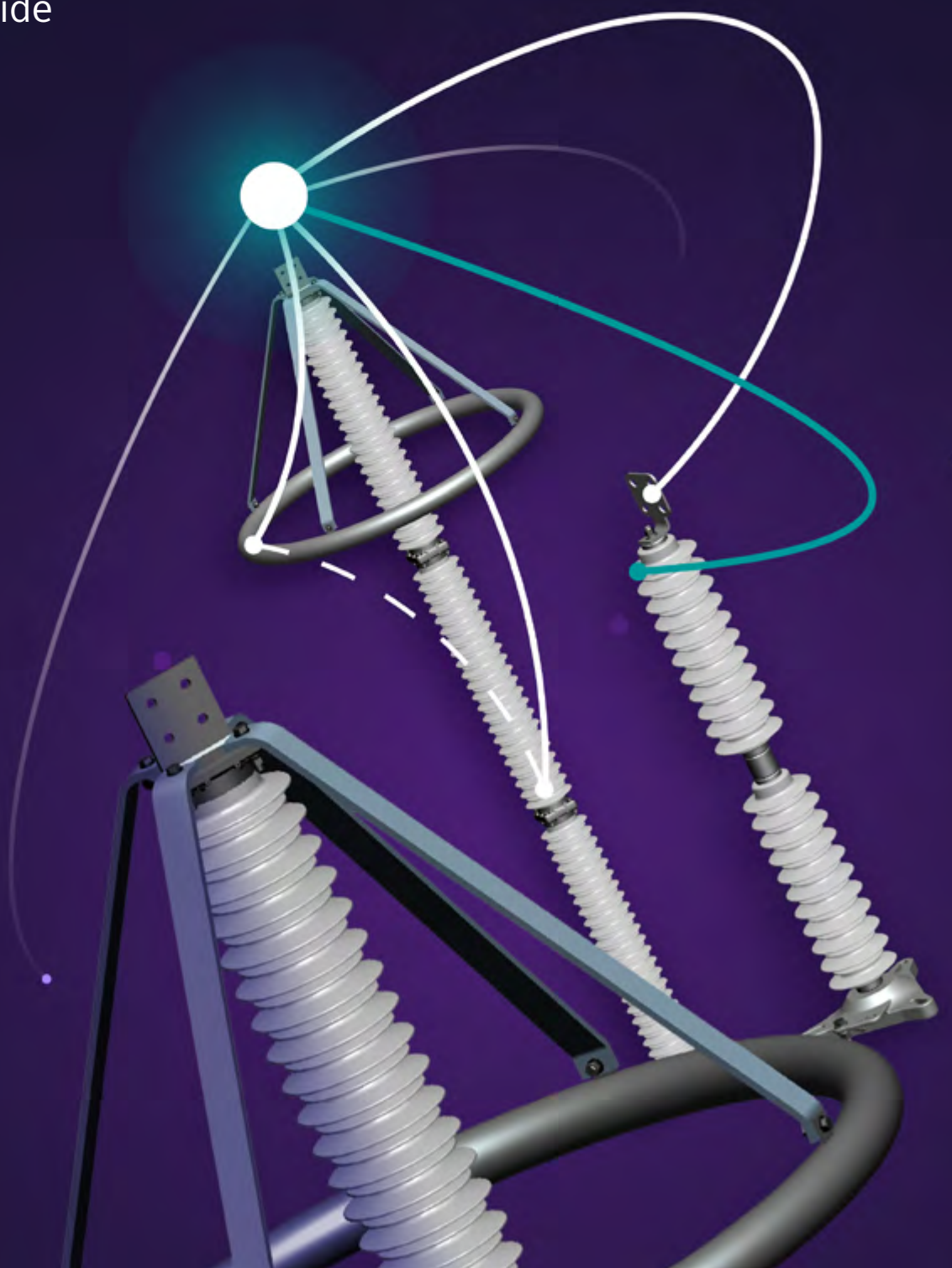


# High-voltage surge arresters

Product guide





# Definition of surge arresters

Surge arresters are used to protect high-voltage equipment in substations, such as transformers, circuit breakers, and bushings, against the effects of overvoltages caused by incoming surges. Such overvoltages can be caused by a direct or nearby lightning strike, an electromagnetic pulse, electrostatic discharge, or switching operations in the power supply system as well as in devices. Some overvoltages are very high in energy. The current from the surge is diverted through the arrester, in most cases to earth. Effective overvoltage protection requires different surge arrester types to be used according to the particular application.

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Substation Bidingen 400 kV  
Protection of transformer solution  
with 3EQ4



# Siemens Energy surge arresters for any requirement



Experience is most essential when it comes to reliability in medium- and high-voltage applications. Siemens Energy has been designing and manufacturing medium- and high-voltage surge arresters for standard and special applications since 1925. Continuous research and development, the wealth of Siemens Energy know-how, and comprehensive worldwide experience give Siemens Energy surge arresters a leading edge in overvoltage protection. Their uncompromising quality ensures a long service life and reliability in any application.

Siemens Energy surge arresters are an indispensable aid to insulation coordination in electrical power supply systems. Valuable equipment such as transformers, circuit breakers, generators, motors, capacitors, traction vehicles, and bushings, as well as complete switchgear, is optimally protected against lightning and switching overvoltages.

Siemens Energy surge arresters have been designed to meet the requirements of a wide range of common installation environments, from arctic cold to the heat of the desert and the dampness of tropical climates. They are available for any application from 3 kV up to 1,200 kV including special applications such as high-voltage direct current (HVDC) and FACTS systems as well as all kinds of compensation systems for electric power networks.



Substation Bidingen 400 kV Protection of switchgear solution with 3EQ4

# Always the best solution

Developments in technology and practical experience have led to three different surge arrester designs:

- Surge arresters with porcelain housings
- Surge arresters with silicone housings
- Surge arresters with metal enclosures

Siemens Energy provides each of these types in several versions, making it possible to find the optimal surge arrester for every conceivable application and meet even specific demands, such as

High mechanical stability for outstanding seismic safety

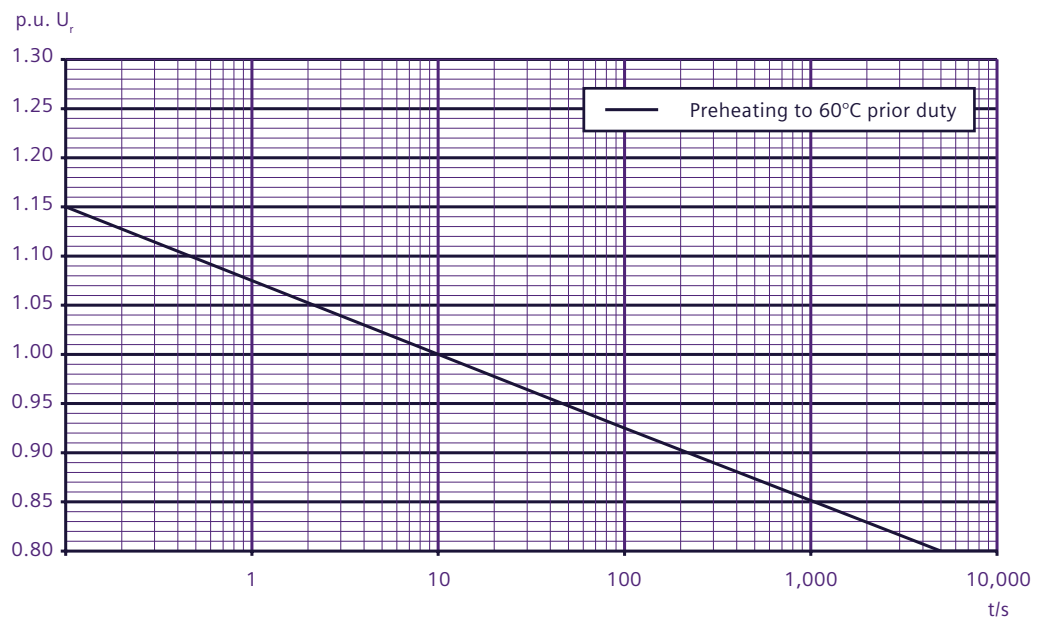
- Extremely reliable pressure relief behavior for use in areas requiring special protection
- Excellent pollution layer characteristics for use in coastal and desert regions or in areas with extreme air pollution.

All Siemens Energy surge arresters feature a superior sealing system that reliably prevents moisture ingress to ensure the highest possible degree of overvoltage protection and decades of trouble-free service. Moreover, the choice of materials used in the making of Siemens Energy surge arresters contributes to the protection of the environment.



# MOVs: the core of Siemens Energy surge arresters

IEC power-frequency voltage vs. time (U-t) characteristic (TOV)



The main task of an arrester is to protect equipment from the effects of overvoltages. During normal operation, an arrester should have no negative effect on the power system. Moreover, the arrester must be able to withstand typical surges without incurring any damage. Nonlinear resistors fulfill these requirements thanks to the following properties:

- Low resistance during surges, so that overvoltages are limited
- High resistance during normal operation to avoid negative effects on the power system
- Sufficient energy absorption capability for stable operation

With this kind of nonlinear resistor, there is only a small flow of current when continuous operating voltage is being applied. When there are surges, however, excess energy can quickly be removed from the power system by a high discharge current.

Nonlinear resistors made of metal oxide (MO) have proven especially suitable for this use. The nonlinearity of MO resistors is considerably high, which is why MO arresters do not need series gaps. Siemens Energy has many years of experience with gapless MO arresters in low-voltage systems, distribution systems, and transmission systems.

Siemens Energy metal oxide varistors (MOVs) provide a high energy absorption capability and a very low protection level. This means they absorb a high amount of energy while avoiding thermal runaways. The MOVs are characterized by their high long-duration current impulse withstand capability – an indirect measure of their single impulse energy absorption capability. Siemens Energy surge arresters are less prone to self-heating and consequent selfdestruction, and they maintain their characteristics throughout their lifetime.

# Silicone rubber

As a pioneer in the field of silicone rubber insulation and one of the few suppliers with comprehensive in-house research and development capabilities in this technology, Siemens Energy has been providing surge arresters with silicone rubber housing for more than 25 years and has gathered excellent service experience from even the most severe climatic and environmental conditions. Today, silicone rubber is among the most widely used materials for high-voltage outdoor equipment.

Siemens Energy silicone rubber-housed surge arresters are polymer-housed arresters that use silicone rubber as the only insulating material. The exclusive use of silicone has proven to be the best solution in several studies: Silicone rubber is highly hydrophobic. While there are many polymeric materials with similar initial hydrophobic properties, most of them, such as EPDM alloy rubber, lose their hydrophobicity after a relatively short period. Only genuine silicone rubber as used by Siemens Energy is capable of maintaining its hydrophobicity throughout its entire lifetime. This ensures the long service life of Siemens Energy surge arresters with silicone rubber housing. Even the most severe ambient conditions, such as salt fog in coastal regions or dust-laden air causing serious contamination in an industrial area, cannot impair the hydrophobicity of silicone rubber. This material property reliably prevents conductive moisture from forming on the arrester surface, thus averting surface currents and discharges. Moreover, genuine silicone is highly fire-retardant and self-extinguishing, and it is neither subject to erosion nor sensitive to UV radiation. This ensures the long-term stability of the housing material.

There are several characteristics that set the silicone elastomers used by Siemens Energy apart from other organic insulating materials.

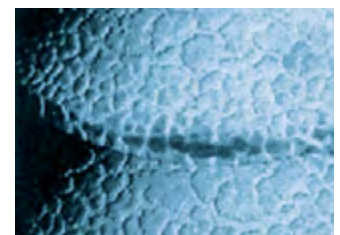
As a matter of principle, Siemens Energy only uses HTV (high-temperature vulcanized) or LSR (liquid silicone rubber) silicone elastomers. These types of silicone help maintain the properties mentioned above.

The  $\text{-Si-O-}$  backbone of silicone rubber has a higher bonding energy than the  $\text{-C-C-}$  backbone of EPDM. Silicone rubber has a lower carbon proportion than EPDM. Consequently, silicone rubber boasts inherently better chemical and physical resistance, better UV resistance, and lower flammability than EPDM. Consider these facts:

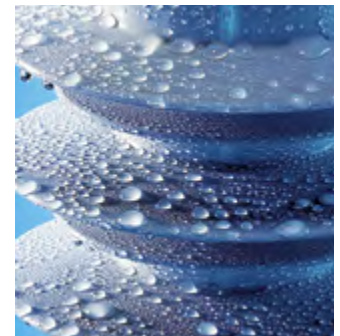
- Silicone rubber is highly stable under the influence of ultraviolet radiation (sunlight), ozone, and nitrogen oxide. Its stability beats that of EPDM-based alloy rubbers.
- The hydrophobic performance of a silicone rubber surface remains excellent throughout the entire arrester service life, whereas EPDM-based alloy rubbers lack this critical requirement.
- The hydrophobicity of silicone rubber returns after a corona discharge, which assures reliable long-term performance.
- The arcing resistance of silicone rubber is higher as compared to EPDM-based alloy rubbers.
- The flame-retardant properties of silicone rubber comply with IEC 60707 and UL94 V-0 (i.e. self-extinguishing, no burning drips, probe does not burn).
- Silicone rubber is resistant to all common organic and nonorganic cleaning agents and solvents.
- Silicone rubber performs well in an ambient temperature range of  $-60\text{ }^{\circ}\text{C}$  to  $+200\text{ }^{\circ}\text{C}$ . No other polymeric material can beat silicone rubber.

## Characteristic damage on EPDM insulators due to natural UV radiation

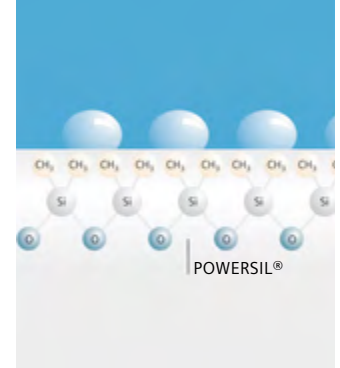
Chalking



Cracking



Moisture



Hydrophobic effect on Siemens Energy 3EL surge arrester due to alignment of methyl groups in silicone polymers.

# Porcelain

Siemens Energy porcelain surge arresters feature a directional pressure relief device that ensures maximum protection in the case of an overload. Thanks to the excellent sealing of its surge arresters, Siemens Energy has recorded decades of trouble-free service life without failures or moisture ingress.

Both ends of a porcelain surge arrester housing are equipped with aluminum flanges that are cemented to the housing. Sulfur

cement is the first choice for this purpose. It has favorable mechanical properties and also proves advantageous over Portland cement, which is quite common in the insulator industry. The main advantage of sulfur cement is that it can be brought into contact with aluminum during manufacturing without causing any corrosion, and it can be quickly processed, since it almost reaches its full mechanical strength directly after application.

The design of the flanges and the end sections of the porcelain housings is key to the strength of the entire housing. This is why these parts of Siemens Energy arresters are designed in a way that ensures that the cement joint is mechanically stronger than the porcelain itself. This enables making full use of the porcelain's strength when specifying the permissible mechanical head loads of the arrester housing.



# High-voltage station class surge arresters

Siemens Energy provides three surge arrester product families for standard and special AC applications from 3 kV up to 800 kV, which are described in this brochure:

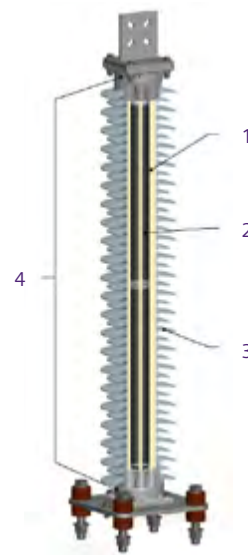
- 3EL surge arresters with silicone housing, Cage Design™
- 3EQ surge arresters with silicone housing, composite hollow core design
- 3EP surge arresters with porcelain housing

# 3EL silicone rubber surge arresters

with Cage Design™

## Design features

- 1 Cage of FRP rods
- 2 Metal oxide blocks
- 3 Silicone rubber sheds directly molded on metal oxide blocks and on end fittings
- 4 End fittings



Siemens Energy's cage design ensures high mechanical strength and safe overload performance. It is characterized by the use of silicone and fiberglass-reinforced plastic (FRP) rods as housing materials. Reliability is guaranteed by the direct molding of the silicone rubber onto the MO blocks and the FRP rods. This ensures the total embedding of all components free of bubbles and gaps, thus preventing any partial discharge or moisture ingress.

The MO blocks of 3EL surge arresters are enclosed by a cage made of prestressed FRP rods, which leads to a rigid, reinforced structure ensuring high mechanical strength. The high tensile strength of the FRP rods is used to hold the arrester's MO blocks in place tightly. This is why cage design arresters are among the mechanically strongest polymer arresters available on the market and at the same time ensure minimal use of material and very low weight. As the MO blocks are neither enclosed in a sealed mechanical shell nor wrapped in hard material, no excess pressure will develop in the case of an overload or the extremely rare event of an arrester short circuit. The arc can escape

directly through the soft silicone housing, and the ejection of internal parts that could damage other equipment nearby is prevented almost completely.

## Long service life

Silicone is the only polymeric material that maintains its hydrophobicity throughout its lifetime: Water and pollution do not form a continuous conductive film on its surface. This reduces surface currents and the risk of a flashover, especially in polluted and coastal environments.

Other polymeric materials may be hydrophobic, too, but they lose this property after a short period of time. Unlike other polymeric materials such as EPDM, for example, the silicone used for our 3EL arresters is also fire-retardant and self-extinguishing, and it is neither subject to erosion nor sensitive to UV radiation. This ensures the long-term stability of the housing material.

### Low weight: flexible and easy installation

The use of FRP and silicone as housing materials also makes Siemens Energy 3EL arresters extremely lightweight, allowing easy transport and flexible installation. The use of 3EL surge arresters helps reduce the required strength and weight of arrester supports and the need for heavy installation equipment.

### Applications

The 3EL series of surge arresters covers a wide range of common installation requirements including station and line surge arresters for the protection of switchgear, transformers, and other equipment in high-voltage systems of

up to 550 kV. 3EL surge arresters can be installed at all mounting angles (e.g. horizontally, vertically, or suspended from the transmission line as line surge arrester). Mechanically strong enough to meet common mechanical requirements and with sheds that are resistant to damage resulting from transport, installation, storms, earthquakes, and vandalism, 3EL surge arresters are perfectly suited for installations that demand low weight and indestructibility of the arrester.



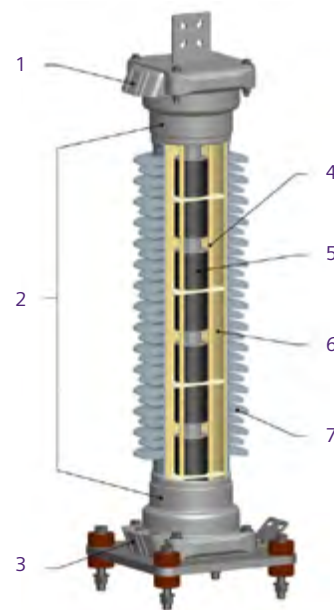
Horizontal cut of a cage design arrester

# 3EQ silicone rubber surge arresters

with composite hollow core design

## Design features

- 1 Directional pressure relief device
- 2 End fittings with directional pressure relief device and sealing system
- 3 Directional pressure relief device
- 4 Cage of FRP rods
- 5 Metal oxide blocks
- 6 FRP tube
- 7 Silicone rubber sheds directly molded on FRP tube



Siemens Energy's innovative composite hollow core design uses silicone and a FRP hollow core as housing materials. The advantages of this design are more than compelling, as it offers the perfect combination of cost savings and safety for substations. The direct molding of the silicone rubber onto the FRP hollow core ensures reliability, while an excellent special sealing of the flanges at both ends of the surge arrester effectively prevents partial discharges and moisture ingress. The combination of silicone rubber and fiber-glass-reinforced hollow core also allows an enormous load carrying capacity for the structure.

Hence, 3EQ surge arresters are the perfect choice for the replacement of existing post insulators in substations of up to 800 kV. The composite hollow core design provides a very high degree of safety: In the case of an overload or the extremely rare case of an arrester short circuit, the arc escapes directly through directional pressure relief devices, internal parts are not ejected, and the housing does not break.

## A reliable, sturdy, and economic choice

Siemens Energy 3EQ composite hollow core design surge arresters are virtually indestructible. While the composite hollow core design provides the highest possible mechanical strength and enables the support of high bending moments, the silicone rubber insulation is ideal for outdoor applications in severe environmental conditions.

No matter how tough environmental and operating conditions may be, 3EQ arresters assure 100% reliable pressure relief performance and provide the ultimate in protection. They are shatterproof and retain at least 75 percent of their mechanical strength even after pressure relief, and they provide the greatest stability, even during earthquakes.

## Reduced space requirements

Whenever space is at a premium, 3EQ surge arresters can even be mounted directly over a transformer to support connectors without any danger to neighboring equipment. Their unique composite hollow core design ensures maximum stability, even if an arrester should “blow out” after overloading. Pressure relief is absolutely reliable – there is no danger to equipment in the direct vicinity, no parts will be ejected, and the emerging arc will safely burn between the ends of the pressure relief device.

## Longevity and reliability

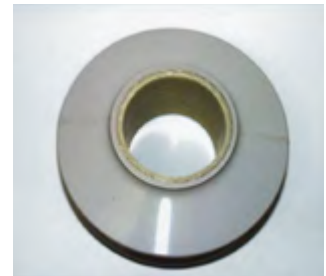
The silicone rubber housings of 3EQ surge arresters provide the best possible long life performance for high-voltage surge arresters. They make use of all the advantages of vulcanizing silicone rubber sheds onto an FRP hollow core, providing enhanced safety and meeting every requirement.

With their silicone rubber housings, the arresters enjoy all-around protection. The silicone rubber shed provides a reliable defense against snow, sandstorms, ozone, high-level UV radiation, sea salt, soot, and acid rain in industrial regions. Only genuine silicone rubber is capable of maintaining its hydrophobic properties throughout its entire service life – and is resistant to UV radiation. The silicone rubber of the 3EQ surge arresters reliably prevents the formation of films of water or dirt. Surface currents resulting from conductive layers of accumulated dirt are eliminated.

## Applications

Siemens Energy 3EQ composite hollow core design surge arresters will go the extra mile. They meet highest mechanical demands and are ideally suited for challenging environments, such as areas with heavy seismic activity or extremely high wind loads.

3EQ surge arresters boast a prolonged service life, because they are absolutely shatterproof and feature reliable overload performance with no hazardous splinters being ejected even under maximum pressure. These arresters can be installed close to costly system components. 3EQ composite hollow core design arresters are virtually indestructible during transportation, installation, storms, and earthquakes, and they are immune to vandalism.

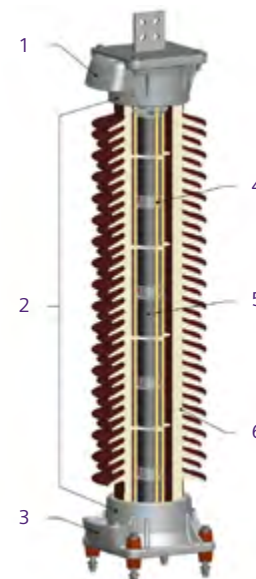


Horizontal cut of a composite hollow core design arrester

# 3EP porcelain surge arresters

## Design features

- 1 Directional pressure relief device
- 2 End fittings with directional pressure relief device and sealing system
- 3 Directional pressure relief device
- 4 Cage of FRP rods
- 5 Metal oxide blocks
- 6 Porcelain housing



Siemens Energy 3EP porcelain-housed surge arresters are the ideal choice for high mechanical performance requirements at voltage levels of up to 800 kV. With a seismic qualification of 0.5 g that is guaranteed up to 800 kV, they suit environments with even the most challenging mechanical requirements, such as heavy seismic activity and extremely high wind loads.

3EP surge arresters ensure maximum protection in an overload situation thanks to a specially designed directional pressure relief device. In the case of an overload or the extremely rare case of an arrester short circuit, the arc escapes easily through the pressure relief devices.

No pressure is built up inside the arrester and no internal parts are ejected, which prevents damage to surrounding equipment.

The excellent sealing system of 3EP surge arresters prevents failures or moisture ingress and guarantees decades of troublefree service. The use of nonporous sulfur cement instead of corrosive Portland cement for bonding protects the MO blocks and prevents aging effects. The MO blocks of 3EP surge arresters are enclosed by a rigid, reinforced cage made of FRP rods. The high tensile strength of the FRP rods is used to hold the arrester's MO blocks in place tightly.

## Applications

Thanks to their high degree of safety and reliability, Siemens Energy 3EP porcelain-housed surge arresters can be installed in close proximity to costly system components. 3EP composite hollow core design arresters are virtually indestructible during transportation, installation, storms, and earthquakes, and they are immune to vandalism.

# Standards and testing – reliability you can count on

## Tests

Siemens Energy surge arresters have been designed and tested in compliance with the latest IEC 60099-4, IEEE C62.11, and GB 11032 standards. All type tests are performed by independent, PEHLA-certified laboratories; reports are available on request. Please contact your Siemens Energy representative for details. Moreover, every single surge arrester that leaves the Siemens Energy factory undergoes a routine test and is delivered with a routine test certificate.

## Quality Assurance

Siemens Energy meets all requirements of ISO 9001:2008, ISO 14002:2004, and BS OHSAS 18001:2007. All Siemens Energy suppliers need to be certified according to ISO standards or will be audited by Siemens Energy. To maintain sustainable quality improvement, Siemens Energy introduced corporate quality guidelines that contribute to each step of the quality process.



The test field is certified by the »Deutsche Akkreditierungsstelle« (Germany's national accreditation body) according to DIN EN ISO/IEC 17025



Test generator supplying both impulse voltages (1.2/50  $\mu$ s and 250/250  $\mu$ s) and impulse currents (8/20  $\mu$ s and 30/60  $\mu$ s)



UHV arrester prepared for testing in the HV test laboratory

## Standardization

The aim of the IEC's Technical Committee 37 (TC 37) as well as the IEEE's Surge Protective Device Committee (SPDC) is the standardization of surge arrester testing and application. The TC 37 develops the standards IEC 60099-4, IEC 60099-8 (EGLA), IEC 60099-9 (HVDC), and the application guide IEC 60099-5, while the SPDC develops the standard IEEE C62.11 and the application guide IEEE C62.22. Both committees include representatives of manufacturers, utilities, test field labs, and universities.

Siemens Energy R&D experts are members of both bodies, thus playing an important role in the definition of the standards. They also share their expert knowledge in electrical power systems in CIGRE, the international council on large electric systems, which participates in the development of international standards.

# Selection table

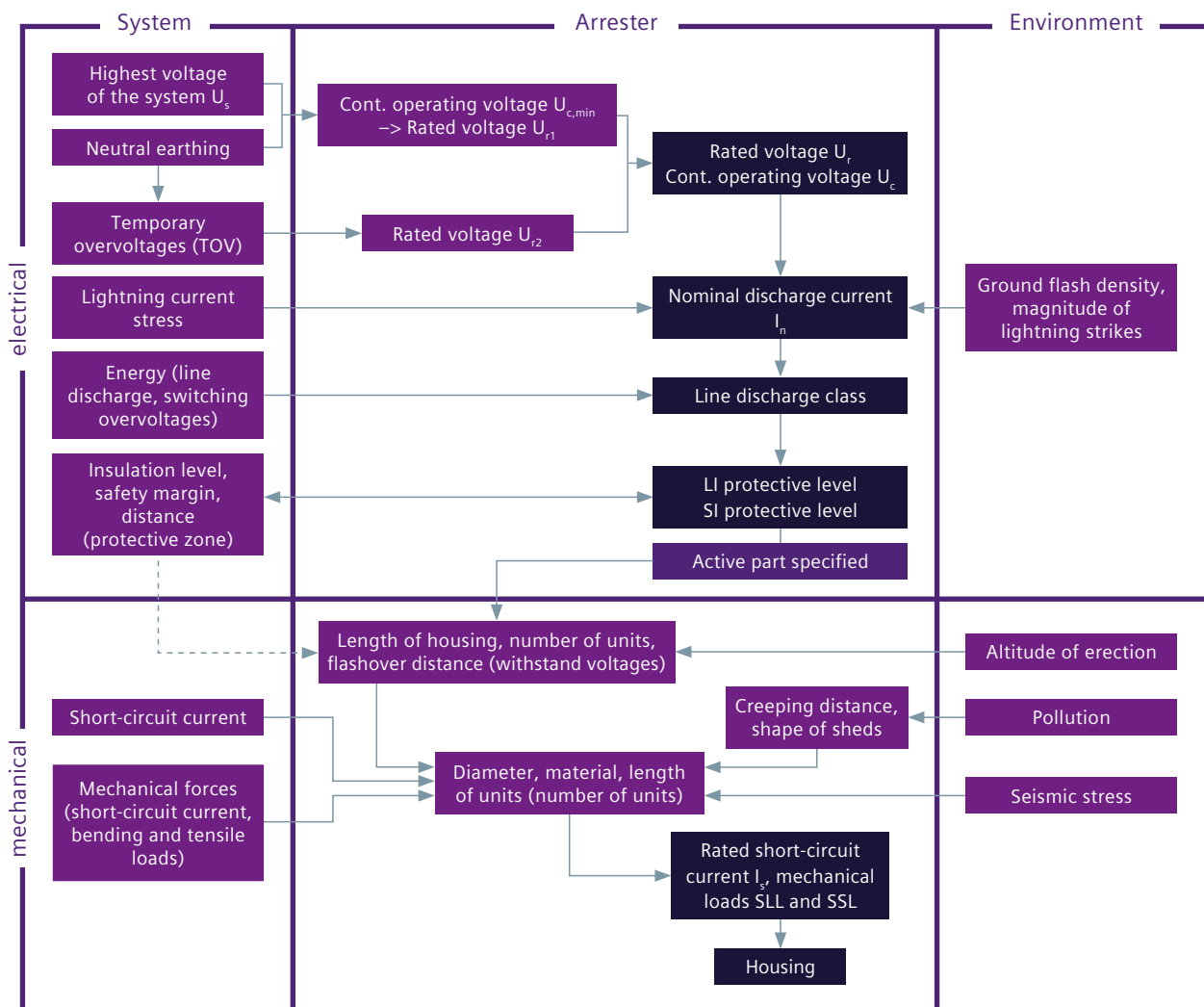


Fig. 1: Configuration procedure for an MO surge arrester

# How to select a suitable surge arrester

This section describes the general approach to selecting typical arresters for overvoltage protection in high-voltage systems.

The requirements for a surge arrester emerge from two basic requirements: It should provide adequate protection with a sufficient safety margin, which means that overvoltages at the device to be protected must always remain below its withstand voltage. Furthermore, the surge arrester should be dimensioned for stable continuous operation, which means that the arrester must remain electrically and thermally stable under all conditions while handling all long-term, temporary, and transient stress resulting from network operation.

These two requirements cannot be fulfilled independently. A reduction of the protective level automatically means a higher degree of specific electrical stress during continuous operation, and conversely, the continuous operating voltage of an arrester cannot be increased arbitrarily without raising its protective level as well. Both operating points are for a given type of MOV strictly associated with each other through the voltage-current (U-I-) characteristic curve.

## Step 1: Selection of the continuous operating voltage and the rated voltage.

The first step is to define the minimally required continuous operating voltage  $U_{c,min}$ . This must be as high as the continuous phase-to-earth voltage of the system. Here, »continuously« applied voltage means every voltage that occurs within an uninterrupted period of more than 30 minutes. The type of neutral earthing of the system is decisive in determining the continuous operating voltage. In isolated or resonant earthed neutral systems, the voltage of a healthy phase against ground takes on the value of the phase-to-phase voltage in the case of a one-phase earth fault (earth fault factor  $k = 1.73$ ). Since resonant earthed neutral systems are operated quite commonly for time periods of more than 30 minutes in this condition, the continuous operating voltage of the arrester must, in this case, have the value of the highest voltage of the system,  $U_s$ .

---

**Solidly earthed neutral system:**

$$U_{c,min} \geq U_s/\sqrt{3}$$


---

**Isolated or resonant earthed neutral system:**

$$U_{c,min} \geq U_s$$


---

The definition of the minimally required continuous operating voltage, a factor which usually has a value of 1.25, helps achieve a rated voltage  $U_r = 1.25 \cdot U_{c,min}$ . This is the lowest necessary rated voltage of the arrester. Table »Typical rated voltages  $U_r$  for highest voltages of the system  $U_s$ « on page 27 lists typically applied rated voltages.

## Step 2: Selection of the nominal discharge current $I_n$

The nominal discharge current  $I_n$  serves to classify a surge arrester. From a technical point of view, it is calculated from a typical maximum lightning current amplitude that can be expected in the substation, for which the insulation coordination is performed via the arrester's lightning protection level. This amplitude is calculated from the flashover voltage  $U_{fo}$  of the line insulators, the lightning protection level  $U_{pl}$  of the arresters, and the surge impedance  $Z$  of the line for  $I_{max}$ :

$$I_{max} = (2 \cdot U_{fo} - U_{pl}) / Z$$

Example for a 420 kV system:

$$U_{fo} = 2.1 \text{ MV}$$

$$U_{pl} = 806 \text{ kV}$$

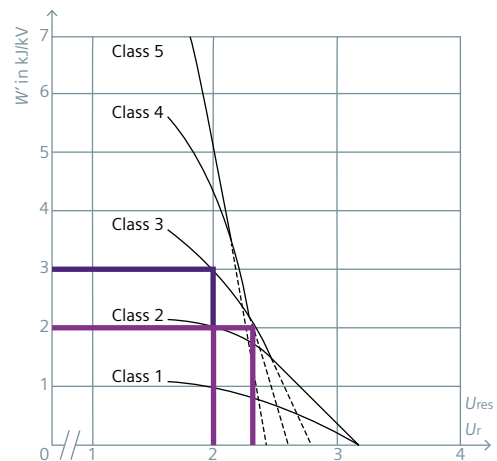
$$Z = 350 \text{ } \Omega$$

$$I_{max} = 9.7 \text{ kA}$$

A 10 kA arrester, for instance, can readily withstand lightning current impulses of higher amplitudes without severe damage.

## Step 3: Selection of the line discharge class

The line discharge class is the actual determining characteristic of a high-voltage arrester. Presently, it is the only way of specifying the energy-handling capability of an arrester in accordance with IEC 60099-4. It is, however, only indirectly found within the value of the line discharge class. The definition of the line discharge class is based on the assumption that a long transmission line, charged to a certain overvoltage during a switching operation, will discharge into a connected arrester in the form of a traveling wave process.



Specific energy in kJ/kV of rated voltage dependent on the ratio of switching impulse residual voltage  $U_{res}$  to the r.m.s. value of the rated voltage  $U_r$  of the arrester (from IEC 60099-4)

The IEC standard 60099-4 provides a diagram that represents the converted energy during a single line discharge in a test object with reference to its rated voltage. This energy is not a fixed value, but instead depends on the arrester's protective level. The higher the residual voltage, the less energy the arrester absorbs during the line discharge, since the line will discharge less intensely when the residual voltage is higher. The diagram referred to is shown in the figure above. It is now possible to easily identify the issue when the energy-handling capability is specified with the help of the line discharge class.

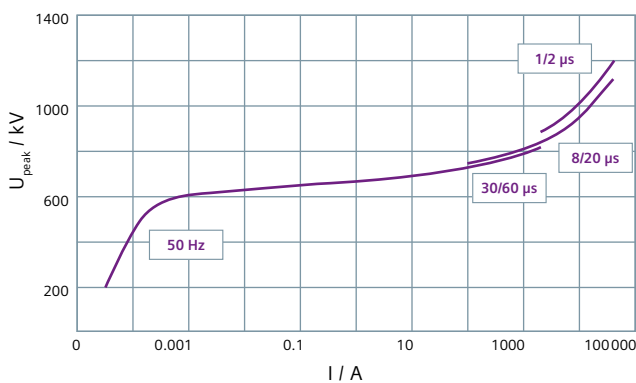
## Step 4: Selection of protective levels

The protective characteristics of an arrester are most frequently assessed by means of its lightning impulse protective level: It is assessed according to its residual voltage while the nominal discharge current is flowing. This usually means that a protective level equalling the standard lightning impulse withstand voltage of the device to be protected and divided by a factor of 1.4 is adequate for protection against lightning overvoltages.

$$U_{pl}, 10kA, 8/20\mu s < BIL / 1.4$$

The selection of the electrical characteristics of the arrester is finished when the requirements regarding the protective levels of all mentioned current impulse stresses are fulfilled.

Example U-I-curve 550 kV network:



## Step 5: Selection of the housing

Dielectric and mechanical requirements are generally taken into account when selecting the housing. The length, the creepage distance, and the material must be determined. The arrester characteristics determined by the housing are the rated short-circuit current  $I_s$ , the specified long-term load, SLL, and the specified short-term load, SSL.

The minimal housing length first of all results from the demand that the MOV column (the active part) must fit. The length of this column is determined by the electrical data that were gathered during the selection steps taken up to that point. Generally speaking, further demands cause the housing lengths to be much greater than those of the active parts.

First of all, the clearance, which results from the withstand voltage requirements, must be determined. Siemens Energy takes care of the parameters »demand by MOV column« and »clearance« by stating the minimum required housing length.

Creepage distance requirements are, however, a much more frequent reason for longer housings. The shortest possible housing as a result of the length of the active part can normally be achieved only by designing for specific creepage distances of up to 20 mm/kV. However, specific creepage distances of 25 mm/kV and 31 mm/kV play an important role. In addition, there are environmental conditions, such as maritime and desert climates as well as heavy industrial pollution, that require the use of even longer creepage distance.

After the housing parameters have been determined in order to fulfill the electrical requirements, the next and last steps focus on mechanical criteria. They indirectly lead to the selection of housing material and housing diameter. There often is only a vague idea as to the mechanical stress of an arrester in service, and accordingly no requirements are made or – maybe even worse – values are estimated too high. If there is no information available about the actual requirements, the following values can serve as a guideline for the necessary static head loads in high-voltage systems:

Highest system voltage $U_s$ (kV)	SLL (N)
< 123	350
123 ... 420	400
550	600
800	800

# Glossary

## **Continuous operating voltage (symbol $U_c$ )**

indicates the designated permissible root mean square value of the power frequency voltage that is allowed to be applied continuously between the arrester terminals.

## **Creepage (distance)**

defines the distance between the metal end fittings, measured along the housing surface. It is an important factor in the behavior of an insulator – or a device containing an insulator – in polluted conditions.

## **Highest voltage of a system (symbol $U_s$ )**

indicates the root mean square value of the highest phase-to-phase operating voltage that occurs under normal operating conditions at any time and at any point in the system.

## **Nominal discharge current (symbol $I_n$ )**

indicates the peak value of a lightning current impulse used to classify an arrester.

## **Protective level**

is the maximum value of an arrester's residual voltage at a standard current impulse. In this case, there is a difference between the lightning impulse protective level (8/20  $\mu$ s), the switching impulse protective level (30/60  $\mu$ s), and the steep current impulse (1/2 $\mu$ s) protective level.

## **Rated short-circuit current (symbol $I_s$ )**

indicates the root mean square value of the symmetrical highest short-circuit current that can flow after an arrester has been overloaded without causing violent shattering of the housing.

## **Rated voltage (symbol $U_r$ )**

is the maximum permissible root mean square value of the power frequency voltage between the arrester terminals at which the arrester is designed to operate correctly under temporary overvoltage conditions as established in the operating duty tests. Normally, the manufacturer specifies whether it can be applied to the arrester for a duration of 10 seconds (which corresponds to the value in the operating duty test) or 100 seconds. The rated voltage is the reference parameter for determining the operating characteristics.

## **Residual voltage**

quantifies the voltage drop between the arrester's terminals when a current impulse is injected. For current impulses in the shape and value of a standard test current impulse (lightning current impulse, switching current impulse, steep current impulse), the simultaneously occurring residual voltages define the protective levels that are assigned to this current shape and value.

## **Specific creepage distance (SCD)**

is the creepage distance of an insulator in relation to the highest voltage for the equipment,  $U_s$  (phase-to-phase voltage), given in mm/kV.

## **Specified long-term load (SLL)**

is a force perpendicular to the longitudinal axis of an arrester and allowed to be applied during service for long periods without causing any mechanical damage to the arrester.

## **Specified short-term load (SSL)**

is a force perpendicular to the longitudinal axis of an arrester and allowed to be applied during service for short periods and for relatively rare events (for example, short-circuit current loads, very high wind loads, and seismic loads) without causing any mechanical damage to the arrester.

## **Temporary overvoltage (TOV)**

denominates the power frequency overvoltage that can occur for a duration of several tenths of a second to up to a few seconds, as a result of a switching operation or system failure. Its value depends on the type of neutral earthing in the system.

# Applications as line surge arresters



400 kV line in Bulgaria  
NGLA solution realized with 3EL2



550 kV line in Colombia  
NGLA solution realized with 3EL2

The use of surge arresters on hazardous stretches of a power line helps improve network protection and increases the reliability of the entire transmission system. Offering a highly efficient combination of low weight, outstanding strength, and safety features, Siemens Energy 3EL surge arresters are ideally suited for this purpose.

Siemens Energy provides two solutions for line surge arresters:



## Non-gapped line arresters (NGLA)

Non-gapped line surge arresters offer a high degree of mounting flexibility and operational reliability. Depending on the tower design and the arrangement of insulators and lines, these arresters can either be installed directly on the insulators or on the tower. Thanks to their high energy absorption capacity, non-gapped line arresters ensure a very high level of protection against overvoltages caused by lightning and network-generated switching impulse currents.

Siemens Energy 3EL1, 3EL2, 3EL3, 3EL5 surge arresters are available as NGLA types.



## Externally gapped line arresters (EGLA)

Siemens Energy ECLA line surge arresters of the 3EV1, 3EV2, and 3EV5 series have an external spark gap placed in series that galvanically isolates the active part of the line surge arrester from the line voltage under normal conditions. In case of lightning, the spark gap is ignited and the dangerous overvoltage is safely discharged through the resulting arc. The active component limits the subsequent current to ensure that the arc is extinguished within the first half-cycle of the operating current frequency.

The series varistor units (SVU) of the ECLA 3EV1, 3EV2, and 3EV5 product lines are based on the respective 3EL1, 3EL2, and 3EL5 product lines.

# Early detection of relevant changes through efficient equipment monitoring

Due to continuously growing worldwide power demand, more and more power networks are required to transmit higher loads – sometimes up to the limits of their capacity. This makes reliable, responsible network operation an increasingly difficult challenge. In many of today's markets, transmission and distribution system operators are also liable for compensation in the case of power failures. And natural events like lightning can cripple entire networks. As a result, many network operators are seeking solutions to increase the reliability of their transmission systems. Equipment monitoring is a proven method for the recording of operating states and remaining service life, providing the operator with important asset management data and enabling the immediate assessment of a network's overall state.

Surge arresters are highly reliable components in power transmission and distribution systems. When operated in accordance with their specifications, their service life can reach up to 30 years without any maintenance. Nevertheless, overloads that can cause arrester failure and even endanger the safety of the network may sometimes occur. Equipment monitoring helps detect changes and faults at the earliest possible stage and supports security of supply on a whole new level. Siemens Energy provides a complete line of monitoring devices with a variety of innovative functionalities that can be perfectly matched to customer requirements, ensuring that impending faults will be detected as early as possible and before security of supply is compromised.

## Order code system

Data position	1	2	3	4	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-	Z	
<b>Order code</b>	<b>n</b>	<b>a</b>	<b>a</b>	<b>n</b>	<b>n</b>	<b>n</b>	<b>n</b>	-	<b>n</b>	<b>a</b>	<b>a</b>	<b>n</b>	<b>n</b>	-	<b>n</b>	<b>a</b>	<b>a</b>	<b>n</b>	-	<b>Z</b>	
Product line	3	E	L	2																	
Rated voltage (kV)					0	9	6														
Long duration current impulse, energy absorption capability									2												
Application										P											
Housing size											J										
Line discharge class												3									
Number of units													1								
Form of sheds and color of housing														4							
High-voltage terminal																X					
Nameplate																		A			
Mounting																			1		
Accessories																					Z

a: alphabetical  
n: numerical

## Ordering example

The order code can be obtained through the following steps:

1. Select the product line from table «Main technical data» on page 26.  
Example: product line 3EL2
2. Select the rated voltage and required energy rating of the arrester using the «Ratings and specifications – Electrical Characteristics» in the technical datasheet of the selected product line.  
Example: 3EL2 096-2P.3.-...
3. Select the required housing using the «Ratings and specifications – mechanical characteristics» in the technical datasheet of the selected product line.  
Example: for 3EL2 096-2P.3.-.... the minimum housing is »J«: + 3EL2 ...-..J..., resulting in: 3EL2 096-2PJ31-...
4. Select the required terminal, nameplate, and mounting from the table «Order numbers»  
Example: 3EL2 096-2PJ31-4XA1.  
(4 = upright mounting, X = DIN/NEMA flat terminal, A = English nameplate, 1 = insulated mounting, D = 200mm)
5. Select optional accessories from table «Optional accessories» on page 110  
Example: D91 line clamp, resulting in 3EL2 096-2PJ31-4XA1-Z D91
6. Select optional monitoring device from table «Monitoring devices» on page 111.  
Example: 3EX5 080-0 ACM basic

# Product range

Siemens Energy offers multiple models of each surge arrester product family. The models mainly differ in diameter, length of the housings, and sizes of the MOV blocks to meet different customer requirements.

The following selection table shows the main technical data of the different product lines. Detailed technical data is listed in the sections for each dedicated product line.

For additional specifications, please contact your local Siemens Energy representative.

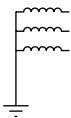
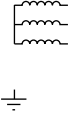
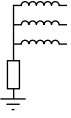
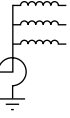
Maximum values				3EL5	3EL1	3EL2	3EL3	3EP5	3EP4	3EP6	3EP3	3EQ1	3EQ4	3EQ3		
Highest voltage of the system				kV	72.5	252	420	550	123	362	800	800	362	800	800	
Maximum rated voltage				kV	60	198	360	444	96	288	588	624	288	588	624	
Nominal discharge current	Line discharge class	Energy absorption capability	Long duration current impulse													
				kA												
		kJ/kV <sub>r</sub>	A													
10	2	4.4	550	■												
10	2	5.0	750		■			■	■				■			
10	3	6.0	800		■											
10	2	5.0	1100			■		■	■				■			
10	3	8.0	1100			■		■	■	■	■	■	■	■		
10	3	8.0	1200			■										
20	4	10.0	1200			■										
20	4	10.0	1600				■			■	■			■	■	
20	5	14.0	2000				■			■	■			■	■	
20	5	16.0	3200								■			■	■	
Rated short-circuit current				kA	20	65	65	65	40	65	65	65	40	651	80	
High current impulse				kA	100	100	100	100	100	100	100	100	100	100	100	
Bending moment dynamic				kNm	0.5	1.2	4.0	10.0	2.0	4.5	18/30 <sup>2</sup>	34/90 <sup>2</sup>	6.0	21/38 <sup>2</sup>	42/72 <sup>2</sup>	

## Main technical data

<sup>1)</sup> Increased rated short-circuit current of 80 kA available on request.

<sup>2)</sup> Increased bending moment

The table below shows an overview of the typical minimum rated voltage for the surge arrester, depending on the highest voltage and grounding of the system.

Highest voltage of system $U_s$ kV	Solidly earthed neutral system $U_r$ kV	Isolated neutral system $U_r$ kV	Impedance earthed neutral system $U_r$ kV	Resonant earthed neutral system $U_r$ kV	Neutral protection $U_r$ kV
					
3.6	3	6	3	6	3
7.2	6	9	9	9	3
12	9	15	12	15	6
17.5	15	24	15	24	9
24	18	30	21	30	12
36	27	45	33	45	15
52	39	66	45	66	21
72.5	54	96	66	96	30
123	90	154	108	154	51
145	108	183	126	183	60
170	123	216	147	216	69
245	180				102
300	222				120
362	261				147
420	336				168
550	396				222
800	580				321

Typical rated voltages  $U_r$  for highest voltages of the system  $U_s$  according to IEC 60099-4.



# 3EL5 Surge arrester

with silicone rubber housing and Cage Design™

## Technical datasheet

### Protection of:

- Transformers
- Circuit breakers
- Generators
- Motors
- Capacitors
- Traction vehicles
- Bushings
- Switchgear
- Transmission lines



Maximum values		3EL5
Highest voltage of the system	kV	72.5
Maximum rated voltage	kV	60
Nominal discharge current	kA	10
Line discharge class		2
Energy absorption capability	kJ/kV <sub>r</sub>	4.4
Long duration current impulse	A	550
Rated short-circuit current	kA	20
High current impulse	kA	100
Bending moment dynamic	kNm	0.5

## 3EL5 – order numbers

Data position	1	2	3	4	5	6	7	–	8	9	10	11	12	–	13	14	15	16	–	Z
<b>Order number</b>	3	E	L	5	x	x	x	–	0	P	H	2	1	–	4	X	A	1	–	Z
<b>Product line</b>																				
Silicone rubber-housed surge arrester, cage design	3	E	L	5																
<b>Rated voltage in kV</b>					x	x	x													
<b>Long duration current impulse, energy absorption capability</b>																				
$I_{2ms} = 550$ A, $E_{th} = 4.4$ kJ/kV <sub>r</sub> , line discharge class 2									0			2								
<b>Application</b>																				
Line surge arrester (For more details refer to catalog Line Surge Arresters)											L									
Phase surge arrester											P									
Neutral point surge arrester											S									
<b>Housing size, number of units. Refer to »Mechanical characteristics« on page 31</b>																				
Housing »B«, 1 unit											B		1							
Housing »C«, 1 unit											C		1							
Housing »D«, 1 unit											D		1							
Housing »E«, 1 unit											E		1							
Housing »F«, 1 unit											F		1							
Housing »H«, 1 unit											H		1							
Housing »J«, 1 unit											J		1							
Housing »K«, 1 unit											K		1							
Housing »2xH«, 2 units											H		2							
<b>Form of sheds and color of silicone rubber</b>																				
Alternating sheds, gray silicone rubber, upright mounting																		4		
Alternating sheds, gray silicone rubber, suspended mounting																		8		
<b>High-voltage terminal</b>																				
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel																			X	
Flat DIN/NEMA, 40x40 ... 50x50, stainless steel																				Y
<b>Nameplate</b>																				
German/English (standard)																				A
French																				B
Czech																				C
Slovene																				D
Russian																				E
Spanish																				F
Portuguese																				G
Arabic																				R
Brazil																				T
CFE (Mexico)																				U
Customized version																				Z
<b>Mounting</b>																				
D=200 mm–254 mm, insulated																				1
D=200 mm–254 mm, grounded																				5
<b>Accessories</b>																				
Refer to table »Optional accessories« on page 110																				Z

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Con- tinuous operating voltage $U_c$ kV	Line discharge class  LD Class	Long duration current 2ms  A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
3.6	3	2.4	2	550	6.6	6.8	7.2	8.0	8.6	9.8	11.4	3EL5 003 - 0 P . 2 . - ....	B	
	6	4.8	2	550	13.2	13.7	14.4	15.9	17.1	19.7	22.7	3EL5 006 - 0 P . 2 . - ....	B	
7.2	6	4.8	2	550	13.2	13.7	14.4	15.9	17.1	19.7	22.7	3EL5 006 - 0 P . 2 . - ....	B	
	9	7.2	2	550	19.8	20.5	21.5	23.9	25.7	29.5	34.1	3EL5 009 - 0 P . 2 . - ....	C	
12	9	7.2	2	550	19.8	20.5	21.5	23.9	25.7	29.5	34.1	3EL5 009 - 0 P . 2 . - ....	C	
	12	9.6	2	550	26.3	27.4	28.7	31.8	34.2	39.3	45.5	3EL5 012 - 0 P . 2 . - ....	D	
17.5	15	12.0	2	550	32.9	34.2	35.9	39.8	42.8	49.2	56.9	3EL5 015 - 0 P . 2 . - ....	D	
	18	14.4	2	550	39.5	41.0	43.1	47.7	51.3	59.0	68.2	3EL5 018 - 0 P . 2 . - ....	E	
24	18	14.4	2	550	39.5	41.0	43.1	47.7	51.3	59.0	68.2	3EL5 018 - 0 P . 2 . - ....	E	
	21	16.8	2	550	46.1	47.9	50.3	55.7	59.9	68.8	79.6	3EL5 021 - 0 P . 2 . - ....	F	
	24	19.2	2	550	52.7	54.7	57.5	63.6	68.4	78.7	91.0	3EL5 024 - 0 P . 2 . - ....	H	
	30	24	2	550	65.8	68.4	71.8	79.5	85.5	98.3	114	3EL5 030 - 0 P . 2 . - ....	H	
36	27	21.6	2	550	59.3	61.6	64.6	71.6	77.0	88.5	102	3EL5 027 - 0 P . 2 . - ....	H	
	30	24.0	2	550	65.8	68.4	71.8	79.5	85.5	98.3	114	3EL5 030 - 0 P . 2 . - ....	H	
	33	26.4	2	550	72.4	75.2	79.0	87.5	94.1	108	125	3EL5 033 - 0 P . 2 . - ....	H	
	45	36	2	550	98.8	103	108	119	128	147	171	3EL5 045 - 0 P . 2 . - ....	K	
48	36	28.8	2	550	79.0	82.1	86.2	95.4	103	118	136	3EL5 036 - 0 P . 2 . - ....	J	
	39	31.2	2	550	85.6	88.9	93.4	103	111	128	148	3EL5 039 - 0 P . 2 . - ....	J	
52	42	34	2	550	92.2	95.8	101	111	120	138	159	3EL5 042 - 0 P . 2 . - ....	J	
	45	36	2	550	98.8	103	108	119	128	147	171	3EL5 045 - 0 P . 2 . - ....	K	
	48	38	2	550	105	109	115	127	137	157	182	3EL5 048 - 0 P . 2 . - ....	2xH	
	51	41	2	550	112	116	122	135	145	167	193	3EL5 051 - 0 P . 2 . - ....	2xH	
72.5	54	43	2	550	119	123	129	143	154	177	205	3EL5 054 - 0 P . 2 . - ....	2xH	
	57	46	2	550	125	130	136	151	162	187	216	3EL5 057 - 0 P . 2 . - ....	2xH	
	60	48	2	550	132	137	144	159	171	197	227	3EL5 060 - 0 P . 2 . - ....	2xH	

### Mechanical characteristics

Housing size	Height [H]  mm	Creepage distance  mm	Housing insulation		Specified short-term load SSL  N	Specified long-term load SLL  N	Grading ring diameter [D]  mm	Maximum weight of arrester  kg	Flashover distance  mm	Arrester type	Figure
			Lightning impulse withstand voltage 1.2/50 $\mu$ s kV	Power frequency withstand voltage 1 min., wet kV							
B	170	372	104	49	2940	2050	-	3.6	180	3EL5 ... - .. B . 1 - ....	A
C	200	485	122	57	2500	1750	-	3.9	210	3EL5 ... - .. C . 1 - ....	A
D	240	605	144	67	2080	1450	-	4.5	248	3EL5 ... - .. D . 1 - ....	A
E	270	775	166	77	1850	1290	-	4.9	286	3EL5 ... - .. E . 1 - ....	A
F	300	900	184	86	1660	1160	-	5.2	318	3EL5 ... - .. F . 1 - ....	A
H	400	1230	242	113	1250	870	-	6.2	418	3EL5 ... - .. H . 1 - ....	A
J	470	1420	281	131	1060	740	-	7.0	484	3EL5 ... - .. J . 1 - ....	A
K	510	1595	302	140	980	680	-	7.4	520	3EL5 ... - .. K . 1 - ....	A
2xH	840	2460	484	226	590	410	-	10.2	836	3EL5 ... - .. H . 2 - ....	B

The maximum arrester weight can vary depending on rated voltage and line discharge class.

Line terminals

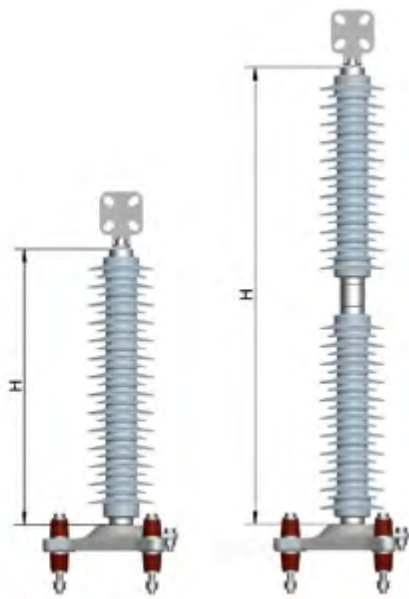
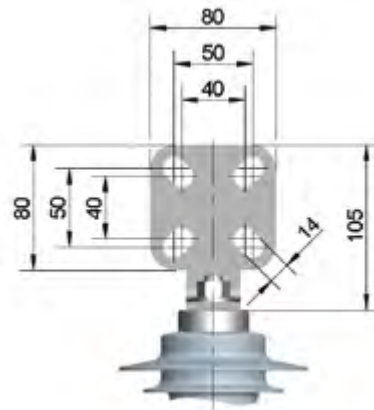


Figure A

Figure B

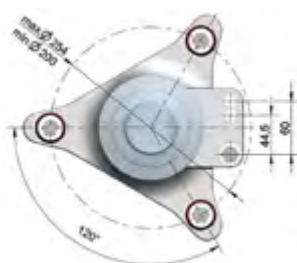
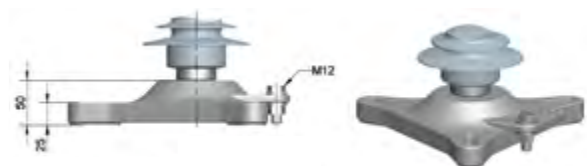
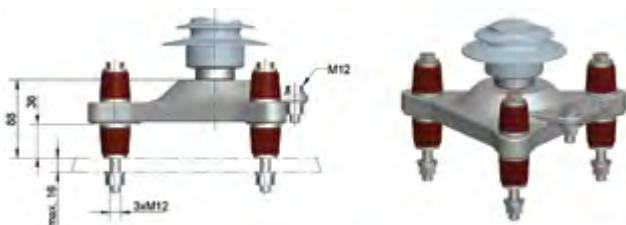


DIN/NEMA flat terminal

3EL5 ...-.....-X.. (hot dip galvanized)

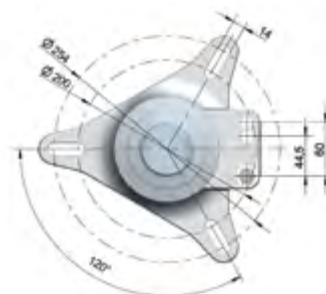
3EL5 ...-.....-Y.. (stainless steel)

Mounting



Insulated

3EL5 ...-.....-1



Grounded

3EL5 ...-.....-5

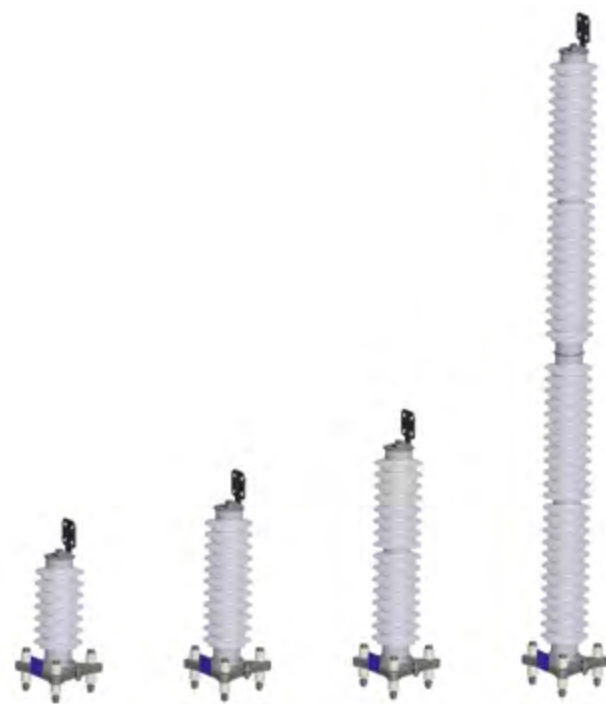
# 3EL1 Surge arrester

with silicone rubber housing and Cage Design™

## Technical datasheet

### Protection of:

- Transformers
- Circuit breakers
- Generators
- Motors
- Capacitors
- Traction vehicles
- Bushings
- Switchgear
- Transmission lines



Maximum values		3EL1	3EL1
Highest voltage of the system	kV	252	170
Maximum rated voltage	kV	198	156
Nominal discharge current	kA	10	10
Line discharge class		2	3
Energy absorption capability	kJ/kV <sub>r</sub>	5.0	6.0
Long duration current impulse	A	750	800
Rated short-circuit current	kA	65	65
High current impulse	kA	100	100
Bending moment dynamic	kNm	1.2	1.2

## 3EL1 – order numbers

Data position	1	2	3	4	–	5	6	7	–	8	9	10	11	12	–	13	14	15	16	–	
<b>Order number</b>	3	E	L	1	–	x	x	x	–	1	P	H	2	1	–	4	D	A	1	–	Z
<b>Product line</b>																					
Silicone rubber-housed surge arrester, cage design	3	E	L	1																	
<b>Rated voltage in kV</b>						x	x	x													
<b>Long duration current impulse, energy absorption capability</b>																					
$I_{2ms} = 750 \text{ A}$ , $E_{th} = 5 \text{ kJ/kV}_r$ , line discharge class 2										1			2								
$I_{2ms} = 800 \text{ A}$ , $E_{th} = 6 \text{ kJ/kV}_r$ , line discharge class 3										1			3								
<b>Application</b>																					
Line surge arrester (For more details refer to catalog Line Surge Arresters)											L										
Phase surge arrester											P										
Neutral point surge arrester											S										
<b>Housing size, number of units. Refer to »Mechanical characteristics« on page 37</b>																					
Housing »C«, 1 unit											C		1								
Housing »E«, 1 unit											E		1								
Housing »H«, 1 unit											H		1								
Housing »K«, 1 unit											K		1								
Housing »E+H«, 2 units											N		2								
Housing »2xH«, 2 units											H		2								
Housing »E+K«, 2 units											P		2								
Housing »H+K«, 2 units											Q		2								
Housing »2xK«, 2 units											K		2								
<b>Form of sheds and color of silicone rubber</b>																					
Alternating sheds, gray silicone rubber, upright mounting																4					
Alternating sheds, gray silicone rubber, suspended mounting																8					
<b>High-voltage terminal</b>																					
Metal plate with M10 thread insert																					A
Bolt, 30 mm diameter, 80 mm length, stainless steel																					D
Bolt, 40 mm diameter, 80 mm length, stainless steel																					G
Bolt, 40 mm diameter, 120 mm length, stainless steel																					J
Flat DIN/NEMA, 40x40 ... 50x50, aluminum																					T
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel																					X
Flat DIN/NEMA, 40x40 ... 50x50, stainless steel																					Y
Bolt, 26 mm diameter, 100 mm length, stainless steel																					Z
Bolt, 35 mm diameter, 120 mm length, stainless steel																					Z
Flat, 4xD=16, aluminum																					Z
Flat, 2xD=18/60, Palm 7, aluminum																					Z
<b>Nameplate</b>																					
German/English (standard)																					A
French																					B
Czech																					C
Slovene																					D
Russian																					E
Spanish																					F
Portuguese																					G
Arabic																					R
Brazil																					T
CFE (Mexico)																					U
Customized version																					Z
<b>Mounting</b>																					
Metal plate with M10 thread insert																					0
D=200 mm–254 mm, insulated																					1
D=200 mm–254 mm, grounded																					5
<b>Accessories</b>																					
Refer to table »Optional accessories« on page 110																					Z

P1A  
P1F  
P5A  
P5J

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Con- tinuous operating voltage $U_c$ kV	Line discharge class  LD Class	Long duration current 2ms  A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
3.6	3	2.4	2	750	5.9	6.1	6.4	7.1	7.7	8.6	9.8	3EL1 003 - 1 P . 2 . - ....	C	
	3	2.4	3	800	5.9	6.1	6.4	7.1	7.7	8.6	9.8	3EL1 003 - 1 P . 3 . - ....	C	
	6	4.8	2	750	11.8	12.2	12.9	14.2	15.3	17.1	19.6	3EL1 006 - 1 P . 2 . - ....	C	
	6	4.8	3	800	11.8	12.2	12.9	14.2	15.3	17.1	19.6	3EL1 006 - 1 P . 3 . - ....	C	
7.2	6	4.8	2	750	11.8	12.2	12.9	14.2	15.3	17.1	19.6	3EL1 006 - 1 P . 2 . - ....	C	
	6	4.8	3	800	11.8	12.2	12.9	14.2	15.3	17.1	19.6	3EL1 006 - 1 P . 3 . - ....	C	
	9	7.2	2	750	17.7	18.4	19.3	21.3	23.0	25.7	29.4	3EL1 009 - 1 P . 2 . - ....	C	
	9	7.2	3	800	17.7	18.4	19.3	21.3	23.0	25.7	29.4	3EL1 009 - 1 P . 3 . - ....	C	
12	9	7.2	2	750	17.7	18.4	19.3	21.3	23.0	25.7	29.4	3EL1 009 - 1 P . 2 . - ....	C	
	9	7.2	3	800	17.7	18.4	19.3	21.3	23.0	25.7	29.4	3EL1 009 - 1 P . 3 . - ....	C	
	12	9.6	2	750	23.6	24.5	25.7	28.5	30.6	34.3	39.2	3EL1 012 - 1 P . 2 . - ....	C	
	12	9.6	3	800	23.6	24.5	25.7	28.5	30.6	34.3	39.2	3EL1 012 - 1 P . 3 . - ....	C	
17.5	15	12.0	2	750	29.5	30.6	32.1	35.6	38.3	42.8	49.0	3EL1 015 - 1 P . 2 . - ....	C	
	15	12.0	3	800	29.5	30.6	32.1	35.6	38.3	42.8	49.0	3EL1 015 - 1 P . 3 . - ....	C	
	18	14.4	2	750	35.3	36.7	38.6	42.7	45.9	51.4	58.8	3EL1 018 - 1 P . 2 . - ....	C	
	18	14.4	3	800	35.3	36.7	38.6	42.7	45.9	51.4	58.8	3EL1 018 - 1 P . 3 . - ....	C	
	24	19.2	2	750	47.1	49.0	51.4	56.9	61.2	68.5	78.3	3EL1 024 - 1 P . 2 . - ....	C	
	24	19.2	3	800	47.1	49.0	51.4	56.9	61.2	68.5	78.3	3EL1 024 - 1 P . 3 . - ....	E	
24	21	16.8	2	750	41.2	42.8	45.0	49.8	53.6	60.0	68.5	3EL1 021 - 1 P . 2 . - ....	C	
	21	16.8	3	800	41.2	42.8	45.0	49.8	53.6	60.0	68.5	3EL1 021 - 1 P . 3 . - ....	C	
	24	19.2	2	750	47.1	49.0	51.4	56.9	61.2	68.5	78.3	3EL1 024 - 1 P . 2 . - ....	C	
	24	19.2	3	800	47.1	49.0	51.4	56.9	61.2	68.5	78.3	3EL1 024 - 1 P . 3 . - ....	E	
	30	24.0	2	750	58.9	61.2	64.3	71.1	76.5	85.7	97.9	3EL1 030 - 1 P . 2 . - ....	E	
	30	24.0	3	800	58.9	61.2	64.3	71.1	76.5	85.7	97.9	3EL1 030 - 1 P . 3 . - ....	E	
36	30	24.0	2	750	58.9	61.2	64.3	71.1	76.5	85.7	97.9	3EL1 030 - 1 P . 2 . - ....	E	
	30	24.0	3	800	58.9	61.2	64.3	71.1	76.5	85.7	97.9	3EL1 030 - 1 P . 3 . - ....	E	
	45	36	2	750	88.4	91.8	96.4	107	115	129	147	3EL1 045 - 1 P . 2 . - ....	E	
	45	36	3	800	88.4	91.8	96.4	107	115	129	147	3EL1 045 - 1 P . 3 . - ....	H	
52	42	34	2	750	82.5	85.7	90.0	99.6	107	120	137	3EL1 042 - 1 P . 2 . - ....	E	
	42	34	3	800	82.5	85.7	90.0	99.6	107	120	137	3EL1 042 - 1 P . 3 . - ....	E	
	45	36	2	750	88.4	91.8	96.4	107	115	129	147	3EL1 045 - 1 P . 2 . - ....	E	
	45	36	3	800	88.4	91.8	96.4	107	115	129	147	3EL1 045 - 1 P . 3 . - ....	H	
72.5	54	43	2	750	106	110	116	128	138	154	176	3EL1 054 - 1 P . 2 . - ....	H	
	54	43	3	800	106	110	116	128	138	154	176	3EL1 054 - 1 P . 3 . - ....	H	
	60	48	2	750	118	122	129	142	153	171	196	3EL1 060 - 1 P . 2 . - ....	H	
	60	48	3	800	118	122	129	142	153	171	196	3EL1 060 - 1 P . 3 . - ....	K	
	66	53	2	750	130	135	141	157	168	188	215	3EL1 066 - 1 P . 2 . - ....	H	
	66	53	3	800	130	135	141	157	168	188	215	3EL1 066 - 1 P . 3 . - ....	K	
	72	58	2	750	141	147	154	171	184	206	235	3EL1 072 - 1 P . 2 . - ....	H	
	72	58	3	800	141	147	154	171	184	206	235	3EL1 072 - 1 P . 3 . - ....	K	

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Con- tinuous operating voltage $U_c$ kV	Line discharge class  LD Class	Long duration current 2ms  A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
123	96	77	2	750	188	196	206	228	245	274	313	3EL1 096 - 1 P . 2 . - ....	K	
	96	77	3	800	188	196	206	228	245	274	313	3EL1 096 - 1 P . 3 . - ....	N	
	102	82	2	750	200	208	218	242	260	291	333	3EL1 102 - 1 P . 2 . - ....	K	
	102	82	3	800	200	208	218	242	260	291	333	3EL1 102 - 1 P . 3 . - ....	2xH	
	108	86	2	750	212	220	231	256	275	308	353	3EL1 108 - 1 P . 2 . - ....	K	
	108	86	3	800	212	220	231	256	275	308	353	3EL1 108 - 1 P . 3 . - ....	2xH	
145	120	96	2	750	236	245	257	285	306	343	392	3EL1 120 - 1 P . 2 . - ....	2xH	
	120	96	3	800	236	245	257	285	306	343	392	3EL1 120 - 1 P . 3 . - ....	P	
	132	106	2	750	259	269	283	313	337	377	431	3EL1 132 - 1 P . 2 . - ....	2xH	
	132	106	3	800	259	269	283	313	337	377	431	3EL1 132 - 1 P . 3 . - ....	P	
	144	115	2	750	283	294	308	341	367	411	470	3EL1 144 - 1 P . 2 . - ....	P	
	144	115	3	800	283	294	308	341	367	411	470	3EL1 144 - 1 P . 3 . - ....	Q	
170	138	110	2	750	271	282	296	327	352	394	450	3EL1 138 - 1 P . 2 . - ....	2xH	
	138	110	3	800	271	282	296	327	352	394	450	3EL1 138 - 1 P . 3 . - ....	Q	
	144	115	2	750	283	294	308	341	367	411	470	3EL1 144 - 1 P . 2 . - ....	P	
	144	115	3	800	283	294	308	341	367	411	470	3EL1 144 - 1 P . 3 . - ....	Q	
	150	120	2	750	295	306	321	356	383	428	490	3EL1 150 - 1 P . 2 . - ....	P	
	150	120	3	800	295	306	321	356	383	428	490	3EL1 150 - 1 P . 3 . - ....	Q	
245	192	154	2	750	377	392	411	455	490	548	627	3EL1 192 - 1 P . 2 . - ....	2xK	
	198	158	2	750	389	404	424	470	505	565	646	3EL1 198 - 1 P . 2 . - ....	2xK	

### Electrical characteristics – neutral ground arresters

12	9	7.2	2	750	17.7	18.4	19.3	21.3	23.0	25.7	29.4	3EL1 009 - 1 S . 2 . - ....	C
	9	7.2	3	800	17.7	18.4	19.3	21.3	23.0	25.7	29.4	3EL1 009 - 1 S . 3 . - ....	C
24	12	9.6	2	750	23.6	24.5	25.7	28.5	30.6	34.3	39.2	3EL1 012 - 1 S . 2 . - ....	C
	12	9.6	3	800	23.6	24.5	25.7	28.5	30.6	34.3	39.2	3EL1 012 - 1 S . 3 . - ....	C
36	15	12.0	2	750	29.5	30.6	32.1	35.6	38.3	42.8	49.0	3EL1 015 - 1 S . 2 . - ....	C
	15	12.0	3	800	29.5	30.6	32.1	35.6	38.3	42.8	49.0	3EL1 015 - 1 S . 3 . - ....	C
	45	36	2	750	88.4	91.8	96.4	107	115	129	147	3EL1 045 - 1 S . 2 . - ....	E
	45	36	3	800	88.4	91.8	96.4	107	115	129	147	3EL1 045 - 1 S . 3 . - ....	H
72.5	30	24.0	2	750	58.9	61.2	64.3	71.1	76.5	85.7	97.9	3EL1 030 - 1 S . 2 . - ....	E
	30	24.0	3	800	58.9	61.2	64.3	71.1	76.5	85.7	97.9	3EL1 030 - 1 S . 3 . - ....	E
	45	36	2	750	88.4	91.8	96.4	107	115	129	147	3EL1 045 - 1 S . 2 . - ....	E
	45	36	3	800	88.4	91.8	96.4	107	115	129	147	3EL1 045 - 1 S . 3 . - ....	H
123	51	41	2	750	100	104	109	121	130	146	166	3EL1 051 - 1 S . 2 . - ....	H
	51	41	3	800	100	104	109	121	130	146	166	3EL1 051 - 1 S . 3 . - ....	H
	60	48	2	750	118	122	129	142	153	171	196	3EL1 060 - 1 S . 2 . - ....	H
	60	48	3	800	118	122	129	142	153	171	196	3EL1 060 - 1 S . 3 . - ....	K
	72	58	2	750	141	147	154	171	184	206	235	3EL1 072 - 1 S . 2 . - ....	H
	72	58	3	800	141	147	154	171	184	206	235	3EL1 072 - 1 S . 3 . - ....	K
245	102	82	2	750	200	208	218	242	260	291	333	3EL1 102 - 1 S . 2 . - ....	K
	102	82	3	800	200	208	218	242	260	291	333	3EL1 102 - 1 S . 3 . - ....	2xH
	108	86	2	750	212	220	231	256	275	308	353	3EL1 108 - 1 S . 2 . - ....	K
	108	86	3	800	212	220	231	256	275	308	353	3EL1 108 - 1 S . 3 . - ....	2xH

## Ratings and specifications

### Mechanical characteristics

Housing size	Height [H] mm	Creepage distance mm	Housing insulation		Specified short-term load SSL N	Specified long-term load SLL N	Grading ring diameter [D] mm	Maximum weight of arrester kg	Flashover distance mm	Arrester type	Figure
			Lightning impulse withstand voltage 1.2/50µs kV	Power frequency withstand voltage 1 min., wet kV							
C	305	900	183	85	3930	2750	-	7.9	315	3EL1 ... - .. C . 1 - ....	A
E	445	1400	264	123	2690	1880	-	10.0	455	3EL1 ... - .. E . 1 - ....	A
H	620	2050	365	170	1930	1350	-	12.5	630	3EL1 ... - .. H . 1 - ....	A
K	900	3075	528	246	1330	930	-	16.5	910	3EL1 ... - .. K . 1 - ....	A
N	1070	3450	629	293	1120	780	-	19.7	1085	3EL1 ... - .. N . 2 - ....	B
2xH	1245	4100	731	340	960	670	-	22.1	1260	3EL1 ... - .. H . 2 - ....	B
P	1350	4475	792	369	880	620	-	23.6	1365	3EL1 ... - .. P . 2 - ....	B
Q	1525	5125	893	416	780	550	-	25.7	1540	3EL1 ... - .. Q . 2 - ....	B
2xK	1805	6150	1056	492	660	460	-	29.3	1820	3EL1 ... - .. K . 2 - ....	B

The maximum arrester weight can vary depending on rated voltage and line discharge class.



Figure A

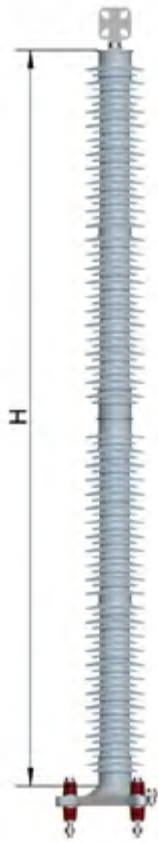
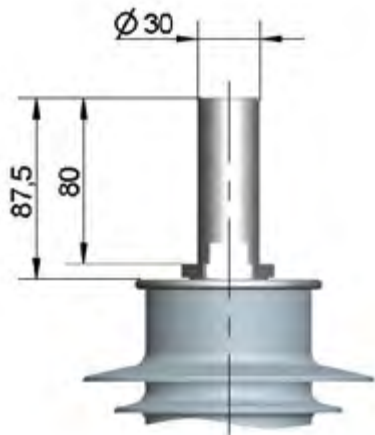
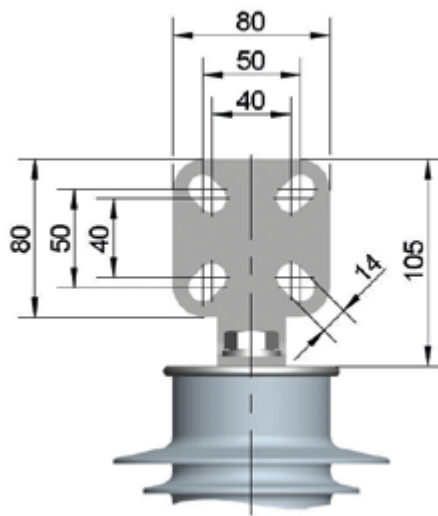


Figure B

Line terminals

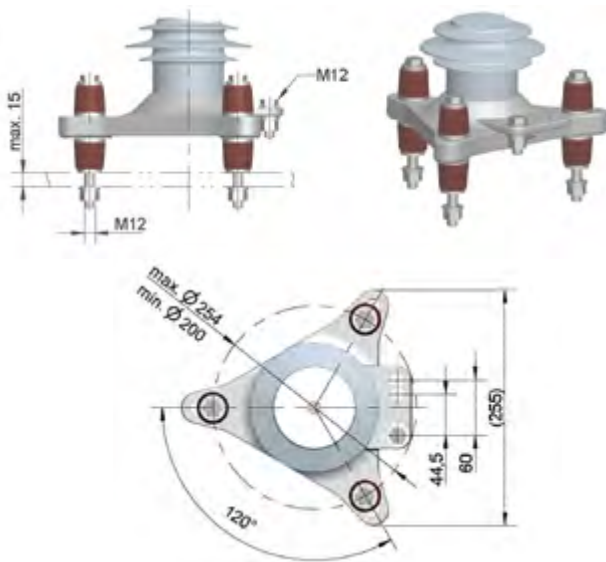


**Bolt**  
3EL1 .....-D..

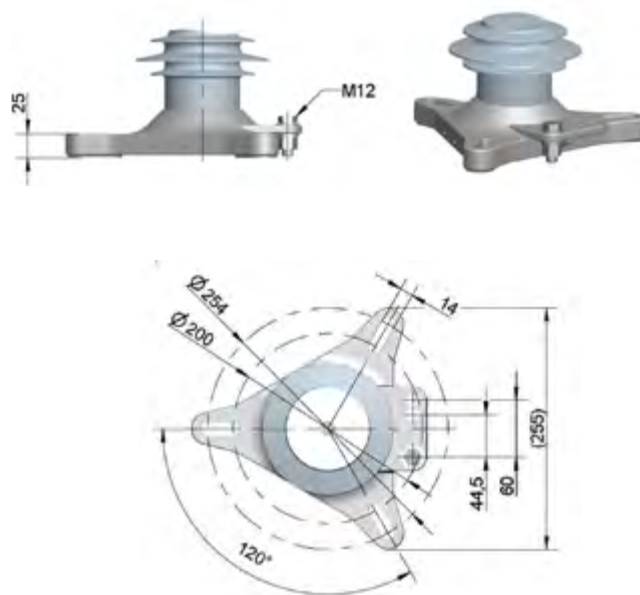


**DIN/NEMA flat terminal**  
3EL1 .....-T.. (aluminum)  
3EL1 .....-X.. (hot dip galvanized)  
3EL1 .....-Y.. (stainless steel)

Mounting



**Insulated**  
3EL1 .....-1



**Grounded**  
3EL1 .....-5

# 3EL2 Surge arrester

with silicone rubber housing and Cage Design™

## Technical datasheet

### Protection of:

- Transformers
- Circuit breakers
- Generators
- Motors
- Capacitors
- Traction vehicles
- Bushings
- Switchgear
- Transmission lines



Maximum values		3EL2	3EL2	3EL2	3EL2
Highest voltage of the system	kV	362	420	420	420
Maximum rated voltage	kV	288	360	360	360
Nominal discharge current	kA	10	10	20	20
Line discharge class		2	3	3	4
Energy absorption capability	kJ/kV <sub>r</sub>	5.0	8.0	8.0	10.0
Long duration current impulse	A	1100	1100	1200	1200
Rated short-circuit current	kA	65	65	65	65
High current impulse	kA	100	100	100	100
Bending moment dynamic	kNm	4.0	4.0	4.0	4.0

## 3EL2 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-						
<b>Order number</b>	3	E	L	2	-	x	x	x	-	2	P	J	3	1	-	4	D	A	1	-	Z					
<b>Product line</b>																										
Silicone rubber-housed surge arrester, cage design	3	E	L	2																						
<b>Rated voltage in kV</b>						x	x	x																		
<b>Long duration current impulse, energy absorption capability</b>																										
$I_{2ms} = 1100 \text{ A}$ , $E_{th} = 5 \text{ kJ/kV}_r$ , line discharge class 2										2				2												
$I_{2ms} = 1100 \text{ A}$ , $E_{th} = 8 \text{ kJ/kV}_r$ , line discharge class 3										2				3												
$I_{2ms} = 1200 \text{ A}$ , $E_{th} = 8 \text{ kJ/kV}_r$ , line discharge class 3										6				3												
$I_{2ms} = 1200 \text{ A}$ , $E_{th} = 10 \text{ kJ/kV}_r$ , line discharge class 4										6				4												
<b>Application</b>																										
Line surge arrester (For more details refer to catalog Line Surge Arresters)																						L				
Phase surge arrester																							P			
Neutral point surge arrester																							S			
<b>Housing size, number of units. Refer to »Mechanical characteristics« on page 45</b>																										
Housing »C«, 1 unit																							C	1		
Housing »F«, 1 unit																								F	1	
Housing »J«, 1 unit																								J	1	
Housing »M«, 1 unit																								M	1	
Housing »C+J«, 2 units																								P	2	
Housing »F+J«, 2 units																								Q	2	
Housing »F+M«, 2 units																								R	2	
Housing »2xJ«, 2 units																								J	2	
Housing »J+M«, 2 units																								W	2	
Housing »2xM«, 2 units																								M	2	
Housing »F+J+J«, 3 units																								X	3	
Housing »3xJ«, 3 units																								J	3	
<b>Form of sheds and color of silicone rubber</b>																										
Alternating sheds, gray silicone rubber, upright mounting																										4
Alternating sheds, gray silicone rubber, suspended mounting																										8
<b>High-voltage terminal</b>																										
Metal plate																										A
Bolt, 30 mm diameter, 80 mm length, stainless steel																										D
Bolt, 30 mm diameter, 100 mm length, stainless steel																										E
Bolt, 40 mm diameter, 80 mm length, stainless steel																										G
Bolt, 40 mm diameter, 120 mm length, stainless steel																										J
Flat DIN/NEMA, 40x40 ... 50x50, 20 mm, hot dip galvanized steel																										L
Flat DIN/NEMA, 40x40 ... 50x50, aluminum																										T
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel																										X
Flat DIN/NEMA, 40x40 ... 50x50, stainless steel																										Y
Bolt, 26 mm diameter, 100 mm length, stainless steel																										Z
Bolt, 30 mm diameter, 80 mm length, aluminum																										Z
Bolt, 35 mm diameter, 120 mm length, stainless steel																										Z
Bolt, 38 mm diameter, 125 mm length, stainless steel																										Z
Bolt, 40 mm diameter, 80 mm length, aluminum																										Z
Bolt, 40 mm diameter, 125 mm length, aluminum																										Z
Bolt, 40 mm diameter, 150 mm length, aluminum																										Z
Bolt, 40 mm diameter, 80 mm length, copper																										Z
Flat, 4xD=16, aluminum																										Z
Flat, 4xD=14/50, Palm 5, aluminum																										Z
Flat, 2xD=18/60, Palm 7, aluminum																										Z
Flat, 4xD=18/60, Palm 8, aluminum																										Z
Flat, 6xD=18/70, Palm 13, aluminum																										Z
Flat, 6xD=18 60/60, hot dip galvanized steel																										Z
																										P1A
																										P1C
																										P1F
																										P1G
																										P1H
																										P1L
																										P1N
																										P1Q
																										P5A
																										P5G
																										P5J
																										P5K
																										P5P
																										P5S

## 3EL2 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-			
<b>Order number</b>	<b>3</b>	<b>E</b>	<b>L</b>	<b>2</b>	-	<b>x</b>	<b>x</b>	<b>x</b>	-	<b>2</b>	<b>P</b>	<b>J</b>	<b>3</b>	<b>1</b>	-	<b>4</b>	<b>D</b>	<b>A</b>	<b>1</b>	-	<b>Z</b>		
<b>Nameplate</b>																							
German/English (standard)																				A			
French																				B			
Czech																				C			
Slovene																				D			
Russian																				E			
Spanish																				F			
Portuguese																				G			
Arabic																				R			
Brazil																				T			
CFE (Mexico)																				U			
Customized version																				Z			
<b>Mounting</b>																							
D=140 mm, grounded																				0			
D=200 mm–276 mm, insulated																				1			
200 mm x 200 mm, insulated																				2			
310 mm x 310 mm, insulated																				3			
D=200 mm–276 mm, grounded																				5			
170 mm x 170 mm, insulated																				9		R1B	
<b>Accessories</b>																							
Refer to table »Optional accessories« on page 110																				Z			

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system	Rated voltage	Continuous operating voltage	Line discharge class	Long duration current 2ms	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 μs 0.5 kA kV	30/60 μs 1 kA kV	30/60 μs 2 kA kV	8/20 μs 5 kA kV	8/20 μs 10 kA kV	8/20 μs 20 kA kV	8/20 μs 40 kA kV			
U <sub>s</sub> kV	U <sub>r</sub> kV	U <sub>c</sub> kV	LD Class	A										
12	9	7.2	2	1100	16.2	16.6	17.4	19.0	20.3	22.5	25.5	3EL2 009 - 2 P. 2 . - ....	C	
	9	7.2	3	1100	16.9	17.3	18.2	19.9	21.2	23.5	26.6	3EL2 009 - 2 P. 3 . - ....	C	
	9	7.2	4	1200	17.5	17.9	18.8	20.3	21.6	23.8	25.9	3EL2 009 - 6 P. 4 . - ....	C	
	12	9.6	2	1100	21.6	22.1	23.2	25.4	27.0	30.0	34.0	3EL2 012 - 2 P. 2 . - ....	C	
	12	9.6	3	1100	22.6	23.1	24.3	26.5	28.2	31.3	35.5	3EL2 012 - 2 P. 3 . - ....	C	
	12	9.6	4	1200	23.3	23.9	25.1	27.1	28.8	31.7	34.6	3EL2 012 - 6 P. 4 . - ....	C	
17.5	15	12.0	2	1100	27.0	27.7	29.0	31.7	33.8	37.5	42.5	3EL2 015 - 2 P. 2 . - ....	C	
	15	12.0	3	1100	28.2	28.9	30.3	33.1	35.3	39.1	44.4	3EL2 015 - 2 P. 3 . - ....	C	
	15	12.0	4	1200	29.2	29.9	31.3	33.8	36.0	39.6	43.2	3EL2 015 - 6 P. 4 . - ....	C	
	18	14.4	2	1100	32.4	33.2	34.8	38.1	40.5	45.0	51.0	3EL2 018 - 2 P. 2 . - ....	C	
	18	14.4	3	1100	33.8	34.7	36.4	39.8	42.3	47.0	53.3	3EL2 018 - 2 P. 3 . - ....	C	
	18	14.4	4	1200	35.0	35.9	37.6	40.6	43.2	47.5	51.8	3EL2 018 - 6 P. 4 . - ....	C	
	24	19.2	2	1100	43.2	44.3	46.4	50.8	54.0	59.9	68.0	3EL2 024 - 2 P. 2 . - ....	C	
	24	19.2	3	1100	45.1	46.2	48.5	53.0	56.4	62.6	71.1	3EL2 024 - 2 P. 3 . - ....	C	
24	21	16.8	2	1100	37.8	38.7	40.6	44.4	47.3	52.4	59.5	3EL2 021 - 2 P. 2 . - ....	C	
	21	16.8	3	1100	39.5	40.5	42.4	46.4	49.4	54.8	62.2	3EL2 021 - 2 P. 3 . - ....	C	
	21	16.8	4	1200	40.8	41.8	43.8	47.4	50.4	55.4	60.5	3EL2 021 - 6 P. 4 . - ....	C	
	30	24.0	2	1100	54.0	55.4	58.1	63.5	67.5	74.9	85.1	3EL2 030 - 2 P. 2 . - ....	C	
	30	24.0	3	1100	56.4	57.8	60.6	66.3	70.5	78.3	88.8	3EL2 030 - 2 P. 3 . - ....	C	
36	30	24.0	4	1200	58.3	59.8	62.6	67.7	72.0	79.2	86.4	3EL2 030 - 6 P. 4 . - ....	C	
	45	36	2	1100	81.0	83.0	87.1	95.2	101	112	128	3EL2 045 - 2 P. 2 . - ....	C	
	45	36	3	1100	84.6	86.7	90.9	99.4	106	117	133	3EL2 045 - 2 P. 3 . - ....	F	
	45	36	4	1200	87.5	89.6	94.0	102	108	119	130	3EL2 045 - 6 P. 4 . - ....	F	
	52	42	34	3	1100	79.0	80.9	84.9	92.8	98.7	110	124	3EL2 042 - 2 P. 3 . - ....	C
		42	34	4	1200	81.6	83.7	87.7	94.8	101	111	121	3EL2 042 - 6 P. 4 . - ....	F
45		36	3	1100	84.6	86.7	90.9	99.4	106	117	133	3EL2 045 - 2 P. 3 . - ....	F	
45		36	4	1200	87.5	89.6	94.0	102	108	119	130	3EL2 045 - 6 P. 4 . - ....	F	
72.5	54	43	3	1100	102	104	109	119	127	141	160	3EL2 054 - 2 P. 3 . - ....	F	
	54	43	4	1200	105	108	113	122	130	143	156	3EL2 054 - 6 P. 4 . - ....	F	
	60	48	3	1100	113	116	121	133	141	157	178	3EL2 060 - 2 P. 3 . - ....	F	
	60	48	4	1200	117	120	125	135	144	158	173	3EL2 060 - 6 P. 4 . - ....	F	
	66	53	3	1100	124	127	133	146	155	172	195	3EL2 066 - 2 P. 3 . - ....	F	
	66	53	4	1200	128	131	138	149	158	174	190	3EL2 066 - 6 P. 4 . - ....	F	
	72	58	3	1100	135	139	146	159	169	188	213	3EL2 072 - 2 P. 3 . - ....	F	
	72	58	4	1200	140	143	150	162	173	190	207	3EL2 072 - 6 P. 4 . - ....	F	

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system	Rated voltage	Con- tinuous operating voltage	Line discharge class	Long duration current 2ms	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
$U_s$ kV	$U_r$ kV	$U_c$ kV	LD Class	A										
123	96	77	3	1100	180	185	194	212	226	250	284	3EL2 096 - 2 P . 3 . - ....	J	
	96	77	4	1200	187	191	200	217	230	253	276	3EL2 096 - 6 P . 4 . - ....	J	
	102	82	3	1100	192	197	206	225	240	266	302	3EL2 102 - 2 P . 3 . - ....	J	
	102	82	4	1200	198	203	213	230	245	269	294	3EL2 102 - 6 P . 4 . - ....	J	
	108	86	3	1100	203	208	218	239	254	282	320	3EL2 108 - 2 P . 3 . - ....	J	
	108	86	4	1200	210	215	226	244	259	285	311	3EL2 108 - 6 P . 4 . - ....	J	
	154	123	3	1100	290	297	311	340	362	402	456	3EL2 154 - 2 P . 3 . - ....	M	
145	120	96	3	1100	226	231	243	265	282	313	355	3EL2 120 - 2 P . 3 . - ....	J	
	120	96	4	1200	233	239	251	271	288	317	346	3EL2 120 - 6 P . 4 . - ....	J	
	132	106	3	1100	248	254	267	292	310	344	391	3EL2 132 - 2 P . 3 . - ....	M	
	132	106	4	1200	257	263	276	298	317	348	380	3EL2 132 - 6 P . 4 . - ....	M	
	144	115	3	1100	271	277	291	318	338	376	426	3EL2 144 - 2 P . 3 . - ....	M	
	144	115	4	1200	280	287	301	325	346	380	415	3EL2 144 - 6 P . 4 . - ....	M	
170	138	110	3	1100	259	266	279	305	324	360	409	3EL2 138 - 2 P . 3 . - ....	M	
	138	110	4	1200	268	275	288	311	331	364	397	3EL2 138 - 6 P . 4 . - ....	M	
	144	115	3	1100	271	277	291	318	338	376	426	3EL2 144 - 2 P . 3 . - ....	M	
	144	115	4	1200	280	287	301	325	346	380	415	3EL2 144 - 6 P . 4 . - ....	M	
	150	120	3	1100	282	289	303	331	353	391	444	3EL2 150 - 2 P . 3 . - ....	M	
	150	120	4	1200	292	299	313	338	360	396	432	3EL2 150 - 6 P . 4 . - ....	M	
245	192	154	3	1100	361	370	388	424	451	501	569	3EL2 192 - 2 P . 3 . - ....	Q	
	192	154	4	1200	373	382	401	433	461	507	553	3EL2 192 - 6 P . 4 . - ....	Q	
	198	158	3	1100	372	382	400	437	465	516	586	3EL2 198 - 2 P . 3 . - ....	Q	
	198	158	4	1200	385	394	413	447	475	523	570	3EL2 198 - 6 P . 4 . - ....	Q	
	228	182	3	1100	429	439	461	504	536	595	675	3EL2 228 - 2 P . 3 . - ....	R	
	228	182	4	1200	443	454	476	514	547	602	657	3EL2 228 - 6 P . 4 . - ....	2xJ	
300	228	182	3	1100	429	439	461	504	536	595	675	3EL2 228 - 2 P . 3 . - ....	R	
	228	182	4	1200	443	454	476	514	547	602	657	3EL2 228 - 6 P . 4 . - ....	2xJ	
	240	192	3	1100	451	462	485	530	564	626	711	3EL2 240 - 2 P . 3 . - ....	2xJ	
	240	192	4	1200	467	478	501	541	576	634	691	3EL2 240 - 6 P . 4 . - ....	2xJ	
362	276	221	3	1100	519	532	558	610	649	720	817	3EL2 276 - 2 P . 3 . - ....	W	
	276	221	4	1200	537	550	576	623	662	729	795	3EL2 276 - 6 P . 4 . - ....	W	
	288	230	3	1100	541	555	582	636	677	751	853	3EL2 288 - 2 P . 3 . - ....	2xM	
	288	230	4	1200	560	574	601	650	691	760	829	3EL2 288 - 6 P . 4 . - ....	2xM	
420	336	269	3	1100	632	647	679	742	790	876	995	3EL2 336 - 2 P . 3 . - ....	3xJ	
	336	269	4	1200	653	669	702	758	806	887	968	3EL2 336 - 6 P . 4 . - ....	3xJ	
	360	288	3	1100	677	694	728	795	846	939	1066	3EL2 360 - 2 P . 3 . - ....	3xJ	
	360	288	4	1200	700	717	752	812	864	950	1037	3EL2 360 - 6 P . 4 . - ....	3xJ	

## Ratings and specifications

### Electrical characteristics – neutral ground arresters

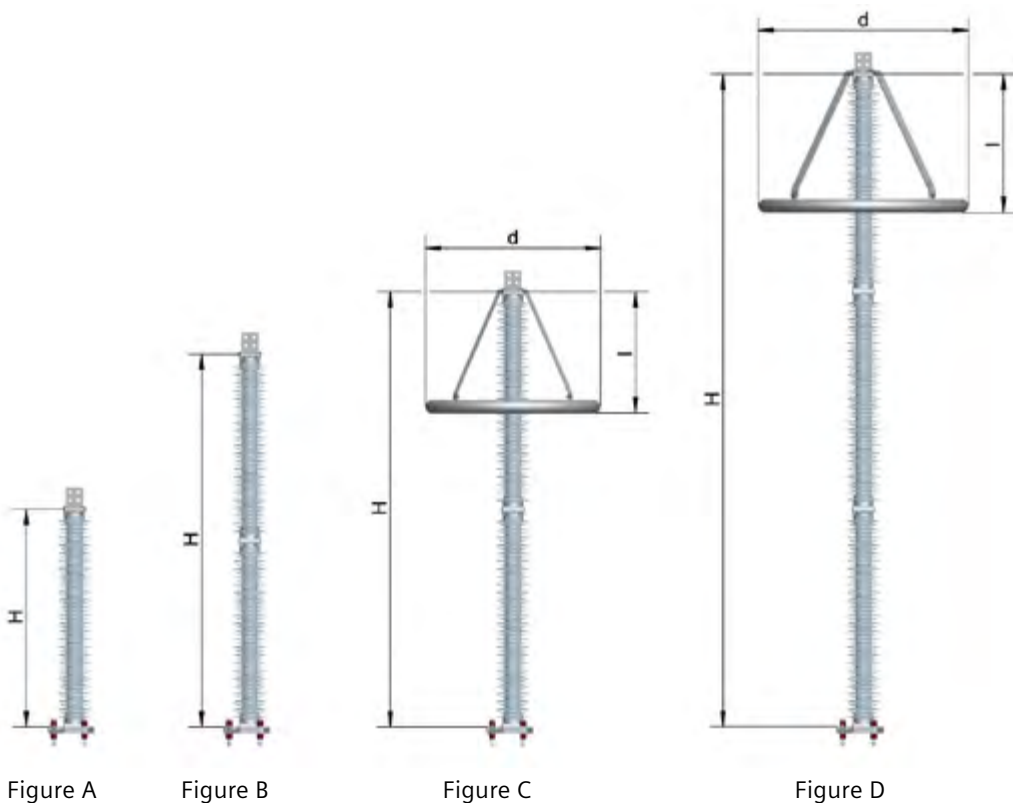
Highest voltage of the system	Rated voltage	Continuous operating voltage	Line discharge class	Long duration current 2ms	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
$U_s$ kV	$U_r$ kV	$U_c$ kV	LD Class	A										
72.5	30	24.0	3	1100	56.4	57.8	60.6	66.3	70.5	78.3	88.8	3EL2 030 - 2 S . 3 . - ....	C	
	30	24.0	4	1200	58.3	59.8	62.6	67.7	72.0	79.2	86.4	3EL2 030 - 6 S . 4 . - ....	C	
	45	36	3	1100	84.6	86.7	90.9	99.4	106	117	133	3EL2 045 - 2 S . 3 . - ....	F	
	45	36	4	1200	87.5	89.6	94.0	102	108	119	130	3EL2 045 - 6 S . 4 . - ....	F	
123	51	41	3	1100	95.9	98.3	103	113	120	133	151	3EL2 051 - 2 S . 3 . - ....	F	
	51	41	4	1200	99.1	102	106	115	122	135	147	3EL2 051 - 6 S . 4 . - ....	F	
	60	48	3	1100	113	116	121	133	141	157	178	3EL2 060 - 2 S . 3 . - ....	F	
	60	48	4	1200	117	120	125	135	144	158	173	3EL2 060 - 6 S . 4 . - ....	F	
	66	53	3	1100	124	127	133	146	155	172	195	3EL2 066 - 2 S . 3 . - ....	F	
	66	53	4	1200	128	131	138	149	158	174	190	3EL2 066 - 6 S . 4 . - ....	F	
	72	58	3	1100	135	139	146	159	169	188	213	3EL2 072 - 2 S . 3 . - ....	F	
	72	58	4	1200	140	143	150	162	173	190	207	3EL2 072 - 6 S . 4 . - ....	F	
	90	72	3	1100	169	173	182	199	212	235	266	3EL2 090 - 2 S . 3 . - ....	J	
145	80	64	3	1100	150	154	162	177	188	209	237	3EL2 080 - 2 S . 3 . - ....	J	
	80	64	4	1200	156	159	167	180	192	211	230	3EL2 080 - 6 S . 4 . - ....	J	
245	102	82	3	1100	192	197	206	225	240	266	302	3EL2 102 - 2 S . 3 . - ....	J	
	102	82	4	1200	198	203	213	230	245	269	294	3EL2 102 - 6 S . 4 . - ....	J	
	108	86	3	1100	203	208	218	239	254	282	320	3EL2 108 - 2 S . 3 . - ....	J	
	108	86	4	1200	210	215	226	244	259	285	311	3EL2 108 - 6 S . 4 . - ....	J	
420	168	134	3	1100	316	324	340	371	395	438	497	3EL2 168 - 2 S . 3 . - ....	P	
	168	134	4	1200	327	335	351	379	403	444	484	3EL2 168 - 6 S . 4 . - ....	Q	

## Ratings and specifications

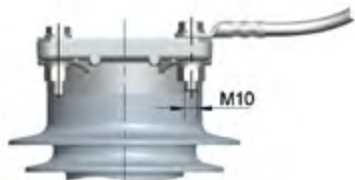
### Mechanical characteristics

Housing size	Height [H] mm	Creepage distance mm	Housing insulation			Specified short-term load SSL N	Specified long-term load SLL N	Grading ring diameter [D] mm	Maximum weight of arrester kg	Flashover distance mm	Arrester type	Figure
			Lightning impulse withstand voltage 1.2/50µs kV	Switching impulse withstand voltage 250µs/2500µs, wet kV	Power frequency withstand voltage 1 min., wet kV							
C	482	1470	235	170	109	8290	5800	-	17.7	405	3EL2 ... - .. C . 1 - ....	A
F	705	2340	365	265	170	5670	3970	-	23.5	630	3EL2 ... - .. F . 1 - ....	A
J	1062	3820	571	414	266	3760	2630	-	32.3	985	3EL2 ... - .. J . 1 - ....	A
M	1240	4495	676	489	315	3220	2250	-	37.6	1165	3EL2 ... - .. M . 1 - ....	A
P	1544	5290	806	584	375	2590	1810	-	46.2	1390	3EL2 ... - .. P . 2 - ....	B
Q	1767	6160	936	678	436	2260	1580	-	51.3	1615	3EL2 ... - .. Q . 2 - ....	B
R	1945	6835	1041	754	485	2050	1430	-	56.9	1795	3EL2 ... - .. R . 2 - ....	B
2xJ	2124	7640	1142	827	532	1880	1310	-	57.2	1970	3EL2 ... - .. J . 2 - ....	B
W	2302	8315	1247	903	581	1730	1210	600	63.6	1905	3EL2 ... - .. W . 2 - ....	C
2xM	2480	8990	1352	979	629	1610	1120	800	69.6	1925	3EL2 ... - .. M . 2 - ....	C
X	2829	9980	1507	1093	702	1410	980	800	79.8	2250	3EL2 ... - .. X . 3 - ....	D
3xJ	3186	11460	1713	1242	798	1250	870	1000	86.7	2470	3EL2 ... - .. J . 3 - ....	D
3xM	3720	13485	2028	1467	945	1070	750	1000	93.2	2950	3EL2 ... - .. M . 3 - ....	D

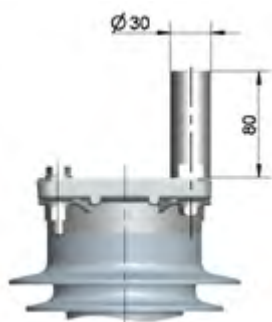
The maximum arrester weight can vary depending on rated voltage and line discharge class.



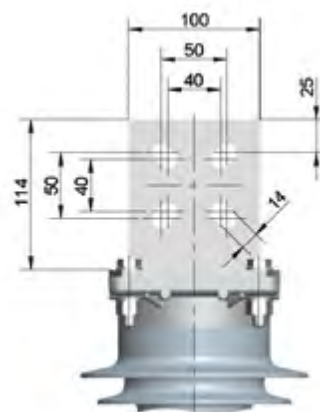
Line terminals



**Plate**  
3EL2 .....-A..

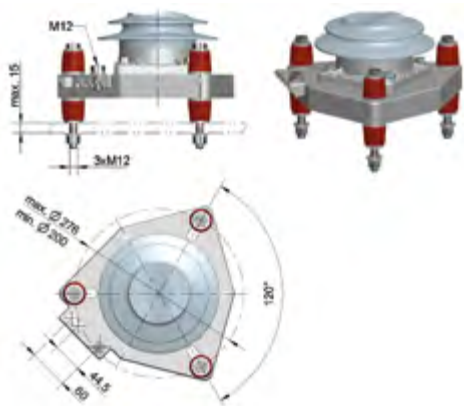


**Bolt**  
3EL2 .....-D..

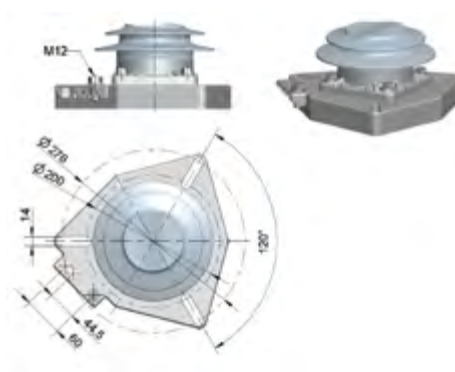


**DIN/NEMA flat terminal**  
3EL2 .....-T.. (aluminum)  
3EL2 .....-X.. (hot dip galvanized)  
3EL2 .....-Y.. (stainless steel)

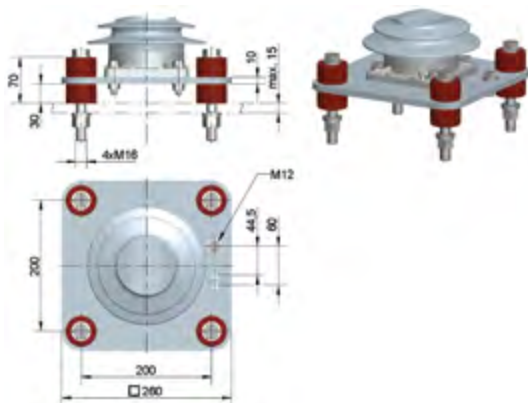
Mounting



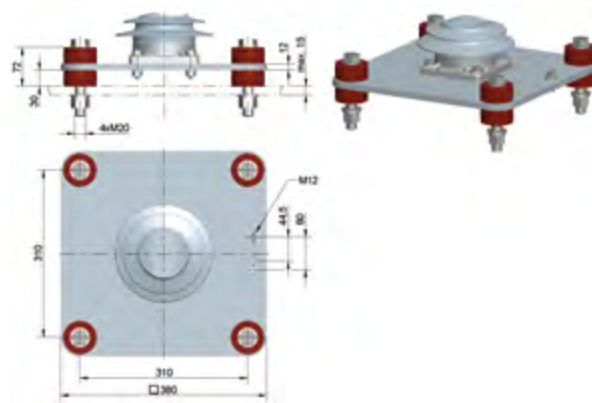
**Insulated**  
3EL2 .....-1



**Grounded**  
3EL2 .....-5



**Insulated**  
3EL2 .....-2



**Insulated**  
3EL2 .....-3

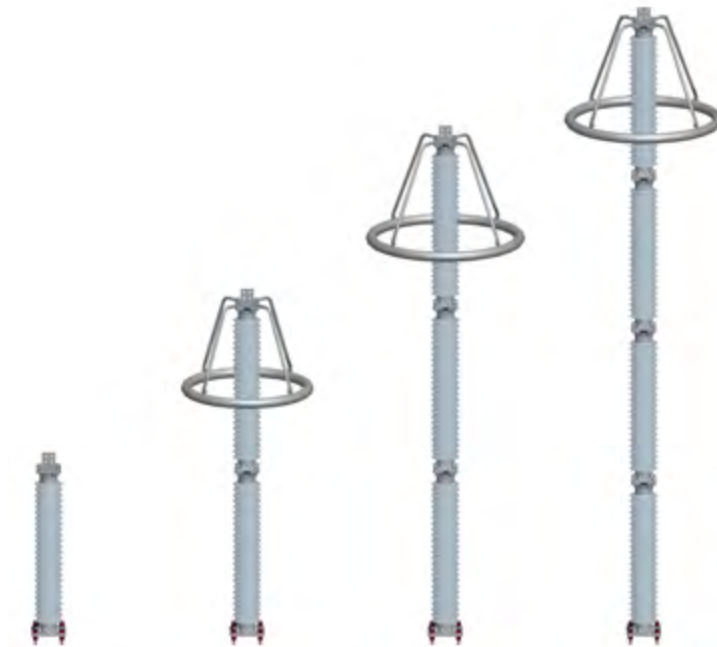
# 3EL3 Surge arrester

with silicone rubber housing and Cage Design™

## Technical datasheet

### Protection of:

- Transformers
- Circuit breakers
- Generators
- Motors
- Capacitors
- Traction vehicles
- Bushings
- Switchgear
- Transmission lines



Maximum values		3EL3	3EL3
Highest voltage of the system	kV	550	550
Maximum rated voltage	kV	444	468
Nominal discharge current	kA	20	20
Line discharge class		4	5
Energy absorption capability	kJ/kV <sub>r</sub>	10.0	14.0
Long duration current impulse	A	1600	2000
Rated short-circuit current	kA	65	65
High current impulse	kA	100	100
Bending moment dynamic	kNm	10.0	10.0

## 3EL3 – order numbers

Data position	1	2	3	4	–	5	6	7	–	8	9	10	11	12	–	13	14	15	16	–	
<b>Order number</b>	3	E	L	3	–	x	x	x	–	4	P	J	4	1	–	4	D	A	1	–	Z
<b>Product line</b>																					
Silicone rubber-housed surge arrester, cage design	3	E	L	3																	
<b>Rated voltage in kV</b>						x	x	x													
<b>Long duration current impulse, energy absorption capability</b>																					
$I_{2ms} = 1600$ A, $E_{th} = 10$ kJ/kV <sub>r</sub> , line discharge class 4										4			4								
$I_{2ms} = 2000$ A, $E_{th} = 14$ kJ/kV <sub>r</sub> , line discharge class 5										4			5								
<b>Application</b>																					
Line surge arrester (For more details refer to catalog Line Surge Arresters)											L										
Phase surge arrester											P										
Neutral point surge arrester											S										
<b>Housing size, number of units. Refer to »Mechanical characteristics« on page 51</b>																					
Housing »F«, 1 unit											F		1								
Housing »G«, 1 unit											G		1								
Housing »H«, 1 unit											H		1								
Housing »J«, 1 unit											J		1								
Housing »K«, 1 unit											K		1								
Housing »L«, 1 unit											L		1								
Housing »M«, 1 unit											M		1								
Housing »2xG«, 2 units											G		2								
Housing »2xH«, 2 units											H		2								
Housing »2xJ«, 2 units											J		2								
Housing »2xK«, 2 units											K		2								
Housing »2xL«, 2 units											L		2								
Housing »2xM«, 2 units											M		2								
Housing »3xJ«, 3 units											J		3								
Housing »3xK«, 3 units											K		3								
Housing »3xL«, 3 units											L		3								
Housing »3xM«, 3 units											M		3								
<b>Form of sheds and color of silicone rubber</b>																					
Alternating sheds, gray silicone rubber, upright mounting																	4				
Alternating sheds, gray silicone rubber, suspended mounting																	8				
<b>High-voltage terminal</b>																					
Metal plate																					A
Bolt, 30 mm diameter, 80 mm length, hot dip galvanized steel																					C
Bolt, 30 mm diameter, 80 mm length, stainless steel																					D
Bolt, 40 mm diameter, 80 mm length, stainless steel																					G
Bolt, 40 mm diameter, 120 mm length, stainless steel																					J
Flat DIN/NEMA, 40x40 ... 50x50, 20 mm, hot dip galvanized steel																					L
Flat DIN/NEMA, 40x40 ... 50x50, aluminum																					T
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel																					X
Flat DIN/NEMA, 40x40 ... 50x50, stainless steel																					Y

## 3EL3 – order numbers

Data position	1	2	3	4	–	5	6	7	–	8	9	10	11	12	–	13	14	15	16	–	
<b>Order number</b>	3	E	L	3	–	x	x	x	–	4	P	J	4	1	–	4	D	A	1	–	Z
<b>Nameplate</b>																					
German/English (standard)																				A	
French																				B	
Czech																				C	
Slovene																				D	
Russian																				E	
Spanish																				F	
Portuguese																				G	
Arabic																				R	
Brazil																				T	
CFE (Mexico)																				U	
Customized version																				Z	
<b>Mounting</b>																					
200 mm x 200 mm, grounded																				0	
200 mm x 200 mm, insulated																				1	
D=10", insulated with DIN/NEMA earth terminal																				2	
310 mm x 310 mm, insulated																				3	
D=10", grounded																				5	
D=10", insulated																				7	
<b>Accessories</b>																					
Refer to table »Optional accessories« on page 110																				– Z	

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system	Rated voltage	Continuous operating voltage	Line discharge class	Long duration current 2ms	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 µs 0.5 kA kV	30/60 µs 1 kA kV	30/60 µs 2 kA kV	8/20 µs 5 kA kV	8/20 µs 10 kA kV	8/20 µs 20 kA kV	8/20 µs 40 kA kV			
U <sub>s</sub> kV	U <sub>r</sub> kV	U <sub>c</sub> kV	LD Class	A										
123	96	77	4	1600	179	185	190	204	216	235	257	3EL3 096 - 4 P . 4 . - ....	H	
	102	82	4	1600	190	196	202	217	230	250	273	3EL3 102 - 4 P . 4 . - ....	H	
	108	86	4	1600	202	208	214	230	243	265	289	3EL3 108 - 4 P . 4 . - ....	H	
	154	123	4	1600	288	296	305	327	347	378	412	3EL3 154 - 4 P . 4 . - ....	L	
145	120	96	4	1600	224	231	238	255	270	294	321	3EL3 120 - 4 P . 4 . - ....	J	
	132	106	4	1600	247	254	261	281	297	324	353	3EL3 132 - 4 P . 4 . - ....	K	
	144	115	4	1600	269	277	285	306	324	353	386	3EL3 144 - 4 P . 4 . - ....	L	
170	138	110	4	1600	258	265	273	293	311	338	369	3EL3 138 - 4 P . 4 . - ....	K	
	144	115	4	1600	269	277	285	306	324	353	386	3EL3 144 - 4 P . 4 . - ....	L	
	150	120	4	1600	280	289	297	319	338	368	402	3EL3 150 - 4 P . 4 . - ....	L	
245	192	154	4	1600	359	369	380	408	432	471	514	3EL3 192 - 4 P . 4 . - ....	2xH	
	198	158	4	1600	370	381	392	421	446	486	530	3EL3 198 - 4 P . 4 . - ....	2xH	
	228	182	4	1600	426	439	451	485	513	559	610	3EL3 228 - 4 P . 4 . - ....	2xJ	
300	228	182	4	1600	426	439	451	485	513	559	610	3EL3 228 - 4 P . 4 . - ....	2xJ	
	240	192	4	1600	448	462	475	510	540	589	643	3EL3 240 - 4 P . 4 . - ....	2xJ	
362	276	221	4	1600	515	531	546	587	621	677	739	3EL3 276 - 4 P . 4 . - ....	2xL	
	276	221	5	2000	515	531	546	587	621	677	739	3EL3 276 - 4 P . 5 . - ....	2xL	
	288	230	4	1600	538	554	570	612	648	706	771	3EL3 288 - 4 P . 4 . - ....	2xL	
	288	230	5	2000	538	554	570	612	648	706	771	3EL3 288 - 4 P . 5 . - ....	2xL	
420	336	269	4	1600	627	646	665	714	756	824	900	3EL3 336 - 4 P . 4 . - ....	3xJ	
	336	269	5	2000	627	646	665	714	756	824	900	3EL3 336 - 4 P . 5 . - ....	3xJ	
	360	288	4	1600	672	693	713	765	810	883	964	3EL3 360 - 4 P . 4 . - ....	3xK	
	360	288	5	2000	672	693	713	765	810	883	964	3EL3 360 - 4 P . 5 . - ....	3xK	
550	396	317	4	1600	740	762	784	842	891	971	1060	3EL3 396 - 4 P . 4 . - ....	3xM	
	396	317	5	2000	740	762	784	842	891	971	1060	3EL3 396 - 4 P . 5 . - ....	3xM	
	420	336	4	1600	784	808	832	893	945	1030	1125	3EL3 420 - 4 P . 4 . - ....	4xK	
	420	336	5	2000	784	808	832	893	945	1030	1125	3EL3 420 - 4 P . 5 . - ....	4xK	
	444	355	4	1600	829	854	879	944	999	1089	1189	3EL3 444 - 4 P . 4 . - ....	4xK	
	444	355	5	2000	829	854	879	944	999	1089	1189	3EL3 444 - 4 P . 5 . - ....	4xK	
	468	374	4	1600	874	900	927	995	1053	1148	1253	3EL3 468 - 4 P . 4 . - ....	4xK	
	468	374	5	2000	874	900	927	995	1053	1148	1253	3EL3 468 - 4 P . 5 . - ....	4xK	

### Electrical characteristics – neutral ground arresters

Highest voltage of the system	Rated voltage	Continuous operating voltage	Line discharge class	Long duration current 2ms	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 µs 0.5 kA kV	30/60 µs 1 kA kV	30/60 µs 2 kA kV	8/20 µs 5 kA kV	8/20 µs 10 kA kV	8/20 µs 20 kA kV	8/20 µs 40 kA kV			
U <sub>s</sub> kV	U <sub>r</sub> kV	U <sub>c</sub> kV	LD Class	A										
245	102	82	4	1600	190	196	202	217	230	250	273	3EL3 102 - 4 S . 4 . - ....	H	
	108	86	4	1600	201	206	216	233	248	273	298	3EL3 108 - 4 S . 4 . - ....	H	
420	168	134	4	1600	314	323	333	357	378	412	450	3EL3 168 - 4 S . 4 . - ....	M	

## Ratings and specifications

### Mechanical characteristics

Housing size	Height [H] mm	Creepage distance mm	Housing insulation			Specified short-term load SSL N	Specified long-term load SLL N	Grading ring diameter [D] mm	Maximum weight of arrester kg	Flashover distance mm	Arrester type	Figure
			Lightning impulse withstand voltage 1.2/50µs kV	Switching impulse withstand voltage 250µs/2500µs, wet kV	Power frequency withstand voltage 1 min., wet kV							
F	747	2476	370	240	160	13380	9370	-	36.0	648	3EL3 ... - .. F . 1 - ....	A
G	836	2864	420	280	180	11960	8370	-	39.1	737	3EL3 ... - .. G . 1 - ....	A
H	925	3252	470	320	200	10810	7560	-	43.1	826	3EL3 ... - .. H . 1 - ....	A
J	1014	3640	520	350	220	9860	6900	-	46.1	915	3EL3 ... - .. J . 1 - ....	A
K	1104	4029	580	380	240	9050	6340	-	50.2	1005	3EL3 ... - .. K . 1 - ....	A
L	1193	4417	630	420	260	8380	5860	-	53.3	1094	3EL3 ... - .. J . 1 - ....	A
M	1282	4805	680	450	290	7800	5460	-	57.2	1183	3EL3 ... - .. M . 1 - ....	A
2xG	1672	5728	850	560	360	5980	4180	-	75.5	1474	3EL3 ... - .. G . 2 - ....	B
2xH	1850	6504	950	640	410	5400	3780	-	82.6	1652	3EL3 ... - .. H . 2 - ....	B
2xJ	2028	7280	1050	700	450	4930	3450	-	88.6	1830	3EL3 ... - .. J . 2 - ....	B
2xK	2208	8058	1160	760	480	4520	3170	600	96.3	1768	3EL3 ... - .. K . 2 - ....	C
2xL	2386	8834	1260	840	520	4190	2930	600	103	1940	3EL3 ... - .. L . 2 - ....	C
2xM	2564	9610	1360	900	580	3900	2730	800	107	1956	3EL3 ... - .. M . 2 - ....	C
3xJ	3042	10920	1560	1050	660	3280	2300	800	134	2367	3EL3 ... - .. J . 2 - ....	D
3xK	3312	12087	1740	1140	720	3010	2110	1000	145	2523	3EL3 ... - .. K . 2 - ....	D
3xL	3579	13251	1890	1260	780	2790	1950	1000	153	2763	3EL3 ... - .. L . 2 - ....	D
3xM	3846	14415	2040	1350	870	2600	1820	1200	163	3006	3EL3 ... - .. M . 3 - ....	D
4xK	4416	16116	2320	1520	960	2260	1580	1500	197	3656	3EL3 ... - .. K . 4 - ....	E

The maximum arrester weight can vary depending on rated voltage and line discharge class.

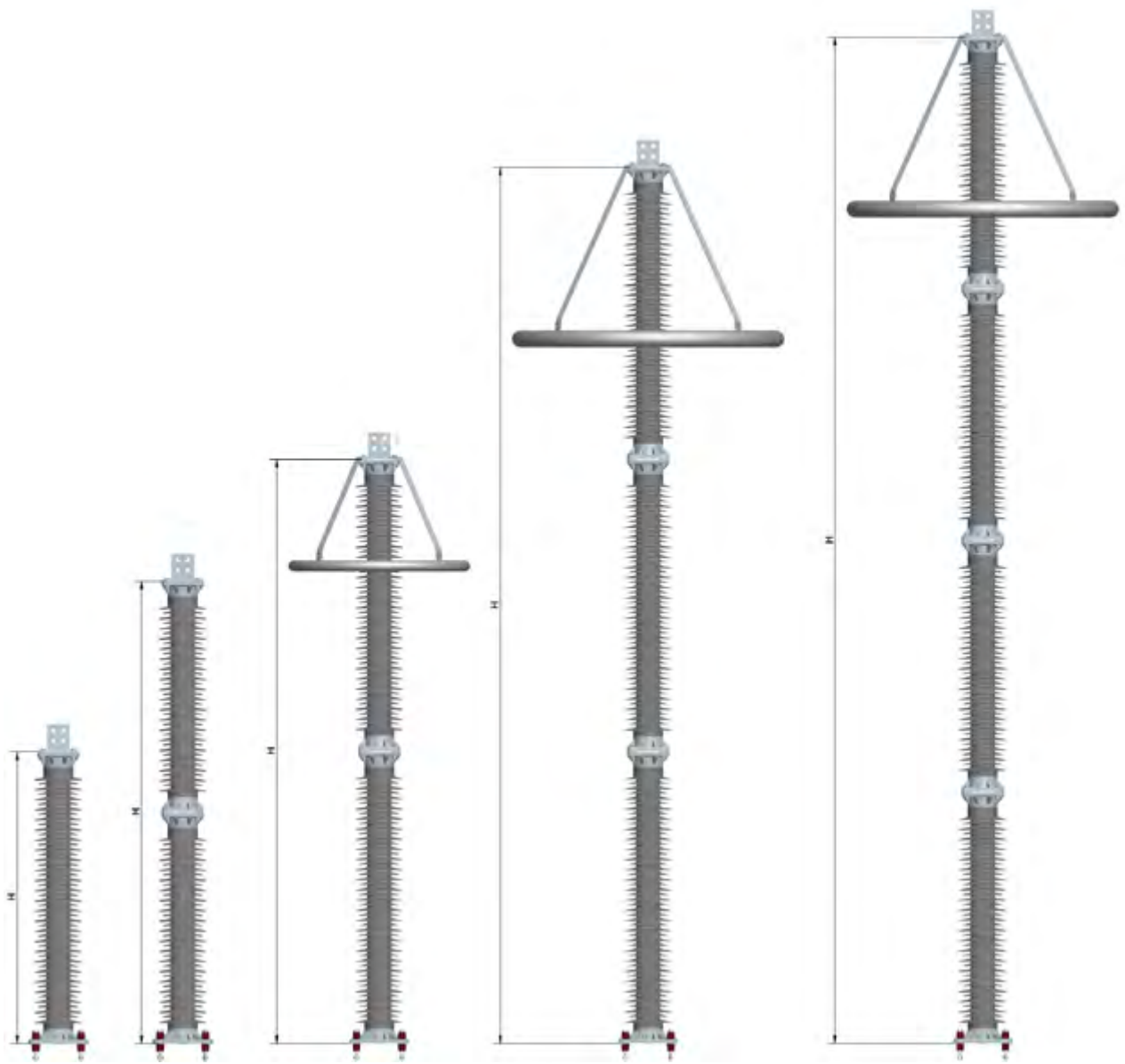


Figure A

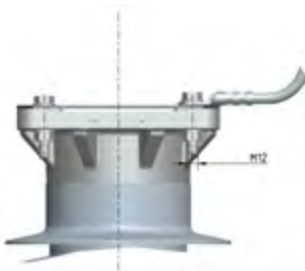
Figure B

Figure C

Figure D

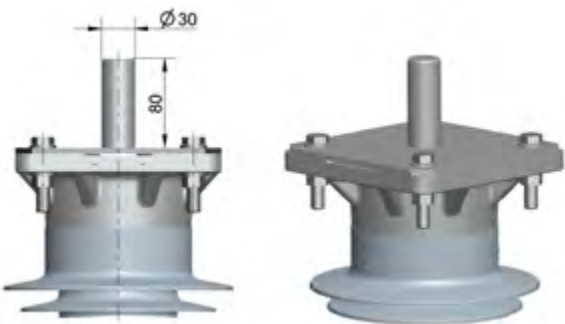
Figure E

Line terminals



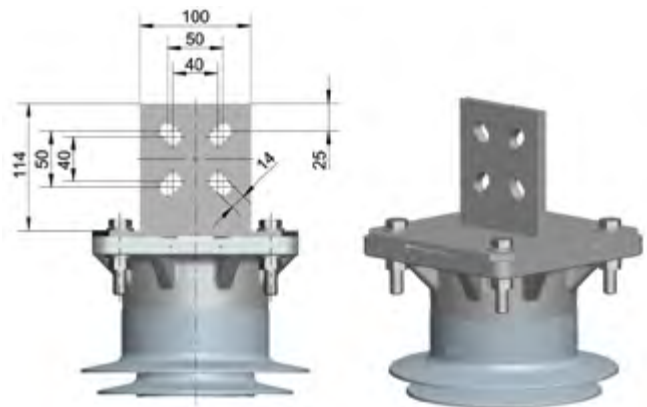
Plate

3EL3 ...-.....-A..



Bolt

3EL3 ...-.....-D..



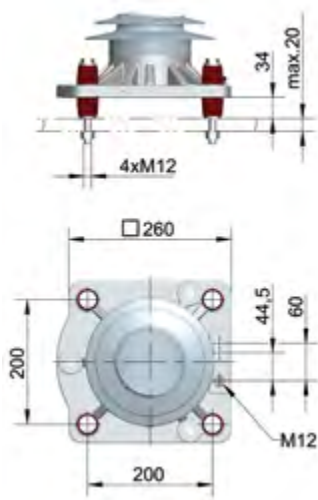
DIN/NEMA flat terminal

3EL3 ...-.....-T.. (aluminum)

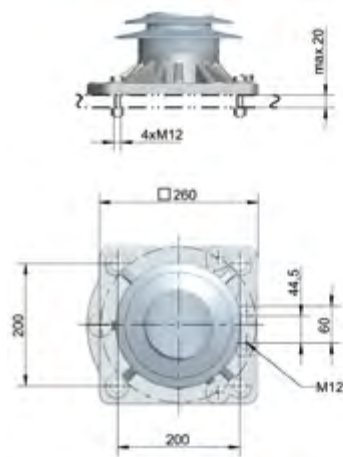
3EL3 ...-.....-X.. (hot dip galvanized)

3EL3 ...-.....-Y.. (stainless steel)

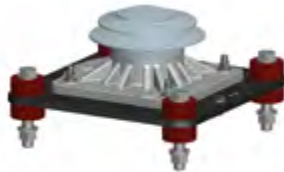
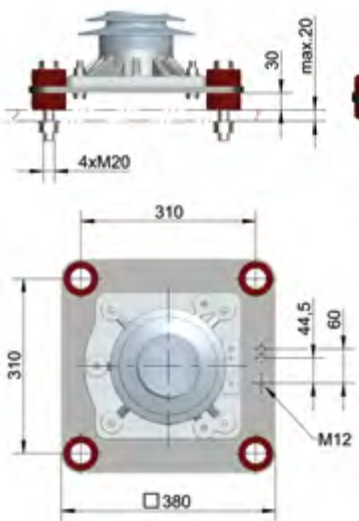
Mounting



Insulated  
3EL3 .....1



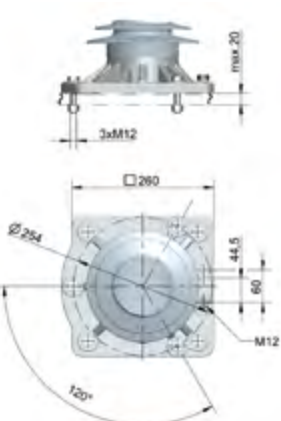
Grounded  
3EL3 .....0



Insulated  
3EL3 .....3



Insulated  
3EL3 .....7



Grounded  
3EL3 .....5

# 3EP5 Surge arrester

with porcelain housing

## Technical datasheet

### Protection of:

- Transformers
- Circuit breakers
- Generators
- Motors
- Capacitors
- Bushings
- Switchgear



Maximum values		3EP5	3EP5	3EP5
Highest voltage of the system	kV	123	123	123
Maximum rated voltage	kV	96	96	96
Nominal discharge current	kA	10	10	10
Line discharge class		2	2	2
Energy absorption capability	kJ/kV <sub>r</sub>	5.0	5.0	8.0
Long duration current impulse	A	750	1100	1100
Rated short-circuit current	kA	40	40	40
High current impulse	kA	100	100	100
Bending moment dynamic	kNm	2.0	2.0	2.0

## 3EP5 – order numbers

Data position	1	2	3	4	–	5	6	7	–	8	9	10	11	12	–	13	14	15	16	–			
<b>Order number</b>	3	E	P	5	–	x	x	x	–	2	P	E	3	1	–	1	D	A	1	–	Z		
<b>Product line</b>																							
Porcelain-housed surge arrester	3	E	P	5																			
<b>Rated voltage in kV</b>																							
						x	x	x															
<b>Long duration current impulse, energy absorption capability</b>																							
$I_{2ms} = 750 \text{ A}$ , $E_{th} = 5 \text{ kJ/kV}_r$ , line discharge class 2											1											2	
$I_{2ms} = 1100 \text{ A}$ , $E_{th} = 5 \text{ kJ/kV}_r$ , line discharge class 2											2											2	
$I_{2ms} = 1100 \text{ A}$ , $E_{th} = 8 \text{ kJ/kV}_r$ , line discharge class 3											2											3	
<b>Application</b>																							
Phase surge arrester											P												
Neutral point surge arrester											S												
<b>Housing size, number of units. Refer to »Mechanical characteristics« on page 59</b>																							
Housing »C«, 1 unit											C											1	
Housing »E«, 1 unit											E											1	
Housing »H«, 1 unit											H											1	
Housing »J«, 1 unit											J											1	
<b>Form of sheds and color of porcelain</b>																							
Normal sheds, brown porcelain, upright mounting																	1						
Normal sheds, gray porcelain, upright mounting																	3						
Normal sheds, brown porcelain, suspended mounting																	5						
Normal sheds, gray porcelain, suspended mounting																	7						
<b>High-voltage terminal</b>																							
Bolt, 30 mm diameter, 80 mm length, stainless steel																	D						
Bolt, 40 mm diameter, 80 mm length, stainless steel																	G						
Bolt, 40 mm diameter, 120 mm length, stainless steel																	J						
Flat DIN/NEMA, 40x40 ... 50x50, copper																	R						
Flat DIN/NEMA, 40x40 ... 50x50, aluminum																	U						
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel																	X						
Flat DIN/NEMA, 40x40 ... 50x50, stainless steel																	Y						
Bolt, 26 mm diameter, 100 mm length, stainless steel																	Z						
Bolt, 30 mm diameter, 80 mm length, aluminum																	Z						
Bolt, 35 mm diameter, 120 mm length, stainless steel																	Z						
Bolt, 40 mm diameter, 80 mm length, aluminum																	Z						
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel, horizontal																	Z						
Flat, 4xD=16, aluminum																	Z						
Flat, 4xD=14/50, Palm 5, aluminum																	Z						
<b>Nameplate</b>																							
German/English (standard)																	A						
French																	B						
Czech																	C						
Slovene																	D						
Russian																	E						
Spanish																	F						
Portuguese																	G						
Arabic																	R						
Brazil																	T						
CFE (Mexico)																	U						
Customized version																	Z						
<b>Mounting</b>																							
D=200 mm–254 mm, insulated																							1
D=200 mm–254 mm, grounded																							5
<b>Accessories</b>																							
Refer to table »Optional accessories« on page 110																						Z	

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Continuous operating voltage $U_c$ kV	Line discharge class LD Class	Long duration current 2ms A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
12	9	7.2	2	750	17.7	18.4	19.3	21.3	23.0	25.7	29.4	3EP5 009 - 1 P . 2 . - . . . .	C	
	9	7.2	3	1100	17.3	17.7	18.6	20.3	21.6	24.0	27.2	3EP5 009 - 2 P . 3 . - . . . .	C	
	12	9.6	2	750	23.6	24.5	25.7	28.5	30.6	34.3	39.2	3EP5 012 - 1 P . 2 . - . . . .	C	
	12	9.6	3	1100	23.0	23.6	24.8	27.1	28.8	32.0	36.3	3EP5 012 - 2 P . 3 . - . . . .	C	
17.5	15	12.0	2	750	29.5	30.6	32.1	35.6	38.3	42.8	49.0	3EP5 015 - 1 P . 2 . - . . . .	C	
	15	12.0	3	1100	28.8	29.5	31.0	33.8	36.0	40.0	45.4	3EP5 015 - 2 P . 3 . - . . . .	C	
	18	14.4	2	750	35.3	36.7	38.6	42.7	45.9	51.4	58.8	3EP5 018 - 1 P . 2 . - . . . .	C	
	18	14.4	3	1100	34.6	35.4	37.2	40.6	43.2	48.0	54.4	3EP5 018 - 2 P . 3 . - . . . .	C	
24	21	16.8	2	750	41.2	42.8	45.0	49.8	53.6	60.0	68.5	3EP5 021 - 1 P . 2 . - . . . .	C	
	21	16.8	3	1100	40.3	41.3	43.3	47.4	50.4	55.9	63.5	3EP5 021 - 2 P . 3 . - . . . .	C	
	24	19.2	2	750	47.1	49.0	51.4	56.9	61.2	68.5	78.3	3EP5 024 - 1 P . 2 . - . . . .	C	
	24	19.2	3	1100	46.1	47.2	49.5	54.1	57.6	63.9	72.6	3EP5 024 - 2 P . 3 . - . . . .	C	
	30	24.0	2	750	58.9	61.2	64.3	71.1	76.5	85.7	97.9	3EP5 030 - 1 P . 2 . - . . . .	C	
	30	24.0	3	1100	57.6	59.0	61.9	67.7	72.0	79.9	90.7	3EP5 030 - 2 P . 3 . - . . . .	C	
36	30	24.0	2	750	58.9	61.2	64.3	71.1	76.5	85.7	97.9	3EP5 030 - 1 P . 2 . - . . . .	C	
	30	24.0	3	1100	57.6	59.0	61.9	67.7	72.0	79.9	90.7	3EP5 030 - 2 P . 3 . - . . . .	C	
	36	28.8	2	750	70.7	73.4	77.1	85.4	91.8	103	118	3EP5 036 - 1 P . 2 . - . . . .	E	
	36	28.8	3	1100	69.1	70.8	74.3	81.2	86.4	95.9	109	3EP5 036 - 2 P . 3 . - . . . .	C	
	45	36	2	750	88.4	91.8	96.4	107	115	129	147	3EP5 045 - 1 P . 2 . - . . . .	E	
	45	36	3	1100	86.4	88.6	92.9	102	108	120	136	3EP5 045 - 2 P . 3 . - . . . .	E	
52	42	34	2	750	82.5	85.7	90.0	99.6	107	120	137	3EP5 042 - 1 P . 2 . - . . . .	E	
	42	34	3	1100	80.6	82.7	86.7	94.8	101	112	127	3EP5 042 - 2 P . 3 . - . . . .	E	
	54	43	2	750	106	110	116	128	138	154	176	3EP5 054 - 1 P . 2 . - . . . .	E	
	54	43	3	1100	104	106	111	122	130	144	163	3EP5 054 - 2 P . 3 . - . . . .	E	
72.5	54	43	2	750	106	110	116	128	138	154	176	3EP5 054 - 1 P . 2 . - . . . .	E	
	54	43	3	1100	104	106	111	122	130	144	163	3EP5 054 - 2 P . 3 . - . . . .	E	
	60	48	2	750	118	122	129	142	153	171	196	3EP5 060 - 1 P . 2 . - . . . .	E	
	60	48	3	1100	115	118	124	135	144	160	181	3EP5 060 - 2 P . 3 . - . . . .	E	
	66	53	2	750	130	135	141	157	168	188	215	3EP5 066 - 1 P . 2 . - . . . .	H	
	66	53	3	1100	127	130	136	149	158	176	200	3EP5 066 - 2 P . 3 . - . . . .	H	
	72	58	2	750	141	147	154	171	184	206	235	3EP5 072 - 1 P . 2 . - . . . .	H	
	72	58	3	1100	138	142	149	162	173	192	218	3EP5 072 - 2 P . 3 . - . . . .	H	
123	96	77	2	750	188	196	206	228	245	274	313	3EP5 096 - 1 P . 2 . - . . . .	J	
	96	77	3	1100	184	189	198	217	230	256	290	3EP5 096 - 2 P . 3 . - . . . .	J	

## Ratings and specifications

### Electrical characteristics – neutral ground arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Continuous operating voltage $U_c$ kV	Line discharge class LD Class	Long duration current 2ms A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
12	9	7.2	2	750	17.7	18.4	19.3	21.3	23.0	25.7	29.4	3EP5 009 - 1 S . 2 . - ....	C	
	9	7.2	3	1100	17.3	17.7	18.6	20.3	21.6	24.0	27.2	3EP5 009 - 2 S . 3 . - ....	C	
24	12	9.6	2	750	23.6	24.5	25.7	28.5	30.6	34.3	39.2	3EP5 012 - 1 S . 2 . - ....	C	
	12	9.6	3	1100	23.0	23.6	24.8	27.1	28.8	32.0	36.3	3EP5 012 - 2 S . 3 . - ....	C	
36	15	12.0	2	750	29.5	30.6	32.1	35.6	38.3	42.8	49.0	3EP5 015 - 1 S . 2 . - ....	C	
	15	12.0	3	1100	28.8	29.5	31.0	33.8	36.0	40.0	45.4	3EP5 015 - 2 S . 3 . - ....	C	
	45	36	2	750	88.4	91.8	96.4	107	115	129	147	3EP5 045 - 1 S . 2 . - ....	E	
	45	36	3	1100	86.4	88.6	92.9	102	108	120	136	3EP5 045 - 2 S . 3 . - ....	E	
72.5	30	24.0	2	750	58.9	61.2	64.3	71.1	76.5	85.7	97.9	3EP5 030 - 1 S . 2 . - ....	C	
	30	24.0	3	1100	57.6	59.0	61.9	67.7	72.0	79.9	90.7	3EP5 030 - 2 S . 3 . - ....	C	
123	51	41	2	750	100	104	109	121	130	146	166	3EP5 051 - 1 S . 2 . - ....	E	
	51	41	3	1100	97.9	100	105	115	122	136	154	3EP5 051 - 2 S . 3 . - ....	E	
	60	48	2	750	118	122	129	142	153	171	196	3EP5 060 - 1 S . 2 . - ....	E	
	60	48	3	1100	115	118	124	135	144	160	181	3EP5 060 - 2 S . 3 . - ....	E	
	72	58	2	750	141	147	154	171	184	206	235	3EP5 072 - 1 S . 2 . - ....	H	
	72	58	3	1100	138	142	149	162	173	192	218	3EP5 072 - 2 S . 3 . - ....	H	

## Ratings and specifications

### Mechanical characteristics

Housing size	Height [H] mm	Creepage distance mm	Housing insulation		Specified short-term load SSL N	Specified long-term load SLL N	Grading ring diameter [D] mm	Maximum weight of arrester kg	Flashover distance mm	Arrester type	Figure
			Lightning impulse withstand voltage 1.2/50µs kV	Power frequency withstand voltage 1 min., wet kV							
C	368	648	157	67	5430	2170	-	24.1	242	3EP5 ... - .. C . 1 - ....	A
E	566	1260	266	114	3530	1410	-	32.9	440	3EP5 ... - .. E . 1 - ....	A
H	764	1871	375	160	2610	1040	-	41.6	638	3EP5 ... - .. H . 1 - ....	A
J	896	2279	448	191	2230	890	-	46.2	770	3EP5 ... - .. J . 1 - ....	A

The maximum arrester weight can vary depending on rated voltage and line discharge class.

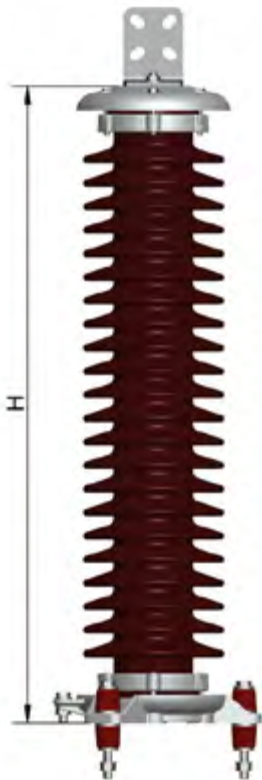
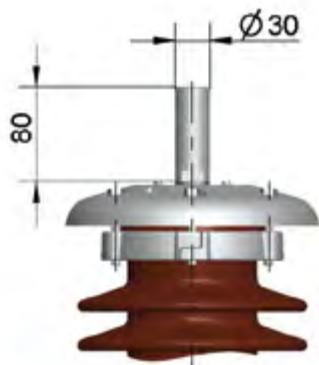
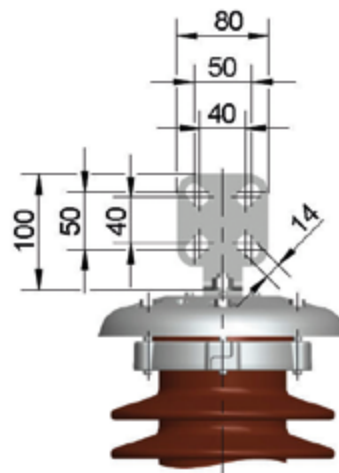


Figure A

Line terminals

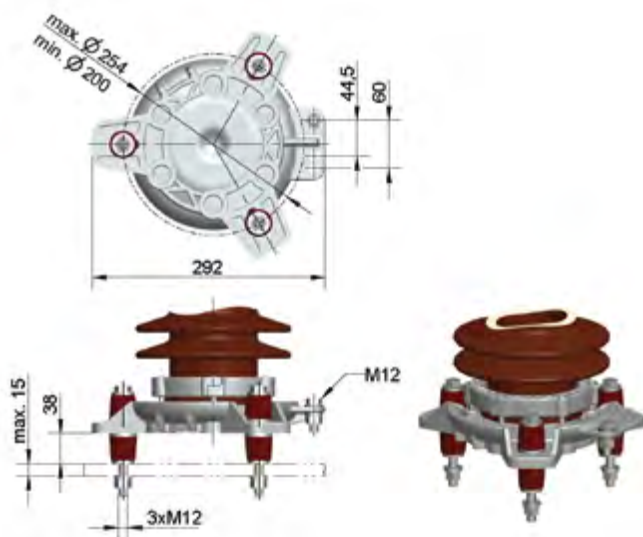


**Bolt**  
3EP5 .....-D..

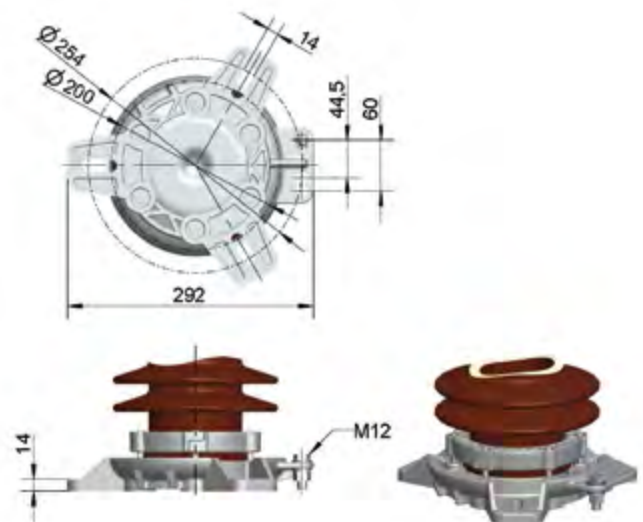


**DIN/NEMA flat terminal**  
3EP5 .....-R.. (copper)  
3EP5 .....-U.. (aluminum)  
3EP5 .....-X.. (hot dip galvanized)  
3EP5 .....-Y.. (stainless steel)

Mounting



**Insulated**  
3EP5 .....-1



**Grounded**  
3EP5 .....-5

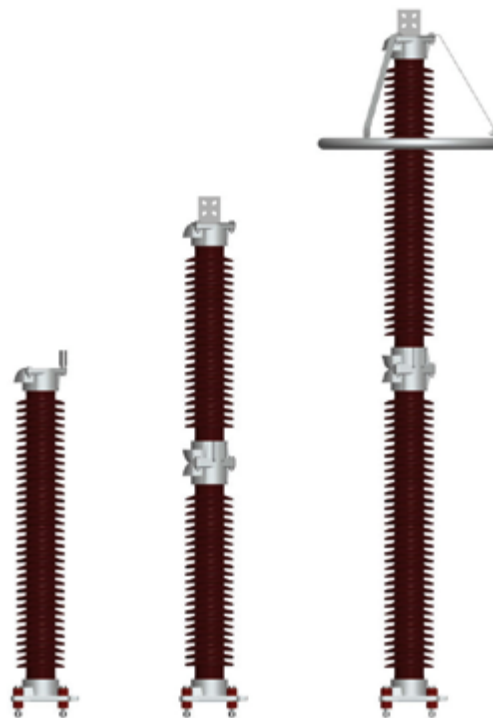
# 3EP4 Surge arrester

with porcelain housing

## Technical datasheet

### Protection of:

- Transformers
- Circuit breakers
- Generators
- Motors
- Capacitors
- Bushings
- Switchgear



Maximum values		3EP4	3EP4	3EP4
Highest voltage of the system	kV	300	300	362
Maximum rated voltage	kV	240	240	288
Nominal discharge current	kA	10	10	10
Line discharge class		2	2	3
Energy absorption capability	kJ/kV <sub>r</sub>	5.0	5.0	8.0
Long duration current impulse	A	750	1100	1100
Rated short-circuit current	kA	65	65	65
High current impulse	kA	100	100	100
Bending moment dynamic	kNm	4.5	4.5	4.5

## 3EP4 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-	
<b>Order number</b>	3	E	P	4	-	x	x	x	-	2	P	E	3	1	-	1	D	A	1	-	Z
<b>Product line</b>																					
Porcelain-housed surge arrester	3	E	P	4																	
<b>Rated voltage in kV</b>						x	x	x													
<b>Long duration current impulse, energy absorption capability</b>																					
$I_{2ms} = 750$ A, $E_{th} = 5$ kJ/kV <sub>r</sub> , line discharge class 2										1				2							
$I_{2ms} = 1100$ A, $E_{th} = 5$ kJ/kV <sub>r</sub> , line discharge class 2										2				2							
$I_{2ms} = 1100$ A, $E_{th} = 8$ kJ/kV <sub>r</sub> , line discharge class 3										2				3							
<b>Application</b>																					
Phase surge arrester											P										
Neutral point surge arrester											S										
<b>Housing size, number of units. Refer to »Mechanical characteristics« on page 65</b>																					
Housing »B«, 1 unit												B		1							
Housing »C«, 1 unit												C		1							
Housing »D«, 1 unit												D		1							
Housing »E«, 1 unit												E		1							
Housing »F«, 1 unit												F		1							
Housing »2xD«, 2 units												D		2							
Housing »2xE«, 2 units												E		2							
Housing »2xF«, 2 units												F		2							
<b>Form of sheds and color of porcelain</b>																					
Normal sheds, brown porcelain, upright mounting																					1
Normal sheds, gray porcelain, upright mounting																					3
Normal sheds, brown porcelain, suspended mounting																					5
Normal sheds, gray porcelain, suspended mounting																					7
<b>High-voltage terminal</b>																					
Metal plate																					A
Bolt, 30 mm diameter, 80 mm length, stainless steel																					D
Bolt, 30 mm diameter, 100 mm length, stainless steel																					E
Bolt, 40 mm diameter, 80 mm length, stainless steel																					G
Bolt, 40 mm diameter, 120 mm length, stainless steel																					J
Flat DIN/NEMA, 40x40 ... 50x50, copper																					R
Flat DIN/NEMA, 40x40 ... 50x50, aluminum																					T
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel																					X
Flat DIN/NEMA, 40x40 ... 50x50, stainless steel																					Y
Bolt, 26 mm diameter, 100 mm length, stainless steel																					Z
Bolt, 30 mm diameter, 80 mm length, aluminum																					Z
Bolt, 35 mm diameter, 120 mm length, stainless steel																					Z
Bolt, 40 mm diameter, 125 mm length, aluminum																					Z
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel, horizontal																					Z
Flat, 4xD=16, aluminum																					Z
Flat, 4xD=17.5 50/50, hot dip galvanized steel																					Z
Flat, 4xD=17.5 50/50, aluminum																					Z
Flat, 4xD=14/50, Palm 5, aluminum																					Z
Flat, 4xD=18/60, Palm 8, aluminum																					Z
																					P1A
																					P1C
																					P1F
																					P1L
																					P2Q
																					P5A
																					P5D
																					P5E
																					P5G
																					P5K

## 3EP4 – order numbers

Data position	1	2	3	4	–	5	6	7	–	8	9	10	11	12	–	13	14	15	16	–	
<b>Order number</b>	3	E	P	4	–	x	x	x	–	2	P	E	3	1	–	1	D	A	1	–	Z
<b>Nameplate</b>																					
German/English (standard)																				A	
French																				B	
Czech																				C	
Slovene																				D	
Russian																				E	
Spanish																				F	
Portuguese																				G	
Arabic																				R	
Brazil																				T	
CFE (Mexico)																				U	
Customized version																				Z	
<b>Mounting</b>																					
200 mm x 200 mm, grounded																				0	
200 mm x 200 mm, insulated																				1	
310 mm x 310 mm, insulated																				3	
D=10", grounded																				5	
D=10", insulated																				7	
<b>Accessories</b>																					
Refer to table »Optional accessories« on page 110																					Z

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Continuous operating voltage $U_c$ kV	Line discharge class LD Class	Long duration current 2ms A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
72.5	54	43	2	750	106	110	116	128	138	154	176	3EP4 054 - 1 P . 2 . - ....	C	
	54	43	3	1100	104	106	111	122	130	144	163	3EP4 054 - 2 P . 3 . - ....	C	
	60	48	2	750	118	122	129	142	153	171	196	3EP4 060 - 1 P . 2 . - ....	D	
	60	48	3	1100	115	118	124	135	144	160	181	3EP4 060 - 2 P . 3 . - ....	D	
	66	53	2	750	130	135	141	157	168	188	215	3EP4 066 - 1 P . 2 . - ....	D	
	66	53	3	1100	127	130	136	149	158	176	200	3EP4 066 - 2 P . 3 . - ....	D	
	72	58	2	750	141	147	154	171	184	206	235	3EP4 072 - 1 P . 2 . - ....	D	
	72	58	3	1100	138	142	149	162	173	192	218	3EP4 072 - 2 P . 3 . - ....	D	
123	96	77	2	750	188	196	206	228	245	274	313	3EP4 096 - 1 P . 2 . - ....	D	
	96	77	2	1100	173	177	186	203	216	240	272	3EP4 096 - 2 P . 2 . - ....	D	
	96	77	3	1100	184	189	198	217	230	256	290	3EP4 096 - 2 P . 3 . - ....	D	
	102	82	2	750	200	208	218	242	260	291	333	3EP4 102 - 1 P . 2 . - ....	D	
	102	82	3	1100	196	201	211	230	245	272	308	3EP4 102 - 2 P . 3 . - ....	D	
	108	86	2	750	212	220	231	256	275	308	353	3EP4 108 - 1 P . 2 . - ....	D	
	108	86	3	1100	207	213	223	244	259	288	327	3EP4 108 - 2 P . 3 . - ....	D	
	154	123	3	1100	296	303	318	347	370	410	466	3EP4 154 - 2 P . 3 . - ....	E	
145	120	96	2	750	236	245	257	285	306	343	392	3EP4 120 - 1 P . 2 . - ....	D	
	120	96	3	1100	230	236	248	271	288	320	363	3EP4 120 - 2 P . 3 . - ....	D	
	132	106	3	1100	253	260	272	298	317	352	399	3EP4 132 - 2 P . 3 . - ....	E	
	144	115	3	1100	276	283	297	325	346	384	435	3EP4 144 - 2 P . 3 . - ....	E	
170	138	110	3	1100	265	272	285	311	331	368	417	3EP4 138 - 2 P . 3 . - ....	E	
	144	115	3	1100	276	283	297	325	346	384	435	3EP4 144 - 2 P . 3 . - ....	E	
	150	120	3	1100	288	295	310	338	360	400	454	3EP4 150 - 2 P . 3 . - ....	E	
245	192	154	3	1100	369	378	396	433	461	511	581	3EP4 192 - 2 P . 3 . - ....	2xD	
	198	158	3	1100	380	390	409	447	475	527	599	3EP4 198 - 2 P . 3 . - ....	2xD	
	228	182	3	1100	438	449	471	514	547	607	689	3EP4 228 - 2 P . 3 . - ....	2xD	
300	228	182	3	1100	438	449	471	514	547	607	689	3EP4 228 - 2 P . 3 . - ....	2xD	
	240	192	3	1100	461	472	495	541	576	639	726	3EP4 240 - 2 P . 3 . - ....	2xD	
362	276	221	3	1100	530	543	570	623	662	735	835	3EP4 276 - 2 P . 3 . - ....	2xF	
	288	230	3	1100	553	567	594	650	691	767	871	3EP4 288 - 2 P . 3 . - ....	2xF	

## Ratings and specifications

### Electrical characteristics – neutral ground arresters

Highest voltage of the system	Rated voltage	Continuous operating voltage	Line discharge class	Long duration current 2ms	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
$U_s$ kV	$U_r$ kV	$U_c$ kV	LD Class	A										
72.5	30	24.0	2	750	58.9	61.2	64.3	71.1	76.5	85.7	97.9	3EP4 030 - 1 S . 2 . - ....	B	
	30	24.0	3	1100	57.6	59.0	61.9	67.7	72.0	79.9	90.7	3EP4 030 - 2 S . 3 . - ....	B	
123	51	41	2	750	100	104	109	121	130	146	166	3EP4 051 - 1 S . 2 . - ....	C	
	51	41	3	1100	97.9	100	105	115	122	136	154	3EP4 051 - 2 S . 3 . - ....	C	
	60	48	2	750	118	122	129	142	153	171	196	3EP4 060 - 1 S . 2 . - ....	D	
	60	48	3	1100	115	118	124	135	144	160	181	3EP4 060 - 2 S . 3 . - ....	D	
	72	58	2	750	141	147	154	171	184	206	235	3EP4 072 - 1 S . 2 . - ....	D	
145	80	64	2	750	157	163	171	190	204	228	261	3EP4 080 - 1 S . 2 . - ....	D	
	80	64	3	1100	154	157	165	180	192	213	242	3EP4 080 - 2 S . 3 . - ....	D	
	84	67	2	750	165	171	180	199	214	240	274	3EP4 084 - 1 S . 2 . - ....	D	
	84	67	3	1100	161	165	173	190	202	224	254	3EP4 084 - 2 S . 3 . - ....	D	
245	102	82	2	750	200	208	218	242	260	291	333	3EP4 102 - 1 S . 2 . - ....	D	
	102	82	3	1100	196	201	211	230	245	272	308	3EP4 102 - 2 S . 3 . - ....	D	
	108	86	2	750	212	220	231	256	275	308	353	3EP4 108 - 1 S . 2 . - ....	D	
	108	86	3	1100	207	213	223	244	259	288	327	3EP4 108 - 2 S . 3 . - ....	D	

### Mechanical characteristics

Housing size	Height [H]	Creepage distance	Housing insulation			Specified short-term load SSL	Specified long-term load SLL	Grading ring diameter [D]	Maximum weight of arrester	Flashover distance	Arrester type	Figure
			Lightning impulse withstand voltage 1.2/50 $\mu$ s kV	Switching impulse withstand voltage 250 $\mu$ s/2500 $\mu$ s, wet kV	Power frequency withstand voltage 1 min., wet kV							
	mm	mm				N	N	mm	kg	mm		
B	390	470	113	78	46	11530	4610	–	21.1	195	3EP4 ... - .. B . 1 - ....	A
C	555	980	206	142	83	8100	3240	–	27.3	355	3EP4 ... - .. C . 1 - ....	A
D	1050	2490	484	334	196	4280	1710	–	50.2	835	3EP4 ... - .. D . 1 - ....	A
E	1315	3405	658	454	267	3420	1360	–	65.5	1135	3EP4 ... - .. E . 1 - ....	A
F	1460	3835	722	498	293	3080	1230	–	73.3	1245	3EP4 ... - .. F . 1 - ....	A
2xD	2100	4980	900	620	360	2140	850	–	105	1670	3EP4 ... - .. D . 2 - ....	B
2xE	2630	6810	1316	908	534	1710	680	800	134	1885	3EP4 ... - .. E . 2 - ....	C
2xF	2920	7670	1444	996	586	1540	610	800	148	2150	3EP4 ... - .. F . 2 - ....	C

The maximum arrester weight can vary depending on rated voltage and line discharge class.

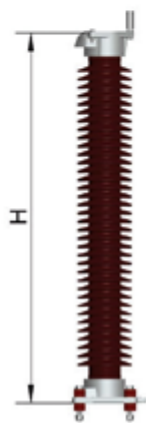


Figure A

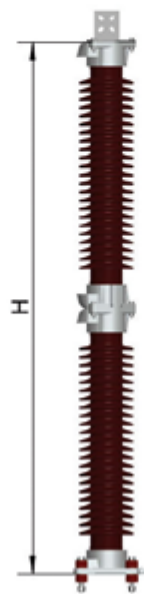


Figure B

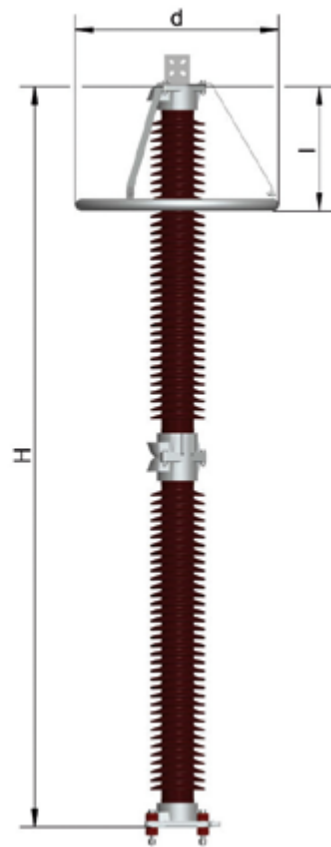
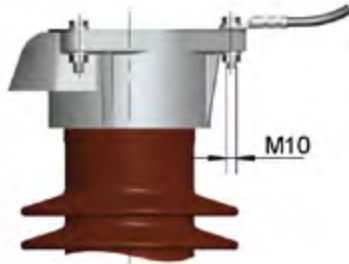
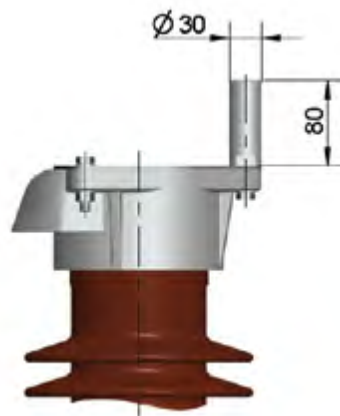


Figure C

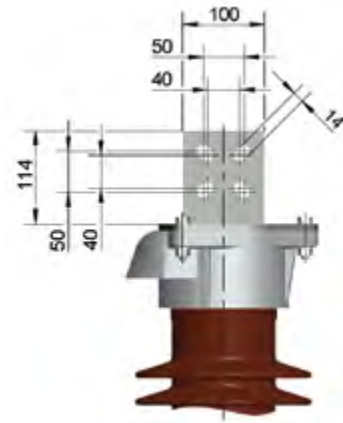
Line terminals



**Plate**  
3EP4 .....-A..

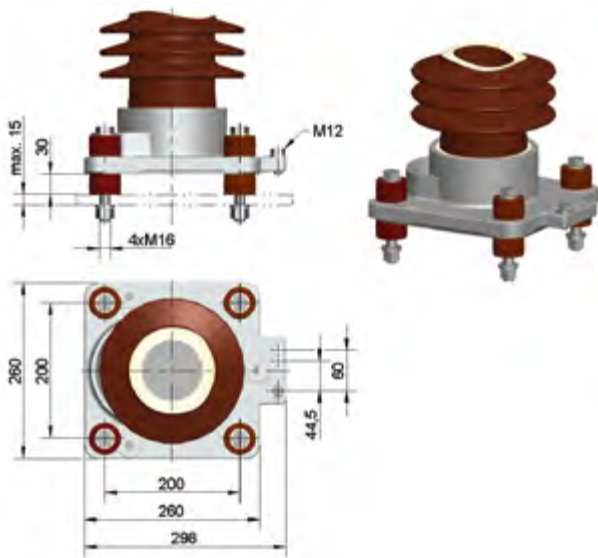


**Bolt**  
3EP4 .....-D..

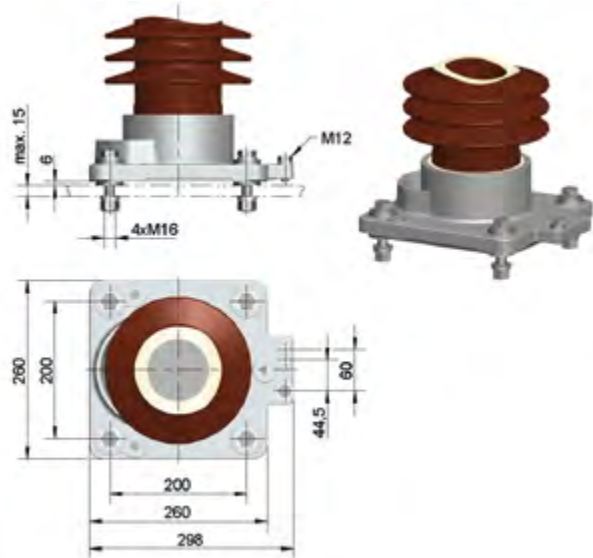


**DIN/NEMA flat terminal**  
3EP4 .....-R.. (copper)  
3EP4 .....-T.. (aluminum)  
3EP4 .....-X.. (hot dip galvanized)  
3EP4 .....-Y.. (stainless steel)

Mounting

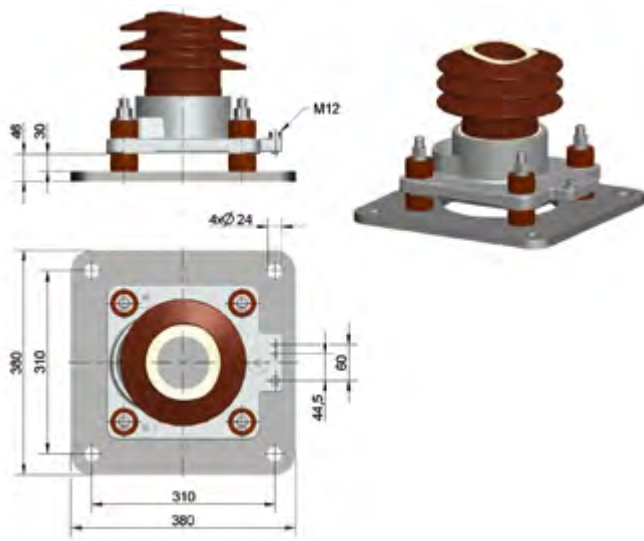


**Insulated**  
3EP4 .....-1



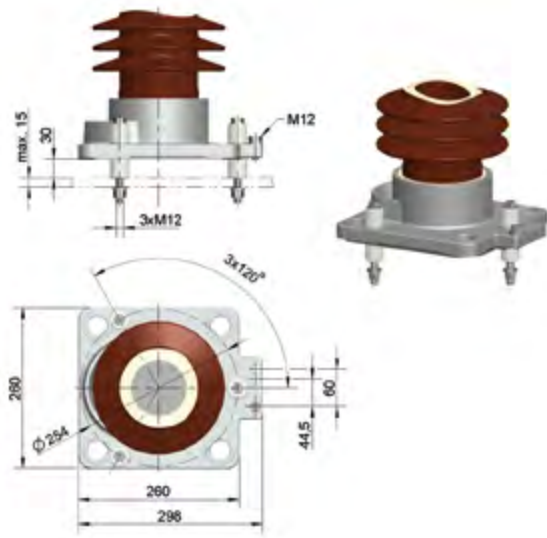
**Grounded**  
3EP4 .....-0

Mounting



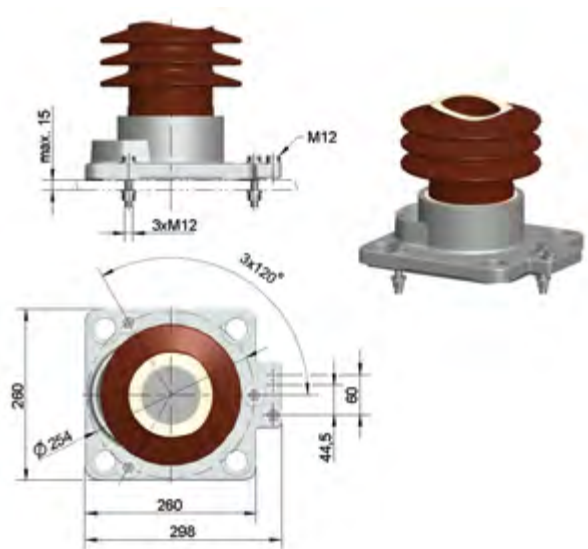
Insulated

3EP4 .....3



Insulated

3EP4 .....7



Grounded

3EP4 .....5

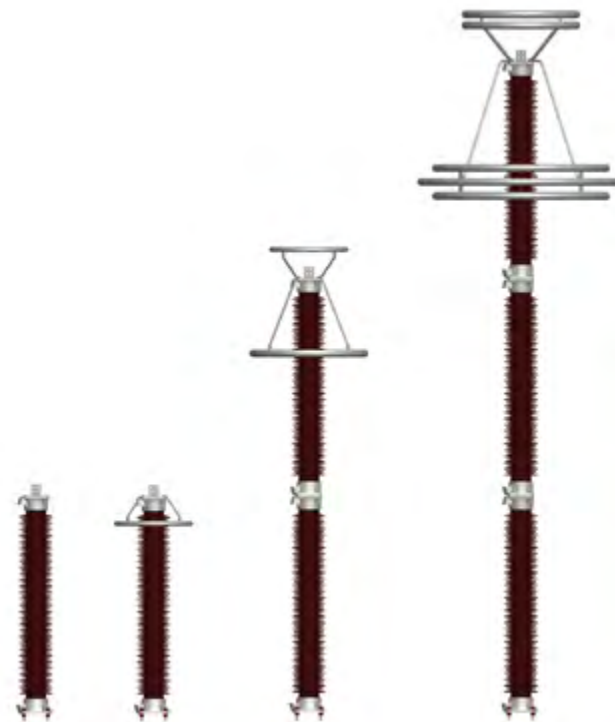
# 3EP6 Surge arrester

with porcelain housing

## Technical datasheet

### Protection of:

- Transformers
- Circuit breakers
- Generators
- Motors
- Capacitors
- Bushings
- Switchgear



Maximum values			3EP6	3EP6	3EP6
Highest voltage of the system	kV		420	550	800
Maximum rated voltage	kV		360	468	588
Nominal discharge current	kA		10	20	20
Line discharge class			3	4	5
Energy absorption capability	kJ/kV <sub>r</sub>		8.0	10.0	14.0
Long duration current impulse	A		1100	1600	2000
Rated short-circuit current	kA		65	65	65
High current impulse	kA		100	100	100
Bending moment dynamic	kNm		18/30	18/30	18/30

## 3EP6 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-		
<b>Order number</b>	3	E	P	6	-	x	x	x	-	2	P	F	3	1	-	2	D	A	1	-	Z	
<b>Product line</b>																						
Porcelain-housed surge arrester	3	E	P	6																		
<b>Rated voltage in kV</b>						x	x	x														
<b>Long duration current impulse, energy absorption capability</b>																						
$I_{2ms} = 1100 \text{ A}$ , $E_{th} = 8 \text{ kJ/kV}_r$ , line discharge class 3										2				3								
$I_{2ms} = 1600 \text{ A}$ , $E_{th} = 10 \text{ kJ/kV}_r$ , line discharge class 4										3				4								
$I_{2ms} = 2000 \text{ A}$ , $E_{th} = 14 \text{ kJ/kV}_r$ , line discharge class 5										4				5								
<b>Application</b>																						
Phase surge arrester											P											
Neutral point surge arrester											S											
<b>Housing size, number of units. Refer to »Mechanical characteristics« on page 74</b>																						
Housing »C«, 1 unit												C		1								
Housing »D«, 1 unit												D		1								
Housing »F«, 1 unit												F		1								
Housing »F«, 1 unit, increased SSL												F		5								
Housing »G«, 1 unit												G		1								
Housing »G«, 1 unit, increased SSL												G		5								
Housing »J«, 1 unit												J		1								
Housing »J«, 1 unit, increased SSL												J		5								
Housing »2xD«, 2 units												D		2								
Housing »D+F«, 2 units												N		2								
Housing »D+G«, 2 units												P		2								
Housing »2xF«, 2 units												F		2								
Housing »2xF«, 2 units, increased SSL												F		6								
Housing »2xG«, 2 units												G		2								
Housing »2xG«, 2 units, increased SSL												G		6								
Housing »F+J«, 2 units												R		2								
Housing »F+J«, 2 units, increased SSL												R		6								
Housing »G+J«, 2 units												S		2								
Housing »2xJ«, 2 units												J		2								
Housing »2xJ«, 2 units, increased SSL												J		6								
Housing »3xF«, 3 units												F		3								
Housing »3xF«, 3 units, increased SSL												F		7								
Housing »3xG«, 3 units												G		3								
Housing »3xG«, 3 units, increased SSL												G		7								
Housing »3xJ«, 3 units												J		3								
Housing »3xJ«, 3 units, increased SSL												J		7								
<b>Form of sheds and color of porcelain</b>																						
Alternating sheds, brown porcelain, upright mounting																						2
Alternating sheds, gray porcelain, upright mounting																						4
Alternating sheds, brown porcelain, suspended mounting																						6
Alternating sheds, gray porcelain, suspended mounting																						8

## 3EP6 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-				
<b>Order number</b>	3	E	P	6	-	x	x	x	-	2	P	F	3	1	-	2	D	A	1	-	Z			
<b>High-voltage terminal</b>																								
Metal plate																		A						
Bolt, 30 mm diameter, 80 mm length, hot dip galvanized steel																		C						
Bolt, 30 mm diameter, 80 mm length, stainless steel																		D						
Bolt, 40 mm diameter, 80 mm length, stainless steel																		G						
Bolt, 40 mm diameter, 120 mm length, stainless steel																		J						
Flat double DIN, 200x100, hot dip galvanized steel																		M						
Flat DIN/NEMA, 40x40 ... 50x50, copper																		R						
Flat DIN/NEMA, 40x40 ... 50x50, aluminum																		T						
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel																		X						
Flat DIN/NEMA, 40x40 ... 50x50, stainless steel																		Y						
Bolt, 30 mm diameter, 125 mm length, stainless steel																		Z					P1E	
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel, horizontal																		Z					P2R	
Flat, 4xD=16, aluminum																		Z					P5A	
Flat, 4xD=14/50, Palm 5, aluminum																		Z					P5G	
<b>Nameplate</b>																								
German/English (standard)																		A						
French																		B						
Czech																		C						
Slovene																		D						
Russian																		E						
Spanish																		F						
Portuguese																		G						
Arabic																		R						
Brazil																		T						
CFE (Mexico)																		U						
Customized version																		Z						
<b>Mounting</b>																								
240 mm x 240 mm, grounded																							0	
240 mm x 240 mm, insulated																							1	
310 mm x 310 mm, insulated																							3	
D=10", grounded																							5	
D=16,5", grounded																							6	
D=10", insulated																							7	
D=16,5", insulated																							8	
240 mm x 240 mm, insulated, increased SSL																							9	
<b>Accessories</b>																								
Refer to table »Optional accessories« on page 110																								Z

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Continuous operating voltage $U_c$ kV	Line discharge class LD Class	Long duration current 2ms A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
					123	96	77	3	1100	184	189	198		
	96	77	4	1600	179	183	192	208	221	243	265	3EP6 096 - 3 P . 4 . - ....	C	
	102	82	3	1100	196	201	211	230	245	272	308	3EP6 102 - 2 P . 3 . - ....	C	
	102	82	4	1600	190	195	204	221	235	258	282	3EP6 102 - 3 P . 4 . - ....	C	
	108	86	3	1100	207	213	223	244	259	288	327	3EP6 108 - 2 P . 3 . - ....	C	
	108	86	4	1600	201	206	216	233	248	273	298	3EP6 108 - 3 P . 4 . - ....	C	
	154	123	3	1100	296	303	318	347	370	410	466	3EP6 154 - 2 P . 3 . - ....	C	
	154	123	4	1600	287	294	308	333	354	390	425	3EP6 154 - 3 P . 4 . - ....	C	
145	120	96	3	1100	230	236	248	271	288	320	363	3EP6 120 - 2 P . 3 . - ....	C	
	120	96	4	1600	224	229	240	259	276	304	331	3EP6 120 - 3 P . 4 . - ....	C	
	132	106	3	1100	253	260	272	298	317	352	399	3EP6 132 - 2 P . 3 . - ....	C	
	132	106	4	1600	246	252	264	285	304	334	364	3EP6 132 - 3 P . 4 . - ....	C	
	144	115	3	1100	276	283	297	325	346	384	435	3EP6 144 - 2 P . 3 . - ....	C	
	144	115	4	1600	268	275	288	311	331	364	397	3EP6 144 - 3 P . 4 . - ....	C	
170	138	110	3	1100	265	272	285	311	331	368	417	3EP6 138 - 2 P . 3 . - ....	C	
	138	110	4	1600	257	263	276	298	317	349	381	3EP6 138 - 3 P . 4 . - ....	C	
	144	115	3	1100	276	283	297	325	346	384	435	3EP6 144 - 2 P . 3 . - ....	C	
	144	115	4	1600	268	275	288	311	331	364	397	3EP6 144 - 3 P . 4 . - ....	C	
	150	120	3	1100	288	295	310	338	360	400	454	3EP6 150 - 2 P . 3 . - ....	C	
	150	120	4	1600	279	286	300	324	345	380	414	3EP6 150 - 3 P . 4 . - ....	C	
245	192	154	3	1100	369	378	396	433	461	511	581	3EP6 192 - 2 P . 3 . - ....	F	
	192	154	4	1600	358	367	384	415	442	486	530	3EP6 192 - 3 P . 4 . - ....	F	
	198	158	3	1100	380	390	409	447	475	527	599	3EP6 198 - 2 P . 3 . - ....	F	
	198	158	4	1600	369	378	396	428	455	501	546	3EP6 198 - 3 P . 4 . - ....	F	
	214	171	3	1100	411	421	442	483	514	570	647	3EP6 214 - 2 P . 3 . - ....	F	
	214	171	4	1600	399	409	428	463	492	541	591	3EP6 214 - 3 P . 4 . - ....	F	
	216	173	3	1100	415	425	446	487	518	575	653	3EP6 216 - 2 P . 3 . - ....	F	
	216	173	4	1600	402	412	432	467	497	546	596	3EP6 216 - 3 P . 4 . - ....	F	
	228	182	3	1100	438	449	471	514	547	607	689	3EP6 228 - 2 P . 3 . - ....	G	
	228	182	4	1600	425	435	456	493	524	577	629	3EP6 228 - 3 P . 4 . - ....	G	
300	228	182	3	1100	438	449	471	514	547	607	689	3EP6 228 - 2 P . 3 . - ....	G	
	228	182	4	1600	425	435	456	493	524	577	629	3EP6 228 - 3 P . 4 . - ....	G	
	240	192	3	1100	461	472	495	541	576	639	726	3EP6 240 - 2 P . 3 . - ....	J	
	240	192	4	1600	447	458	480	519	552	607	662	3EP6 240 - 3 P . 4 . - ....	J	
362	276	221	3	1100	530	543	570	623	662	735	835	3EP6 276 - 2 P . 3 . - ....	J-g	
	276	221	4	1600	514	527	552	597	635	698	762	3EP6 276 - 3 P . 4 . - ....	J-g	
	276	221	5	2000	515	531	546	587	621	677	739	3EP6 276 - 4 P . 5 . - ....	J-g	
	288	230	3	1100	553	567	594	650	691	767	871	3EP6 288 - 2 P . 3 . - ....	2xD	
	288	230	4	1600	537	550	576	623	662	729	795	3EP6 288 - 3 P . 4 . - ....	2xD	
	288	230	5	2000	538	554	570	612	648	706	771	3EP6 288 - 4 P . 5 . - ....	2xD	

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Continuous operating voltage $U_c$ kV	Line discharge class LD Class	Long duration current 2ms A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
					420	336	269	3	1100	645	661	694		
	336	269	4	1600	626	641	672	726	773	850	927	3EP6 336 - 3 P . 4 . - ....	2xG	
	336	269	5	2000	627	646	665	714	756	824	900	3EP6 336 - 4 P . 5 . - ....	P	
	360	288	3	1100	691	708	743	812	864	959	1089	3EP6 360 - 2 P . 3 . - ....	2xG	
	360	288	4	1600	671	687	720	778	828	911	994	3EP6 360 - 3 P . 4 . - ....	2xG	
	360	288	5	2000	672	693	713	765	810	883	964	3EP6 360 - 4 P . 5 . - ....	2xG	
550	396	317	4	1600	738	756	792	856	911	1002	1093	3EP6 396 - 3 P . 4 . - ....	R	
	396	317	5	2000	740	762	784	842	891	971	1060	3EP6 396 - 4 P . 5 . - ....	R	
	420	336	4	1600	782	802	840	908	966	1063	1159	3EP6 420 - 3 P . 4 . - ....	2xJ	
	420	336	5	2000	784	808	832	893	945	1030	1125	3EP6 420 - 4 P . 5 . - ....	2xJ	
	444	355	4	1600	827	848	888	960	1021	1123	1225	3EP6 444 - 3 P . 4 . - ....	3xF	
	444	355	5	2000	829	854	879	944	999	1089	1189	3EP6 444 - 4 P . 5 . - ....	2xJ	
	468	374	4	1600	872	893	936	1012	1076	1184	1292	3EP6 468 - 3 P . 4 . - ....	3xF	
	468	374	5	2000	874	900	927	995	1053	1148	1253	3EP6 468 - 4 P . 5 . - ....	3xF	
800	580	464	5	2000	1083	1116	1148	1233	1305	1422	1553	3EP6 580 - 4 P . 5 . - ....	3xJ	
	588	470	5	2000	1098	1131	1164	1250	1323	1442	1574	3EP6 588 - 4 P . 5 . - ....	3xJ	

### Electrical characteristics – neutral ground arresters

245	102	82	3	1100	196	201	211	230	245	272	308	3EP6 102 - 2 S . 3 . - ....	C
	102	82	4	1600	190	195	204	221	235	258	282	3EP6 102 - 3 S . 4 . - ....	C
	108	86	3	1100	207	213	223	244	259	288	327	3EP6 108 - 2 S . 3 . - ....	C
	108	86	4	1600	201	206	216	233	248	273	298	3EP6 108 - 3 S . 4 . - ....	C
420	168	134	3	1100	323	331	347	379	403	448	508	3EP6 168 - 2 S . 3 . - ....	D
	168	134	4	1600	313	321	336	363	386	425	464	3EP6 168 - 3 S . 4 . - ....	D

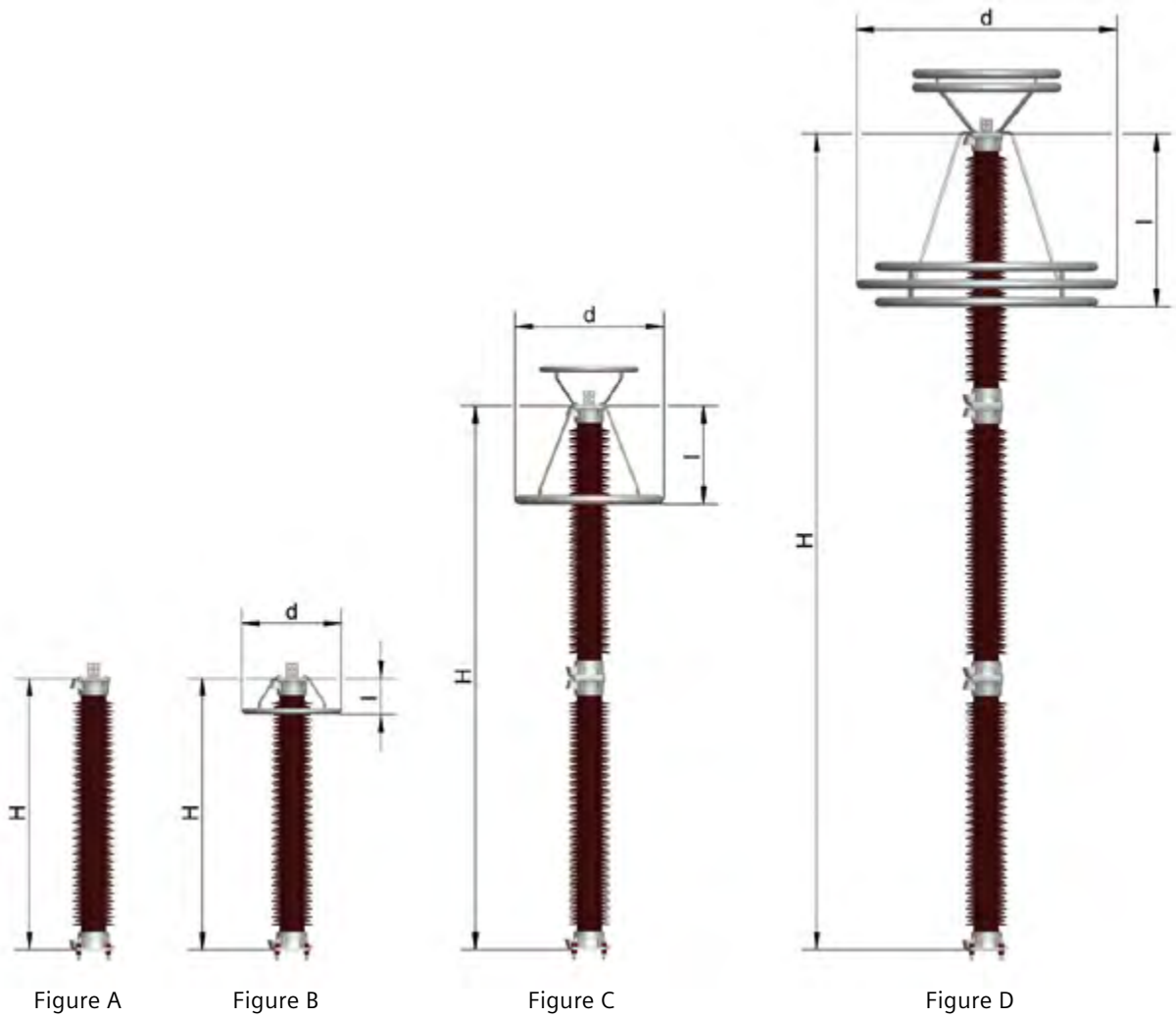
## Ratings and specifications

### Mechanical characteristics

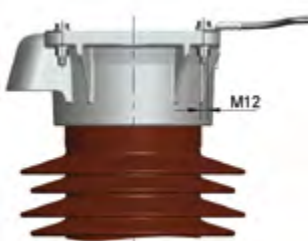
Housing size	Height [H] mm	Creepage distance mm	Housing insulation			Specified short-term load SSL N	Specified long-term load SLL N	Grading ring diameter [D] mm	Maximum weight of arrester kg	Flashover distance mm	Arrester type	Figure
			Lightning impulse withstand voltage 1.2/50µs kV	Switching impulse withstand voltage 250µs/2500µs, wet kV	Power frequency withstand voltage 1 min., wet kV							
C	1299	3941	600	392	243	13850	5540	–	137	1034	3EP6 ... - .. C . 1 - ....	A
D	1459	4505	690	451	280	12330	4930	–	164	1190	3EP6 ... - .. D . 1 - ....	A
F	1749	5809	860	563	349	10290	4110	–	197	1483	3EP6 ... - .. F . 1 - ....	A
G	1869	6335	931	609	377	9630	3850	–	212	1605	3EP6 ... - .. G . 1 - ....	A
J	2189	7668	1116	730	452	8220	3280	–	251	1924	3EP6 ... - .. J . 1 - ....	A
J-g	2189	7668	1116	730	452	8220	3280	800	251	1770	3EP6 ... - .. J . 1 - ....	B
2xD	2924	9010	1380	903	486	6150	2460	800	333	2033	3EP6 ... - .. D . 2 - ....	C
N	3214	10314	1550	1014	592	5600	2240	1000	351	2170	3EP6 ... - .. N . 2 - ....	C
P	3334	10840	1621	1060	620	5390	2150	1000	379	2305	3EP6 ... - .. P . 2 - ....	C
2xF	3504	11618	1720	1125	697	5130	2050	1000	398	2470	3EP6 ... - .. F . 2 - ....	C
	3504	11406	1720	1125	697	8560	3420	1000	413	2470	3EP6 ... - .. F . 6 - ....	C
2xG	3744	12670	1862	1218	754	4800	1920	1000	423	2669	3EP6 ... - .. G . 2 - ....	C
	3744	12457	1862	1218	754	8010	3200	1000	441	2669	3EP6 ... - .. G . 6 - ....	C
R	3944	13477	1976	1293	801	4560	1820	1000	435	2915	3EP6 ... - .. R . 2 - ....	C
	3944	13265	1976	1293	801	7600	3040	1000	450	2915	3EP6 ... - .. R . 6 - ....	C
S	4064	14003	2047	1339	829	4420	1770	1200	463	2984	3EP6 ... - .. S . 2 - ....	C
2xJ	4384	15336	2232	1460	904	4100	1640	1200	498	3235	3EP6 ... - .. J . 2 - ....	C
	4384	15124	2232	1460	904	6840	2730	1200	520	3235	3EP6 ... - .. J . 6 - ....	C
3xF	5259	17427	2580	1688	1046	3420	1360	1500	445	3761	3EP6 ... - .. F . 3 - ....	D
	5259	17003	2580	1688	1046	5700	2280	1500	635	3761	3EP6 ... - .. F . 7 - ....	D
3xG	5619	19005	2793	1827	1131	3200	1280	1500	464	4097	3EP6 ... - .. G . 3 - ....	D
	5619	18579	2793	1827	1131	5330	2130	1500	668	4097	3EP6 ... - .. G . 7 - ....	D
3xJ	6573	23004	3348	2190	1356	2730	1090	2100	571	4776	3EP6 ... - .. J . 3 - ....	D
	6573	22520	3348	2190	1356	4560	1820	2100	802	4776	3EP6 ... - .. J . 7 - ....	D

The maximum arrester weight can vary depending on rated voltage and line discharge class.

## Ratings and specifications



### Line terminals



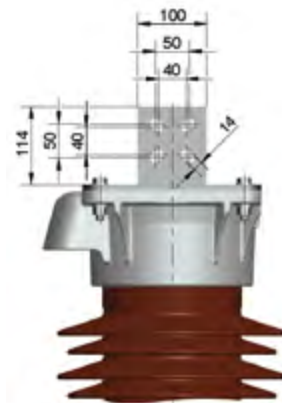
**Plate**

3EP6 .....-A..



**Bolt**

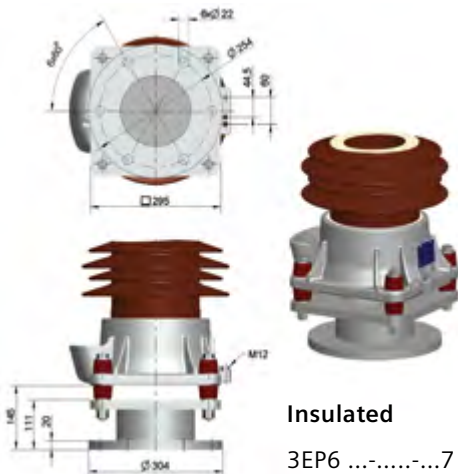
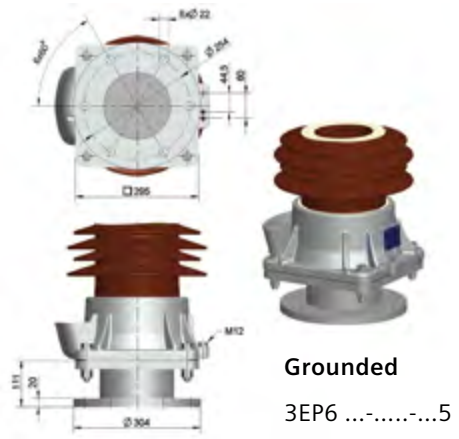
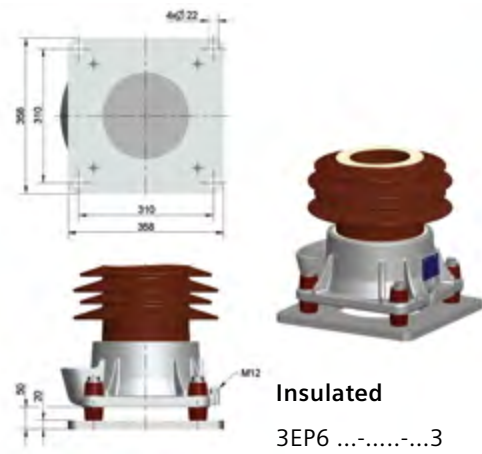
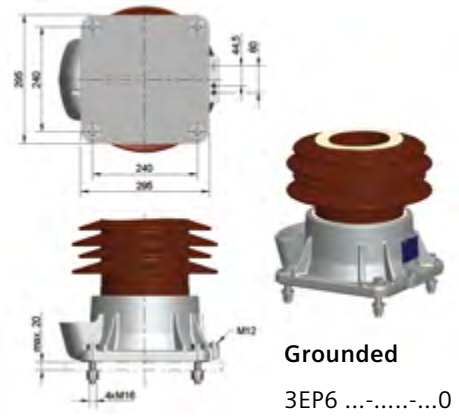
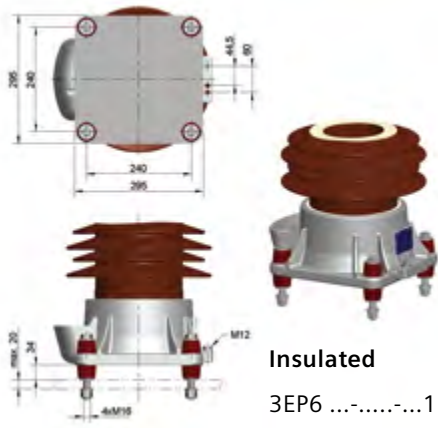
3EP6 .....-D..



**DIN/NEMA flat terminal**

- 3EP6 .....-R.. (copper)
- 3EP6 .....-T.. (aluminum)
- 3EP6 .....-X.. (hot dip galvanized)
- 3EP6 .....-Y.. (stainless steel)

Mounting



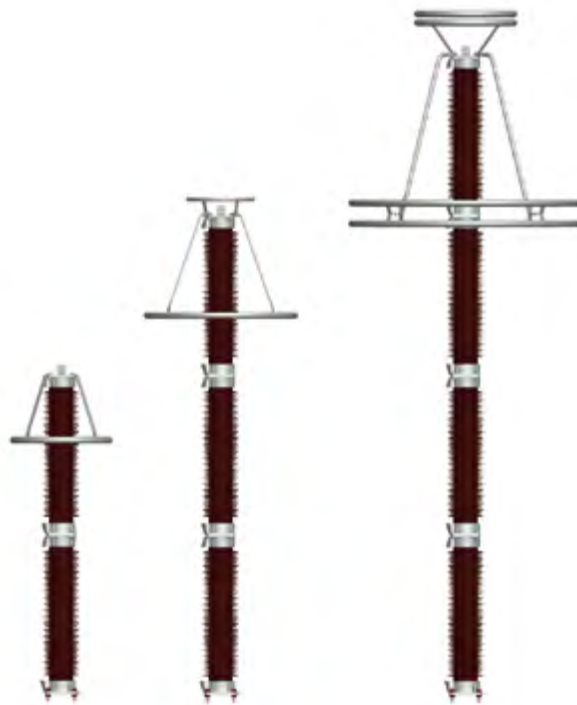
# 3EP3 Surge arrester

with porcelain housing

## Technical datasheet

### Protection of:

- Transformers
- Circuit breakers
- Generators
- Motors
- Capacitors
- Bushings
- Switchgear



Maximum values		3EP3	3EP3	3EP3
Highest voltage of the system	kV	550	800	800
Maximum rated voltage	kV	468	624	624
Nominal discharge current	kA	20	20	20
Line discharge class		4	5	5
Energy absorption capability	kJ/kV <sub>r</sub>	10.0	14.0	16.0
Long duration current impulse	A	1600	2000	3200
Rated short-circuit current	kA	65	65	65
High current impulse	kA	100	100	100
Bending moment dynamic	kNm	34/90	34/90	34/90

## 3EP3 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-			
<b>Order number</b>	3	E	P	3	-	x	x	x	-	3	P	K	4	3	-	2	D	A	1	-	Z		
<b>Product line</b>																							
Porcelain-housed surge arrester	3	E	P	3																			
<b>Rated voltage in kV</b>						x	x	x															
<b>Long duration current impulse, energy absorption capability</b>																							
$I_{2ms} = 1100 \text{ A}$ , $E_{th} = 8 \text{ kJ/kV}_r$ , line discharge class 3										2			3										
$I_{2ms} = 1600 \text{ A}$ , $E_{th} = 10 \text{ kJ/kV}_r$ , line discharge class 4										3			4										
$I_{2ms} = 2000 \text{ A}$ , $E_{th} = 14 \text{ kJ/kV}_r$ , line discharge class 5										4			5										
$I_{2ms} = 3200 \text{ A}$ , $E_{th} = 16 \text{ kJ/kV}_r$ , line discharge class 5										5			5										
<b>Application</b>																							
Phase surge arrester											P												
Neutral point surge arrester											S												
<b>Housing size, number of units. Refer to »Mechanical characteristics« on page 81</b>																							
Housing »2xF«, 2 units												F		2									
Housing »2xK«, 2 units												K		2									
Housing »3xH«, 3 units												H		3									
Housing »3xK«, 3 units												K		3									
Housing »4xH«, 4 units												H		4									
Housing »4xK«, 4 units												K		4									
<b>Form of sheds and color of porcelain</b>																							
Alternating sheds, brown porcelain																						2	
Alternating sheds, gray porcelain																							4
<b>High-voltage terminal</b>																							
Metal plate																						A	
Bolt, 30 mm diameter, 80 mm length, hot dip galvanized steel																							C
Bolt, 30 mm diameter, 80 mm length, stainless steel																							D
Bolt, 30 mm diameter, 100 mm length, stainless steel																							E
Bolt, 40 mm diameter, 80 mm length, stainless steel																							G
Bolt, 40 mm diameter, 120 mm length, stainless steel																							J
Flat double DIN, 200x100, hot dip galvanized steel																							M
Flat DIN/NEMA, 40x40 ... 50x50, copper																							R
Flat DIN/NEMA, 40x40 ... 50x50, aluminum																							T
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel																							X
Flat DIN/NEMA, 40x40 ... 50x50, stainless steel																							Y
Bolt, 30 mm diameter, 125 mm length, stainless steel																							Z
Bolt, 40 mm diameter, 80 mm length, aluminum																							Z
Bolt, 40 mm diameter, 80 mm length, copper																							Z
Flat, 4xD=16, aluminum																							Z
Flat, 4xD=17.5 50/50, hot dip galvanized steel																							Z
Flat, 4xD=17.5 50/50, aluminum																							Z
Flat, 4xD=14/50, Palm 5, aluminum																							Z
Flat, 4xD=18/60, Palm 8, copper																							Z
Flat, 4x, 70x60, Palm 12, copper																							Z
Flat, 6x, 60x60, copper																							Z
Flat, 6xD=18 60/60, hot dip galvanized steel																							Z
																							P1E
																							P1H
																							P1Q
																							P5A
																							P5D
																							P5E
																							P5G
																							P5L
																							P5N
																							P5R
																							P5S



## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Continuous operating voltage $U_c$ kV	Line discharge class LD Class	Long duration current 2ms A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
245	192	154	5	3200	347	355	367	392	413	446	487	3EP3 192 - 5 P . 5 . - ....	2xF	
420	336	269	4	1600	626	641	672	726	773	850	927	3EP3 336 - 3 P . 4 . - ....	2xK	
	360	288	4	1600	671	687	720	778	828	911	994	3EP3 360 - 3 P . 4 . - ....	2xK	
	360	288	5	2000	672	693	713	765	810	883	964	3EP3 360 - 4 P . 5 . - ....	2xK	
	360	288	5	3200	650	666	689	735	774	836	913	3EP3 360 - 5 P . 5 . - ....	2xK	
550	396	317	4	1600	738	756	792	856	911	1002	1093	3EP3 396 - 3 P . 4 . - ....	3xH	
	396	317	5	2000	740	762	784	842	891	971	1060	3EP3 396 - 4 P . 5 . - ....	3xH	
	396	317	5	3200	715	732	758	809	851	920	1005	3EP3 396 - 5 P . 5 . - ....	3xH	
	399	319	4	1600	743	762	798	863	918	1009	1101	3EP3 399 - 3 P . 4 . - ....	3xH	
	399	319	5	2000	745	768	790	848	898	979	1068	3EP3 399 - 4 P . 5 . - ....	3xH	
	399	319	5	3200	721	738	763	815	858	926	1012	3EP3 399 - 5 P . 5 . - ....	3xH	
	420	336	4	1600	782	802	840	908	966	1063	1159	3EP3 420 - 3 P . 4 . - ....	3xH	
	420	336	5	2000	784	808	832	893	945	1030	1125	3EP3 420 - 4 P . 5 . - ....	3xH	
	420	336	5	3200	759	777	804	858	903	975	1066	3EP3 420 - 5 P . 5 . - ....	3xH	
	444	355	5	2000	829	854	879	944	999	1089	1189	3EP3 444 - 4 P . 5 . - ....	3xH	
	444	355	5	3200	802	821	850	907	955	1031	1126	3EP3 444 - 5 P . 5 . - ....	3xH	
	468	374	5	2000	874	900	927	995	1053	1148	1253	3EP3 468 - 4 P . 5 . - ....	3xH	
	468	374	5	3200	845	865	896	956	1006	1087	1187	3EP3 468 - 5 P . 5 . - ....	3xH	
	800	580	464	5	2000	1083	1116	1148	1233	1305	1422	1553	3EP3 580 - 4 P . 5 . - ....	4xK
580		464	5	3200	1047	1072	1110	1185	1247	1347	1471	3EP3 580 - 5 P . 5 . - ....	4xK	
588		470	5	2000	1098	1131	1164	1250	1323	1442	1574	3EP3 588 - 4 P . 5 . - ....	4xK	
588		470	5	3200	1062	1087	1125	1201	1264	1365	1492	3EP3 588 - 5 P . 5 . - ....	4xK	
597		478	5	2000	1115	1148	1182	1269	1343	1464	1598	3EP3 597 - 4 P . 5 . - ....	4xK	
597		478	5	3200	1078	1104	1142	1219	1284	1386	1515	3EP3 597 - 5 P . 5 . - ....	4xK	
612		490	5	2000	1143	1177	1212	1301	1377	1501	1639	3EP3 612 - 4 P . 5 . - ....	4xK	
612		490	5	3200	1105	1132	1171	1250	1316	1421	1553	3EP3 612 - 5 P . 5 . - ....	4xK	
624		499	5	2000	1165	1200	1236	1327	1404	1530	1671	3EP3 624 - 4 P . 5 . - ....	4xK	
624		499	5	3200	1127	1154	1194	1275	1342	1449	1583	3EP3 624 - 5 P . 5 . - ....	4xK	

## Ratings and specifications

### Mechanical characteristics

Housing size	Height [H] mm	Creepage distance mm	Housing insulation			Specified short-term load SSL N	Specified long-term load SLL N	Grading ring diameter [D] mm	Maximum weight of arrester kg	Flashover distance mm	Arrester type	Figure
			Lightning impulse withstand voltage 1.2/50µs kV	Switching impulse withstand voltage 250µs/2500µs, wet kV	Power frequency withstand voltage 1 min., wet kV							
2xF	2820	7680	1276	880	484	12050	4820	1000	433	1640	3EP3 ... - .. F . 2 - ....	A
2xK	3740	11030	1810	1248	686	9090	3630	1200	598	2520	3EP3 ... - .. K . 2 - ....	A
3xH	4920	14025	2313	1596	878	6910	2760	1800	778	3340	3EP3 ... - .. H . 3 - ....	B
3xK	5610	16545	2715	1872	1030	6060	2420	1800	866	3810	3EP3 ... - .. K . 3 - ....	B
4xH	6560	18700	2313	1596	878	5180	2070	1800	1001	4610	3EP3 ... - .. H . 4 - ....	C
4xK	7480	22060	3620	2496	1373	4540	1810	2650	1169	5380	3EP3 ... - .. K . 4 - ....	C

The maximum arrester weight can vary depending on rated voltage and line discharge class.

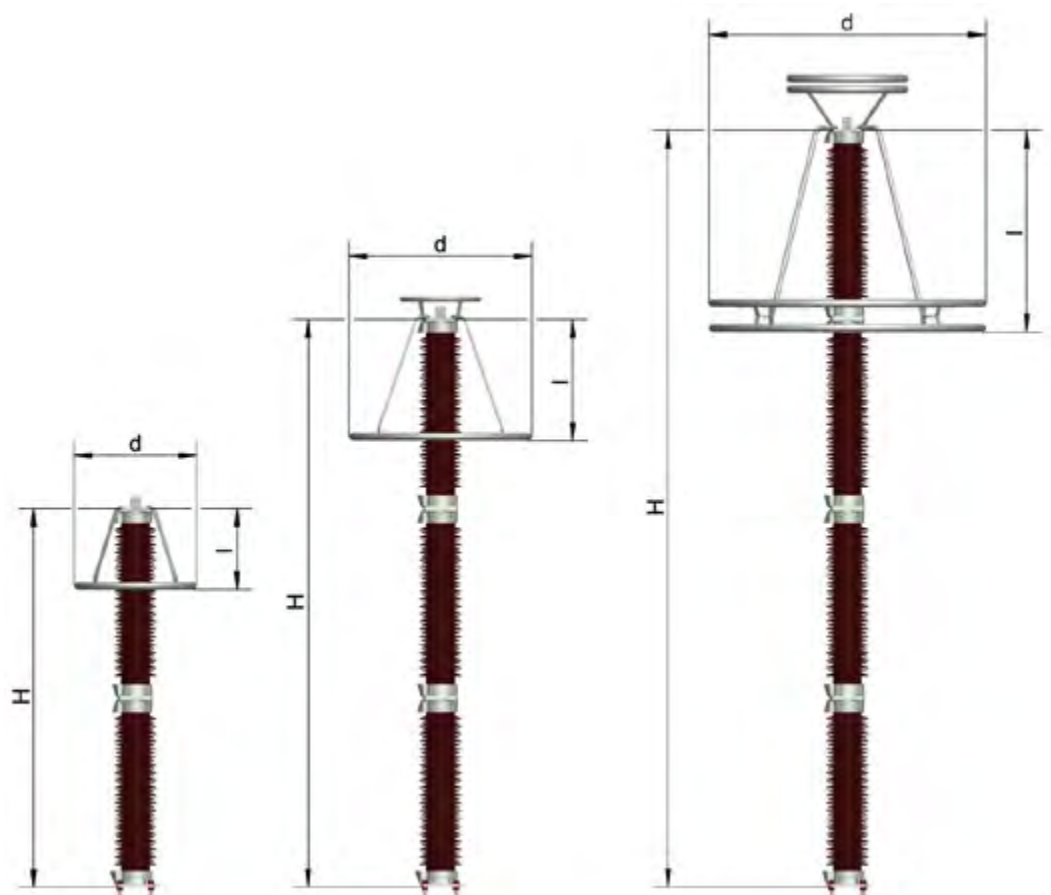
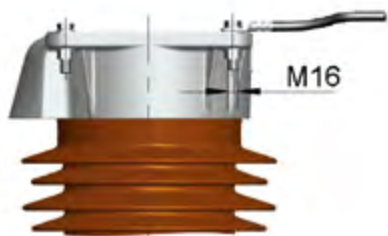


Figure A

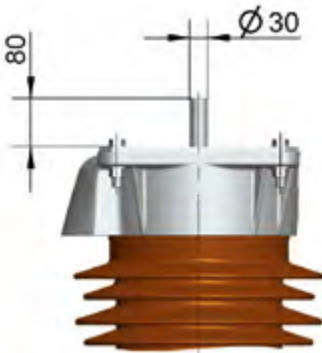
Figure B

Figure C

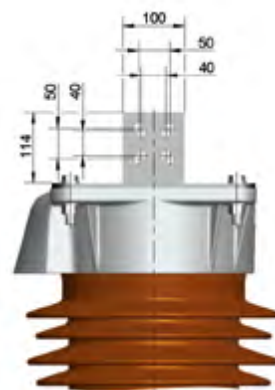
Line terminals



**Plate**  
3EP3 .....-A..

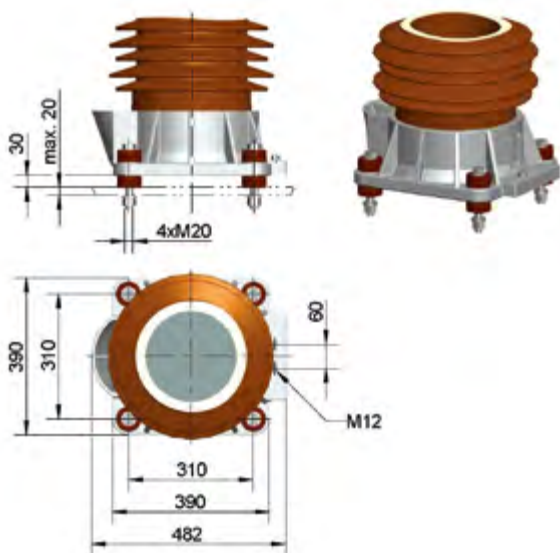


**Bolt**  
3EP3 .....-D..

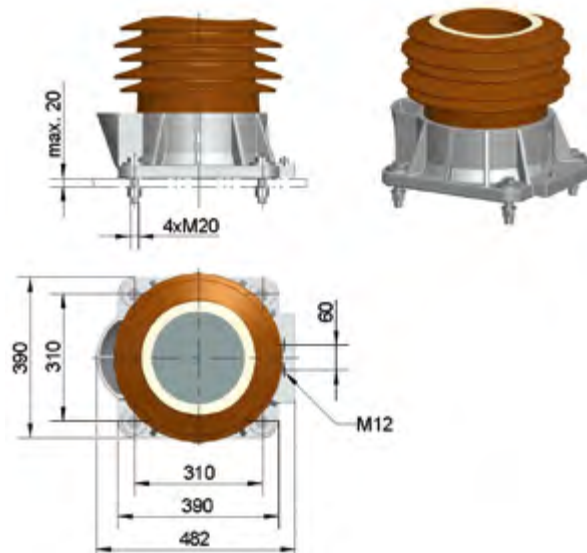


**DIN/NEMA flat terminal**  
3EP3 .....-R.. (copper)  
3EP3 .....-T.. (aluminum)  
3EP3 .....-X.. (hot dip galvanized)  
3EP3 .....-Y.. (stainless steel)

Mounting

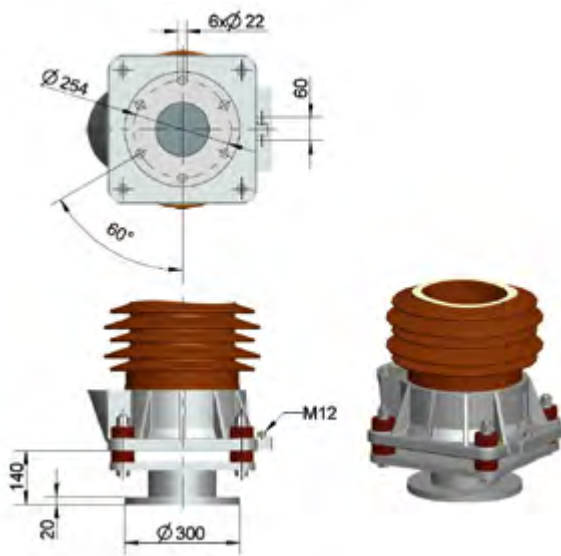


**Insulated**  
3EP3 .....-1



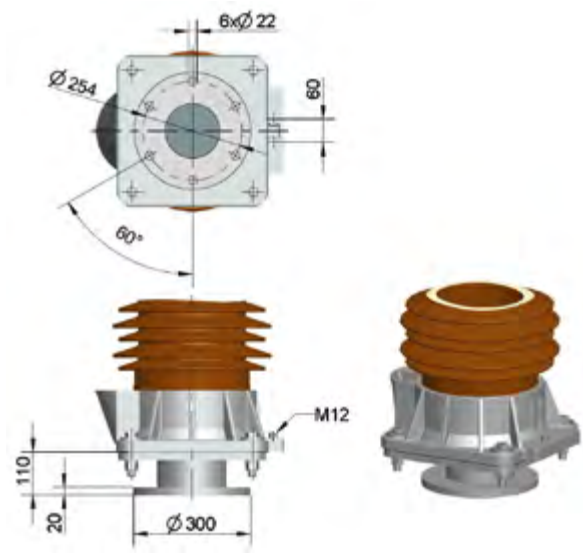
**Grounded**  
3EP3 .....-0

Mounting



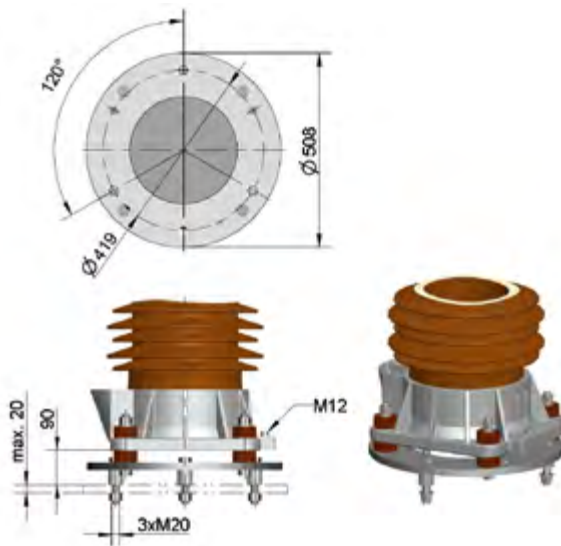
Insulated

3EP3 .....7



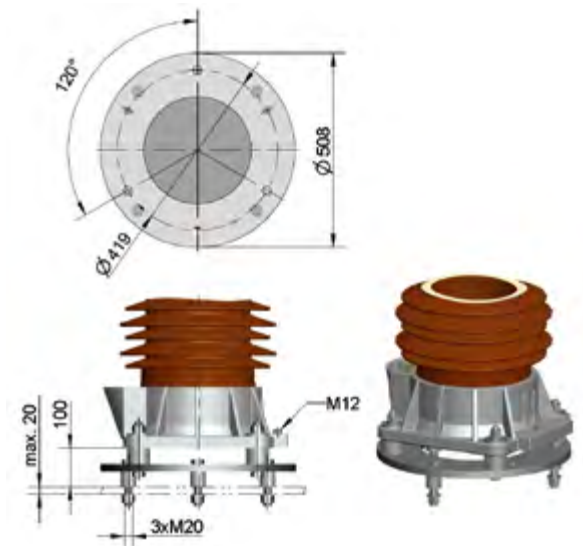
Grounded

3EP3 .....5



Insulated

3EP3 .....8



Grounded

3EP3 .....6



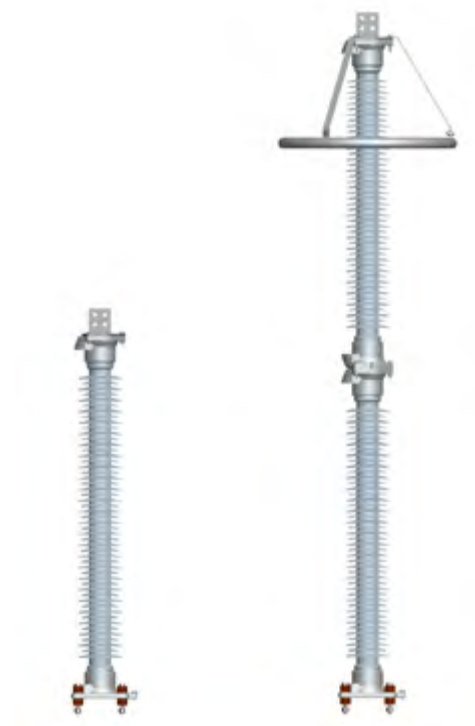
# 3EQ1 Surge arrester

with composite hollow core design

## Technical datasheet

### Protection of:

- Circuit breakers
- Transformers
- Generators
- Motors
- Capacitors
- Bushings
- Switchgear



Maximum values			3EQ1	3EQ1	3EQ1
Highest voltage of the system	kV		300	300	362
Maximum rated voltage	kV		240	240	288
Nominal discharge current	kA		10	10	10
Line discharge class			2	2	3
Energy absorption capability	kJ/kV <sub>r</sub>		5.0	5.0	8.0
Long duration current impulse	A		750	1100	1100
Rated short-circuit current	kA		40	40	40
High current impulse	kA		100	100	100
Bending moment dynamic	kNm		6.0	6.0	6.0

## 3EQ1 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-	
<b>Order number</b>	3	E	Q	1	-	x	x	x	-	2	P	J	3	1	-	4	D	A	1	-	Z
<b>Product line</b>																					
Silicone rubber-housed surge arrester, hollow core design	3	E	Q	1																	
<b>Rated voltage in kV</b>						x	x	x													
<b>Long duration current impulse, energy absorption capability</b>																					
$I_{2ms} = 750$ A, $E_{th} = 5$ kJ/kV <sub>r</sub> , line discharge class 2										1			2								
$I_{2ms} = 1100$ A, $E_{th} = 5$ kJ/kV <sub>r</sub> , line discharge class 2										2			2								
$I_{2ms} = 1100$ A, $E_{th} = 8$ kJ/kV <sub>r</sub> , line discharge class 3										2			3								
<b>Application</b>																					
Phase surge arrester											P										
Neutral point surge arrester											S										
<b>Housing size, number of units. Refer to »Mechanical characteristics« on page 89</b>																					
Housing »B«, 1 unit											B		1								
Housing »E«, 1 unit											E		1								
Housing »J«, 1 unit											J		1								
Housing »P«, 1 unit											P		1								
Housing »S«, 1 unit											S		1								
Housing »2X«, 2 units											J		2								
Housing »2xP«, 2 units											P		2								
<b>Form of sheds and color of silicone rubber</b>																					
Alternating sheds, gray silicone rubber, upright mounting																4					
Alternating sheds, gray silicone rubber, suspended mounting																8					
<b>High-voltage terminal</b>																					
Metal plate																					A
Bolt, 30 mm diameter, 80 mm length, stainless steel																					D
Bolt, 30 mm diameter, 100 mm length, stainless steel																					E
Bolt, 40 mm diameter, 80 mm length, stainless steel																					G
Bolt, 40 mm diameter, 120 mm length, stainless steel																					J
Flat DIN/NEMA, 40x40 ... 50x50, 90°, 20 mm, hot dip galvanized steel																					L
Flat DIN/NEMA, 40x40 ... 50x50, copper																					R
Flat DIN/NEMA, 40x40 ... 50x50, aluminum																					T
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel																					X
Flat DIN/NEMA, 40x40 ... 50x50, stainless steel																					Y
Bolt, 26 mm diameter, 100 mm length, stainless steel																					Z
Bolt, 30 mm diameter, 80 mm length, aluminum																					Z
Bolt, 35 mm diameter, 120 mm length, stainless steel																					Z
Bolt, 40 mm diameter, 125 mm length, aluminum																					Z
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel, horizontal																					Z
Flat, 4xD=16, aluminum																					Z
Flat, 4xD=17.5 50/50, hot dip galvanized steel																					Z
Flat, 4xD=17.5 50/50, aluminum																					Z
Flat, 4xD=14/50, Palm 5, aluminum																					Z
Flat, 4xD=18/60, Palm 8, aluminum																					Z

## 3EQ1 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-	
<b>Order number</b>	3	E	Q	1	-	x	x	x	-	2	P	J	3	1	-	4	D	A	1	-	Z
<b>Nameplate</b>																					
German/English (standard)																			A		
French																			B		
Czech																			C		
Slovene																			D		
Russian																			E		
Spanish																			F		
Portuguese																			G		
Arabic																			R		
Brazil																			T		
CFE (Mexico)																			U		
Customized version																			Z		
<b>Mounting</b>																					
200 mm x 200 mm, grounded																			0		
200 mm x 200 mm, insulated																			1		
310 mm x 310 mm, insulated																			3		
D=10", grounded																			5		
D=10", insulated																			7		
<b>Accessories</b>																					
Refer to table »Optional accessories« on page 110																				Z	

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Continuous operating voltage $U_c$ kV	Line discharge class LD Class	Long duration current 2ms A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
72.5	54	43	2	750	106	110	116	128	138	154	176	3EQ1 054 - 1 P . 2 . - ....	B	
	54	43	3	1100	104	106	111	122	130	144	163	3EQ1 054 - 2 P . 3 . - ....	B	
	60	48	2	750	118	122	129	142	153	171	196	3EQ1 060 - 1 P . 2 . - ....	B	
	60	48	2	1100	108	111	116	127	135	150	170	3EQ1 060 - 2 P . 2 . - ....	B	
	60	48	3	1100	115	118	124	135	144	160	181	3EQ1 060 - 2 P . 3 . - ....	B	
	66	53	2	750	130	135	141	157	168	188	215	3EQ1 066 - 1 P . 2 . - ....	B	
	66	53	3	1100	127	130	136	149	158	176	200	3EQ1 066 - 2 P . 3 . - ....	B	
	72	58	2	750	141	147	154	171	184	206	235	3EQ1 072 - 1 P . 2 . - ....	B	
72	58	3	1100	138	142	149	162	173	192	218	3EQ1 072 - 2 P . 3 . - ....	B		
123	96	77	2	750	188	196	206	228	245	274	313	3EQ1 096 - 1 P . 2 . - ....	B	
	96	77	2	1100	173	177	186	203	216	240	272	3EQ1 096 - 2 P . 2 . - ....	B	
	96	77	3	1100	184	189	198	217	230	256	290	3EQ1 096 - 2 P . 3 . - ....	B	
	102	82	2	750	200	208	218	242	260	291	333	3EQ1 102 - 1 P . 2 . - ....	B	
	102	82	3	1100	196	201	211	230	245	272	308	3EQ1 102 - 2 P . 3 . - ....	B	
	108	86	2	750	212	220	231	256	275	308	353	3EQ1 108 - 1 P . 2 . - ....	E	
	108	86	3	1100	207	213	223	244	259	288	327	3EQ1 108 - 2 P . 3 . - ....	E	
	154	123	3	1100	296	303	318	347	370	410	466	3EQ1 154 - 2 P . 3 . - ....	J	
145	120	96	2	750	236	245	257	285	306	343	392	3EQ1 120 - 1 P . 2 . - ....	J	
	120	96	3	1100	230	236	248	271	288	320	363	3EQ1 120 - 2 P . 3 . - ....	J	
	132	106	3	1100	253	260	272	298	317	352	399	3EQ1 132 - 2 P . 3 . - ....	J	
	144	115	3	1100	276	283	297	325	346	384	435	3EQ1 144 - 2 P . 3 . - ....	J	
170	138	110	3	1100	265	272	285	311	331	368	417	3EQ1 138 - 2 P . 3 . - ....	J	
	144	115	3	1100	276	283	297	325	346	384	435	3EQ1 144 - 2 P . 3 . - ....	J	
	150	120	3	1100	288	295	310	338	360	400	454	3EQ1 150 - 2 P . 3 . - ....	J	
245	192	154	3	1100	369	378	396	433	461	511	581	3EQ1 192 - 2 P . 3 . - ....	P	
	198	158	3	1100	380	390	409	447	475	527	599	3EQ1 198 - 2 P . 3 . - ....	S	
	228	182	3	1100	438	449	471	514	547	607	689	3EQ1 228 - 2 P . 3 . - ....	2xJ	
300	228	182	3	1100	438	449	471	514	547	607	689	3EQ1 228 - 2 P . 3 . - ....	2xJ	
	240	192	3	1100	461	472	495	541	576	639	726	3EQ1 240 - 2 P . 3 . - ....	2xJ	
362	276	221	3	1100	530	543	570	623	662	735	835	3EQ1 276 - 2 P . 3 . - ....	2xP	
	288	230	3	1100	553	567	594	650	691	767	871	3EQ1 288 - 2 P . 3 . - ....	2xP	

### Electrical characteristics – neutral ground arresters

123	72	58	2	750	141	147	154	171	184	206	235	3EQ1 072 - 1 S . 2 . - ....	B
	72	58	3	1100	138	142	149	162	173	192	218	3EQ1 072 - 2 S . 3 . - ....	B
	90	72	2	750	177	184	193	213	230	257	294	3EQ1 090 - 1 S . 2 . - ....	B
	90	72	3	1100	173	177	186	203	216	240	272	3EQ1 090 - 2 S . 3 . - ....	B
245	102	82	2	750	200	208	218	242	260	291	333	3EQ1 102 - 1 S . 2 . - ....	B
	102	82	3	1100	196	201	211	230	245	272	308	3EQ1 102 - 2 S . 3 . - ....	B
	108	86	2	750	212	220	231	256	275	308	353	3EQ1 108 - 1 S . 2 . - ....	E
	108	86	3	1100	207	213	223	244	259	288	327	3EQ1 108 - 2 S . 3 . - ....	E

## Ratings and specifications

### Mechanical characteristics

Housing size	Height [H] mm	Creepage distance mm	Housing insulation			Specified short-term load SSL N	Specified long-term load SLL N	Grading ring diameter [D] mm	Maximum weight of arrester kg	Flashover distance mm	Arrester type	Figure
			Lightning impulse withstand voltage 1.2/50µs kV	Switching impulse withstand voltage 250µs/2500µs, wet kV	Power frequency withstand voltage 1 min., wet kV							
B	885	2075	348	252	162	6780	4750	-	29.5	600	3EQ1 ... - ... B . 1 - ....	A
E	1035	2635	435	315	203	5800	4060	-	32.8	750	3EQ1 ... - ... E . 1 - ....	A
J	1235	3390	551	399	257	4860	3400	-	37.6	950	3EQ1 ... - ... J . 1 - ....	A
P	1485	4330	696	504	324	4040	2830	-	43.1	1200	3EQ1 ... - ... P . 1 - ....	A
S	1635	4895	783	567	365	3670	2570	-	45.6	1350	3EQ1 ... - ... S . 1 - ....	A
2xJ	2470	6780	1102	798	513	2430	1700	800	69.1	1615	3EQ1 ... - ... J . 2 - ....	B
2xP	2970	8660	1392	1008	648	2020	1410	800	77.3	2090	3EQ1 ... - ... P . 2 - ....	B

The maximum arrester weight can vary depending on rated voltage and line discharge class.

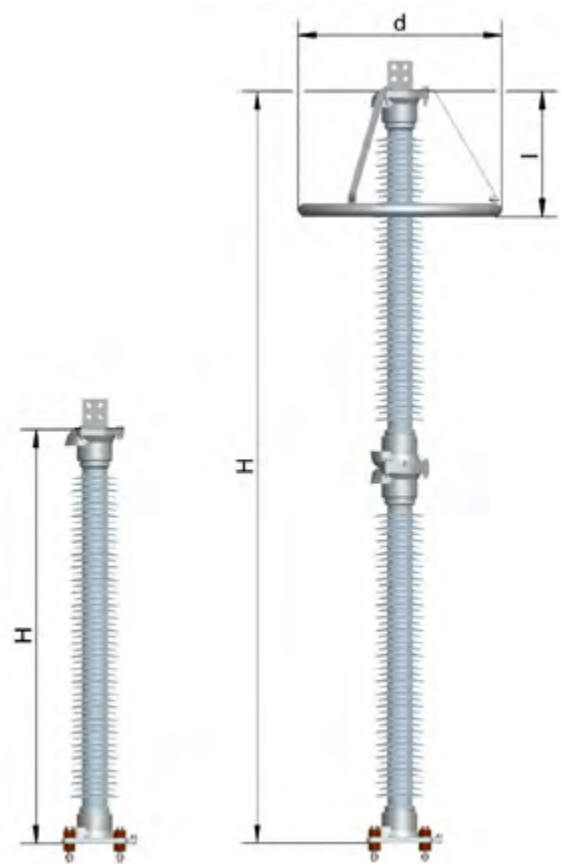
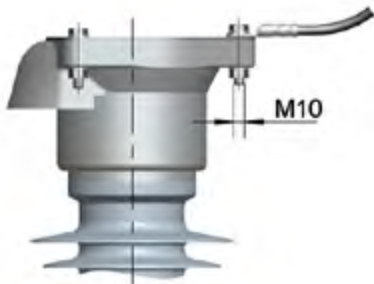


Figure A

Figure B

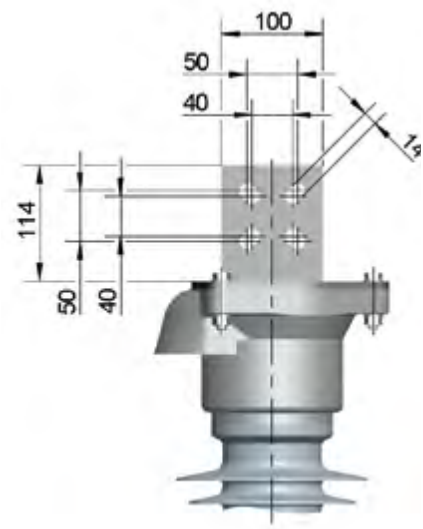
Line terminals



**Plate**  
3EQ1 .....A..

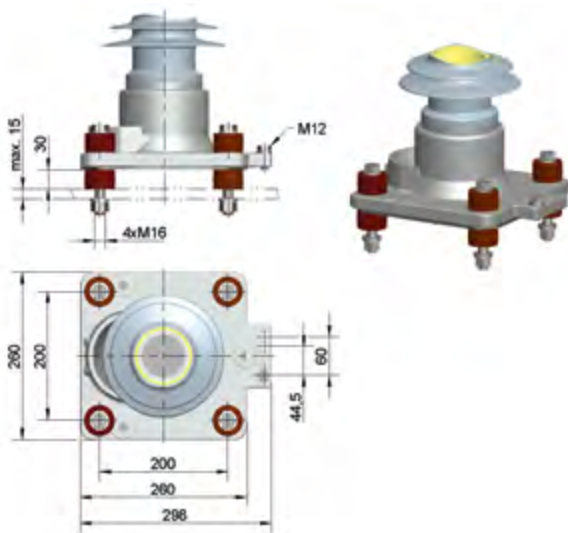


**Bolt**  
3EQ1 .....D..

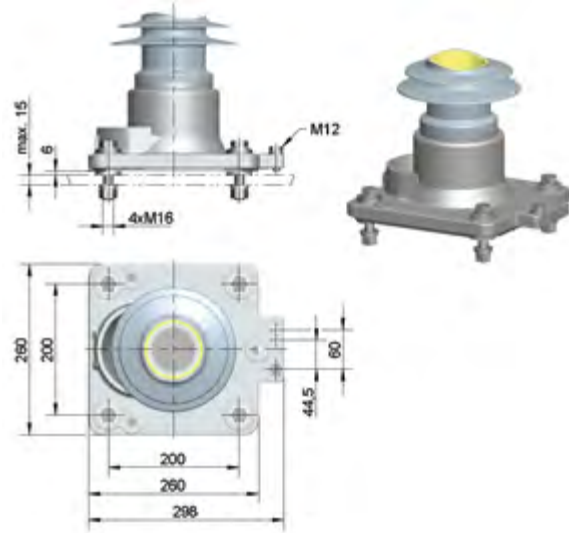


**DIN/NEMA flat terminal**  
3EQ1 .....R.. (copper)  
3EQ1 .....T.. (aluminum)  
3EQ1 .....X.. (hot dip galvanized)  
3EQ1 .....Y.. (stainless steel)

Mounting

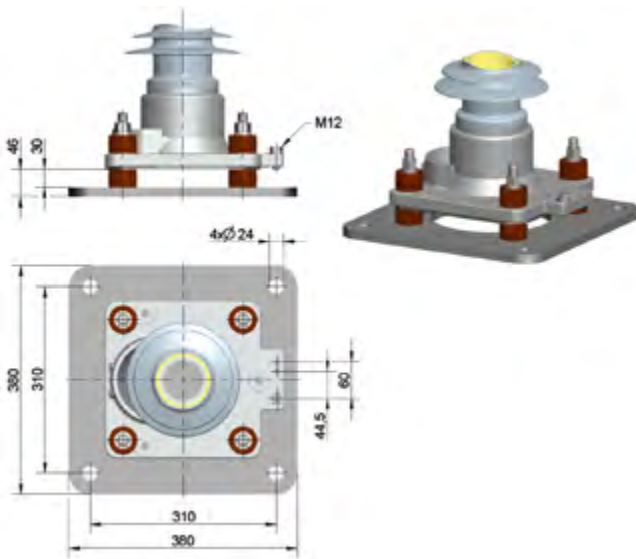


**Insulated**  
3EQ1 .....1



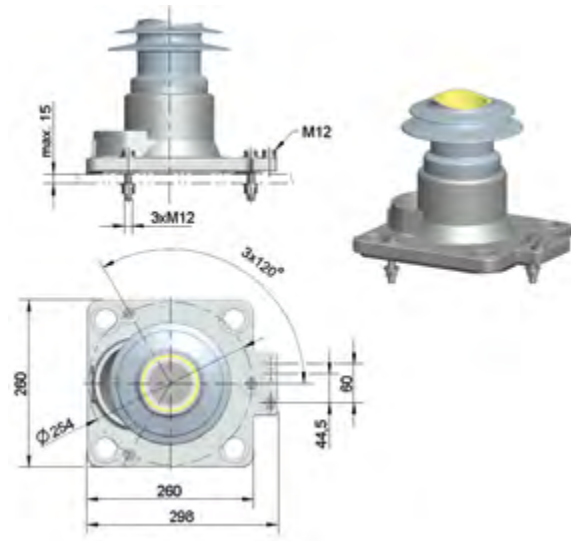
**Grounded**  
3EQ1 .....0

Mounting



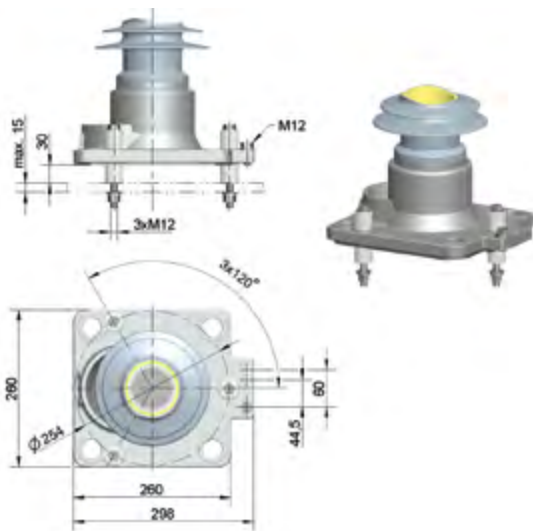
Insulated

3EQ1 .....3



Grounded

3EQ1 .....5



Insulated

3EQ1 .....7



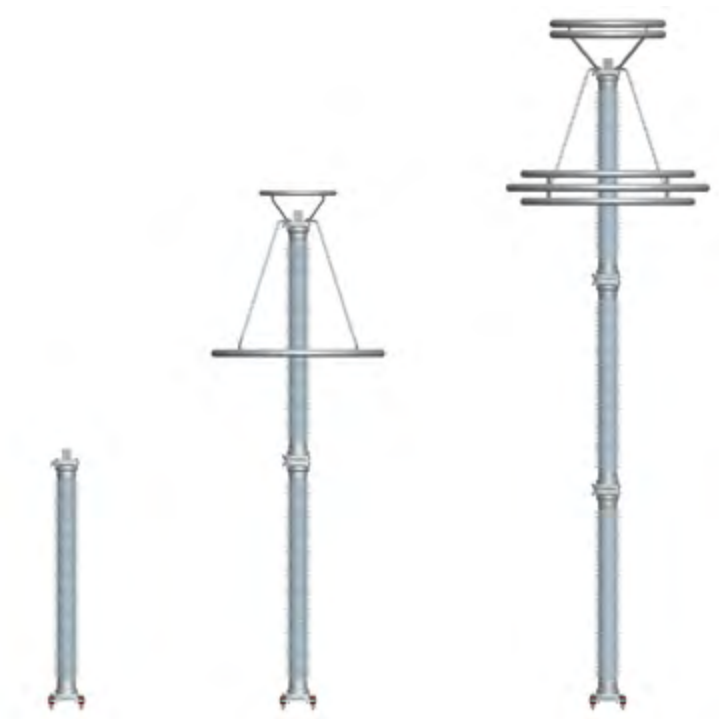
# 3EQ4 Surge arrester

with composite hollow core design

## Technical datasheet

### Protection of:

- Circuit breakers
- Transformers
- Generators
- Motors
- Capacitors
- Bushings
- Switchgear



Maximum values		3EQ4	3EQ4	3EQ4	3EQ4
Highest voltage of the system	kV	420	550	800	800
Maximum rated voltage	kV	360	444	588	588
Nominal discharge current	kA	10	20	20	20
Line discharge class		3	4	5	5
Energy absorption capability	kJ/kV <sub>r</sub>	8.0	10.0	14.0	16.0
Long duration current impulse	A	1100	1600	2000	3200
Rated short-circuit current	kA	65 <sup>1)</sup>	65 <sup>1)</sup>	65 <sup>1)</sup>	65 <sup>1)</sup>
High current impulse	kA	100	100	100	100
Bending moment dynamic	kNm	21/38	21/38	21/38	21/38

<sup>1)</sup> Increased rated short-circuit current of 80 kA available on request

## 3EQ4 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-				
<b>Order number</b>	<b>3</b>	<b>E</b>	<b>Q</b>	<b>4</b>	-	<b>x</b>	<b>x</b>	<b>x</b>	-	<b>2</b>	<b>P</b>	<b>V</b>	<b>3</b>	<b>1</b>	-	<b>4</b>	<b>D</b>	<b>A</b>	<b>1</b>	-	<b>Z</b>			
<b>Product line</b>																								
Silicone rubber-housed surge arrester, hollow core design	3	E	Q	4																				
<b>Rated voltage in kV</b>						x	x	x																
<b>Long duration current impulse, energy absorption capability</b>																								
$I_{2ms} = 1100 \text{ A}$ , $E_{th} = 8 \text{ kJ/kV}_r$ , line discharge class 3														2									3	
$I_{2ms} = 1600 \text{ A}$ , $E_{th} = 10 \text{ kJ/kV}_r$ , line discharge class 4														3									4	
$I_{2ms} = 2000 \text{ A}$ , $E_{th} = 14 \text{ kJ/kV}_r$ , line discharge class 5														4									5	
$I_{2ms} = 3200 \text{ A}$ , $E_{th} = 16 \text{ kJ/kV}_r$ , line discharge class 5														5									5	
<b>Application</b>																								
Phase surge arrester																							P	
Neutral point surge arrester																							S	
<b>Housing size, number of units. Refer to »Mechanical characteristics« on page 97</b>																								
Housing »N«, 1 unit																							N	1
Housing »N«, 1 unit, increased SSL																							N	5
Housing »P«, 1 unit																							P	1
Housing »P«, 1 unit, increased SSL																							P	5
Housing »R«, 1 unit																							R	1
Housing »R«, 1 unit, increased SSL																							R	5
Housing »S«, 1 unit																							S	1
Housing »S«, 1 unit, increased SSL																							S	5
Housing »V«, 1 unit																							V	1
Housing »V«, 1 unit, increased SSL																							V	5
Housing »2xN«, 2 units																							N	2
Housing »2xN«, 2 units, increased SSL																							N	6
Housing »2xP«, 2 units																							P	2
Housing »2xP«, 2 units, increased SSL																							P	6
Housing »2xR«, 2 units																							R	2
Housing »2xS«, 2 units																							S	2
Housing »2xS«, 2 units, increased SSL																							S	6
Housing »2xV«, 2 units																							V	2
Housing »2xV«, 2 units, increased SSL																							V	6
Housing »3xP«, 3 units, increased SSL																							P	7
Housing »3xS«, 3 units, increased SSL																							S	7
<b>Form of sheds and color of silicone rubber</b>																								
Alternating sheds, gray silicone rubber, upright mounting																								4
Alternating sheds, gray silicone rubber, suspended mounting																								8

## 3EQ4 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-			
<b>Order number</b>	<b>3</b>	<b>E</b>	<b>Q</b>	<b>4</b>	-	<b>x</b>	<b>x</b>	<b>x</b>	-	<b>2</b>	<b>P</b>	<b>V</b>	<b>3</b>	<b>1</b>	-	<b>4</b>	<b>D</b>	<b>A</b>	<b>1</b>	-	<b>Z</b>		
<b>High-voltage terminal</b>																							
Metal plate																							
Bolt, 30 mm diameter, 80 mm length, hot dip galvanized steel																							A
Bolt, 30 mm diameter, 80 mm length, stainless steel																							C
Bolt, 30 mm diameter, 80 mm length, stainless steel																							D
Bolt, 30 mm diameter, 100 mm length, stainless steel																							E
Bolt, 40 mm diameter, 80 mm length, stainless steel																							G
Bolt, 40 mm diameter, 120 mm length, stainless steel																							J
Flat DIN/NEMA, 40x40 ... 50x50, 20 mm, hot dip galvanized steel																							L
Flat double DIN, 200x100, hot dip galvanized steel																							M
Flat DIN/NEMA, 40x40 ... 50x50, copper																							R
Flat DIN/NEMA, 40x40 ... 50x50, aluminum																							T
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel																							X
Flat DIN/NEMA, 40x40 ... 50x50, stainless steel																							Y
Bolt, 30 mm diameter, 125 mm length, stainless steel																							Z
Bolt, 40 mm diameter, 80 mm length, aluminum																							Z
Bolt, 40 mm diameter, 130 mm length, stainless steel																							Z
Bolt, 50 mm diameter, 125 mm length, stainless steel																							Z
Bolt, 40 mm diameter, 80 mm length, copper																							Z
Bolt, 30 mm diameter, 125 mm length, aluminum																							Z
Flat, 4xD=16, aluminum																							Z
Flat, 4xD=17.5 50/50, hot dip galvanized steel																							Z
Flat, 4xD=17.5 50/50, aluminum																							Z
Flat, 4xD=14/50, Palm 5, aluminum																							Z
Flat, 2xD=18/60, Palm 7, aluminum																							Z
Flat, 4xD=18/60, Palm 8, copper																							Z
Flat, 4x, 70x60, Palm 12, copper																							Z
Flat, 6x, 60x60, copper																							Z
Flat, 6xD=18 60/60, hot dip galvanized steel																							Z
<b>Nameplate</b>																							
German/English (standard)																							A
French																							B
Czech																							C
Slovene																							D
Russian																							E
Spanish																							F
Portuguese																							G
Arabic																							R
Brasil																							T
CFE (Mexico)																							U
Customized version																							Z
<b>Mounting</b>																							
310 mm x 310 mm, insulated																							1
D=10", grounded																							5
D=16.5", grounded																							6
D=10", insulated																							7
D=16.5", insulated																							8
310 mm x 310 mm, insulated, increased SSL																							9
D=10", grounded, increased SSL																							9
D=16.5", grounded, increased SSL																							9
D=10", insulated, increased SSL																							9
191 mm x 191 mm, grounded																							9
<b>Accessories</b>																							
Refer to table »Optional accessories« on page 110																							Z

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Continuous operating voltage $U_c$ kV	Line discharge class LD Class	Long duration current 2ms A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
245	192	154	3	1100	369	378	396	433	461	511	581	3EQ4 192 - 2 P. 3 - ....	N	
	192	154	4	1600	358	367	384	415	442	486	530	3EQ4 192 - 3 P. 4 - ....	N	
	198	158	3	1100	380	390	409	447	475	527	599	3EQ4 198 - 2 P. 3 - ....	N	
	198	158	4	1600	369	378	396	428	455	501	546	3EQ4 198 - 3 P. 4 - ....	N	
	228	182	3	1100	438	449	471	514	547	607	689	3EQ4 228 - 2 P. 3 - ....	P	
	228	182	4	1600	425	435	456	493	524	577	629	3EQ4 228 - 3 P. 4 - ....	P	
300	228	182	3	1100	438	449	471	514	547	607	689	3EQ4 228 - 2 P. 3 - ....	P	
	228	182	4	1600	425	435	456	493	524	577	629	3EQ4 228 - 3 P. 4 - ....	P	
	240	192	3	1100	461	472	495	541	576	639	726	3EQ4 240 - 2 P. 3 - ....	R	
	240	192	4	1600	447	458	480	519	552	607	662	3EQ4 240 - 3 P. 4 - ....	R	
362	258	206	3	1100	495	508	533	582	619	687	780	3EQ4 258 - 2 P. 3 - ....	R	
	258	206	4	1600	481	493	516	558	593	653	712	3EQ4 258 - 3 P. 4 - ....	R	
	276	221	3	1100	530	543	570	623	662	735	835	3EQ4 276 - 2 P. 3 - ....	V	
	276	221	4	1600	514	527	552	597	635	698	762	3EQ4 276 - 3 P. 4 - ....	V	
	288	230	3	1100	553	567	594	650	691	767	871	3EQ4 288 - 2 P. 3 - ....	V	
	288	230	4	1600	537	550	576	623	662	729	795	3EQ4 288 - 3 P. 4 - ....	V	
420	336	269	3	1100	645	661	694	758	806	895	1016	3EQ4 336 - 2 P. 3 - ....	2xN	
	336	269	4	1600	626	641	672	726	773	850	927	3EQ4 336 - 3 P. 4 - ....	2xN	
	336	269	5	2000	627	646	665	714	756	824	900	3EQ4 336 - 4 P. 5 - ....	2xN	
	360	288	3	1100	691	708	743	812	864	959	1089	3EQ4 360 - 2 P. 3 - ....	2xP	
	360	288	4	1600	671	687	720	778	828	911	994	3EQ4 360 - 3 P. 4 - ....	2xP	
	360	288	5	2000	672	693	713	765	810	883	964	3EQ4 360 - 4 P. 5 - ....	2xP	
550	396	317	4	1600	738	756	792	856	911	1002	1093	3EQ4 396 - 3 P. 4 - ....	2xR	
	396	317	5	2000	740	762	784	842	891	971	1060	3EQ4 396 - 4 P. 5 - ....	2xR	
	396	317	5	3200	715	732	758	809	851	920	1005	3EQ4 396 - 5 P. 5 - ....	2xR	
	420	336	4	1600	782	802	840	908	966	1063	1159	3EQ4 420 - 3 P. 4 - ....	2xR	
	420	336	5	2000	784	808	832	893	945	1030	1125	3EQ4 420 - 4 P. 5 - ....	2xR	
	420	336	5	3200	759	777	804	858	903	975	1066	3EQ4 420 - 5 P. 5 - ....	2xR	
	444	355	4	1600	827	848	888	960	1021	1123	1225	3EQ4 444 - 3 P. 4 - ....	2xV	
	444	355	5	2000	829	854	879	944	999	1089	1189	3EQ4 444 - 4 P. 5 - ....	2xS	
	444	355	5	3200	802	821	850	907	955	1031	1126	3EQ4 444 - 5 P. 5 - ....	2xS	
800	580	464	5	2000	1083	1116	1148	1233	1305	1422	1553	3EQ4 580 - 4 P. 5 - ....	7xS	
	588	470	5	2000	1098	1131	1164	1250	1323	1442	1574	3EQ4 588 - 4 P. 5 - ....	7xS	

### Electrical characteristics – neutral ground arresters

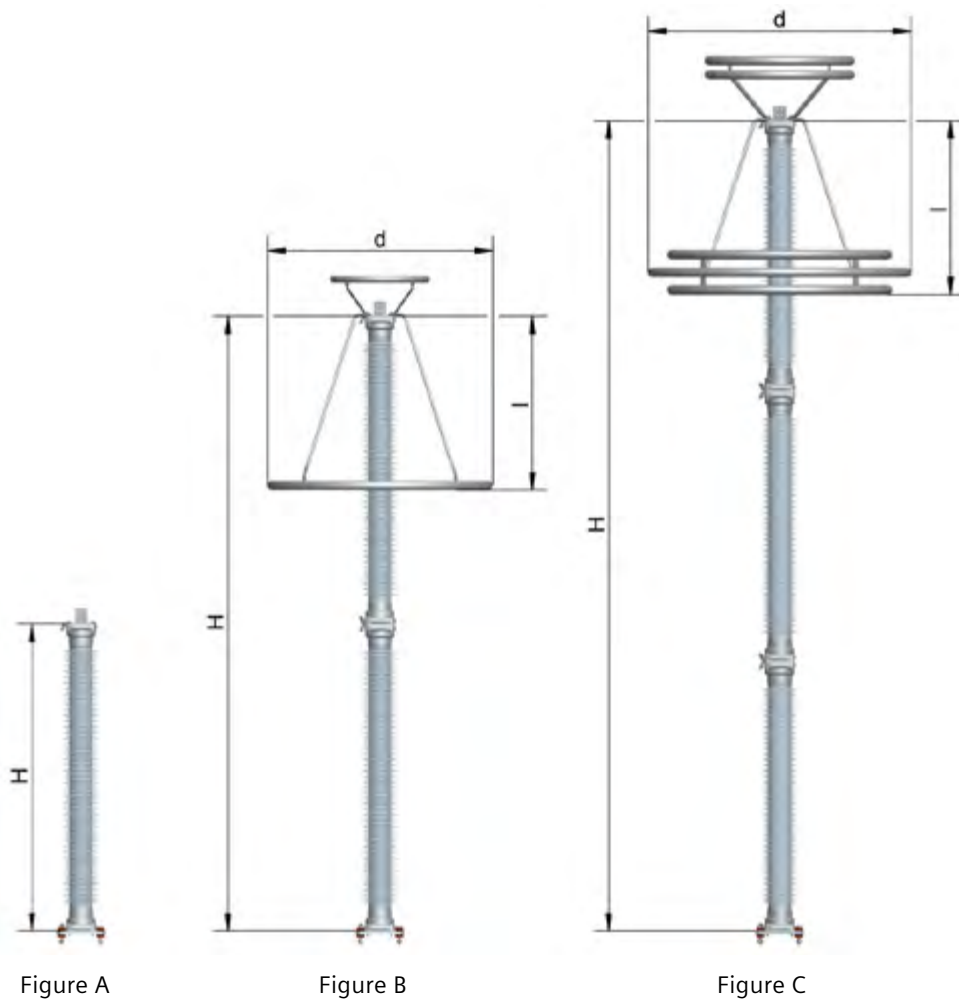
245	102	82	3	1100	196	201	211	230	245	272	308	3EQ4 102 - 2 S. 3 - ....	N
	102	82	4	1600	190	195	204	221	235	258	282	3EQ4 102 - 3 S. 4 - ....	N
	108	86	3	1100	207	213	223	244	259	288	327	3EQ4 108 - 2 S. 3 - ....	N
	108	86	4	1600	201	206	216	233	248	273	298	3EQ4 108 - 3 S. 4 - ....	N
420	168	134	3	1100	323	331	347	379	403	448	508	3EQ4 168 - 2 S. 3 - ....	N
	168	134	4	1600	313	321	336	363	386	425	464	3EQ4 168 - 3 S. 4 - ....	N

## Ratings and specifications

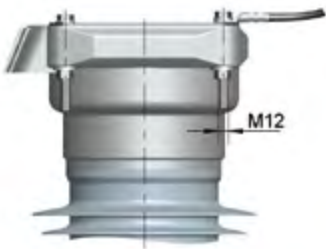
### Mechanical characteristics

Housing size	Height [H] mm	Creepage distance mm	Housing insulation			Specified short-term load SSL N	Specified long-term load SLL N	Grading ring diameter [D] mm	Maximum weight of arrester kg	Flashover distance mm	Arrester type	Figure
			Lightning impulse withstand voltage 1.2/50µs kV	Switching impulse withstand voltage 250µs/2500µs, wet kV	Power frequency withstand voltage 1 min., wet kV							
N	1760	5085	812	588	378	11930	8350	–	131	1400	3EQ4... - .. N . 1 - ....	A
P	1860	5460	870	630	405	11290	7900	–	136	1500	3EQ4... - .. P . 1 - ....	A
R	2060	6210	950	680	490	10190	7130	–	144	1700	3EQ4... - .. R . 1 - ....	A
S	2160	6590	1000	700	510	9720	6800	–	147	1800	3EQ4... - .. S . 1 - ....	A
V	2460	7715	1175	800	570	8530	5970	–	167	2100	3EQ4... - .. V . 1 - ....	A
2xN	3520	10170	1624	1176	756	5960	4170	1000	227	2320	3EQ4... - .. N . 2 - ....	B
2xP	3720	10920	1740	1260	810	5640	3950	1000	263	2520	3EQ4... - .. P . 2 - ....	B
	3720	10920	1740	1260	810	10210	7150	1000	263	2520	3EQ4... - .. P . 6 - ....	B
2xR	4120	12420	1612	1168	751	5090	3560	1200	279	2840	3EQ4... - .. R . 2 - ....	B
	4120	12420	1612	1168	751	9220	6450	1200	279	2840	3EQ4... - .. R . 6 - ....	B
2xS	4320	13180	1728	1252	805	4860	3400	1200	290	3040	3EQ4... - .. S . 2 - ....	B
	4320	13180	1728	1252	805	8790	6150	1200	290	3040	3EQ4... - .. S . 6 - ....	B
2xV	4920	15430	2071	1499	964	4260	2980	1500	304	3480	3EQ4... - .. V . 2 - ....	B
	4920	15430	2071	1499	964	7720	5400	1500	304	3480	3EQ4... - .. V . 6 - ....	B
7xS	6480	19770	2593	1877	1207	4940	3450	2240	348	4500	3EQ4... - .. S . 7 - ....	C

The maximum arrester weight can vary depending on rated voltage and line discharge class.



Line terminals



**Plate**  
3EQ4 ...-.....-A..

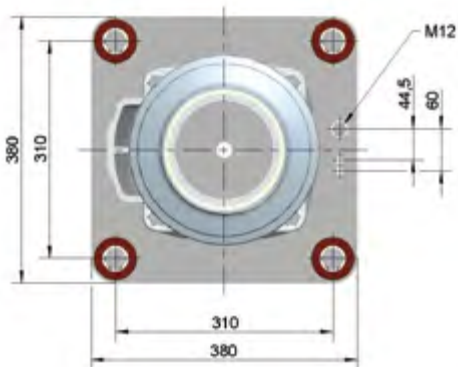
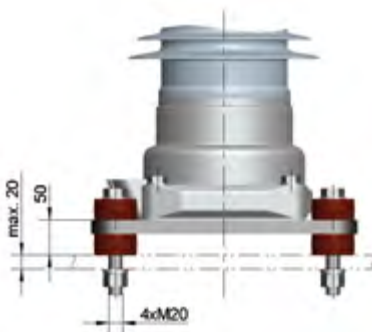


**Bolt**  
3EQ4 ...-.....-D..



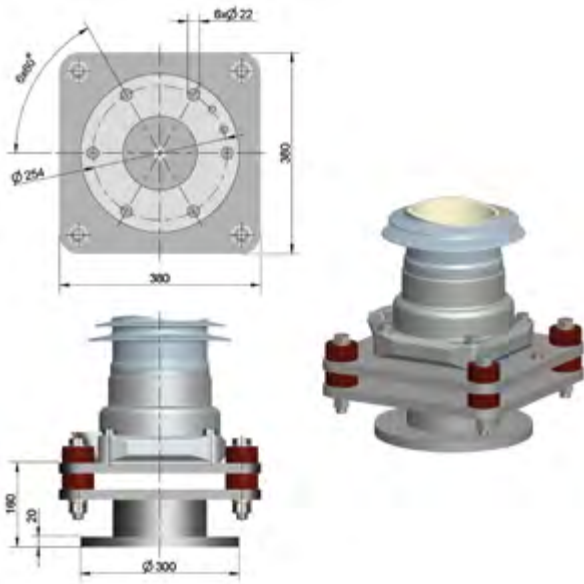
**DIN/NEMA flat terminal**  
3EQ4 ...-.....-R.. (copper)  
3EQ4 ...-.....-T.. (aluminum)  
3EQ4 ...-.....-X.. (hot dip galvanized)  
3EQ4 ...-.....-Y.. (stainless steel)

Mounting

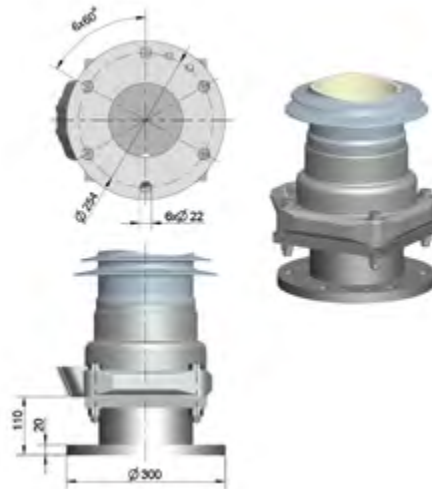


**Insulated**  
3EQ4 ...-.....-1

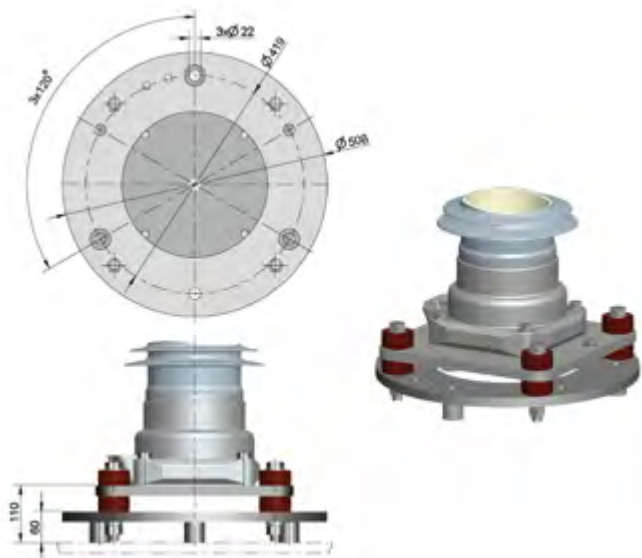
Mounting



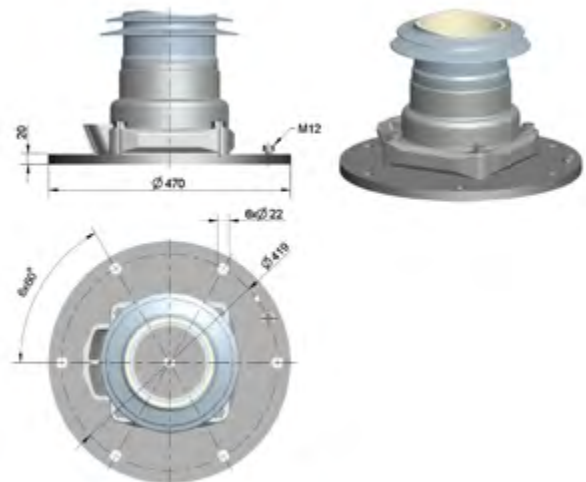
**Insulated**  
3EQ4 .....7



**Grounded**  
3EQ4 .....5



**Insulated**  
3EQ4 .....8



**Grounded**  
3EQ4 .....6

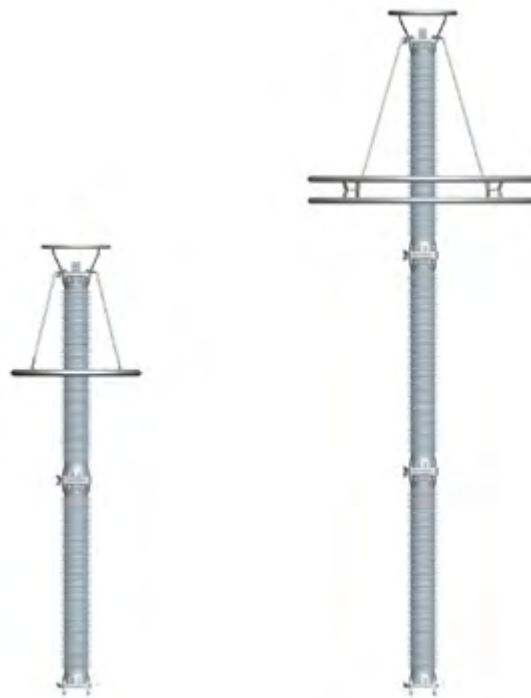
# 3EQ3 Surge arrester

with composite hollow core design

## Technical datasheet

### Protection of:

- Circuit breakers
- Transformers
- Generators
- Motors
- Capacitors
- Bushings
- Switchgear



Maximum values		3EQ3	3EQ3	3EQ3
Highest voltage of the system	kV	550	800	800
Maximum rated voltage	kV	468	624	624
Nominal discharge current	kA	20	20	20
Line discharge class		4	5	5
Energy absorption capability	kJ/kV <sub>r</sub>	10.0	14.0	16.0
Long duration current impulse	A	1600	2000	3200
Rated short-circuit current	kA	80	80	80
High current impulse	kA	100	100	100
Bending moment dynamic	kNm	42/72	42/72	42/72

## 3EQ3 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-				
<b>Order number</b>	3	E	Q	3	-	x	x	x	-	5	P	T	5	3	-	4	D	A	1	-	Z			
<b>Product line</b>																								
Silicone rubber-housed surge arrester, hollow core design	3	E	Q	3																				
<b>Rated voltage in kV</b>																								
						x	x	x																
<b>Long duration current impulse, energy absorption capability</b>																								
$I_{2ms} = 1600 \text{ A}$ , $E_{th} = 10 \text{ kJ/kV}$ , line discharge class 4												3												4
$I_{2ms} = 2000 \text{ A}$ , $E_{th} = 14 \text{ kJ/kV}$ , line discharge class 5												4												5
$I_{2ms} = 3200 \text{ A}$ , $E_{th} = 16 \text{ kJ/kV}$ , line discharge class 5												5												5
<b>Application</b>																								
Phase surge arrester												P												
Neutral point surge arrester												S												
<b>Housing size, number of units. Refer to »Mechanical characteristics« on page 104</b>																								
Housing »2xL«, 2 units												L												2
Housing »2xM«, 2 units												M												2
Housing »2xN«, 2 units												N												2
Housing »2xS«, 2 units												S												2
Housing »2xT«, 2 units												T												2
Housing »3xS«, 3 units												S												3
Housing »3xT«, 3 units												T												3
Housing »3xU«, 3 units												U												3
<b>Form of sheds and color of silicone rubber</b>																								
Alternating sheds, gray silicone rubber																	4							
<b>High-voltage terminal</b>																								
Metal plate																		A						
Bolt, 30 mm diameter, 80 mm length, hot dip galvanized steel																		C						
Bolt, 30 mm diameter, 80 mm length, stainless steel																		D						
Bolt, 30 mm diameter, 100 mm length, stainless steel																		E						
Bolt, 40 mm diameter, 80 mm length, stainless steel																		G						
Bolt, 40 mm diameter, 120 mm length, stainless steel																		J						
Flat double DIN, 200x100, hot dip galvanized steel																		M						
Flat DIN/NEMA, 40x40 ... 50x50, copper																		R						
Flat DIN/NEMA, 40x40 ... 50x50, aluminum																		T						
Flat DIN/NEMA, 40x40 ... 50x50, hot dip galvanized steel																		X						
Flat DIN/NEMA, 40x40 ... 50x50, stainless steel																		Y						
Bolt, 30 mm diameter, 125 mm length, stainless steel																		Z						P1E
Bolt, 40 mm diameter, 80 mm length, aluminum																		Z						P1H
Bolt, 40 mm diameter, 80 mm length, copper																		Z						P1Q
Valve-tower cover plate $t=8,0 \text{ M20x150}$																		Z						P2V
Flat, $4xD=16$ , aluminum																		Z						P5A
Flat, $4xD=17.5 \text{ 50/50}$ , hot dip galvanized steel																		Z						P5D
Flat, $4xD=17.5 \text{ 50/50}$ , aluminum																		Z						P5E
Flat, $4xD=14/50$ , Palm 5, aluminum																		Z						P5G
Flat, $4xD=18/60$ , Palm 8, copper																		Z						P5L
Flat, 4x, 70x60, Palm 12, copper																		Z						P5N
Flat, 6x, 60x60, copper																		Z						P5R
Flat, $6xD=18 \text{ 60/60}$ , hot dip galvanized steel																		Z						P5S

## 3EQ3 – order numbers

Data position	1	2	3	4	-	5	6	7	-	8	9	10	11	12	-	13	14	15	16	-			
<b>Order number</b>	<b>3</b>	<b>E</b>	<b>Q</b>	<b>3</b>	-	<b>x</b>	<b>x</b>	<b>x</b>	-	<b>5</b>	<b>P</b>	<b>T</b>	<b>5</b>	<b>3</b>	-	<b>4</b>	<b>D</b>	<b>A</b>	<b>1</b>	-	<b>Z</b>		
<b>Nameplate</b>																							
German/English (standard)																				A			
French																				B			
Czech																				C			
Slovene																				D			
Russian																				E			
Spanish																				F			
Portuguese																				G			
Arabic																				R			
Brazil																				T			
CFE (Mexico)																				U			
Customized version																				Z			
<b>Mounting</b>																							
270 mm x 270 mm, grounded																				0			
270 mm x 270 mm, insulated																				1			
D=16.5", grounded																				6			
D=16.5", insulated																				8			
D=20", insulated																				9		R2U	
D=20", grounded																				9		R2V	
D=20", NEMA, insulated, copper tin-plated																				9		R2W	
D=20", NEMA, insulated, with connection plate, copper tin-plated																				9		R2X	
270 mm x 270 mm, insulated, increased SSL																				9		R4B	
270 mm x 270 mm, NEMA, grounded																				9		R5C	
<b>Accessories</b>																							
Refer to table »Optional accessories« on page 110																							Z

## Ratings and specifications

### Electrical characteristics – phase arresters

Highest voltage of the system $U_s$ kV	Rated voltage $U_r$ kV	Continuous operating voltage $U_c$ kV	Line discharge class LD Class	Long duration current 2ms A	Maximum values of the residual voltages at discharge currents of the following impulses								Arrester type	Minimum housing size
					30/60 $\mu$ s 0.5 kA kV	30/60 $\mu$ s 1 kA kV	30/60 $\mu$ s 2 kA kV	8/20 $\mu$ s 5 kA kV	8/20 $\mu$ s 10 kA kV	8/20 $\mu$ s 20 kA kV	8/20 $\mu$ s 40 kA kV			
					420	336	269	4	1600	626	641	672		
	336	269	5	2000	627	646	665	714	756	824	900	3EQ3 336 - 4 P . 5 . - ....	2xL	
	360	288	4	1600	671	687	720	778	828	911	994	3EQ3 360 - 3 P . 4 . - ....	2xM	
	360	288	5	2000	672	693	713	765	810	883	964	3EQ3 360 - 4 P . 5 . - ....	2xM	
550	420	336	4	1600	782	802	840	908	966	1063	1159	3EQ3 420 - 3 P . 4 . - ....	2xS	
	420	336	5	2000	784	808	832	893	945	1030	1125	3EQ3 420 - 4 P . 5 . - ....	2xS	
	420	336	5	3200	759	777	804	858	903	975	1066	3EQ3 420 - 5 P . 5 . - ....	2xS	
	444	355	4	1600	827	848	888	960	1021	1123	1225	3EQ3 444 - 3 P . 4 . - ....	2xT	
	444	355	5	2000	829	854	879	944	999	1089	1189	3EQ3 444 - 4 P . 5 . - ....	2xT	
	444	355	5	3200	802	821	850	907	955	1031	1126	3EQ3 444 - 5 P . 5 . - ....	2xS	
800	580	464	5	2000	1083	1116	1148	1233	1305	1422	1553	3EQ3 580 - 4 P . 5 . - ....	3xT	
	580	464	5	3200	1047	1072	1110	1185	1247	1347	1471	3EQ3 580 - 5 P . 5 . - ....	3xS	
	588	470	5	2000	1098	1131	1164	1250	1323	1442	1574	3EQ3 588 - 4 P . 5 . - ....	3xT	
	588	470	5	3200	1062	1087	1125	1201	1264	1365	1492	3EQ3 588 - 5 P . 5 . - ....	3xS	
	597	478	5	2000	1115	1148	1182	1269	1343	1464	1598	3EQ3 597 - 4 P . 5 . - ....	3xT	
	597	478	5	3200	1078	1104	1142	1219	1284	1386	1515	3EQ3 597 - 5 P . 5 . - ....	3xS	
	612	490	5	2000	1143	1177	1212	1301	1377	1501	1639	3EQ3 612 - 4 P . 5 . - ....	3xU	
	612	490	5	3200	1105	1132	1171	1250	1316	1421	1553	3EQ3 612 - 5 P . 5 . - ....	3xT	
	624	499	5	2000	1165	1200	1236	1327	1404	1530	1671	3EQ3 624 - 4 P . 5 . - ....	3xU	
	624	499	5	3200	1127	1154	1194	1275	1342	1449	1583	3EQ3 624 - 5 P . 5 . - ....	3xU	

### Mechanical characteristics

Housing size	Height [H] mm	Creepage distance mm	Housing insulation			Specified short-term load SSL N	Specified long-term load SLL N	Grading ring diameter [D] mm	Maximum weight of arrester kg	Flashover distance mm	Arrester type	Figure
			Lightning impulse withstand voltage 1.2/50 $\mu$ s kV	Switching impulse withstand voltage 250 $\mu$ s/ 2500 $\mu$ s, wet kV	Power frequency withstand voltage 1 min., wet kV							
2xL	3400	9790	1566	1134	729	12350	8640	1200	261	2100	3EQ3... - .. L . 2 - ....	A
2xM	3600	10540	1682	1218	783	11660	8160	1200	272	2295	3EQ3... - .. M . 2 - ....	A
2xN	3800	11300	1798	1302	837	11050	7730	1200	277	2495	3EQ3... - .. N . 2 - ....	A
2xS	4600	14300	1891	1369	880	9130	6390	1800	350	2940	3EQ3... - .. S . 2 - ....	A
2xT	4800	15060	2007	1453	934	8750	6120	1800	358	3135	3EQ3... - .. T . 2 - ....	A
3xS	6900	21450	2836	2054	1320	6080	4260	2200	513	4780	3EQ3... - .. S . 3 - ....	B
3xT	7200	22590	3010	2180	1401	5830	4080	2200	526	5000	3EQ3... - .. T . 3 - ....	B
3xU	7500	23700	3184	2306	1482	5600	3920	2650	538	5230	3EQ3... - .. U . 3 - ....	B

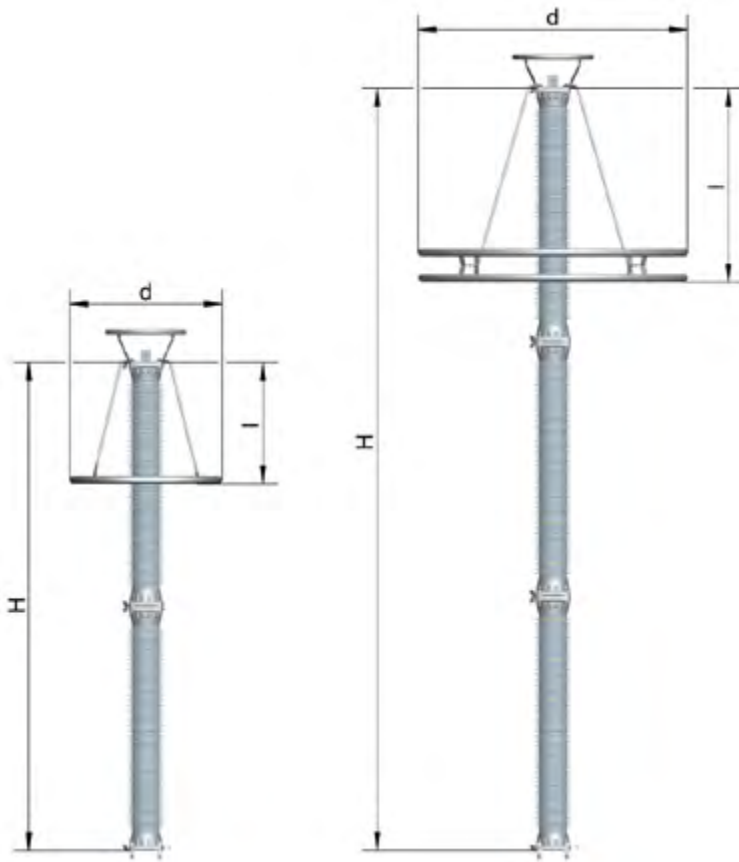
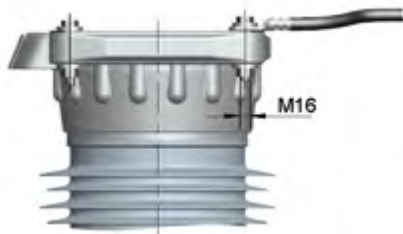


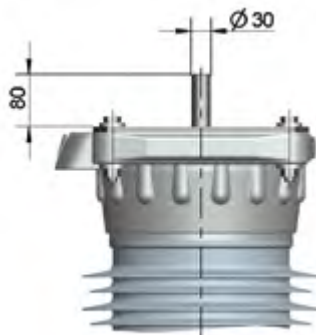
Figure A

Figure B

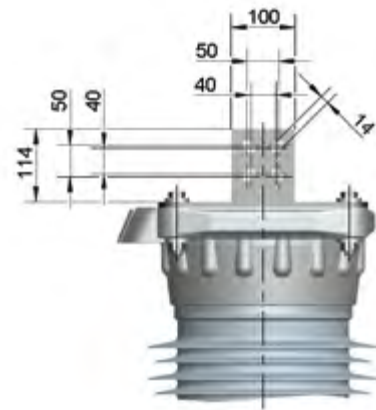
Line terminals



**Plate**  
3EQ3 .....-A...

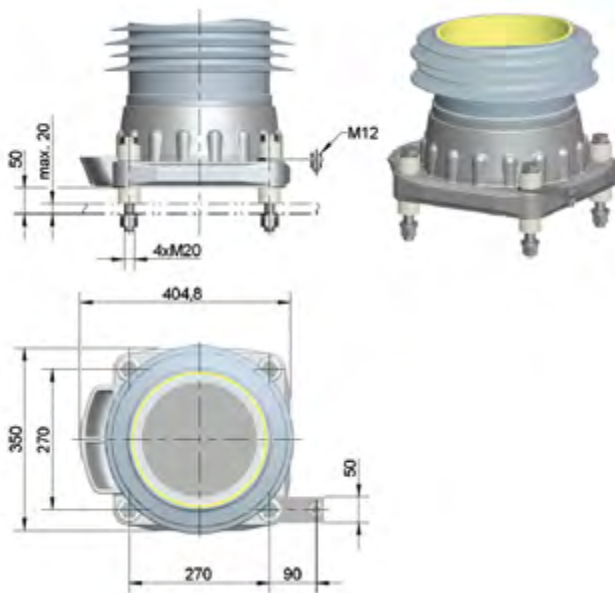


**Bolt**  
3EQ3 .....-D..

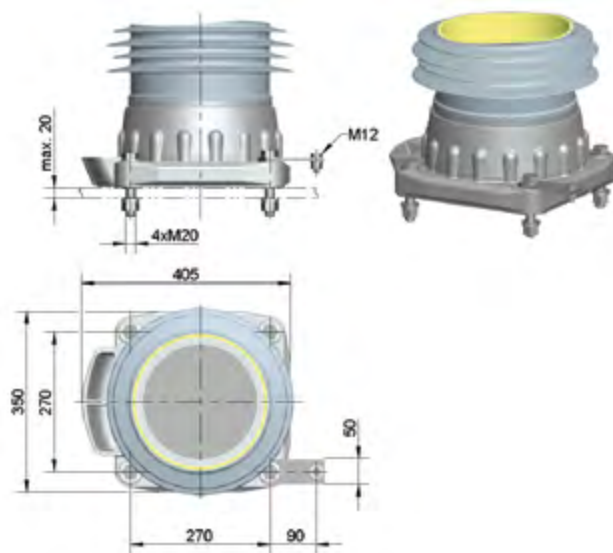


**DIN/NEMA flat terminal**  
3EQ3 .....-R.. (copper)  
3EQ3 .....-T.. (aluminum)  
3EQ3 .....-X.. (hot dip galvanized)  
3EQ3 .....-Y.. (stainless steel)

Mounting

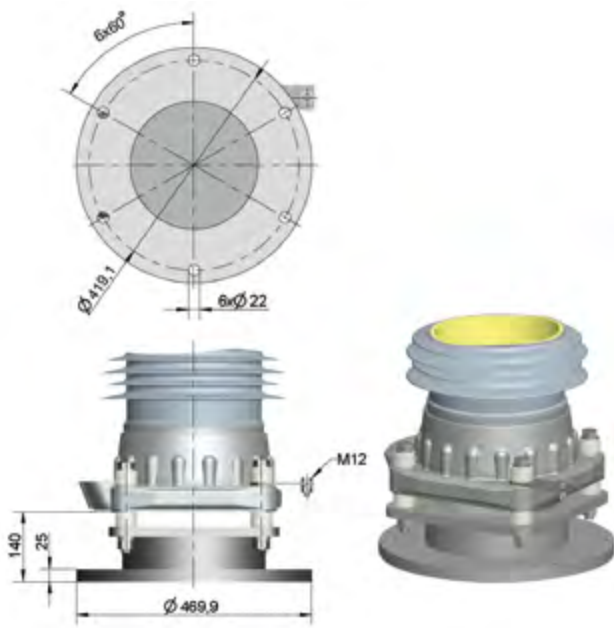


**Insulated**  
3EQ3 .....-1



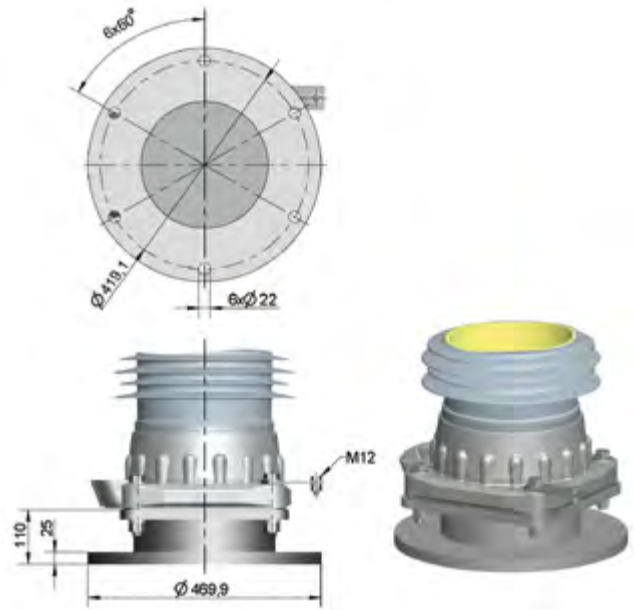
**Grounded**  
3EQ3 .....-0

Mounting



Insulated

3EQ3 .....8



Grounded

3EQ3.....6



# Accessories and monitoring

Accessories for surge arresters

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Monitoring devices for surge arresters

## Accessories for surge arresters

Siemens Energy surge arresters can optionally be equipped with one or more accessories, which are listed in the table below. The selected code for the accessory should be added to the order number of the surge arrester. Example: 3EL2 096-2PJ31-4XA1-Z D91.

Accessories	Code	3EL5	3EL1	3EL2	3EL3	3EP5	3EP4	3EP6	3EP3	3EQ1	3EQ4	3EQ3
Earth terminal, copper tin-plated	D51		■	■	■	■	■	■	■	■	■	
DIN/NEMA earth terminal	D71			■			■			■	■	
Adapter DIN/NEMA to double DIN flat terminal, including 2 line clamps	D81		■	■			■			■	■	
Adapter DIN/NEMA to double NEMA flat terminal, including 2 line clamps	D82		■	■			■			■	■	
Line clamp	D91	■	■	■	■	■	■	■	■	■	■	■
Eyebolt earth terminal	D92	■	■	■	■	■	■	■	■	■	■	■
NEMA earth terminal, stainless steel	D93	■	■	■	■	■	■	■	■	■	■	
NEMA earth terminal, copper	D94	■	■	■	■	■	■	■	■	■	■	
Palm earth terminal, aluminum	D95		■	■		■	■		■	■	■	
Earth terminal, 2x D14, stainless steel	D96								■		■	■
N <sub>2</sub> filling	K02					■	■	■	■	■	■	■
Yellow cover panels for gas diverter	K14						■	■	■	■	■	■
Increased rated short-circuit current of 80 kA	K80										■	

Optional accessories

## Monitoring devices for surge arresters

Surge arresters are highly reliable components in power transmission and distribution systems. When operated in accordance with their specifications, their service life can span as much as 30 years without any maintenance. Nevertheless, overloads may sometimes occur that can cause arrester failure and even endanger the safety of the network.

Monitors assist in the early detection of relevant changes and support security of supply on a whole new level.

Siemens Energy offers a complete line of monitoring devices with a variety of innovative functionalities that can be perfectly matched to the customer's requirements, ensuring that impending faults will be detected as early as possible and before the security of supply is compromised.

### Based on solid experience

Siemens Energy has over 85 years of experience with surge arresters – a solid foundation on which to build a comprehensive range of monitors that are precisely tailored to today's surge arrester technology. Siemens Energy's line of surge arrester monitors ranges from simple counters and condition indicators to periodic analytic condition monitoring and a future live condition monitoring system. All monitors provide the requisite information on surge arrester responses and the arrester's condition – perfectly matched to the respective voltage level, network situation, and customer requirements.

## Monitoring devices



Surge counter



Surge counter with leakage current meter



ACM Basic  
ACM Advanced



Sensor and display

Product type	Order number									
<b>Surge counter</b>	3	E	X	5		0	3	0	-	0
... with auxiliary contact	3	E	X	5		0	3	0	-	1
<b>Surge counter with leakage current meter (0–30 mA)</b>	3	E	X	5		0	5	0	-	0
... with auxiliary contact	3	E	X	5		0	5	0	-	1
<b>Surge counter with leakage current meter (0–50 mA)</b>	3	E	X	5		0	5	0	-	2
<b>Arrester Condition Monitor (ACM) basic</b>	3	E	X	5		0	8	0	-	0
<b>Arrester Condition Monitor (ACM) advanced</b>	3	E	X	5		0	8	0	-	1
... (USB wireless module)	3	E	X	5		0	8	6		
<b>Upgrade from ACM basic to ACM advanced</b>	3	E	X	5		0	8	1		
<b>Sensor</b>	3	E	X	5		0	6	0	-	1
<b>Display</b>	3	E	X	5		0	6	2	-	1
<b>Connecting lead (required for operation)</b>	3	E	X	5		9	6	3	-	
... Length 3 m.										0D
... Length 6 m.										0G
... Length 10 m.										1A
... Length 12 m.										1C
... Length 14 m.										1E
... Length 16 m.										1G
... Length 18 m.										1J
... Length 20 m.										2A
... Length 22 m.										2C
... Length 24 m.										2E
... Length 26 m.										2G
... Length 28 m.										2J
... Length 30 m.										3A
<b>Mounting bracket for surge counter</b>	3	E	X	5		9	3	0		
<b>Connection cable for monitors</b>	3	E	X	5		9	5	2		
<b>Earth lead</b>	3	E	X	5		9	5	5		

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