3
socket	eye	PU	502	1,7
eye	clevis	UV	511	1,4
socket	ball	PB	488	1,7
clevis	ball	VB	496	1,4
socket	clevis	PV	491	2,0
clevis	clevis	VV 90°	499	1,5
rod	rod	II	528	1,4
rod	rod	II ¾''	528	2,6

Marks on insulator

Izoelektro Manufacturer

NKI X Type of MV composite insulator

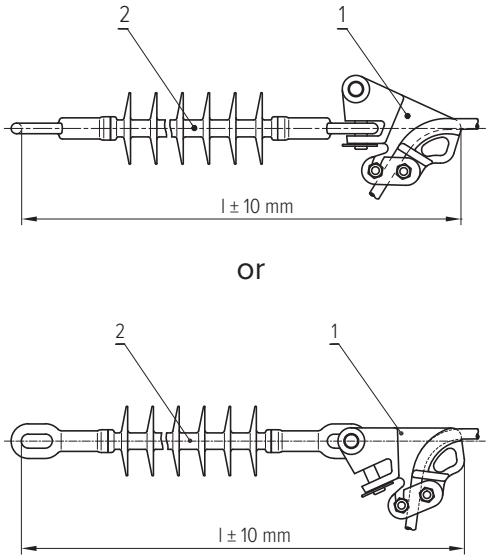
M/Y Month and year of production

≤90 kN Specified mechanical load (SML)

** Shape of end fittings in chapter 4.2*
*** Commercial designation consisting of top and bottom end fittings*

4.7 **NKI Single Tension String**

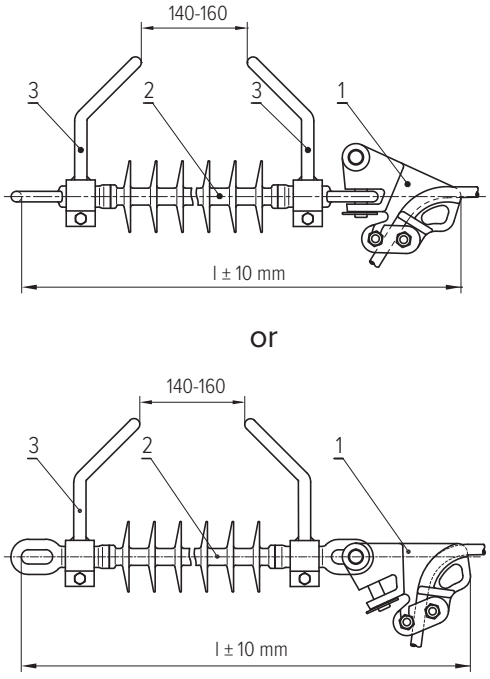
Note: SZ-U clamp (pos. 1) allows fastening in two planes



Name	l (mm)	Pos.	Pcs	Mass (kg)
EZ-01 N/UU	590	1	1	1,1
		2	1	1,0
EZ-01 L/UU	630	1	1	1,1
		2	1	1,1
EZ-01 M/UU	557	1	1	1,1
		2	1	1,1
EZ-01 X/UU	686	1	1	1,1
		2	1	1,3

4.8 **NKI Single Tension String with Arcing Horn**

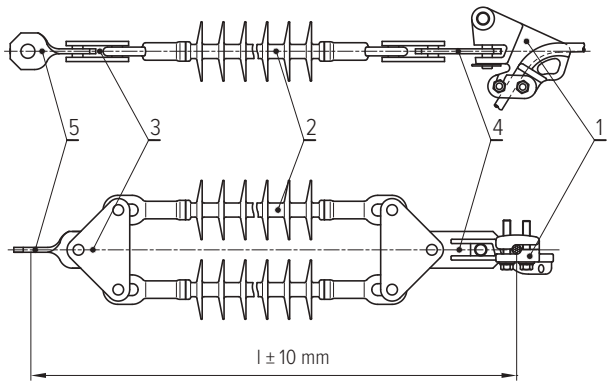
Note: SZ-U clamp (pos. 1) allows fastening in two planes



Name	l (mm)	Pos.	Pcs	Mass (kg)
EZI-01 N/UU	590	1	1	1,1
		2	1	1,0
		3	2	0,3
EZI-01 L/UU	630	1	1	1,1
		2	1	1,1
		3	2	0,3
EZI-01 X/UU	686	1	1	1,1
		2	1	1,3
		3	2	0,3

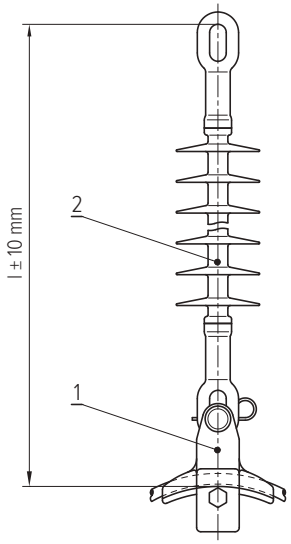
4.9 **NKI Double Tension String**

Note: SZ-U clamp (pos. 1) allows fastening in two planes



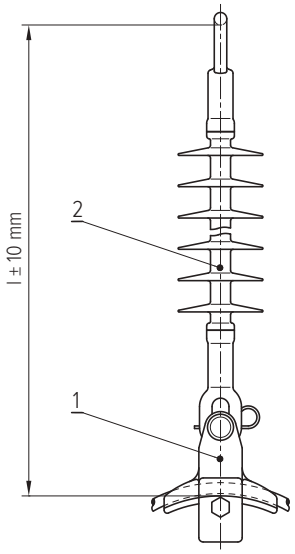
Name	l (mm)	Pos.	Pcs	Mass (kg)
DZ-01 N/UU	872	1	1	1,1
		2	2	1,0
		3	2	1,6
		4	1	0,5
		5	1	0,5
DZ-01 L/UU	912	1	1	1,1
		2	2	1,1
		3	2	1,6
		4	1	0,5
		5	1	0,5
DZ-01 M/UU	839	1	1	1,1
		2	2	1,1
		3	2	1,6
		4	1	0,5
		5	1	0,5
DZ-01 X/UU	968	1	1	1,1
		2	2	1,3
		3	2	1,6
		4	1	0,5
		5	1	0,5

4.10 **NKI Single Suspension String**



Name	l (mm)	Pos.	Pcs	Mass (kg)
EN-01 N/UU	511	1	1	0,7
		2	1	1,0
EN-01 L/UU	551	1	1	0,7
		2	1	1,1
EN-01 M/UU	478	1	1	0,7
		2	1	1,1
EN-01 X/UU	607	1	1	0,7
		2	1	1,3

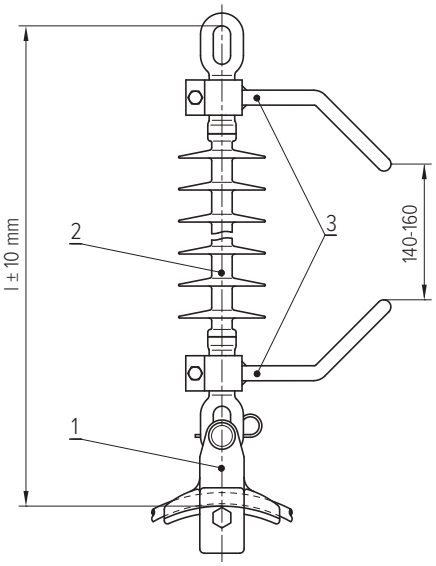
4.11 **NKI Single Suspension String 90°**



Name	l (mm)	Pos.	Pcs	Mass (kg)
EN-02 N/UU	511	1	1	0,7
		2	1	1,0
EN-02 L/UU	551	1	1	0,7
		2	1	1,1
EN-02 M/UU	478	1	1	0,7
		2	1	1,1
EN-02 X/UU	607	1	1	0,7
		2	1	1,3

4.12 **NKI Single Suspension String with Arcing Horn**

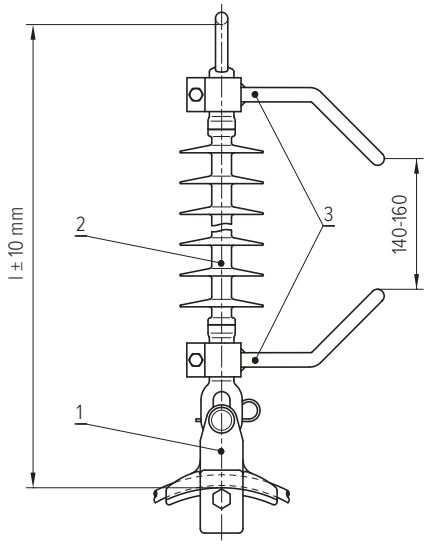
Note: use with covered conductors (CC)



Name	l (mm)	Pos.	Pcs	Mass (kg)
ENI-01 N/UU	511	1	1	0,7
		2	1	1,0
		3	2	0,3
ENI-01 L/UU	551	1	1	0,7
		2	1	1,1
		3	2	0,3
ENI-01 X/UU	607	1	1	0,7
		2	1	1,2
		3	2	0,3

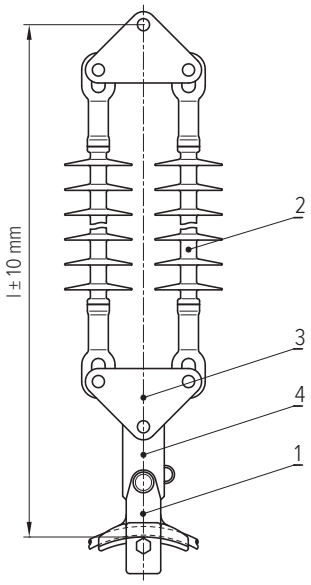
4.13 **NKI Single Suspension String 90° with Arcing Horn**

Note: use with covered conductors (CC)



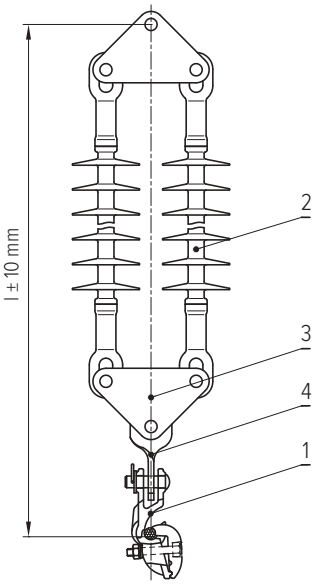
Name	l (mm)	Pos.	Pcs	Mass (kg)
ENI-02 N/UU	511	1	1	0,7
		2	1	1,0
		3	2	0,3
ENI-02 L/UU	551	1	1	0,7
		2	1	1,1
		3	2	0,3
ENI-02 X/UU	607	1	1	0,7
		2	1	1,3
		3	2	0,3

4.14 **NKI Double Suspension String**



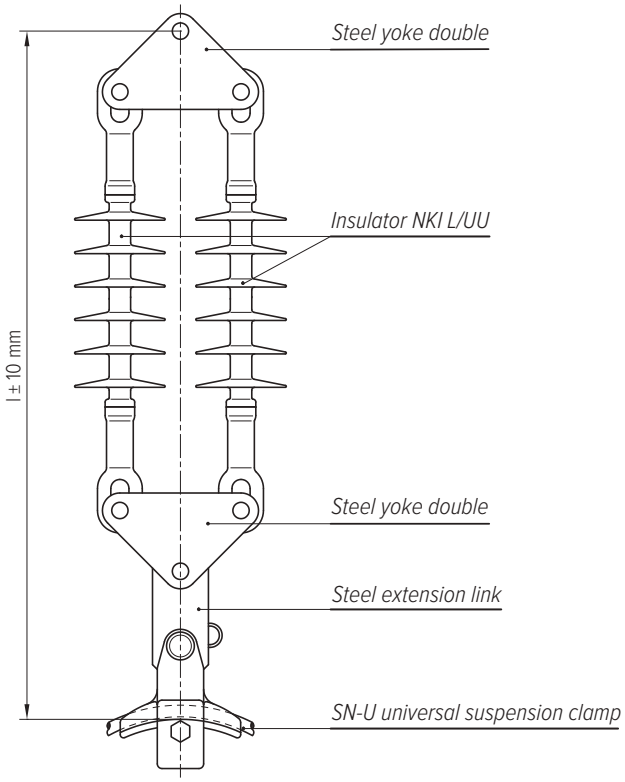
Name	l (mm)	Pos.	Pcs	Mass (kg)
DN-01 N/UU	710	1	1	0,7
		2	2	1,0
		3	2	1,6
		4	1	0,5
DN-01 L/UU	750	1	1	0,7
		2	2	1,1
		3	2	1,6
		4	1	0,5
DN-01 M/UU	677	1	1	0,7
		2	2	1,1
		3	2	1,6
		4	1	0,5
DN-01 X/UU	806	1	1	0,7
		2	2	1,3
		3	2	1,6
		4	1	0,5

4.15 **NKI Double Suspension String 90°**



Name	l (mm)	Pos.	Pcs	Mass (kg)
DN-02 N/UU	710	1	1	0,7
		2	2	1,0
		3	2	1,6
		4	1	0,5
DN-02 L/UU	750	1	1	0,7
		2	2	1,1
		3	2	1,6
		4	1	0,5
DN-02 M/UU	677	1	1	0,7
		2	2	1,1
		3	2	1,6
		4	1	0,5
DN-02 X/UU	806	1	1	0,7
		2	2	1,3
		3	2	1,6
		4	1	0,5

4.16 **NKI Insulator String - Order Example 1**



Name: **DN-02 L/UU**

Explanation of the Name

DN	type of insulator string
02	string ending
L/UU	type of NKI insulator

Types of insulator strings

EZ	single tension
EZI	single tension with arcing horn
DZ	double tension
EN	single suspension
ENI	single suspension with arcing horn
DN	double suspension

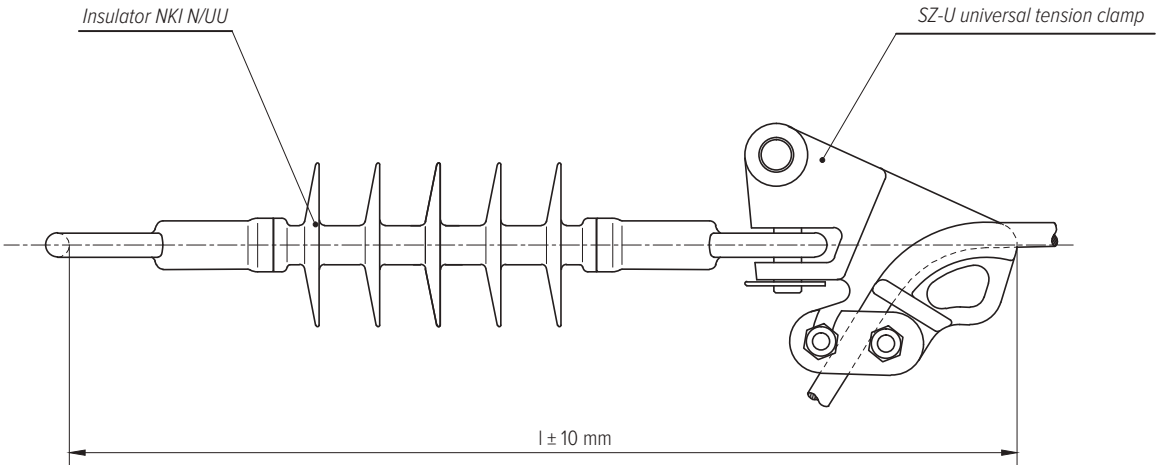
String ending

01	straight ending
02	90° ending

Type of NKI insulator in string

L/UU	the name of the tension composite insulator is used without the mark NKI.

4.17 NKI Insulator String - Order Example 2



Name: **EZI-01 N/UU**

Explanation of the Name

EZI	type of insulator string
01	string ending
N/UU	type of NKI insulator in string

Types of insulator strings

EZ	single tension
EZI	single tension with arcing horn
DZ	double tension
EN	single suspension
ENI	single suspension with arcing horn
DN	double suspension

String ending

01	straight ending
02	90° ending

Type of NKI insulator in string

N/UU	the name of the tension composite insulator is used without the mark NKI.

MV Post Insulators

5.1 PKI: Overview

PKI insulators are composite post insulators with silicone housing. They are designed for installation on overhead power lines with rated voltages up to 52 kV.

Characteristics

PKI composite post insulators offer the following features:

- UV radiation and chemical resistance,
- weathering and aging resistance,
- silicone rubber housing without additives,
- suitable for aggressive and polluted environments (industry, seaside, desert climate, etc.),
- usable for overhead power lines and other substation applications,
- impact insensitivity.

Installation

The installation of composite post insulators PKI follows directives and technical regulations. They are typically installed in new constructions, reconstructions, and during maintenance. The fitted spring clamp, along with the appropriate cover, ensures adequate factory pre-set vertical and horizontal pull-out forces. It is important to note that the installation of PKI insulators, regardless of the previously installed insulators, does not affect the insulation coordination in power system.

General data

- Specified cantilever load (SCL): 12,5 and 15 kN
- Ambient temperature range: T = -60 °C ... +85 °C
- Housing: silicone
- Silicone colour: grey
- Material of top fitting: PA6 GF UV
- Material of steel end fitting: ST 52-3
- Connector thread on bottom: M20 or M24
- Zinc coating: ≥ 70 µm
- Length tolerance: ±5 mm
- Tested according to standards: IEC 62217, IEC 61952, IEC 60437
- Production of standardized types according to standards: IEC 61952-1:2019, IEC 61284

Competitive advantages

MV composite post insulators PKI for indoor and outdoor installation offer the following features:

- certification from an accredited laboratory,
- innovativeness: the PKI insulator with a top end fitting made of insulating material is the result of expert studies conducted by our researchers and published in the prestigious journal IEEE Transactions on Power Delivery in 2009. It incorporates our patented design and practical feedback from users, addressing the limitations of insulators with metal top end fittings and helical metal cable ties,
- innovative and efficient conductor fixing method,
- lightweight construction,
- easy installation process,
- customizable production with end fittings based on customer requirements.

5.2 **PKI Innovation**

Through user experiences and thermo-vision footage of power lines, we have gathered evidence that partial discharges occur during the lifespan of insulators when a bare conductor or a covered conductor is:

- attached to a metal top end fitting,
- fastened with a metal helical tie to the ceramic insulator.

A comprehensive study on the distribution of electric field strength on the metal top end fitting of composite post insulators has confirmed a high probability of excessively high electric field strength with prolonged usage of insulators featuring a metal top fitting. This can lead to conductor damage and cutting due to burns where the conductor comes into contact with metal top fittings or metal bonds.
Theoretical research has also revealed that during operation, a non-homogeneous electric field is established along the insulator, influenced by material characteristics and insulator geometry. This non-homogeneous electric field affects the dielectric loads of the insulator, which are dependent on the shape of conducting parts and increase with higher voltages (U) or electric fields (E).

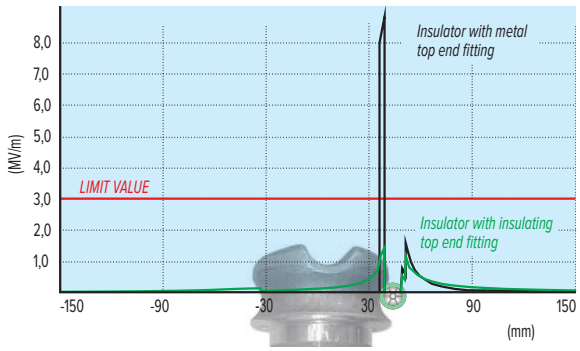
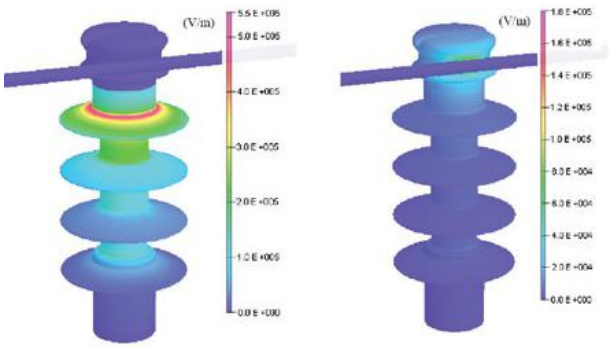


Diagram of electric field strength

Insulative Top

The PKI insulators with top end fittings made of insulating material are the outcome of extensive research and practical feedback from our valued users. These insulators address the shortcomings associated with insulators that utilize metal top fittings or employ helical ties for conductor fastening. The top fitting is constructed using polyamide PA6 with the incorporation of glass fibres, ensuring excellent mechanical properties, long-term stability, and resistance to environmental factors and UV light. The insulative top fitting is distinguishably black in colour. It is worth noting that we have been successfully utilizing this material in our spring clamp for over twenty years.



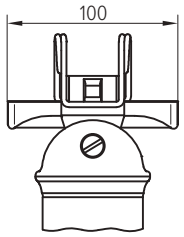
Metal top end fitting

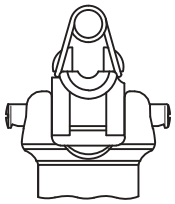
PA insulation top end fitting

Allocation of electric field strength

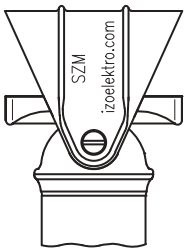
5.3 A PKI Shape of Top End Fittings

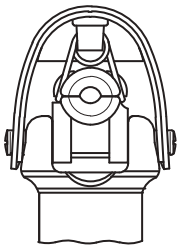
A PKI S - spring clamp



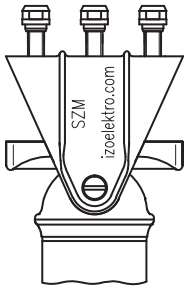


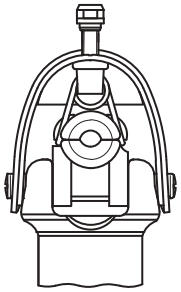
A PKI Z - spring clamp with cap SZM/0



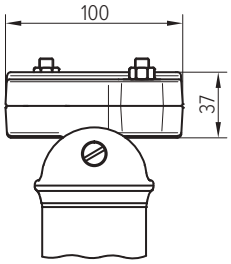


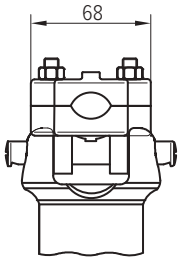
A PKI M - spring clamp with cap SZM/3



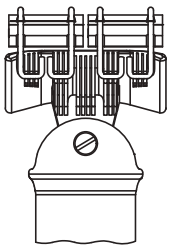


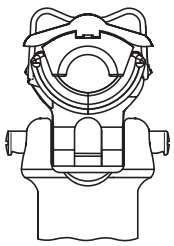
A PKI G - screw clamp





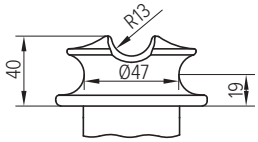
A PKI E – for conductors from Ø15 to Ø30

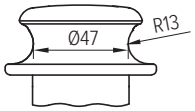




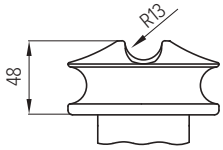
5.4 **PKI - Shape of Top End Fittings**

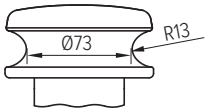
PKI O - without clamp



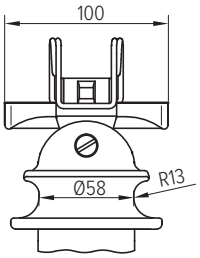


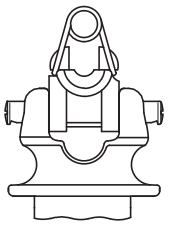
PKI H - without clamp



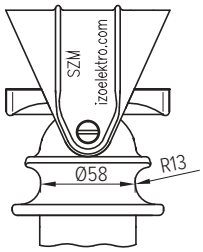


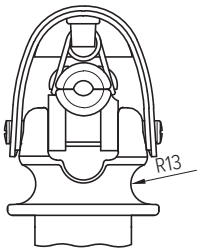
PKI S - spring clamp



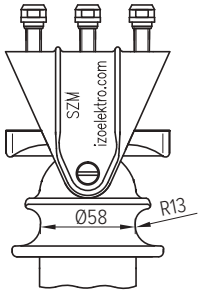


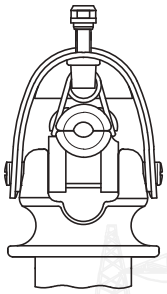
PKI Z - spring clamp with cap SZM/0





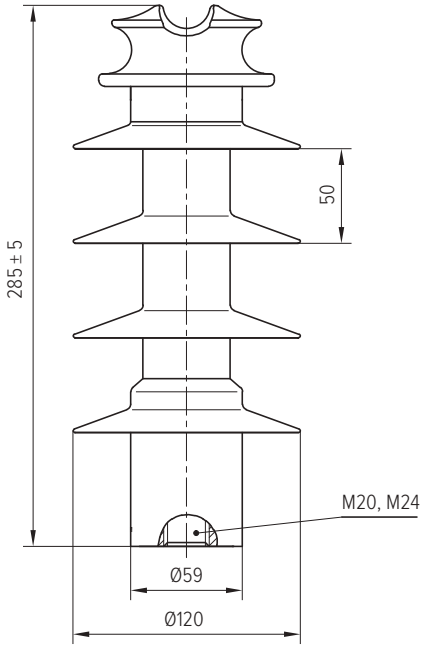
PKI M - spring clamp with cap SZM/3





5.5 **Silicone Coat N**

Note: selection of the insulator



PKI NO

Type	Commercial designation	Nominal operating voltage	Number of Sheds	Creepage distance	Arcing distance	Dry lighting impulse withstand voltage	Wet power frequency withstand voltage
PKI N	O, H	24 kV	4	543 mm	250 mm	155 kV	77 kV
A PKI N	S, V, Z, M, M 120/99, G, E	24 kV	4	643 mm	308 mm	177 kV	82 kV

The choice of insulators PKI N and A PKI N

Type	Commercial designation	Top fitting	Bottom end fitting	IEC 61952-1 designation	Length L ± 5% [mm]	Mass m [kg]
PKI N	O	without clamp	M20, M24	CLP7.5-170NRN-543	285	1,70
PKI N	H	without clamp	M20, M24	CLP7.5-170NRN-543	310	1,65
A PKI / PKI N	S	with spring clamp	M20, M24	CLP7.5-170JRN-670	305	2,00
A PKI N	V	with a weakened spring clamp	M20, M24	CLP7.5-170JRN-670	305	2,05
A PKI / PKI N	Z	with cap SZM/0	M20, M24	CLP7.5-170JRN-670*	305	2,10
A PKI / PKI N	M	with cap SZM/3	M20, M24	CLP7.5-170JRN-670**	305	2,10
A PKI N	M 120/99	for conductor AlFe 120/CC99	M20, M24	CLP7.5-170JRN-670	305	2,10
A PKI N	G	with screw clamp	M20, M24	/	308	2,10
A PKI N	E	for conductor from Ø15 to Ø30	M20, M24	/	320	2,25

** with a spring clamp and a SZM/0 cap* *** with a spring clamp and a SZM/3 cap*

Marks on insulator

Izoelektro Manufacturer

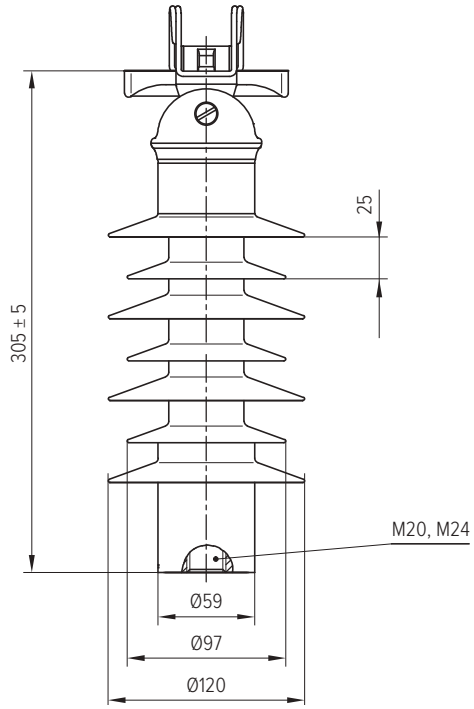
A PKI or PKI Type of MV composite insulator

M/Y Month and year of production

12,5 or 15 kN Specified cantilever load (SCL)

5.6 **Silicone Coat L**

Note: selection of the insulator



A PKI LS

Type	Commercial designation	Nominal operating voltage	Number of Sheds	Creepage distance	Arcing distance	Dry lighting impulse withstand voltage	Wet power frequency withstand voltage
PKI L	O, H	36 kV	7	680 mm	250 mm	158 kV	89 kV
A PKI L	S, V, Z, M, M 120/99, G, E	36 kV	7	741 mm	308 mm	182 kV	82 kV

The choice of insulators PKI L and A PKI L

Type	Commercial designation	Top fitting	Bottom end fitting	IEC 61952-1 designation	Length L ± 5% [mm]	Mass m [kg]
PKI L	O	without clamp	M20, M24	CLP7.5-170NRN-670	285	1,80
PKI L	H	without clamp	M20, M24	CLP7.5-170NRN-670	310	1,75
A PKI / PKI L	S	with spring clamp	M20, M24	CLP7.5-170JRN-782	305	2,10
A PKI L	V	with a weakened spring clamp	M20, M24	CLP7.5-170JRN-782	305	2,10
A PKI / PKI L	Z	with cap SZM/0	M20, M24	CLP7.5-170JRN-782*	305	2,15
A PKI / PKI L	M	with cap SZM/3	M20, M24	CLP7.5-170JRN-782**	305	2,20
A PKI L	M 120/99	for conductor AlFe 120/CC99	M20, M24	CLP7.5-170JRN-782	305	2,20
A PKI L	G	with screw clamp	M20, M24	/	308	2,20
A PKI L	E	for conductor from Ø15 to Ø30	M20, M24	/	320	2,35

** with a spring clamp and a SZM/0 cap* *** with a spring clamp and a SZM/3 cap*

Marks on insulator

Izoelektro Manufacturer

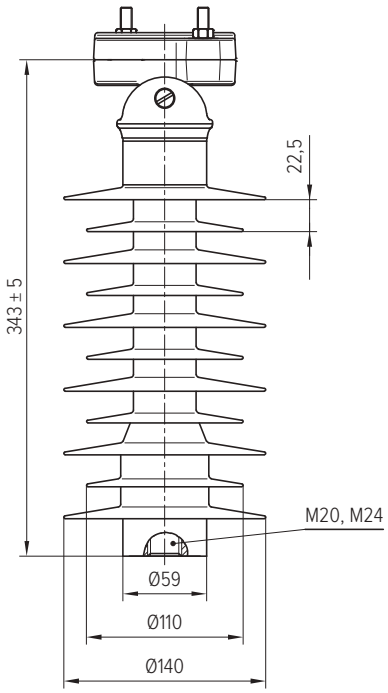
A PKI or PKI Type of MV composite insulator

M/Y Month and year of production

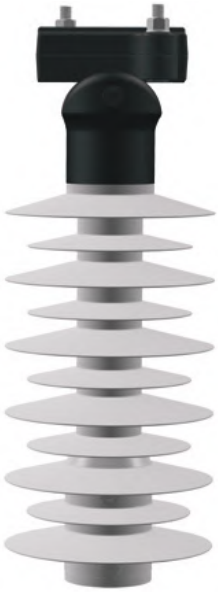
12,5 or 15 kN Specified cantilever load (SCL)

5.7 **Silicone Coat X**

Note: selection of the insulator



A PKI XG



Type	Commercial designation	Nominal operating voltage	Number of Sheds	Creepage distance	Arcing distance	Dry lighting impulse withstand voltage	Wet power frequency withstand voltage
PKI X	O, H	52 kV	11	1170 mm	296 mm	190 kV	104 kV
A PKI X	S, V, Z, M, M 120/99, G, E	52 kV	11	1230 mm	380mm	230 kV	106 kV

The choice of insulators PKI X and A PKI X

Type	Commercial designation	Top fitting	Bottom end fitting	IEC 61952-1 designation	Length L ± 5% [mm]	Mass m [kg]
PKI X	O	without clamp	M20, M24	CLP7.5-200NRN-1150	330	2,10
PKI X	H	without clamp	M20, M24	CLP7.5-200NRN-1150	350	2,05
A PKI / PKI X	S	with spring clamp	M20, M24	CLP7.5-200JRN-1230	340	2,40
A PKI X	V	with a weakened spring clamp	M20, M24	CLP7.5-200JRN-1230	340	2,40
A PKI / PKI X	Z	with cap SZM/0	M20, M24	CLP7.5-200JRN-1230*	340	2,45
A PKI / PKI X	M	with cap SZM/3	M20, M24	CLP7.5-200JRN-1230**	340	2,40
A PKI X	M 120/99	for conductor AlFe 120/CC99	M20, M24	CLP7.5-200JRN-1230	340	2,40
A PKI X	G	with screw clamp	M20, M24	/	343	2,40
A PKI X	E	for conductor from Ø15 to Ø30	M20, M24	/	365	2,65

** with a spring clamp and a SZM/0 cap* *** with a spring clamp and a SZM/3 cap*

Marks on insulator

Izoelektro Manufacturer

A PKI or PKI Type of MV composite insulator

M/Y Month and year of production

12,5 or 15 kN Specified cantilever load (SCL)

5.8 **PKI 12-66 kV**

Name: **PKI 12 S/M20**

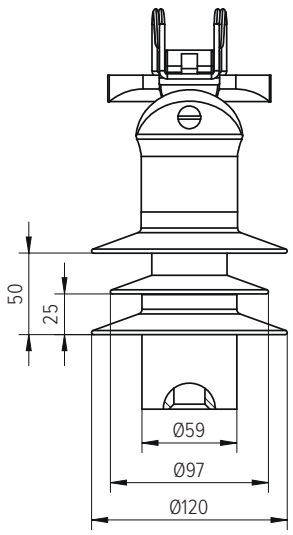
Name explanation

PKI	Type (PKI)
12	Voltage level (12 - 66 kV)
S	Top end fitting (O, H, S, V, Z, M, G, E)
M20	Bottom end fitting (M20/M24*)

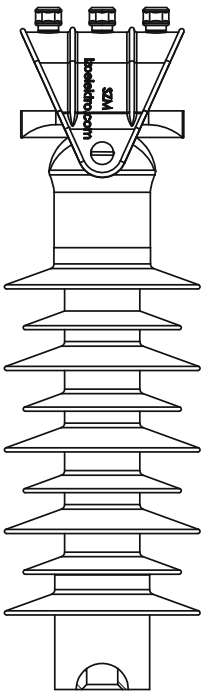
Top end fittings

- O	(without clamp)
- H	(without clamp)
- S	(with spring clamp**)
- V	(with weakened spring clamp**)
- Z	(with cap SZM/0**)
- M	(with cap SZM/3**)
- G	(with screw clamp)
- E	(for conductor Ø15 - Ø30)

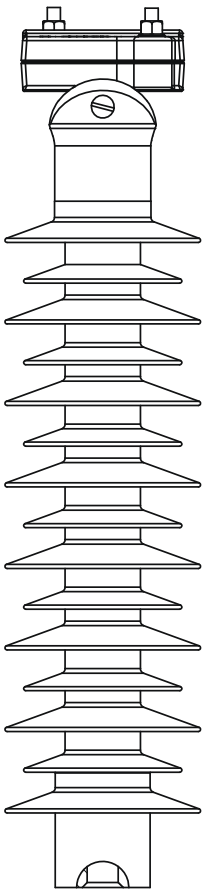
PKI 12



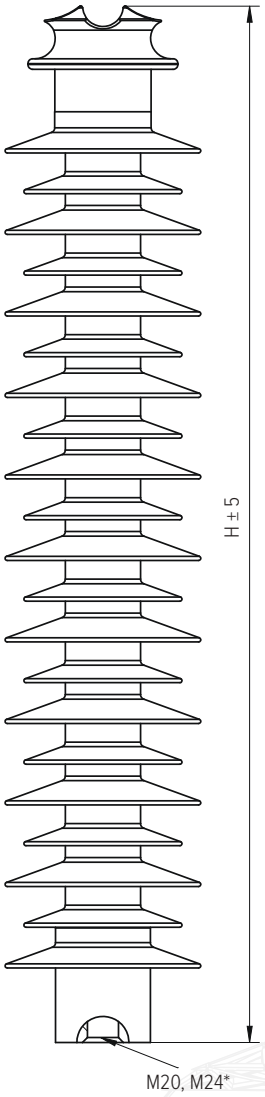
PKI 30



PKI 48



PKI 66



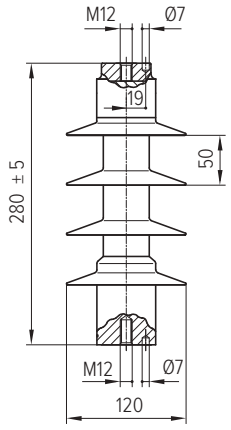
The drawings are symbolic and do not show all insulator heights.

** Customized bottom end fitting can be made to customer specifications.*
*** Obligatory specification of PA cover.*

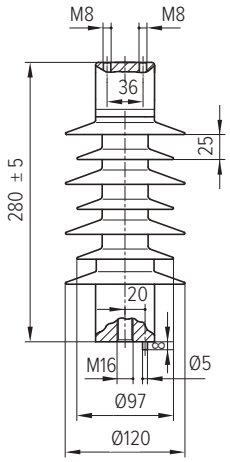
Type	PKI 12	PKI 18	PKI 24	PKI 30	PKI 36	PKI 42	PKI 48	PKI 54	PKI 60	PKI 66
Nominal operating voltage	12 kV	18 kV	24 kV	30 kV	36 kV	42 kV	48 kV	54 kV	60 kV	66 kV
Creepage distance O, H (mm)	354	517	680	843	1006	1169	1332	1495	1658	1821
Creepage distance S, V, Z, M, G, E (mm)	415	578	741	904	1067	1230	1393	1556	1719	1882
Arcing distance O,H (mm)	150	200	250	300	350	400	450	500	550	600
Arcing distance S, V, Z, M, G, E (mm)	208	258	308	358	408	458	508	558	608	658
Weight O, H (kg)	1,25	1,52	1,80	2,08	2,35	2,63	2,91	3,19	3,46	3,74
Weight S, V, Z, M, G, E (kg)	1,43	1,95	2,23	2,51	2,78	3,06	3,34	3,62	3,89	4,17
Length (mm)	121	171	221	271	321	371	421	471	521	571
Number of sheds	3 (2+1)	5 (3+2)	7 (4+3)	9 (5+4)	11 (6+5)	13 (7+6)	15 (8+7)	17 (9+8)	19 (10+9)	21 (11+10)

5.9 PKIL for Switch Disconnector

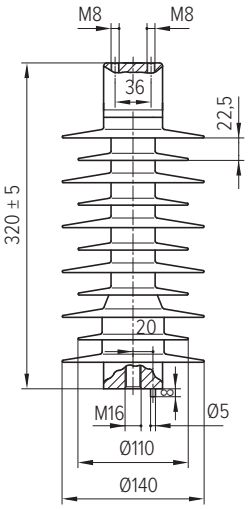
Note: we make the holes for attaching connectors on customer's request



PKIL N



PKIL L

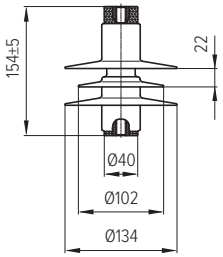


PKIL X

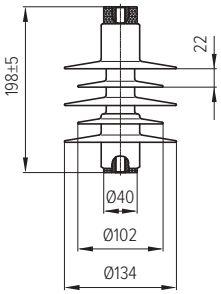
Type	PKIL N	PKIL L	PKIL X
Commercial designation	ES	TSN	ME
Nominal operating voltage	24 kV	36 kV	52 kV
Creepage distance	493 mm	620 mm	1125 mm
Arcing distance	275 mm	275 mm	330 mm
Dry lighting impulse withstand voltage	155 kV	180 kV	210 kV
Wet power frequency withstand voltage	70 kV	80 kV	100 kV
Mass	2,0 kg	2,1 kg	2,4 kg

5.10 PKIL IZO for Switch Disconnector

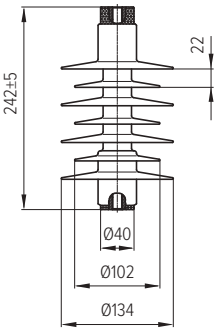
Note: we make the holes for attaching connectors on customer's request



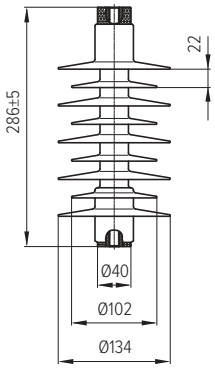
PKIL 12



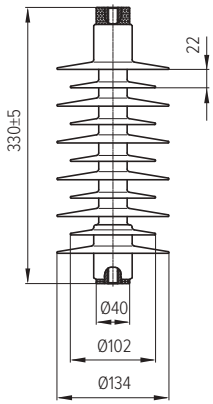
PKIL 24



PKIL 36



PKIL 44



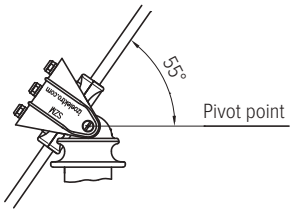
PKIL 52

Name	PKIL	PKIL	PKIL	PKIL	PKIL
Commercial designation	12	24	36	44	52
Nominal operating voltage	12 kV	24 kV	36 kV	44 kV	52 kV
Creepage distance	357 mm	557 mm	757 mm	957 mm	1157 mm
Arcing distance	170 mm	214 mm	258 mm	302 mm	346 mm
Mass	1,2 kg	1,4 kg	1,6 kg	1,8 kg	2,0 kg

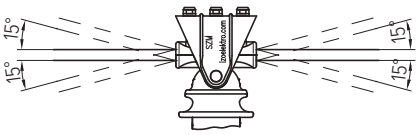
5.11 A PKI and PKI Inclination and Conductor Declination

Note: the data in the images below represents the maximum inclinations and declinations of conductors in the top fitting of A PKI and PKI insulators according to their installation.

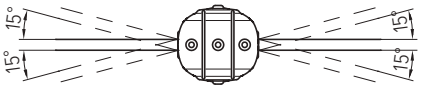
Insulator top inclination



Vertical conductor declination

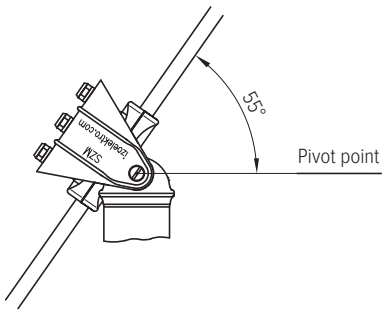


Horizontal conductor declination

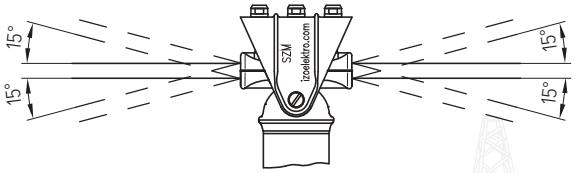


A PKI, PKI (G, S, V, Z, M, M120/99) **PKI (O, H)**

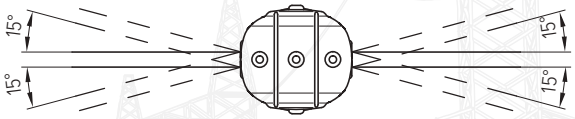
Insulator top inclination



Vertical conductor declination



Horizontal conductor declination



A PKI, PKI (G, S, V, Z, M, M120/99)

5.12 **Wildlife Protection: Overview**

A PKI and PKI with commercial designation »B« are composite post insulators that, in combination with the silicone coat SILP and the protection cap SZM/0, provide wildlife protection. These insulators are specifically designed for installation on overhead power lines with rated voltages of up to 52 kV. Their purpose is to ensure reliable and safe operation of power lines in areas prone to wildlife interference.

Characteristic

The A PKI and PKI composite post insulators with commercial designation »B« are equipped with a protective cap SZM/0 to safeguard wildlife from the metal parts of the insulator's top end fitting. The silicone coat SILP, mounted on the bare conductor, provides insulation for the bare conductor attached to the insulator on both sides. A screw clamp, tightened to the specified torque, allows the conductor to move through the SILP silicone coat while preventing any movement of the coat in relation to the attachment point.

Installation

Installation of wildlife protection on overhead power lines is generally recommended, especially in areas designated for wildlife conservation as determined by the regulations. We recommend installing wildlife protection in locations where earth faults frequently occur due to factors such as:

- larger birds,
- birds landing and taking off,
- or rodents jumping onto poles.

In collaboration with our users, we have developed a system for installing standard protective elements. To implement a wildlife protection system, the following components are necessary:

- insulators A PKI or PKI with commercial designation »G«,
- silicone coat SILP,
- cap SZM/0.

Ordering

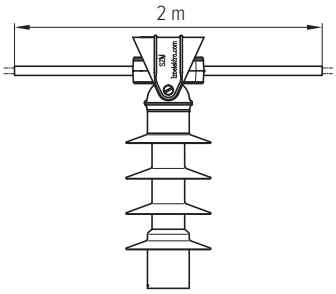
Select any A PKI or PKI composite post insulator with commercial designation "G" along with the cap SZM/0 and the recommended length of the silicone coat SILP. Please follow the instructions provided in section 5.12 Wildlife Protection - Set for an example of a single set of the wildlife protection system.

Competitive advantages

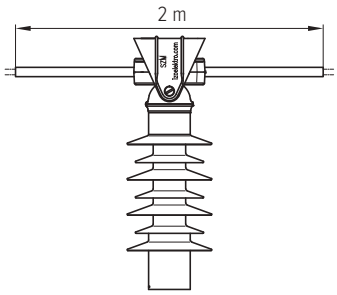
- Easy and fast system upgrades available for all installed A PKI and PKI composite post insulators with commercial designation "G".
- Ensures 100% wildlife protection at installation sites.
- Reliable wildlife protection even in extreme weather conditions.

5.13 **Wildlife Protection - Set**

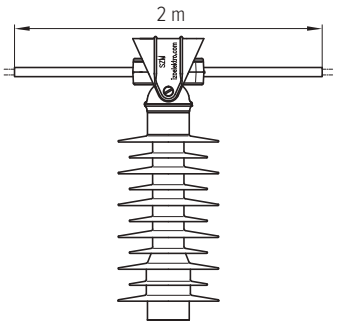
Horizontal pull-out force of the conductor (Fh): 2,8 kN
Vertical maximum load of clamp (Fv): 4,0 kN



A PKI NB



A PKI LB

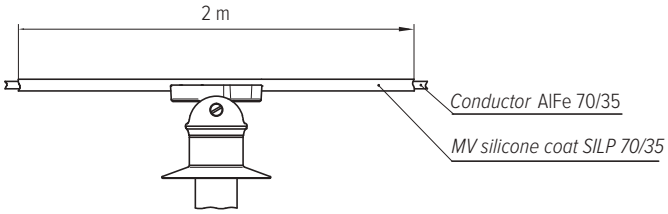


A PKI XB

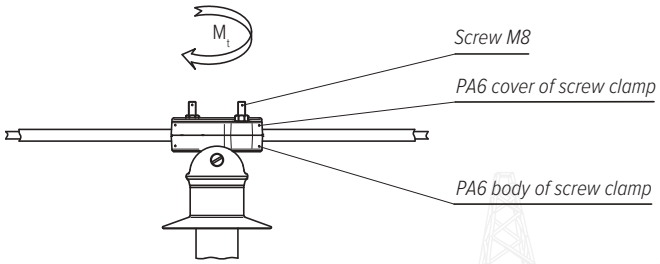
Set	Quantity
A PKI NG or A PKI LG or A PKI XG	1 pcs
+ MV SILP 70/35 silicone coat	2 m
+ SZM/0 cap	1 pcs

Installation instructions for wildlife protection with a screw clamp

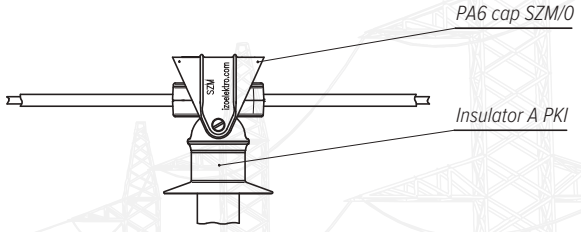
1. The SILP 70/35 silicone coat is installed onto the conductur symmetrically to the screw clamp



2. Tighten the screws with a torque of Mt=6 Nm



3. Install the cap SZM/0



5.14 Safe Installation of Power Lines through Forests: Overview

A PKI composite post insulators with commercial designation “V” are purpose-built post insulators with a weakened spring clamp. These insulators are specifically designed for safe installation of medium voltage overhead power lines in forested areas. They are intended for use on power lines with rated voltages up to 52 kV.

Characteristic

These composite post insulators are equipped with a specially designed weakened spring clamp that allows for easier collapsing in extreme weather conditions.

Installation

The installation of dedicated A PKI composite post insulators with commercial designation “V” should follow the directives and technical regulations of electrical distributors. These insulators are specifically used in power lines passing through forests where interruptions of power supply are common due to various factors such as:

- extreme weather conditions,
- falling trees,
- breaking branches,
- and snow and ice falling from trees.

In worst-case scenarios, power line collapses can occur, although often the conductor remains unbroken. Recognizing this, our company conducted a comprehensive study in collaboration with end-users and technical staff to ensure the safe installation of power lines in forested areas. The research was further supported by a field test conducted in a natural environment, which can be viewed on the Izoelektro YouTube channel. To ensure the safe installation of power lines through forests, the following equipment is required:

- A PKI post insulators with weakened spring clamps,
- hook,
- conductor safety arc.

Calculation and ordering

The selection of conductor safety arc diameter and the size of the hook must be determined through calculation. To carry out the “safe transmission line installation through forests,” please request a quotation based on the transmission line route plan and conductor cross-section.

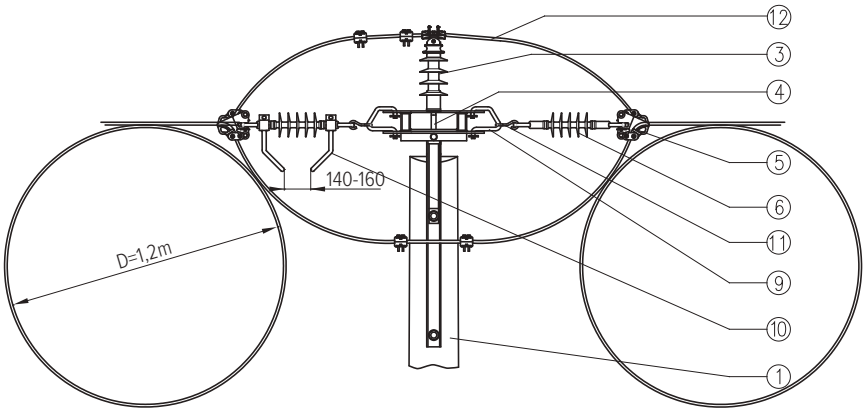
General data

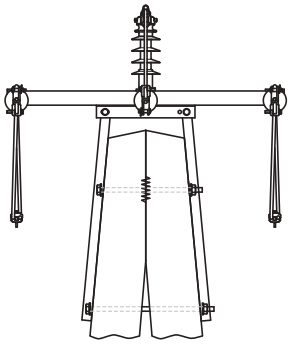
- Specified cantilever load (SCL): 12,5 or 15 kN
- Ambient temperature range T = -60 °C ... +85 °C
- Housing: silicone
- Silicone colour: grey
- Material of top fitting: PA6 GF UV
- Material of steel end fitting: ST 52-3
- Zinc coating: ≥ 70 µm

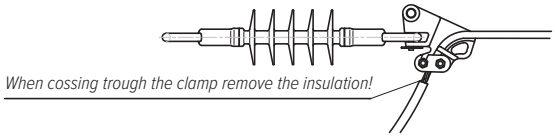
Competitive advantages

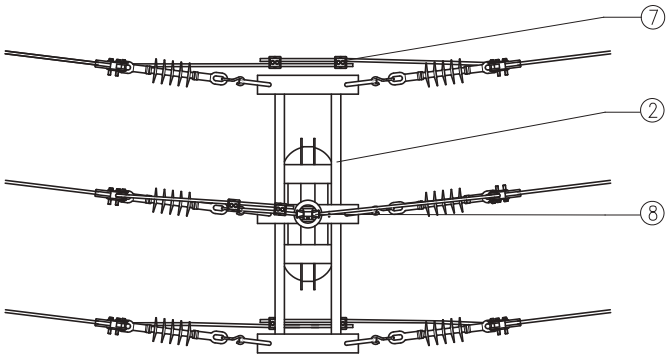
- The system for safe installation with the A PKI post insulators with commercial designation »V« ensures the utmost safety of the overhead power line.
- It effectively protects poles from potential damage caused by falling trees onto the conductors.
- The system is developed as a result of extensive research conducted by our expert researchers in collaboration with users and technical staff from the renowned Milan Vidmar Electric Power Research Institute (ElMV).

5.15 A PKI Safe Installation Through the Woods - Example





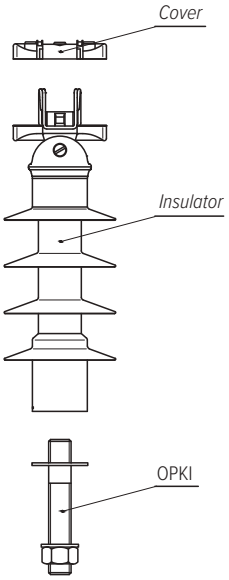




Pos	Name	Pcs
1	Pole	1
2	Suspension crossarm brace - set	1
3	A PKI post composite insulator	1
4	Pin OPKI	1
5	SZ-U tension clamp	6
6	NKI tension composite insulator	6
7	Current clamp	3
8	Cover	1
9	OS 80 shackle	6
10	NKI arcing horn	6
11	90° hook	6

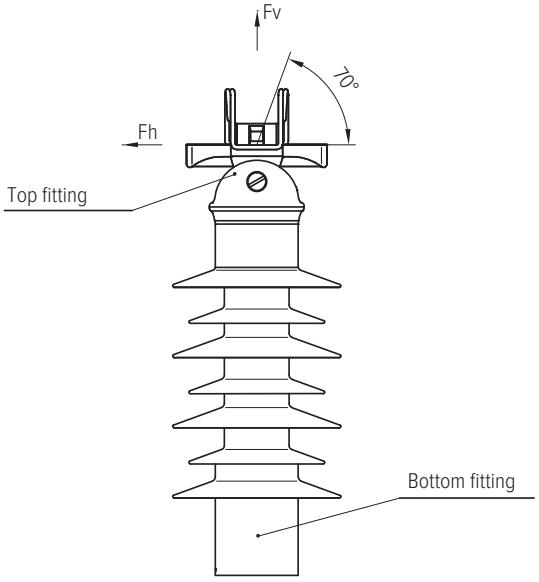
5.16 **A PKI Insulator Sets**

Note: we produce sets per customer's request.



Set	Pcs
Insulator A PKI NS M24	1
+ Cover 35-AlFe	1
+ OPKI M24/M24x120	1
Insulator A PKI NS M24	1
+ Cover 50-AlFe	1
+ OPKI M24/M24x120	1
Insulator A PKI NS M24	1
+ Cover 70-AlFe	1
+ OPKI M24/M24x120	1

5.17 **A PKI Insulators - Order Example**



Name: **PKI LS M24**

Explanation of the Name

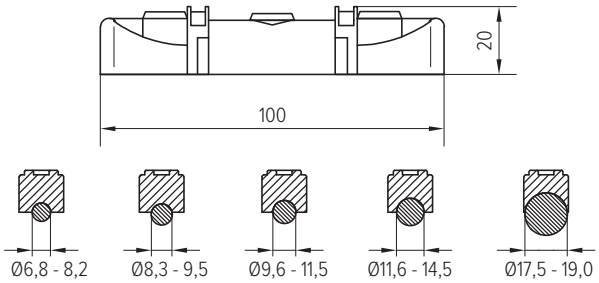
A PKI, PKI	Type of MV composite insulator
N, L, X	Creepage distance
S, O, H, D, Z, M, G, B	Shape of top fitting
M24, M20	Connector thread on the bottom end fitting

Marks on composite insulator

Izoelektro	Manufacturer
A PKI	Type of MV composite insulator
M/Y	Month / year of production
15 kN	Specified tensile load (STL)

5.18 **PA Cover**

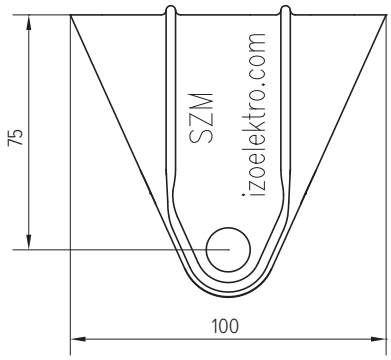
Intended use: required to install the spring clamp
Material: polyamide PA6 GF UV



Ø of Conductor	PA cover
6,8 - 8,2	35 AlFe
8,3 - 9,5	50 AlFe
9,6 - 11,5	70 AlFe and 35 CC
11,6 - 14,5	95 AlFe and 70 CC
17,5 – 19,0	120 AlFe and 99 CC

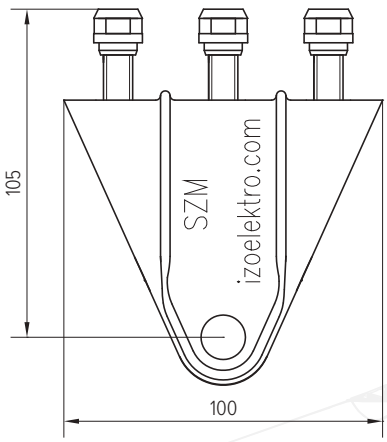
5.19 **PA Cap SZM/0**

Intended use: an upgrade for the “S“ A PKI and PKI insulators
Material: polyamide PA6 GF UV



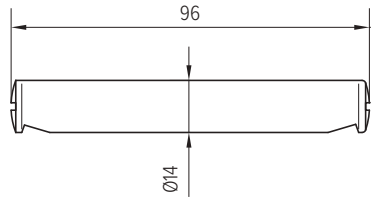
5.20 **PA Cap SZM/3**

Intended use: for increasing the vertical and horizontal pull-out force of the spring clamp
Material: polyamide PA6 GF UV



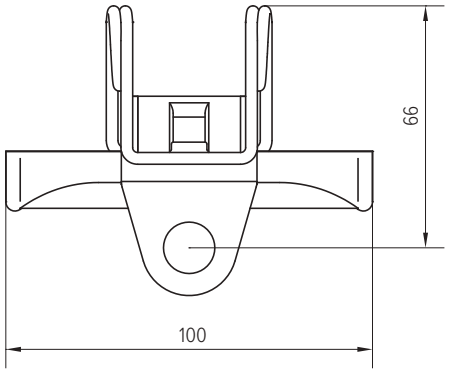
5.21 **PA Bolt**

Intended use: used for replacing PA clamp in the top fitting of A PKI and PKI insulators
Material: polyamide PA6 GV UV



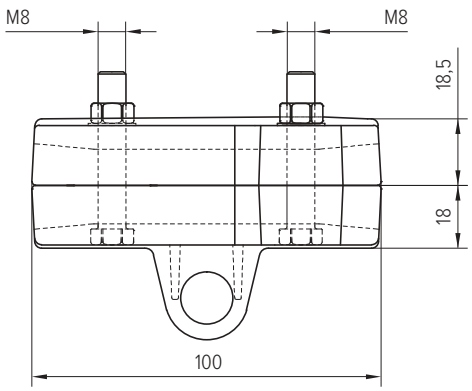
5.22 **PA Body with Spring Clamp**

Intended use: in top fittings of “S“, “Z“, “M“ A PKI and PKI insulators
Diameter: Ø6,8 - 19
Material: polyamide PA6 GF UV and stainless steel A2/A4



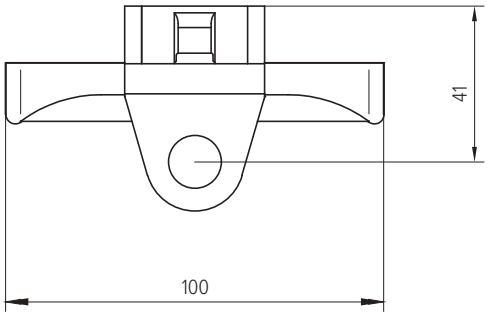
5.23 **PA Screw Clamp**

Intended use: in top fitting of A PKI insulator »G«
Diameter: Ø14 - 22
Material: polyamide PA6 GF UV and stainless steel A2/A4



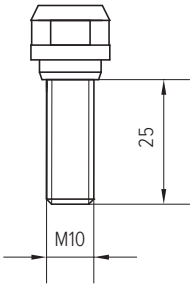
5.24 **PA Body of Spring Clamp**

Intended use: in top fittings of “S“, “Z“, “M“ A PKI and PKI insulators
Diameter: Ø 6,8 - 19
Material: polyamide PA6 GF UV



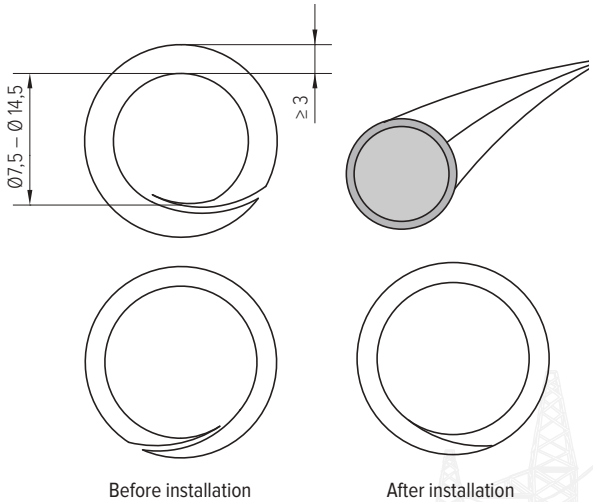
5.25 **PA Screw**

Intended use: with the SZM/3 cap
Material: polyamide PA6 GF UV



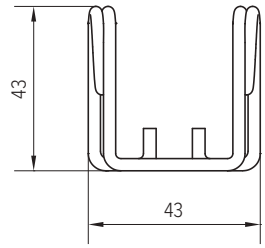
5.26 **MV Silicone Coat SILP**

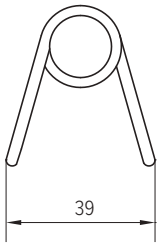
Intended use: for wildlife protection set
Material: silicone



5.27 **MV Spring**

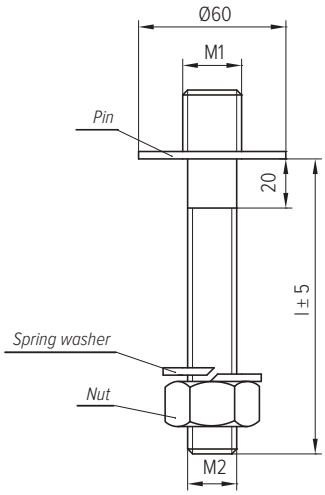
Intended use: with the PA spring clamp body
Material: stainless steel A2/A4





5.28 **OPKI Pins**

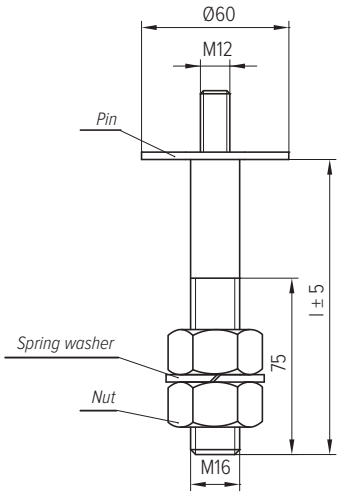
Intended use: for installing A PKI and PKI insulators onto the bracket
Note: the shape and dimensions can be produced per customer's request
Material: stainless steel or hot-dip galvanized steel



Name	M1	M2	l (mm)
OPKI M20/M20x140	20	20	140
OPKI M20/M20x170	20	20	170
OPKI M24/M20x170	24	20	170
OPKI M24/M24x80	24	24	80
OPKI M24/M24x140	24	24	140
OPKI M24/M24x170	24	24	170

5.29 **OPKIL Pin for Switch Disconnector**

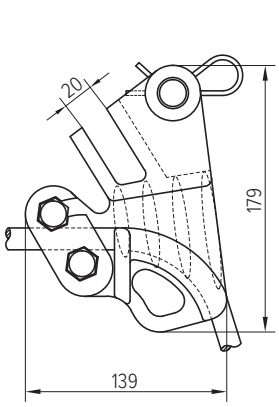
Intended use: for the replacement of ceramic insulators
with PKIL insulators on disconnecting switches
Material: stainless steel or hot-dip galvanized steel

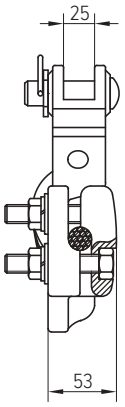


PL Accessories

6.1 **SZ-U Universal Tension Clamp**

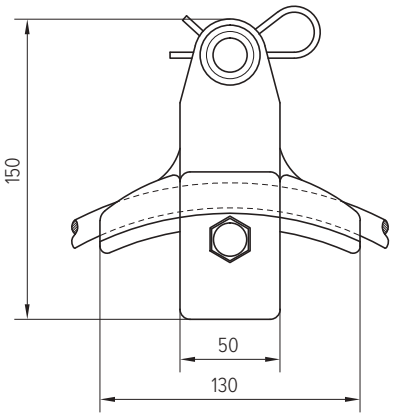
Minimum breaking load: 60 kN
Screw tightening torque: 45 Nm
Conductor diameter AlFe: 6,8-14,0 mm
Material: Al alloy, stainless steel A2/A4 and hot-dip galvanized steel

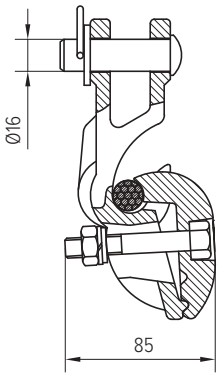




6.2 **SN-U Universal Suspension Clamp**

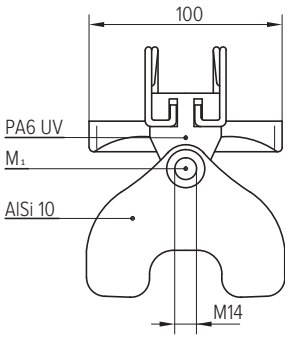
Minimum breaking load: 60 kN
Screw tightening torque: 45 Nm
Conductor diameter AlFe: 6,8-14,0 mm
Material: Al alloy, stainless steel A2/A4 and hot-dip galvanized steel



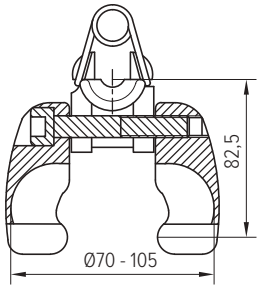


6.3 **VS Spring Clamp**

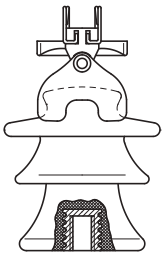
VS 20 - spring clamp
VS 25 - spring clamp
Conductor diameter: 6,8 - 19 mm
Material: Al alloy, stainless steel A2/A4 and polyamide PA6 GF UV
Note: PA cover required (refer to chapter 5.17)
Intended use: for attaching conductors to ceramic insulators VHD 20, VHD 25, PI and LPI



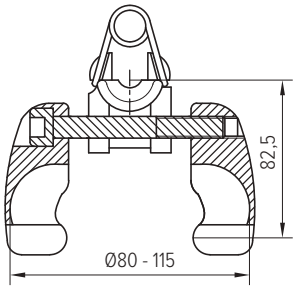
VS 20 / VS 25



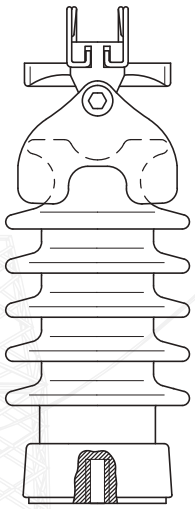
VS 20



Example: VS VHD 25



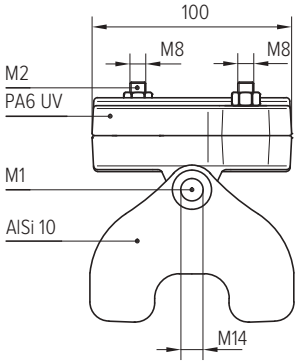
VS 25



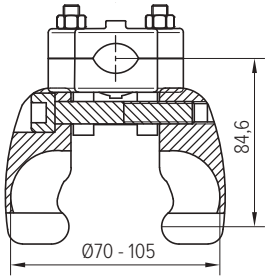
Example: VS LPI L

6.4 **VSV Screw Clamp**

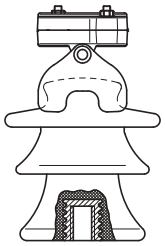
VSV 20 screw clamp
VSV 25 screw clamp
Conductor diameter: 14 - 22 mm
Tightening torque M1 = 25 Nm for screw M14
Tightening torque M2 = 8 Nm for screw M8
Tightening torque M2 = 6 Nm for screw M8 when mounting SILP (wildlife protection)
Material: Al alloy, stainless steel A2/A4 and polyamide PA6 GF UV
Intended use: for attaching conductors to ceramic insulators VHD 20, VHD 25, PI and LPI



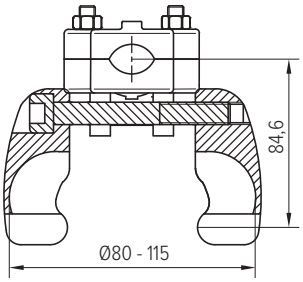
VSV 20 / VSV 25



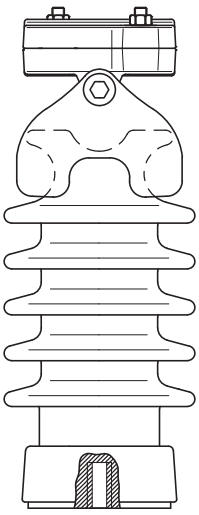
VSV 20



Example: VSV VHD 20



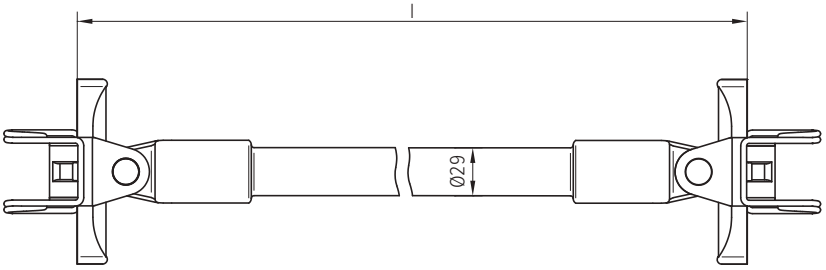
VSV 25



Example: VSV LPI L

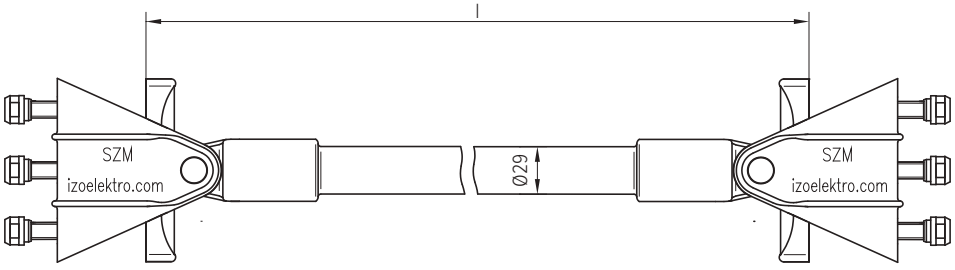
6.5 DSI S Insulating Spacer with a Spring Clamp

Version: with spring clamp
Material: stainless steel A2/A4, polyamide PA6 GF UV
Length: 400 - 4100 mm



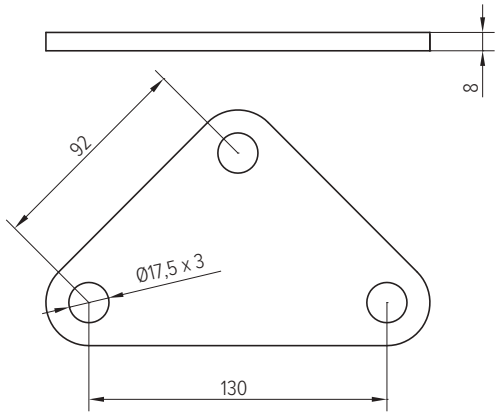
6.6 DSI M Insulating Spacer With a Spring Clamp and cap SZM/3

Version: with spring clamp and reinforcement cap
Material: stainless steel A2/A4, polyamide PA6 GF UV
Length: 400 - 4100 mm



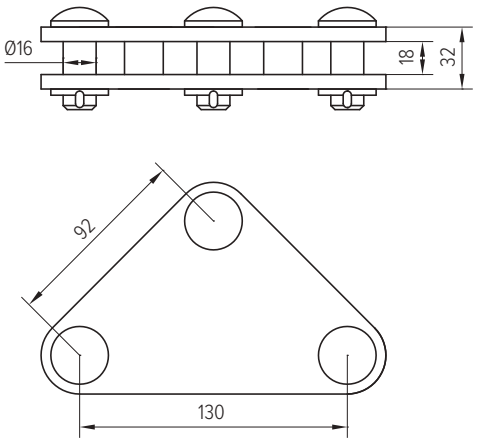
6.7 **Steel Yoke**

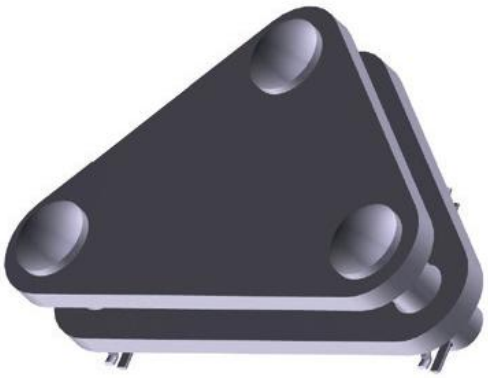
Minimum breaking load: 90 kN
Material: hot-dip galvanized steel



6.8 **Steel Yoke Double**

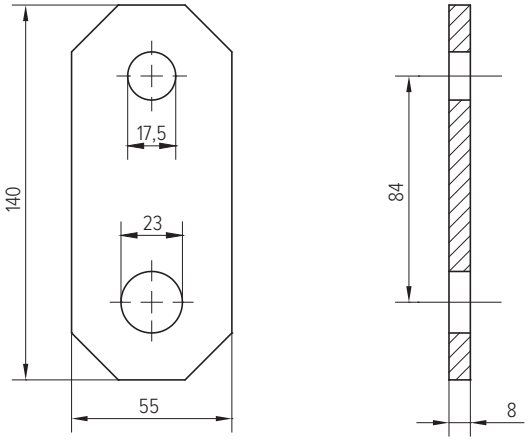
Minimum breaking load: 90 kN
Material: hot-dip galvanized steel





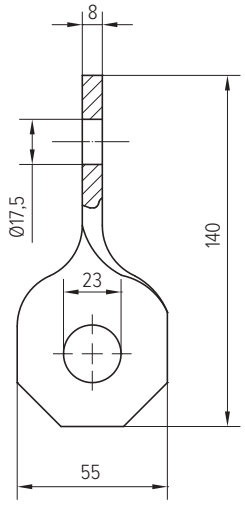
6.9 **Steel Extension Link**

Minimum breaking load: 90 kN
Material: hot-dip galvanized steel



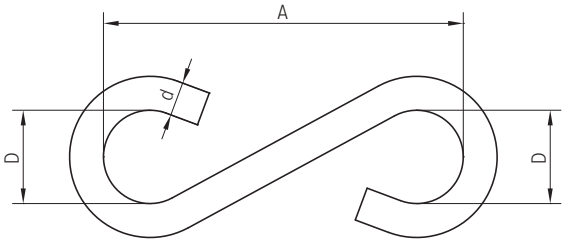
6.10 **Steel Extension Link 90°**

Minimum breaking load: 90 kN
Material: hot-dip galvanized steel



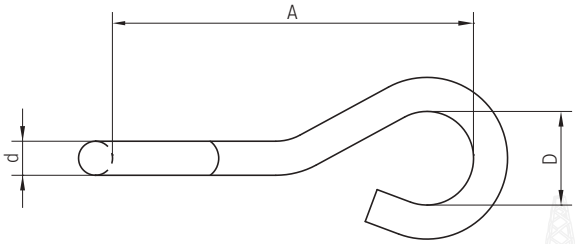
6.11 **S - Hook**

Name: S - hook 4 kN, dimension (mm) A=85, D=22, d=8
Name: S - hook 6 kN, dimension (mm) A=80, D=22, d=10
Material: hot-dip galvanized steel



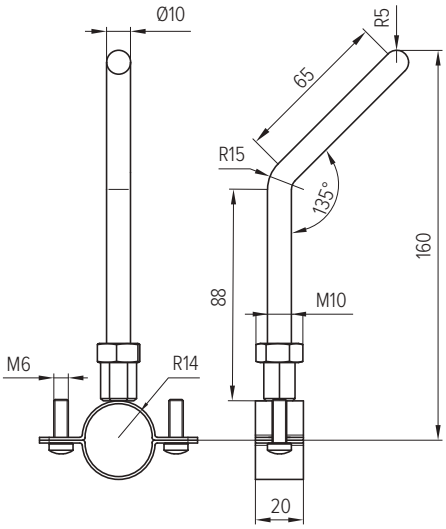
6.12 **S - Hook 90°**

Name: S - hook 90° 4 kN, dimension (mm) A=85, D=22, d=8
Name: S - hook 90° 6 kN, dimension (mm) A=80, D=22, d=10
Material: hot-dip galvanized steel



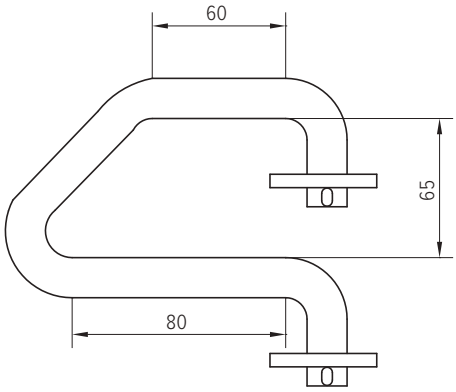
6.13 **Arcing Horn NKI**

Tightening torque M6: 16 Nm
Material: hot-dip galvanized steel



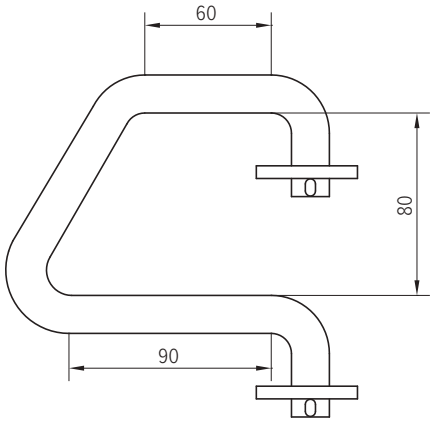
6.14 **G Shackle OS 65**

Minimum breaking load: 90 kN
Material: hot-dip galvanized steel



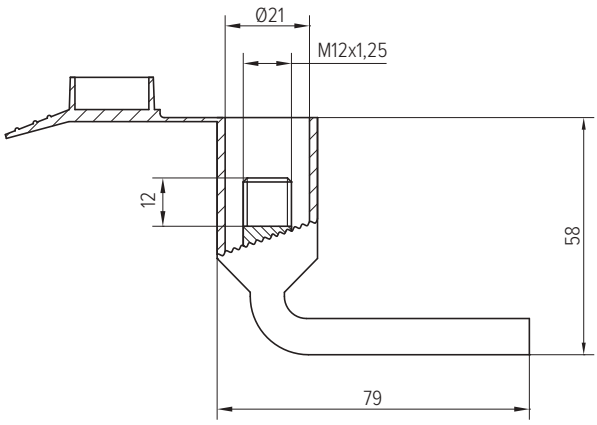
6.15 **G Shackle OS 80**

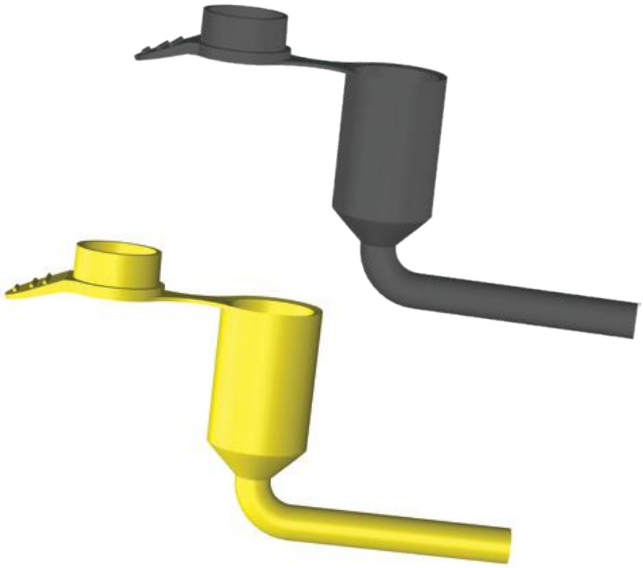
Minimum breaking load: 90 kN
Material: hot-dip galvanized steel



6.16 **Earthing Screw**

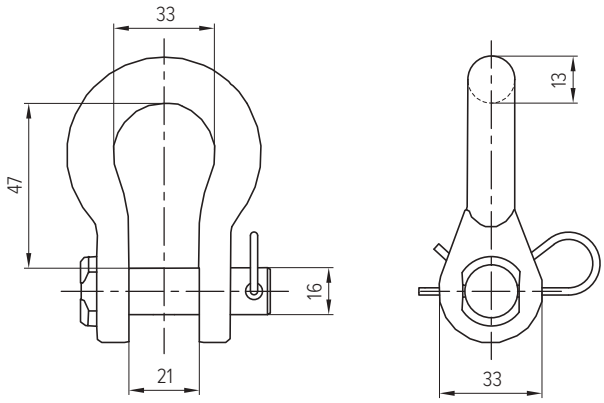
Name: Earthing screw – yellow
Name: Earthing screw – black
Material: CuZn28, polyamide PA6 GF UV
Name: Earthing screw – yellow Cu
Name: Earthing screw – black Cu
Material: Cu, polyamide PA6 GF UV
Tightening torque M12: 8 Nm





6.17 **Anchor Shackle**

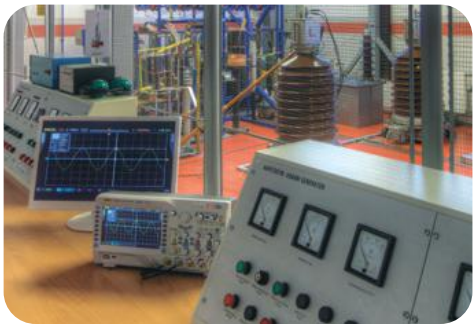
Minimum breaking load: 80 kN
Material: hot-dip galvanized steel, stainless steel



Notes

HV Laboratory

7.1 High Voltage Laboratory: Overview



Our company operates a well-equipped laboratory for conducting electrical and mechanical measurements. The laboratory primarily serves our internal needs, facilitating various tests throughout the product development process, including early-phase testing and final product validation. Additionally, we offer testing services to external entities such as companies, research institutes, and educational institutions. Our team of experts generate test reports and expert opinions based on the results obtained. To ensure the accuracy and reliability of our measurements, we regularly calibrate our instruments through an authorized institution.

Fields of Application

Our laboratory specializes in testing MV surge arresters and insulators with operating voltages up to 60 kV. Varistors blocks undergo testing up to 6 kV. We utilize high current pulses of various shapes, following the guidelines outlined in the IEC 60099-4 and IEC 61643 standards.

For insulator testing, we subject them to power frequency voltage up to 220 kV, as well as lightning impulse voltage with a waveform of 1,2/50 µs and up to 500 kV.

7.2 Technical Capabilities

Power Frequency Voltage Generator

The power frequency voltage generator has a peak value of 220 kV. It generates a continuous power frequency voltage that serves to determine the wet power frequency withstand voltage of insulators, as outlined in the IEC 61109, IEC 61952, and IEC 60383 standards.

Moreover, the same generator is utilized to establish the reference voltage for surge arresters, following the guidelines provided by the IEC 60099-4 and IEC 61643 standards. It also enables the measurement of the resistive component of surge arresters' leakage current.

Lightning Impulse Voltage Generator

The lightning impulse voltage generator has a peak value of 500 kV for a 1,2/50 µs waveform. This generator enables the generation of lightning impulse voltage for testing insulators in compliance with the IEC 61109, IEC 61952, and IEC 60383 standards. It is also utilized for testing surge arresters as per the IEC 60099-4 standard.

Lightning Impulse Current Generator

The lightning impulse current generator produces peak values for various waveforms:

- 10/350 µs: 50 kA
- 8/20 µs: 50 kA
- 4/10 µs: 100 kA
- 2 ms: 1000 A

These values allow for the generation of lightning impulse currents required for testing purposes.

Generated Current Impulses

Standard Waveforms:

- 4/10 µs
- 8/20 µs
- 10/350 µs
- Long duration current 1 ms
- Long duration current 2 ms

Nonstandard Waveforms:

- Range from 4/10 µs to 30/60 µs
- Range from 250 µs to 2000 µs

The generator is utilized for conducting operating duty tests in compliance with the IEC 60099-4 and IEC 61643 standards.

Digital Partial Discharge Tester for Precise Partial Discharge Measurements

The digital partial discharge tester is used to accurately measure partial discharges on surge arresters and insulators. It enables measurements with an alternating voltage up to 100 kV and offers an exceptional sensitivity of 0.1 pC, according to the IEC 60270 standard.

7.3 Test Protocols

LV Surge Arresters (IEC 61643-1)

- Measurement of residual voltage using 8/20 µs current impulses
- Operating duty test
- Test of thermal stability
- Dielectric withstand test

MV Surge Arresters (IEC 60099-4)

- Insulation withstand test conducted on the arrester housing
- Residual voltage test
- Long-duration current impulse withstand test
- Operating duty test
- Accelerated ageing test
- Measurement of resistive leakage current
- Routine testing in accordance with the IEC 60099-5 standard

Tension Composite Insulators (IEC 61109)

- Dry lightning impulse withstand voltage test
- Wet power frequency voltage test
- Mechanical load test
- Partial discharge testing
- Verification of zinc thickness

Line Post Composite Insulators (IEC 61952)

- Dry lightning impulse withstand voltage test
- Wet power frequency voltage test
- Mechanical tests
- Partial discharge testing
- Dye penetration test
- Verification of zinc thickness

Notes

IZOELEKTRO

Name of Company	Izoelektro, proizvodnja in trgovina d.o.o.
Short Name	Izoelektro d.o.o.
Date of Registration	25. 01. 1999
Legal Form	Limited Liability Company
Registration Number	1366009
VAT Number	SI56506635
IBAN	SI56 0451 5000 0204 790
D-U-N-S® Number	499269017
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AAA

Platinum Creditworthiness

ISO 9001
Q-262

ISO 14001
E-238

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