streamer electric

LINE LIGHTNING PROTECTION DEVICES

LINE LIGHTNING PROTECTION UP TO 69 KV

CATALOGUE 2024

TABLE OF CONTENTS

GLOSSARY

LLPD
Line Lightning Protection Devices

BIL
Basic Insulation Level

UV
Ultraviolet

MOA/SA/TLA
Metal-Oxide Arrester

A surge arrester utilizing varistor elements fabricated from nonlinear resistance metal-oxide materials

DLS
Direct Lightning Strike

Lightning striking a component of the network such as the conductor, tower or substation equipment

FTR
Footing Resistance

The resistance offered by the metal parts of a tower and the ground resistance

IEC
International Electrotechnical Commission

The world's leading organization that prepares and publishes international standards for all electrical, electronic and related technologies

BFO
Back Flashover

A flashover of phase-to-earth insulation resulting from a lightning strike to that part of the system which is normally at earth potential

IOV
Induced Overvoltage

An overvoltage in the network that is induced by a lightning strike that does not strike directly at any part of the network

PMT
Pole-Mounted Transformer

A distribution transformer that provides the final voltage transformation in the electric power distribution system, stepping down the voltage used in the distribution lines to the level used by the customer, and is located on the pole of an overhead line

MPFC
Maximum Prospective Fault Current

The highest electric current which can exist in a particular electrical system under short-circuit conditions without any protective or current-limiting devices. It is determined by power, voltage and impedance of the supply system

ICON LEGENDS:

Highest voltage for equipment, kV

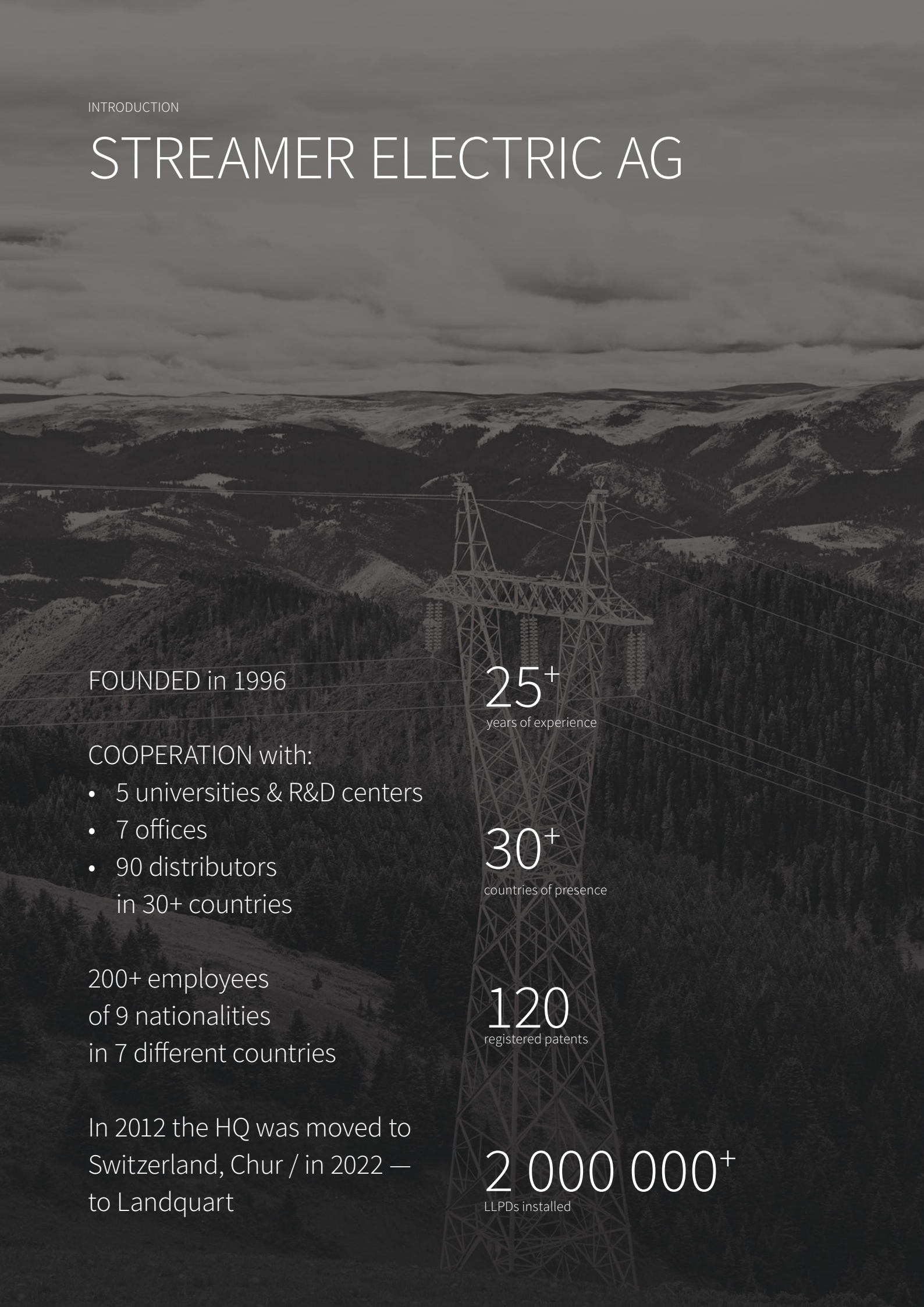
Protects from Back Flashover

No maintenance is required

Protects from Direct Lightning Strike

Protects from Induced Overvoltage

STREAMER ELECTRIC AG



FOUNDED in 1996

COOPERATION with:
- 5 universities & R&D centers
- 7 offices
- 90 distributors in 30+ countries

200+ employees
of 9 nationalities
in 7 different countries

In 2012 the HQ was moved to Switzerland, Chur / in 2022 — to Landquart

25+
years of experience

30+
countries of presence

120
registered patents

2 000 000+
LLPDs installed

PRODUCT RANGE

LLPD
Line Lightning Protection Devices

A unique lightning protection solution for overhead lines: Line Lightning Protection Devices (LLPDs) with EasyQuench (EQ) technology have been invented and patented by Streamer.

More than 2 million LLPDs have been installed worldwide (China, Indonesia, Malaysia, Brazil, UAE, Iran, Vietnam, Switzerland, Germany and other).

TRANSEC
Moisture monitoring and extraction for power transformers

Moisture is one of the primary causes of failures for power transformers and one of the main degradation factors for the insulation paper. It, therefore, increases the risks of operation failures and shortens the life expectancy of the asset.

After several year of service operations, moisture can appear in a transformer from several sources which are external or internal and it has a complex dynamic between the oil and paper within the transformer. Also it is difficult to evaluate the moisture situation of a transformer without a thorough monitoring.

TRANSEC offers an efficient solution for both moisture monitoring and extraction which is online and does not require any operator.

FIPRES
Electrical Fire Prevention & Overheating Control system

FIPRES detects abnormal overheating of electrical equipment, allowing to avoid fire and related to it material damage, profit loss and life threats.

In a nutshell, the system consists of thermolabels (rFPT), a special gas sensor (FPA), and a concentrator unit (FPC).

rFPT is a sticker made of composite material with encapsulated gas inside. These stickers are glued at the contact connections (CB inputs/outputs, bus-bars, cable terminations, etc.). Since the contact is heated up to the activation temperature of the sticker, rFPT releases safe and non-toxic signal gas. This gas is detected by FPA, which in turn sends ALARM signal to maintenance personnel through Modbus, dry contact relay, or via SMS in case of using with FPC.

FIPRES offers a new and unique solution at an affordable price that takes utility and industrial companies to a new level of safety and maintenance efficiency.

TYPE TESTS

PRODUCTS ARE TESTED IN THE LEADING AND MOST RECOGNIZED HIGH VOLTAGE LABORATORIES WORLDWIDE:

CESI (Italy)

STRI (Sweden)

CPRI (India)

CEPRI (China)

CUSTOMER LIST

Indonesia
- Perusahaan Listrik Negara
- VALE
- Pertamina
- Medco Energy (Indonesia)

Vietnam
- VietNam Electricity

Malaysia
- Tenaga Nasional Berhad

Philippines
- Dagupan Electric
- NGCP

China
- China Railway First Group co
- China Southern Power Grid
- State Grid Corporation of China
- Zhinu spring phase 4 wind power
- Electric power branch d plant

Brazil
- Celesc
- CPFL Energia
- Rio Grande Energia

Colombia
- EPM
- Mineros

Peru
- Electrosur

Jamaica
- JPSCo

Botswana
- Botswana Power Corporation

South Africa
- AngloAmerican
- Seriti (south Africa)

Saudi Arabia
- Saudi Aramco

Switzerland
- BKW
- Groupe E
- Repower

Germany
- Westnetz

Ecuador
- EERSA

New Zealand
- Electronet

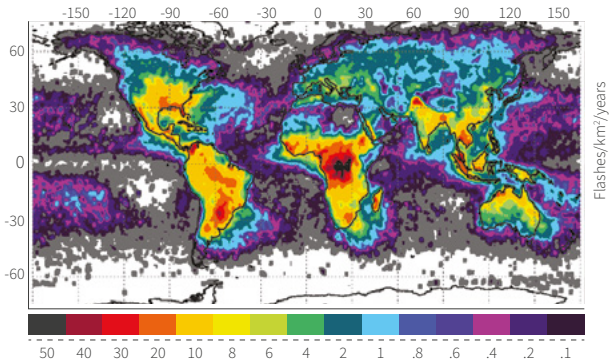
Laos
- EDL

Italy
- ENEL

Croatia
- HEP

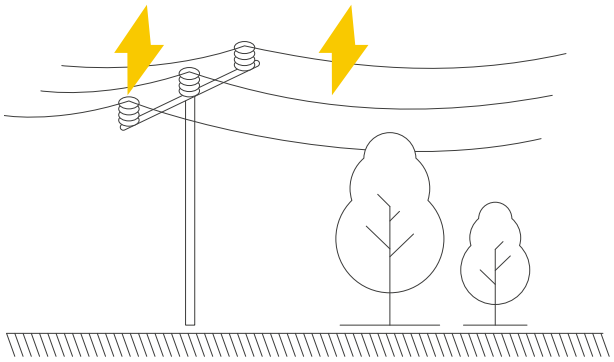
LIGHTNING: GENERAL INFORMATION

LIGHTNING AND ITS INTERACTION WITH OVERHEAD LINES

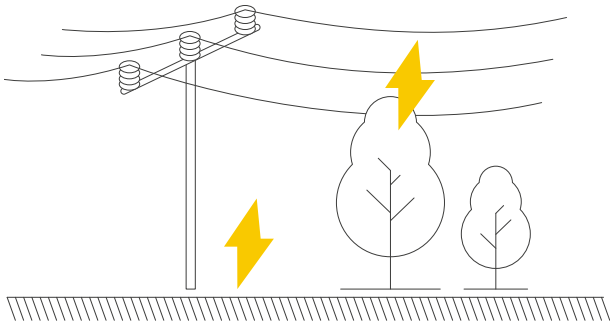


Lightning is a very common natural phenomenon. About 6 lightning strikes hit the Earth's surface each second. Below is a map of the ground flash density developed by NASA. You can estimate the situation in your region: if ground flash density (GFD) is greater than 10, then you should not ignore it.

LIGHTNING OVERVOLTAGE ORIGINS ON OVERHEAD LINES



Direct Lightning Strike (DLS)



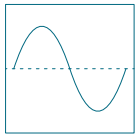
Induced Overvoltage (IOV)

STRIKE LOCATION

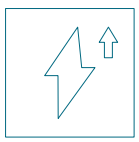
- Poles/towers
- Phase conductors
- Overhead shielding wire

- Trees
- Buildings
- Telecom towers
- Adjacent overhead lines

PARAMETERS



- Average voltage 6 MV
- Average current 30 kA



- Voltage up to 300 kV

LIGHTNING: GENERAL INFORMATION

ISSUES CAUSED BY LIGHTNING ON OVERHEAD LINES

- Lightning strikes ON or CLOSE to the line
- Overvoltage on the line
- Flashover of insulation
- Follow Current (short circuit)
- Damages and trip

Direct strike creates a lightning impulse splitting and propagating along the line making insulators flashover on its way.

Indirect strike generates induced overvoltages up to 300kV on a power line due to electromagnetic effect.

After insulators flashover, the current powered by a transformer at the nearest substation deviates from the normal circuit: fault current establishes along the insulators affected by lightning overvoltage.

POSSIBLE CONSEQUENCES

- Of follow current
- Failure of the transformer by mechanical stress and temperature rise
- Outages and trips
- Conductor breakage (in particular covered conductors)
- Insulator breakage
- Of lightning overvoltage propagation
- Metal Oxide Arrester breakage
- Failure of the transformer due to insulation failure

EASYQUENCH

A UNIQUE & EFFICIENT TECHNOLOGY FOR LINE LIGHTNING PROTECTION

EasyQuench is a unique technology, developed and being improved since 1996 by Streamer. Products featuring the EasyQuench technology protect overhead lines against direct and indirect lightning strikes, thus helping to prevent breakage of conductors, insulators and power outages. Due to their operating principle, line lightning protection devices (LLPDs) do not require any special grounding (e.g. a ground lead). Therefore, these devices are especially efficient in areas with high soil resistivity.

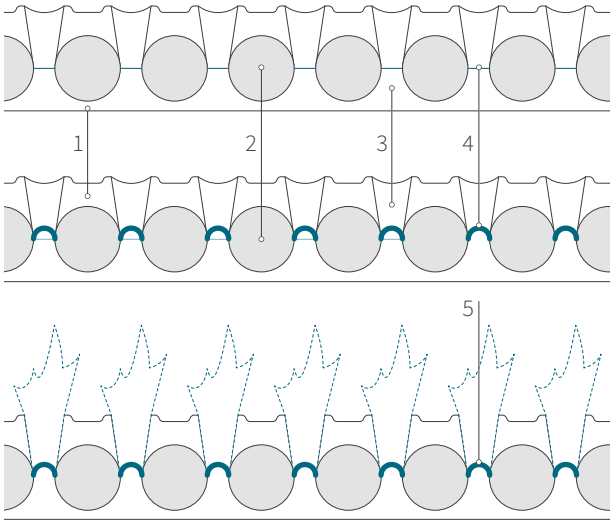
The Operating principle of LLPDs with the EasyQuench system is based on the following concepts:

1. Insulation coordination. Coordination of lightning protection devices with line insulation is necessary to ensure proper operation and is achieved by adjusting BIL (CFO) of LLPD so that it is lower than those of the protected insulator. By fulfilling this requirement, it can be guaranteed that in case of a direct or an indirect lightning strike, the LLPD will operate correctly and prevent flashovers of the protected insulator.
2. Follow current interruption. Since all power lines are connected to transformers, when there's a flashover of LLPD somewhere on the line, a power frequency short-circuit current (or follow current) starts flowing immediately through it. Thanks to the EasyQuench system, LLPD can interrupt the fault current within one half of the period.

When a follow current starts flowing through the EasyQuench system, it immediately gets split into a series of small power arcs located inside the device. Each of the miniature arcs is then quenched individually.

When power frequency follow current crosses zero, it is eliminated. The line then immediately gets back to normal operation, therefore no short circuit will be sensed by protection relays and there will be no outage or power supply interruption.

Diagram of discharge initiation:



The EasyQuench system consists of a series of small discharge/arcing chambers, being formed by two adjacent metal electrodes placed in a silicone rubber body. Electrodes are separated from each other with tiny air gaps, that break down as soon as the LLPD is subjected to lightning overvoltage.

1. Silicone rubber body
2. Intermediate electrodes
3. Arc quenching chamber
4. Arc
5. Plasma jet

EASYQUENCH BENEFITS

- Prevents outages on the line;
- protects overhead lines from direct lightning strike and induced overvoltage;
- no dedicated grounding to be arranged;
- no maintenance required;
- works perfectly in areas with high soil resistivity;
- works under extreme climatic conditions and high-altitude landscape;
- quenches follow current (short circuit current) in less than one semiperiod of industrial power frequency;
- 20 years life expectancy;
- fix and forget.

SELECTION GUIDE LLPD

Highest voltage for equipment, kV*	12		15 & 24		40.5	52	72.5
Protection from**	DLS	IOV	DLS	IOV	DLS	DLS	DLS
LLPD d10z	+	+					
LLPD i20z		+		+			
LLPD dC20z			+	+			
LLPD d24z			+	+			
LLPD dM35z					+		
LLPD d45z						+	
LLPD d69z							+
Note: The above data corresponds to altitude up to 1000 metres							

Basic values of maximum prospective fault current (MPFC) are:

- 1.5 kA for LLPD i-series;
- 5 kA for LLPD d-series;
- provided that the rated voltage of the LLPD matches the rated voltage of the overhead line. If MPFC is more than 5 kA, please check the information below and on page 17.

* According to IEC 60038

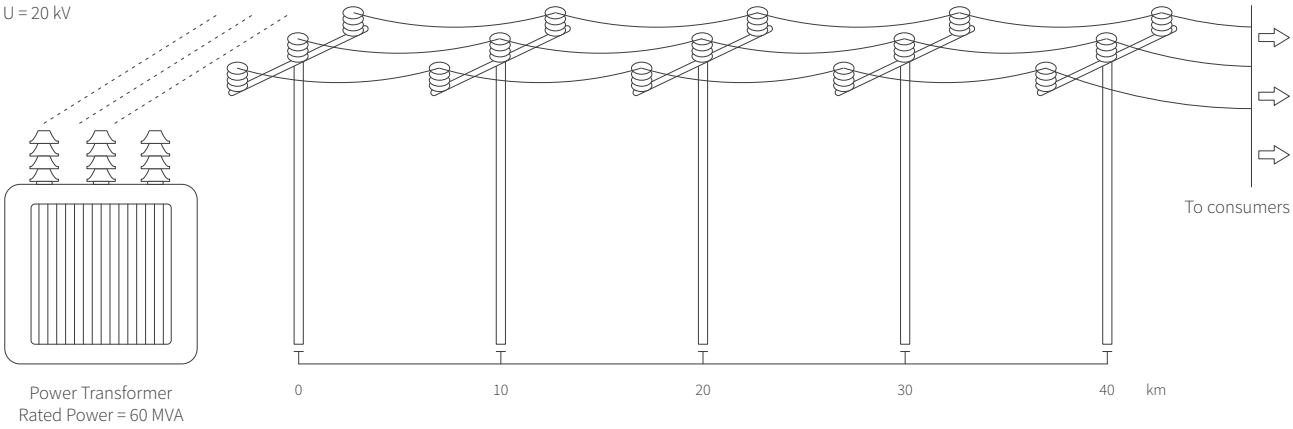
**Basic indications for use LLPD d-series:

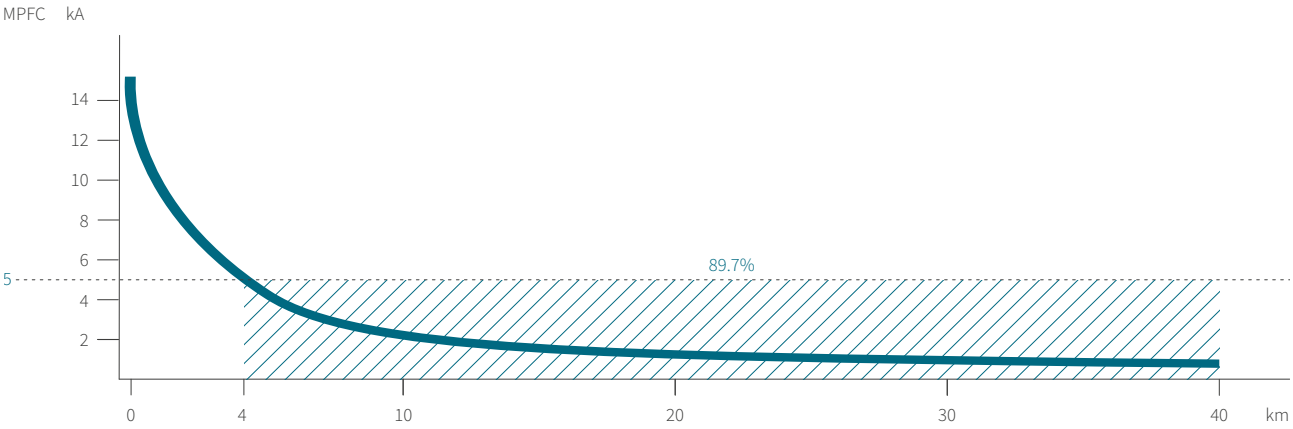
- open areas without natural shielding;
- hilly, mountainous areas;
- river crossings;
- sections subjected to frequent lightning strikes;
- areas with poor accessibility.

SELECTION GUIDE LLPD

VALUE OF MPFC DEPENDS ON THE DISTANCE TO THE POWER TRANSFORMER WHICH FEEDS THE FAULT POINT. LET'S CONSIDER AN EXAMPLE.

For this standard case the prospective fault current is lower than 5 kA (max LLPD short circuit breaking capability) at 89.7% of the overhead line. It is possible to install the first LLPD 4 km away from the substation.





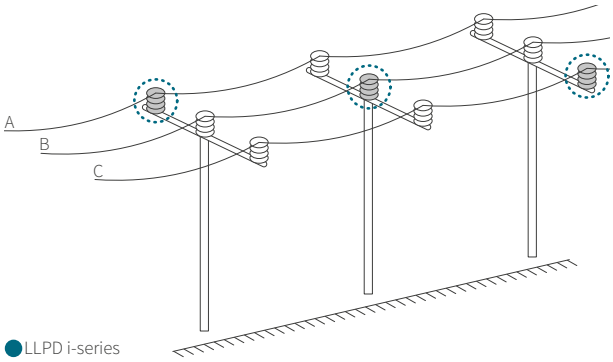
INSTALLATION METHODS

PROTECTION AGAINST IOV FOR GROUNDED POLES: STEEL, CONCRETE OR WOODEN POLES WITH GROUND LEAD

Basic recommendations for using LLPD i-series.

Sections of an overhead line located on:

- line is surrounded by high objects shielding it from direct lightning strikes (forest, city, over lines, etc.);
- valley/ravine areas;
- areas subjected to frequent lightning strikes;
- areas with poor accessibility.



1 piece per circuit.
Phase alternation: A-> B-> C-> A-> B-> C

PROTECTION AGAINST IOV FOR UNGROUNDED POLES

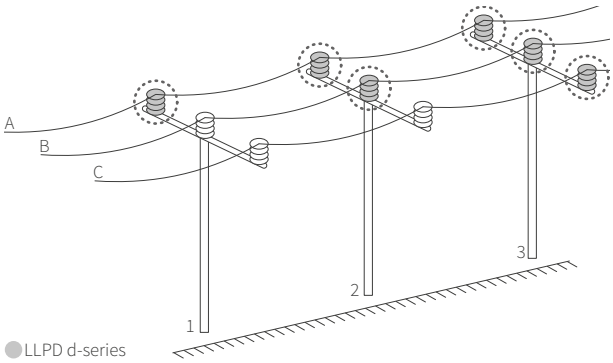
Check page 14–15

PROTECTION AGAINST DLS AND BFO FOR GROUNDED OR UNGROUNDED POLES

Basic recommendations for using LLPD d-series.

Sections of an overhead line located on:

- open areas without natural shielding;
- hilly, mountainous areas;
- river crossings;
- areas subjected to freque t lightning strikes;
- 3–4 poles before substation (for nominal system voltage <35kv - considering average span of 50–70 m; considering 35 kv average span of 150–200 m).



1, 2 or 3 pcs per pole depending on:

- ground flash density;
- terrain profile;
- shielding factor;
- line geometry;
- footing resistance;
- BIL of the line;
- presence of shielding wire;
- ... and other factors*.

INSTALLATION METHODS

INSTALLATION METHODS FOR COVERED CONDUCTORS FROM IOV

PIC INSULATION

- Partially Insulated Cables
- Insulation: HDPE 1.5…3.5 mm

CONSEQUENCES

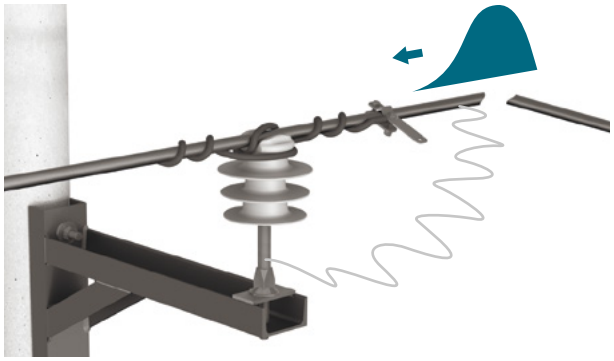
- Outages due to short circuit
- Burnout and falling cable

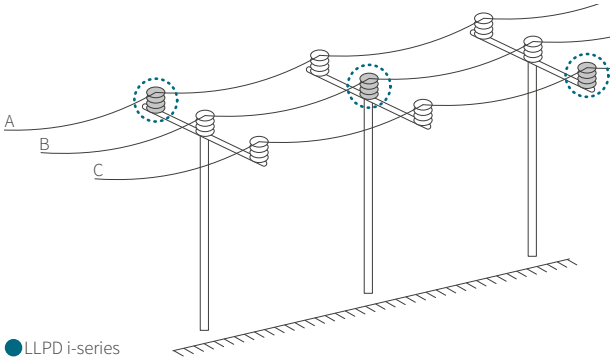
PROCESS

Induced overvoltages are high enough to flashover line insulation by puncturing thin conductor insulation that leads to creation of a stable, not moving, arc, melting down cable core and thus reducing its cross-section at this location.
As a result, the cable falls to the ground, causing the an overhead line outage.

HOW TO PROTECT

By installation of 1x LLPD i-series per pole with phase alternation to protect each phase insulation on each pole.





INSTALLATION METHODS

INSTALLATION METHODS FOR COVERED CONDUCTORS FROM IOV

SAC INSULATION

- Spacer Aerial Cables
- Insulation: HDPE/XLPE 5…7 mm

CONSEQUENCES

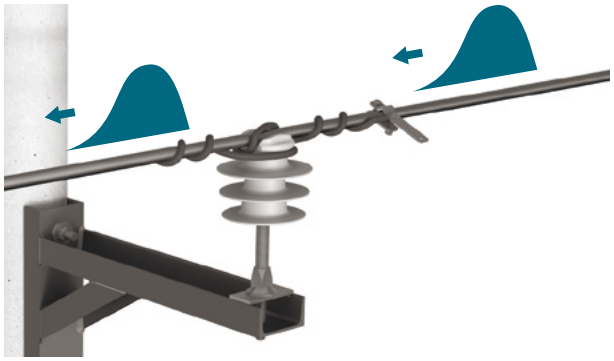
- Premature failures of MOAs, PMTs and even substation equipment

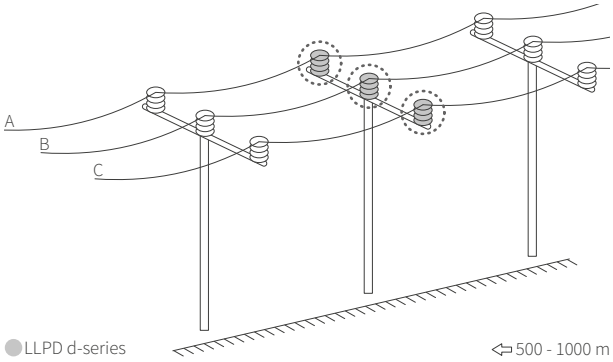
PROCESS

Induced overvoltage might reach up to 300kV, which is rarely enough to flashover such insulation. However, overvoltages keep travelling along the line until the closest discharge point (MOA, PMT, damaged insulation). Thus all overvoltages aggregated by whole line length are applied to same points, leading to premature failures of MOAs, PMTs and other sensitive equipment.

HOW TO PROTECT

By installation of 3x LLPD d-series on one pole every 500–1000 metres to discharge travelling waves of overvoltage.



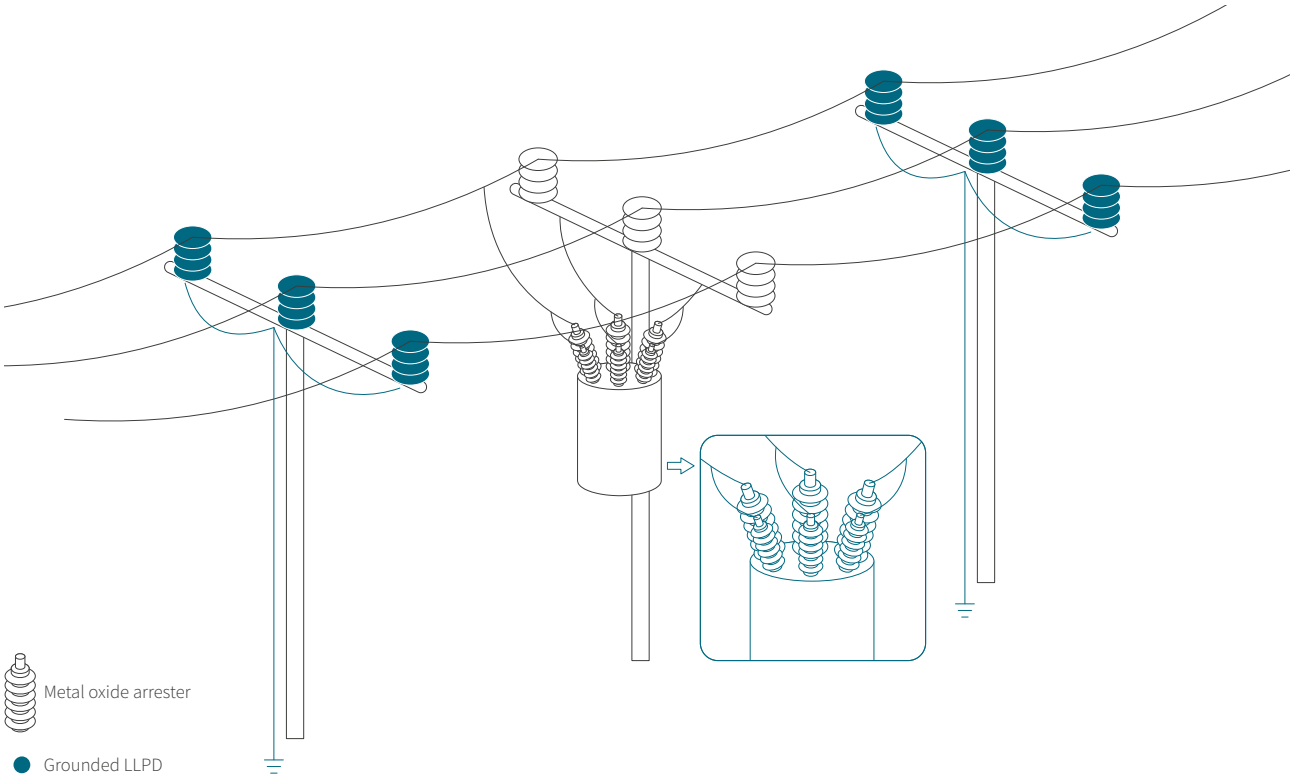


INSTALLATION METHODS

INSTALLATION METHOD FOR POWER TRANSFORMER PROTECTION

It is necessary to protect, not only the line and insulators from damage and unwanted outages, but also the pole mounted distribution transformers which are deployed along the line.

The main device for transformer protection from lightning surges is a surge arrester. Unfortunately, with frequent activations due to overvoltages, the arrester reaches the limit of its capability and is unable to discharge pulses anymore which leads to breakdowns, leaving the transformer unprotected in case of new overvoltage. This is especially true for poles with high values of footing resistance and high BIL. To avoid this situation, Streamer can suggest a solution for protecting arresters and improving the reliability of the transformer.



Streamer recommends installing 3 LLPD d-series on poles adjacent to the transformer and to ground them. In case of DLS on the line, LLPD limits surge of overvoltage on both sides of the protected transformer, reducing the load on the arresters and preventing the arresters from breaking down.

Thus, Streamer's solution allows extended lifespan of the arresters and as a result provides protection of the transformer.

INSTALLATION METHODS

RECOMMENDATIONS CONCERNING SHORT-CIRCUIT CURRENT (SCC) & INSULATION COORDINATION

When the MPFC is greater the MPFC of the LLPD, Streamer recommends to the use of LLPD of a higher voltage class, while observing BIL_{LLPD} <BIL_{line} condition.

The following are possible cases to protect against large prospective fault current (PFC):

Product	Highest voltage for equipment, kV*	Nominal system voltage, kV	Prospective fault current, kA	
			Insulated (compensated) neutral	Solidly grounded neutral
LLPD d24z	12	10;11	6.6	5.9
LLPD d24z	15	12–13.8	5.2	5
LLPD dM35z	24	20; 22	6.6	5.9
LLPD d45z	40.5	33; 35	6	5.5
LLPD d69z	52	45	6.2	5.6

* According to IEC 60038

LIGHTNING DISCHARGE CAPABILITY

LIGHTNING DISCHARGE CAPABILITY TEST

According to IEC 60099-8, the test is meant to prove the capability of the tested device to withstand lightning discharges having current waveforms with durations of several tens of microseconds for devices applied on shielded lines, and several hundreds of microseconds for devices on unshielded lines. The related test also covers the effects of multiple lightning strikes.

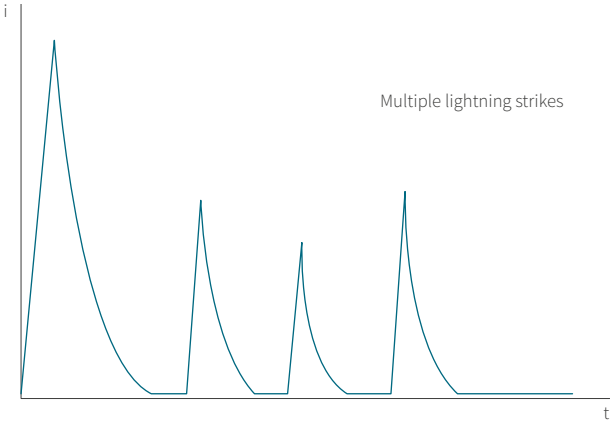
Wave shape of impulse	200–230 µs
Quantity of impulses	20
Charge, °C	Declared by manufacturer

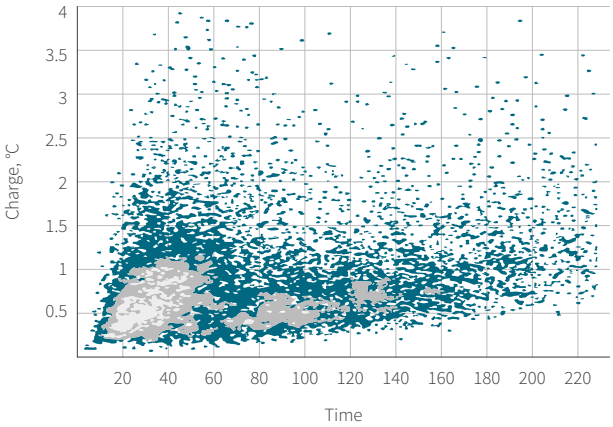
IEC 60099-8 prescribes lightning discharge capability in °C to appear among other parameters on a product nameplate permanently attached to the protection device.

The graph presents probability distribution of lightning parameters provided by IEEE Std 1410-2010. Each point on the graph matches lightning with a specific charge of lightning impulse (measured in °C) and specific duration of impulse (measured in µs).

In case of a direct lightning strike there is a 50% probability of observing a charge exceeding 0.8 °C flowing through the protective device installed. Thus a protective device tested with 0.8 °C has a 50% probability of facing an impact exceeding its proven lightning discharge capability, with unpredictable results at each direct lightning event.

About 90% of cloud-to-ground lightning fl ashes are composed of two or more strikes.

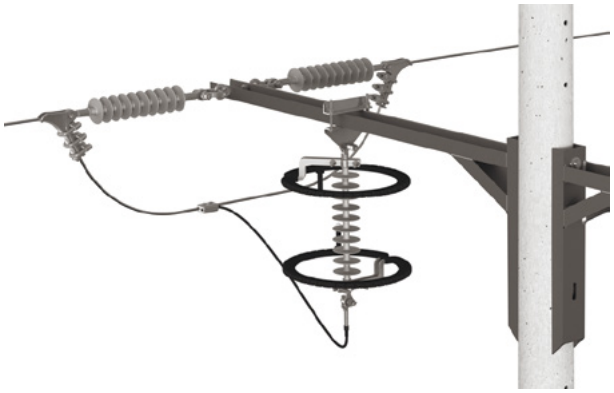




LIGHTNING DISCHARGE CAPABILITY

LLPD

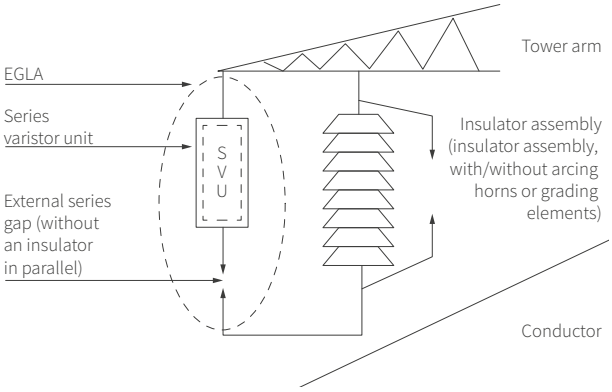
2.8 °C – Lightning discharge capability of d-LLPD.



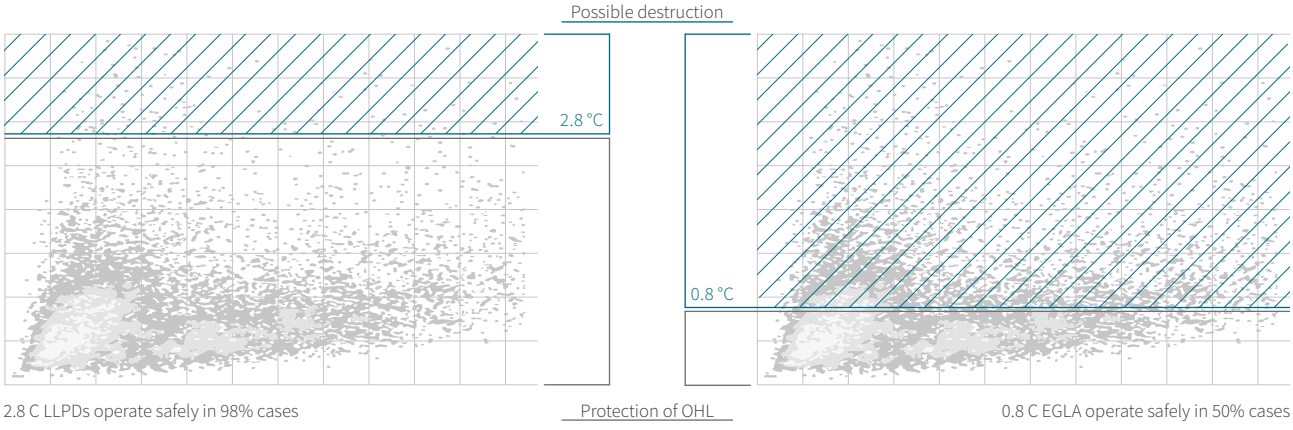
LLPD with proven 2.8 °C lightning discharge capability ensures safe product operation within 98% of direct lightning strike cases.

EGLA

<0.8 °C – Quantity of coulombs which consist in high current impulse 65 kA, 4/10 µs corresponding to “Class name X2” in EGLA classification.

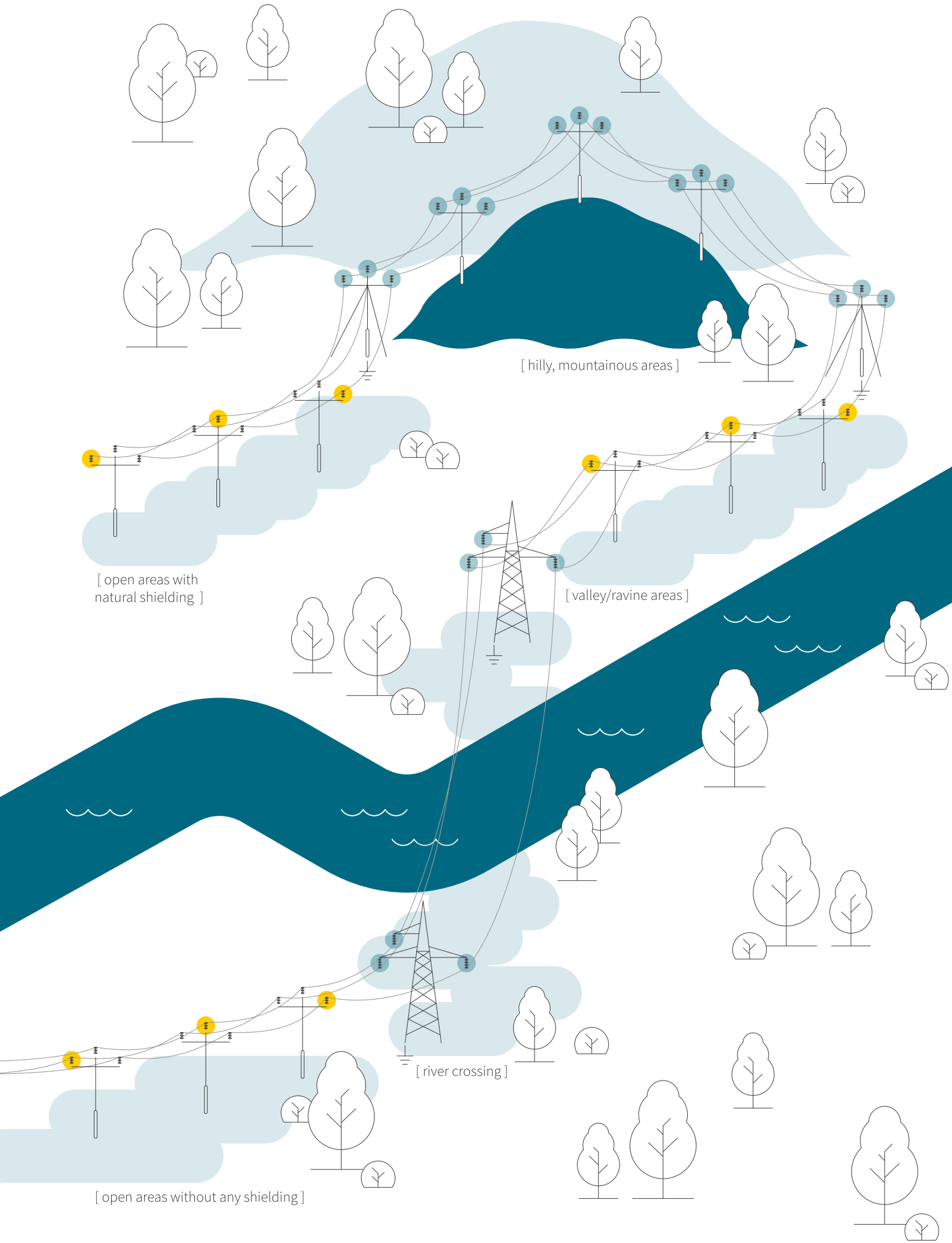


Protective device with proven 0.8 °C lightning discharge capability ensures safe product operation within only half of direct lightning strike cases.



INSTALLATION MAP

- LLPD i-series
- LLPD d-series for 10–20 kV
- LLPD d-series for 35–69 kV


[hilly, mountainous areas]
[open areas with
natural shielding]
[valley/ravine areas]
[river crossing]
[open areas without any shielding]

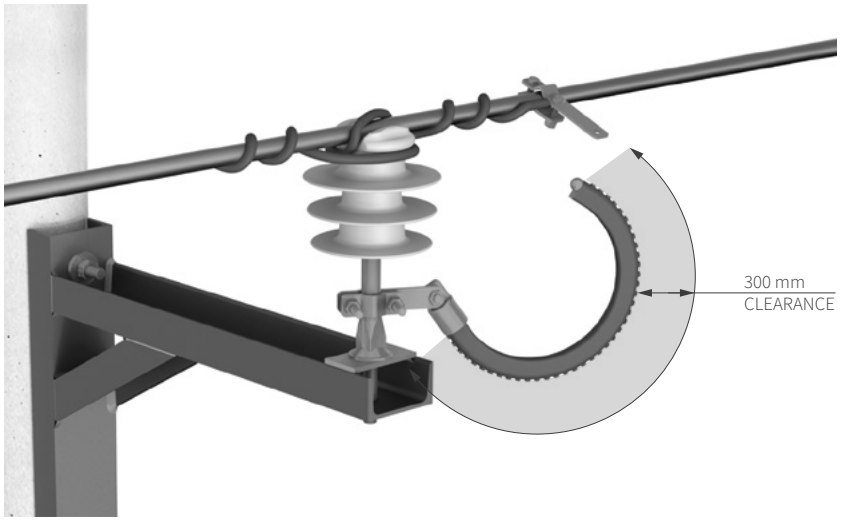
RESTRICTIONS

There are a few restrictions when installing LLPD:

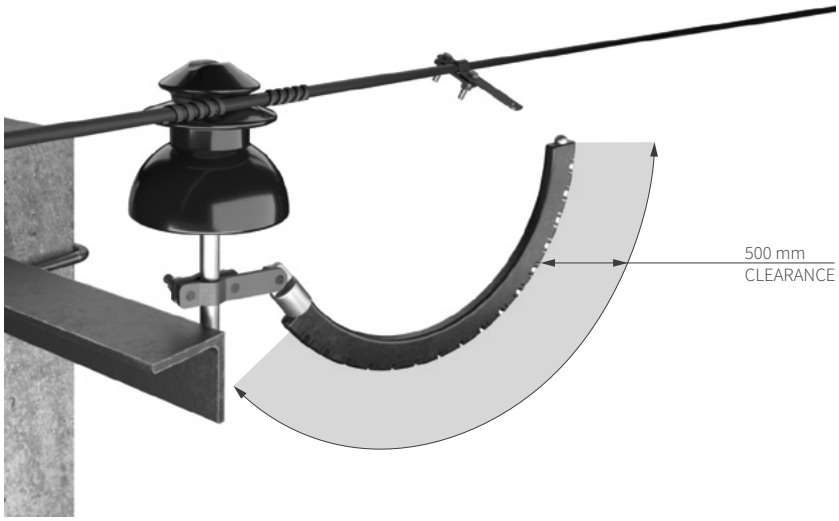
1. There must be no conductive or grounded parts of the overhead line within a 500 mm (300 mm for LLPD i20z) radius from the edge of the EasyQuench system;

2. There should be no other LLPDs within 1000 mm radius from the edge of the EasyQuench system.

These restrictions are due to the fact that when the LLPD operates, a plasma jet is ejected from the nozzles on the LLPD's surface. When a plasma jet hits conductive or grounded parts, this may lead to conductive channel creation, through which the follow current begins to flow, creating a phase to ground or phase to phase short circuit.

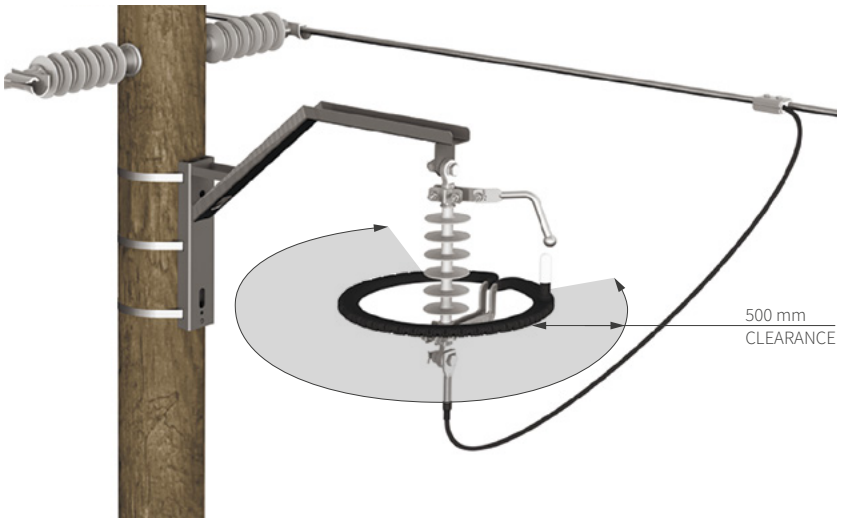


LLPD i20z

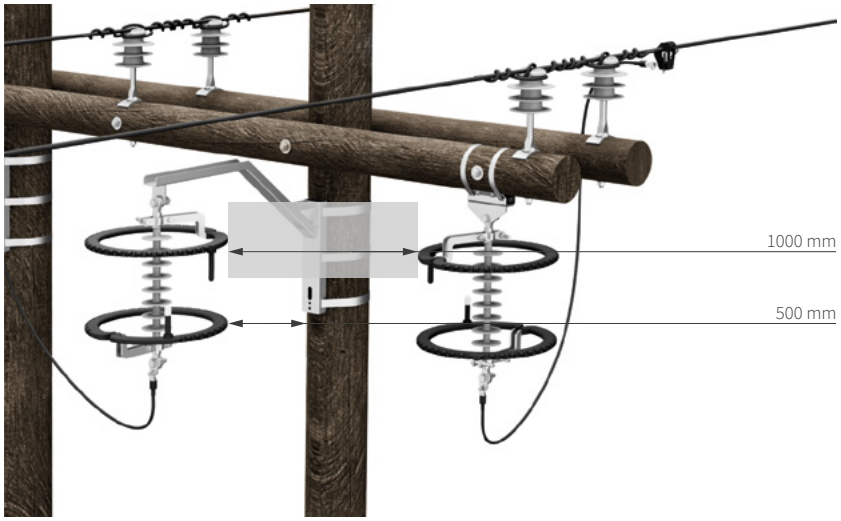


LLPD d10z
LLPD dC20z

RESTRICTIONS



LLPD d24z
LLPD dM35z
LLPD d45z
LLPD d69z



Distance between LLPD and Pole = 500 mm (min)

Distance between 2 LLPDs = 1000 mm (min)

TRANSCRIPTION OF MARKING ON THE EXAMPLE OF LLPD i20Z

LLPD i20z | 24 kV | 1.5 kA | 10 kA | 2.4 C |

1 2 3 4 5

_____-_____/_____

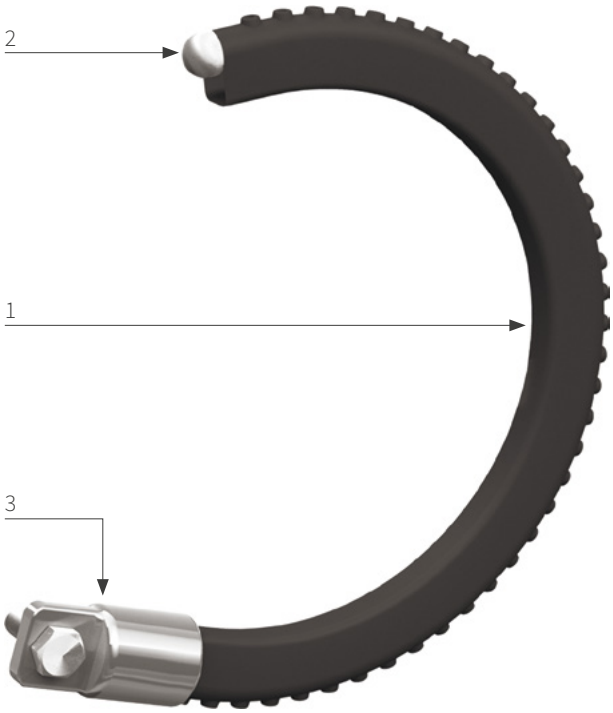
EASYQUENCH TECHNOLOGY

1. Product name
2. Highest voltage for equipment, kV
3. Maximum prospective fault current, kA
4. Standard nominal discharge current kA
5. Lightning discharge capability (200 µs), C

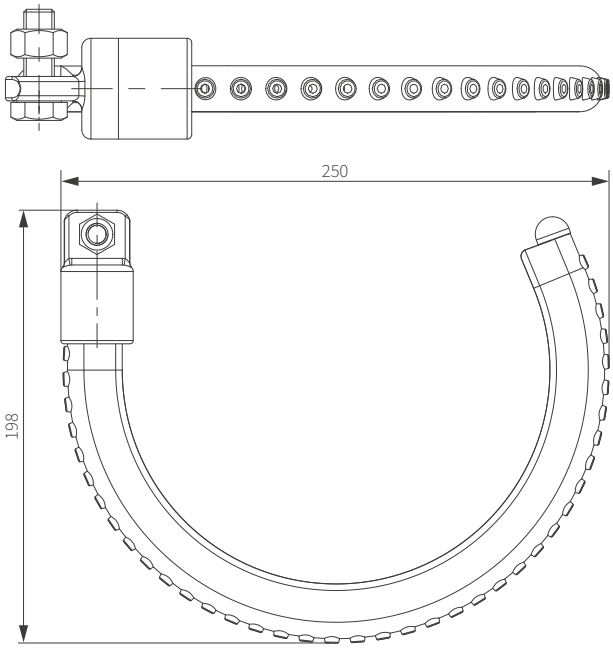
LLPD i20z

Electrical Line Parameters	
Highest voltage for equipment*, kV	24
Maximum prospective fault current, kA	1.5
External air gap, mm	60–80
50% flashover voltage (60 mm air gap), kV	<110
Power frequency withstand voltage**, kV (wet/dry)	30/40
Lightning Parameters	
Lightning discharge capability (200 µs)***, C	2.4
High current impulse (4/10 µs), kA	65
Maximum quenching lightning current, kA	3 (1/50µs)
Minimum withstand amount of operations	10
General Parameters	
Additional power losses on the line, %	0
Average expected lifespan, years	30
UV resistance****, h	1000
Weight, kg	0.43
Maintenance	1 visual verification/ year
Reference	SAI.020.Z.WW/820

* According to IEC 60038
** According to IEC 60071-1
*** According to IEC 60099-8
**** According to ISO 4892-2, method A, IEC 62217

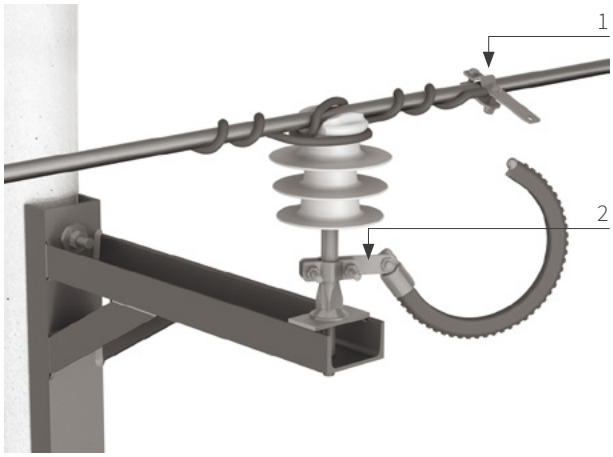


1. EQ system
2. Terminal electrode
3. End fitting with the attachment point

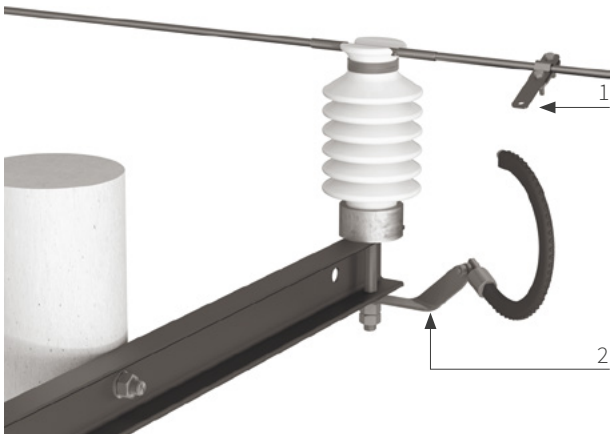


1. PIN/POST/PIN-POST

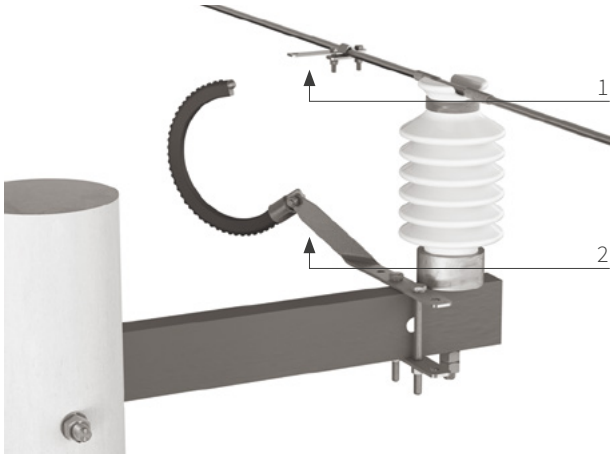
1A	
Type of line insulation	PIN
Type of pole	Any
Type of cross-arm	Any
Point of connection	Insulator's PIN
Notes: Insulator's pin must be round and should have ø≤38 mm; in case of insulator's pin ø>38 mm check options 1B, 1C, 1D	
Accessories required	1. Conductor clamp 2. Bracket IDAA.1B



1B	
Type of line insulation	PIN-POST
Type of pole	Any
Type of cross-arm	Any
Point of connection	Insulator's PIN
Notes: Installation using existing insulator pin up to M24 nut	
Accessories required	1. Conductor clamp 2. Bracket IDAB.1B

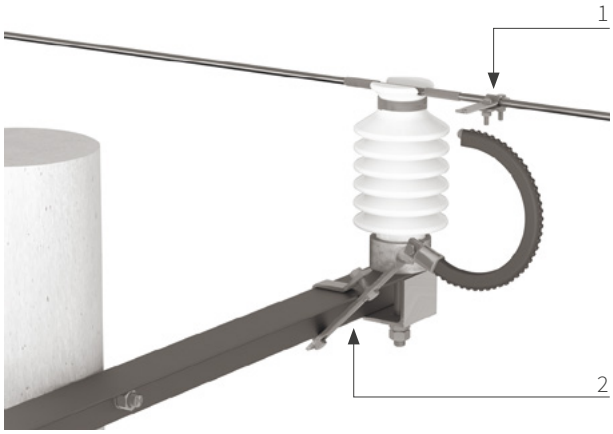


1C	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm
Notes: Maximum permissible size of cross-arm 150x130 mm	
Accessories required	1. Conductor clamp 2. Bracket CUAA.1B



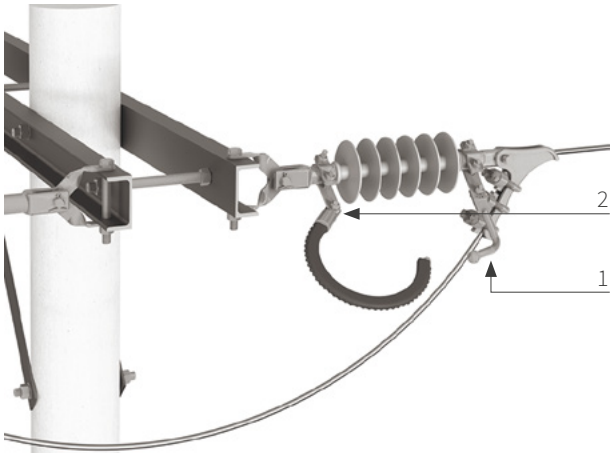
1. PIN/POST/PIN-POST

1D	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm
Notes: Maximum permissible size of L-bar 90x90 mm	
Accessories required	1. Conductor clamp 2. Bracket CLAA.1B

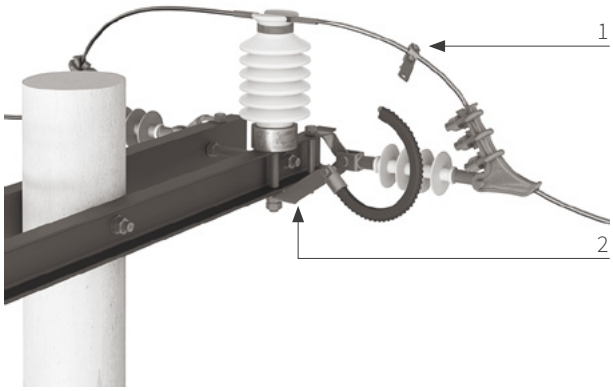


2. TENSION

2A	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	Any
Point of connection	On insulator
Notes: This option is the best for composite and long-rod porcelain insulators; for cap-and-pin insulators it is highly recommended to install as per 2B, 2C or 2D	
Accessories required	1. Horn electrode BH11.1B 2. Bracket IDAA.1B

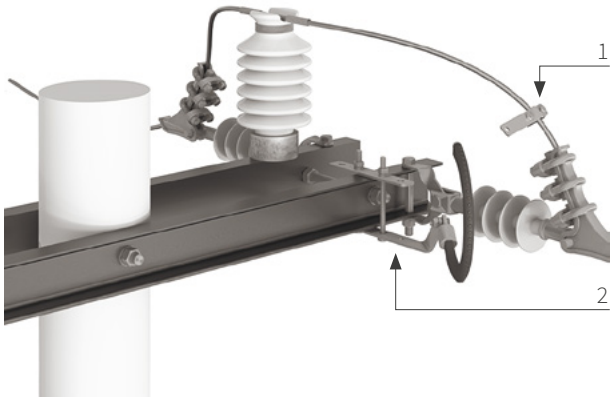


2B	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	Any
Point of connection	PIN of jumper’s insulator
Notes: Suitable for cases with a pin-post insulator in the jumper. The most convenient method of installation. Installation using existing insulator’s pin up to M24 nut	
Accessories required	1. Conductor clamp 2. Bracket IDAB.1B

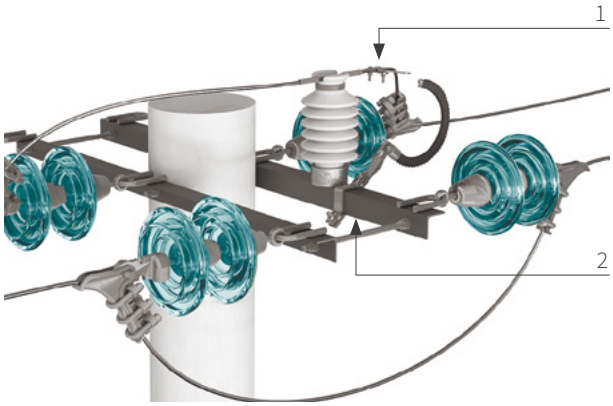


2. TENSION

2C	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm
Notes: Suitable for cases with pin or post insulator in the jumper. The most convenient method of installation	
Accessories required	1. Conductor clamp 2. Bracket CUAA.1B



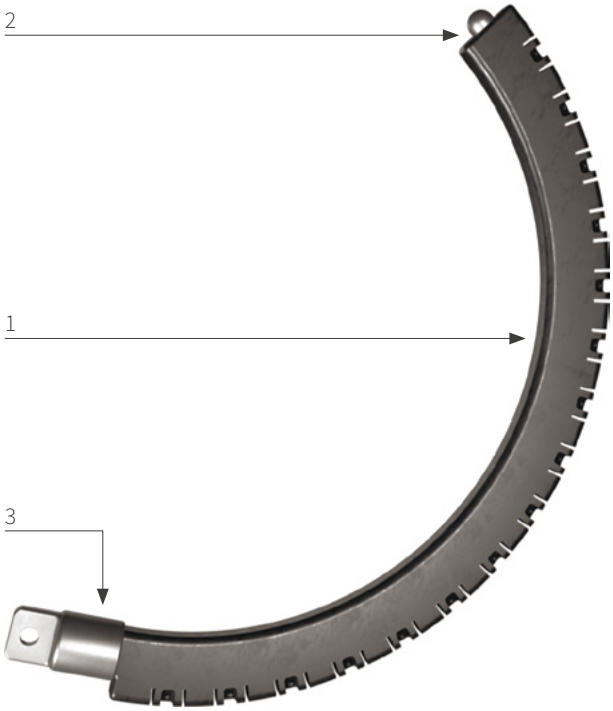
2D	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm
Notes: Maximum permissible size of L-bar 90x90 mm	
Accessories required	1. Conductor clamp 2. Bracket CLAA.1B



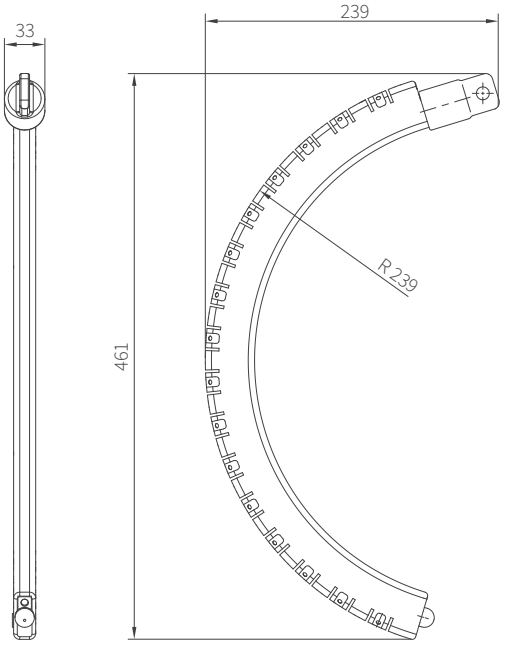
LLPD d10z

Electrical Line Parameters	
Highest voltage for equipment*, kV	12
Maximum prospective fault current, kA	5
External air gap, mm	50–70
50% flashover voltage (70 mm air gap), kV	<115
Power frequency withstand voltage**, kV (wet/dry)	28/38
Lightning Parameters	
Lightning discharge capability (200 µs)***, C	2.4
High current impulse (4/10 µs), kA	65
Maximum quenching lightning current, kA	20 (8/50µs)
Minimum withstand amount of operations	10
General Parameters	
Additional power losses on the line, %	0
Average expected lifespan, years	30
UV resistance****, h	1000
Weight, kg	1.1
Maintenance	1 visual verification/ year
Reference:	LL.PD.D012.E0.WW

* According to IEC 60038
** According to IEC 60071-1
*** According to IEC 60099-8
**** According to ISO 4892-2, method A, IEC 62217

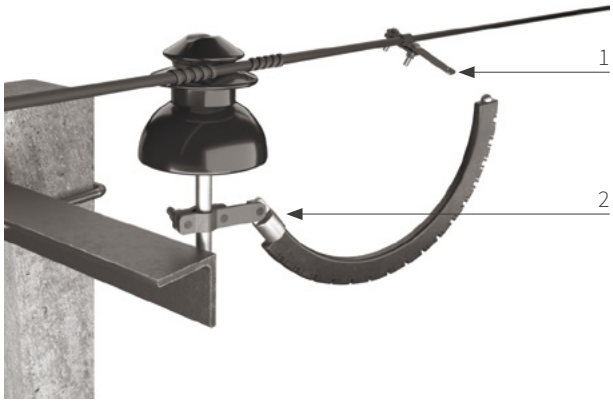


1. EQ system
2. Terminal electrode
3. End fitting with the attachment point



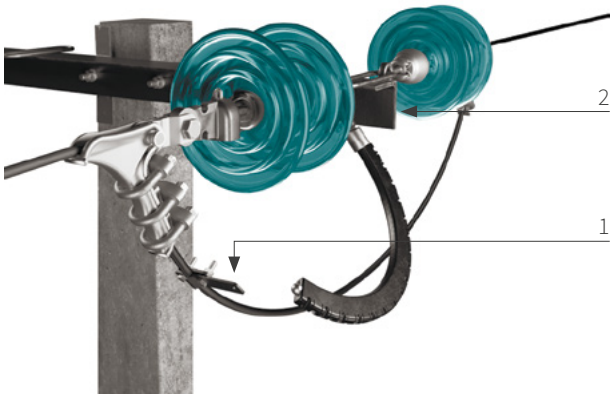
1. PIN/POST/PIN-POST

1A	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	Any
Point of connection	Insulator's PIN
Notes: Insulator's pin must be round and should have ø≤38 mm	
Accessories required	1. Conductor clamp 2. Bracket IDAA.1B



2. TENSION

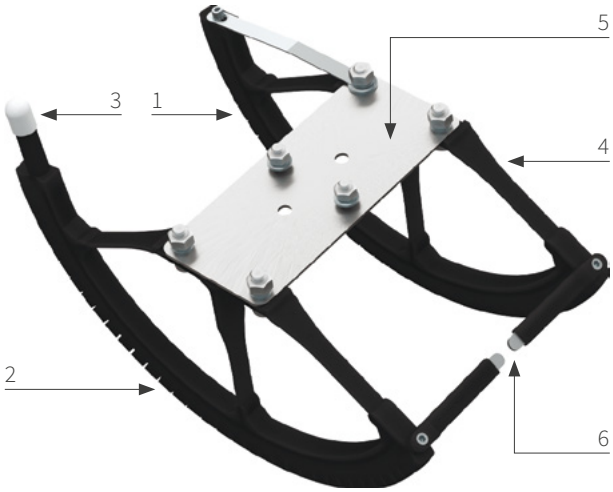
2A	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	Any
Point of connection	On insulator
Accessories required	1. Conductor clamp 2. Bracket IDAA.1B



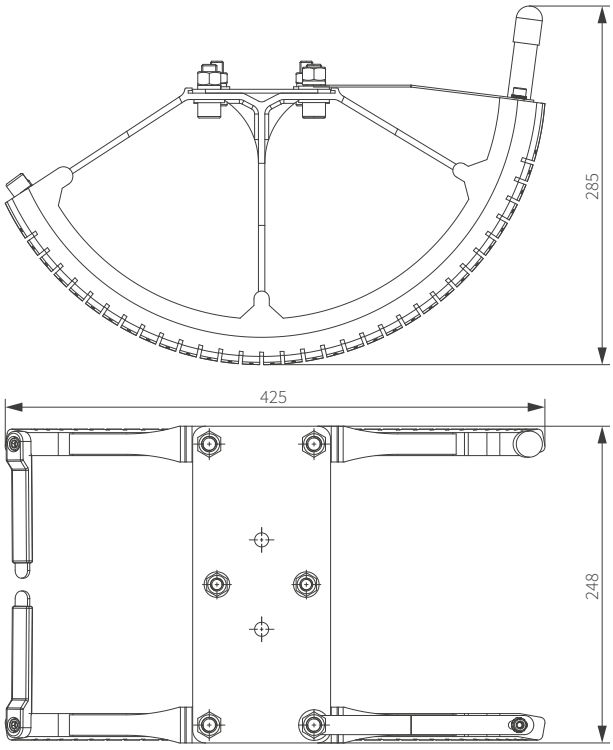
LLPD dC20z

Electrical Line Parameters	
Highest voltage for equipment*, kV	24
Maximum prospective fault current, kA	5
External air gap, mm	60–80
50% flashover voltage (80 mm air gap), kV	<185
Power frequency withstand voltage**, kV (wet/dry)	40/50
Lightning Parameters	
Lightning discharge capability (200 µs)***, C	2.8
High current impulse (4/10 µs), kA	65
Maximum quenching lightning current, kA	20 (8/50µs)
Minimum withstand amount of operations	10
General Parameters	
Additional power losses on the line, %	0
Average expected lifespan, years	30
UV resistance****, h	1000
Weight, kg	2.6
Maintenance	1 visual verification/ year
Reference	SAD.C20.Z.WW/920

* According to IEC 60038
** According to IEC 60071-1
*** According to IEC 60099-8
**** According to ISO 4892-2, method A, IEC 62217

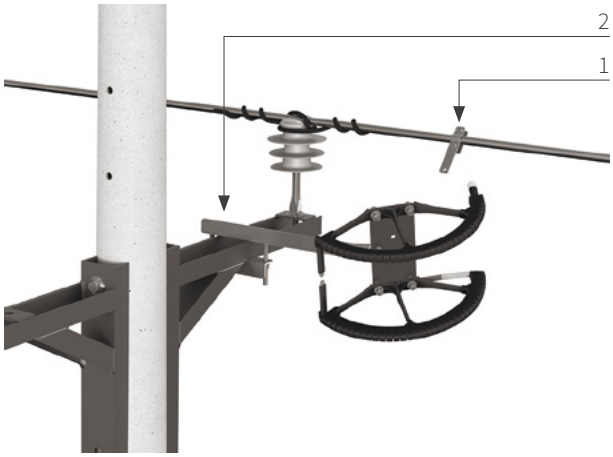


1. Module A with EQ system
2. Module B with EQ system
3. Terminal electrode with one-time glass indicator
4. Insulating load-bearing frame
5. Attachment point
6. Auxiliary electrodes

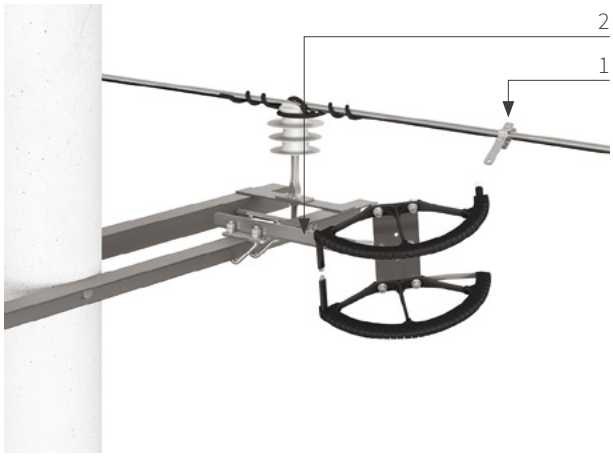


1. PIN/POST/PIN-POST

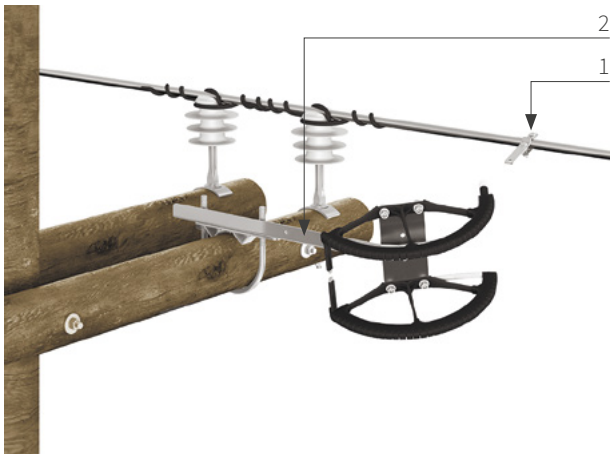
1A	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm
Notes: Maximum permissible size of cross-arm 150x130 mm	
Accessories required	1. Conductor clamp 2. Bracket CUBA.1B



1B	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm
Notes: Permissible size of L-bar 60x60 (with CLBA.1B) or 90x90 (with CLBA.2B)	
Accessories required	1. Conductor clamp 2. Bracket CLBA.XB

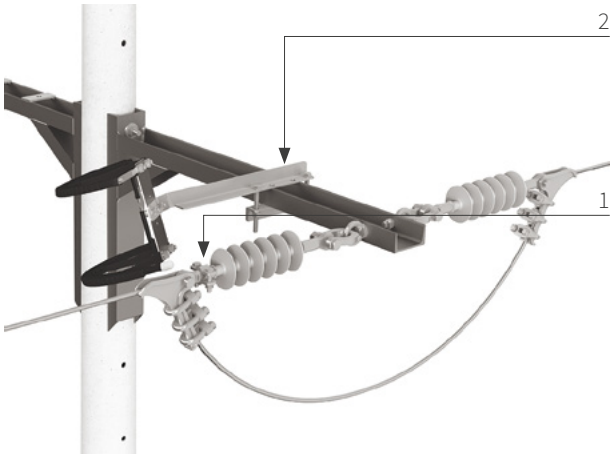


1C	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	Round
Point of connection	Cross-arm
Notes: Permissible diameter of cross-arm 140–180 mm	
Accessories required	1. Conductor clamp 2. Bracket CRBA.1B

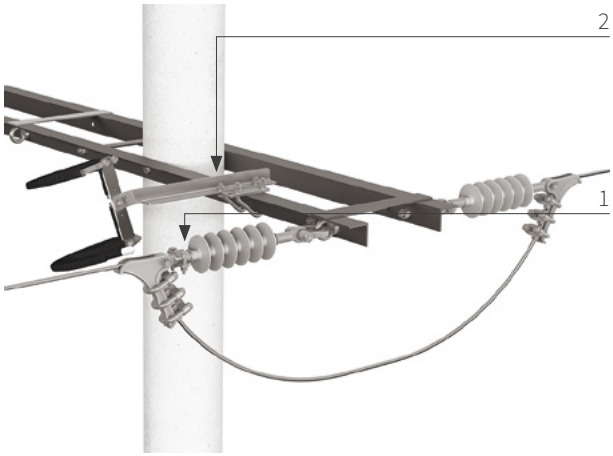


2. TENSION

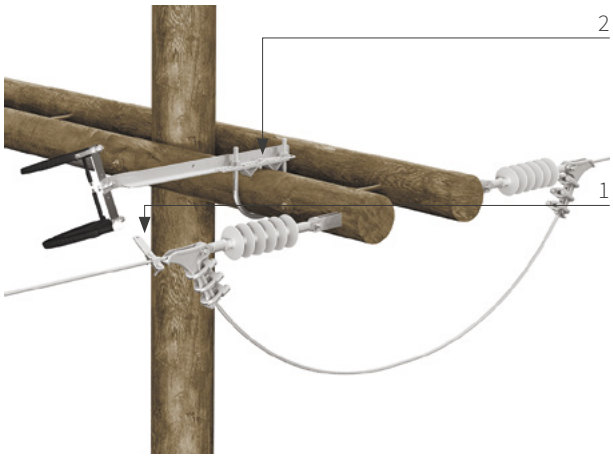
2A	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm
Notes: Maximum permissible size of cross-arm 150x130 mm	
Accessories required	1. Conductor clamp (or horn electrode BH10.1B) 2. Bracket CUBA.1B



2B	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm
Notes: Permissible size of L-bar 60x60 (with CLBA.1B) or 90x90 (with CLBA.2B)	
Accessories required	1. Conductor clamp (or horn electrode BH10.1B) 2. Bracket CLBA.XB

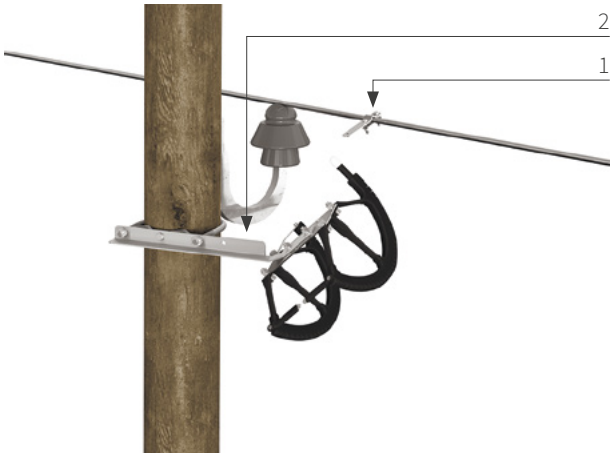


2C	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	Round
Point of connection	Cross-arm
Notes: Permissible diameter of cross-arm 140–180 mm	
Accessories required	1. Conductor clamp (or horn electrode BH10.1B) 2. Bracket CRBA.1B



4. HORIZONTAL POST

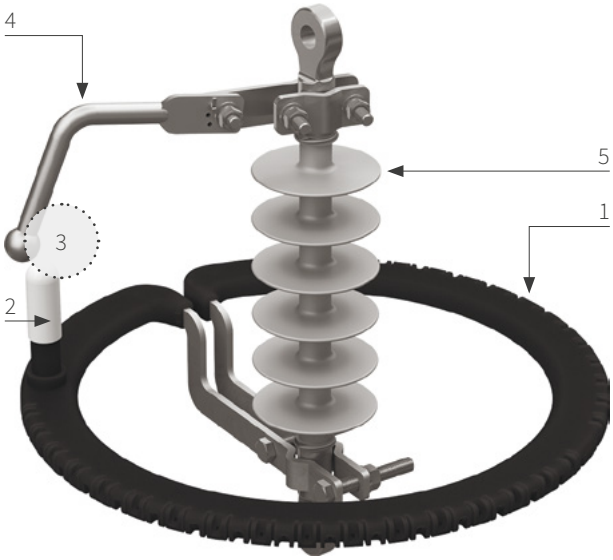
4A	
Type of line insulation	HORIZONTAL POST
Type of pole	Armless pole
Type of cross-arm	–
Point of connection	Pole
Notes: Permissible diameter of pole 150–200 mm	
Accessories required	1. Conductor clamp 2. Bracket PRBA.1B



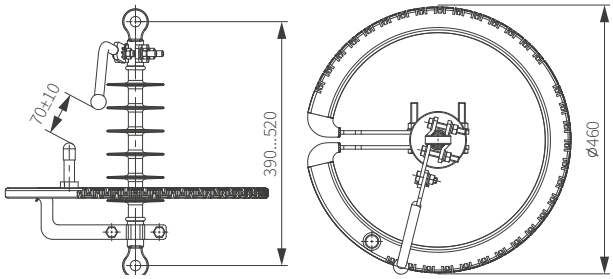
LLPD d24z

Electrical Line Parameters	
Highest voltage for equipment*, kV	24
Maximum prospective fault current, kA	5
External air gap, mm	60–80
50% flashover voltage (80 mm air gap), kV	<150
Power frequency withstand voltage**, kV (wet/dry)	40/50
Lightning Parameters	
Lightning discharge capability (200 µs)***, C	2.8
High current impulse (4/10 µs), kA	65
Maximum quenching lightning current, kA	20 (8/50µs)
Minimum withstand amount of operations	10
General Parameters	
Additional power losses on the line, %	0
Average expected lifespan, years	30
UV resistance****, h	1000
Weight, kg	2.8
Maintenance	1 visual verification/ year
Reference	LL.PD.D024.B0.WW

* According to IEC 60038
** According to IEC 60071-1
*** According to IEC 60099-8
**** According to ISO 4892-2, method A, IEC 62217

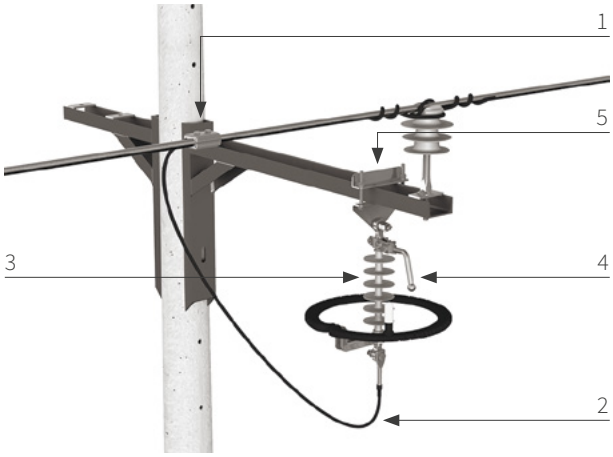


1. Module with EQ system
2. Electrode with indicator
3. Air gap
4. Horn Electrode (not included)
5. Suspension composite insulator (not included)

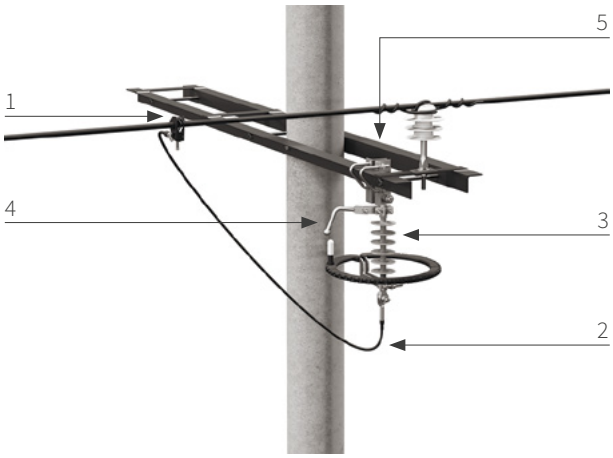


1. PIN/POST/PIN-POST

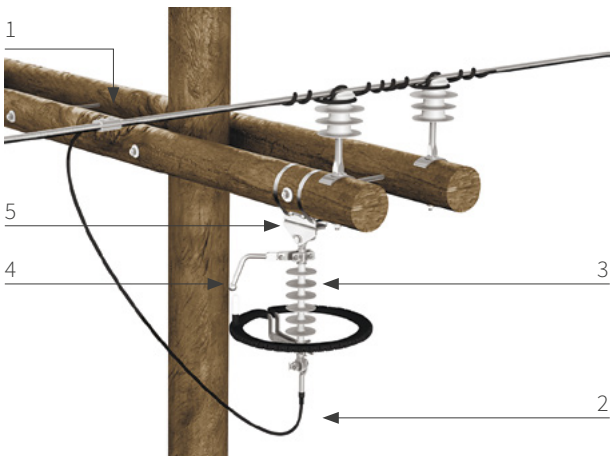
1A	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm
Notes: Maximum permissible size of cross-arm 150x130 mm	
Accessories required	1. Parallel groove clamp /shear head conductor clamp 2. Jumper FL27.1A / LL25.1A 3. Insulator BA3X.11 4. Horn electrode BH12.1B 5. Bracket CUCA.1B



1B	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm
Notes: Permissible size of L-bar 70x70...80x80 mm	
Accessories required	1. Parallel groove clamp /shear head conductor clamp 2. Jumper FL27.1A / LL25.1A 3. Insulator BA3X.11 4. Horn electrode BH12.1B 5. Bracket CLCB.1B

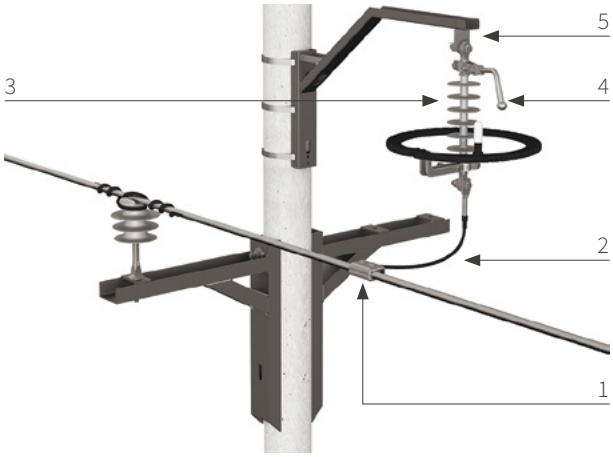


1C	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	Round
Point of connection	Cross-arm
Accessories required	1. Parallel groove clamp /shear head conductor clamp 2. Jumper FL27.1A / LL25.1A 3. Insulator BA3X.11 4. Horn electrode BH12.1B 5. Bracket CRCA.1B



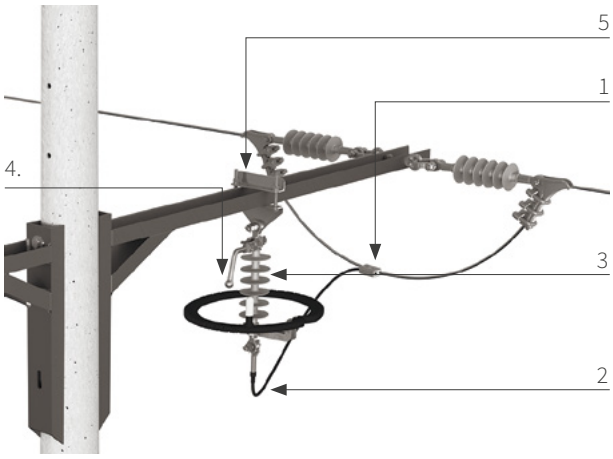
1. PIN/POST/PIN-POST

1D	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Round
Type of cross-arm	Any
Point of connection	Additional cross-arm
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp /shear head conductor clamp 2. Jumper FL27.1A / LL25.1A 3. Insulator BA3X.11 4. Horn electrode BH12.1B 5. Additional cross-arm BH01.AB



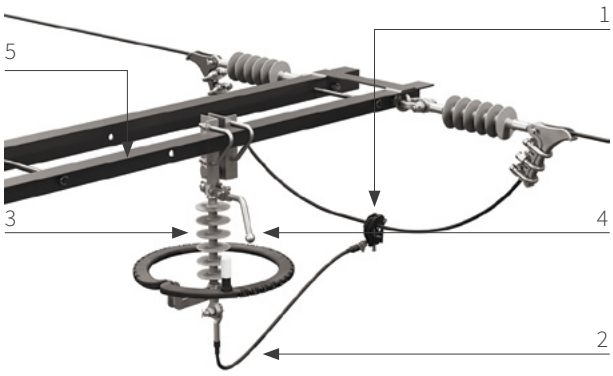
2. TENSION

2A	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm
Notes: Maximum permissible size of cross-arm 150x130 mm	
Accessories required	1. Parallel groove clamp /shear head conductor clamp 2. Jumper FL27.1A / LL25.1A 3. Insulator BA3X.11 4. Horn electrode BH12.1B 5. Bracket CUCA.1B

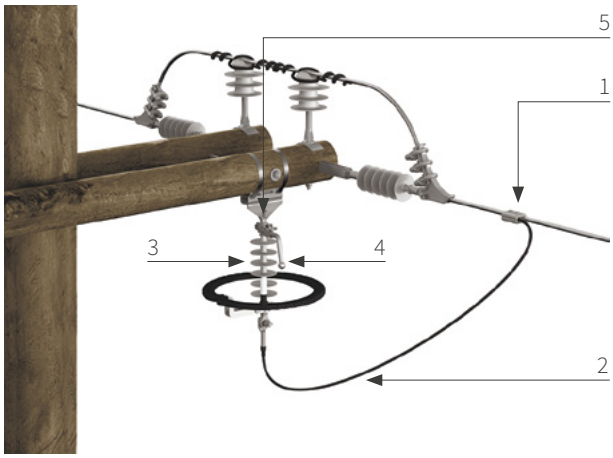


2. TENSION

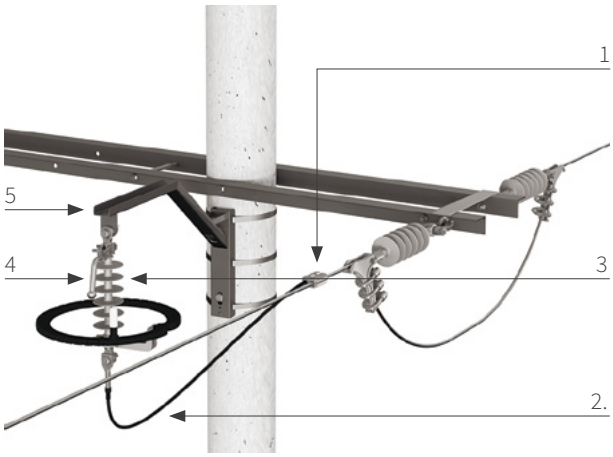
2B	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm
Notes: Permissible size of L-bar 70x70...80x80 mm	
Accessories required	1. Parallel groove clamp /shear head conductor clamp 2. Jumper FL27.1A / LL25.1A 3. Insulator BA3X.11 4. Horn electrode BH12.1B 5. Bracket CLCB.1B



2C	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	Round
Point of connection	Cross-arm
Accessories required	1. Parallel groove clamp /shear head conductor clamp 2. Jumper FL27.1A / LL25.1A 3. Insulator BA3X.11 4. Horn electrode BH12.1B 5. Bracket CRCA.1B

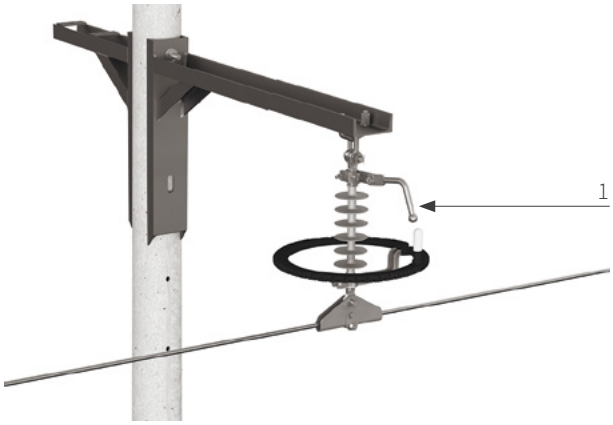


2D	
Type of line insulation	TENSION
Type of pole	Round
Type of cross-arm	Any
Point of connection	Additional cross-arm
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp /shear head conductor clamp 2. Jumper FL27.1A / LL25.1A 3. Insulator BA3X.11 4. Horn electrode BH12.1B 5. Additional cross-arm BH01.AB

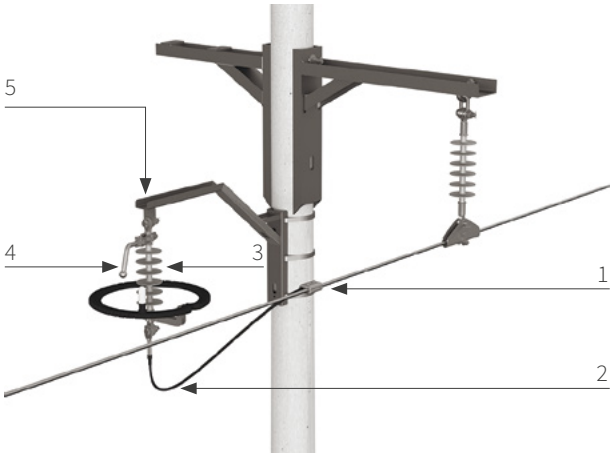


3. SUSPENSION

3A	
Type of line insulation	SUSPENSION (composite)
Type of pole	Any
Type of cross-arm	Any
Point of connection	Suspension insulator
Notes: This is the easiest and cheapest method, but it is essential that the size and shape of the isolator allows this. Otherwise check option 3B	
Accessories required	1. Horn electrode BH12.1B

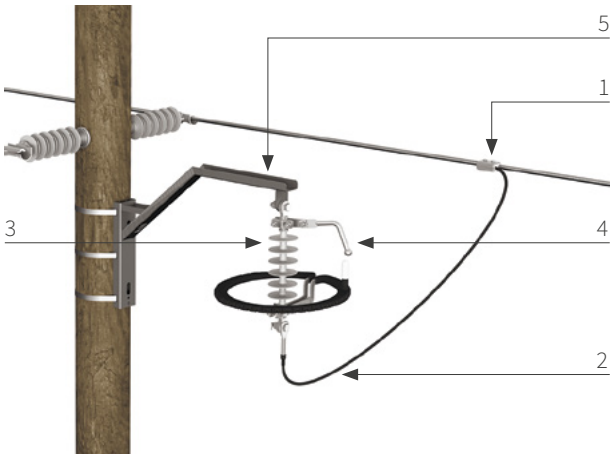


3B	
Type of line insulation	SUSPENSION (type: any)
Type of pole	Round
Type of cross-arm	Any
Point of connection	Additional cross-arm
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp /shear head conductor clamp 2. Jumper FL27.1A / LL25.1A 3. Insulator BA3X.11 4. Horn electrode BH12.1B 5. Additional cross-arm BH01.AB



4. HORIZONTAL/VERTICAL POST

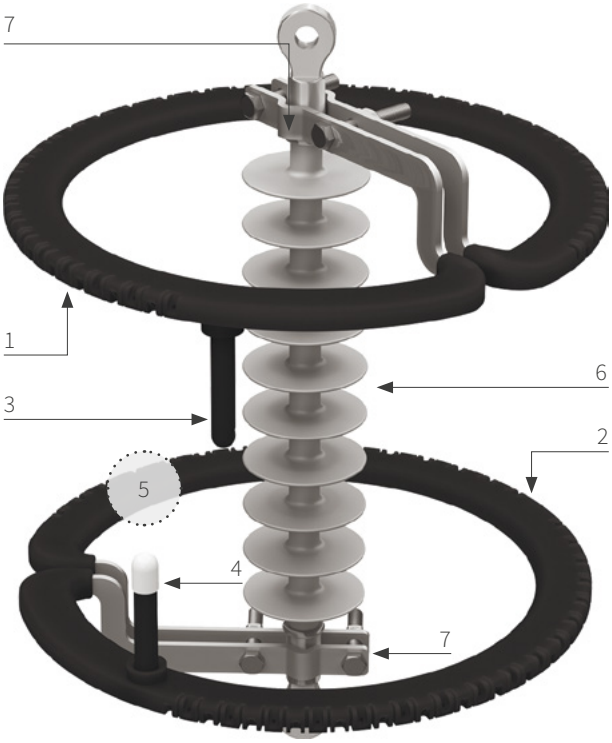
4A	
Type of line insulation	POST (Horizontal/Vertical)
Type of pole	Armless pole
Type of cross-arm	–
Point of connection	Pole
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp /shear head conductor clamp 2. Jumper FL27.1A / LL25.1A 3. Insulator BA3X.11 4. Horn electrode BH12.1B 5. Additional cross-arm BH01.AB



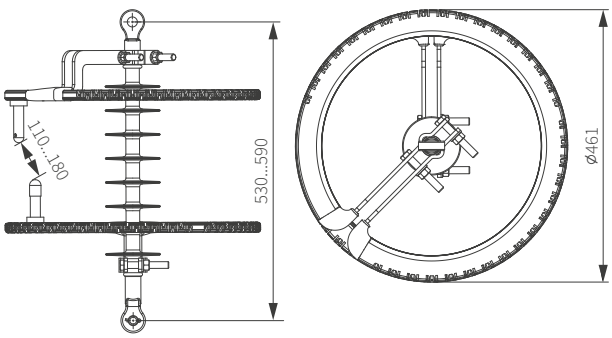
LLPD dM35z

Electrical Line Parameters	
Highest voltage for equipment*, kV	40.5
Maximum prospective fault current, kA	5
External air gap, mm	115–180
50% flashover voltage (180 mm air gap), kV	<200
Power frequency withstand voltage**, kV (wet/dry)	65/80
Lightning Parameters	
Lightning discharge capability (200 µs)***, C	2.8
High current impulse (4/10 µs), kA	65
Maximum quenching lightning current, kA	20 (8/50µs)
Minimum withstand amount of operations	10
General Parameters	
Additional power losses on the line, %	0
Average expected lifespan, years	30
UV resistance****, h	1000
Weight, kg	6.2
Maintenance	1 visual verification/ year
Reference	SAD.M35.Z.WW/920

* According to IEC 60038
** According to IEC 60071-1
*** According to IEC 60099-8
**** According to ISO 4892-2, method A, IEC 62217

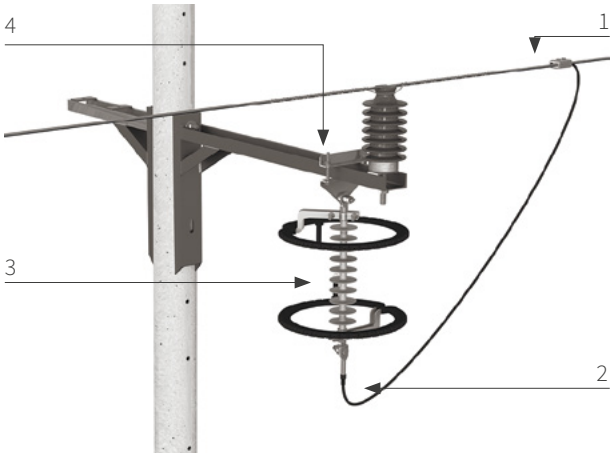


1. Upper module with EQ system
2. Lower module with EQ system
3. Terminal electrode
4. Terminal electrode with one-time glass indicator
5. Air gap
6. Suspension composite insulator (not included)
7. Attachment point

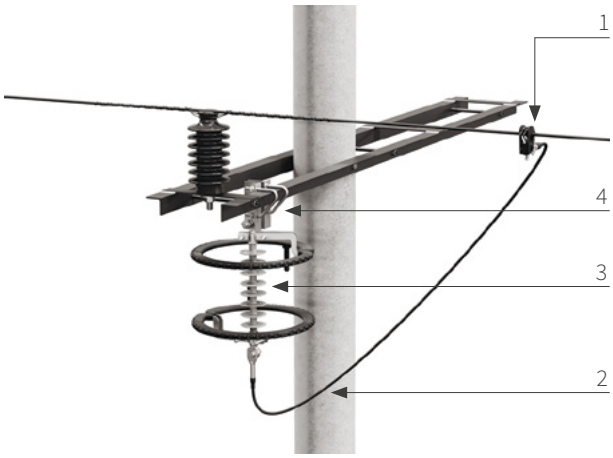


1. PIN/POST/PIN-POST

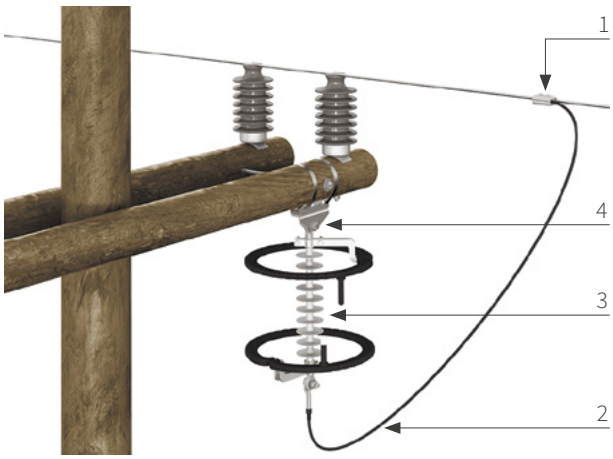
1A	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm
Notes: Maximum permissible size of cross-arm 150x130 mm	
Accessories required	1. Parallel groove clamp/ conductor clamp 0037.XA 2. Jumper FL27.1A / LL25.1A 3. Insulator CA3X.1X 4. Bracket CUCA.1B



1B	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm
Notes: Permissible size of L-bar 70x70...80x80 mm	
Accessories required	1. Parallel groove clamp/ conductor clamp 0037.XA 2. Jumper FL27.1A / LL25.1A 3. Insulator CA3X.1X 4. Bracket CLCB.1B

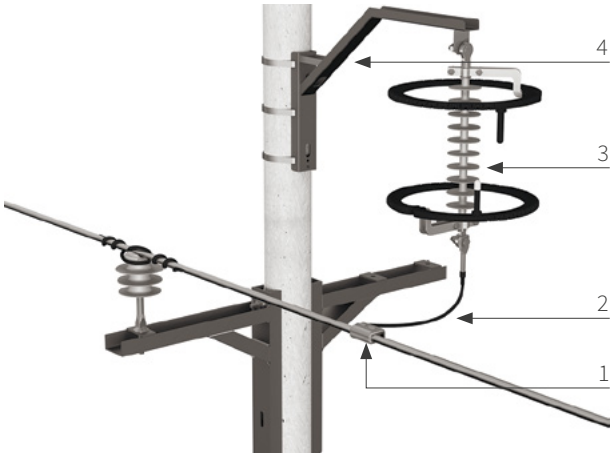


1C	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Any
Type of cross-arm	Round
Point of connection	Cross-arm
Accessories required	1. Parallel groove clamp/ conductor clamp 0037.XA 2. Jumper FL27.1A / LL25.1A 3. Insulator CA3X.1X 4. Bracket CRCA.1B



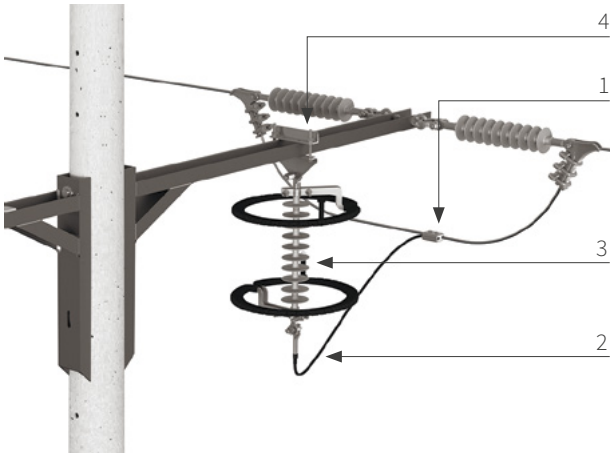
1. PIN/POST/PIN-POST

1D	
Type of line insulation	PIN/POST/PIN-POST
Type of pole	Round
Type of cross-arm	Any
Point of connection	Additional cross-arm
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp/ conductor clamp 0037.XA 2. Jumper FL27.1A / LL25.1A 3. Insulator CA3X.1X 4. Additional cross-arm BH01.AB

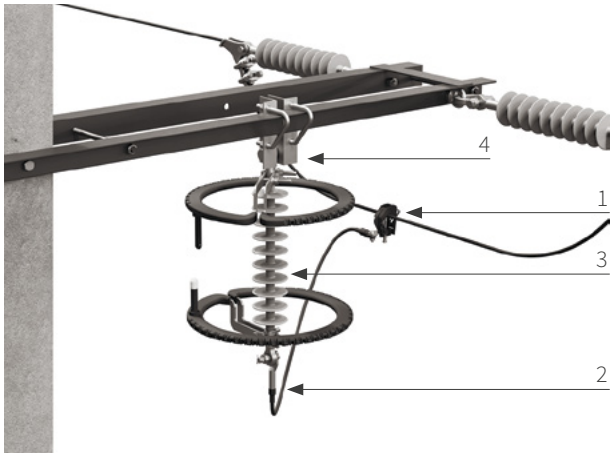


2. TENSION

2A	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm
Notes: Maximum permissible size of cross-arm 150x130 mm	
Accessories required	1. Parallel groove clamp/ conductor clamp 0037.XA 2. Jumper FL27.1A / LL25.1A 3. Insulator CA3X.1X 4. Bracket CUCA.1B

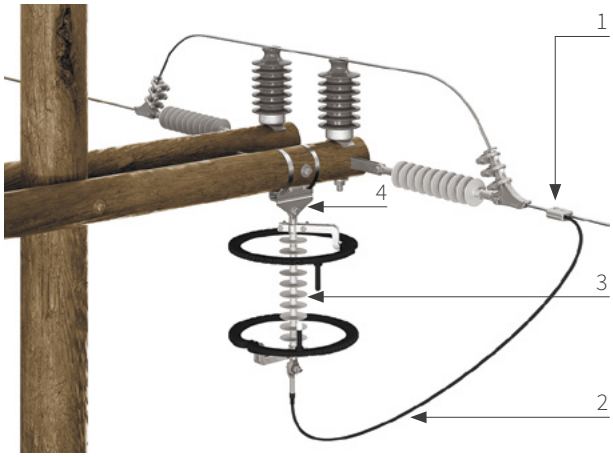


2B	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm
Notes: Permissible size of L-bar 70x70...80x80 mm	
Accessories required	1. Parallel groove clamp/ conductor clamp 0037.XA 2. Jumper FL27.1A / LL25.1A 3. Insulator CA3X.1X 4. Bracket CLCB.1B

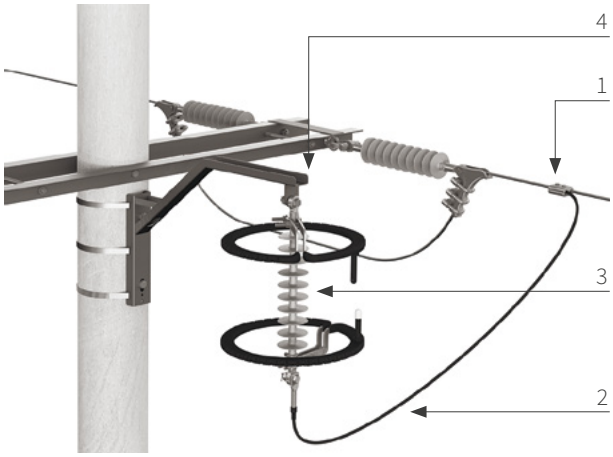


2. TENSION

2C	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	Round
Point of connection	Cross-arm
Accessories required	1. Parallel groove clamp/ conductor clamp 0037.XA 2. Jumper FL27.1A / LL25.1A 3. Insulator CA3X.1X 4. Bracket CRCA.1B



2D	
Type of line insulation	TENSION
Type of pole	Round
Type of cross-arm	Any
Point of connection	Additional cross-arm
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp/ conductor clamp 0037.XA 2. Jumper FL27.1A / LL25.1A 3. Insulator CA3X.1X 4. Additional cross-arm BH01.AB

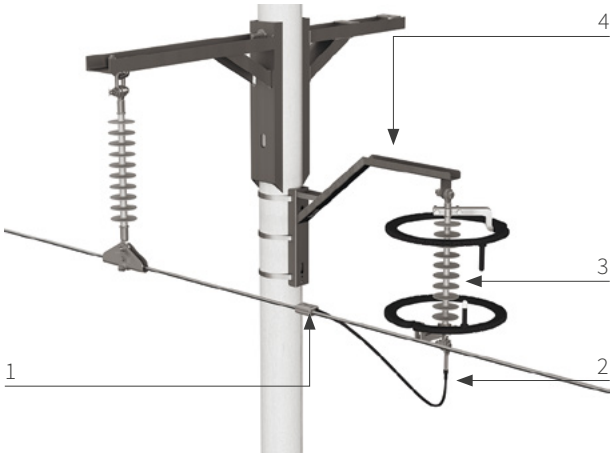


3. SUSPENSION

3A	
Type of line insulation	SUSPENSION (composite)
Type of pole	Any
Type of cross-arm	Any
Point of connection	Suspension insulator
Notes: This is the easiest and cheapest method, but it is essential that the size and shape of the isolator allows this. Otherwise check option 3B	
No accessories are required	

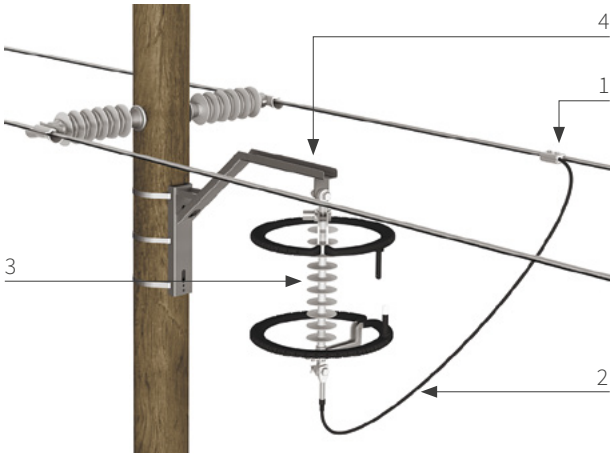
3. SUSPENSION

3B	
Type of line insulation	SUSPENSION (type: any)
Type of pole	Round
Type of cross-arm	Any
Point of connection	Additional cross-arm
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp/ conductor clamp 0037.XA 2. Jumper FL27.1A / LL25.1A 3. Insulator CA3X.1X 4. Additional cross-arm BH01.AB



4. HORIZONTAL/VERTICAL POST

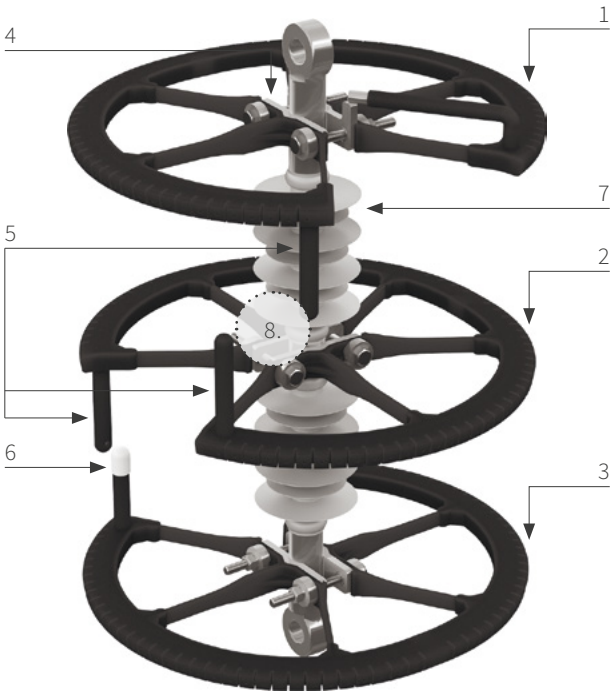
4A	
Type of line insulation	POST (Horizontal/Vertical)
Type of pole	Round or tangent armless pole
Type of cross-arm	–
Point of connection	Pole
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp/ conductor clamp 0037.XA 2. Jumper FL27.1A / LL25.1A 3. Insulator CA3X.1X 4. Additional cross-arm BH01.AB



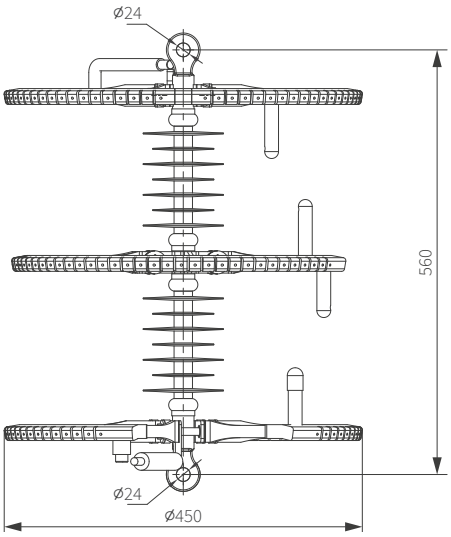
LLPD d45z

Electrical Line Parameters	
Highest voltage for equipment*, kV	52
Maximum prospective fault current, kA	5
External air gap, mm	80+80
50% flashover voltage, kV (80+80 mm air gap)	<280
Power frequency withstand voltage**, kV (wet/dry)	95/95
Lightning Parameters	
Lightning discharge capability (200 µs)***, C	2.8
High current impulse (4/10 µs), kA	65
Maximum quenching lightning current, kA	20 (8/50µs)
Minimum withstand amount of operations	10
General Parameters	
Additional power losses on the line, %	0
Average expected lifespan, years	30
UV resistance****, h	1000
Weight, kg	7
Maintenance	1 visual verification/ year
Reference	SAD.045.Z.WW/930

* According to IEC 60038
** According to IEC 60071-1
*** According to IEC 60099-8
**** According to ISO 4892-2, method A, IEC 62217

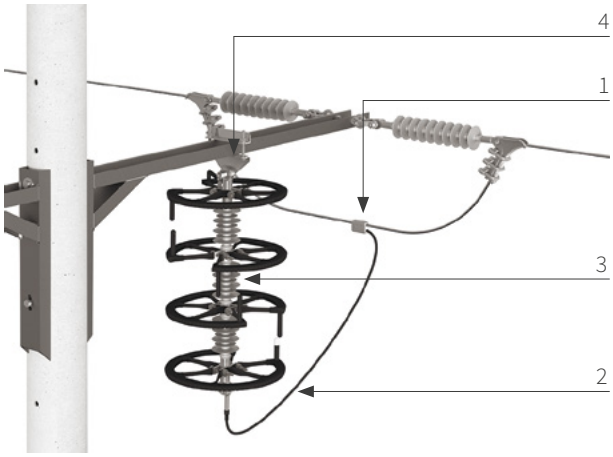


1. Upper module with EQ system
2. Intermediate module with EQ system
3. Lower module with EQ system
4. Insulating load-bearing frame
5. Terminal electrodes
6. Terminal electrode with one-time glass indicator
7. Suspension composite insulator (not included)
8. Air gap

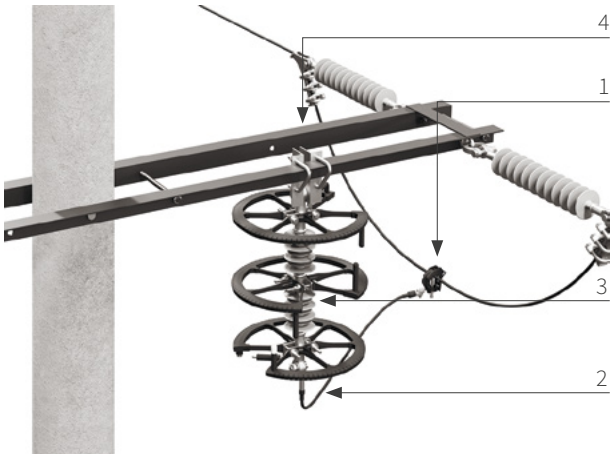


2. TENSION

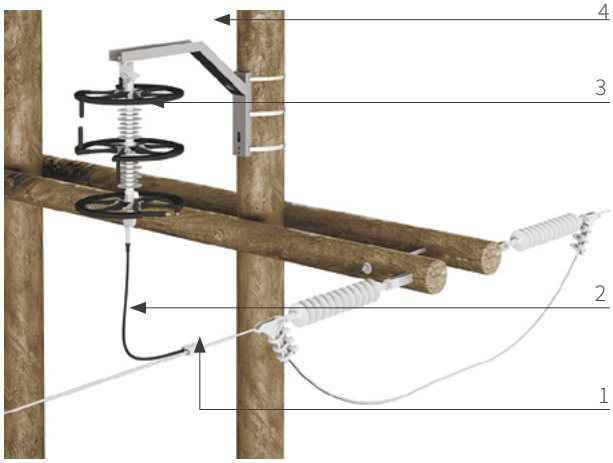
2A	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm
Notes: Maximum permissible size of cross-arm 150x130 mm	
Accessories required	1. Parallel groove clamp (out of STREAMER product range) 2. Jumper FL27.1A 3. Insulator DB3A.11 4. Bracket CUCA.1B



2B	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm
Notes: Permissible size of L-bar 70x70...80x80 mm	
Accessories required	1. Parallel groove clamp (out of STREAMER product range)/conductor clamp 0037.XA 2. Jumper FL27.1A 3. Insulator DB3A.11 4. Bracket CLCB.1B

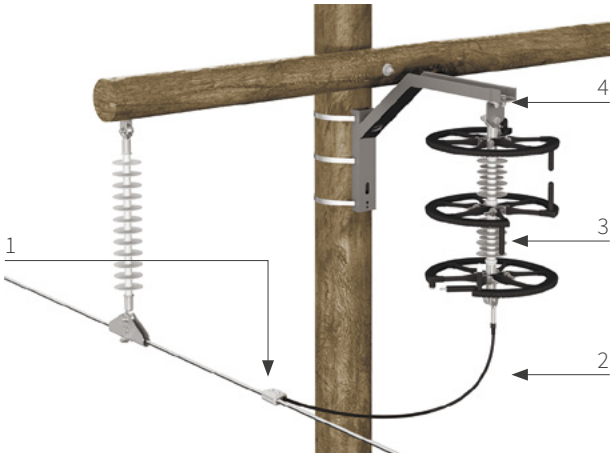


2C	
Type of line insulation	TENSION
Type of pole	Round
Type of cross-arm	Any
Point of connection	Additional cross-arm
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp (out of STREAMER product range) 2. Jumper FL27.1A 3. Insulator DB3A.11 4. Additional cross-arm BH02.AB



3. SUSPENSION

3A	
Type of line insulation	SUSPENSION
Type of pole	Round
Type of cross-arm	Any
Point of connection	Additional cross-arm
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp (out of STREAMER product range) 2. Jumper FL27.1A 3. Insulator DB3A.11 4. Additional cross-arm BH02.AB

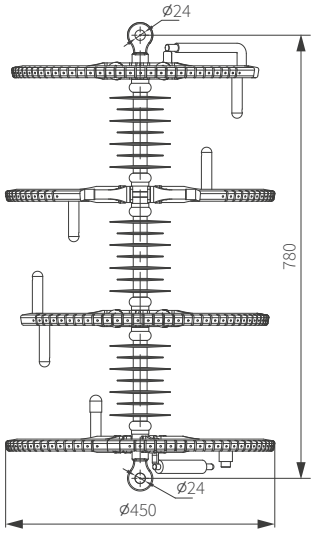


LLPD d69z

Electrical Line Parameters	
Highest voltage for equipment*, kV	72.5
Maximum prospective fault current, kA	5
External air gap, mm	80+80+120
50% flashover voltage (75+75+115 mm air gap), kV	<440
Power frequency withstand voltage**, kV (wet/dry)	140/140
Lightning Parameters	
Lightning discharge capability (200 µs)***, C	2.8
High current impulse (4/10 µs), kA	65
Maximum quenching lightning current, kA	20 (8/50µs)
Minimum withstand amount of operations	10
General Parameters	
Additional power losses on the line, %	0
Average expected lifespan, years	30
UV resistance****, h	1000
Weight, kg	9.3
Maintenance	1 visual verification/ year
Reference	SAD.069.Z.WW/920

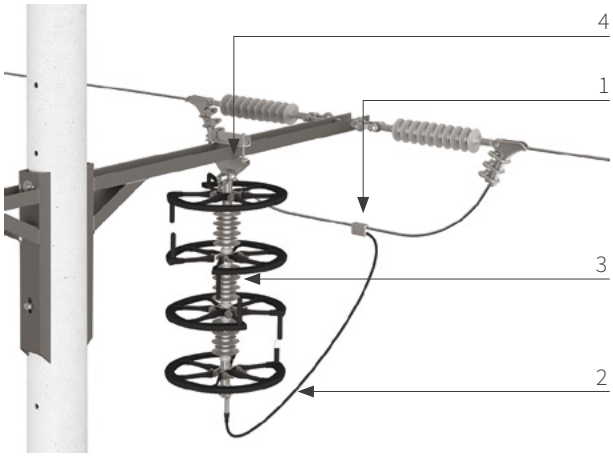
* According to IEC 60038
** According to IEC 60071-1
*** According to IEC 60099-8
**** According to ISO 4892-2, method A, IEC 62217

1. Upper module with EQ system
2. Intermediate module with EQ system 1
3. Intermediate module with EQ system 2
4. Lower module with EQ system
5. Insulating load-bearing frame
6. Terminal electrodes
7. Terminal electrode with one-time glass indicator
8. Suspension composite insulator (not included)
9. Air gap

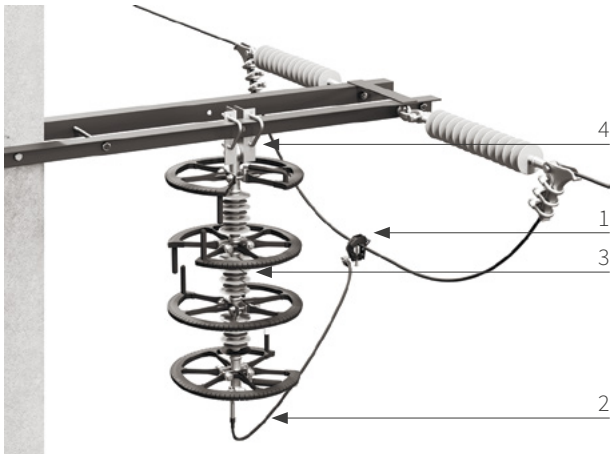


2. TENSION

2A	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm
Notes: Maximum permissible size of cross-arm 150x130 mm	
Accessories required	1. Parallel groove clamp (out of STREAMER product range) 2. Jumper FL27.1A 3. Insulator EB3A.11 4. Bracket CUCA.1B



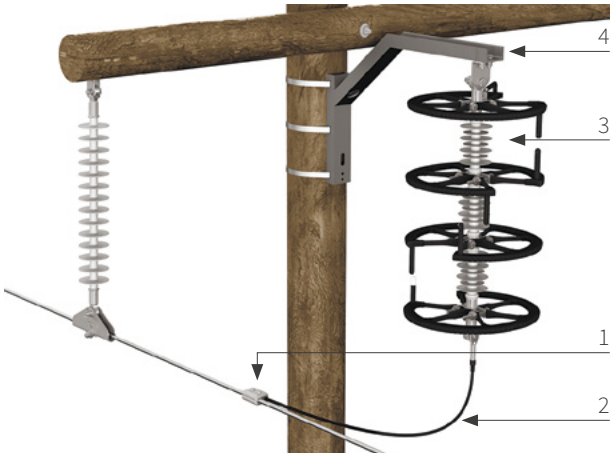
2B	
Type of line insulation	TENSION
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm
Notes: Permissible size of L-bar 70x70...80x80 mm	
Accessories required	1. Parallel groove clamp (out of STREAMER product range) /conductor clamp | 0037.XA 2. Jumper FL27.1A 3. Insulator EB3A.11 4. Bracket CLCB.1B



2C	
Type of line insulation	TENSION
Type of pole	Round
Type of cross-arm	Any
Point of connection	Additional cross-arm
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp (out of STREAMER product range) 2. Jumper FL27.1A 3. Insulator EB3A.11 4. Additional cross-arm BH02.AB

3. SUSPENSION

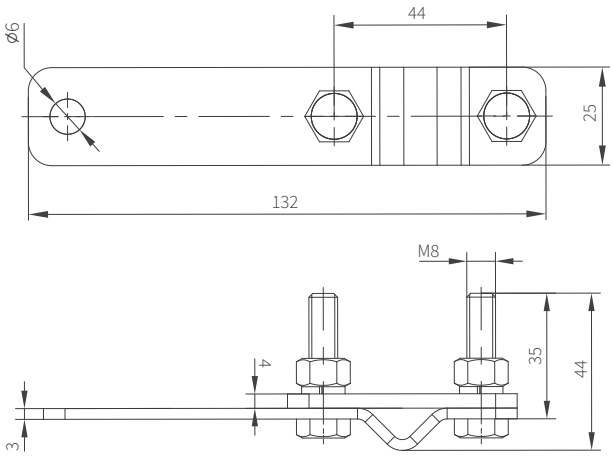
3A	
Type of line insulation	SUSPENSION
Type of pole	Round
Type of cross-arm	Any
Point of connection	Additional cross-arm
Notes: The most versatile way of installation; doesn't depend on type of line insulation	
Accessories required	1. Parallel groove clamp (out of STREAMER product range) 2. Jumper FL27.1A 3. Insulator EB3A.11 4. Additional cross-arm BH02.AB



CONDUCTOR CLAMPS (NON-INSULATED)

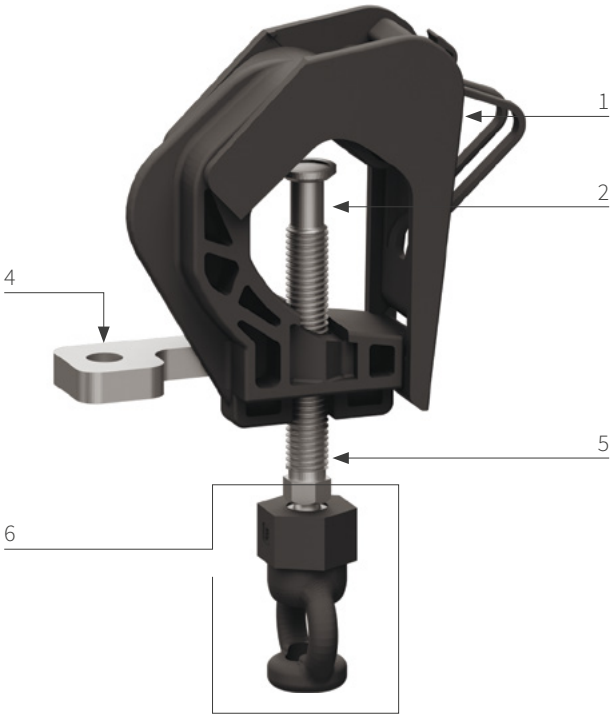
BA04.1B

Technical data	
Minimum external diameter of conductor, mm	8
Maximum external diameter of conductor, mm	25
Material	Stainless Steel
Coating	No
Weight, kg	0.17
Type of conductor	Bare
Reference	LL.CL.BA04.1B.WW



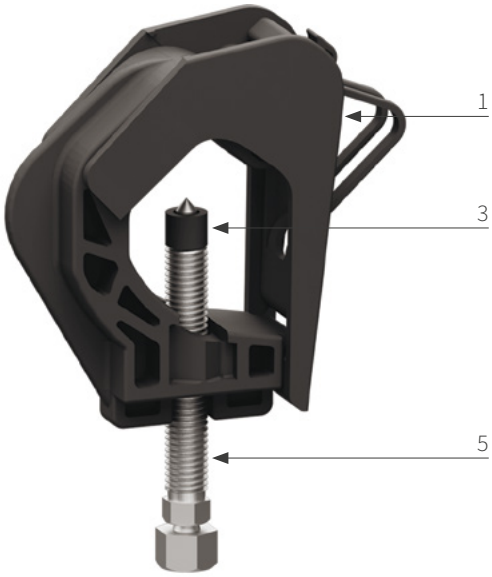
SHEAR HEAD CONDUCTOR CLAMPS

NON-PIERCING



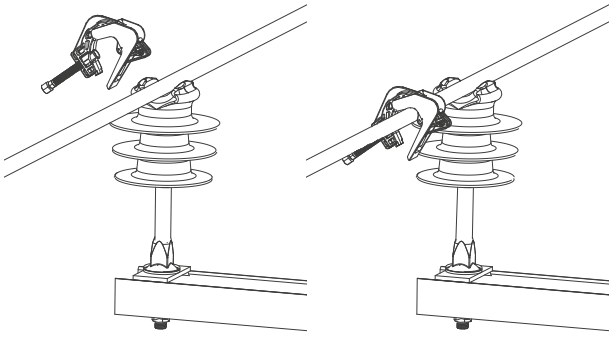
1. Clamp body
2. Non-piercing electrode
3. Piercing electrode
4. Jumper connection plate
5. Pointing on threaded pin
6. Hotstick connection ring

PIERCING

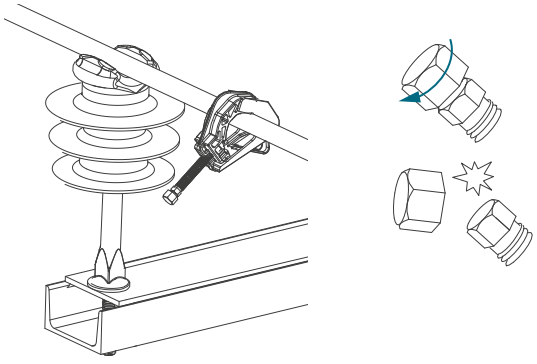


- Can be installed on live-line
- Clamp pierce cable insulation up to 8 mm of thickness
- Seals piercing point thanks to IP55 protection
- Doesn`t damage cable core
- Provides optimal torque thanks to shear head
- Suitable for almost all external diameters of conductor

INSTALLATION OF THE CLAMP TO THE CONDUCTOR



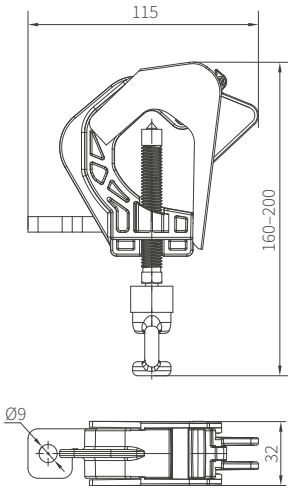
Install the clamp on the conductor



Tighten until a break off of shear head

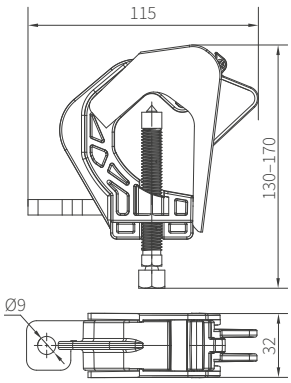
0837.LA

Technical data	
Hot-stick connection ring	+
Jumper connection plate	+
Minimum external diameter of conductor, mm	16
Maximum external diameter of conductor, mm	37
Weight, kg	8
Type of conductor	0.14
Reference	LL.CC.0837.LA.WW



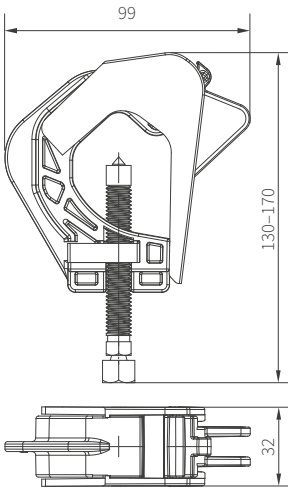
0837.0A

Technical data	
Hot-stick connection ring	–
Jumper connection plate	+
Minimum external diameter of conductor, mm	16
Maximum external diameter of conductor, mm	37
Weight, kg	8
Type of conductor	0.13
Reference	LL.CC.0837.0A.WW



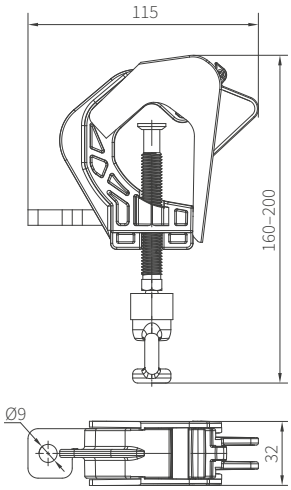
0837.00

Technical data	
Hot-stick connection ring	–
Jumper connection plate	–
Minimum external diameter of conductor, mm	16
Maximum external diameter of conductor, mm	37
Weight, kg	8
Type of conductor	0.11
Reference	LL.CC.0837.00.WW



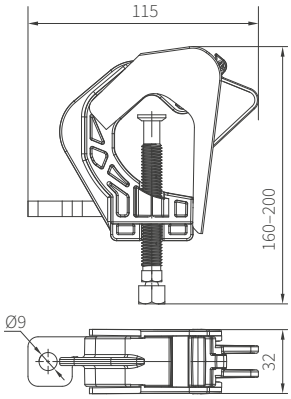
0037.LA

Technical data	
Hot-stick connection ring	+
Jumper connection plate	+
Minimum external diameter of conductor, mm	6
Maximum external diameter of conductor, mm	24
Weight, kg	0.14
Reference	LL.CB.0037.LA.WW



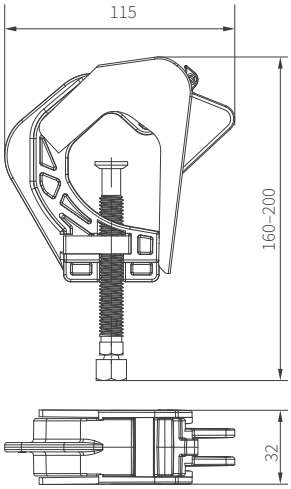
0037.0A

Technical data	
Hot-stick connection ring	–
Jumper connection plate	+
Minimum external diameter of conductor, mm	6
Maximum external diameter of conductor, mm	24
Weight, kg	0.13
Reference	LL.CB.0037.0A.WW



0037.00

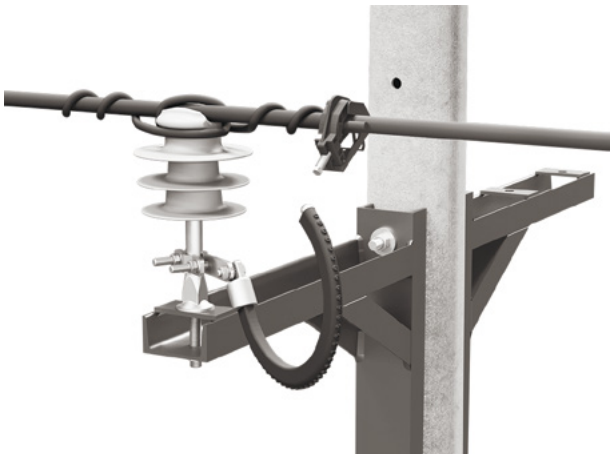
Technical data	
Hot-stick connection ring	–
Jumper connection plate	–
Minimum external diameter of conductor, mm	6
Maximum external diameter of conductor, mm	24
Weight, kg	0.11
Reference	LL.CB.0037.00.WW



SHEAR HEAD CONDUCTOR CLAMPS

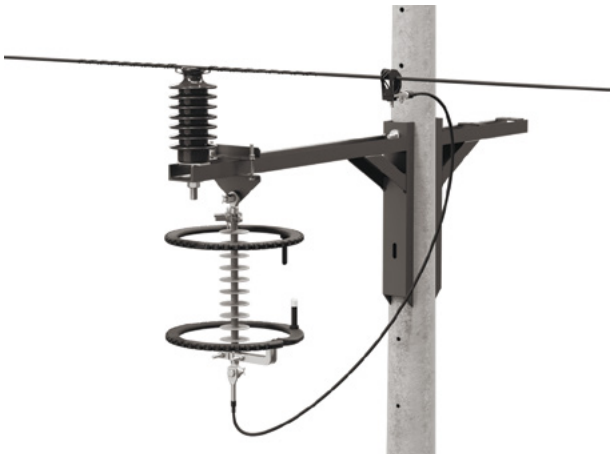
INSTALLATION WITH LLPD

INSTALLATION OF LLPDS WITHOUT JUMPER



Compatible with
LLPD i20z
LLPD d10z
LLPD dC20z

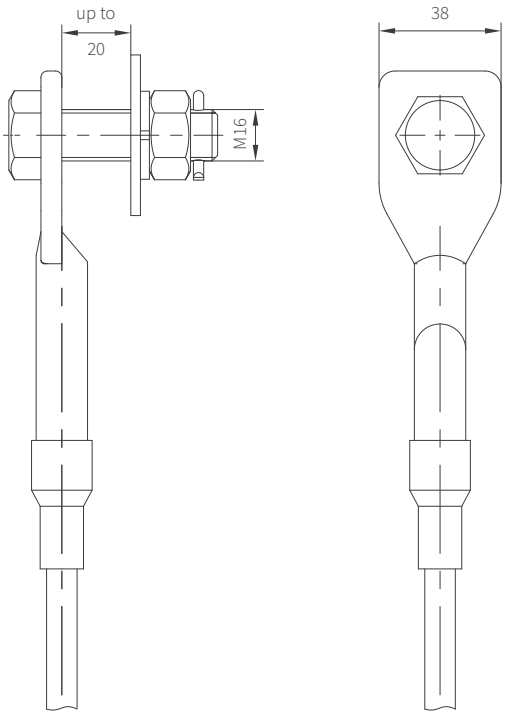
INSTALLATION OF LLPDS WITH JUMPER



Compatible with
LLPD d24z
LLPD dM35z

JUMPERS

FL27.1A

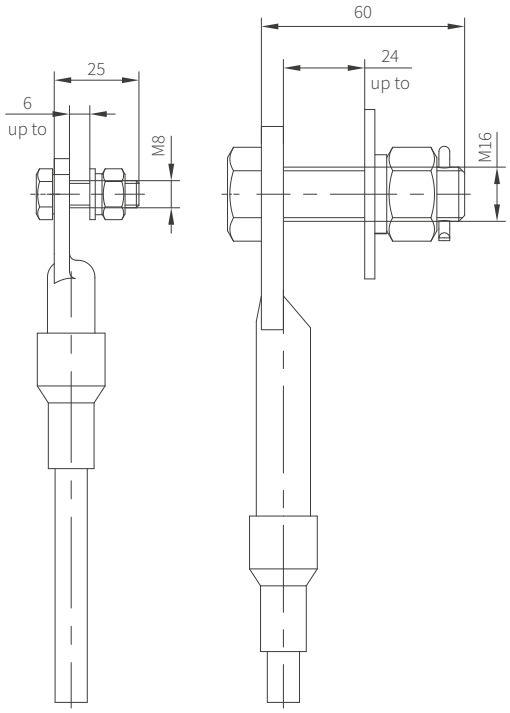


Technical data	
Length, m	3
Terminal 1 connection option	Free end (for parallel groove clamp)
Terminal 2 connection option	Cable lug
Thickness of insulation layer, mm	2.5
Weight, kg	0.65
Length can be adjusted on-site	

Compatible with
LLPD d24z
LLPD dM35z
LLPD d45z
LLPD d69z
Reference
LL.JU.FL27.1A.WW

JUMPERS

LL25.1A

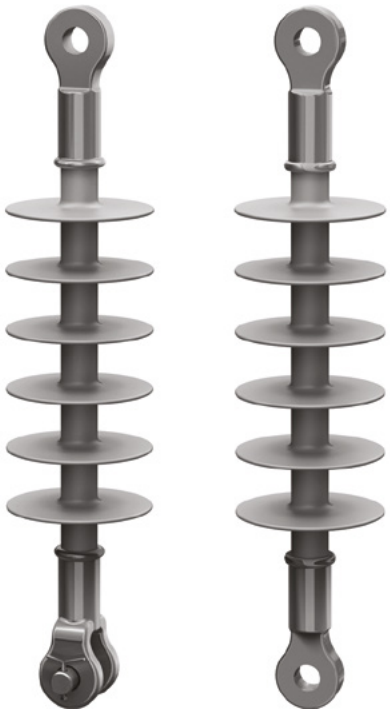


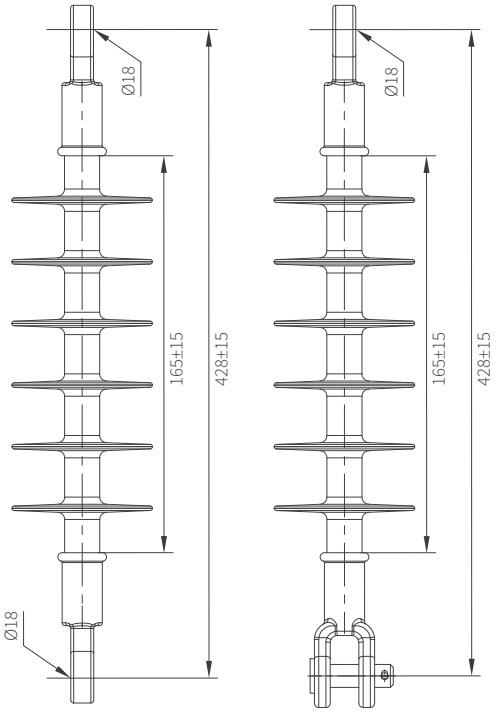
Technical data	
Length, m	2.5
Terminal 1 connection option	Cable lug
Terminal 2 connection option	Cable lug (for shear head conductor clamps)
Thickness of insulation layer, mm	2.5
Weight, kg	0.57
Length can be adjusted on-site	

Compatible with
LLPD d24z
LLPD dM35z
LLPD d45z
LLPD d69z
LL.CC.0837.LA.WW
LL.CC.0837.0A.WW
LL.CB.0037.LA.WW
LL.CB.0037.0A.WW
Reference
LL.JU.LL25.1A.WW

INSULATORS

BA3X.11



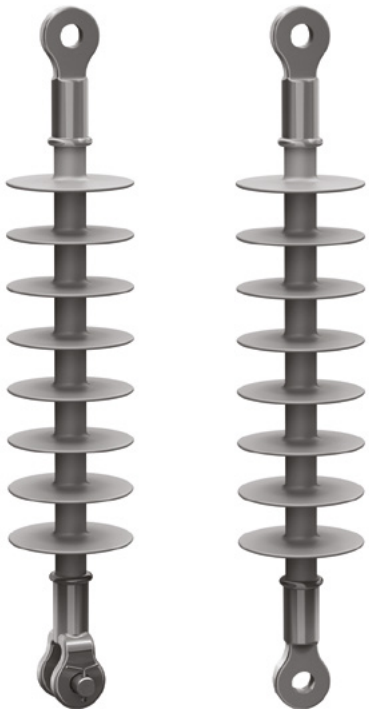


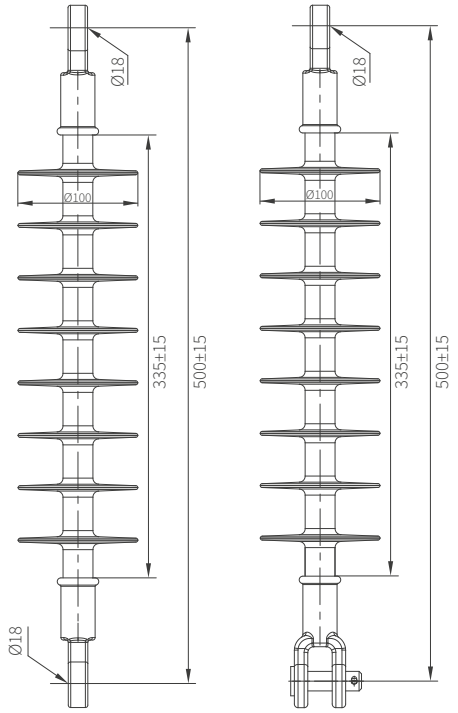
Technical data	
Nominal voltage, kV	20
Highest voltage for equipment, kV	24
Rated frequency, Hz	48–62
Power-frequency withstand voltage, kV	50
Specified Mechanical Load (SML), kN	70
Creepage distance, mm	686
Weight, kg	1.43

Compatible with	
LLPD d24z	
Reference	
LL.IN.BA3B.11.TH	Grey, clevis/tongue
LL.IN.BA3A.11.TH	Grey, tongue/tongue

INSULATORS

CA3X.11



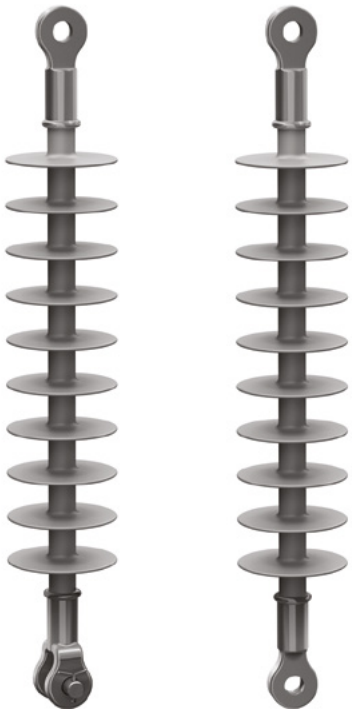


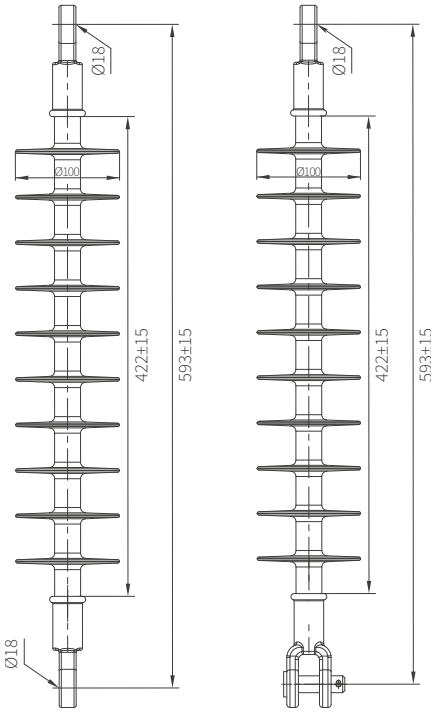
Technical data	
Nominal voltage, kV	35
Highest voltage for equipment, kV	40.5
Rated frequency, Hz	48–62
Power-frequency withstand voltage, kV	80
Specified Mechanical Load (SML), kN	70
Creepage distance, mm	914
Weight, kg	1.6

Compatible with	
LLPD dM35z	
Reference	
LL.IN.CA3B.11.TH	Grey, clevis/tongue
LL.IN.CA3A.11.TH	Grey, tongue/tongue

INSULATORS

CA3X.12



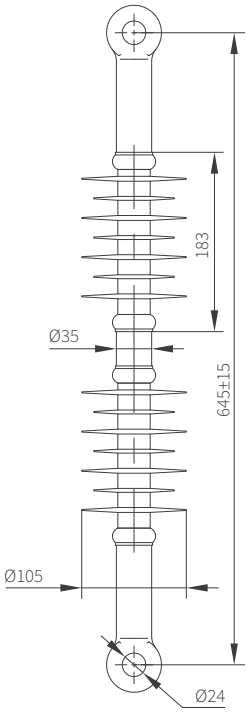


Technical data	
Nominal voltage, kV	35
Highest voltage for equipment, kV	40.5
Rated frequency, Hz	48–62
Power-frequency withstand voltage, kV	80
Specified Mechanical Load (SML), kN	70
Creepage distance, mm	1137
Weight, kg	1.66

Compatible with	
LLPD dM35z	
Reference	
LL.IN.CA3B.12.TH	Grey, clevis/tongue
LL.IN.CA3A.12.TH	Grey, tongue/tongue

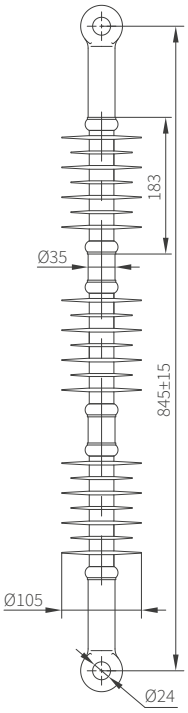
INSULATORS

DB3A.11



Technical data	
Nominal voltage, kV	45
Highest voltage for equipment, kV	52
Rated frequency, Hz	48–62
Power-frequency withstand voltage, kV	95
Specified Mechanical Load (SML), kN	160
Creepage distance, mm	1130
Weight, kg	3.3
Compatible with	
LLPD d45z	
Reference	
LL.IN. DB3A.11.CN	Grey, tongue/tongue

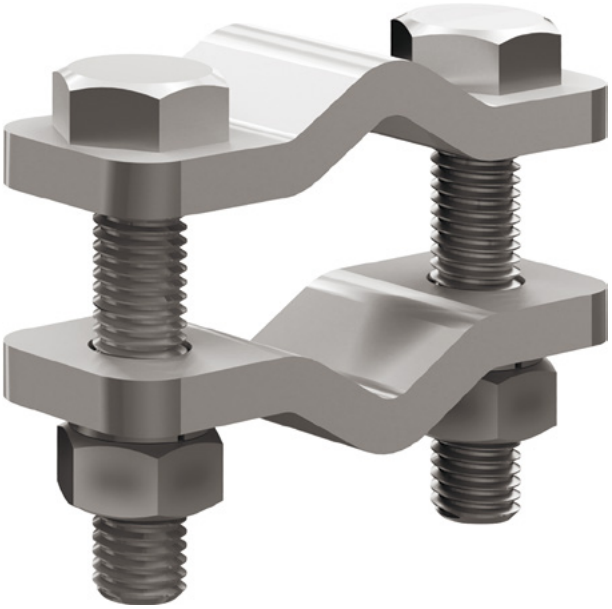
EB3A.11

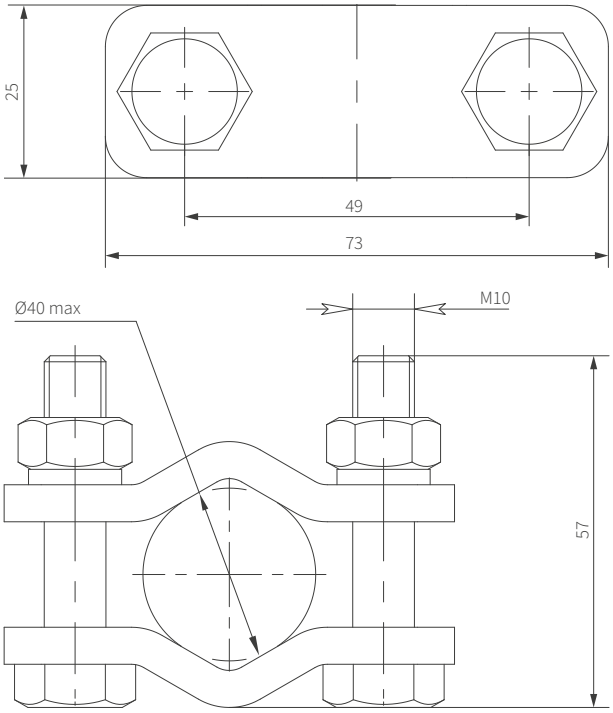


Technical data	
Nominal voltage, kV	69
Highest voltage for equipment, kV	72.5
Rated frequency, Hz	48–62
Power-frequency withstand voltage, kV	140
Specified Mechanical Load (SML), kN	160
Creepage distance, mm	1730
Weight, kg	4
Compatible with	
LLPD d69z	
Reference	
LL.IN.EB3A.11.CN	Grey, tongue/tongue

HORN ELECTRODES

BH10.1B



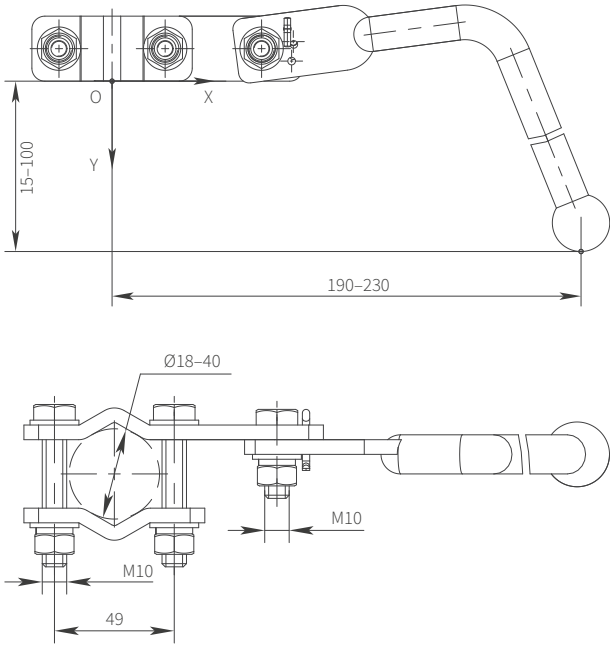


Technical data	
Horn electrode length, mm	0
Maximum external diameter of insulator end fitting, mm	40
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	0.27

Compatible with
LLPD d10z (in case of installation directly on a tension insulator), check case 2A
Reference
LL.HR.BH10.1B.WW

HORN ELECTRODES

BH11.1B

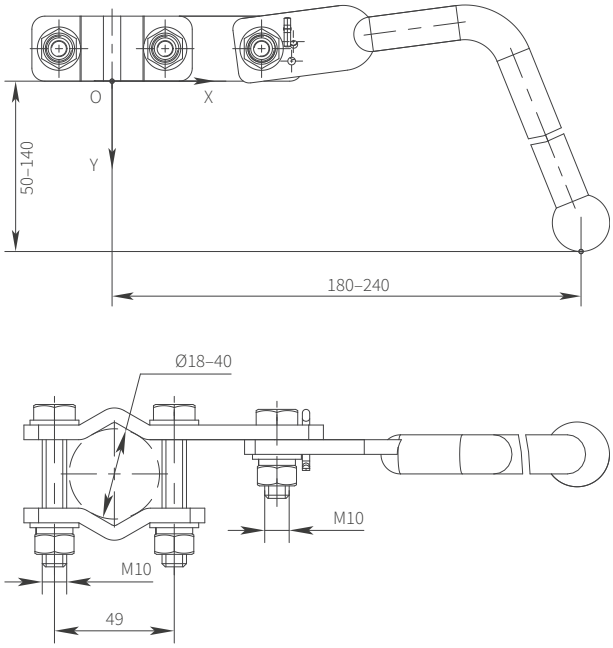


Technical data	
Horn electrode length, mm	75
Maximum external diameter of insulator end fitting, mm	40
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	0.77

Compatible with	
LLPD i20z (in case of installation directly on a tension insulator) check case 2A	Page 26
Reference	
LL.HR.BH11.1B.WW	

HORN ELECTRODES

BH12.1B

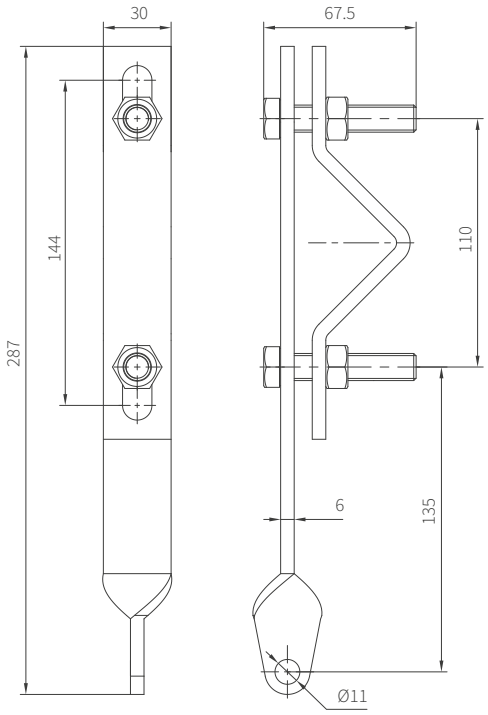


Technical data	
Horn electrode length, mm	115
Maximum external diameter of insulator end fitting, mm	40
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	0.81

Compatible with
LLPD d24z
Reference
LL.HR.BH12.1B.WW

BRACKETS

CLAA.1B

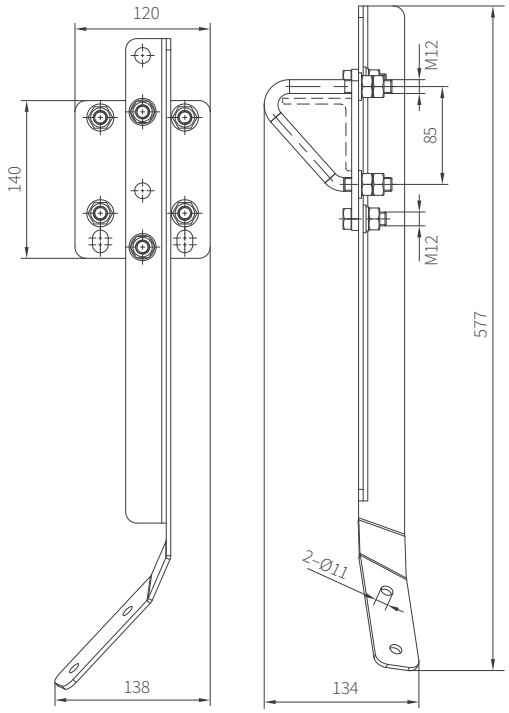


Technical data	
Minimum permissible size of L-bar, mm	60x60
Maximum permissible size of L-bar, mm	90x90
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	0.78
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm

Compatible with		
LLPD i20z 1d	1D	Page 26
LLPD i20z 2d	2D	Page 27
Reference		
LL.BR.CLAA.1B.WW		

BRACKETS

CLBA.XB

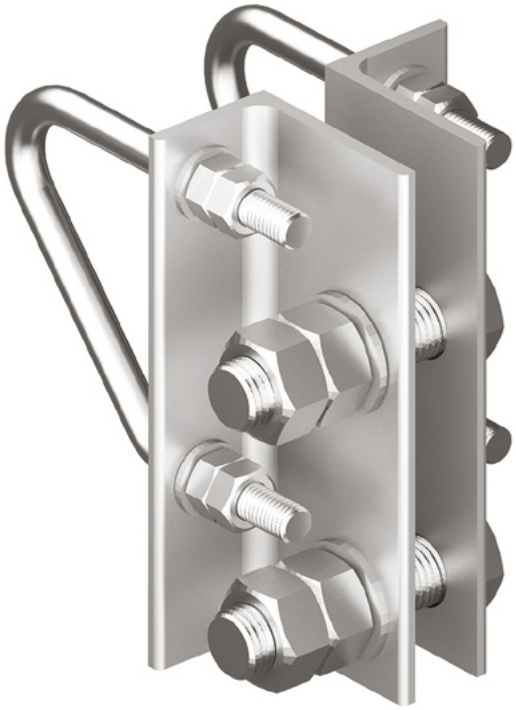


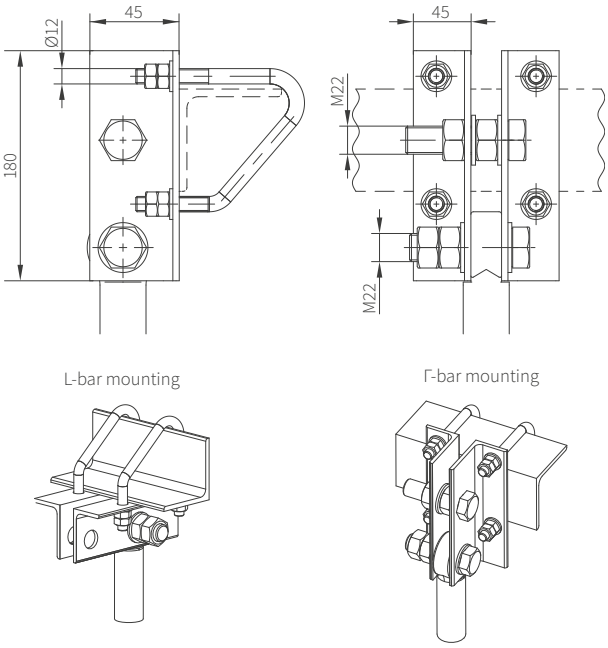
Technical data	
Permissible size of L-bar, mm	60x60 (CLBA.1B)
	90x90 (CLBA.2B)
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	2.7-2.8
Type of pole	Any
Type of cross-arm	L-bar
Point of connection	Cross-arm

Compatible with		
LLPD dC20z	1B	Page 31
LLPD dC20z	2B	Page 32
Reference		
LL.BR.CLBA.1B.WW for L-bar 60x60 mm		
LL.BR.CLBA.2B.WW for L-bar 90x90 mm		

BRACKETS

CLCB.1B





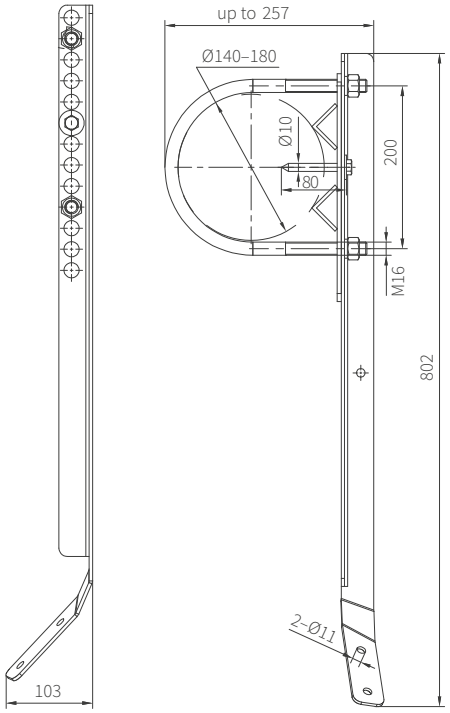
Technical data	
Permissible size of Г-/L- shape L-bar , mm	70x70 … 80x80
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	3.2
Type of pole	Any
Type of cross-arm	Г/L-bar
Point of connection	Cross-arm

Compatible with					
LLPD d24z	1B	Page 35	LLPD d45z	2B	Page 45
	2B	Page 37	LLPD d69z	2B	Page 48
LLPD dM35z	1B	Page 40			
	2B	Page 41			

Reference
LL.BR.CLCB.1B.WW

BRACKETS

CRBA.1B

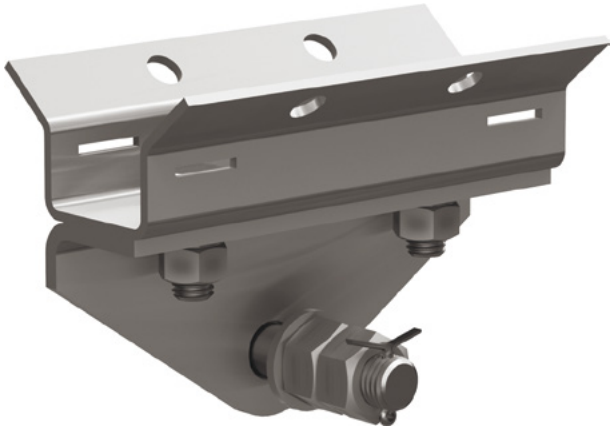


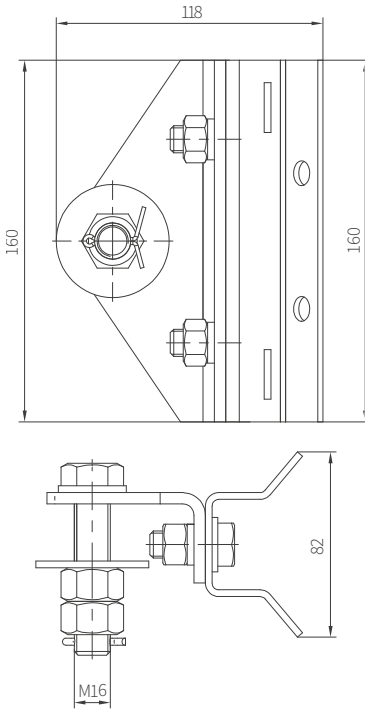
Technical data	
Permissible diameter of cross-arm, mm	140 –180
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	2.5
Type of pole	Any
Type of cross-arm	Round wooden
Point of connection	Cross-arm

Compatible with		
LLPD dC20z	1C	Page 31
LLPD dC20z	2C	Page 32
Reference		
LL.BR.CRBA.1B.WW		

BRACKETS

CRCA.1B



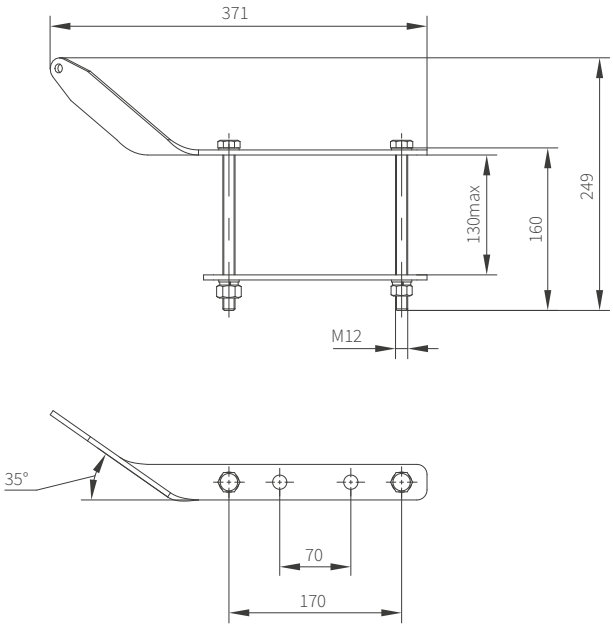


Technical data	
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	1.35
Type of pole	Any
Type of cross-arm	Round
Point of connection	Cross-arm

Compatible with					
LLPD d24z	1C	Page 35	LLPD dM35z	1C	Page 40
	2C	Page 37		2C	Page 42
Reference					
LL.BR.CRCA.1B.WW					

BRACKETS

CUAA.1B

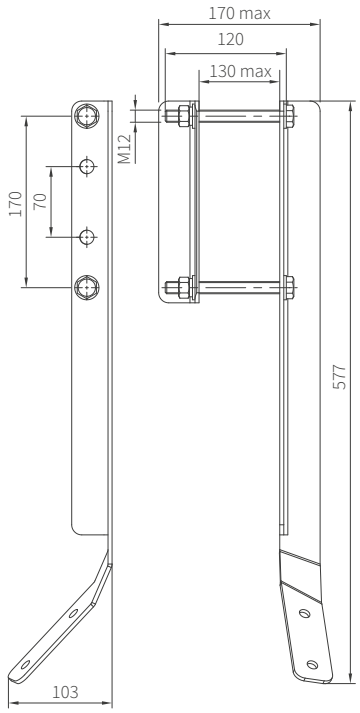


Technical data	
Max. permissible size of cross-arm (WxH), mm	150x130
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	1.17
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm

Compatible with		
LLPD i20z	1C	Page 25
	2C	Page 27
Reference		
LL.BR.CUAA.1B.WW		

BRACKETS

CUBA.1B

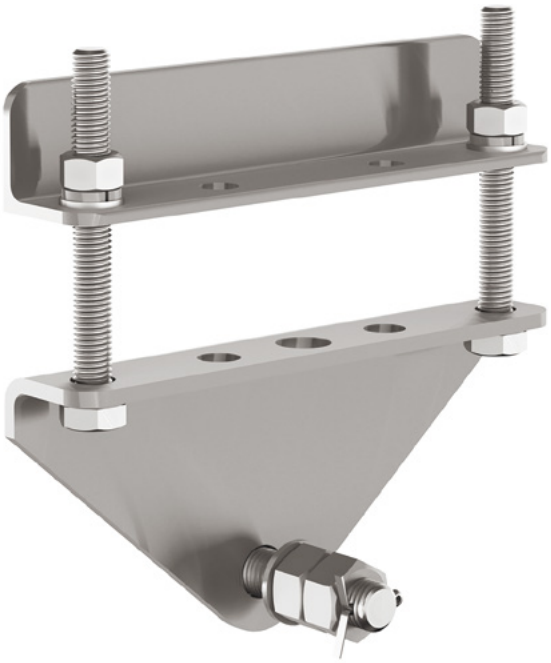


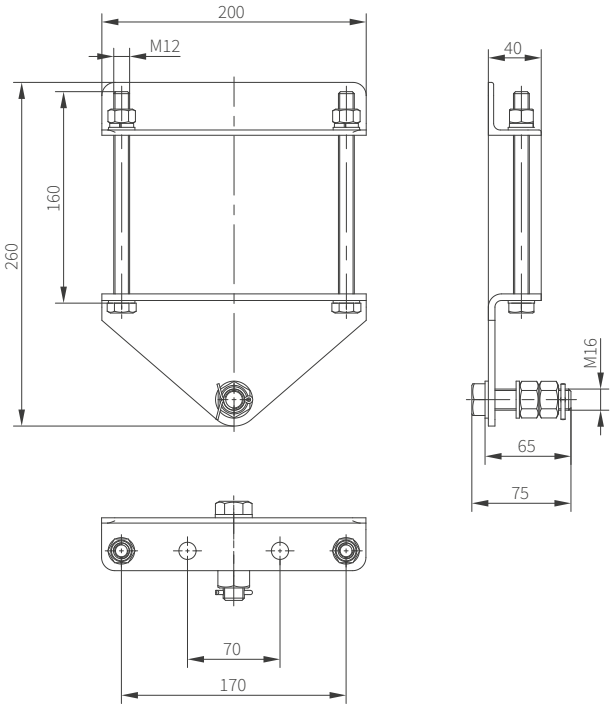
Technical data	
Max. permissible size of cross-arm (WxH), mm	150x130
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	1.95
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm

Compatible with		
LLPD dC20z	1A	Page 31
	2A	Page 32
Reference		
LL.BR.CUBA.1B.WW		

BRACKETS

CUCA.1B



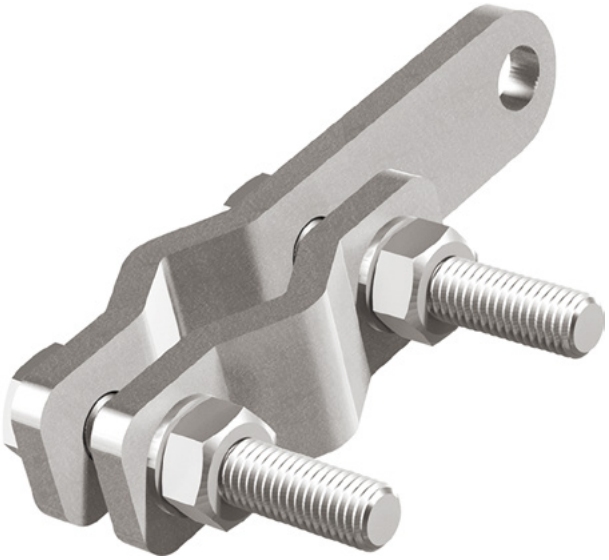


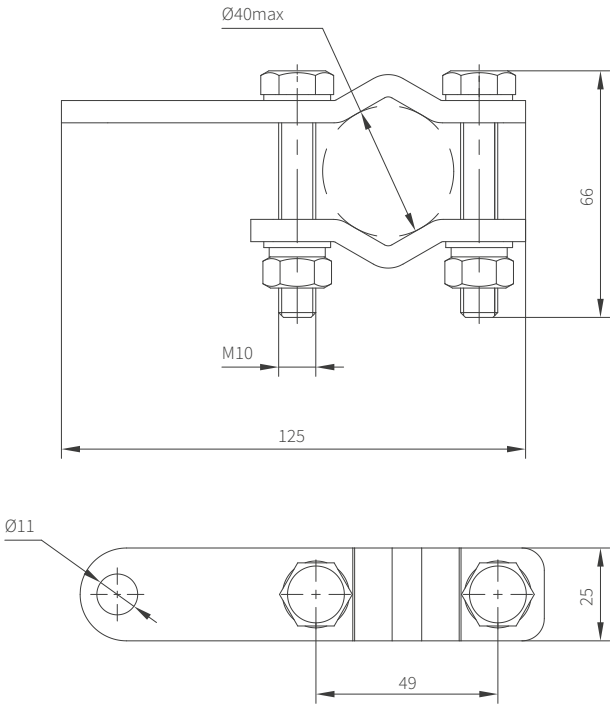
Technical data	
Max. permissible size of cross-arm (WxH), mm	150x130
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	1.76
Type of pole	Any
Type of cross-arm	U-section
Point of connection	Cross-arm

Compatible with					
LLPD d24z	1A	Page 35	LLPD dM35z	1A	Page 40
	2A	Page 36		2A	Page 41
LLPD d45z	2A	Page 45			
LLPD d69z	2A	Page 48			
Reference					
LL.BR.CUCA.1B.WW					

BRACKETS

IDAA.1B





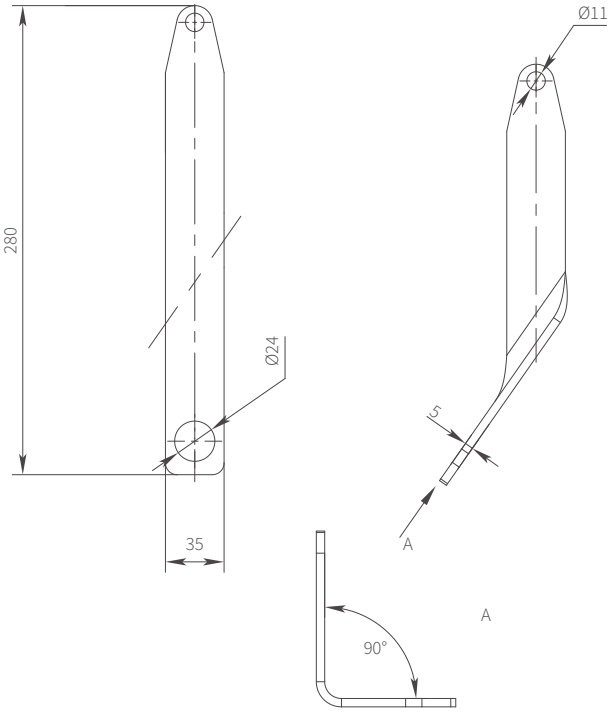
Technical data	
Maximum diameter of insulator's pin, mm	40
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	0.34
Type of pole	Any
Type of cross-arm	Any
Point of connection	PIN of insulator

Compatible with					
LLPD i20z	1A	Page 25	LLPD d10z	1A	Page 29
	2A	Page 26		2A	Page 29

Reference
LL.BR.IDAA.1B.WW

BRACKETS

IDAB.1B

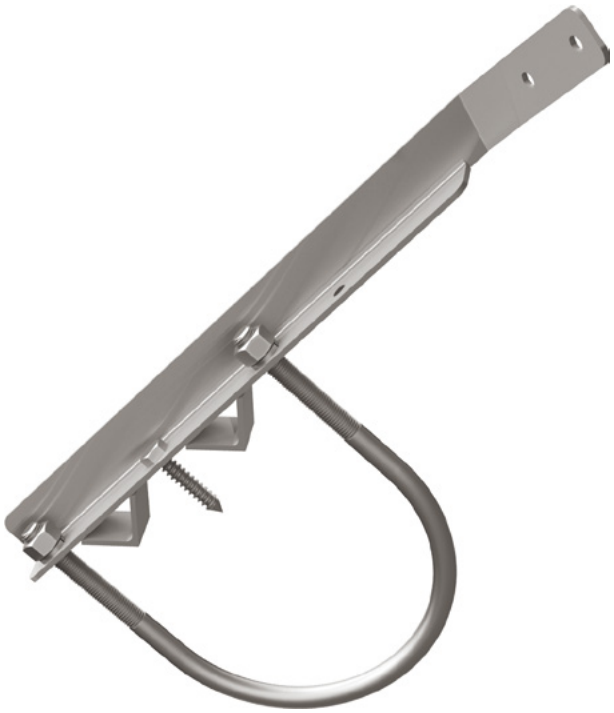


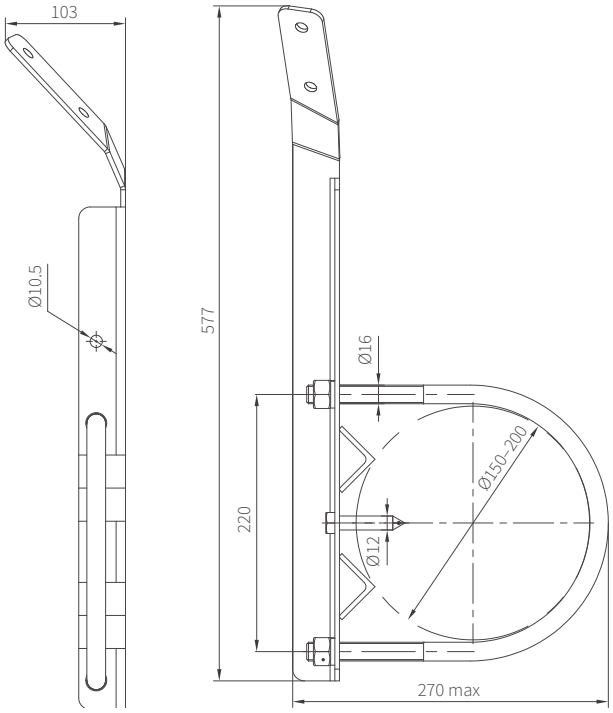
Technical data	
Maximum diameter of insulator's pin, mm	24
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	0.4
Type of pole	Any
Type of cross-arm	Any
Point of connection	PIN of insulator

Compatible with		
LLPD i20z	1B	Page 25
	2B	Page 26
Reference		
LL.BR.IDAB.1B.WW		

BRACKETS

PRBA.1B





Technical data	
Permissible diameter of pole, mm	150–200
Material	Steel
Coating	Zn 75 µm (HDG)
Weight, kg	2.5
Type of pole	Armless pole (wooden)
Type of cross-arm	–
Point of connection	Pole

Compatible with		
LLPD dC20z	4A*	Page 33
Reference		
LL.BR.PRBA.1B.WW		

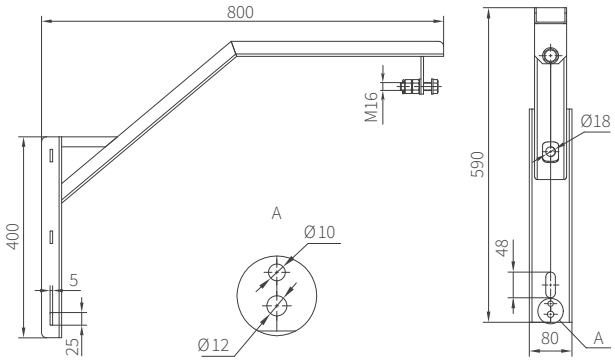
ADDITIONAL CROSS-ARMS

BH01.AB

Technical data					
Material			Steel		
Coating			Zn 75 µm (HDG)		
Weight, kg			4.06		
Compatible with					
LLPD d24z	1D	Page 36	LLPD dM35z	1D	Page 41
	2D	Page 37		2D	Page 42
	3B	Page 38		3B	Page 43
	4A	Page 38		4A	Page 43
Reference					
LL.AC.BH01.AB.WW					

concrete poles

wooden poles



Suitable steel straps*: Width up to 25 mm, Thickness up to 5 mm.

Suitable screws and washers*: Wood screw (DIN 571) M12x100/M16x80/M16x100 Washer (DIN 125): M12/M16.

Mount steel straps using steel banding tool*.

*Steel straps, screws, washers, steel banding tool are not included in package.

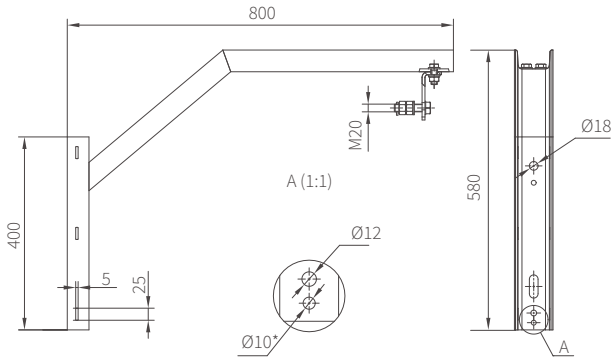
ADDITIONAL CROSS-ARMS

BH02.AB

Technical data		
Material		Steel
Coating		Zn 75 µm (HDG)
Weight, kg		10.8
Compatible with		
LLPD d45z	2C	Page 45
	3A	Page 46
LLPD d69z	2C	Page 48
	3A	Page 49
Reference		
LL.AC.BH02.AB.WW		

concrete poles

wooden poles



Suitable steel straps*: Width up to 25 mm, Thickness up to 5 mm.

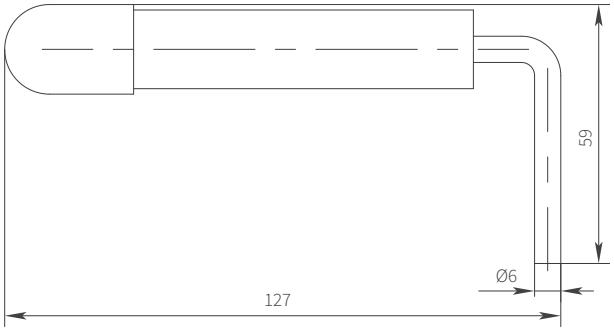
Suitable screws and washers*: Wood screw (DIN 571) M12x100/M16x80/M16x100 Washer (DIN 125): M12/M16.

Mount steel straps using steel banding tool*.

*Steel straps, screws, washers, steel banding tool are not included in package.

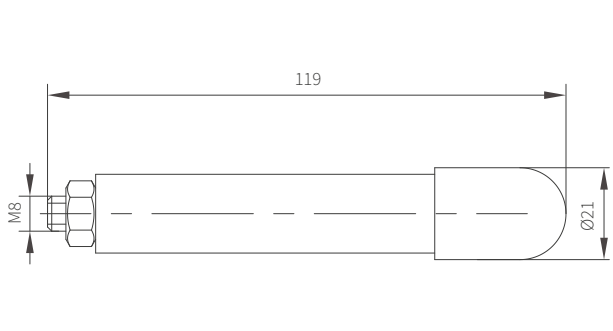
INDICATORS

0001.BA



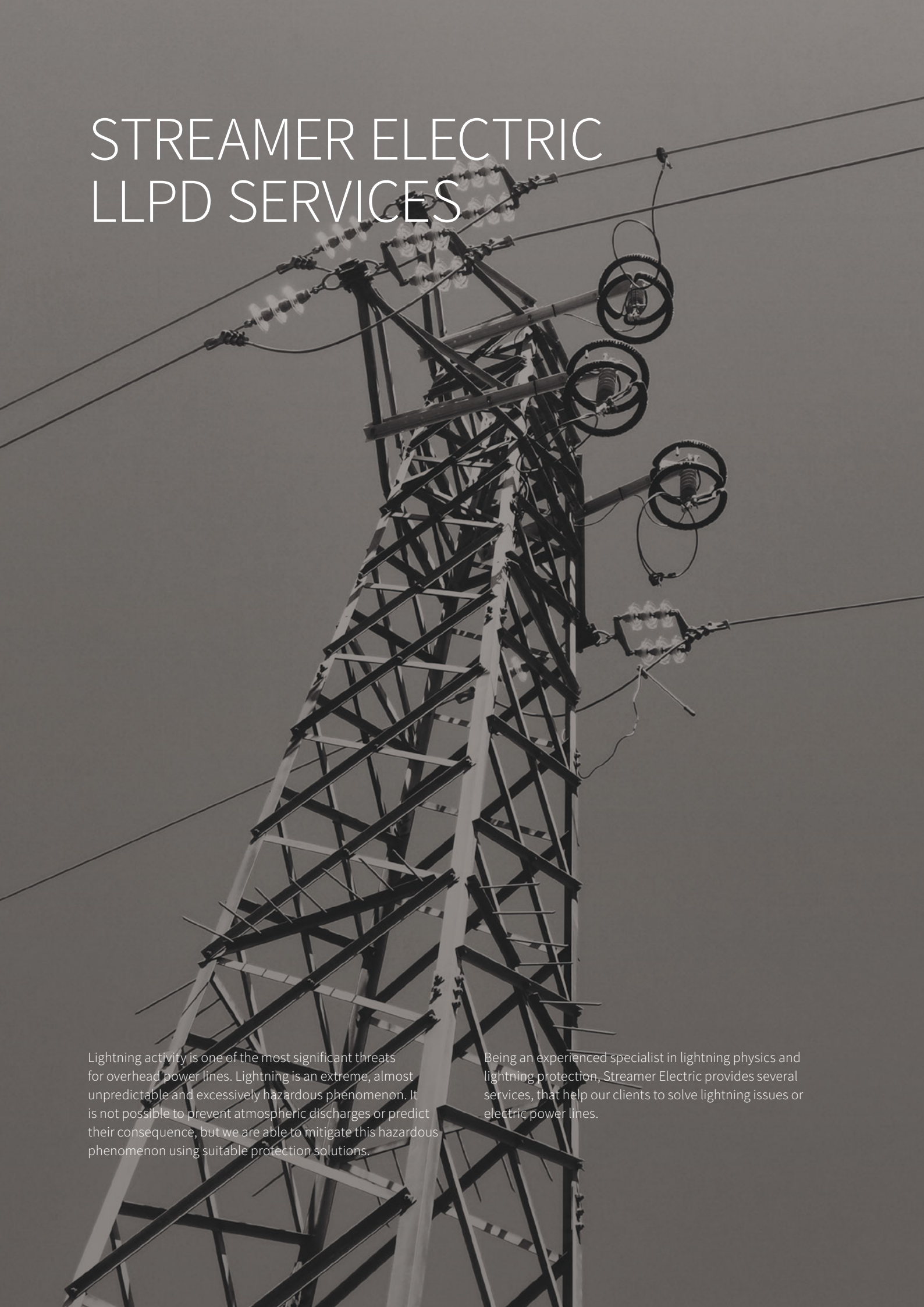
Technical data	
Weight, kg	0.12
Compatible with	Parallel groove clamps (out of STREAMER product range)
One-time indication of LLPD operation	
Reference	
LL.ID.0001.BA.WW	

0001.SA



Technical data	
Weight, kg	0.08
Compatible with	Conductor clamp
One-time indication of LLPD operation	
Reference	
LL.ID.0001.SA.WW	

STREAMER ELECTRIC LLPD SERVICES



Lightning activity is one of the most significant threats for overhead power lines. Lightning is an extreme, almost unpredictable and excessively hazardous phenomenon. It is not possible to prevent atmospheric discharges or predict their consequence, but we are able to mitigate this hazardous phenomenon using suitable protection solutions.

Being an experienced specialist in lightning physics and lightning protection, Streamer Electric provides several services, that help our clients to solve lightning issues or electric power lines.

SITE SURVEY SERVICE

Data acquisition is an important step on the way to efficient lightning protection. To collect the information, it is important to be an experienced specialist in order to know what is relevant to the lightning assessment study.

The Streamer inspection team will collect essential information about specific overhead power lines on-site. Our experts visit the line in order to analyse the potential origin of outages due to lightning strikes. With our lightning assessment experience, we:

- review the profile of the line;
- visit each different environment area;
- check all types of poles.

This information helps to investigate all issues and prepare the most adapted solution taking into consideration the following basic line parameters:

- operating voltage;
- type of terrain;
- altitude;
- evaluation of short circuit currents;
- lightning flash density.

As well as detailed data about each type of pole, such as:

- height of structures;
- type of insulators;
- materials and dimensions of structural elements.

In accordance with the result of the survey, Streamer issues a detailed technical report, including collected data regarding all visited poles with photos and GPS locations, and containing comprehensive information about equipment of each pole type. This data can be used for a qualitative lightning assessment.

Reference	LL.SR.INSP.00.WW

LIGHTNING ASSESSMENT SERVICE

Correct assessment of lightning causes is important since according to the Pareto principle, 20% of the effort provides 80% of the results. Our lightning assessment service will help the client to achieve understanding of:

- most dangerous line sections;
- several solutions for line protection;
- number of protective devices required and cost efficiency analysis;
- the line outage status with or without protection.

Parameter	Value
Line length	9 km
Nominal voltage	20 kV
Conductor section	95 mm^2
Conductor height	12 m
Presence of ground wire	Yes
Transformer power	30 MVA
Short-circuit voltage UK, %	10,50%
Footing resistance of poles	5 Ohm
Neutral arrangement	Solidly grounded
Number of circuits	Single
Pole material	Reinforced concrete
Insulator type	PF-70D
Insulation CFO	185 kV
Amount of poles	180

Table 1: Parameters of example line, used for evaluation of lightning performance

Reference	LR.SR.LASS.00.WW

In order to evaluate the line lightning performance Streamer R&D team creates the mathematical model of the overhead power line using software based on the IEEE Guide for improving the lightning performance of electric power overhead distribution lines and longstanding professional experience. Our lightning assessment service includes three options:

1. Evaluation of lightning performance with/without protection.
2. Selection of protective devices and their deployment in order to a reach certain level of line performance.
3. Guidelines of most efficient way to deploy a certain amount of protective devices along the line.

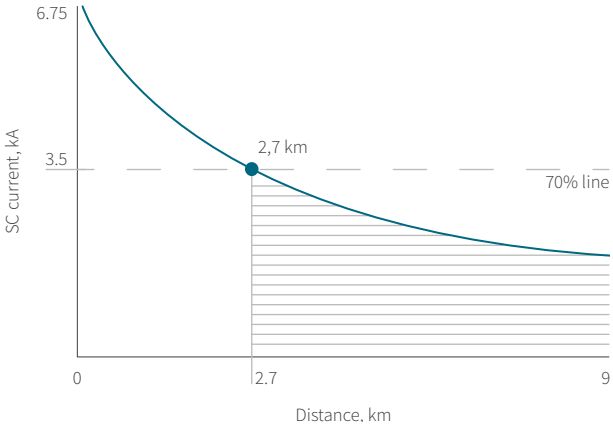


Figure 1: Prospecti ve fault current diagram for example researched line

LIGHTNING ASSESSMENT SERVICE

EVALUATION OF LIGHTNING PERFORMANCE WITH OR WITHOUT PROTECTION

Modelization of the overhead power line based on proprietary own software in order to evaluate line lightning performance with or without protection including comparison with the current situation. As a result, several different options are suggested for line lightning protection

The following lightning assessment was made for an example line to demonstrate the importance of the service. Parameters of the line are provided in table 1, prospective fault current is demonstrated in figure 1.

As a result, there are three different options provided in table 2 for line lightning protection which can be chosen in accordance with improvement needed and available resources.

Case	Amount of outages		Necessary amount of LLPD	Improvement, %
	Without protection	With protection		
3 LLPD dC20z per pole	4.43	0.57	378 dC20z	87.2
2 LLPD dC20z per pole	4.43	1.04	252 dC20z	76.5
3 LLPD dC20z per pole + LLPD i20z with PA*	4.43	2.07	126 dC20z	53.2
* Phase alternation				

Table 2: Result of evaluation of lightning performance with/without protection

THE SELECTION OF PROTECTIVE DEVICES AND THEIR DEPLOYMENT IN ORDER TO REACH A CERTAIN LEVEL OF LINE PERFORMANCE

In order to control the power quality supply indices it is important to achieve a certain level of line performance. The lightning assessment service provides this opportunity with a detailed description of the most efficient number of protective devices and their allocation along the line, that are necessary to ensure the indicated level of performance. Results are provided in table 3.

Targeted amount of outages per year	Initial amount of outages per year	Amount of LLPD
1	4.43	270
2	4.43	151
3	4.43	82

Table 3: Result of selection of protective devices based on targeted amount of outages

LIGHTNING ASSESSMENT SERVICE

GUIDELINES OF THE MOST EFFICIENT WAY TO DEPLOY A CERTAIN AMOUNT OF PROTECTIVE DEVICES ALONG THE LINE

Also it is necessary to understand that the efficiency of protective devices depends not only on the quantity, but also on the correct location and phase. The lightning assessment service provides a simulation of different arrangements and outage status calculation based on the specific amount of LLPD. Results are provided in table 4.

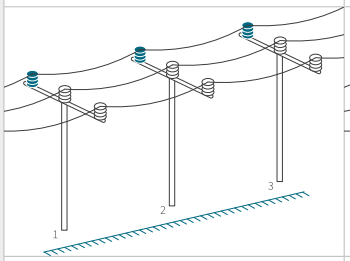
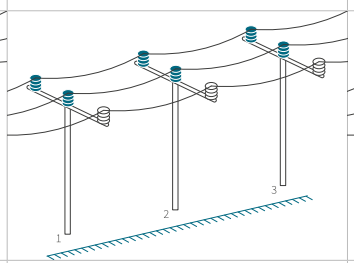
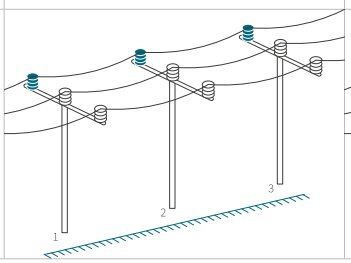
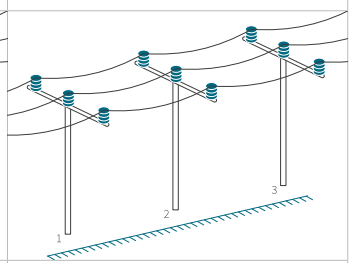
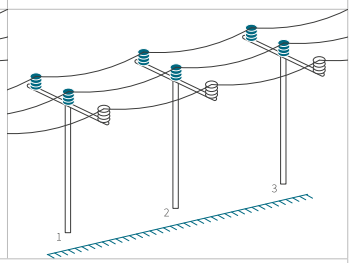
Available LLPD amount	100	200	300
Initial amount of outages per year	4.43	4.43	4.43
Forecasted performance	2.68	1.54	0.88
Most efficient arrangement	100 first poles  0 next poles	74 first poles  52 next poles 	48 first poles  78 next poles 

Table 4: Results of guideline of most efficient way to deploy a certain amount of protective devices along the line

DESIGNING SERVICES

For some challenging cases it is not possible to use traditional mounting options (with already existing accessories) and then solutions for specific poles/towers should be developed. The Streamer Electric design team can provide this service.

Reference	LL.SR.DSGN.00.WW

To gain a complete understanding of the mounting construction Streamer Electric can propose and create detailed blueprints for each client.

Reference	LL.SR.BLUP.00.WW

The Streamer design team will elaborate additional supporting design documentation which includes:

- 3D drawings for a specific construction of the pole, bracket or LLPD installation scheme;
- development of specific construction;
- CAD designing documentation of construction to provide the blueprint design;
- backup documentation about deployment of new and existing equipment.

LLPD SERVICES

INSTALLATION SUPERVISION

During LLPD installation Streamer Electric will provide supervision service field support engineers installation, assistance and training on-site.

As a result, Streamer Electric provides a report which contains advice about LLPD installation for the current overhead power line with backup documentation about deployment of new and existing equipment.

Reference	LL.SR.SINS.00.WW

TURNKEY SOLUTION

WHEN THE TURNKEY SOLUTION OPTION IS UTILIZED, THE PROJECT RECEIVES COMPLEX FOLLOW-UP SUPPORT, CONTAINING ALL AVAILABLE SERVICES IN ONE PACKAGE:

- Site survey
- Design services
- Lightning assessment
- Installation supervision

The multifaceted approach helps to prepare the most cost-effective solution to protect your overhead power line against lightning activity as well as detailed documentation of LLPD installation and maintenance guidelines for the service company.

Reference	LL.SR.TRNK.00.WW

FOR NOTES

FOR NOTES

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