

Katalog izdelkov *Product catalogue*

06/2020



IZOELEKTRO

Splošno

Predmet našega poslovanja je razvoj, proizvodnja in prodaja opreme za izgradnjo elektroenergetskih sistemov do 52 kV. Naši najpomembnejši proizvodi so:

- odvodniki prenapetosti,
- indikatorji stanja odvodnikov prenapetosti,
- natezni in podporni kompozitni izolatorji,
- sistemi izgradnje daljnovodov,
- spojna in obesna oprema,
- koncentrični material.

Poleg prodaje lastnih izdelkov dobavljamo vso ostalo opremo, ki jo kupci pri nas zahtevajo.

Visokonapetostni laboratorij

Imamo lasten visokonapetostni laboratorij, ki ga nenehno dograjujemo v skladu z najnovejšimi zahtevami standardov. Omogoča izvajanje večine preizkusov na sredjenapetostnih odvodnikih po standardu IEC 60099-4. Za potrebe razvoja in proizvodnje lahko preizkušamo izolatorje do 60 kV obratovalne napetosti. Meritve izvajamo tudi za zunanje naročnike.

Certifikati

Zavedamo se, da je za naše odjemalce najpomembnejša kakovost proizvodov. Od leta 2000 imamo v podjetju vzpostavljen in ustrezno vzdrževan sistem vodenja, ki izpolnjuje zahteve standarda ISO 9001. Leta 2007 pridobljen certifikat ISO 14001 pa potrjuje odgovorno načrtovanje novih proizvodov in ekološko ravnanje z okoljem.

Inovativnost

V naših proizvodih je vgrajenih devet patentov, ki smo jih razvili v lastnem razvojno-raziskovalnem inštitutu. Prvi v svetu smo razvili, patentirali in leta 2004 pričeli s prodajo kompozitnih podpornih izolatorjev z izolacijskim zgornjim priključkom in inovativnim načinom pritrditve vodnika. Leta 2019 smo patentirali RAM-1 z digitalnim javljanjem uporovne komponente odvodnika prenapetosti v obratovanju.

Novost

SN odvodnik razreda DH - tip SNO je preizkušen v skladu z najnovejšo izdajo standarda IEC 60099-4:2014. PKI - E nova različica zgornjega PA priključka z vzmetno sponko za vodnike premera Ø15 do Ø30. RAM-1 sistem za brezžični nadzor odvodnikov prenapetosti nad 1 kV.

Cilji

Naš cilj je razviti in prijaviti vsaj dva patenta letno in postati v svetu prepoznaven proizvajalec izdelkov z vgrajenimi lastnimi patenti.

Vizija

Nadaljnji razvoj je usmerjen v proizvodnjo pametnih sredjenapetostnih odvodnikov prenapetosti s silikonskim plaščem, kompozitnih podpornih izolatorjev z uporabo priključkov iz izolacijskega materiala in kompozitnih izolatorjev s kapacitivnim kazalnikom z daljinskim prikazovalnikom.

IZOELEKTRO - KORAK PRED ČASOM

General

The subject of our business is the development, production and sales of power distribution equipment intended for the constructions of electro systems up to 52 kV. Our most important products are:

- surge arresters,*
- surge arresters condition monitor,*
- tension and post composite insulators,*
- overhead power lines construction systems,*
- junction and suspension equipment,*
- connecting sleeves.*

Along with the supply of our own products we supply all the other equipment that customers request from us.

High voltage laboratory

We have our own high voltage laboratory which is being continuously developed in line with the latest standard requirements. It allows us to perform most of the tests for medium voltage surge arresters according to the standard IEC 60099-4. For the purposes of development and production we can test insulators with operating voltage of up to 60 kV. We also perform tests for customers.

Certificates

We are aware that the quality of products is most important to our customers. Since 2000 we have established and suitably maintained a system of guidance which fulfils the demands of the ISO standard 9001. The ISO certifikat 14001 acquired year 2007 confirms responsible development of new products and eco-environmental management.

Innovativeness

Our products incorporate nine patents which were developed by our own Research and Development Institute. Izoelektro was the first to develop, patent and, in 2004, begin sales of post composite insulators with insulated top fitting and an innovative method for attachment of the wire conductor. In 2019 we patented the RAM-1 with digital reporting of the resistive component of surge arrester in operation.

Innovation

Class DH surge arrester - SNO type is tested according to the latest edition of the IEC 60099-4:2014 standard. PKI E - new version of PA top fitting with spring clamp for conductor with cross sections Ø15 to Ø30. RAM-1 remote condition monitor for surge arresters above 1 kV.

Goals

Our goal is to develop and apply at least two patents per year and become an internationally recognized producer of products with its own patents installed.

Vision

Further development is focused on the production of smart medium voltage surge arresters with silicone coat and with an indication of leakage current, post line composite insulators with end fittings made of insulating material and composite insulators with a capacitive pointer with a remote display.

IZOELEKTRO - AHEAD OF IT'S TIME

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Odporno na UV sevanje		<i>UV resistance</i>
Samočistilnost		<i>Self-cleaning</i>
IP zaščita		<i>IP protection</i>
Odklopna naprava		<i>Disconnecting Device</i>
Ozemljitveni vodnik H07V-K		<i>Earthing conductor H07V-K</i>
Kabelski čevelj		<i>Cable lug</i>
Votlica		<i>Terminal tube</i>
Varovalo		<i>Safety tie</i>
100% kontrola		<i>100% control</i>
Montaža: zgoraj		<i>Mounting: top</i>
Montaža: spodaj		<i>Mounting: bottom</i>
Izolacijski zgornji priključek		<i>Insulated top fitting</i>
Kratek čas dobave		<i>Short delivery time</i>
Narejeno v Sloveniji		<i>Made in Slovenia</i>
Proizvedeno po EU standardih		<i>Conformité Européenne</i>
Možnost reciklaže		<i>Recyclable</i>

Seznam kratic

μs	– mikrosekunda
$^{\circ}C$	– stopinj celzija
AD	– preskočna razdalja
AgL	– tip varovalke
Al	– aluminij
CD	– plazilna pot
d	– premer
D_{min}	– minimalna razdalja
DOPPS	– Društvo za opazovanje in preučevanje ptic
DV	– daljnovod
E	– električna poljska jakost
F_h	– horizontalna sila
F_v	– vertikalna sila
H	– višina
IEC	– Mednarodna komisija za elektrotehniko
I_{imp}	– impulzni odvodni tok
I_{max}	– maksimalni odvodni tok
I_n	– nazivni odvodni tok
IP	– stopnja zaščite
kg	– kilogram
kJ	– kilo joule
kV	– kilo volt
l	– dolžina
L	– faza
m	– meter
mA	– miliamper
mm	– milimeter (enota tehničnih risb)
mm^2	– kvadratni milimeter
M	– moment
M_t	– torzijski moment
M_u	– upogibni moment
N	– newton
Nm	– newton meter
NN	– nizka napetost
ns	– nanosekunda
PA	– poliamid
PIV	– polizoliran vodnik
s	– sekunda
SCL	– nazivna upogibna sila
SN	– srednja napetost
ST	– jeklo
t	– čas
T	– temperatura
tA	– odzivni čas
U_c	– trajna obratovalna napetost
UL 94	– standard gorljivosti
U_{max}	– maksimalna napetost
U_p	– napetostni zaščitni nivo
U_r	– nazivna napetost
U_{res}	– preostala napetost
UV	– ultravijolična zaščita
v	– hitrost širjenja udarnega vala
V-0	– stopnja gorljivosti po UL 94
W	– energijska absorpcija

List of abbreviations

μs	– microsecond
$^{\circ}C$	– degrees celsius
AD	– arcing distance
AgL	– fuse type
Al	– aluminium
CD	– creepage distance
d	– diameter
D_{min}	– minimum distance
DOPPS	– Association for the observation and study of birds
PV	– power line
E	– electric field strength
F_h	– horizontal load
F_v	– vertical load
H	– height
IEC	– International Electrotechnical Commisison
I_{imp}	– discharge current
I_{max}	– maximum discharge current
I_n	– nominal discharge current
IP	– Ingress protection level
kg	– kilogram
kJ	– kilo joule
kV	– kilo volt
l	– length
L	– line
m	– meter
mA	– milliampere
mm	– millimetre (unit of technical drawings)
mm^2	– square millimetre
M	– torque
M_t	– Terminal torque
M_u	– Cantilever strength
N	– newton
Nm	– newton metre
LV	– low voltage
ns	– nanosecond
PA	– polyamide
CC	– covered conductor
s	– second
SCL	– specified cantilever load
MV	– medium voltage
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

1

NN odvodniki prenapetosti *LV surge arresters*



IZOELEKTRO

1.1 NNO in MOSIPO splošno

Proizvod

Nizko napetostni kovinsko oksidni odvodniki prenapetosti so namenjeni za vgradnjo v nizko napetostne prosto zračne vode ali razdelilne omarice do 1 kV kot prva stopnja zaščite pred direktnim udarom strele. Varistorji nizko napetostnih odvodnikov tipa NNO in MOSIPO so oplaščeni s silikonsko gumo, zaradi česar dosegajo izredno visoko stopnjo zaščite IP67.

Lastnosti

Odklopna naprava reagira:

- po določenem številu udarov, ko v normalnem obratovanju tok skozi odvodnik naraste nad 1 mA,
- v primeru atmosferske praznitve (tok večji od 65 kA).

Po delovanju odklopne naprave je potrebno zamenjati odvodnik prenapetosti. Odklopna naprava po delovanju vidno loči povezavo med odvodnikom prenapetosti in ozemljitvijo.

Vgradnja

Mesto montaže odvodnikov prenapetosti tipa NNO in MOSIPO, določajo pravilniki in tehnični predpisi. Obvezno se vgradijo na:

- vse odcepe in zaključke nizkonapetostnih prostih vodov,
- medsebojni razdalji maksimalno do 1000m,
- razdalji < 500m, kjer so nevihte pogostejše,
- vseh prehodih prosto zračnih vodov na kable in obratno.

Splošni podatki

- Napetostni nivoji: **275, 280, 360, 440, 690 V**
- Ozemljitveni vodnik: **H07V-K 6 mm² - črn**
- Temperaturno območje okolja: **T = -60 °C ... +85 °C**
- Stopnja zaščite: **IP 67**
- Odzivni čas: **tA < 25 ns**
- Plašč: **silikon LSR**
- Barva silikona: **NCS S 2502 - siva**
- IEC razred: **II**
- Testirani po standardu: **IEC 61643-1 in IEC 61643-11**



Prednosti pred konkurenco

NNO in MOSIPO odvodniki prenapetosti imajo:

- stopnjo zaščite IP 67,
- ohišje iz silikonske gume,
- vedno integriran ozemljitveni vodnik,
- po delovanju odklopne naprave dobro vidno ločen ozemljitveni vodnik,

Na zahtevo kupca izdelamo odvodnike prenapetosti NNO in MOSIPO:

- brez ozemljitvenega vodnika,
- s poljubno dolžino, barvo in zaključkom ozemljitvenega vodnika,
- kot tovarniški komplet po izbiri kupca.

1.1 NNO and MOSIPO generally

Product

Low voltage metal oxide surge arresters with silicone coating are designed to be installed in low voltage power lines or in junction boxes up to 1 kV as the first level of protection against direct lightning strikes. Varistors of low voltage arresters type NNO and MOSIPO are coated with silicone rubber, so they have a high ingress protection level IP 67.

Characteristics

The disconnecting device reacts:

- after a certain no. of strokes when in normal operation the current through the arrester increases over 1 mA,
- in case of atmospheric discharge (current bigger than 65 kA).

After the disconnecting device has been activated, the surge arrester and earthing conductor are visibly separated. It is then 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 ends of LV overhead power lines,
- at a maximum mutual distance up to 1000m,
- at a distance < 500m, where storms occur more often,
- in all passages from free conductors to cables and vice versa.

General data

- Voltage levels: **275, 280, 360, 440, 690 V**
- Earthing conductor: **H07V-K 6 mm² - black**
- Ambient temperature range: **T = -60 °C ... +85 °C**
- Ingress protection level: **IP 67**
- Response time: **tA < 25 ns**
- Coat: **silicone LSR**
- Silicone colour: **NCS S 2502 - grey**
- IEC class: **II**
- Tested according to standard: **IEC 61643-1 and IEC 61643-11**

Competitive advantages

NNO and MOSIPO surge arresters have:

- an ingress protection level IP 67,
- a housing made of silicone rubber,
- an always integrated earthing conductor,
- a well visible separated conductor after operation of the disconnecting device,

At the customer's request we produce surge arresters NNO and MOSIPO:

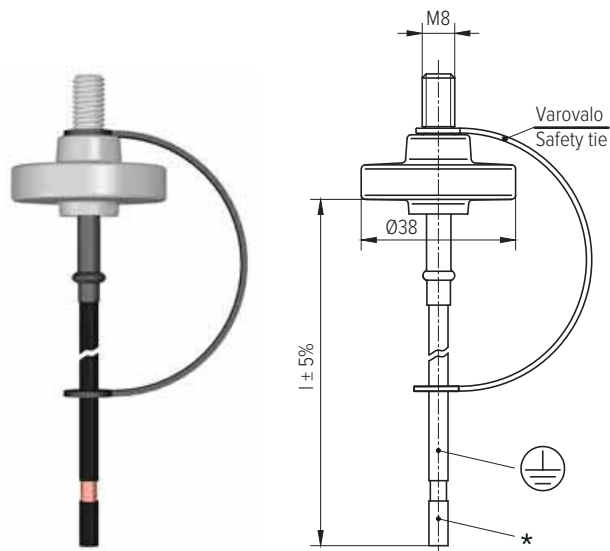
- without earthing conductor,
- with any earthing conductor, length, colour and end fitting,
- as a factory set by customer's demand.

NN odvodniki prenapetosti

LV surge arresters

1.2 NNO

Na zahtevo kupca izdelamo NNO odvodnik s poljubno dolžino, barvo in zaključkom ozemljitvenega vodnika.



* Zaključki ozemljitvenega vodnika / * End fittings of earthing conductor



1.2 NNO

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

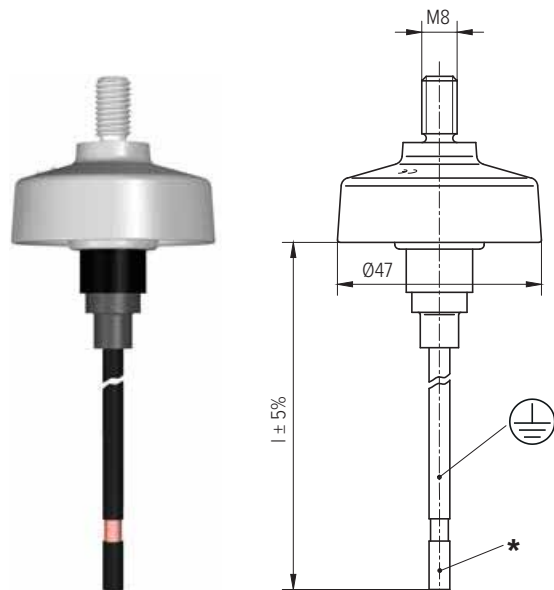
Splošni podatki / General data

- Napetostni nivoji / Voltage levels: **280, 440, 690 V**
- Ozemljitveni vodnik / Earthing conductor: **H07V-K 6 mm² - črn/black**
- Temperaturno območje okolja / Ambient temperature range: **T = -60 °C ... +85 °C**
- Stopnja zaščite / Ingress protection level: **IP 67**
- Plašč / Coat: **silicone LSR**
- Barva silikona / Silicone colour: **NCS S 2502 - siva/grey**
- IEC razred / IEC class: **II**
- Testirani po standardu / Tested according to standard: **IEC 61643-11**

Naziv/Name	I _n [kA]	U _c (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

1.3 MOSIPO

Na zahtevo kupca izdelamo NNO odvodnik s poljubno dolžino, barvo in zaključkom ozemljitvenega vodnika.



* Zaključki ozemljitvenega vodnika / * End fittings of earthing conductor



1.3 MOSIPO

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

Splošni podatki / General data

- Napetostni nivoji / Voltage levels: **275, 440, 690 V**
- Ozemljitveni vodnik / Earthing conductor: **H07V-K 6 mm² - črn/black**
- Temperaturno območje okolja / Ambient temperature range: **T = -60 °C ... +85 °C**
- Stopnja zaščite / Ingress protection level: **IP 67**
- Plašč / Coat: **silicone LSR**
- Barva silikona / Silicone colour: **NCS S 2502 - siva/grey**
- IEC razred / IEC class: **II**
- Testirani po standardu / Tested according to standard: **IEC 61643-1, IEC 61643-11**

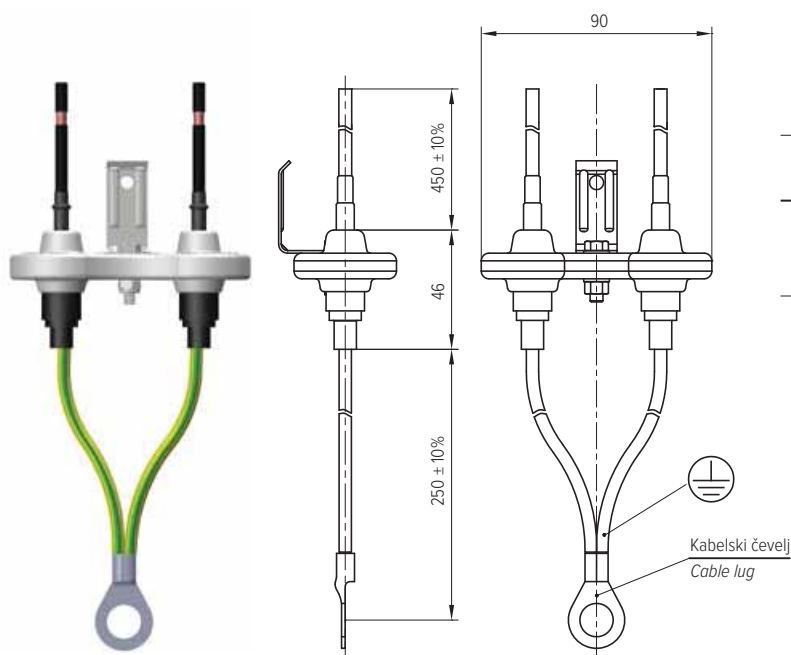
Naziv/Name	I _n [kA]	U _c (AC/DC) [V]	U _p [kV]	W [J]
MOSIPO 10/275	10	275/350	1,20	2450
MOSIPO 10/440	10	440/585	1,80	3200
MOSIPO 10/690	10	690/910	2,50	3960
MOSIPO 15/275	15	275/350	1,50	2450
MOSIPO 15/440	15	440/585	2,00	3200
MOSIPO 15/690	15	690/910	3,00	3960

1.4 NNO dvojni

Ozemljitveni vodnik: H07V-K 6 mm²
Kabelski čevelj: Cu 16/12 mm

1.4 NNO double

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



Naziv/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

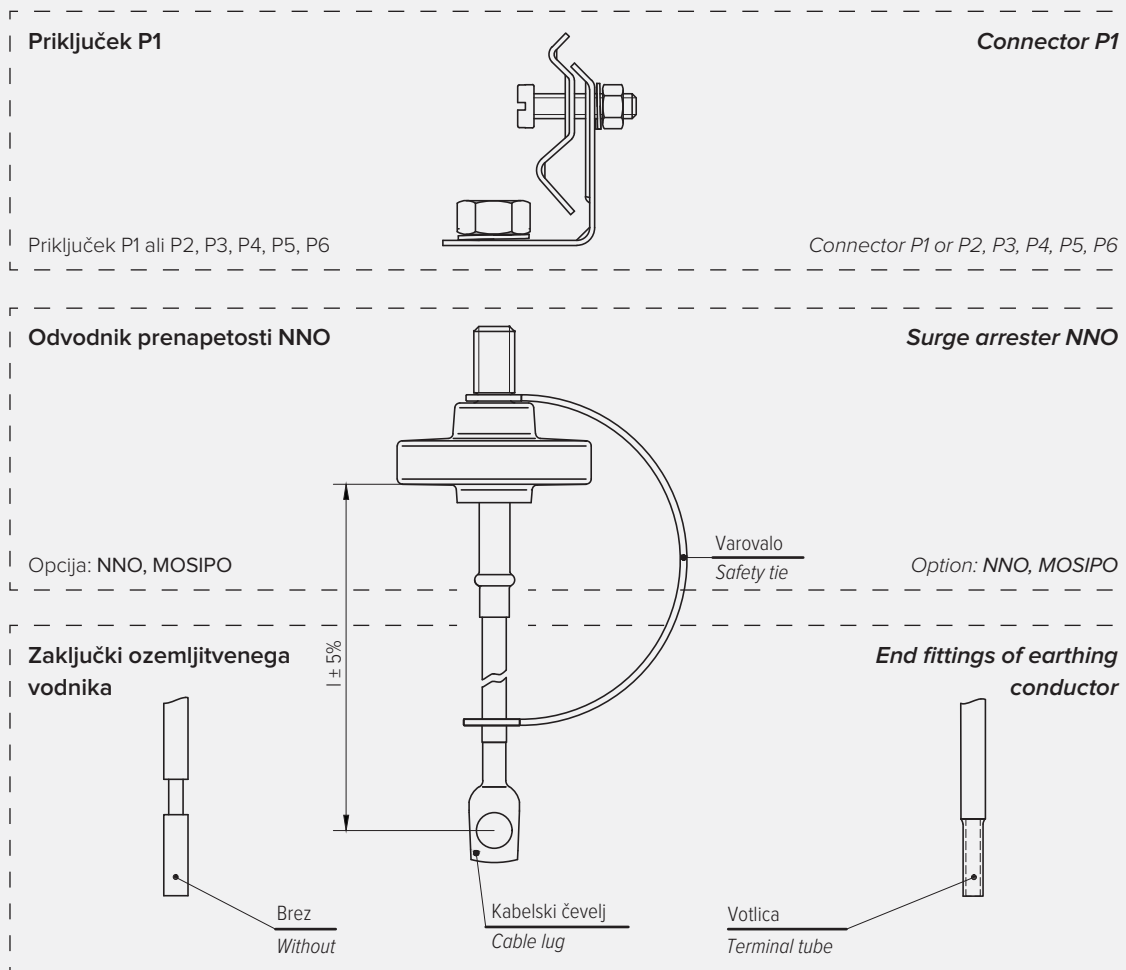
1.5 Najbolj uporabljene kode za naročilo

1.5 Most used codes for order

Koda/Code	Naziv/Name	I _n [kA]	U _c (AC/DC) [V]	U _p [kV]	W [J]	Masa/Mass [kg]	l [m]
20 50 10	NNO 5/280 - 0,5m	5	280/350	1,00	2450	0,0608	0,5
20 50 11	NNO 5/280 - 1,0m	5	280/350	1,00	2450	0,0967	1,0
20 50 20	NNO 5/440 - 0,5m	5	440/585	1,50	3200	0,0971	0,5
20 50 21	NNO 5/440 - 1,0m	5	440/585	1,50	3200	0,1037	1,0
20 60 50	NNO 10/280 - 0,5m	10	280/350	1,20	2450	0,0608	0,5
20 60 51	NNO 10/280 - 1,0m	10	280/350	1,20	2450	0,0967	1,0
20 60 60	NNO 10/440 - 0,5m	10	440/585	1,80	3200	0,097	0,5
20 60 61	NNO 10/440 - 1,0m	10	440/585	1,80	3200	0,1037	1,0
20 60 11	MOSIPO 10/275 - 0,5m	10	275/350	1,20	2450	0,0870	0,5
20 60 12	MOSIPO 10/275 - 1,0m	10	275/350	1,20	2450	0,1170	1,0
20 60 21	MOSIPO 10/440 - 0,5m	10	440/585	1,80	3200	0,0950	0,5
20 60 22	MOSIPO 10/440 - 1,0m	10	440/585	1,80	3200	0,1230	1,0
20 60 27	MOSIPO 10/690 - 0,5m	10	690/910	2,50	3960	0,1000	0,5
20 60 32	MOSIPO 10/690 - 1,0m	10	690/910	2,50	3960	0,3000	1,0
20 66 10	MOSIPO 15/275 - 0,5m	15	275/350	1,50	2450	0,0870	0,5
20 66 11	MOSIPO 15/275 - 1,0m	15	275/350	1,50	2450	0,1170	1,0
20 66 20	MOSIPO 15/440 - 0,5m	15	440/585	2,00	3200	0,0950	0,5
20 66 21	MOSIPO 15/440 - 1,0m	15	440/585	2,00	3200	0,1230	1,0
22 66 27	MOSIPO 15/690 - 0,5m	15	690/910	3,00	3960	0,1000	0,5
22 66 32	MOSIPO 15/690 - 1,0m	15	690/910	3,00	3960	0,3000	1,0

1.6 NNO - primer naročila

1.6 NNO - order example



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

Razlaga naziva

NNO - Tip NN odvodnika
10 - Nazivni odvodni tok I_n (kA)
440 - Trajna obratovalna napetost (V)
1,0 - Dolžina ozemljitvenega vodnika l (m)
KČ 6/8 - Oznaka zaključka ozemljitvenega vodnika
P1 - Priključek

Name explanation

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

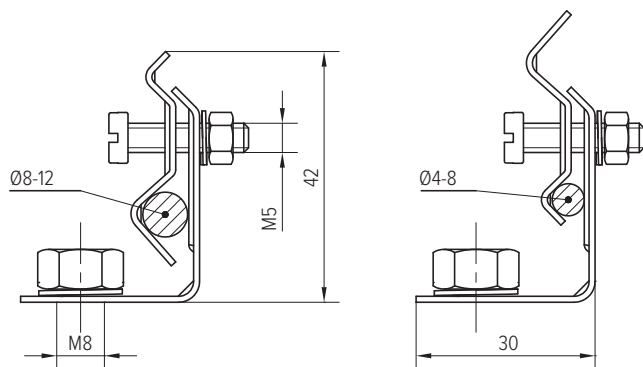
1.7 Priključek P1

Namen: priključek za goli vodnik $\varnothing 4-12$

Moment M8: 5 Nm

Moment M5: 6 Nm

Koda: **20 66 01**



1.7 Connector P1

Purpose: connector for bare conductor $\varnothing 4-12$

Torque M8: 5 Nm

Torque M5: 6 Nm

Code: **20 66 01**



1.8 Priključek P2

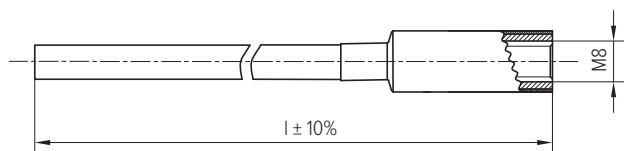
Namen: priključek za izoliran vodnik

Moment M8: 5 Nm - zategniti z roko

- 0,5 m; koda: **20 66 02**

- 1,0 m; koda: **20 66 05**

Opomba: dolžina priključka P2 po izbiri



1.8 Connector P2

Purpose: connector for covered conductor

Torque M8: 5 Nm - tighten by hand

- 0,5 m; code: **20 66 02**

- 1,0 m; code: **20 66 05**

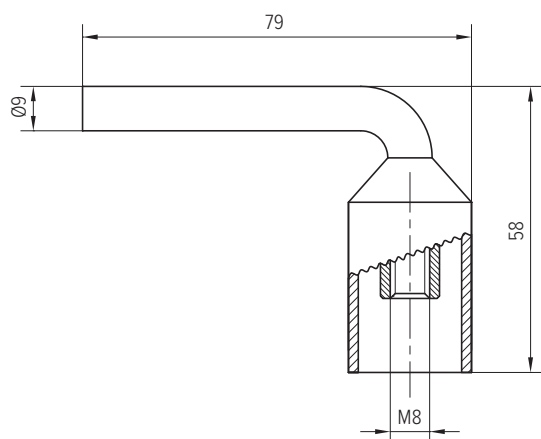
Note: length of connector P2 by choice



1.9 Priključek P3

Namen: priključek za izoliran vodnik

Koda: **20 66 03**



1.9 Connector P3

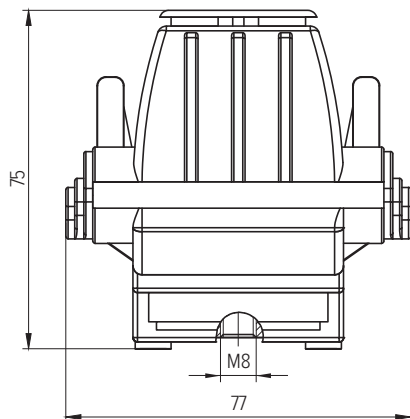
Purpose: connector for covered conductor

Code: **20 66 03**



1.10 Priključek P4

Namen: priključek za izoliran vodnik $\phi 16-95$
Moment M8: 5 Nm - zategniti z roko
Koda: **20 66 57**



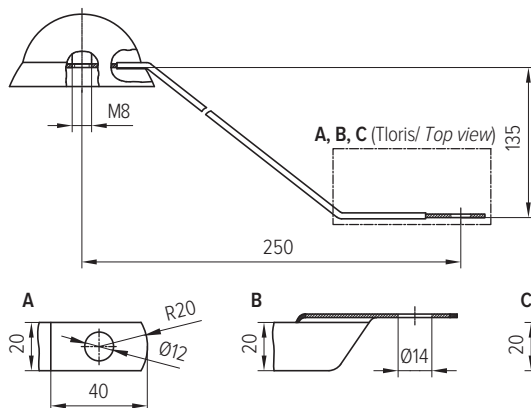
1.10 Connector P4

Purpose: connector for covered conductor $\phi 16-95$
Torque M8: 5 Nm - tighten by hand
Code: **20 66 57**



1.11 Priključek P5

Namen: izolacijski priključek
- raven (A), koda: **20 66 04**
- 90° (B), koda: **20 66 09**
- okrogel (C), koda: **20 66 66**



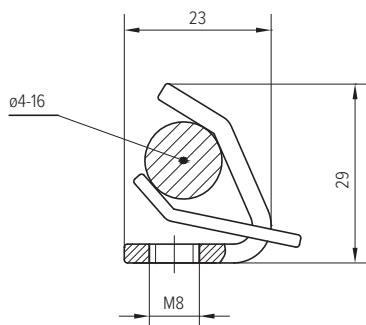
1.11 Connector P5

Purpose: insulated connector
- flat (A), code: **20 66 04**
- 90° (B), code: **20 66 09**
- round (C), code: **20 66 66**



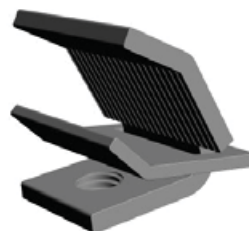
1.12 Priključek P6

Namen: priključek za goli vodnik $\phi 4-16$
Moment M8: 5 Nm - zategniti z roko
Koda: **20 66 08**



1.12 Connector P6

Purpose: connector for bare conductor $\phi 4-16$
Torque M8: 5 Nm - tighten by hand
Code: **20 66 08**



1.13 TY1 in TY1-F splošno

Proizvod

TY1 so kovinsko oksidni odvodniki prenapetosti v modularnem ohišju. TY1-F so kompaktni kovinsko oksidni odvodniki prenapetosti z varovalko. Namenjeni so za vgradnjo v glavno razdelilno omarico kot prva stopnja zaščite pred direktnim udarom strele.

Lastnosti

Odklopna naprava reagira:

- ko v normalnem obratovanju tok skozi odvodnik naraste nad 1 mA,
- v primeru atmosferske praznitve (tok večji od 100 kA).

Po delovanju odklopne naprave se vidno polje obarva rdeče. V tem primeru je potrebno pri TY1 zamenjati modul, pri TY1-F pa celoten odvodnik prenapetosti.

Vgradnja

Mesto montaže TY1 in TY1-F odvodnikov prenapetosti določajo pravilniki in tehnični predpisi. Obvezno se vgradijo v razdelilne omare.

Splošni podatki

- Odzivni čas: $t_A < 25 \text{ ns}$
- Glavna predvarovalka pri TY1: **100 AgL**
- Temperaturno območje okolja: $T = -40^\circ\text{C} \dots +80^\circ\text{C}$
- Stopnja zaščite: **IP 20**
- Material ohišja: **termoplast V-0 (UL 94)**
- Možnost daljinskega upravljanja
- Montaža na klobučno letev 35 mm
- Presek priključnega vodnika:
 - enožilni 35 mm²
 - večžilni 25 mm²
- IEC razred: I, II
- Testirani po standardu: **IEC 61643-11**



Prednosti pred konkurenco

TY1-F odvodniki prenapetosti za notranjo montažo imajo vgrajeno predvarovalko. Zato vgradnja predvarovalke (glavna > 100 A) 100 AgL ni potrebna.

TY1 in TY1-F odvodniki prenapetosti za notranjo montažo imajo:

- ugodno ceno,
- modularno ohišje,
- zanesljivo delovanje.

1.13 TY1 and TY1-F generally

Product

TY1 are metal oxide surge arresters in a modular housing. TY1-F are compact metal oxide surge arresters with an integrated backup fuse. They are designed to be installed into the main junction box as the first level of protection against direct lightning strikes.

Characteristics

The disconnecting device reacts:

- when in normal operation the current through the surge arrester increases over 1 mA,
- in case of an atmospheric discharge (current higher than 100 kA).

After the disconnecting device has been active the visual field turns red. In this case it is necessary to replace the TY1 module or in case of TY1-F the complete surge arrester.

Installation

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

General data

- Response time: $t_A < 25 \text{ ns}$
- Main Backup fuse: **100 AgL**
- Ambient temperature range: $T = -40^\circ\text{C} \dots +80^\circ\text{C}$
- Ingress protection level: **IP 20**
- Housing material: **thermoplastic V-0 (UL 94)**
- Possibility of remote control
- Mounting on top hat rail 35 mm
- Cross-section of connection conductor:
 - single-strand 35 mm²
 - multi-strand 25 mm²
- IEC class: I, II
- Tested according to standard: **IEC 61643-11**

Competitive advantages

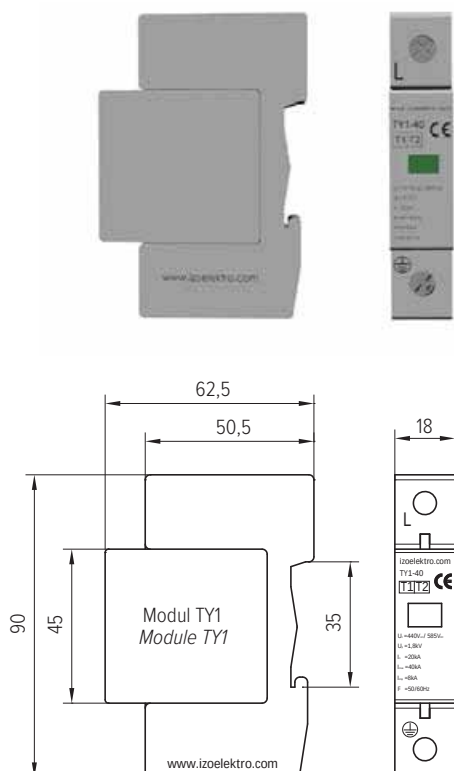
TY1-F surge arresters for indoor installation have an integrated backup fuse. Therefore the installation of a backup fuse (if main > 100 A) 100 AgL is not necessary.

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

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

1.14 TY1 enopolni

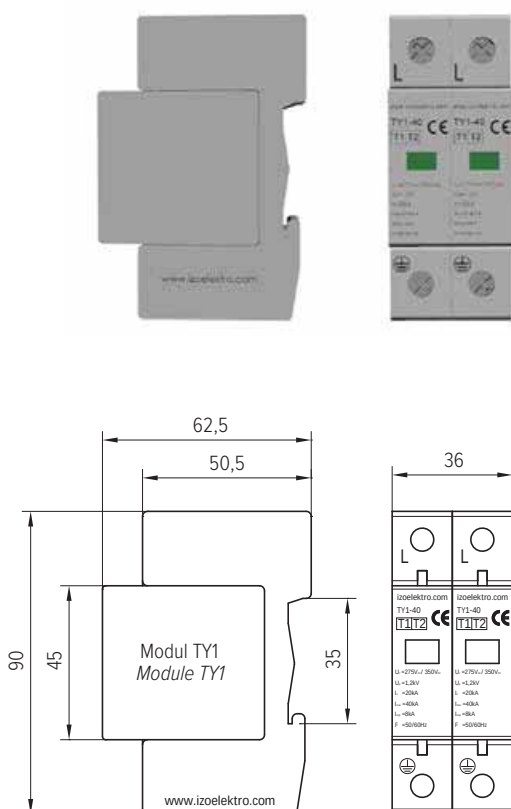
1.14 TY1 single pole



Naziv kompleta	Modul TY1	U _c	I _n	I _{imp}	I _{max}	U _p
Set name	TY1 module	(V)	(kA)	(kA)	(kA)	(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

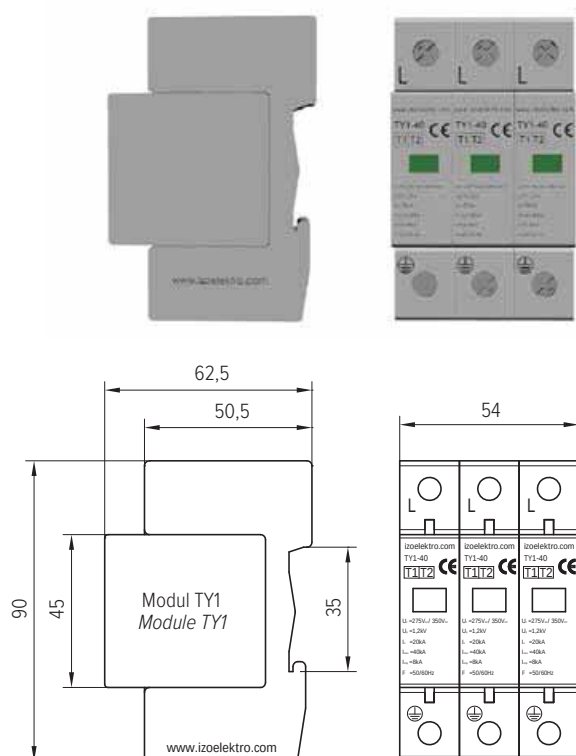
1.15 TY1 dvopolni

1.15 TY1 double pole



Naziv kompleta	Modul TY1	U _c	I _n	I _{imp}	I _{max}	U _p
Set name	TY1 module	(V)	(kA)	(kA)	(kA)	(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

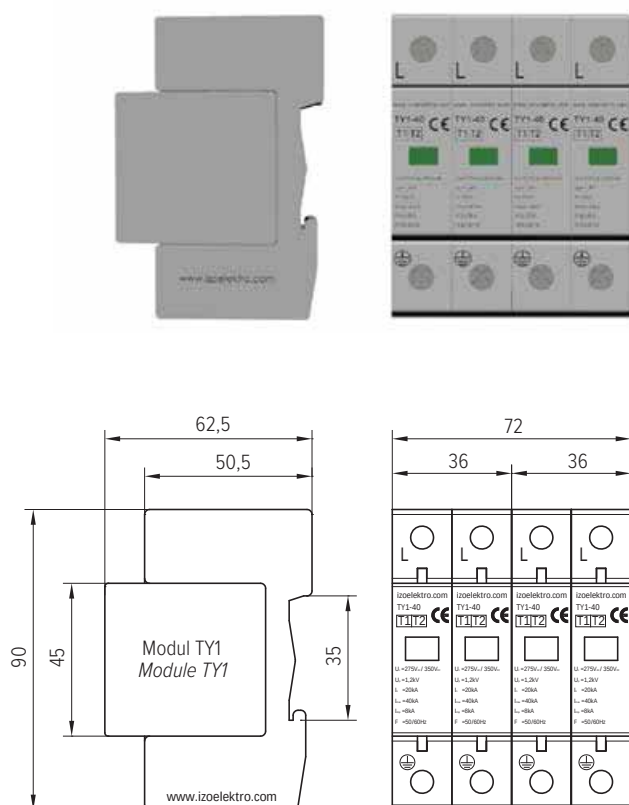
1.16 TY1 tripolni



1.16 TY1 triple pole

Naziv kompleta Set name	Modul TY1 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

1.17 TY1 štiripolni

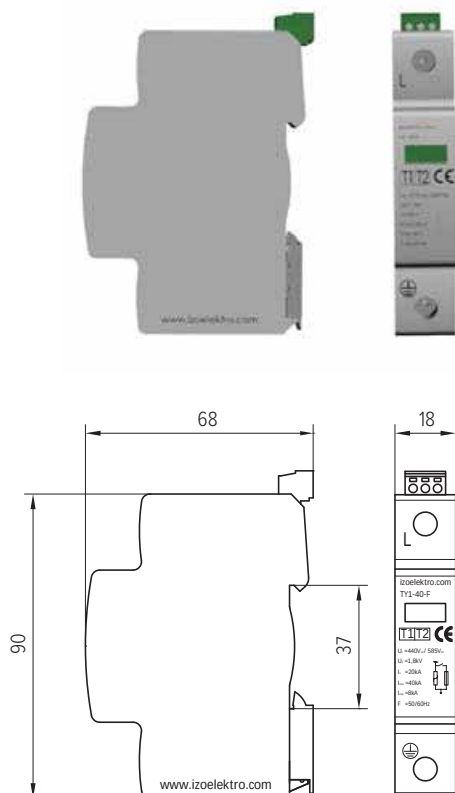


1.17 TY1 quadruple pole

Naziv kompleta Set name	Modul TY1 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

1.18 TY1-F enopolni

1.18 TY1-F single pole



Naziv kompleta 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

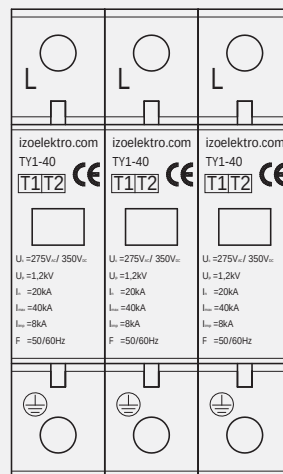
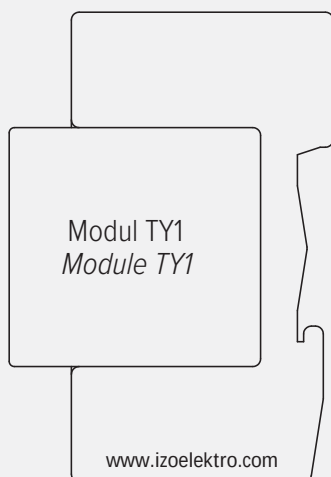
1.19 Najbolj uporabljene kode za naročilo TY1

1.19 Most used codes for order TY1

Koda/Code	Naziv/Name	I _n (kA)	U _c (V)	I _{imp} (kA)	I _{max} (kA)	Masa/Mass (kg)	U _p (kV)	Št. polov/ No. of poles
20 70 01	TY1-1-275-40	20	275	8	40	0,126	<1,2	1
20 70 04	TY1-1-440-40	20	440	8	40	0,129	<1,8	1
20 70 05	TY1-2-275-40	20	275	8	40	0,260	<1,2	2
20 70 08	TY1-2-440-40	20	440	8	40	0,266	<1,8	2
20 70 09	TY1-3-275-40	20	275	8	40	0,362	<1,2	3
20 70 12	TY1-3-440-40	20	440	8	40	0,390	<1,8	3
20 70 13	TY1-4-275-40	20	275	8	40	0,520	<1,2	4
20 70 05	TY1-4-440-40	20	440	8	40	0,540	<1,8	4

1.20 TY1 in TY1-F - primer naročila

1.20 TY1 and TY1-F - order example



Naziv/Name: TY1-3-275-40

Razlaga naziva

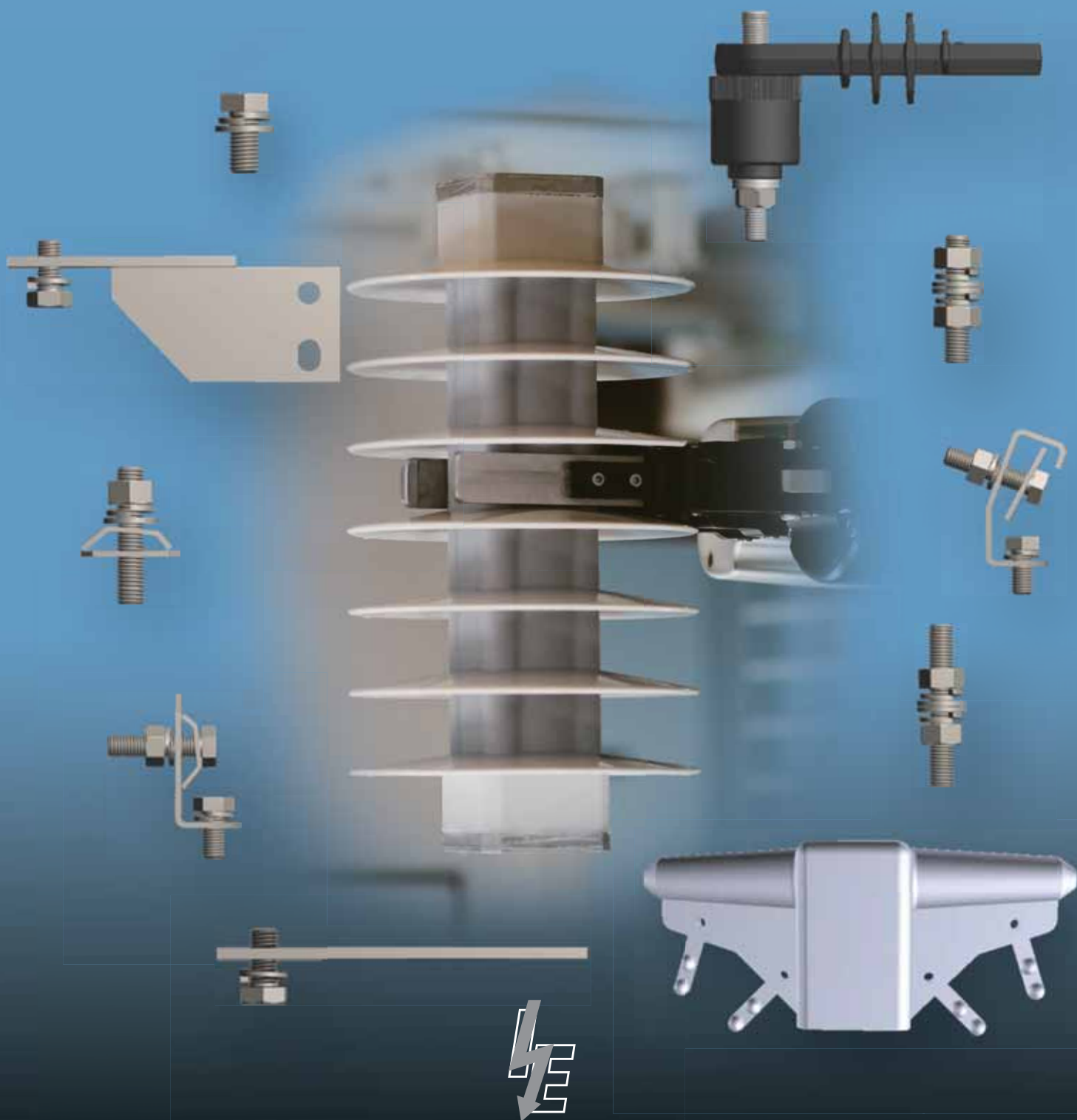
- TY1** - Tip NN odvodnika
3 - Število polov
275 - Trajna obratovalna napetost U_c (V)
40 - Maksimalni odvodni tok I_{max} (kA)

Name explanation

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

SN odvodniki prenapetosti *MV surge arresters*

2



IZOELEKTRO

2.1 SNO in 2SS15N splošno

Proizvod

SNO in 2SS15N so tipi srednjenapetostnih kovinsko oksidnih odvodnikov prenapetosti s silikonskim plaščem. Namenjeni so za vgradnjo v SN omrežje do 52 kV kot zaščita pred direktnim udarom strele.

Lastnosti

Vrhunsko kvaliteto jim zagotavlja:

- zmogljiv varistorski blok,
- toga konstrukcija,
- plašč odporen na UV sevanje in kemične vplive,
- vgrajen material, obstojen na vremenske vplive in staranje,
- varistorski blok, neposredno zalit s silikonom.

Vgradnja

Mesto montaže odvodnikov prenapetosti SNO in 2SS15N, določajo pravilniki in tehnični predpisi.

Odvodnike prenapetosti SNO in 2SS15N vgrajujemo:

- zunaj in znotraj,
- pri zaščiti elektroenergetskih naprav,
- za zaščito kompenzacijskih naprav,
- na železnicah, rudnikih, ...

Splošni podatki

- Temperaturno območje okolja $T = -60\text{ °C} \dots +85\text{ °C}$
- Plašč: **silikon LSR**
- Barva silikona: **siva**
- Priključni navoj: **M12x20 mm**

Tip	SNO	2SS15N
Standard	IEC 60099-4:2014 in IEC 60099-5	IEC 60099-4:2004 in IEC 60099-5
IEC razred	DH	1

2.1 SNO and 2SS15N generally

Product

SNO and 2SS15N are medium voltage metal oxide surge arresters with silicone coating. They are designed to be installed in MV power networks up to 52 kV as protection against direct lightning strikes.

Characteristics

Their top quality is ensured by:

- a top quality varistor block,
- a rigid construction,
- coat resistant to UV radiation and chemical influences,
- a built-in materials is resistant to weathering and ageing,
- varistors that are directly enclosed in silicone.

Installation

The position for installing SNO and 2SS15N surge arresters is determined 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 $T = -60\text{ °C} \dots +85\text{ °C}$
- Coat: **silicone LSR**
- Silicone colour: **grey**
- Connection thread: **M12x20 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

**Prednosti pred konkurenco**

SNO in 2SS15N odvodniki prenapetosti za zunanjo in notranjo montažo imajo:

- certifikat akreditiranega laboratorija,
- varistorje neposredno zalite s silikonom,
- togo konstrukcijo ohišja,
- nizko preostalo napetost,
- visoko energetska absorpcijo,
- odlične mehanske lastnosti,
- 100% končno kontrolo v lastnem laboratoriju,
- predvidena vgradnja indikatorja stanja.

Na zahtevo kupca izdelamo in dobavimo odvodnike prenapetosti SNO in 2SS15N:

- kot tovarniški komplet po izbiri kupca,
- s trajno obratovalno napetostjo U_c od 1 do 44 kV,
- z neizbrisljivo številko meritve na vsakem odvodniku.

Competitive advantages

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

- a certificate from an accredited laboratory,
- varistors directly enclosed by silicone,
- a rigid housing construction,
- low residual voltage,
- high energy absorption,
- excellent mechanical properties,
- 100% final inspection in our own laboratory,
- planned installation for condition monitors.

At the customer's request we produce and deliver SNO and 2SS15N surge arresters:

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

2.2 Razred 1 - izračun in izbira

2.2 Class 1 - calculation and selection

2.2.1 Izračun

2.2.1 Calculation

Podatki omrežja distributerja

- U_m – maksimalna napetost
- t – čas trajanja kratkega stika
- k_z – faktor zemeljskega stika
 $k_z = 1,40$ – neposredno ozemljeno
 $k_z = 1,40 - 1,7$ z malim uporom
 $k_z = 1,73 - 1,8$ z izolirano nevtralno točko

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

Podatki odvodnikov 2SS15N

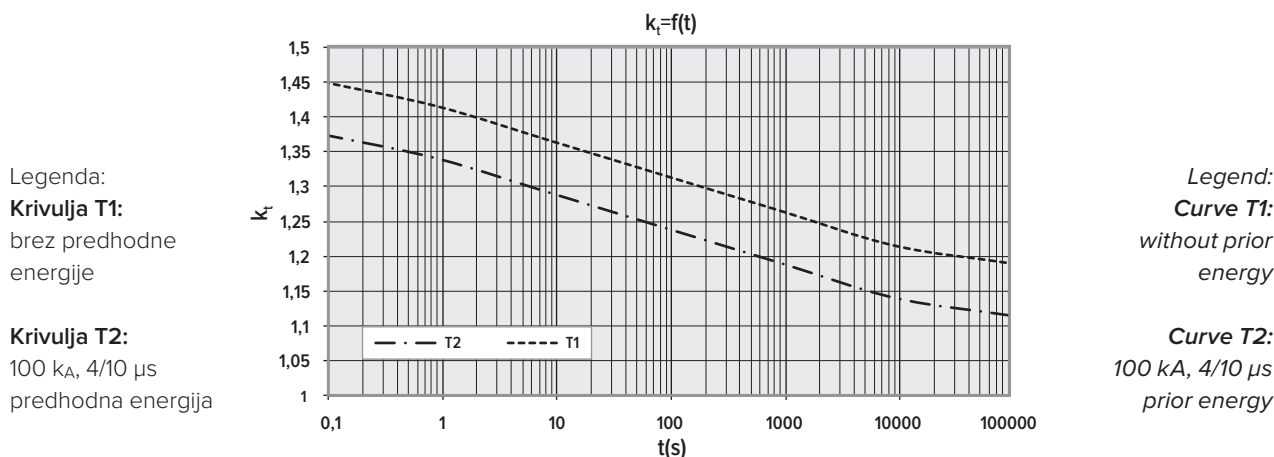
- $k_0 = 0,8$
- k_t = faktor trajne obratovalne napetosti za časno prenapetost.

Data for surge arresters type 2SS15N

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

Diagram karakteristik za tip 2SS15N

Characteristics diagram for type 2SS15N



Izračun

- Trajna obratovalna napetost sistema:

$$U_{cs} = \frac{U_m}{\sqrt{3}} \text{ [kV]}$$
- Predhodna obratovalna napetost odvodnika:

$$U_{c1} = \frac{U_{cs}}{k_0} \text{ [kV]}$$
- Najvišja pričakovana časna prenapetost odvodnika:

$$U_t = k_z \frac{U_m}{\sqrt{3}} \text{ [kV]}$$
- Trajna obratovalna napetost odvodnika:

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

Calculation

- Continuous operating voltage of system:

$$U_{cs} = \frac{U_m}{\sqrt{3}} \text{ [kV]}$$
- Preliminary operating voltage of surge arrester:

$$U_{c1} = \frac{U_{cs}}{k_0} \text{ [kV]}$$
- Highest expected transient over voltage of surge arrester:

$$U_t = k_z \frac{U_m}{\sqrt{3}} \text{ [kV]}$$
- Continuous operating voltage of surge arrester:

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

2.2.2 Izbira

2.2.2 Selection

Ustreden odvodnik prenapetosti izberemo iz tabel s podatki, na podlagi višje izračunane vrednosti med U_{c1} in U_{c2} tako, da izberemo prvo višjo trajno obratovalno napetost U_c , ki je podana v tabeli.

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.

2.3 Določitev zaščitne razdalje

Podatki omrežja distributerja

Stopnja zaščite naprav na daljnovodih je odvisna od razdalje med ščiteno napravo in odvodnikom. Prenapetostni odvodnik ščiti v določeni razdalji od mesta, kjer je montiran.

Za izračun so potrebni najmanj naslednji podatki:

- I_z – zaščitna razdalja odvodnika
- U_z – zdržna udarna napetost izolacije opreme.
- U_{res} – maksimalna vrednost preostale napetosti za določen tip odvodnika
- v – hitrost širjenja udarnega vala po električnih vodih
 $v = 300 \text{ m}/\mu\text{s}$ – nadzemni vod
 $v = 150 \text{ m}/\mu\text{s}$ – kabel
- S – pričakovana strmina prenapetostnega udara strele
 $S = 1550 \text{ kV}/\mu\text{s}$ – leseni drogovi
 $S = 800 \text{ kV}/\mu\text{s}$ – ozemljene konzole

Izračun

Poenostavljena formula za izračun zaščitne razdalje:

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

Praviloma naj bo odvodnik prenapetosti priključen čim bližje ščiteni napravi.

2.4 Parametri za tip 2SS15N - razred 1

Razred odvodnika	1
Tip prenapetostnega odvodnika	2SS15N
Komercialne oznake oblike	R, RP, RO, NO
Trajna obratovalna napetost U_c	3 – 44 kV
Nazivna napetost U_r	3,7 – 55 kV
Nazivni odvodni tok I_n (8/20 μ s)	10 kA
Visok impulzni tok (4/10 μ s)	100 kA
Zdržni kratkostični tok (I_{sc})	20 kA
Tok dolgega vala (I_{2ms})	250 A
Sposobnost energijske absorpcije (dolgi val) (W_{2ms})	2,8 kJ/kVU _c
Sposobnost energijske absorpcije (impulzni tok) ($W_{4/10}$)	4,8 kJ/kVU _c
Upogibni moment 24 kV (M_u)	300 Nm
Upogibni moment 36 kV (M_u)	250 Nm
Vertikalna sila (F_v)	625 N
Torzijski moment pri $U_r = 45 \text{ kV}$ (M_t)	80 Nm

2.3 Determination of the shielding distance

Data of electric network

The level of protection for devices on power lines is dependent on the distance between the protected device and the surge arrester. The surge arrester offers protection in a certain distance from the spot where it is mounted.

The next data is necessary for the calculations:

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

Calculation

Simplified formula for calculating the shielding distance:

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

As a rule, the surge arrester should be mounted as near as possible to the device it protects.

2.4 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 (8/20 μ s)	10 kA
High impulse current (4/10 μ s)	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 $U_r = 45 \text{ kV}$ (M_t)	80 Nm

2.5 Razred DH - izračun in izbira

2.5 Class DH - calculation and selection

2.5.1 Izračun

2.5.1 Calculation

Podatki omrežja distributerja

- U_m – maksimalna napetost
- t – čas trajanja kratkega stika
- k_z – faktor zemeljskega stika
 $k_z = 1,40$ – neposredno ozemljeno
 $k_z = 1,40 - 1,7$ z malim uporom
 $k_z = 1,73 - 1,8$ z izolirano nevtralno točko

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

Podatki odvodnikov SNO

- $k_0 = 0,8$
- k_t = faktor nazivne napetosti za časno prenapetost.

Data for surge arresters types SNO

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

Karakteristike za tip SNO

Characteristics for type SNO

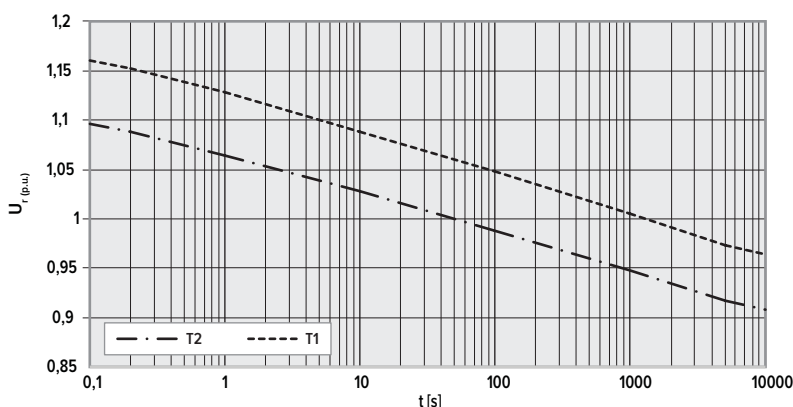
Legenda:

Krivulja T1:

brez predhodne energije

Krivulja T2:

2 x 34 kA, 8/20 μ s
predhodna energija



Legend:

Curve T1:

without prior energy

Curve T2:

2 x 34 kA, 8/20 μ s
prior energy

Izračun

- Nazivna napetost sistema:

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

- Predhodna nazivna napetost odvodnika:

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

- Najvišja pričakovana časna prenapetost odvodnika:

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

- Nazivna obratovalna napetost odvodnika:

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

Calculation

- Rated voltage of system:

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

- Preliminary rated voltage of surge arrester:

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

- Highest expected transient over voltage of surge arrester:

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

- Rated voltage of surge arrester:

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

2.5.2 Izbira

2.5.2 Selection

Ustreden odvodnik prenapetosti izberemo iz tabel s podatki, na podlagi višje izračunane vrednosti med U_{r1} in U_{r2} tako, da izberemo prvo višjo nazivno napetost U_r , ki je podana v tabeli.

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.

2.6 Določitev zaščitne razdalje

Podatki omrežja distributerja

Stopnja zaščite naprav na daljnovodih je odvisna od razdalje med ščiteno napravo in odvodnikom. Prenapetostni odvodnik ščiti v določeni razdalji od mesta, kjer je montiran.

Za izračun so potrebni najmanj naslednji podatki:

- I_z – zaščitna razdalja odvodnika
- U_z – zdržna udarna napetost izolacije opreme.
- U_{res} – maksimalna vrednost preostale napetosti za določen tip odvodnika
- v – hitrost širjenja udarnega vala po električnih vodih
 $v = 300 \text{ m}/\mu\text{s}$ – nadzemni vod
 $v = 150 \text{ m}/\mu\text{s}$ – kabel
- S – pričakovana strmina prenapetostnega udara strele
 $S = 1550 \text{ kV}/\mu\text{s}$ – leseni drogovi
 $S = 800 \text{ kV}/\mu\text{s}$ – ozemljene konzole

Izračun

Poenostavljena formula za izračun zaščitne razdalje:

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

Praviloma naj bo odvodnik prenapetosti priključen čim bližje ščiteni napravi.

2.7 Parametri za tip SNO - razred DH

Razred odvodnika	DH
Tip prenapetostnega odvodnika	SNO
Komercialna oznaka oblike	RP
Trajna obratovalna napetost U_c	3 – 44 kV
Nazivna napetost U_r	4 – 55 kV
Nazivni odvodni tok I_n (8/20 μ s)	10 kA
Visok impulzni tok (4/10 μ s)	100 kA
Zdržni kratkostični tok (I_{sc})	20 kA
Sposobnost prenosa termičnega naboja (Q_{th})	1,1 C
Sposobnost prenosa ponavljajočega naboja (Q_{rs})	0,4 C
Upogibni moment pri $U_r = 55 \text{ kV}$ (M_u)	238 Nm
Vertikalna sila (F_v)	800 N
Torzijski moment pri $U_r = 55 \text{ kV}$ (M_t)	50 Nm

2.6 Determination of the shielding distance

Data of electric network

The level of protection for devices on power lines is dependent on the distance between the protected device and the surge arrester. The surge arrester offer protection in a certain distance from the spot where it is mounted.

The following data is necessary for the calculations:

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

Calculation

Simplified formula for calculating the shielding distance:

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

As a rule, the surge arrester should be mounted as near as possible to the device it protects.

2.7 Parameters for type SNO - class DH

Arrester class	DH
Arrester type	SNO
Commercial designation	RP
Continuous operating voltage U_c	3 – 44 kV
Rated voltage U_r	4 – 55 kV
Nominal discharge current I_n (8/20 μ s)	10 kA
High impulse current (4/10 μ s)	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 $U_r = 55 \text{ kV}$ (M_u)	238 Nm
Vertical load (F_v)	800 N
Terminal torque at $U_r = 55 \text{ kV}$ (M_t)	50 Nm

2.8 Primerjava energijskih absorbcij med razredom 1 in razredom DH po IEC 60099-4:2014 (Ed.3.0)

2.8 The Comparison of energy absorption between class 1 and class DH according to IEC 60099-4:2014 (Ed.3.0)

Primerjalna tabela iz IEC 60099-4:2014 (Ed.3.0)

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

Table L.3 – comparison 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 $(\approx 1,1 \times Q_{rs})$
	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 $U_{resmin} (I_{min}) = 1,8 \times U_r$, ^b Estimated from LD parameters and b) and c) above.

Tabela L3: prepis iz IEC 60099-4:2014 (Ed.3.0), str. 165

Table L3: transcript from IEC 60099-4:2014 (Ed.3.0), p. 165

Razlaga primerjalnega diagrama 1

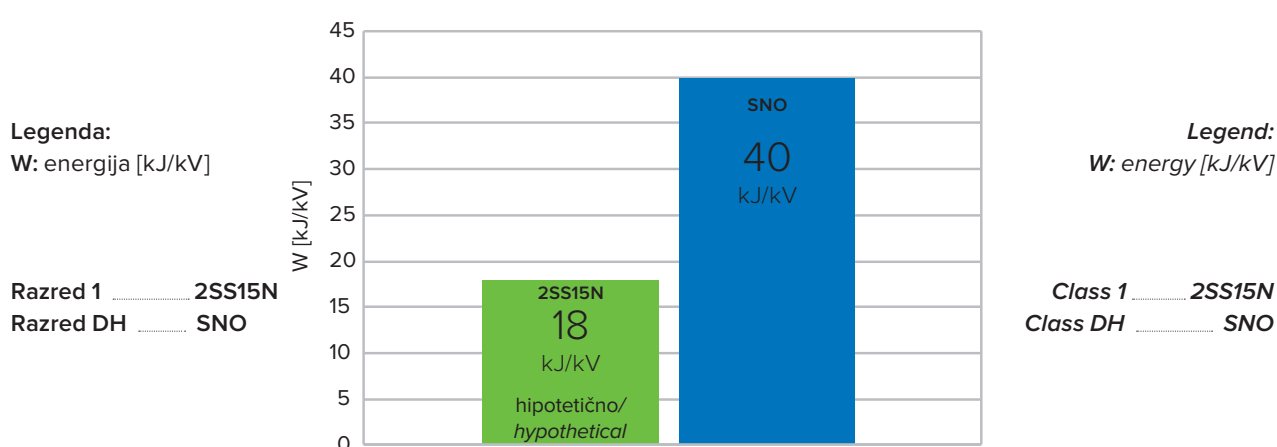
Na podlagi primerjalne tabele L.3 je v primerjalnem diagramu 1 izrisana grafična ponazoritev celotnega testa hipotetične absorbcije energije odvodnika prenapetosti za razred 1 in dejanske testne absorbcije energije za razred DH. Po novem standardu bi odvodnik prenapetosti razreda 1 po izračunu moral na testu prenesti skupno 18 kJ/kV energije, odvodnik razreda DH pa dejansko na testu po novem standardu prenese 40 kJ/kV.

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.

Primerjalni diagram 1 Energijska absorbcija

Comparative diagram 1 Energy absorption



Povzetek

Odvodniki prenapetosti tip SNO razreda DH so sposobni absorbirati in odvesti za 122 % več energije, kot jih odvedejo odvodniki prenapetosti razreda 1.

Abstract

The Class DH surge arresters type SNO are capable to absorb and dissipate 122 % more energy than the Class 1 surge arresters.

2.9 Razred DH

2.9 Class DH

2.9.1 SNO - RP

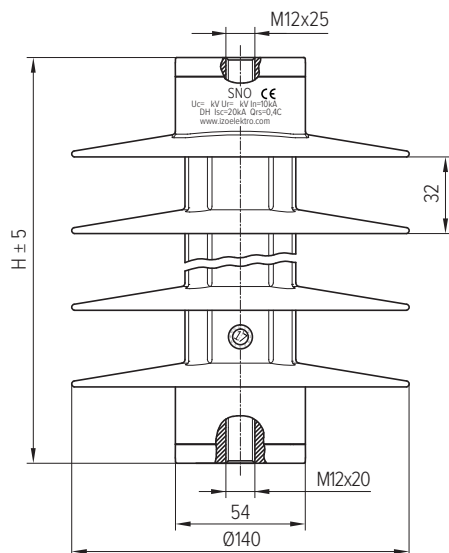
2.9.1 SNO - RP

Tip prenapetostnega odvodnika: SNO

Surge arrester type: SNO

Komericalna oznaka oblike: RP

Commercial designation: RP



SNO - RP 12 kV
Koda/Code: 12 20 00

Koda Code	ELEKTRIČNE KARAKTERISTIKE / ELECTRICAL CHARACTERISTICS								MEHANSKE KARAKTERISTIKE / MECHANICAL CHARACTERISTICS							
	U _c	U _r	U _{res}				U _{peak}	U _{rms}	SSL	SLL	AD	CD	A	B	H	N
	[kV]	[kV]	1/2,5μs 10 kA	8/20μs 5 kA	8/20μs 10 kA	8/20μs 100 A	1,2/50μs [kV]	50 Hz, 1 min [kV]	[N]	[N]	[mm]	[mm]	[mm]	[mm]	[mm]	
10 40 00	3,2	4,0	10,31	9,12	9,84	7,35							80	100		
10 60 00	6,4	8,0	20,62	18,24	19,68	14,70	90	35	1800	1437	154	343	100	120	136	3
10 80 00	7,6	9,5	24,49	21,67	23,38	17,64							120	140		
11 00 00	10,8	13,5	34,80	30,79	33,22	24,99							140	160		
11 20 00	12,0	15,0	38,67	34,22	36,93	27,93	105	40	1454	1163	186	453	160	180	168	4
11 40 00	14,0	17,5	45,11	39,91	43,04	32,34	120	45	1220	975	218	563	180	200	200	5
11 60 00	16,0	20,0	51,55	43,34	46,76	36,75	130	50	1052	841	250	674	200	220	232	6
12 00 00	20,4	25,5	65,73	55,89	60,30	47,04							240	260		
12 20 00	22,0	27,5	70,90	62,75	67,70	51,45	140	65	929	742	282	784	240	260	263	7
12 40 00	24,0	30,0	77,34	68,44	73,86	55,86							300	320		
12 60 00	26,0	32,5	83,78	74,13	79,98	63,21	150	75	828	662	314	894	320	340	295	8
12 80 00	28,0	35,0	90,22	79,82	86,12	64,68							340	360		
13 20 00	32,8	41,0	105,70	92,45	100,32	76,44	160	80	747	597	345	1004	380	400	327	9
13 40 00	34,0	42,5	109,57	96,97	104,62	79,38							400	420		
13 60 00	36,0	45,0	116,01	102,68	110,78	83,79	170	85	680	544	377	1114	420	440	359	10
13 80 00	38,0	47,5	122,45	108,38	116,93	88,20							440	460		
14 00 00	40,4	50,5	130,19	115,23	124,32	94,08	180	90	625	500	409	1234	450	470	391	11
14 40 00	44,0	55,0	141,80	125,50	135,40	102,90							470	490		

U_c Trajna obratovalna napetost
 U_r Nazivna napetost
 U_{res} Preostala napetost pri različnih tokovnih impulzih
 U_{peak} Atmosferska udarna napetost 1,2/50μs v suhem
 U_{rms} Izmenična vzdržna napetost 50 Hz v mokrem, 1min
 SSL Specifična kratkotrajna obremenitev
 SLL Specifična dolgotrajna obremenitev
 AD Preskočna razdalja
 CD Plazilna pot
 A Minimalna razdalja do stene
 B Minimalna razdalja med fazami
 H Višina odvodnika prenapetosti
 N Število reber

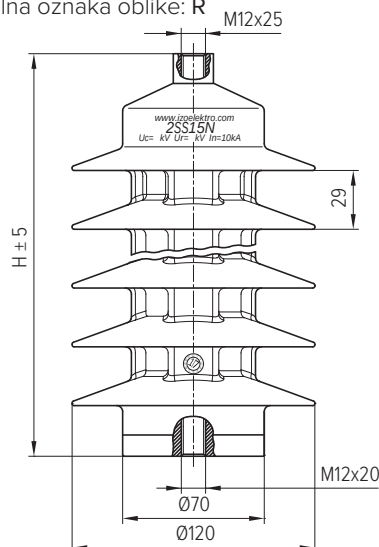
U_c Continuous operating voltage
 U_r Rated voltage
 U_{res} Residual voltages at different impulse currents
 U_{peak} Lightning impulse withstand voltage 1,2/50μs in dry
 U_{rms} Power frequency withstand voltage 1 min. 50Hz, wet
 SSL Specific short-term load
 SLL Specific long-term load
 AD Arcing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

2.10 Razred 1

2.10.1 2SS15N - R

Tip prenapetostnega odvodnika: 2SS15N

Komercialna oznaka oblike: R



2.10 Class 1

2.10.1 2SS15N - R

Surge arrester type: 2SS15N

Commercial designation: R



2SS15N - R 12 kV
Koda/Code: 21 48 06

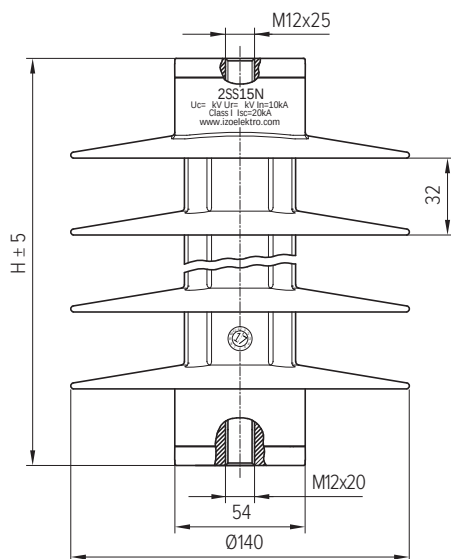
Koda Code	ELEKTRIČNE KARAKTERISTIKE / ELECTRICAL CHARACTERISTICS											MEHANSKE KARAKTERISTIKE / MECHANICAL CHARACTERISTICS						
	U _c [kV]	U _r [kV]	U _{res}								U _{peak} 1,2/50μs [kV]	U _{rms} 50 Hz, 1 min [kV]	AD [mm]	CD [mm]	A [mm]	B [mm]	H [mm]	N
			1/20μs	1/20μs	8/20μs	8/20μs	8/20μs	30/60μs	30/60μs									
			5 kA	10 kA	5 kA	10 kA	20 kA	125 A	500 A									
2148 01	3	3,75	8,55	9,65	7,18	8,78	9,60	7,35	7,85			139	360	60	90			
2148 02	4	5,00	12,8	14,20	11,25	12,92	14,15	9,63	10,16	62	25			80	100	147	3	
2148 03	6	7,50	21,35	23,85	17,95	21,70	23,75	16,98	18,01					100	120			
2148 04	8	10,00	25,60	28,40	26,12	25,84	28,30	19,26	20,32					120	140			
2148 05	10	12,50	34,15	38,05	29,00	34,62	37,90	26,61	28,17	98	35	185	520	140	160	193	5	
2148 06	12	15,00	38,40	42,60	33,15	38,96	42,45	28,89	30,48					160	180			
2148 07	14	17,50	46,95	52,25	39,98	47,54	52,05	36,24	38,33					180	200			
2148 08	16	20,00	51,20	56,80	44,10	51,68	56,60	38,52	40,64	125	55	235	600	200	220	243	6	
2148 09	18	22,50	59,75	66,45	51,26	60,46	66,20	45,87	48,49					220	240			
2148 10	20	25,00	64,00	71,00	55,45	64,60	70,75	48,15	50,80					240	260			
2148 11	21	26,25	67,55	77,10	58,93	67,95	76,25	52,15	54,55					260	280			
2148 12	22	27,50	72,55	80,65	63,00	73,38	80,35	55,50	58,65	135	60	262	680	270	300	270	7	
2148 22	24	30,00	76,80	85,20	66,15	75,98	84,90	57,78	60,96					320	320			
2148 13	24	30,00	76,80	85,20	66,15	75,95	84,90	57,78	60,96					320	320			
2148 14	26	32,50	85,35	94,85	77,20	84,76	94,50	65,13	68,81	150	65	309	760	340	340	317	8	
2148 15	28	35,00	89,60	99,40	84,90	88,21	99,05	67,41	71,12					360	360			
2148 16	30	37,50	98,15	109,05	88,00	96,99	108,65	74,76	78,97					295	380			
2148 17	32	40,00	102,40	113,60	96,05	101,15	113,20	77,04	81,28					380	400			
2148 24	35	43,75	112,30	125,50	97,86	112,81	125,15	85,16	90,12	170	70	362	1000	410	430	370	11	
2148 23	36	45,00	115,20	127,80	99,10	114,10	127,25	86,67	91,44					420	440			
2148 18	34	42,50	110,95	123,25	96,05	109,93	122,80	84,39	89,13					400	420			
2148 19	36	45,00	115,20	127,80	99,10	114,10	127,35	86,67	91,44	180	75	396	1080	420	440	404	12	
2148 26	40,5	50,60	125,76	136,35	114,89	129,78	146,25	96,12	101,35					450	470			

U_c Trajna obratovalna napetost
U_r Nazivna napetost
U_{res} Preostala napetost pri različnih tokovnih impulzih
U_{peak} Atmosferska udarna napetost 1,2/50μs v suhem
U_{rms} Izmenična vzdržna napetost 50 Hz v mokrem, 1min
AD Preskočna razdalja
CD Plazilna pot
A Minimalna razdalja do stene
B Minimalna razdalja med fazami
H Višina odvodnika prenapetosti
N Število reber

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

2.10.2 2SS15N - RP

Tip prenapetostnega odvodnika: 2SS15N
Komericalna oznaka oblike: RP



2.10.2 2SS15N - RP

Surge arrester type: 2SS15N
Commercial designation: RP



2SS15N-RP 12 kV
Koda/Code: 221 48 06

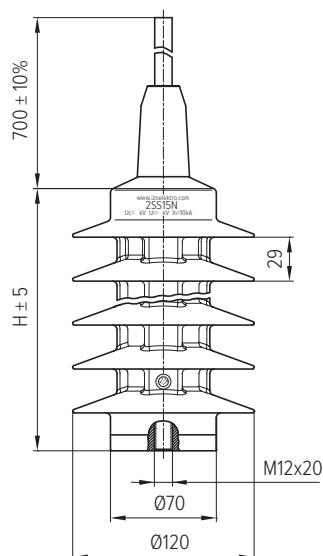
Koda Code	ELEKTRIČNE KARAKTERISTIKE / ELECTRICAL CHARACTERISTICS											MEHANSKE KARAKTERISTIKE / MECHANICAL CHARACTERISTICS										
	U _c [kV]	U _r [kV]	U _{res}								U _{peak} 1,2/50μs [kV]	U _{rms} 50 Hz, 1 min [kV]	AD [mm]	CD [mm]	A [mm]	B [mm]	H [mm]	N				
			1/20μs		1/20μs		8/20μs		8/20μs										30/60μs		30/60μs	
			5 kA	10 kA	5 kA	10 kA	100 A	125 A	500 A	100 A									125 A	500 A	100 A	125 A
22148 01	3	3,75	8,55	9,65	7,18	8,78	6,20	7,35	7,85	90	35	154	343	60	90	136	3					
22148 02	4	5,00	12,80	14,20	11,25	12,92	8,93	9,63	10,16					80	100							
22148 03	6	7,50	21,35	23,85	17,95	21,70	15,12	16,98	18,01					100	120							
22148 04	8	10,00	25,60	28,40	26,12	25,84	17,85	19,26	20,32					120	140							
22148 05	10	12,50	34,15	38,05	29,00	34,62	24,05	26,61	28,17	105	40	186	453	140	160	168	4					
22148 06	12	15,00	38,40	42,60	33,15	38,76	26,78	28,89	30,48					160	180							
22148 07	14	17,50	46,95	52,25	39,98	47,54	32,97	36,24	38,33	120	45	218	563	180	200	200	5					
22148 08	16	20,00	51,20	56,80	44,10	51,68	35,70	38,52	40,64					200	220							
22148 09	18	22,50	59,75	66,45	51,26	60,46	41,90	45,87	48,49	130	50	250	674	220	240	232	6					
22148 10	20	25,00	64,00	71,00	55,45	64,60	44,63	48,15	50,80					240	260							
22148 11	21	26,25	67,55	77,10	58,93	67,95	48,09	52,15	54,55	140	65	282	784	260	280	263	7					
22148 12	22	27,50	72,55	80,65	63,00	73,38	50,82	55,50	58,65					270	300							
22148 13	24	30,00	76,80	85,20	66,15	75,98	53,55	57,78	60,96					300	320							
22148 14	26	32,50	85,35	94,85	74,39	84,76	59,75	65,13	68,81					320	340							
22148 15	28	35,00	89,60	99,40	77,20	88,21	62,48	67,41	71,12	150	75	314	894	340	360	295	8					
22148 16	30	37,50	98,15	109,05	84,90	96,99	68,67	74,46	78,97	160	80	345	1004	360	380	327	9					
22148 17	32	40,00	102,40	113,60	88,00	101,15	71,40	77,04	81,28					380	400							
22148 18	34	42,50	110,95	123,25	96,05	109,93	77,60	84,39	89,13	170	85	377	1114	400	420	359	10					
22148 19	36	45,00	115,20	127,80	99,10	114,10	80,33	86,67	91,44					420	440							
22148 20	38	47,50	120,35	130,33	106,25	123,66	86,52	90,85	95,65	180	90	409	1234	440	460	391	11					
22148 21	40	50,00	124,87	135,63	114,33	129,78	89,25	95,50	100,75					450	470							
22148 22	42	52,50	130,50	138,75	120,63	137,85	95,45	100,43	105,47					460	480							
22148 23	44	55,00	136,75	143,25	127,55	142,68	98,18	103,58	108,35					470	490							

U_c Trajna obratovalna napetost
U_r Nazivna napetost
U_{res} Preostala napetost pri različnih tokovnih impulzih
U_{peak} Atmosferska udarna napetost 1,2/50μs v suhem
U_{rms} Izmenična vzdržna napetost 50 Hz v mokrem, 1min
AD Preskočna razdalja
CD Plazilna pot
A Minimalna razdalja do stene
B Minimalna razdalja med fazami
H Višina odvodnika prenapetosti
N Število reber

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

2.10.3 2SS15N - RO

Tip prenapetostnega odvodnika: 2SS15N
Komericalna oznaka oblike: RO



2.10.3 2SS15N - RO

Surge arrester type: 2SS15N
Commercial designation: RO



2SS15N - RO 12 kV
Koda/Code: 21 49 06

Koda Code	ELEKTRIČNE KARAKTERISTIKE / ELECTRICAL CHARACTERISTICS											MEHANSKE KARAKTERISTIKE / MECHANICAL CHARACTERISTICS					
	U _c [kV]	U _r [kV]	U _{res}							U _{peak} 1,2/50μs [kV]	U _{rms} 50 Hz, 1 min [kV]	AD [mm]	CD [mm]	A [mm]	B [mm]	H [mm]	N
			1/20μs	1/20μs	8/20μs	8/20μs	30/60μs	30/60μs									
			5 kA	10 kA	5 kA	10 kA	20 kA	125 A	500 A								
2149 01	3	3,75	8,55	9,65	7,18	8,78	9,60	7,35	7,85								
2149 02	4	5,00	12,8	14,20	11,25	12,92	14,15	9,63	10,16	62	25	257	491	80	100	129	3
2149 03	6	7,50	21,35	23,85	17,95	21,70	23,75	16,98	18,01					100	120		
2149 04	8	10,00	25,60	28,40	26,12	25,84	28,30	19,26	20,32					120	140		
2149 05	10	12,50	34,15	38,05	29,00	34,62	37,90	26,61	28,17	98	35	303	651	140	160	175	5
2149 06	12	15,00	38,40	42,60	33,15	38,96	42,45	28,89	30,48					160	180		
2149 07	14	17,50	46,95	52,25	39,98	47,54	52,05	36,24	38,33					180	200		
2149 08	16	20,00	51,20	56,80	44,10	51,68	56,60	38,52	40,64	125	55	353	731	200	220	225	6
2149 09	18	22,50	59,75	66,45	51,26	60,46	66,20	45,87	48,49					220	240		
2149 10	20	25,00	64,00	71,00	55,45	64,60	70,75	48,15	50,80					240	260		
2149 11	21	26,25	67,55	77,10	58,93	67,95	76,25	52,15	54,55					260	280		
2149 12	22	27,50	72,55	80,65	63,00	73,38	80,35	55,50	58,65	135	60	380	811	270	300	252	7
2149 20	24	30,00	76,80	85,20	66,15	75,98	84,90	57,78	60,96					320	320		
2149 13	24	30,00	76,80	85,20	74,39	75,95	84,90	57,78	60,96					320	320		
2149 14	26	32,50	85,35	94,85	77,20	84,76	94,50	65,13	68,81	150	65	427	891	340	340	299	8
2149 15	28	35,00	89,60	99,40	84,90	88,21	99,05	67,41	71,12					360	360		
2149 16	30	37,50	98,15	109,05	88,00	96,99	108,65	74,76	78,97					295	380		
2149 17	32	40,00	102,40	113,60	96,05	101,15	113,20	77,04	81,28					380	400		
2149 24	35	43,75	112,30	125,50	97,86	112,81	125,15	85,16	90,12	170	70	480	1131	410	430	352	11
2149 21	36	45,00	115,20	127,80	99,10	114,10	127,25	86,67	91,44					420	440		
2149 18	34	42,50	110,95	123,25	96,05	109,93	122,80	84,39	89,13					400	420		
2149 19	36	45,00	115,20	127,80	99,10	114,10	127,35	86,67	91,44	180	75	517	1211	420	440	386	12
2149 26	40,5	50,60	125,76	136,35	114,89	129,78	146,25	96,12	101,35					450	470		

U_c Trajna obratovalna napetost
U_r Nazivna napetost
U_{res} Preostala napetost pri različnih tokovnih impulzih
U_{peak} Atmosferska udarna napetost 1,2/50μs v suhem
U_{rms} Izmenična vzdržna napetost 50 Hz v mokrem, 1min
AD Preskočna razdalja
CD Plazilna pot
A Minimalna razdalja do stene
B Minimalna razdalja med fazami
H Višina odvodnika prenapetosti
N Število reber

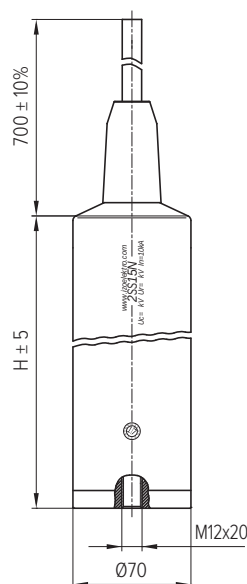
U_c Continuous operating voltage
U_r Rated voltage
U_{res} Residual voltages at different impulse currents
U_{peak} Lightning impulse withstand voltage 1,2/50μs in dry
U_{rms} Power frequency withstand voltage 1 min. 50Hz, wet
AD Arcing distance
CD Creepage distance
A Minimum distance to wall
B Minimum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

2.10.4 2SS15N - NO

Tip prenapetostnega odvodnika: 2SS15N
Komericalna oznaka oblike: NO

2.10.4 2SS15N - NO

Surge arrester type: 2SS15N
Commercial designation: NO



2SS15N-NO 22 kV
Koda/Code: 21 59 12

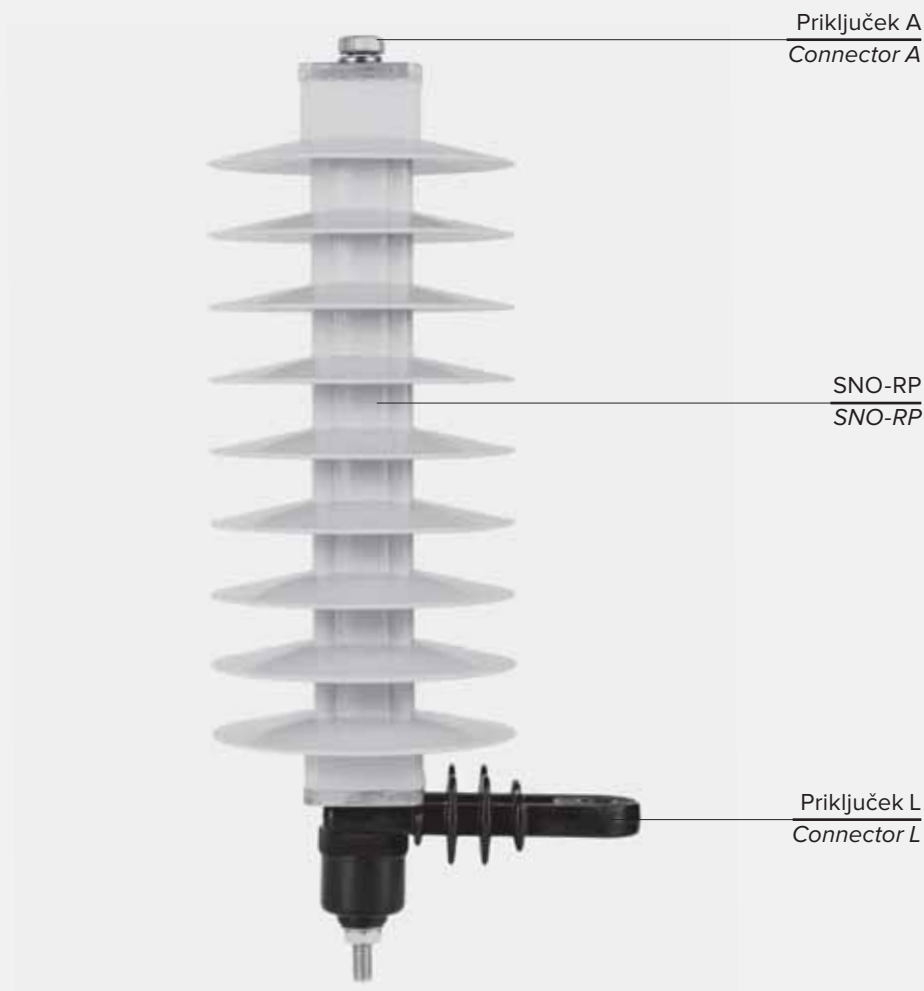
Koda Code	ELEKTRIČNE KARAKTERISTIKE / ELECTRICAL CHARACTERISTICS											MEHANSKE KARAKTERISTIKE / MECHANICAL CHARACTERISTICS				
	U _c [kV]	U _r [kV]	U _{res}							U _{peak} 1,2/50µs [kV]	U _{rms} 50 Hz, 1 min [kV]	AD [mm]	CD [mm]	A [mm]	B [mm]	H [mm]
			1/20µs	1/20µs	8/20µs	8/20µs	30/60µs	30/60µs								
			5 kA	10 kA	5 kA	10 kA	20 kA	125 A	500 A							
2159 01	3	3,75	8,55	9,65	7,18	8,78	9,60	7,35	7,85			215	243	60	90	
2159 02	4	5,00	12,8	14,20	11,25	12,92	14,15	9,63	10,16	62	25			408	100	129
2159 03	6	7,50	21,35	23,85	17,95	21,70	23,75	16,98	18,01					508	120	
2159 04	8	10,00	25,60	28,40	26,12	25,84	28,30	19,26	20,32					120	140	
2159 05	10	12,50	34,15	38,05	29,00	34,62	37,90	26,61	28,17	98	35	271	289	683	160	175
2159 06	12	15,00	38,40	42,60	33,15	38,96	42,45	28,89	30,48					887	180	
2159 07	14	17,50	46,95	52,25	39,98	47,54	52,05	36,24	38,33					180	200	
2159 08	16	20,00	51,20	56,80	44,10	51,68	56,60	38,52	40,64	125	55	321	339	200	220	225
2159 09	18	22,50	59,75	66,45	51,26	60,46	66,20	45,87	48,49					220	240	
2159 10	20	25,00	64,00	71,00	55,45	64,60	70,75	48,15	50,80					240	260	
2159 11	21	26,25	67,55	77,10	58,93	67,95	76,25	52,15	54,55					260	280	
2159 12	22	27,50	72,55	80,65	63,00	73,38	80,35	55,50	58,65	135	60	348	366	270	300	252
2159 20	24	30,00	76,80	85,20	66,15	75,98	84,90	57,78	60,96					320	320	
2159 13	24	30,00	76,80	85,20	74,39	75,95	84,90	57,78	60,96					320	320	
2159 14	26	32,50	85,35	94,85	77,20	84,76	94,50	65,13	68,81	150	65	395	413	340	340	299
2159 15	28	35,00	89,60	99,40	84,90	88,21	99,05	67,41	71,12					360	360	
2159 16	30	37,50	98,15	109,05	88,00	96,99	108,65	74,76	78,97					295	380	
2159 17	32	40,00	102,40	113,60	96,05	101,15	113,20	77,04	81,28					380	400	
2159 24	35	43,75	112,30	125,50	97,86	112,81	125,15	85,16	90,12	170	70	418	466	410	430	352
2159 21	36	45,00	115,20	127,80	99,10	114,10	127,25	86,67	91,44					420	440	
2159 18	34	42,50	110,95	123,25	96,05	109,93	122,80	84,39	89,13					400	420	
2159 19	36	45,00	115,20	127,80	99,10	114,10	127,35	86,67	91,44	180	75	482	500	420	440	386
2159 26	40,5	50,60	125,76	136,35	114,89	129,78	146,25	96,12	101,35					450	470	

U_c Trajna obratovalna napetost
U_r Nazivna napetost
U_{res} Preostala napetost pri različnih tokovnih impulzih
U_{peak} Atmosferska udarna napetost 1,2/50µs v suhem
U_{rms} Izmenična vzdržna napetost 50 Hz v mokrem, 1min
AD Preskočna razdalja
CD Plazilna pot
A Minimalna razdalja do stene
B Minimalna razdalja med fazami
H Višina odvodnika prenapetosti

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

2.11 SNO primer naročila

2.11 SNO order example



Naziv: SNO - RP 34 kV + Priključka AL
Name: SNO - RP 34 kV + Connectors AL

Razlaga naziva

SNO	- tip
RP	- komercialna oznaka oblike
34	- trajna obratovalna napetost (U_c)
kV	- merska enota
AL	- oznake priključkov

Name explanation

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

Oznake na odvodniku prenapetosti

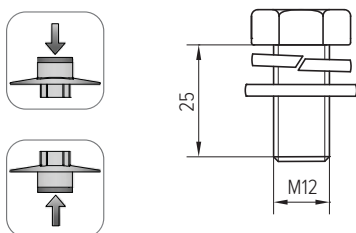
Izoelektro	- proizvajalec
SNO	- tip
12/19	- mesec in leto proizvodnje
U_c ... (kV)	- trajna obratovalna napetost
U_r ... (kV)	- nazivna napetost
I_n ... (kA)	- nazivni odvodni tok
I_{sc} ... (kA)	- kratkostični tok
DH	- IEC razred

Marks on surge arrester

Izoelektro	- manufacturer
SNO	- type
12/19	- 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

2.12 Priključek A

Opis: vijačni priključek za kabelski čevelj
 Material: nerjavno jeklo A2 ali A4
 Moment M12: 60 Nm
 Masa: 0,044 kg
 Koda: **21 47 01**



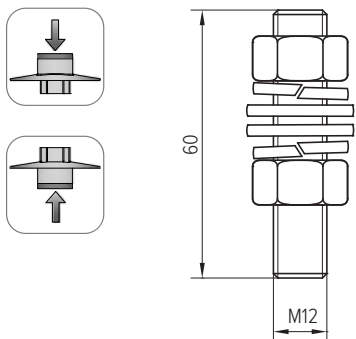
2.12 Connector A

Description: screw connector for cable lug
 Material: stainless steel A2 or A4
 Torque M12: 60 Nm
 Mass: 0,044 kg
 Code: **21 47 01**



2.13 Priključek B

Opis: vijačni priključek za kabelski čevelj
 Material: nerjavno jeklo A2 ali A4
 Moment M12: 60 Nm
 Masa: 0,086 kg
 Koda: **21 47 02**



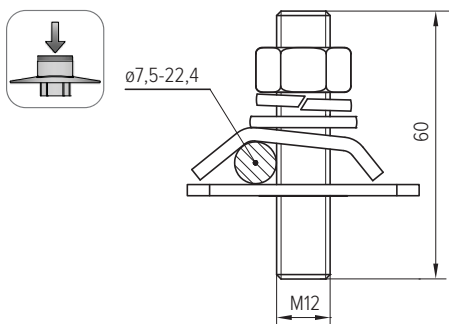
2.13 Connector B

Description: screw connector for cable lug
 Material: stainless steel A2 or A4
 Torque M12: 60 Nm
 Mass: 0,086 kg
 Code: **21 47 02**



2.14 Priključek C

Opis: vijačni priključek za AlFe $\varnothing 7,5-22,4$ mm
 Material: nerjavno jeklo A2
 Masa: 0,133 kg
 Koda: **21 47 03**



2.14 Connector C

Description: screw connector for AlFe $\varnothing 7,5-22,4$ mm
 Material: stainless steel A2
 Mass: 0,133 kg
 Code: **21 47 03**



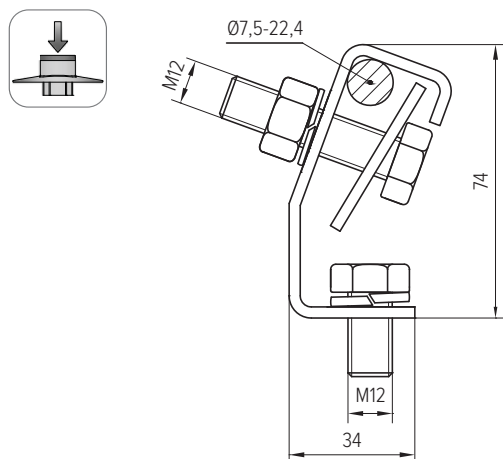
2.15 Priključek F

Opis: vijalni priključek za AlFe $\varnothing 7,5-22,4$ mm

Material: nerjavno jeklo A2

Masa: 0,210 kg

Koda: 21 47 06



2.15 Connector F

Description: screw screw connector for AlFe $\varnothing 7,5-22,4$ mm

Material: stainless steel A2

Mass: 0,210 kg

Code: 21 47 06



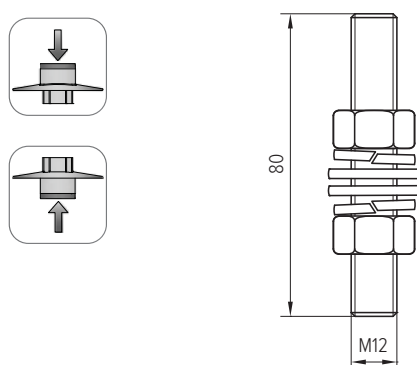
2.16 Priključek G

Opis: vijalni priključek za kabelski čevelj

Material: nerjavno jeklo A2 ali A4

Masa: 0,100 kg

Koda: 21 47 07



2.16 Connector G

Description: screw connector for cable lug

Material: stainless steel A2 or A4

Mass: 0,100 kg

Code: 21 47 07

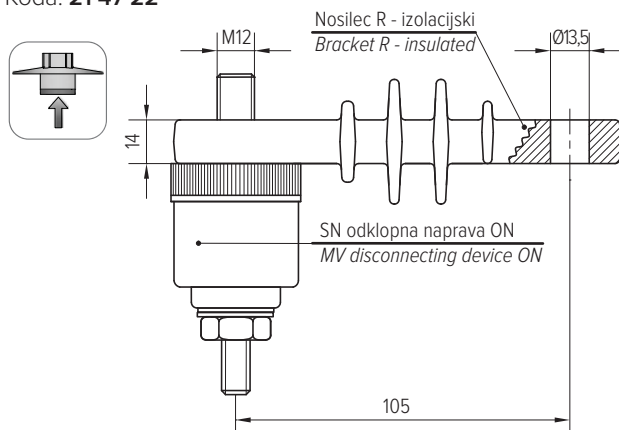


2.17 Priključek L

Opis: izolacijski nosilec R z odklopno napravo ON

Masa: 0,200 kg

Koda: 21 47 22



2.17 Connector L

Description: insulative bracket R with disconnecter ON

Mass: 0,200 kg

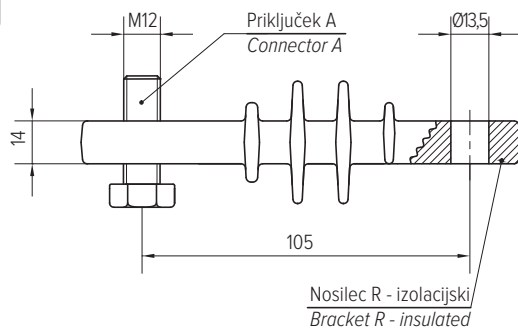
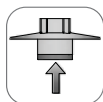
Code: 21 47 22



2.18 Priključek M

Opis: izolacijski nosilec R z vijakom M12x25

Masa: 0,120 kg

Koda: **21 47 23**

2.18 Connector M

Description: insulative bracket R with screw M12x25

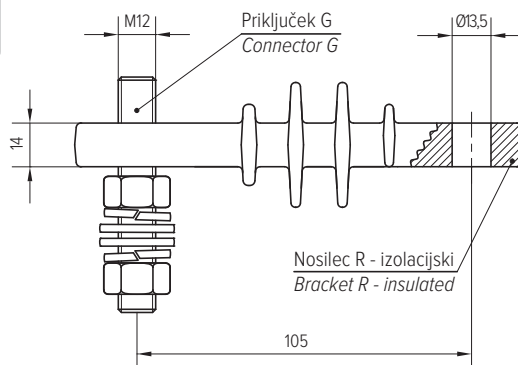
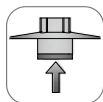
Mass: 0,120 kg

Code: **21 47 23**

2.19 Priključek N

Opis: izolacijski nosilec R s SN priključkom G

Masa: 0,160 kg

Koda: **21 47 24**

2.19 Connector N

Description: insulative bracket R with MV connector G

Mass: 0,160 kg

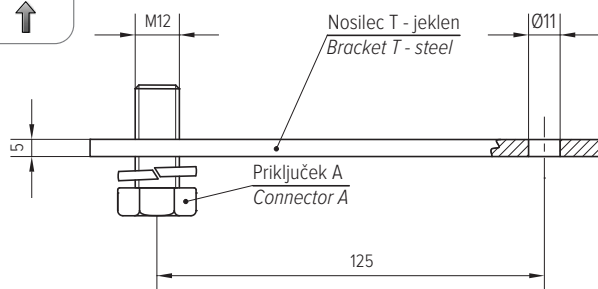
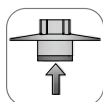
Code: **21 47 24**

2.20 Priključek O

Opis: jeklen nosilec T z vijakom M12x25

Material: nerjavno jeklo A2

Masa: 0,120 kg

Koda: **21 47 25**

2.20 Connector O

Description: steel bracket T with screw M12x25

Material: stainless steel A2

Mass: 0,120 kg

Code: **21 47 25**

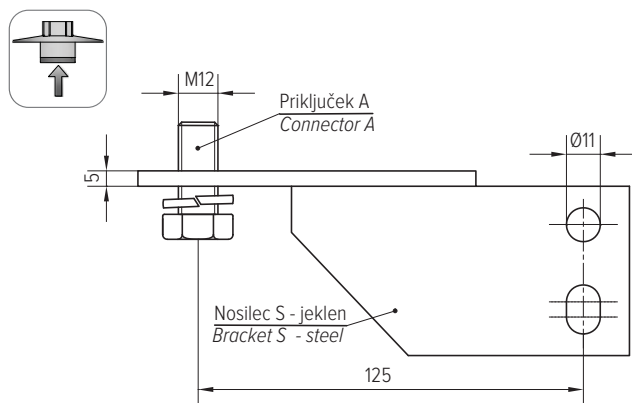
2.21 Priključek P

Opis: jeklen nosilec S (90°) z vijakom M12x25

Material: nerjavno jeklo A2

Masa: 0,220 kg

Koda: 21 47 26



2.21 Connector P

Description: steel bracket S (90°) with screw M12x25

Material: stainless steel A2

Mass: 0,220 kg

Code: 21 47 26



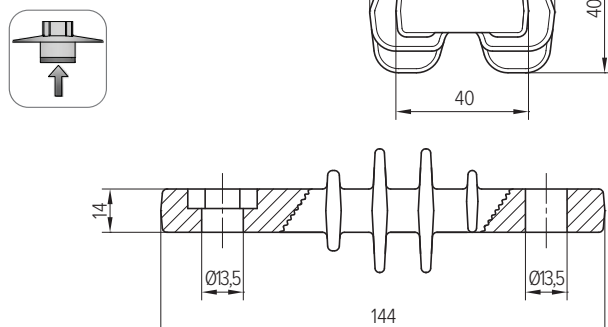
2.22 Nosilec R - izolacijski

Opis: izolacijski nosilec

Material: poliamid PA6

Masa: 0,100 kg

Koda: 21 48 30



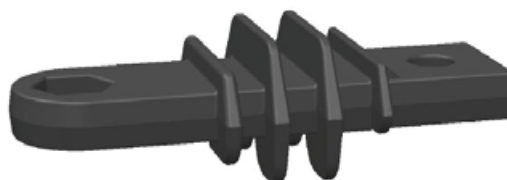
2.22 Bracket R - insulated

Description: insulative bracket

Material: polyamide PA6

Mass: 0,100 kg

Code: 21 48 30



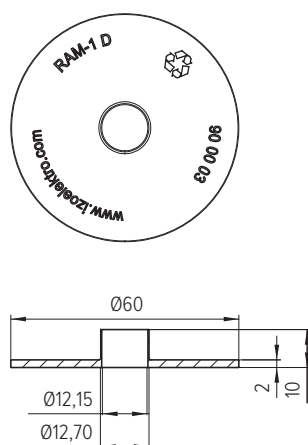
2.23 RAM-1 izolacijski distančnik

Opis: izolacijski distančnik Ø60 za kovinski nosilec

Material: PA6 GV UV

Masa: 0,006 kg

Koda: 90 00 03



2.23 RAM-1 insulative spacer

Description: insulative spacer Ø60 for metal bracket

Material: PA6 GV UV

Mass: 0,006 kg

Code: 90 00 03

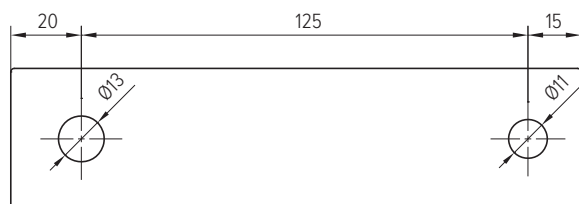
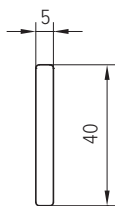
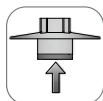


2.24 Nosilec T - jeklen

Opis: nosilec jeklen

Material: nerjavno jeklo A2

Masa: 0,100 kg

Koda: **21 48 32**

2.24 Bracket T - steel

Description: steel bracket

Material: stainless steel A2

Mass: 0,100 kg

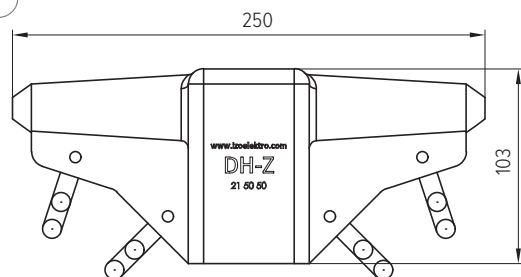
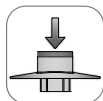
Code: **21 48 32**

2.25 Silikonska zaščita DH-Z

Opis: Zaščita za divje živali

Material: silikon LSR

Masa: 0,183 kg

Koda: **21 50 50**

2.25 Silicone cover DH-Z

Description: Wildlife protection

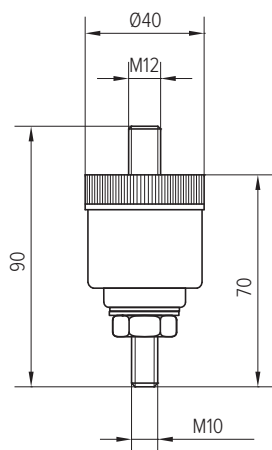
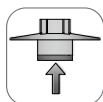
Material: silicone LSR

Mass: 0,183 kg

Code: **21 50 50**

2.26 SN odklopna naprava ON

Namen: odklopi uničen odvodnik prenapetosti

Koda: **21 47 21**

2.26 MV disconnecting device ON

Purpose: disconnects a destroyed surge arrester

Code: **21 47 21**

2.27 RAM-1 - Daljinski nadzor elektroenergetskega omrežja

2.27 RAM-1 - Remote power grid monitoring

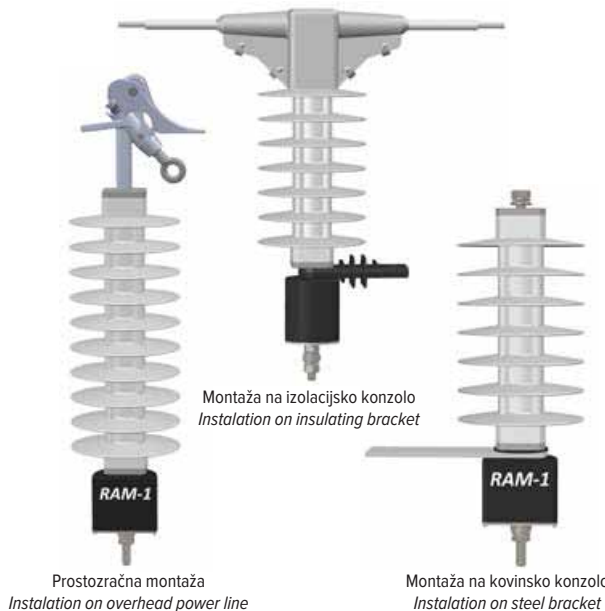
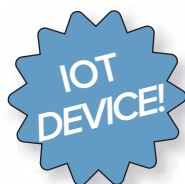
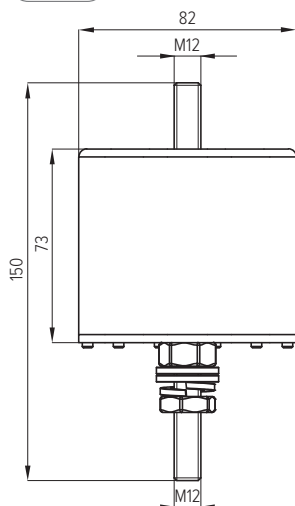
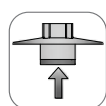
Namen

Prvi v svetu smo izdelali in s patentom zaščitili pametno napravo RAM-1, ki omogoča daljinski nadzor elektroenergetskega omrežja.

Usage

We are the first on the world to design and patent a smart device RAM-1 which is intended for remote monitoring of power grids.

Tehnični podatki		Technical data	
Uporaba	daljinski nadzor vgrajenih odvodnikov prenapetosti nad 1 kV	Application	remote monitoring of installed surge arresters above 1 kV
Osnovna meritve	ohmska komponenta uhajavega toka od 0 ... 3 mA ($\pm 10\%$)	Main measurement	resistive component of leakage current from 0 ... 3 mA ($\pm 10\%$)
Ostale meritve	okvara, števec strel, temperatura, nagib, lokacija	Other measurements	instant fault, surge counter, temperature, position, location
Standard	IEC 60099-5	Standard	IEC 60099-5
Temperaturno območje	- 20 °C (- 40 °C) ... + 85 °C	Temperature range	- 20 °C (- 40 °C) ... + 85 °C
Stopnja zaščite ohišja	IP 67	Housing IP protection level	IP 67
Frekvenca	48 Hz ... 62 Hz	Frequency	48 Hz ... 62 Hz
Uporabniški vmesnik	web, app, email	User interface	web, app, email
Merilni cikel	1 ura	Measuring cycle	1 hour
Komunikacijski cikel	okvara - takoj, normalno delovanje - 60 dni (nastavljivo)	Communication cycle	instant fault - instantly, normal conditions - 60 days (customizable)
Komunikacija	Bluetooth, 4G, 5G ali LoRaWAN	Communication	Bluetooth, 4G, 5G or LoRaWAN
Avtonomija	do 20 let brez vzdrževanja	Autonomy	up to 20 years with out maintenance
Material ohišja	termoplast V-0 (UL 94), nerjavno jeklo A2 ali A4	Housing material	termoplast V-0 (UL 94), stainless steel A2 ali A4
Priključek / material	M12 / nerjavno jeklo A2 ali A4	Connector / material	M12 / stainless steel A2 ali A4
Montaža	na ozemljitveni strani odvodnika	Installation	on the earthing side of the arrester
Masa	0,580 kg	Mass	0,580 kg



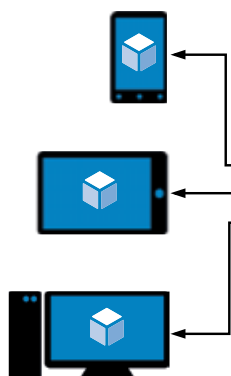
Prednosti

- Trenutno javljanje okvare, avtonomno delovanje, prikaz mesta vgradnje
- Enostavna vgradnja, ugodna cena, do 20 let brez vzdrževanja, brez stroškov povezave
- Dograditev na vse tipe vgrajenih ali na nove odvodnike prenapetosti od 1 kV dalje
- Pripravljeno za strojno učenje

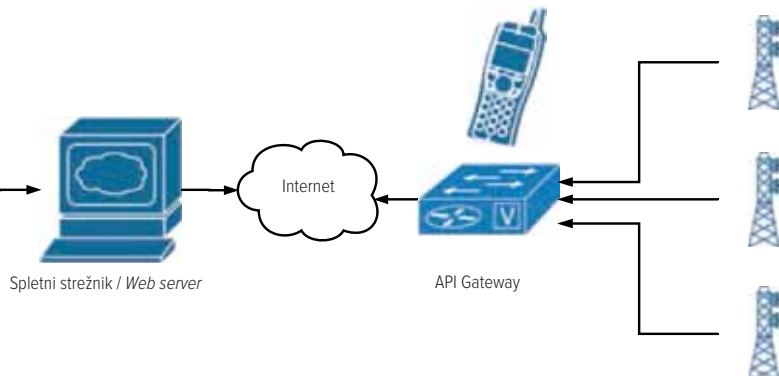
Advantages

- Alarm in case of instant fault, autonomous working, showing the installation location
- Simple installation, low price, up to 20 years with out maintenance, no connection fees
- Installation possible on all already installed or new surge arresters above 1 kV
- Machine Learning ready device

Shema delovanja (RAM-1)



Operation scheme (RAM-1)



Paketi / Package

	1	2	3	4
	Nelicenčni Without licence	Osnovni Basic	Razširjen Extended	Upravljanje Full
Meritve / Measurements				
Ohmska komponenta uhajavega toka IEC 60099:5 Resistive component of leakage current IEC 60099:5	✓	✓	✓	✓
Okvara / Instant fault	✓	✓	✓	✓
Lokacija / Location		✓	✓	✓
Števec strel / Surge counter			✓	✓
Temperatura / Temperature			✓	✓
Nagib / Position			✓	✓
Izračun izgub (v pripravi) / Calculation of power loss (in preparation)			✓	✓
Povezljivost / Connectivity				
4G / 4G	✓	✓	✓	✓
5G / 5G			✓	✓
Bluetooth / Bluetooth	✓	✓	✓	✓
LoRaWan / LoRaWan			✓	✓
Obveščanje / Messaging				
Prikaz sporočila na 2 meseca (email) / Status report every 2 months (email)	✓	✓	✓	✓
Prikaz zadnjih 5 meritev (web, app) / Display of last 5 status reports (web, app)		✓	✓	✓
Prikaz celotne zgodovine meritev, grafični prikaz (web, app) Display of entire history of status reports (web, app)			✓	✓
Avtomatsko obveščanje ob prekoračitvi dovoljene vrednosti (email) Automatic status report when set values are exceeded (email)	✓	✓	✓	✓
Avtomatsko obveščanje ob prekoračitvi dovoljene vrednosti (web, app, email) Automatic status report when set values are exceeded (web, app, email)		✓	✓	✓
Nastavljiv interval poročanja / Adjustable status report interval			✓	✓
GPS lokacija (koordinate) / GPS location (coordinates)		✓	✓	✓
GPS lokacija (koordinate, zemljevid, vodenje do naprave) GPS location (coordinates, map, guidance to surge arrester)			✓	✓
Alarm za okvaro (email) / Alarm in case of instant fault (email)	✓	✓	✓	✓
Alarm za okvaro (web, app, email) Alarm in case of instant fault (web, app, email)		✓	✓	✓
Opcije / Additional options				
Odčitavanje meritev iz naprave RAM-1 na terenu (Bluetooth) Status report from RAM-1 in the field (Bluetooth)		✓	✓	✓
Jezik uporabniškega vmesnika - angleški / User Interface - English language	✓	✓	✓	✓
Jezik uporabniškega vmesnika - na željo kupca / User Interface - language by request			✓	✓
Beleženje aktivnosti naprave (pregledi, popravki, morebitne poškodbe, ...) Activity log (inspections, repairs, maintenance, ...)			✓	✓
Upravljanje z uporabniki (omejeno) / User management (limited)		✓		
Upravljanje z uporabniki (neomejeno) / User management (unlimited)			✓	✓
Upravljanje s sistemom RAM-1 v domeni podjetja Izoelektro Outsourcing services - management of RAM-1 system by Izoelektro				✓
Možnost integracije v obstoječ nadzorni sistem (SCADA) Possibility of integration into the existing control system (SCADA)		✓	✓	
Pripravljeno za strojno učenje / Machine learning ready device	✓	✓	✓	✓

SN natezni/nosilni izolatorji
MV tension/suspension insulators



IZOELEKTRO

3.1 NKI splošno

Proizvod

NKI so natezni/nosilni kompozitni izolatorji s silikonskim plaščem. Namenjeni so za vgradnjo v nadzemne električne vode do nazivne napetosti 52 kV.

Lastnosti

Natezni/nosilni kompozitni izolatorji NKI so:

- odporni na UV sevanje in kemične vplive,
- obstojni na vremenske vplive in staranje,
- oplašeni s silikonom brez dodatkov,
- primerni za agresivna okolja (industrija, morska obala, puščavsko podnebje, ...),
- neobčutljivi na udarce.

Vgradnja

Mesto montaže nateznih/nosilnih kompozitnih izolatorjev NKI določajo pravilniki in tehnični predpisi. Vgrajujejo se v novogradnje, rekonstrukcije in pri vzdrževanju. Ne glede na druge že vgrajene izolatorje v daljnovodih, novo vgrajeni NKI izolatorji ne vplivajo na spremembo koordinacije izolacije.

Splošni podatki

- Nazivna mehanska sila (SML): **90 kN**
- Maksimalna torzijska sila: **50 Nm**
- Temperaturno območje okolja: **T = -60 °C ... +85 °C**
- Plašč: **silikon LSR**
- Barva silikona: **siva**
- Material jeklenih priključkov: **ST 52-3**
- Debelina nanosa cinka: **≥ 70 μm**
- Možno odstopanje po dolžini: **±10 mm**
- Testirani po standardu:
IEC 61109, IEC/TS 60815, IEC 62217, IEC 61466
IEC 61284

3.1 NKI generally

Product

NKI are tension/suspension composite insulators coated with silicone rubber. They are designed to be installed in overhead power lines with voltage up to 52 kV.

Characteristics

Tension/suspension composite insulators NKI are:

- resistant to UV radiation and chemical influences,
- resistant to weathering and aging,
- coated with silicone without additives,
- suitable for aggressive environments (industry, seaside, desert climate, ...),
- insensitive to impacts.

Installation

The position for installing tension composite insulators NKI is decided by directives and technical regulations. They are being installed in new constructions, reconstructions and during maintenance. Newly installed NKI insulators have no impact on any change of insulation coordination regardless to previous installed insulators in overhead power lines.

General data

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



Prednosti pred konkurenco

NKI natezne kompozitne izolatorje za zunanjo in notranjo montažo odlikujejo:

- oblika plašča in priključki izdelani po standardu IEC 61466,
- certifikat akreditiranega laboratorija,
- silikonski plašč je izdelan iz dvokomponentnega silikona brez dodatkov,
- primerni za agresivna okolja,
- verige izdelane iz NKI izolatorjev in našega spojnega materiala so kratke in lahke,
- nazivna natezna sila SML 90 kN,
- 100% rutinski test,
- izdelava s priključki na zahtevo kupca.

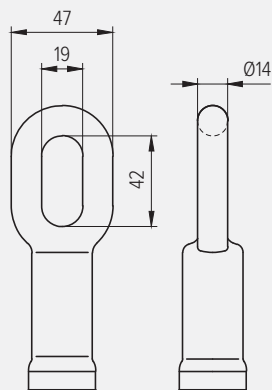
Competitive advantages

NKI tension composite insulators for indoor and outdoor installation feature:

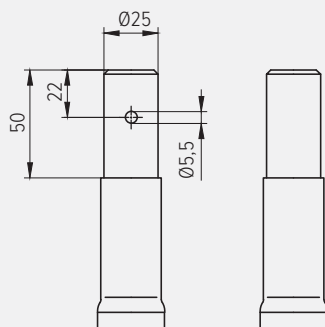
- a shape of the coat and fittings manufactured according to standard IEC 61466,
- a certificate from accredited laboratory,
- a silicone coating is made of a two component silicone without additives,
- suitable also for aggressive environments,
- our short and lightweight strings are made from NKI insulators and connecting material,
- a specified mechanical load SML 90 kN,
- 100% routine tested,
- production with end fittings by customer's request.

3.2 Oblike priključkov

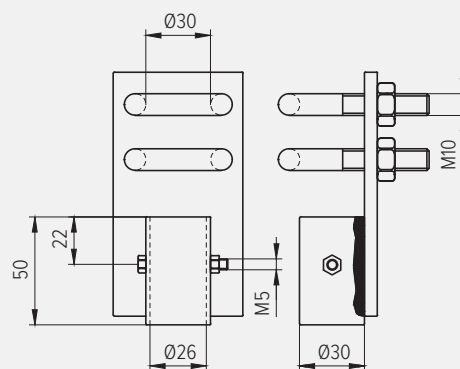
3.2 Shape of end fittings



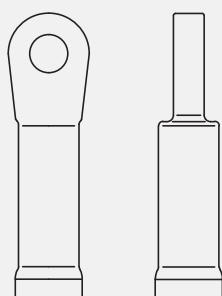
UHO / EYE
»U«



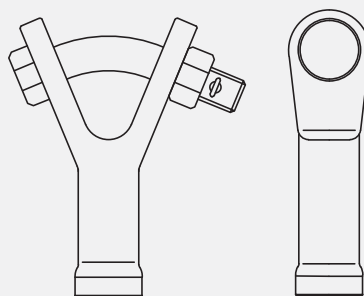
POGON / ROD
»I«



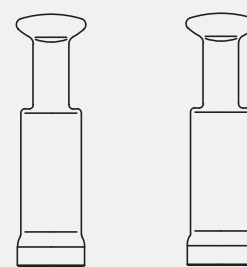
POGON 3/4 / ROD 3/4
»I 3/4«



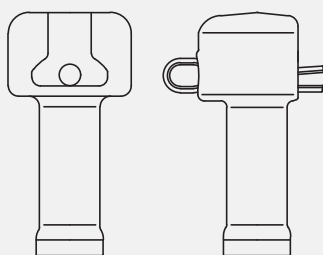
IEC 61466
OKO / TONGUE
»O«



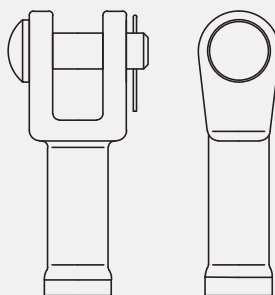
IEC 61466
Y VILICA / Y CLEVIS
»Y«



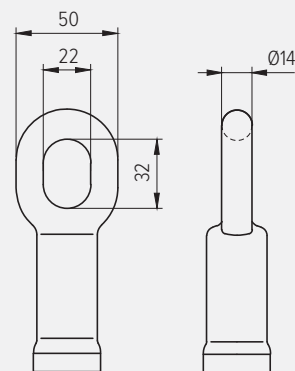
IEC 61466
BATIČ / BALL
»B«



IEC 61466
PONVICA / SOCKET
»P«



IEC 61466
VILICA / CLEVIS
»V«



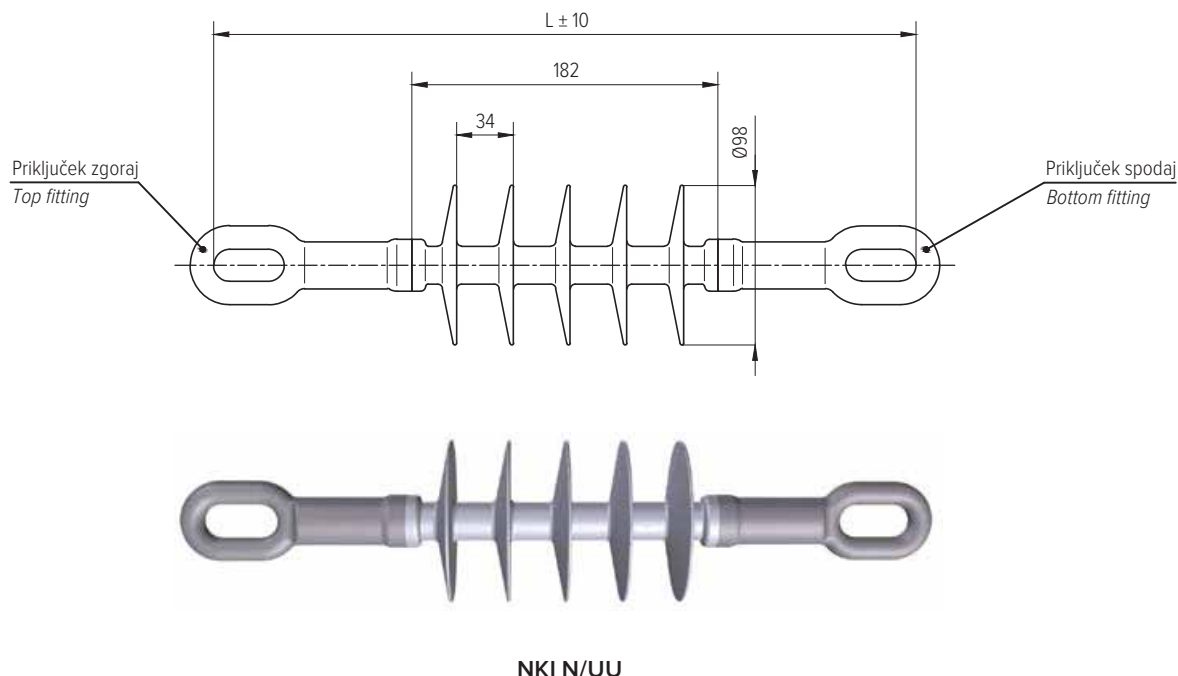
IEC 61466
UHO / EYE
»E«

3.3 Silikonski plašč N - plazilna razdalja 520 mm

Opomba: Izbira izolatorja NKI N

3.3 Silicone coat N - creepage distance 520 mm

Note: selection of insulator NKI N



Tip	Komercialna oznaka	Nazivna obratovalna napetost	Število reber	Plazilna pot	Preskočna razdalja	Vzdržna atm. udarna nap. v suhem	Vzdržna izmenična nap. v mokrem
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

Najbolj uporabljene kode za naročilo NKI izolatorjev / Most used NKI insulator order codes

Zgornji priključek *	Spodnji priključek *	Komercialna oznaka	Koda	Dolžina (mm)	Masa (kg)
Top end fitting *	Bottom end fitting *	Commercial designation	Code	Length (mm)	Mass (kg)
uho/eye	uho/eye	UU	80 70 55	418	1,0
uho/eye	uho/eye	UU 90°	80 70 56	418	1,0
oko/tongue	oko/tongue	OO	80 71 04	410	1,3
oko/tongue	oko/tongue	OO 90°	80 71 41	410	1,3
batič/ball	batič/ball	BB	80 70 60	389	0,9
ponvica/socket	ponvica/socket	PP	80 70 62	378	1,7
vilica/clevis	vilica/clevis	VV	80 70 64	395	1,2
uho/eye	batič/ball	UB	80 70 66	404	1,0
ponvica/socket	uho/eye	PU	80 70 68	398	1,4
uho/eye	vilica/clevis	UV	80 70 70	407	1,1
ponvica/socket	batič/ball	PB	80 70 72	384	1,4
vilica/clevis	batič/ball	NVB	80 70 74	392	1,1
ponvica/socket	vilica/clevis	PV	80 70 76	387	1,7
vilica/clevis	vilica/clevis	VV 90°	80 70 78	395	1,2
pogon/rod	pogon/rod	II	80 70 80	424	1,1
pogon/rod	pogon/rod	II ¾"	80 70 83	424	2,3

Oznake na izolatorju / Marks on insulator

Izoelektro	Proizvajalec Manufacturer
NKI N	Tip SN kompozitnega izolatorja Type of MV composite insulator
3/19	Mesec in leto proizvodnje Month and year of production
≤90 kN	Nazivna mehanska sila (SML) Specified mechanical load (SML)

* Oblike priključkov v poglavju 3.2

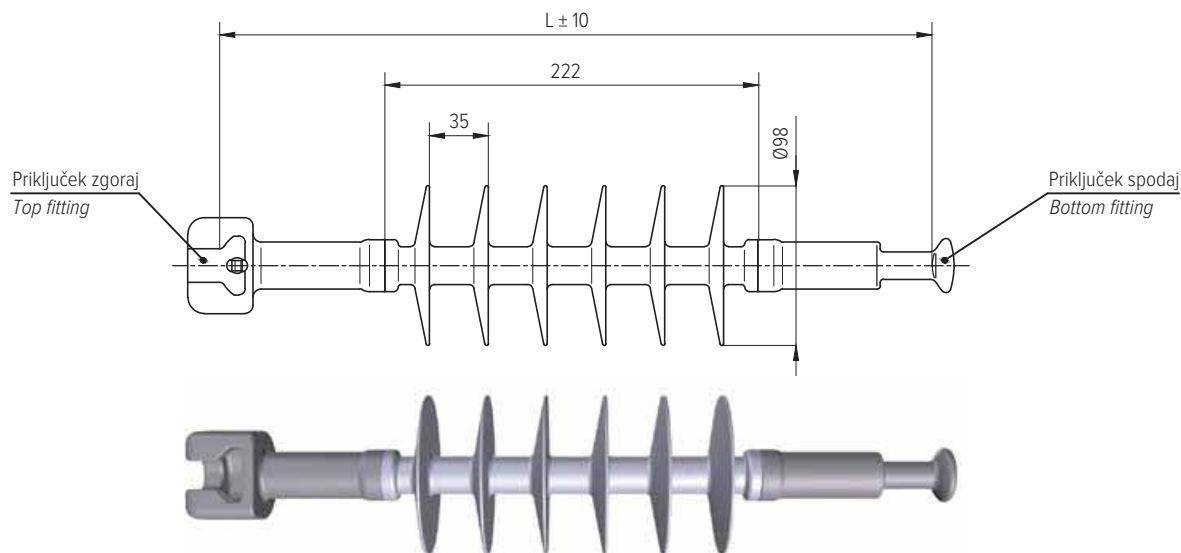
* Shape of end fittings in chapter 3.2

3.4 Silikonski plašč L - plazilna razdalja 630 mm

Opomba: Izbira izolatorja NKI L

3.4 Silicone coat L - creepage distance 630 mm

Note: selection of insulator NKI L



NKI L/PB

Tip	Komercialna oznaka	Nazivna obratovalna napetost	Število reber	Plazilna pot	Preskočna razdalja	Vzdržna atm. udarna nap. v suhem	Vzdržna izmenična nap. v mokrem
Type	Commercial designation	Nominal operating voltage	Number of Sheds	Creepage distance	Arcing distance	Dry lightning impulse withstand voltage	Wet power frequency withstand voltage
NKI L	**	36 kV	6	630 mm	250 mm	186 kV	76 kV

Najbolj uporabljene kode za naročilo NKI izolatorjev / Most used NKI insulator order codes

Zgornji priključek *	Spodnji priključek *	Komercialna oznaka	Koda	Dolžina (mm)	Masa (kg)
Top end fitting *	Bottom end fitting *	Commercial designation	Code	Length (mm)	Mass (kg)
uho/eye	uho/eye	UU	80 70 57	458	1,1
uho/eye	uho/eye	UU 90°	80 70 58	458	1,1
oko/tongue	oko/tongue	OO	80 71 07	450	1,4
oko/tongue	oko/tongue	OO 90°	80 71 42	450	1,4
batič/ball	batič/ball	BB	80 70 61	429	1,0
ponvica/socket	ponvica/socket	PP	80 70 63	418	1,8
vilica/clevis	vilica/clevis	VV	80 70 65	435	1,3
uho/eye	batič/ball	UB	80 70 67	444	1,1
ponvica/socket	uho/eye	PU	80 70 69	438	1,5
uho/eye	vilica/clevis	UV	80 70 71	447	1,2
ponvica/socket	batič/ball	PB	80 70 73	424	1,5
vilica/clevis	batič/ball	N/VB	80 70 75	432	1,2
ponvica/socket	vilica/clevis	PV	80 70 77	427	1,8
vilica/clevis	vilica/clevis	VV 90°	80 70 79	435	1,3
pogon/rod	pogon/rod	II	80 70 81	464	1,2
pogon/rod	pogon/rod	II ¾"	80 70 96	464	2,4

Oznake na izolatorju / Marks on insulator

Izoelektro	Proizvajalec Manufacturer
NKI L	Tip SN kompozitnega izolatorja Type of MV composite insulator
3/19	Mesec in leto proizvodnje Month and year of production
≤90 kN	Nazivna mehanska sila (SML) Specified mechanical load (SML)

* Oblike priključkov v poglavju 3.2

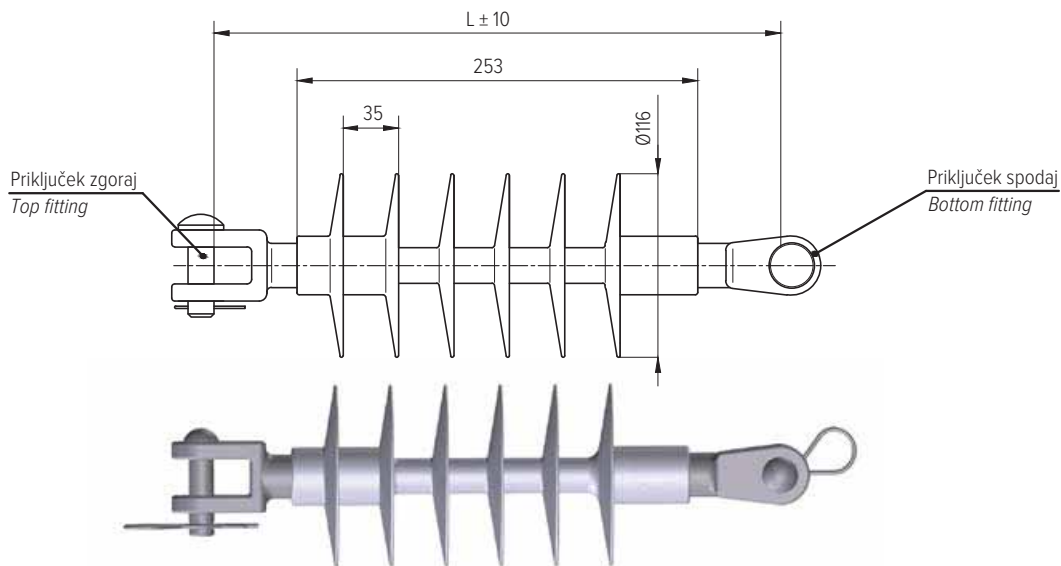
* Shape of end fittings in chapter 3.2

3.5 Silikonski plašč M - plazilna razdalja 783 mm

Opomba: Izbira izolatorja NKI M

3.5 Silicone coat M - creepage distance 783 mm

Note: selection of insulator NKI M



NKI M/VV 90°

Tip	Komercialna oznaka	Nazivna obratovalna napetost	Število reber	Plazilna pot	Preskočna razdalja	Vzdržna atm. udarna nap. v suhem	Vzdržna izmenična nap. v mokrem
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

Najbolj uporabljene kode za naročilo NKI izolatorjev / Most used NKI insulator order codes

Zgornji priključek *	Spodnji priključek *	Komercialna oznaka	Koda	Dolžina (mm)	Masa (kg)
Top end fitting *	Bottom end fitting *	Commercial designation	Code	Length (mm)	Mass (kg)
uho/eye	uho/eye	UU	80 70 00	385	1,1
uho/eye	uho/eye	UU 90°	80 70 11	385	1,1
oko/tongue	oko/tongue	OO	80 71 05	370	1,4
oko/tongue	oko/tongue	OO 90°	80 71 43	370	1,4
batič/ball	batič/ball	BB	80 71 12	352	1,0
ponvica/socket	ponvica/socket	PP	80 71 13	342	1,8
vilica/clevis	vilica/clevis	VV	80 71 14	358	1,3
uho/eye	batič/ball	UB	80 71 15	366	1,1
ponvica/socket	uho/eye	PU	80 71 16	362	1,5
uho/eye	vilica/clevis	UV	80 71 17	369	1,2
ponvica/socket	batič/ball	PB	80 71 18	346	1,5
vilica/clevis	batič/ball	N/VB	80 71 19	355	1,2
ponvica/socket	vilica/clevis	PV	80 71 20	350	1,8
vilica/clevis	vilica/clevis	VV 90°	80 71 21	358	1,3
pogon/rod	pogon/rod	II	80 71 22	387	1,2
pogon/rod	pogon/rod	II ¾"	80 71 23	387	2,4

Oznake na izolatorju / Marks on insulator

Izoelektro	Proizvajalec Manufacturer
NKI M	Tip SN kompozitnega izolatorja Type of MV composite insulator
3/19	Mesec in leto proizvodnje Month and year of production
≤90 kN	Nazivna mehanska sila (SML) Specified mechanical load (SML)

* Oblike priključkov v poglavju 3.2

* Shape of end fittings in chapter 3.2

SN natezni izolatorji

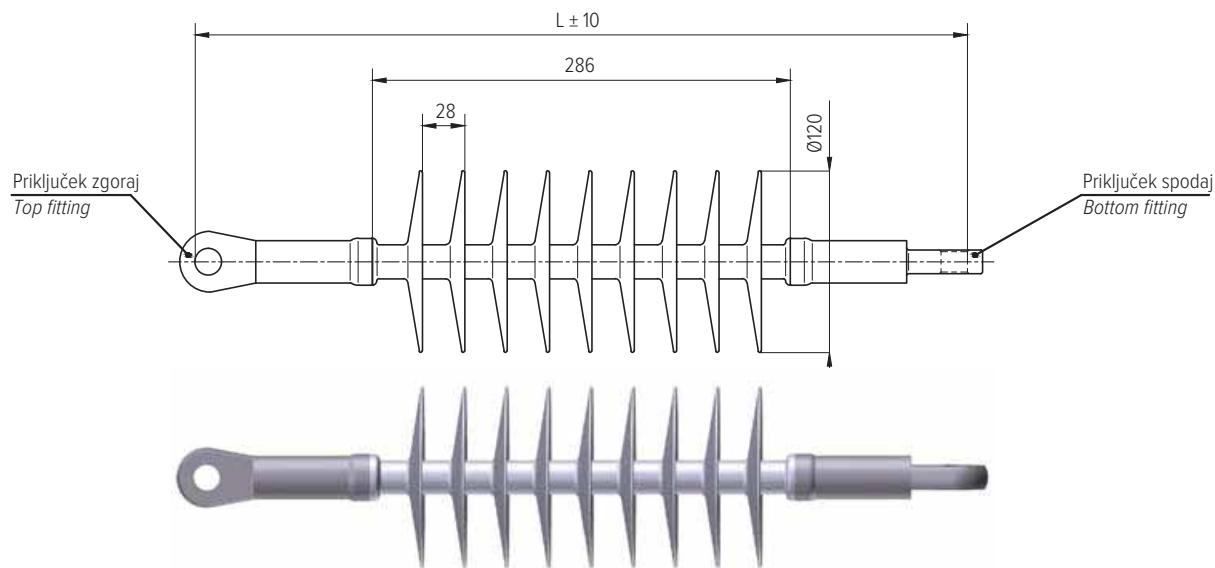
MV tension insulators

3.6 Silikonski plašč X - plazilna razdalja 1120 mm

Opomba: Izbira izolatorja NKI X

3.6 Silicone coat X - creepage distance 1120 mm

Note: selection of insulator NKI X



NKI X/00 90°

Tip	Komercialna oznaka	Nazivna obratovalna napetost	Število reber	Plazilna pot	Preskočna razdalja	Vzdržna atm. udarna nap. v suhem	Vzdržna izmenična nap. v mokrem
Type	Commercial designation	Nominal operating voltage	Number of Sheds	Creepage distance	Arcing distance	Dry lightning impulse withstand voltage	Wet power frequency withstand voltage
NKI X	**	52 kV	9	1120 mm	335 mm	214 kV	106 kV

Najbolj uporabljene kode za naročilo NKI izolatorjev / Most used NKI insulator order codes

Zgornji priključek *	Spodnji priključek *	Komercialna oznaka	Koda	Dolžina (mm)	Masa (kg)
Top end fitting *	Bottom end fitting *	Commercial designation	Code	Length (mm)	Mass (kg)
uho/eye	uho/eye	UU	80 70 59	522	1,3
uho/eye	uho/eye	UU 90°	80 70 84	522	1,3
oko/tongue	oko/tongue	OO	80 71 24	510	1,6
oko/tongue	oko/tongue	OO 90°	80 71 44	510	1,6
batič/ball	batič/ball	BB	80 70 87	493	1,2
ponvica/socket	ponvica/socket	PP	80 70 88	482	2,0
vilica/clevis	vilica/clevis	VV	80 70 85	499	1,5
uho/eye	batič/ball	UB	80 70 90	508	1,3
ponvica/socket	uho/eye	PU	80 70 89	502	1,7
uho/eye	vilica/clevis	UV	80 70 91	511	1,4
ponvica/socket	batič/ball	PB	80 70 92	488	1,7
vilica/clevis	batič/ball	VB	80 70 93	496	1,4
ponvica/socket	vilica/clevis	PV	80 70 94	491	2,0
vilica/clevis	vilica/clevis	VV 90°	80 70 86	499	1,5
pogon/rod	pogon/rod	II	80 70 95	528	1,4
pogon/rod	pogon/rod	II ¾"	80 70 97	528	2,6

Oznake na izolatorju / Marks on insulator

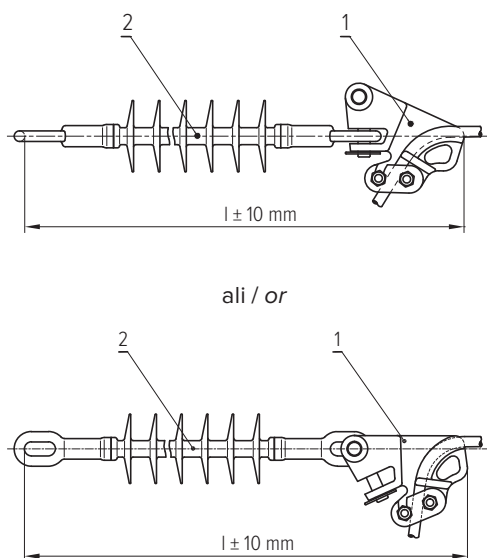
Izoelektro	Proizvajalec Manufacturer
NKI X	Tip SN kompozitnega izolatorja Type of MV composite insulator
3/19	Mesec in leto proizvodnje Month and year of production
≤90 kN	Nazivna mehanska sila (SML) Specified mechanical load (SML)

* Oblike priključkov v poglavju 3.2

* Shape of end fittings in chapter 3.2

3.7 NKL enojna zatezna veriga

Opomba: SZ-U sponka (poz. 1) omogoča vpetje v dveh ravninah



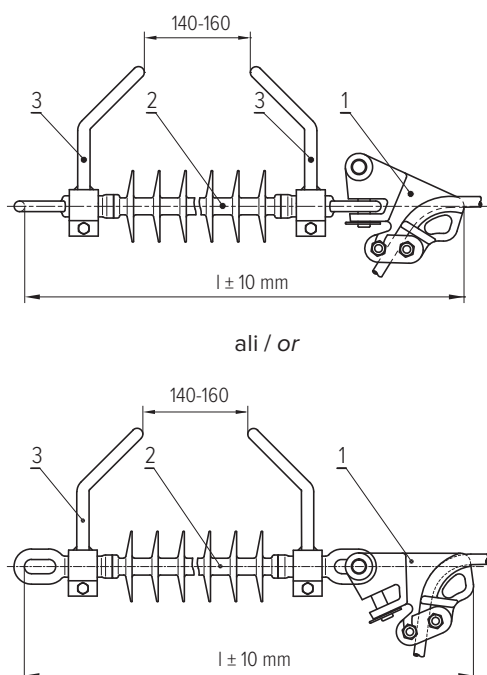
3.7 NKL single tension string

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

Naziv Name	Koda Code	l (mm)	Poz. Pos.	Kos Pcs	Koda Code	Masa Mass (kg)
EZ-01 N/UU	90 70 55	590	1	1	80 60 03	1,1
			2	1	80 70 55	1,0
EZ-01 L/UU	90 70 57	630	1	1	80 60 03	1,1
			2	1	80 70 57	1,1
EZ-01 M/UU	90 71 00	557	1	1	80 60 03	1,1
			2	1	80 71 00	1,1
EZ-01 X/UU	90 70 59	686	1	1	80 60 03	1,1
			2	1	80 70 59	1,3

3.8 NKL enojna zatezna veriga z iskriščem

Opomba: SZ-U sponka (poz. 1) omogoča vpetje v dveh ravninah



3.8 NKL single tension string with arcing horn

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

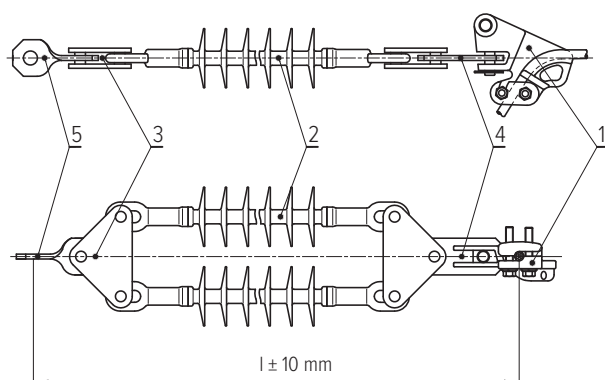
Naziv Name	Koda Code	l (mm)	Poz. Pos.	Kos Pcs	Koda Code	Masa Mass (kg)
EZI-01 N/UU	91 70 55	590	1	1	80 60 03	1,1
			2	1	80 70 55	1,0
			3	2	80 70 54	0,3
EZI-01 L/UU	91 70 57	630	1	1	80 60 03	1,1
			2	1	80 70 57	1,1
			3	2	80 70 54	0,3
EZI-01 X/UU	91 70 59	686	1	1	80 60 03	1,1
			2	1	80 70 59	1,3
			3	2	80 70 54	0,3

SN natezni izolatorji

MV tension insulators

3.9 NKI dvojna zatezna veriga

Opomba: SZ-U sponka (poz. 1) omogoča vpetje v dveh ravninah



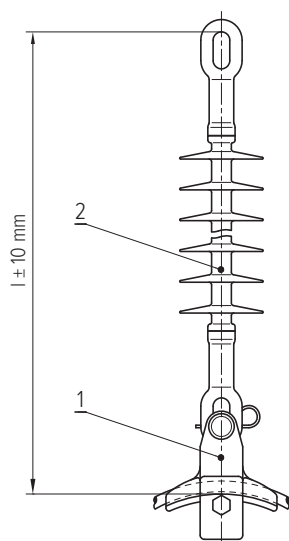
3.9 NKI double tension string

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

Naziv Name	Koda Code	l (mm)	Poz. Pos.	Kos Pcs	Koda Code	Masa Mass (kg)
DZ-01 N/UU	95 70 55	872	1	1	80 60 03	1,1
			2	2	80 70 55	1,0
			3	2	43 29 408	1,6
			4	1	80 60 30	0,5
			5	1	80 60 31	0,5
DZ-01 L/UU	95 70 57	912	1	1	80 60 03	1,1
			2	2	80 70 57	1,1
			3	2	43 29 408	1,6
			4	1	80 60 30	0,5
			5	1	80 60 31	0,5
DZ-01 M/UU	95 71 00	839	1	1	80 60 03	1,1
			2	2	80 71 00	1,1
			3	2	43 29 408	1,6
			4	1	80 60 30	0,5
			5	1	80 60 31	0,5
DZ-01 X/UU	95 70 59	968	1	1	80 60 03	1,1
			2	2	80 70 59	1,3
			3	2	43 29 408	1,6
			4	1	80 60 30	0,5
			5	1	80 60 31	0,5

3.10 NKI enojna nosilna veriga

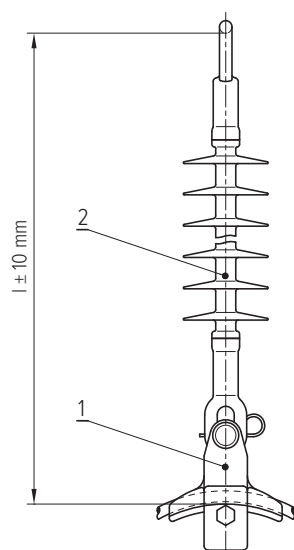
3.10 NKI single suspension string



Naziv Name	Koda Code	l (mm)	Poz. Pos.	Kos Pcs	Koda Code	Masa Mass (kg)
EN-01 N/UU	92 70 55	511	1	1	80 60 04	0,7
			2	1	80 70 55	1,0
EN-01 L/UU	92 70 57	551	1	1	80 60 04	0,7
			2	1	80 70 57	1,1
EN-01 M/UU	92 71 00	478	1	1	80 60 04	0,7
			2	1	80 71 00	1,1
EN-01 X/UU	92 70 59	607	1	1	80 60 04	0,7
			2	1	80 70 59	1,3

3.11 NKI enojna nosilna veriga 90°

3.11 NKI single suspension string 90°



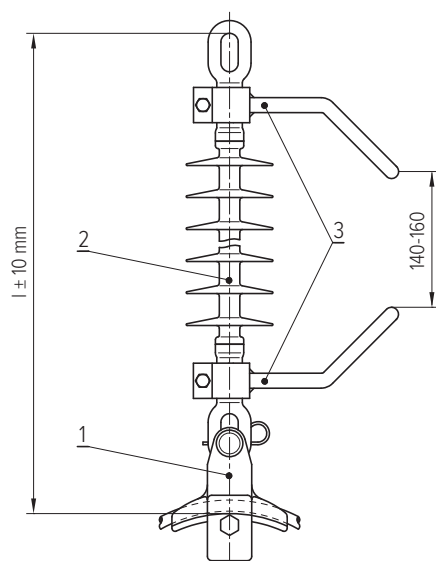
Naziv Name	Koda Code	L (mm)	Poz. Pos.	Kos Pcs	Koda Code	Masa Mass (kg)
EN-02 N/UU	92 70 56	511	1	1	80 60 04	0,7
			2	1	80 70 56	1,0
EN-02 L/UU	92 70 58	551	1	1	80 60 04	0,7
			2	1	80 70 58	1,1
EN-02 M/UU	92 71 11	478	1	1	80 60 04	0,7
			2	1	80 71 11	1,1
EN-02 X/UU	92 70 84	607	1	1	80 60 04	0,7
			2	1	80 70 84	1,3

3.12 NKI enojna nosilna veriga z iskriščem

3.12 NKI single suspension string with arcing horn

Opomba: uporaba za polizolirane vodnike (PIV)

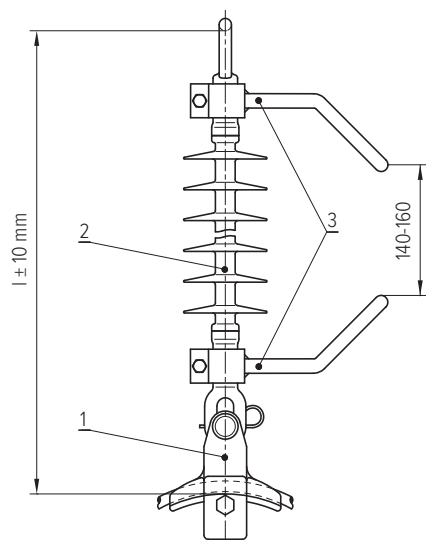
Note: use with covered conductors (CC)



Naziv Name	Koda Code	L (mm)	Poz. Pos.	Kos Pcs	Koda Code	Masa Mass (kg)
ENI-01 N/UU	93 70 55	511	1	1	80 60 04	0,7
			2	1	80 70 55	1,0
			3	2	80 70 54	0,3
ENI-01 L/UU	93 70 57	551	1	1	80 60 04	0,7
			2	1	80 70 57	1,1
			3	2	80 70 54	0,3
ENI-01 X/UU	93 70 59	607	1	1	80 60 04	0,7
			2	1	80 70 59	1,2
			3	2	80 70 54	0,3

3.13 NKI enojna nosilna veriga 90° z iskriščem

Opomba: uporaba za polizolirane vodnike (PIV)



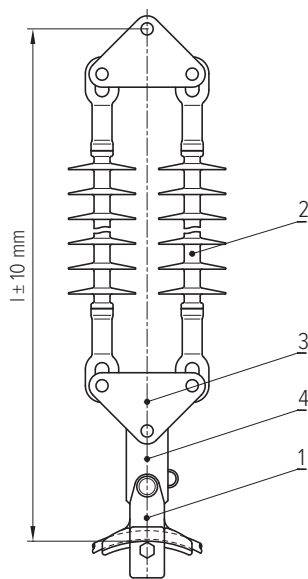
3.13 NKI single suspension string 90° with arcing horn

Note: use with covered conductors (CC)

Naziv Name	Koda Code	l (mm)	Poz. Pos.	Kos Pcs	Koda Code	Masa Mass (kg)
ENI-02 N/UU	93 70 56	511	1	1	80 60 04	0,7
			2	1	80 70 56	1,0
			3	2	80 70 54	0,3
ENI-02 L/UU	93 70 58	551	1	1	80 60 04	0,7
			2	1	80 70 58	1,1
			3	2	80 70 54	0,3
ENI-02 X/UU	93 70 84	607	1	1	80 60 04	0,7
			2	1	80 70 84	1,3
			3	2	80 70 54	0,3

3.14 NKI dvojna nosilna veriga

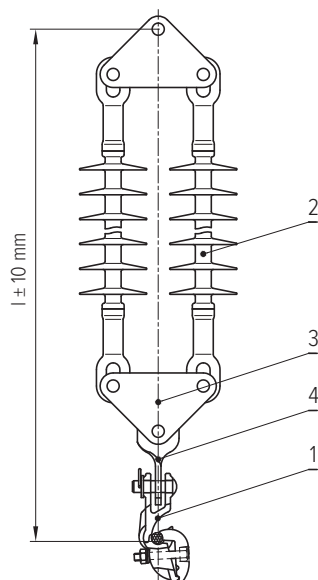
3.14 NKI double suspension string



Naziv Name	Koda Code	l (mm)	Poz. Pos.	Kos Pcs	Koda Code	Masa Mass (kg)
DN-01 N/UU	94 70 55	710	1	1	80 60 04	0,7
			2	2	80 70 55	1,0
			3	2	43 29 408	1,6
			4	1	80 60 30	0,5
DN-01 L/UU	94 70 58	750	1	1	80 60 04	0,7
			2	2	80 70 57	1,1
			3	2	43 29 408	1,6
			4	1	80 60 30	0,5
DN-01 M/UU	94 71 00	677	1	1	80 60 04	0,7
			2	2	80 71 00	1,1
			3	2	43 29 408	1,6
			4	1	80 60 30	0,5
DN-01 X/UU	94 70 57	806	1	1	80 60 04	0,7
			2	2	80 70 59	1,3
			3	2	43 29 408	1,6
			4	1	80 60 30	0,5

3.15 NKI dvojna nosilna veriga 90°

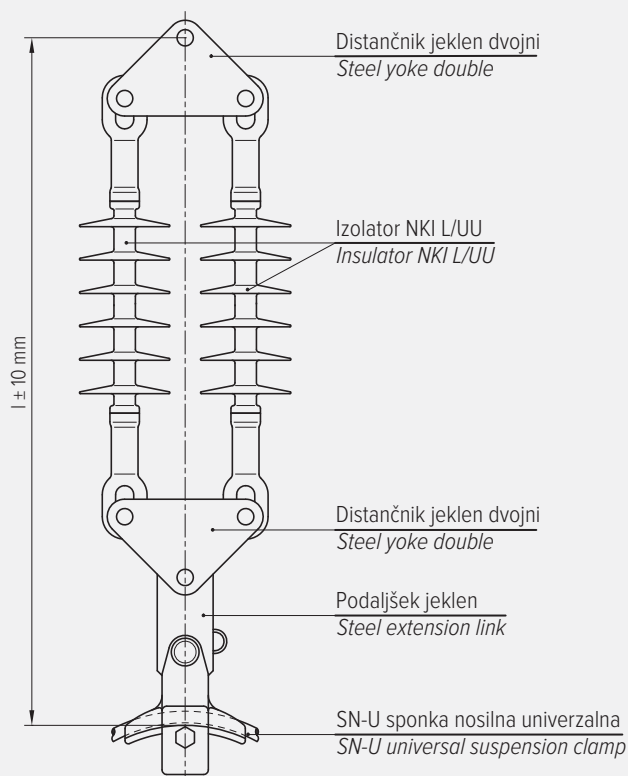
3.15 NKI double suspension string 90°



Naziv Name	Koda Code	l (mm)	Poz. Pos.	Kos Pcs	Koda Code	Masa Mass (kg)
DN-02 N/UU	94 70 56	710	1	1	80 60 04	0,7
			2	2	80 70 55	1,0
			3	2	43 29 408	1,6
			4	1	80 60 31	0,5
DN-02 L/UU	94 70 59	750	1	1	80 60 04	0,7
			2	2	80 70 57	1,1
			3	2	43 29 408	1,6
			4	1	80 60 31	0,5
DN-02 M/UU	94 71 11	677	1	1	80 60 04	0,7
			2	2	80 71 00	1,1
			3	2	43 29 408	1,6
			4	1	80 60 31	0,5
DN-02 X/UU	94 70 60	806	1	1	80 60 04	0,7
			2	2	80 70 59	1,3
			3	2	43 29 408	1,6
			4	1	80 60 31	0,5

3.16 NKI izolatorska veriga - primer naročila 1

3.16 NKI insulator string - order example 1



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

Razlaga naziva

DN - tip izolatorske verige
02 - zaključek verige
L/UU - tip NKI izolatorja

Name explanation

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

Tipi izolatorskih verig

EZ - enojna zatezna
EZI - enojna zatezna z iskriščem
DZ - dvojna zatezna
EN - enojna nosilna
ENI - enojna nosilna z iskriščem
DN - dvojna nosilna

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

Zaključek verige

01 - ravni zaključek
02 - 90° zaključek

String ending

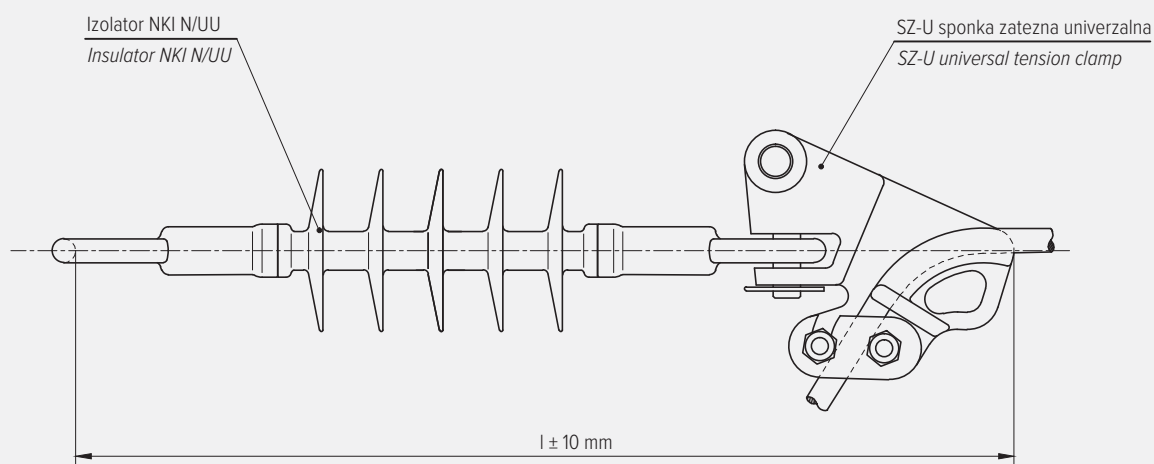
01 - straight ending
02 - 90° ending

Tip NKI izolatorja v verigi

L/UU - uporabljen je naziv nateznega kompozitnega izolatorja brez oznake NKI

Type of NKI insulator in string

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

3.17 NKI izolatorska veriga -
primer naročila 23.17 NKI insulator string -
order example 2

Naziv/ Name: EZI-01 N/UU

Razlaga naziva

EZI - tip izolatorske verige
01 - zaključek verige
N/UU - tip NKI izolatorja v verigi

Name explanation

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

Tipi izolatorskih verig

EZ - enojna zatezna
EZI - enojna zatezna z iskriščem
DZ - dvojna zatezna
EN - enojna nosilna
ENI - enojna nosilna z iskriščem
DN - dvojna nosilna

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

Zaključek verige

01 - ravni zaključek
02 - 90° zaključek

String ending

01 - straight ending
02 - 90° ending

Tip NKI izolatorja v verigi

N/UU - uporabljen je naziv nateznega
kompozitnega izolatorja brez oznake NKI.

Type of NKI insulator in string

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

SN podporni izolatorji ***MV postinsulators***

4



IZOELEKTRO

4.1 PKI splošno

Proizvod

PKI so podporni kompozitni izolatorji s silikonskim plaščem. Namenjeni so za vgradnjo v nadzemne električne vode do nazivne napetosti 52 kV.

Lastnosti

Podporni kompozitni izolatorji PKI so:

- odporni na UV sevanje in kemične vplive,
- obstojni na vremenske vplive in staranje,
- oplašeni s silikonsko gumo brez dodatkov,
- primerni za agresivna in onesnažena okolja (industrija, morska obala, puščavsko podnebje, ...),
- uporabni za daljnovode in naprave,
- neobčutljivi na udarce.

Vgradnja

Mesto montaže podpornih kompozitnih izolatorjev PKI določajo pravilniki in tehnični predpisi. Vgrajujejo se v novogradnje, rekonstrukcije in pri vzdrževanju. Prigradena vzmetna sponka z ustreznim jahačem zagotavlja tovarniško nastavljeno vertikalno in horizontalno izvlečno silo. Ne glede na druge že vgrajene izolatorje v daljnovodih, novo vgrajeni PKI izolatorji ne vplivajo na spremembo koordinacije izolacije.

Splošni podatki

- Nazivna upogibna sila (SCL): **12,5 in 15 kN**
- Temperaturno območje okolja: **T = -60 °C ... +85 °C**
- Plašč: **silikon LSR**
- Barva silikona: **siva**
- Material zgornjega priključka: **PA6, UV stabiliziran**
- Material jeklenih priključkov: **ST 52-3**
- Navoj priključka spodaj: **M20 ali M24**
- Debelina nanosa cinka: **≥ 70 µm**
- Odstopanje po dolžini: **±5 mm**
- Testirani po standardih: **IEC 62217, IEC 61952, IEC 60437**
- Izvedba standardiziranih tipov po standardu **IEC 61952-1/2019**



4.1 PKI generally

Product

The PKI are post composite insulators with silicone coating. They are designed to be installed on overhead power lines with rated voltages up to 52 kV.

Characteristic

Post composite insulators PKI are:

- resistant to UV radiation and chemical influences,
- resistant to weathering and aging,
- coated with silicone without additives,
- suitable for aggressive and polluted environments (industry, seaside, desert climate, ...),
- usable for overhead power lines and devices,
- insensitive to impacts.

Installation

The position for installing post composite insulators PKI is determined by directives and technical regulations. They are installed in new constructions, reconstructions and at maintenance. The fitted spring clamp provides factory-set vertical and horizontal pull-out forces by using the appropriate cover. Newly installed PKI insulators have no impact on any change of insulation coordination regardless to previously installed insulators in overhead power lines.

General data

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

Prednosti pred konkurenco

PKI podporne kompozitne izolatorje za zunanjo in notranjo montažo odlikujejo:

- certifikat akreditiranega laboratorija,
- Inovativnost. Izolator tip PKI z zgornjim priključkom iz izolacijskega materiala je rezultat strokovnih raziskav naših raziskovalcev (objavljeno v svetovno priznani reviji IEEE Transactions on Power Delivery, 2009), našega patenta in praktičnih izkušenj uporabnikov. Odpravlja pomanjkljivosti izolatorjev s kovinskim zgornjim priključkom in kovinskimi vezicami.
- način pritrdjevanja vodnika na izolator,
- majhna teža,
- enostavna montaža,
- izdelava s priključki na zahtevo kupca.

Competitive advantages

PKI post composite insulators for indoor and outdoor installation feature:

- a certificate from accredited laboratory,
- Innovativeness - the PKI insulator type with a top fitting made of insulating material is the result of expert studies carried out by our researchers (published in the world-renowned journal IEEE Transactions on Power Delivery, 2009), our patent and practical experiences of users. It eliminates deficiencies of insulators with metal top fittings and metal cable ties.
- a method of fixing a conductor onto an insulator,
- lightweight,
- easy installation,
- production with fittings on customer's request.

4.2 PKI inovacija

Izkušnje uporabnikov in termovizijski posnetki daljnovodov dokazujejo, da v času življenjske dobe prihaja do parcialnih praznitev, kadar je goli ali pol izoliran vodnik:

- vpet v kovinsko pritrdišče,
- pritrjen s kovinsko vezjo na keramični izolator.

Študija porazdelitve električne poljske jakosti na zgornjem kovinskem priključku kompozitnega podpornega izolatorja potrjuje, da obstaja velika verjetnost, da bo zaradi previsoke električne poljske jakosti ob dolgotrajni uporabi izolatorjev z zgornjim kovinskim priključkom prišlo do prežiga na mestu spodnjega roba zgornjega priključka izolatorja ali do odžiga vodnika na mestu pritrditve.

Teoretične raziskave so pokazale, da se v obratovanju vzdolž izolatorja vzpostavi električno polje, ki ni homogeno, temveč je odvisno od lastnosti materialov in geometrije. To vpliva na dielektrične obremenitve izolatorja, ki so odvisne od oblike prevodnih delov in rastejo z velikostjo napetosti U oziroma električnega polja E.

4.2 PKI innovation

Experiences of users and thermo-vision footage of power lines provide us with proof that in the lifespan partial discharges occur when a bare conductor or a covered conductor is:

- fastened to a metal anchorage,
- astened with the metal bond to the ceramic insulator.

The study of distribution of electric field strength on metal top fitting of composite post insulators confirms high probability of too high electric field strength (at prolonged usage of insulators with top metal fitting). This may lead to damage and cut conductors due to burns where the conductor comes in to contact with metal top fittings or metal bond.

Some theoretical research showed that while in operation a non-homogenous electric field that depends on material characteristics and insulator geometry is established along the insulator. This affects the dielectric loads of the insulator that depend upon the shape of conducting parts and increase with the heights of voltage U or electric field E.

Diagram električne poljske jakosti

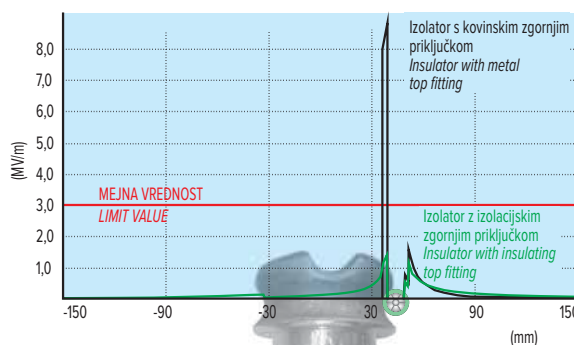


Diagram of electric field strength

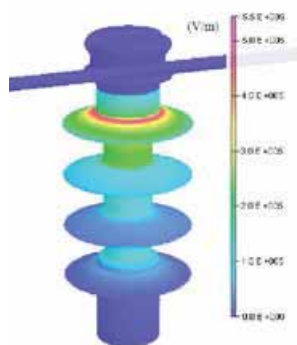
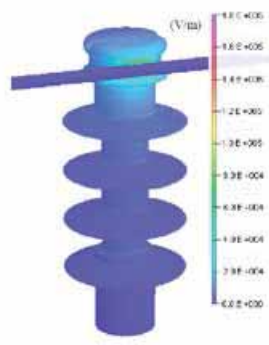
Izolacijski zgornji priključek

Izolator tip PKI z zgornjim priključkom iz izolacijskega materiala je rezultat strokovnih raziskav in praktičnih izkušenj uporabnikov naših izdelkov. Odpravlja pomanjkljivosti izolatorjev s kovinskim zgornjim priključkom. Zgornji priključek je izdelan iz poliamida PA6 z dodatkom steklenih vlaken, kar mu zagotavlja ustrezne mehanske lastnosti, časovno stabilnost, odpornost na atmosferske vplive in UV svetlobo. Je značilne črne barve. Ta material že več kot petnajst let uspešno uporabljamo v naši nihajni sponki.

Insulative top

The insulators type PKI with top fitting made of insulating material is the result of professional research and of practical experiences of our product users. It eliminates deficiencies of insulators with metal top fittings. The top fitting is made of polyamide PA6 with the addition of glass fibres which assure suitable mechanical characteristics, lifetime stability, resistance to atmospheric influences and UV light. It is characteristically black coloured. We have already been successfully using this material in our spring clamp for more than fifteen years.

Porazdelitev električne poljske jakosti

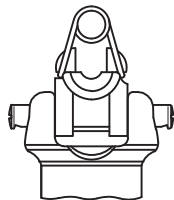
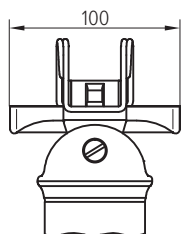
Kovinski zgornji priključek
Metal top fittingIzolacijski zgornji priključek
PA insulation top fitting

Allocation of electric field strength

4.3 A PKI - oblike zgornjih priključkov

4.3 A PKI - shape of top fittings

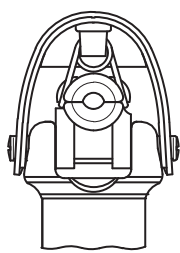
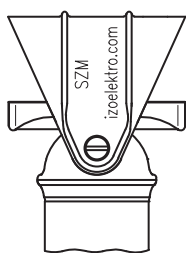
A PKI "S" - VZMETNA SPONKA



A PKI "S" - SPRING CLAMP



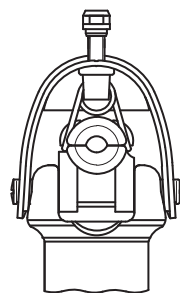
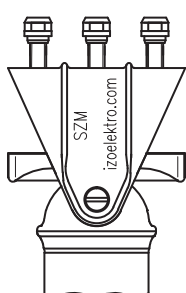
A PKI "Z" - VZMETNA SPONKA S KAPO SZM/0



A PKI "Z" - SPRING CLAMP WITH CAP SMZ/0



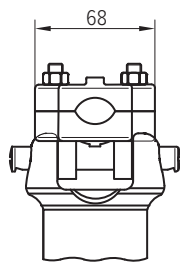
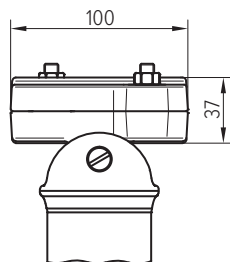
A PKI "M" - VZMETNA SPONKA S KAPO SZM/3



A PKI "M" - SPRING CLAMP WITH CAP SZM/3



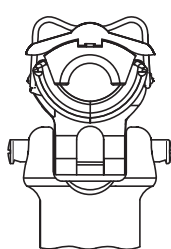
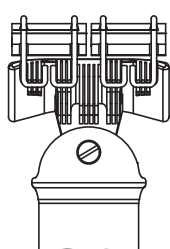
A PKI "G" - VIJAČNA SPONKA



A PKI "G" - SCREW CLAMP



A PKI "E" - ZA VODNIKE OD Ø15 DO Ø30



A PKI "E" - FOR CONDUCTORS FROM Ø15 TO Ø30



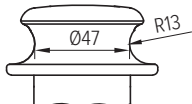
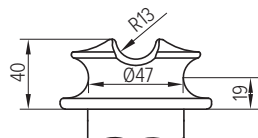
SN podporni izolatorji

MV post insulators

4.4 PKI - oblike zgornjih priključkov

4.4 PKI - shape of top fittings

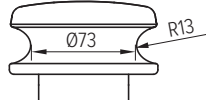
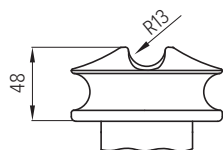
PKI "O" - BREZ SPONKE



PKI "O" - WITHOUT CLAMP



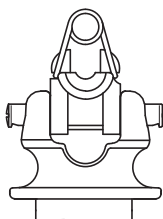
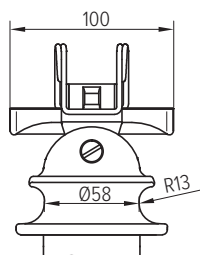
PKI "H" - BREZ SPONKE



PKI "H" - WITHOUT CLAMP



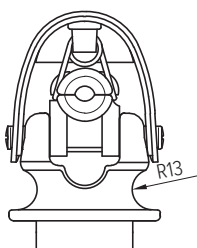
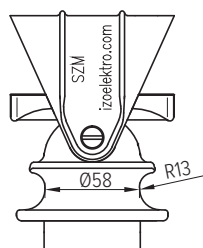
PKI "S" - VZMETNA SPONKA



PKI "S" - SPRING CLAMP



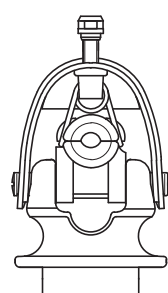
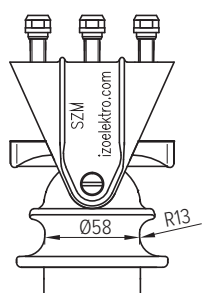
PKI "Z" - VZMETNA SPONKA S KAPO SZM/0



PKI "Z" - SPRING CLAMP WITH CAP SZM/0



PKI "M" - VZMETNA SPONKA S KAPO SZM/3



PKI "M" - SPRING CLAMP WITH CAP SZM/3

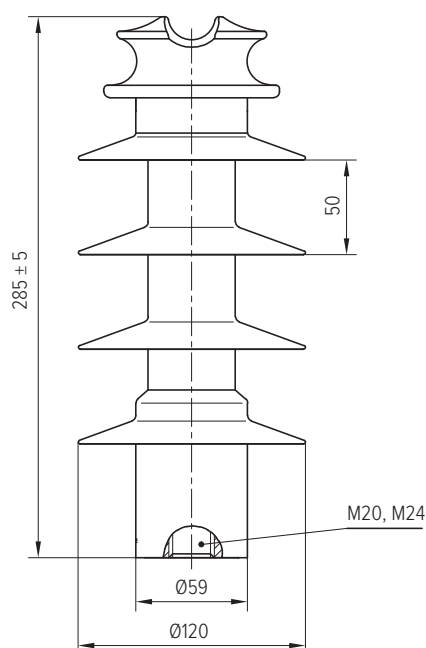


4.5 Silikonski plašč N

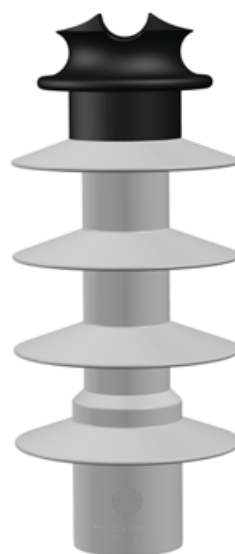
Opomba: izbira izolatorja

4.5 Silicone coat N

Note: selection of the insulator



PKI NO



Tip	Komercialna oznaka	Nazivna obratovalna napetost	Število reber	Plazilna pot	Preskočna razdalja	Vzdržna atm. udarna nap. v suhem	Vzdržna izmenična nap. v mokrem
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

Možnost izbire izolatorjev PKI N in A PKI N / The choice of insulators PKI N and A PKI N

Tip	Komercialna oznaka	Zgornji priključek	Spodnji priključek	IEC 61952-1 oznaka	Dolžina	Masa
Type	Commercial designation	Top fitting	Bottom end fitting	IEC 61952-1 designation	Length L ± 5% [mm]	Mass m [kg]
PKI N	O	brez sponke / without clamp	M20, M24	CLP7.5-170NRN-543	285	1,70
PKI N	H	brez sponke / without clamp	M20, M24	CLP7.5-170NRN-543	310	1,65
A PKI / PKI N	S	z vzmetno sponko / with spring clamp	M20, M24	CLP7.5-170JRN-670	305	2,00
A PKI N	V	z oslabiljeno vzmetno sponko / with a weakened spring clamp	M20, M24	CLP7.5-170JRN-670	305	2,05
A PKI / PKI N	Z	s kapo SZM/0 / with cap SZM/0	M20, M24	CLP7.5-170JRN-670*	305	2,10
A PKI / PKI N	M	s kapo SZM/3 / with cap SZM/3	M20, M24	CLP7.5-170JRN-670**	305	2,10
A PKI N	M 120/99	za vodnike AlFe 120/PIV99 / for conductors AlFe 120/CC99	M20, M24	CLP7.5-170JRN-670	305	2,10
A PKI N	G	z vijakno sponko / with screw clamp	M20, M24	/	308	2,10
A PKI N	E	za vodnike od 150 do 300 / for conductor from 150 to 300	M20, M24	/	320	2,25

* z vzmetno sponko s kapo SZM/0
with a spring clamp and a SZM/0 cap

** z vzmetno sponko s kapo SZM/3
with a spring clamp and a SZM/3 cap

Oznake na izolatorju / Marks on insulator

Proizvajalec Manufacturer	Tip SN kompozitnega izolatorja Type of MV composite insulator	Mesec in leto proizvodnje Month and year of production	Nazivna upogibna sila (SCL) Specified cantilever load (SCL)
Izoelektro	A PKI, PKI	3/19	12,5 ali / or 15 kN

SN podporni izolatorji

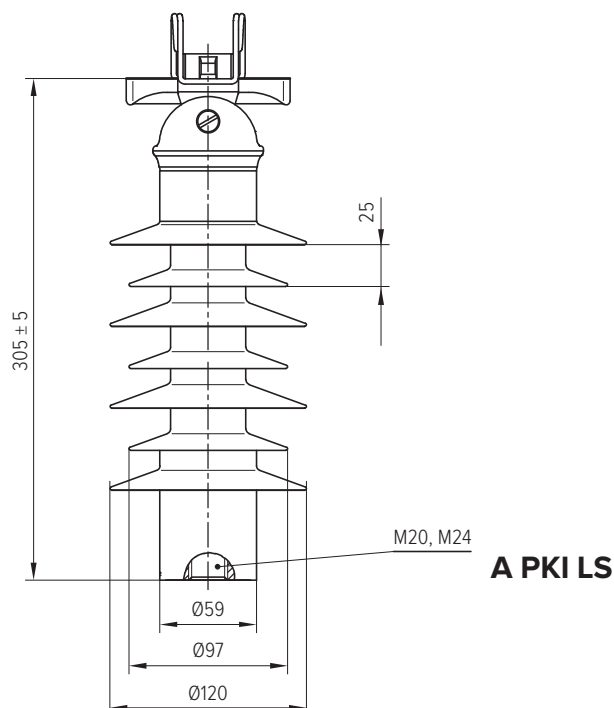
MV post insulators

4.6 Silikonski plašč L

Opomba: izbira izolatorja

4.6 Silicone coat L

Note: selection of the insulator



Tip	Komercialna oznaka	Nazivna obratovalna napetost	Število reber	Plazilna pot	Preskočna razdalja	Vzdržna atm. udarna nap. v suhem	Vzdržna izmenična nap. v mokrem
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

Možnost izbire izolatorjev PKI L in A PKI L / The choice of insulators PKI L and A PKI L

Tip	Komercialna oznaka	Zgornji priključek	Spodnji priključek	IEC 61952-1 oznaka	Dolžina	Masa
Type	Commercial designation	Top fitting	Bottom end fitting	IEC 61952-1 designation	Length L ± 5% [mm]	Mass m [kg]
PKI L	O	brez sponke / without clamp	M20, M24	CLP7.5-170NRN-670	285	1,80
PKI L	H	brez sponke / without clamp	M20, M24	CLP7.5-170NRN-670	310	1,75
A PKI / PKI L	S	z vzmetno sponko / with spring clamp	M20, M24	CLP7.5-170JRN-782	305	2,10
A PKI L	V	z oslabiljeno vzmetno sponko / with a weakened spring clamp	M20, M24	CLP7.5-170JRN-782	305	2,10
A PKI / PKI L	Z	s kapo SZM/0 / with cap SZM/0	M20, M24	CLP7.5-170JRN-782*	305	2,15
A PKI / PKI L	M	s kapo SZM/3 / with cap SZM/3	M20, M24	CLP7.5-170JRN-782**	305	2,20
A PKI L	M 120/99	za vodnike AlFe 120/PIV99 / for conductors AlFe 120/CC99	M20, M24	CLP7.5-170JRN-782	305	2,20
A PKI L	G	z vijčno sponko / with screw clamp	M20, M24	/	308	2,20
A PKI L	E	za vodnike od 150 do 300 / for conductor from 150 to 300	M20, M24	/	320	2,35

* z vzmetno sponko s kapo SZM/0
with a spring clamp and a SZM/0 cap

** z vzmetno sponko s kapo SZM/3
with a spring clamp and a SZM/3 cap

Oznake na izolatorju / Marks on insulator

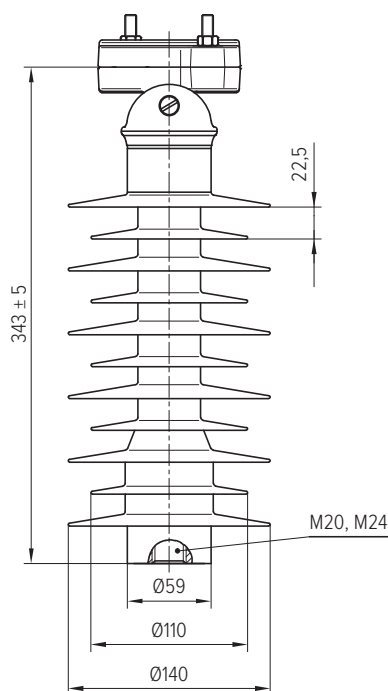
Proizvajalec Manufacturer	Tip SN kompozitnega izolatorja Type of MV composite insulator	Mesec in leto proizvodnje Month and year of production	Nazivna upogibna sila (SCL) Specified cantilever load (SCL)
Izoelektro	A PKI, PKI	3/19	12,5 ali / or 15 kN

4.7 Silikonski plašč X

Opomba: izbira izolatorja

4.7 Silicone coat X

Note: selection of the insulator



A PKI XG



Tip	Komercialna oznaka	Nazivna obratovalna napetost	Število reber	Plazilna pot	Preskočna razdalja	Vzdržna atm. udarna nap. v suhem	Vzdržna izmenična nap. v mokrem
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	380 mm	230 kV	106 kV

Možnost izbire izolatorjev PKI X in A PKI X / The choice of insulators PKI X and A PKI X

Tip	Komercialna oznaka	Zgornji priključek	Spodnji priključek	IEC 61952-1 oznaka	Dolžina	Masa
Type	Commercial designation	Top fitting	Bottom end fitting	IEC 61952-1 designation	Length L ± 5% [mm]	Mass m [kg]
PKI X	O	brez sponke / without clamp	M20, M24	CLP7.5-200NRN-1150	330	2,10
PKI X	H	brez sponke / without clamp	M20, M24	CLP7.5-200NRN-1150	350	2,05
A PKI / PKI X	S	z vzmetno sponko / with spring clamp	M20, M24	CLP7.5-200JRN-1230	340	2,40
A PKI X	V	z oslajeno vzmetno sponko / with a weakened spring clamp	M20, M24	CLP7.5-200JRN-1230	340	2,40
A PKI / PKI X	Z	s kapo SZM/0 / with cap SZM/0	M20, M24	CLP7.5-200JRN-1230*	340	2,45
A PKI / PKI X	M	s kapo SZM/3 / with cap SZM/3	M20, M24	CLP7.5-200JRN-1230**	340	2,40
A PKI X	M 120/99	za vodnike AlFe 120/PIV99 / for conductors AlFe 120/CC99	M20, M24	CLP7.5-200JRN-1230	340	2,40
A PKI X	G	z vijakno sponko / with screw clamp	M20, M24	/	343	2,40
A PKI X	E	za vodnike od 150 do 300 / for conductor from 150 to 300	M20, M24	/	365	2,65

* z vzmetno sponko s kapo SZM/0
with a spring clamp and a SZM/0 cap

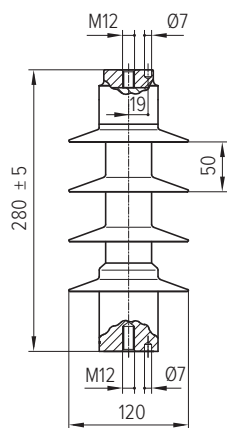
** z vzmetno sponko s kapo SZM/3
with a spring clamp and a SZM/3 cap

Oznake na izolatorju / Marks on insulator

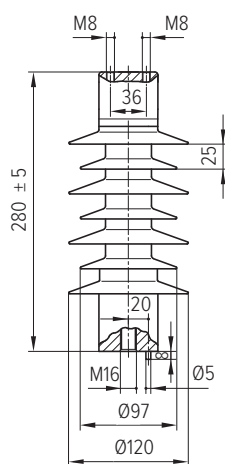
Proizvajalec Manufacturer	Tip SN kompozitnega izolatorja Type of MV composite insulator	Mesec in leto proizvodnje Month and year of production	Nazivna upogibna sila (SCL) Specified cantilever load (SCL)
Izoelektro	A PKI, PKI	3/19	12,5 ali / or 15 kN

4.8 PKIL za ločilnik

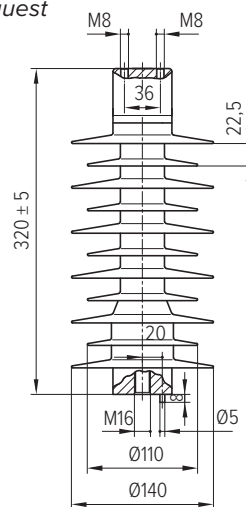
Opomba: obliko in material priključkov izdelamo po zahtevi kupca



PKIL N ES



PKIL L TSN



PKIL X ME

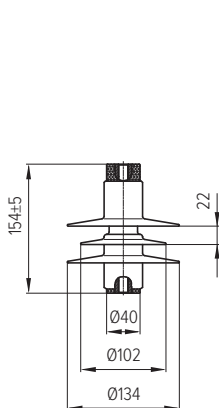
Tip	PKIL N	PKIL L	PKIL X	Type
Komercialna oznaka	ES	TSN	ME	Commercial designation
Nazivna obratovalna napetost	24 kV	36 kV	52 kV	Nominal operating voltage
Plazilna pot	493 mm	620 mm	1125 mm	Creepage distance
Preskočna razdalja	275 mm	275 mm	330 mm	Arcing distance
Vzdržna atm. udarna nap. v suhem	155 kV	180 kV	210 kV	Dry lightning impulse withstand voltage
Vzdržna izmenična nap. v mokrem	70 kV	80 kV	100 kV	Wet power frequency withstand voltage
Masa	2,0 kg	2,1 kg	2,4 kg	Mass

4.8 PKIL for switch disconnector

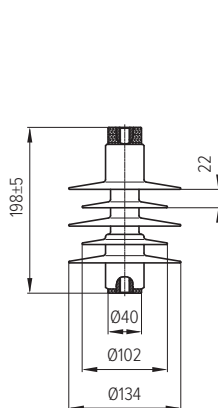
Note: we make the holes for attaching connectors on customer's request

4.9 PKIL IZO za ločilnik

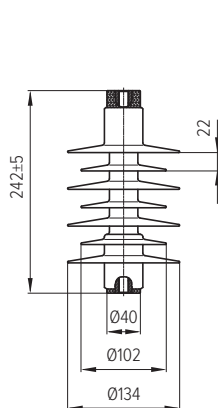
Opomba: obliko in material priključkov izdelamo po zahtevi kupca



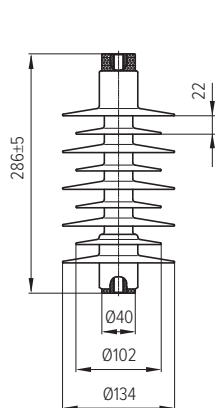
PKIL 12



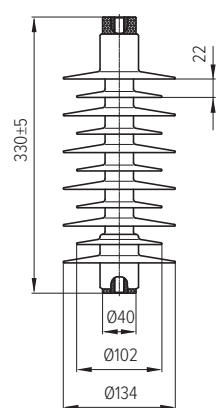
PKIL 24



PKIL 36



PKIL 44



PKIL 52

Naziv	PKIL	PKIL	PKIL	PKIL	PKIL	Name
Komercialna oznaka	12	24	36	44	52	Commercial designation
Nazivna obratovalna napetost	12 kV	24 kV	36 kV	44 kV	52 kV	Nominal operating voltage
Plazilna pot	357 mm	557 mm	757 mm	957 mm	1157 mm	Creepage distance
Preskočna razdalja	170 mm	214 mm	258 mm	302 mm	346 mm	Arcing distance
Masa	1,2 kg	1,4 kg	1,6 kg	1,8 kg	2,0 kg	Mass

4.9 PKIL IZO for switch disconnector

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

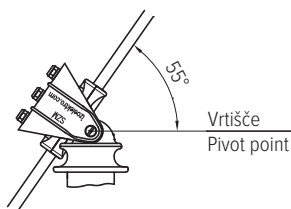
4.10 A PKI in PKI nagib in odkloni vodnika

Opomba: podani so maksimalni nagibi in odkloni vodnika v zgornjem priključku izolatorjev A PKI in PKI glede na način vpetja vodnika.

4.10 A PKI and PKI inclination and conductor declination

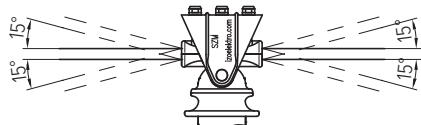
Note: the data in the images below represents the maximum conductor inclinations and declinations in the A PKI and PKI insulators' heads regarding their mounting.

Nagib zgornjega priključka izolatorja



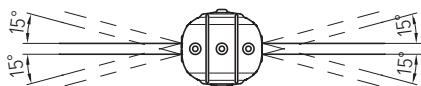
Insulator top inclination

Vertikalni odklon vodnika



Vertical conductor declination

Horizontalni odklon vodnika

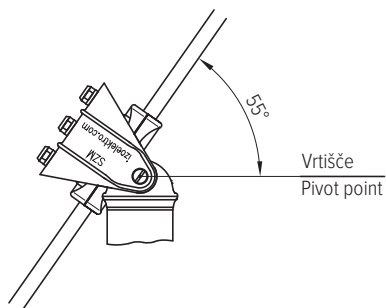


Horizontal conductor declination

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

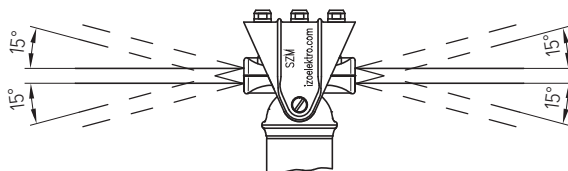
PKI (O, H)

Nagib zgornjega priključka izolatorja



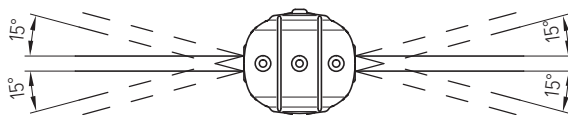
Insulator top inclination

Vertikalni odklon vodnika



Vertical conductor declination

Horizontalni odklon vodnika



Horizontal conductor declination

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

SN podporni izolatorji

MV post insulators

4.11 Zaščita za divje živali splošno

Proizvod

A PKI z oznako »B« so podporni kompozitni izolatorji, ki skupaj s silikonskim plaščem SILP in zaščitno kapo SZM/0 predstavljajo zaščito za divje živali. Vgrajujemo jih v nadzemne električne vode do nazivne napetosti 52 kV.

Lastnosti

Podporni kompozitni izolatorji A PKI z oznako »B« imajo prigrajeno kapo za zaščito kovinskih delov zgornjega priključka kompozitnega izolatorja. Silikonski plašč SILP, montiran na vodniku na vsaki strani izolatorja, izolira goli vodnik pritrjen na izolator. Vijačna sponka privita z predpisanim navorom zagotavlja zdrs vodnika skozi silikonski plašč SILP istočasno pa onemogoča premik silikonskega plašča glede na mesto pritrditve.

Vgradnja

Področja zaščiteni zaradi divjih živali vsaka država samostojno določa. Mi vgradnjo zaščite priporočamo na daljnovodih, kjer pogosto prihaja do zemeljskih stikov zaradi:

- večjih ptic,
- na mestih priletov in odletov jate ptic,
- preskakovanja glodalcev na oporiščih.

V našem podjetju smo skupaj z uporabniki razvili sistem za vgradnjo tipskih zaščitnih elementov. Za izvedbo sistema zaščite za divje živali je potrebno uporabiti:

- izolatorje A PKI z oznako »G«,
- SN silikonski plašč SILP,
- kapa SZM/0.

Naročanje

Izberete kateri koli velikost podpornega kompozitnega izolatorja A PKI z oznako »G«, kapo SZM/0 in priporočeno število metrov silikonskega plašča SILP. Primer garniture za en izolator je podan v točki 4.12 A PKI zaščita za divje živali.

4.11 Wildlife protection generally

Product

A PKI with the mark »B« are composite post insulators which, together with the SILP silicone coating and the SZM/0 protection cap, represent wildlife protection. They are designed to be installed onto overhead power lines with rated voltages up to 52 kV.

Characteristic

The A PKI composite post insulators with mark »B« have a fitted cap for the protection of metal composite insulator head parts. The SILP silicone coat mounted on the conductor insulates the bare conductor attached to the insulator on each side of the insulator. A screw clamp tightened with the specific torque ensures that the conductor can move through the SILP silicone coat, while at the same time preventing the movement of the silicon coat in relation to the attachment point.

Installation

Protected areas for wildlife conservation are determined by the government of a specific country. We recommend the installation of wildlife protection onto overhead power lines wherever earth faults often occur due to:

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

Together with our users we have created a system for installing standard protective elements. For the implementation of a wildlife protection system, it is necessary to use:

- insulators A PKI with mark »G«,
- MV silicone coat SILP,
- Cap SZM/0.

Ordering

Choose any A PKI composite post insulator with the mark »G«, cap SZM/0 and the recommended number of meters of the SILP silicone coat. An example for a single set insulator is given in section 4.12 A PKI for wildlife protection.

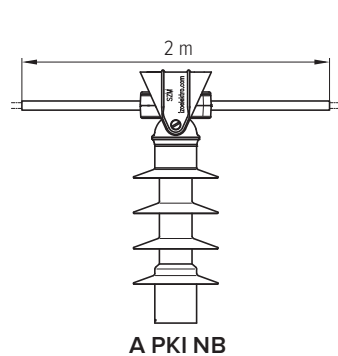
Prednosti pred konkurenco

- Vsa stojna mesta z že vgrajenimi izolatorji A PKI in PKI z oznako »G« imajo možnost enostavne predelave sistema.
- Zagotavlja 100% zaščito na oporiščih.
- Zaščita za divje živali deluje tudi pri ekstremnih vremenskih pogojih.

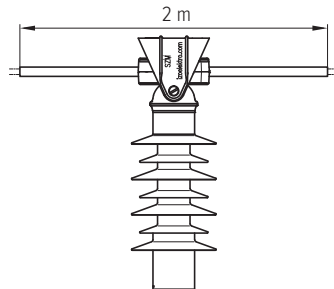
Competitive advantages

- All poles with installed insulators A PKI and PKI with mark »G« have an option of a simple system upgrade.
- Provides 100% protection on poles.
- Wildlife protection works even in extreme weather conditions.

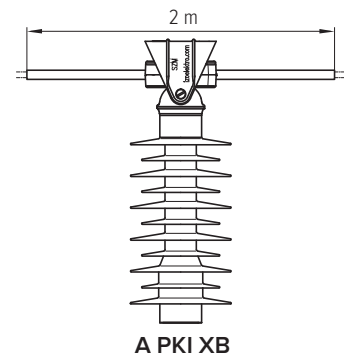
4.12 Zaščita za divje živali - garnitura

Horizontalna izvlečna sila vodnika (Fh): **2,8 kN**Vertikalna dopustna obremenitev sponke (Fv): **4,0 kN**

A PKI NB



A PKI LB

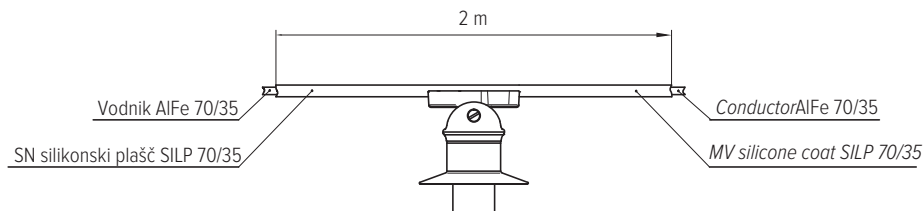


A PKI XB

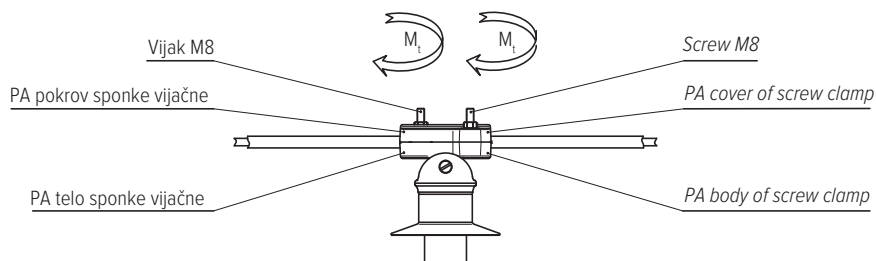
Garnitura	Količina Quantity	Set
A PKI NG ali A PKI LG ali A PKI XG	1 kos/pcs	A PKI NG or A PKI LG or A PKI XG
+ SN silikonski plašč SILP 70/35	2 m	+ MV SILP 70/35 silicone coat
+ Kapa SZM/0	1 kos/pcs	+ SZM/0 cap

Navodila za namestitev zaščite za divje živali z vijačno sponko

1. Silikonski plašč SILP 70/35 namestimo na vodnik simetrično na vijačno sponko.

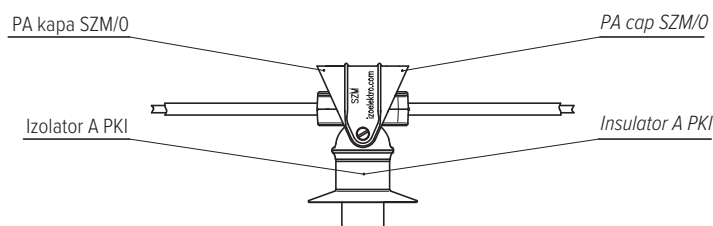


2. Vijaka privijemo z navorom $M_t=6 \text{ Nm}$.



3. Namestimo kapo SZM/0.

3. Install the cap SZM/0.



SN podporni izolatorji

MV post insulators

4.13 A PKI varna montaža skozi gozd splošno

Proizvod

A PKI izolatorji z oznako »V« so namenski podporni kompozitni izolatorji s silikonskim plaščem in z oslabiljeno vzmetno sponko. Namenjeni so za varno montažo skozi gozd. Vgrajujemo jih v nadzemne električne vode do nazivne napetosti 52 kV.

Lastnosti

Podporni kompozitni izolatorji imajo oslabiljeno telo sponke zaradi lažje porušitve pri izrednih vremenskih razmerah.

Vgradnja

Mesto montaže namenskih podpornih kompozitnih izolatorjev A PKI določajo pravilniki in tehnični predpisi elektrodistribucij. Na daljnovodih, kjer trasa poteka skozi gozd, pogosto prihaja do prekinitev napajanja zaradi:

- izrednih vremenskih razmer,
- podiranja dreves,
- lomljenja vej,
- otrsjanja snega in žleda.

V najhujših primerih prihaja do porušitve DV. Dejstvo je, da pri teh porušitvah v večini primerov ostane vodnik nepretrgan.

Zaradi tega smo v našem podjetju skupaj z uporabniki in strokovnimi sodelavci izvedli študijo o varni izgradnji DV skozi gozd ter raziskave podkrepili s preskusom v naravi (video na www.izoelektr.com). Za izvedbo varne montaže skozi gozd so uporabljeni:

- izolatorji A PKI z oslabiljenim telesom sponke,
- kavelj in
- varnostni lok vodnika.

Izračun in naročanje

Premier loka in dimenzije kavlja je potrebno določiti z izračunom. Za izvedbo »varne montaže skozi gozd« zahtevajte ponudbo na osnovi trasnega načrta in preseka vodnika.

Splošni podatki

- Nazivna upogibna sila (SCL): **15 kN**
- Temperaturno območje okolja $T = -60^{\circ}\text{C} \dots +85^{\circ}\text{C}$
- Plašč: **silikon LSR**
- Barva silikona: **siva**
- Material zgornjega priključka: **PA6, UV stabiliziran**
- Material jeklenih priključkov: **ST 52-3**
- Debelina nanosa cinka: $\geq 70 \mu\text{m}$

Prednosti pred konkurenco

- Sistem varne montaže z izolatorji PKI z oznako »V« odlikuje varnost zgrajenega DV.
- Varuje stojna mesta DV pred porušitvijo pri padcu dreves na vodnike.
- Sistem je rezultat strokovnih raziskav naših raziskovalcev skupaj z uporabniki in strokovnimi sodelavci instituta EIMV, Ljubljana.

4.13 A PKI safe installation through the woods generally

Product

A PKI insulators with the mark »V« are dedicated post composite insulators with silicone coating and a weakened spring clamp shuttle. Their purpose is safe installation through the woods. They are designed to be installed onto overhead power lines with rated voltages of up to 52 kV.

Characteristic

Composite post insulators have a weakened spring clamp shuttle for easier collapsing in extreme weather conditions.

Installation

The position for installing dedicated A PKI composite post insulators is determined by directives and technical regulations of electrical distributors. On power lines passing through the woods interruptions of power supply often occur due to:

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

In the worst-cases the collapse of the power line occurs. The fact is that at these collapses in most cases the conductor remains unbroken.

For this reason our company conducted a study cooperation with end-users and technical staff on safe installation of PL through the woods. The research was reinforced by a test in nature (video on www.izoelektr.com). Safe installation through the woods requires the following equipment:

- insulators A PKI with weakened spring clamp shuttle,
- hook and
- conductor safety arc.

Calculation and ordering

Conductor safety arc diameter and hook size should be determined by a calculation. To implement »safe installation through the woods« request a quotation based on power line route plan and the conductor cross-section.

General data

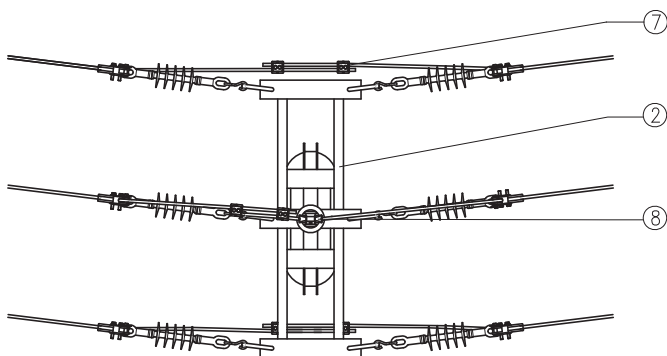
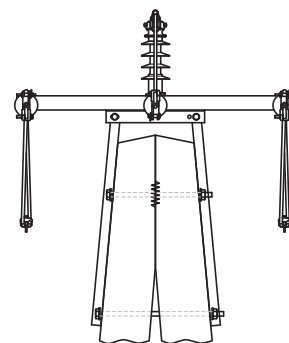
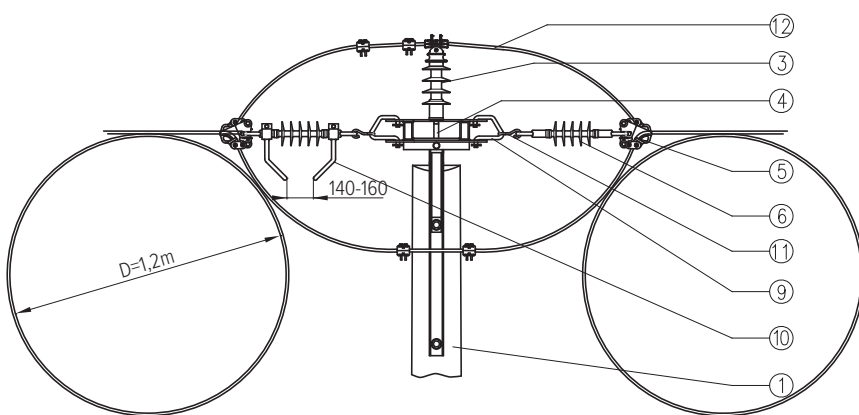
- Specified cantilever load (SCL): **15 kN**
- Ambient temperature range $T = -60^{\circ}\text{C} \dots +85^{\circ}\text{C}$
- Coating: **silicone LSR**
- Silicone colour: **grey**
- Material of top fitting: **PA6, UV stabilized**
- Material of steel end fitting: **ST 52-3**
- Zinc coat: $\geq 70 \mu\text{m}$

Competitive advantages

- The system for safe installation with the PKI insulators with the mark »V« ensures the safety of a power line.
- It protects poles from breaking when trees fall on conductors.
- The system is the result of professional research conducted by our researchers together with users and the technical staff from the EIMV Institute in Ljubljana.

4.14 A PKI varna montaža skozi gozd - primer

4.14 A PKI safe installation through the woods - example



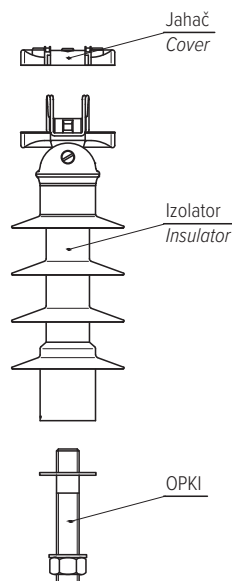
Poz	Naziv	Pos	Name	Kos/Pcs
1	Drog	1	Pole	1
2	Nosilna konzola - komplet	2	Suspension crossarm brace - set	1
3	Podporni kompozitni izolator A PKI	3	A PKI post composite insulato	1
4	Opornica OPKI	4	Pin OPKI	1
5	Sponka zatezna SZ-U	5	SZ-U tension clamp	6
6	Natezni kompozitni izolator NKI	6	NKI tension composite insulator	6
7	Sponka tokovna	7	Current clamp	3
8	Jahač	8	Cover	1
9	Streme OS 80	9	OS 80 shackle	6
10	Rogljica NKI	10	NKI arcing horn	6
11	Kljuka zasukana	11	90° hook	6

SN podporni izolatorji

MV post insulators

4.15 A PKI izolatorji garniture

Opomba: na željo kupca izdelamo garniture po zahtevi.



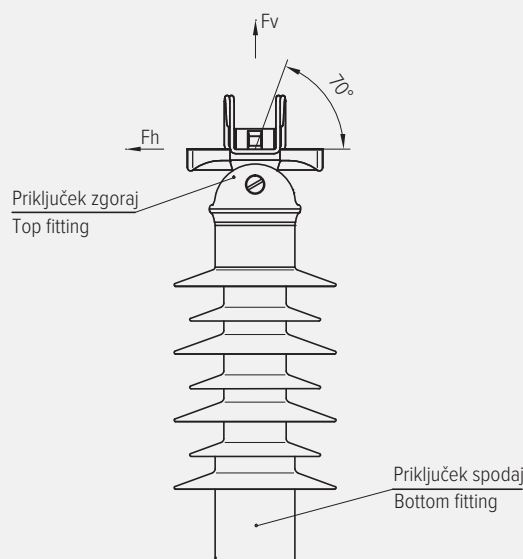
4.15 A PKI insulator sets

Note: we produce sets per customer's request.

Garnitura	Količina Quantity	Set
Izolator A PKI NS M24	1 kos/pcs	Insulator A PKI NS M24
+ Jahač 35-AIFe	1 kos/pcs	+ Cover 35-AIFe
+ OPKI M24/M24x120	1 kos/pcs	+ OPKI M24/M24x120
Izolator A PKI NS M24	1 kos/pcs	Insulator A PKI NS M24
+ Jahač 50-AIFe	1 kos/pcs	+ Cover 50-AIFe
+ OPKI M24/M24x120	1 kos/pcs	+ OPKI M24/M24x120
Izolator A PKI NS M24	1 kos/pcs	Insulator A PKI NS M24
+ Jahač 70-AIFe	1 kos/pcs	+ Cover 70-AIFe
+ OPKI M24/M24x120	1 kos/pcs	+ OPKI M24/M24x120

4.16 A PKI izolatorji - primer naročila

4.16 A PKI insulators - order example



Naziv/Name: PKI LS M24

Razlaga naziva

A PKI, PKI - Tip SN kompozitnega izolatorja
N, L, X - Plazilna pot
S, O, H, D, Z, M, G, B - Oblika priključka zgoraj
M24, M20 - Navoj priključka spodaj

Name explanation

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

Oznake na kompozitnem izolatorju

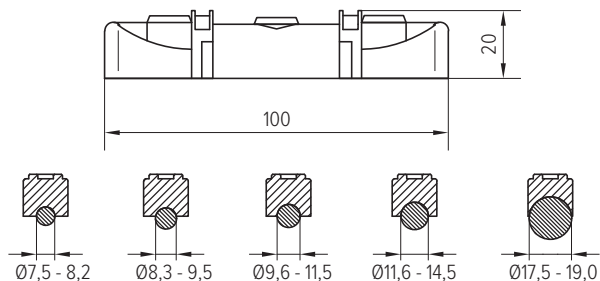
Izoelektro - Proizvajalec
A PKI - Tip SN kompozitnega izolatorja
4/17 - Mesec / leto proizvodnje
15 kN - Nazivna upogibna sila (STL)

Marks on composite insulator

Izoelektro - Manufacturer
A PKI - Type of MV composite insulator
4/17 - Month / year of production
15 kN - Specified tensile load (STL)

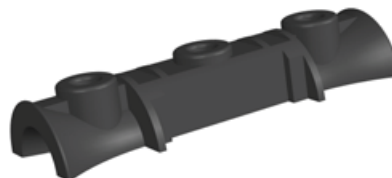
4.17 PA jahači

Uporaba: obvezno vgraditi pri A PKI in PKI izolatorjih
"S", "Z" in "M"



4.17 PA covers

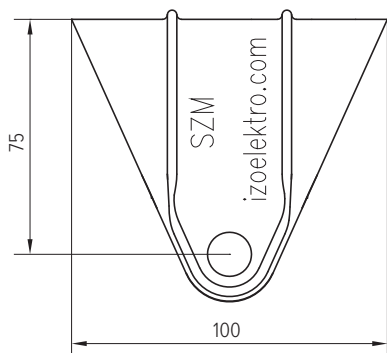
Usage: required to install the "S", "Z" and "M" A PKI and PKI insulators



Ø vodnika Ø of Conductor	Koda Code	Naziv PA jahač	Name PA cover
7,5 - 8,2	11 12 09	35 AlFe	35 AlFe
8,3 - 9,5	11 12 10	50 AlFe	50 AlFe
9,6 - 11,5	11 12 08	70 AlFe in 35 PIV	70 AlFe and 35 CC
11,6 - 14,5	11 12 11	95 AlFe in 70 PIV	95 AlFe and 70 CC
17,5 - 19,0	11 12 12	120 AlFe in 99 PIV	120 AlFe and 99 CC

4.18 PA kapa SZM/0

Uporaba: nadgradnja za A PKI in PKI izolatorje "S"
Koda: 40 10 29



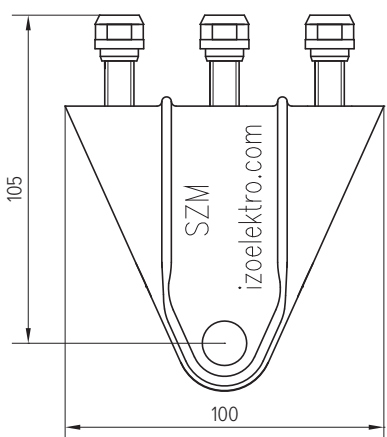
4.18 PA cap SZM/0

Usage: an upgrade for the "S" A PKI and PKI insulators
Code: 40 10 29



4.19 PA kapa SZM/3

Uporaba: pri montaži A PKI in PKI izolatorjev na strmini
Koda: 40 10 31



4.19 PA cap SZM/3

Usage: during the installation of A PKI and PKI insulators
on a slope
Code: 40 10 31

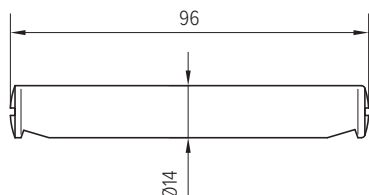


SN podporni izolatorji

MV post insulators

4.20 PA sornik

Uporaba: pri zamenjavi PA telesa vzmetne sponke v zgornjem priključku A PKI in PKI izolatorjev
Koda: **40 10 32**



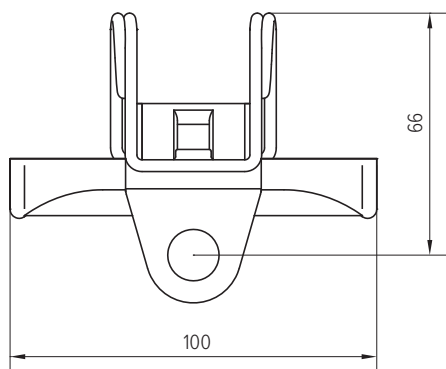
4.20 PA bolt

Usage: during the replacement of the PA clamp in the top fitting of A PKI and PKI insulators
Code: **40 10 32**



4.21 PA telo sponke z vzmetjo

Uporaba: v zgornjem priključku A PKI in PKI izolatorjev "S", "Z" in "M"
Koda: **11 10 01**



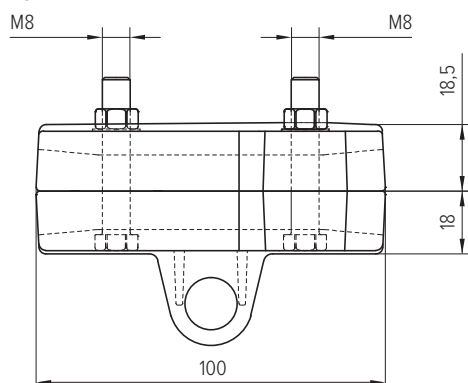
4.21 PA body with spring clamp

Usage: in top fittings of "S", "Z" and "M" A PKI and PKI insulators
Code: **11 10 01**



4.22 PA sponka vijajna

Uporaba: v zgornjem priključku A PKI izolatorja »G«
Premer vodnika: Ø 14 - 22
Koda: **11 11 02**



4.22 PA screw clamp

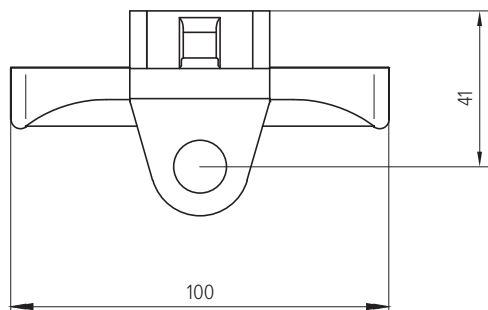
Usage: in top fitting of A PKI insulator »G«
Conductor diameter: Ø 14 - 22
Code: **11 11 02**



4.23 PA telo sponke vzmetne

Uporaba: v zgornjem priključku A PKI in PKI izolatorjev
"S", "Z" in "M"

Koda: 11 10 01



4.23 PA body of spring clamp

Usage: in top fittings of "S", "Z" and "M" A PKI and PKI insulators

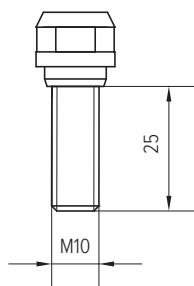
Code: 11 10 01



4.24 PA vijak

Uporaba: pri kapi SZM/3

Koda: 40 10 38



4.24 PA screw

Usage: with the SZM/3 cap

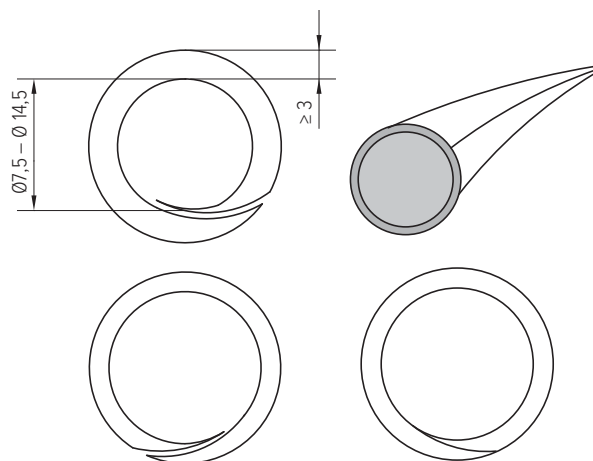
Code: 40 10 38



4.25 SN silikonski plašč SILP

Uporaba: pri zaščiti za divje živali

Koda: 40 10 34



4.25 MV silicone coat SILP

Usage: for wildlife protection set

Code: 40 10 34



Pred montažo / before installation

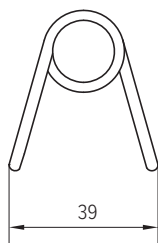
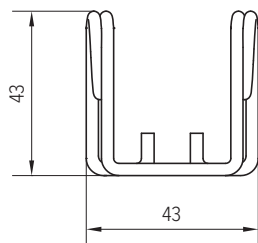
Po montaži / after installation

SN podporni izolatorji

MV post insulators

4.26 SN vzmet

Uporaba: pri PA telesa sponke vzmetne
Koda: **12 10 01**



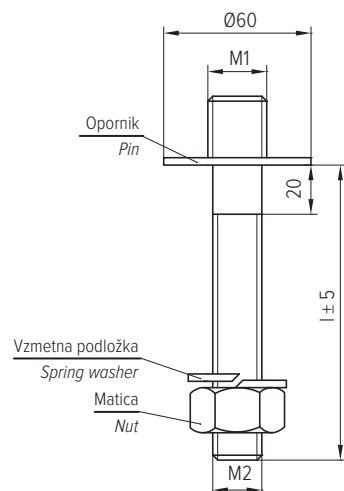
4.26 MV spring

Usage: with the PA spring clamp body
Code: **12 10 01**



4.27 OPKI oporniki

Uporaba: za pritrditev A PKI in PKI izolatorja na konzolo
Opomba: obliko in dimenzije izdelamo na zahtevo kupca



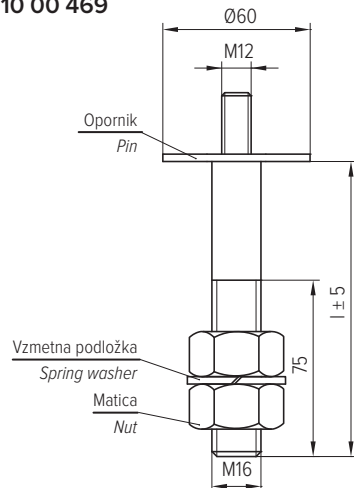
4.27 OPKI pins

Usage: for installing A PKI and PKI insulators onto the bracket
Note: the shape and dimensions can be produced per customer's request

Naziv Name	Koda Code	M1	M2	I (mm)
OPKI M20/M20x140	10 00 461	20	20	140
OPKI M20/M20x170	10 00 462	20	20	170
OPKI M24/M20x170	10 00 467	24	20	170
OPKI M24/M24x80	10 00 459	24	24	80
OPKI M24/M24x140	10 00 479	24	24	140
OPKI M24/M24x170	10 00 464	24	24	170

4.28 OPKIL opornik za ločilnik

Uporaba: za zamenjavo keramičnih izolatorjev s PKIL izolatorji na ločilnih stikalih
Koda: **10 00 469**



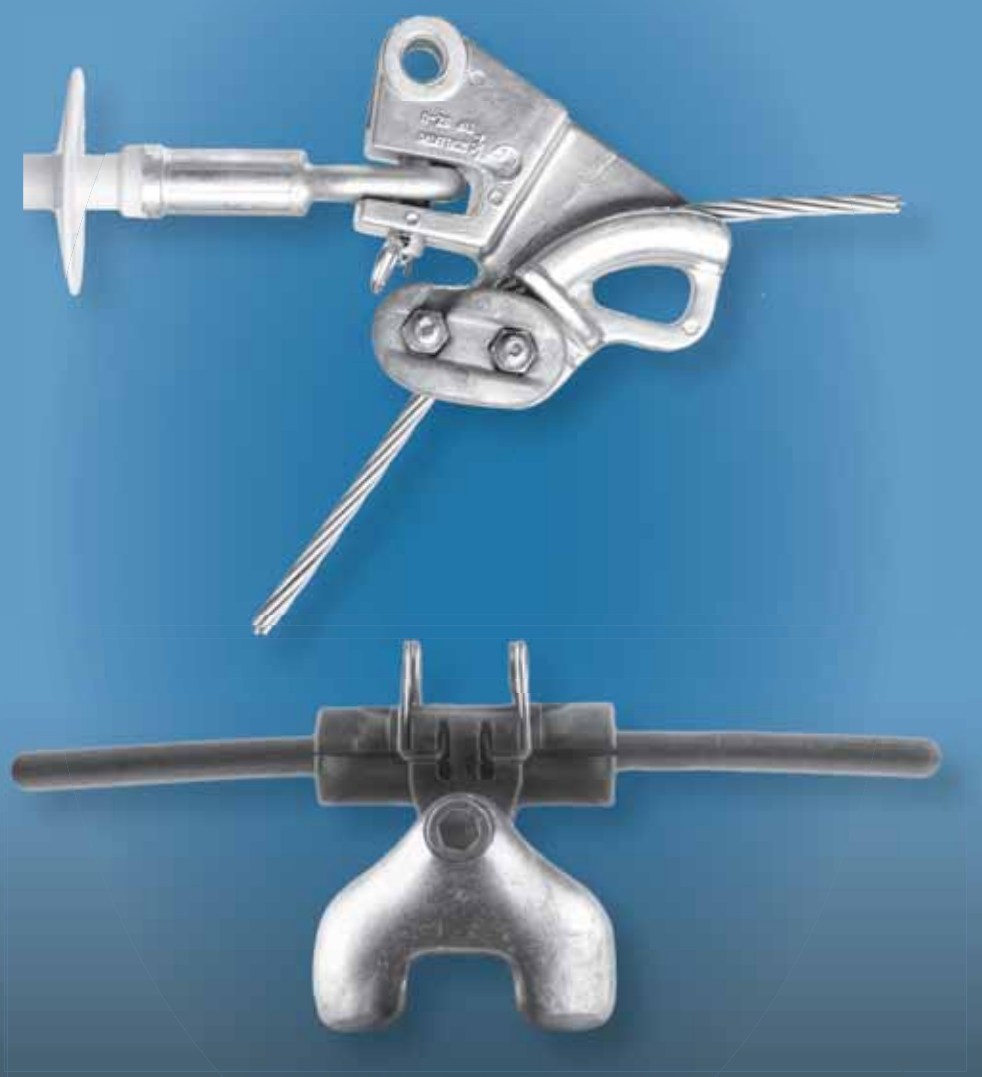
4.28 OPKIL pin for switch disconnecter

Usage: for the replacement of ceramic insulators with PKIL insulators on disconnecting switches
Code: **10 00 469**

Notes

DV pribor
PL accessories

5



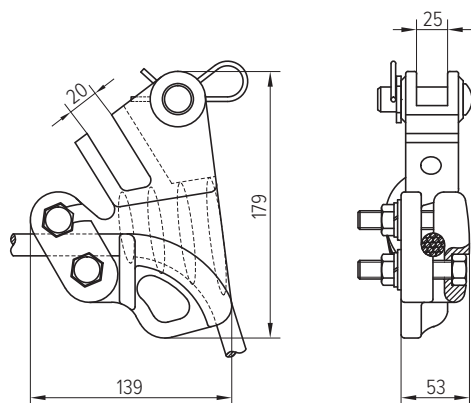
IZOELEKTRO

5.1 SZ-U sponka zatezna univerzalna

Minimalna prelomna sila: 60 kN
 Moment zategnitve vijaka: 45 Nm
 Premer vodnika AlFe: 6,8-14,0 mm
 Material: Al legura, vroče cinkano jeklo
 Koda: **80 60 03**

5.1 SZ-U universal tension clamp

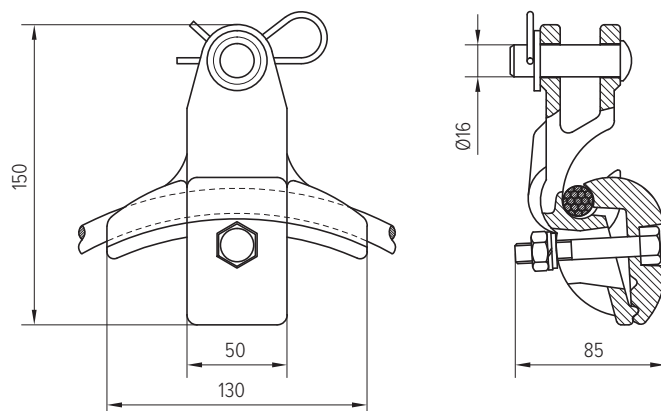
Minimum breaking load: 60 kN
 Tightening torque for screw: 45 Nm
 Conductor diameter AlFe: 6,8-14,0 mm
 Material: Al alloy, hot dip galvanized steel
 Code: **80 60 03**

**5.2 SN-U sponka nosilna univerzalna**

Minimalna prelomna sila: 60 kN
 Moment zategnitve vijaka: 45 Nm
 Premer vodnika AlFe: 6,8-14,0 mm
 Material: Al legura, vroče cinkano jeklo
 Koda: **80 60 04**

5.2 SN-U universal suspension clamp

Minimum breaking load: 60 kN
 Tightening torque for screw: 45 Nm
 Conductor diameter AlFe: 6,8-14,0 mm
 Material: Al alloy, hot dip galvanized steel
 Code: **80 60 04**



5.3 VS sponka vzmetna

Uporaba: za pritrdjevanje vodnikov premera 6,8-18,8 mm za karamične izolatorje.

Sponka VS 20: VHD 20, LPI N, SER-b 20

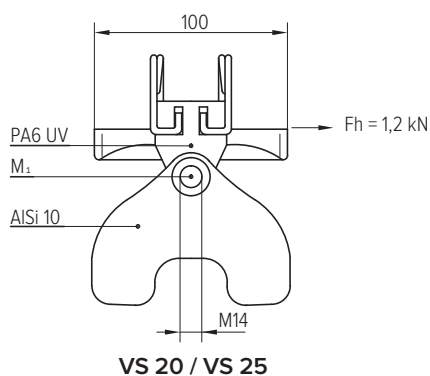
Sponka VS 25: VHD 25, LPI L, SER-b 25

Orodje: imbus 14 mm

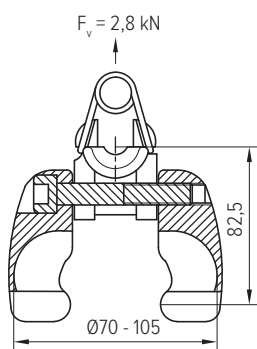
Moment M: 25 Nm

Koda VS 20: 10 10 01

Koda VS 25: 10 10 02



VS 20 / VS 25



VS 20



5.3 VS spring clamp

Usage: for installing conductors with diameter 6,8-18,8 mm for ceramic insulators.

Clamp VS 20: VHD 20, LPI N, SER-b 20

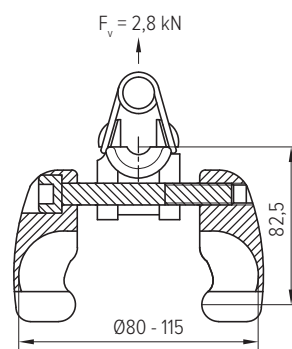
Clamp VS 25: VHD 25, LPI L, SER-b 25

Tool: allen key 14 mm

Torque M: 25 Nm

Code VS 20: 10 10 01

Code VS 25: 10 10 02



VS 25

Opomba: obvezen nastavek PA jahač (poglavje 4.17)

Note: required accessory PA cover (chapter 4.17)

5.4 VSV sponka vijajčna

VSV 20 sponka vzmetna, Koda: **10 10 08**

VSV 25 sponka vzmetna, Koda: **10 10 09**

Premer vodnika: **14-22 mm**

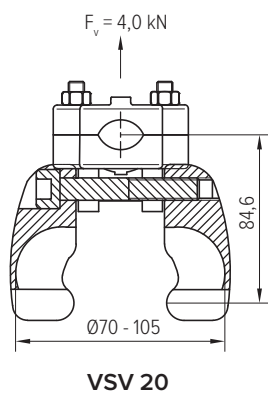
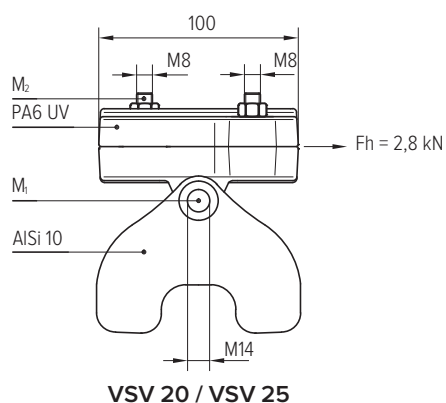
$M_1 = 25 \text{ Nm}$ za vijak M14

$M_2 = 8 \text{ Nm}$ za vijak M8

$M_2 = 6 \text{ Nm}$ za vijak M8 pri montaži SILP (zaščita za živali)

Uporaba za karamične izolatorje:

VHD 20, VHD 25, LPI N, LPI L



5.4 VSV screw clamp

VSV 20 spring clamp, Code: **10 10 08**

VSV 25 spring clamp, Code: **10 10 09**

Conductor diameter: **14-22 mm**

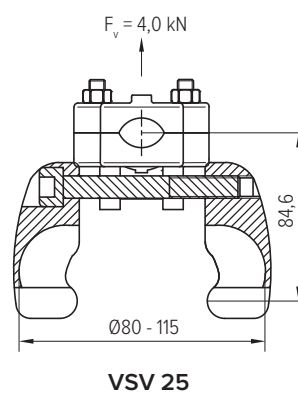
$M_1 = 25 \text{ Nm}$ for screw M14

$M_2 = 8 \text{ Nm}$ for screw M8

$M_2 = 6 \text{ Nm}$ for screw M8 when mounting SILP (wildlife)

Usage for ceramic insulators:

VHD 20, VHD 25, LPI N, LPI L



5.5 DSI S distančnik izolacijski z vzmetno sponko

Izvedba: z vzmetno sponko

l (mm): 0400 - 4100

Koda: **24 xxxx ***

* xxxx = dolžina (l) v mm

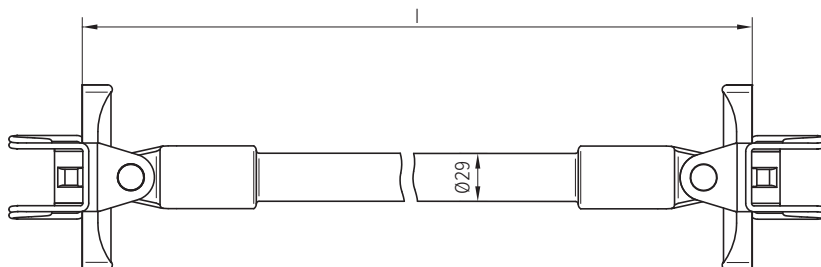
5.5 DSI S insulating spacer with a spring clamp

Version: with spring clamp

l (mm): 0400 - 4100

Code: **24 xxxx ***

* xxxx = length (l) in mm



5.6 DSI M distančnik izolacijski z vijčno sponko

Izvedba: z vijčno sponko

l (mm): 0400 - 4100

Koda: **25 xxxx ***

* xxxx = dolžina (l) v mm

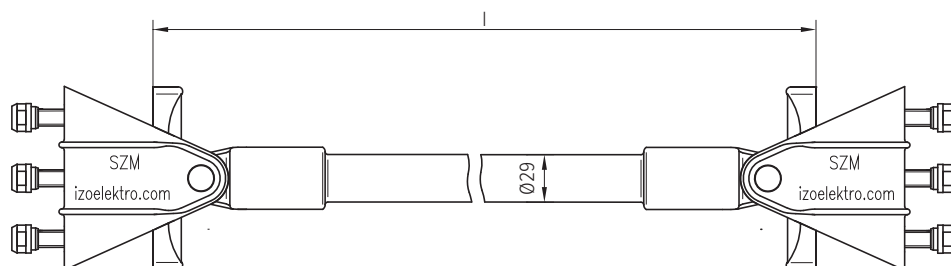
5.6 DSI M insulating spacer with a screw clamp

Version: with screw clamp

l (mm): 0400 - 4100

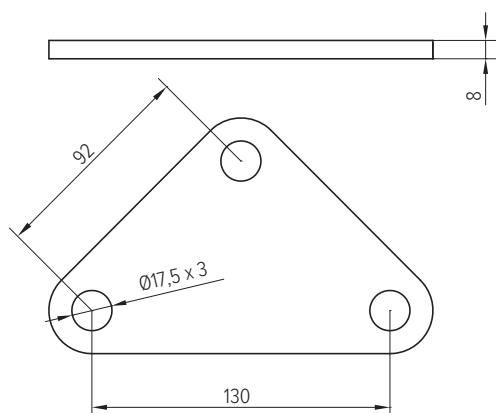
Code: **25 xxxx ***

* xxxx = length (l) in mm



5.7 Distančnik jeklen

Minimalna prelomna sila: 90 kN
Koda: 43 29 407



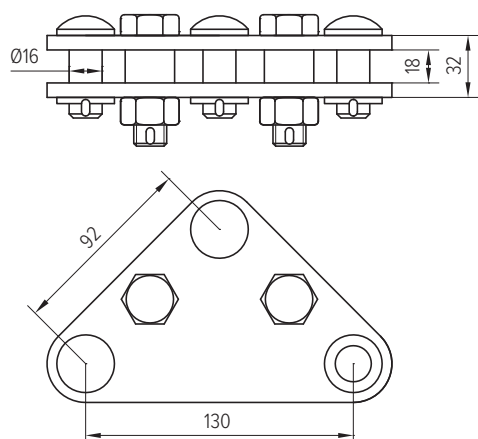
5.7 Steel yoke

Minimum breaking load: 90 kN
Code: 43 29 407



5.8 Distančnik jeklen dvojni

Minimalna prelomna sila: 90 kN
Koda: 43 29 408



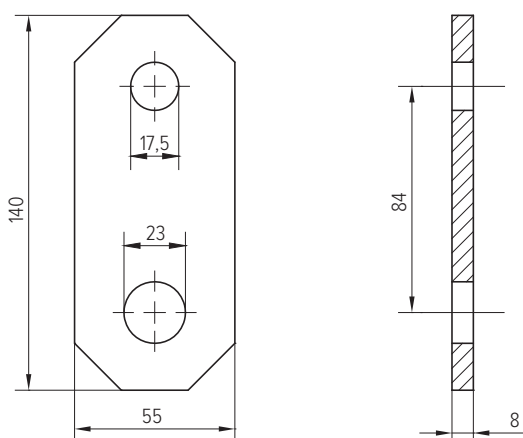
5.8 Steel yoke double

Minimum breaking load: 90 kN
Code: 43 29 408



5.9 Podaljšek jeklen

Minimalna prelomna sila: 90 kN
Koda: 80 60 30



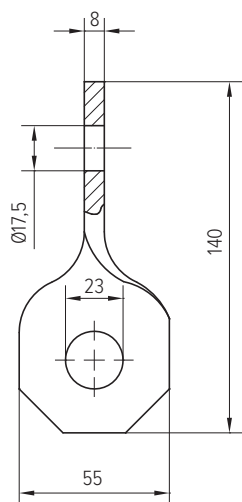
5.9 Steel extension link

Minimum breaking load: 90 kN
Code: 80 60 30



5.10 Podaljšek jeklen 90°

Minimalna prelomna sila: 90 kN
Koda: 80 60 31



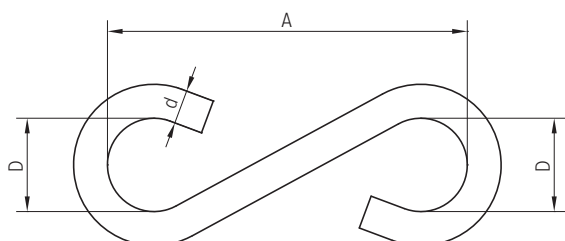
5.10 Steel extension link 90°

Minimum breaking load: 90 kN
Code: 80 60 31



5.11 S - kavelj

Naziv: S - kavelj 4 kN, dimenzije (mm) A=85, D=22, d=8
Naziv: S - kavelj 6 kN, dimenzije (mm) A=80, D=22, d=10



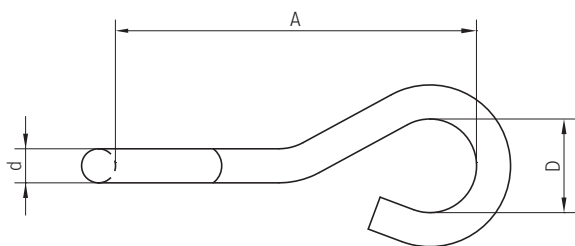
5.11 S - hook

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



5.12 S - kavelj 90°

Naziv: S - kavelj 90° 4 kN, dimenzije (mm) A=85, D=22, d=8
Naziv: S - kavelj 90° 6 kN, dimenzije (mm) A=80, D=22, d=10



5.12 S - hook 90°

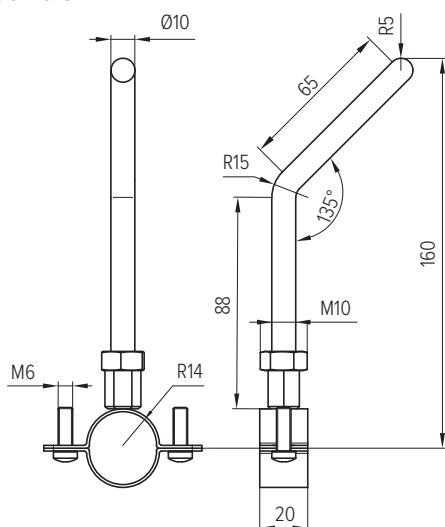
Name: S - hook 90° 4 kN, dimension (mm) A=85, D=22, d=8
Name: S - hook 90° 6 kN, dimension (mm) A=80, D=22, d=10



5.13 Rogljič NKI

Moment M6: 16 Nm

Koda: 80 70 54



5.13 Arcing horn NKI

Torque M6: 16 Nm

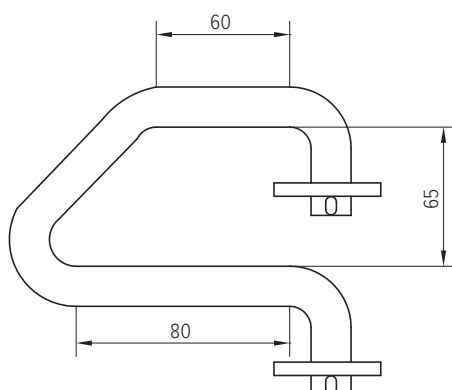
Code: 80 70 54



5.14 G streme OS 65

Minimalna prelomna sila: 90 kN

Koda: 20 150



5.14 G shackle OS 65

Minimum breaking load: 90 kN

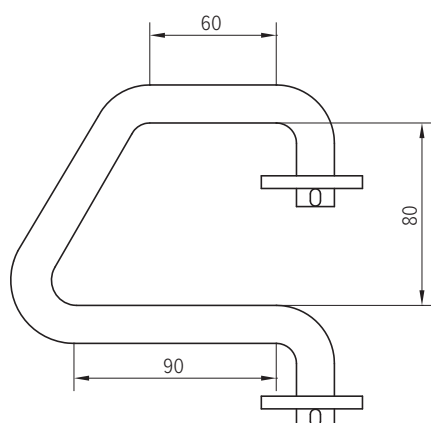
Code: 20 150



5.15 G streme OS 80

Minimalna prelomna sila: 90 kN

Koda: 20 151



5.15 G shackle OS 80

Minimum breaking load: 90 kN

Code: 20 151



5.16 Vijak ozemljitveni

Naziv: Vijak ozemljitveni – rumen; koda: **70 76 01**

Naziv: Vijak ozemljitveni – črn; koda: **70 76 02**

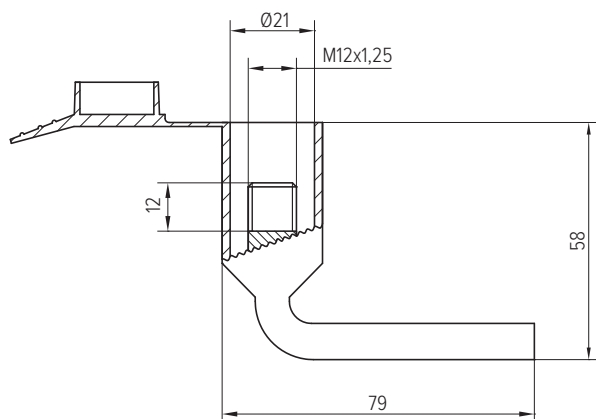
Material: CuZn28, PA6

Moment M12: 8 Nm

Naziv: Vijak ozemljitveni – rumen Cu; koda: **70 76 03**

Naziv: Vijak ozemljitveni – črn Cu; koda: **70 76 04**

Material: Cu, PA6



5.16 Earthing screw

Name: Earthing screw – yellow; code: **70 76 01**

Name: Earthing screw – black; code: **70 76 02**

Material: CuZn28, PA6

Torque M12: 8 Nm

Name: Earthing screw – yellow Cu; code: **70 76 03**

Name: Earthing screw – black Cu; code: **70 76 04**

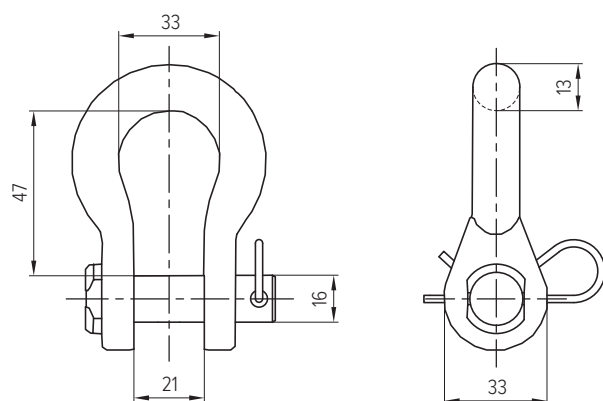
Material: Cu, PA6



5.17 Škopec

Minimalna prelomna sila: 80 kN

Koda: **27 08 10**



5.17 Anchor shackle

Minimum breaking load: 80 kN

Code: **27 08 10**



Beleške

Notes

SN koncentrični material *MV connecting sleeves*

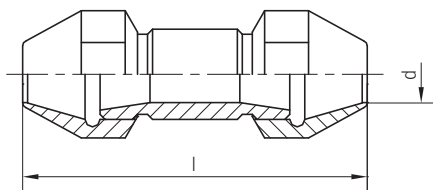
6



IZOELEKTRO

6.1 R sponka ravna z dvojnimi konusom

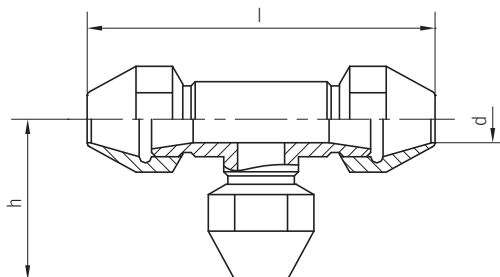
6.1 R double conical flat clamp



Premer vodnika (mm) Conductor diameter (mm)	Koda Code	Tip Type	d (mm)	l (mm)	Ključ (mm) Wrench (mm)
7 - 10	42 40 00	R10	11,3	70	22
7 - 13	42 40 01	R13	14,2	88	27
10 - 16	42 40 02	R16	16,6	102	32
16 - 20	42 40 03	R20	20,5	120	41

6.2 T sponka odcepna z dvojnimi konusom

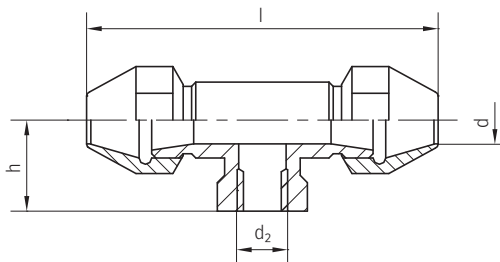
6.2 T double conical branch clamp



Premer vodnika (mm) Conductor diameter (mm)	Koda Code	Tip Type	h (mm)	d (mm)	l (mm)	Ključ (mm) Wrench (mm)
7 - 10	42 41 00	T10	41	11,3	82	22
7 - 13	42 41 01	T13	47	14,2	93	27
10 - 16	42 41 02	T16	60	16,6	118	32
16 - 20	42 41 03	T20	69	20,5	137	41

6.3 Td sponka odcepna s konusom

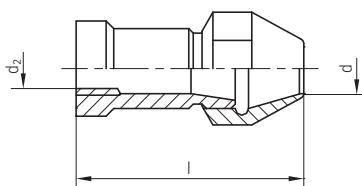
6.3 Td conical branch clamp



Premer vodnika (mm) Conductor diameter (mm)	Koda Code	Tip Type	h (mm)	d (mm)	d ₂ (mm)	l (mm)	Ključ (mm) Wrench (mm)
7 - 10	42 43 00	Td10	25	11,3	M12	85	22
7 - 13	42 43 01	Td13	25	14,2	M16	95	27
10 - 16	42 43 02	Td16	30	16,6	M20	121	32
16 - 20	42 43 03	Td20	30	20,5	M24	140	41

6.4 Rp priključek ravni

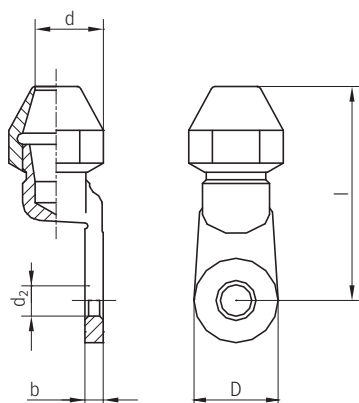
6.4 Rp flat fitting



Premjer vodnika (mm)	Koda	Tip	h	d	d ₂	l	Ključ (mm)
Conductor diameter (mm)	Code	Type	(mm)	(mm)	(mm)	(mm)	Wrench (mm)
7 - 10	42 42 00	Rp10	55	11,3	M12	22	22
7 - 13	42 42 01	Rp13	64	14,2	M16	27	27
10 - 16	42 42 02	Rp16	74	16,6	M20	32	32
16 - 20	42 42 03	Rp20	80	20,5	M24	41	41

6.5 P priključek ploščat

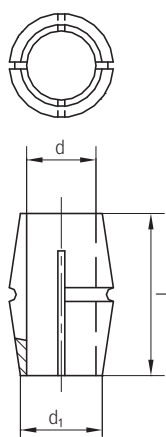
6.5 P plane fitting



Premjer vodnika (mm)	Koda	Tip	D	d	d ₂	l	b	Ključ (mm)
Conductor diameter (mm)	Code	Type	(mm)	(mm)	(mm)	(mm)	(mm)	Wrench (mm)
7 - 10	42 44 00	P10	30	11,3	13	55	6	22
7 - 13	42 44 01	P13	33	14,2	17	64	7	27
10 - 16	42 44 02	P16	36	16,6	21	74	9	32
16 - ø20	42 44 03	P20	39	20,5	25	80	12	41

6.6 V konus

6.6 V cone



Premjer vodnika (mm)	Koda	Tip	d	l	d ₁
Conductor diameter (mm)	Code	Type	(mm)	(mm)	(mm)
7 - 10	42 54 01	V1007	7	23,5	11,8
7 - 10	42 54 02	V1008	8	23,5	11,8
7 - 10	42 54 03	V1009	10	23,5	11,8
7 - 13	42 55 01	V1307	7	26	15,1
7 - 13	42 55 02	V1308	8	26	15,1
7 - 13	42 55 04	V1310	10	26	15,1
7 - 13	42 55 06	V1312	12	26	15,1
7 - 13	42 55 07	V1313	13	26	15,1
10 - 16	42 56 01	V1610	10	34	18
10 - 16	42 56 04	V1613	13	34	18
10 - 16	42 56 05	V1614	14	34	18
10 - 16	42 56 07	V1616	16	34	18
10 - 16	42 56 07	V1616	16	34	18

Notes

[illegible][illegible]

VN laboratorij *HV laboratory*

7



IZOELEKTRO

7.1 Splošno

Obratovanje

V podjetju imamo laboratorij, opremljen z napravami za opravljanje električnih in mehanskih meritev. V glavnem je namenjen lastnim potrebam za izvajanje preskusov od razvoja do validacije izdelka. Vršimo tudi usluge za podjetja, raziskovalne institucije in izobraževalne ustanove. Na osnovi dobljenih rezultatov naši strokovnjaki izdajajo preskusna poročila in strokovna mnenja. Natančnost meritev in verodostojnost podatkov zagotavljamo z rednim umerjanjem instrumentov s strani pooblaščenih institucij.

**Področje dela**

Laboratorij je namenjen preskušanju SN prenapetostnih odvodnikov in izolatorjev do 60 kV obratovalne napetosti. Pri prenapetostnih odvodnikih se meritve izvajajo na blokih do 6 kV. Uporabljajo se močni tokovni impulzi različnih oblik, kakor jih določata standarda IEC 60099-4 in IEC 61643.

Preskusi izolatorjev se izvajajo z izmenično napetostjo do višine 220 kV in z udarno napetostjo oblike vala 1,2/50 μ s do višine 500 kV.

7.2 Tehnične zmogljivosti

Generator izmenične napetosti

Maksimalna amplituda trajne izmenične napetosti: 220 kV

Z generatorjem tvorimo trajno izmenično napetost, ki se pri izolatorjih uporablja za določanje zdržne napetosti v mokrem v skladu s standardi IEC 61109, IEC 61952 in IEC 60383. Pri odvodnikih prenapetosti generator izmenične napetosti uporabljamo za meritve referenčne napetosti v skladu s standardi IEC 60099-4 in IEC 61643. Uporabljamo ga tudi za meritve ohmske komponente uhajavega toka odvodnikov prenapetosti.

Napetostni udarni generator

Maksimalna amplituda udarne napetosti 1,2/50 μ s: 500 kV S tem generatorjem tvorimo atmosfersko udarno napetost, ki služi za preskušanje izolatorjev v skladu s standardi IEC 61109, IEC 61952, IEC 60383 in preskušanje odvodnikov prenapetosti v skladu s standardom IEC 60099-4.

Tokovni udarni generator

Maksimalna amplituda udarnega toka:

- 10/350 μ s 50 kA
- 8/20 μ s 50 kA
- 4/10 μ s 100 kA
- 2 ms 1000 A

7.1 Generally

Operation

In the company, we have a laboratory equipped with devices for performing electrical and mechanical measurements. We use the laboratory mostly for our own needs to perform various tests from the early phase of development to the final validation of a product. We also perform services for other companies, research institutes, and educational institutions. Based on results they get, our experts issue test reports and expert opinions. We verify that our measurements are accurate and data credible with regular calibrations of instruments from an authorized institution.

Fields of application

The laboratory is designed for testing MV surge arresters and insulators of operating voltage up to 60 kV. Surge arresters are tested on the blocks up to 6 kV. High current pulses of different shapes are used for testing, as defined by the IEC 60099-4 and IEC 61643 standards.

Insulators are tested using power frequency voltage of up to 220 kV and the lightning impulse voltage with wave shape of 1,2/50 μ s and up to 500 kV.

7.2 Technical capabilities

Power frequency voltage generator

Peak value of the power-frequency voltage: 220 kV

The generator produces a continuous power frequency voltage which is used to define the insulator wet power frequency withstand voltage in accordance with the IEC 61109, IEC 61952 and IEC 60383 standards. The same generator is used to define the reference voltage of surge arresters in accordance with IEC 60099-4 and IEC 61643. It is also used to measure the leakage current resistive component of surge arresters.

Lightning impulse voltage generator

Peak value of lightning impulse 1,2/50 μ s: 500 kV With this generator, a lightning impulse voltage can be generated to test the insulators in accordance with the IEC 61109, IEC 61952 and IEC 60383 standards and to test surge arresters in accordance with the IEC 60099-4 standard.

Lightning current impulse generator

Peak value of the lightning impulse current:

- 10/350 μ s 50 kA
- 8/20 μ s 50 kA
- 4/10 μ s 100 kA
- 2 ms 1000 A

Oblike udarnih tokov

Standardne:

- 4/10 μ s
- 8/20 μ s
- 10/350 μ s
- dolgega vala 1 ms
- dolgega vala 2 ms

Nestandardne:

- od 4/10 do 30/60 μ s
- od 250 do 2000 μ s

Generator uporabljamo za delovne preskuse v skladu s standardoma IEC 60099-4 in IEC 61643.

Digitalna naprava za merjene parcialnih praznitev

Napravo uporabljamo za merjenje parcialnih praznitev na odvodnikih prenapetosti in izolatorjih z izmenično napetostjo do 100 kV in natančnostjo 0,1 pC v skladu s standardom IEC 60270.

7.3 Preizkusni protokoli**NN odvodniki prenapetosti**

Standard IEC 61643-1

- Meritve preostale napetosti z impulznim tokom 8/20 μ s
- Delovni preskus
- Preskus termične stabilnosti
- Dielektrična vzdržnost

SN odvodniki prenapetosti

Standard IEC 60099-4

- Preskus vzdržnosti izolacije ohišja odvodnika
- Preskusi preostale napetosti
- Preskus z udarnim tokom dolgega vala
- Delovni preskus
- Preskus pospešenega staranja
- Rutinski preizkus

Standard IEC 60099-5

- Meritev ohmske komponente uhajavega toka

Natezni kompozitni izolatorji

Standard IEC 61109

- Vzdržna atm. udarna napetost v suhem
- Vzdržna izmenična napetost v mokrem
- Mehanski preskusi

Podporni kompozitni izolatorji

Standard IEC 61952

- Vzdržna atm. udarna napetost v suhem
- Vzdržna izmenična napetost v mokrem
- Mehanski preskusi
- Meritev penetracije po standardu za palice
- Meritev debeline nanosa cinka

Current impulses generated

Standard:

- 4/10 μ s
- 8/20 μ s
- 10/350 μ s
- long duration current 1 ms
- long duration current 2 ms

Nonstandard:

- from 4/10 μ s to 30/60 μ s
- from 250 μ s to 2000 μ s

The generator is used for operating duty tests in accordance with IEC 60099-4 and IEC 61643 standards.

Digital partial discharge tester for measuring partial discharges

Digital PD tester is used for measure partial discharges on surge arresters and insulators with alternating voltage of up to 100 kV and sensitivity of 0,1 pC in accordance with IEC 60270 standard.

7.3 Test protocols**LV surge arresters**

Standard IEC 61643-1

- Measuring residual voltage with 8/20 μ s current impulses
- Operating duty test
- Test of thermal stability of SPDs
- Dielectric withstand

MV surge arresters

Standard IEC 60099-4

- Insulation withstand test on arrester housing
- Residual voltage tests
- Long-duration current impulse withstand test
- Operating duty test
- Accelerated ageing test
- Routine testing

IEC 60099-5 standard

- Measurement of the resistive leakage current

**Tension composite insulators**

IEC 61109 standard

- Dry lightning impulse withstand voltage test
- Wet power frequency voltage test
- Mechanical load-time tests

**Line post composite insulators**

Standard IEC 61952

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

Beleške

Notes

IZOELEKTRO

Naziv podjetja	Izoelektro, proizvodnja in trgovina d.o.o.	Name of company
Skrajšan naziv	Izoelektro d.o.o.	Short name
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Pravnoorganizacijska oblika	Družba z omejeno odgovornostjo / Limited liability company	Legal form
Matična številka	1366009	Registration number
Davčna številka	SI 56506635	VAT number
TRR	SI56 0451 5000 0204 790	IBAN
	Nova KBM d.d., Maribor	
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