



NUT-091021-018

Technical Specification

for Insulators – Part 1

Part: 1.3: Composite Long-Rod Insulators for High
and Extra-High Voltage Overhead Lines

State: 17.07.08

Replaces: 30.03.05

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Technical Specification for Insulators Part 1

Insulators for High and Extra-High Voltage Overhead Lines

1.3. Composite Long-Rod Insulators

This technical specification is valid for the business units of the market units E.ON Energie and E.ON Ruhrgas and E.ON Nordic.

With this specification, technical determinations were made beyond existing publications.

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1. Area of Application

These technical conditions apply to the manufacturing, the delivery and the testing of composite long-rod insulators made of glass fibre reinforced rods and silicon rubber housing according to EN 61466-2 for high voltage and extra-high voltage overhead lines of the associated companies mentioned in the title.

These insulators are used in suspension insulator and tension insulator sets.

2. General requirements

2.1 Standards, regulations and ordinances

For the manufacturing, delivery and testing of long-rod insulators, the standards listed in Appendix A of this technical specification are valid, as far as no divergent requirements are made in this technical specification.

The respectively most current version or replacement edition of standards and regulations at the moment of delivery must be used, as well as the standards further mentioned in these.

Generally all standards, rules, regulations, provisions and laws applying in the country of the client have to be followed, even if they are not specifically listed in this specification.

The business and communication language is the language of the client.

2.2 Manufacturing facilities

A possibly scheduled relocation to manufacturing facilities not designated in the last pre-qualification procedure of the respective contractor is noticeable and, for a running order, only admissible in case of mutual consent.

The contractor is responsible for the product, including semi-finished products.

3. Further Requirements

3.1 Manufacturing regulations/requirements

The composite long-rod insulators described in this technical specification are specified in Appendix B.

3.1.1 Rod design

The glass fibre reinforced epoxy resin rod (GRP rod) must comply with the requirements of IEC 61109. The rod must take over all mechanical properties. The surface of the rod must be even and homogenous. Inclusions of foreign matter or cavities in the material are inadmissible.

The stability of the GRP rod against hydrolysis must be ensured. Furthermore, the glass fibres must be stable against acids in order to prevent stress corrosion cracking of the GRP rod. The rod material must at least show a high voltage diffusion puncturing strength of the class HD 2 according to DIN VDE 0441-1. The composition of the epoxy resin mixture must prevent hydrolysis and acid formation.



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3.1.2 Design of the rod housing

For protection against environmental influences, UV rays, external pollution and humidity, the rod must be surrounded with an housing. The housing must be made of silicone rubber with a rated thickness of at least 3 mm. The GRP rod and the housing must obtain a permanent chemical binding. The rod housing must comply with the following minimum requirements according to DIN VDE 0441-1:

- High voltage tracking resistance class HK 2
- High voltage arc resistance of class HL 3
- High voltage diffusion puncturing strength HD 2

Furthermore, the rod housing must comply with the flammability classes V0 and HB40 according to IEC 60695-11-10.

3.1.3 Shed design

Shed design must comply with IEC 60815-1. The requirements with respect to high voltage tracking resistance, high voltage arc resistance, high voltage diffusion puncturing strength and flammability classes must be complied with according to 3.1.2.

If the required creeping path is obtained by pushing on the corresponding number of silicone rubber sheds, parts of the insulating body, i. e. GRP rod, housing and sheds, must be joined to each other by vulcanisation or by equivalent methods which obtain a permanent chemical bonding. In every case, a permanently damp-proof bonding between shed and GRP silicone housing is necessary.

If the complete housing is realised with an injection moulding procedure, it should be performed in one single step. If a moulding process in several steps is necessary it must be agreed separately between client and contractor. In no case bubbles and residual tensions in the burrs are allowed. The surface seam must be smooth; burrs must be removed completely.

3.1.4 Design and fastening of the end fittings

The end fittings and the connection dimensions of the end fittings must correspond to EN 61466-1. The centre lines of the cap bores may be twisted against each other by a maximum of 4°. The end fittings are crimped onto the GRP rod.

An appropriate design, or sealing materials, must ensure that humidity cannot enter between housing, GRP rod and end fitting. The proof for this is described in 4.2.1.6.

The contractor must prove the quality of the end fittings by means of incoming inspection protocols. These must be forwarded to the client on request with the insulator test protocols. In every case, the two end fittings to be installed to the insulator must be from the same manufacturer and of the same design (e. g. socket caps C19L).

The constructive height of the end fittings is defined in Appendix B of this technical specification for each insulator type. The constructive length is measured from the centre of the bore to the cap edge. Constructive length values deviating from this must be agreed separately between client and contractor.

The bores in the end fittings for the corresponding bolts are determined for all insulator types in the table of item 3.1.7 (insulator designation e. g. CS 160 **C19L**...).



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As far as required in the Appendix B of this technical specification arcing protection device has to be fitted on the end fittings of the insulator.

3.1.5 Tolerances

The dimensions of the insulator and its individual parts generally must correspond to the tolerances according to IEC 61109. However, the length tolerance of the insulator must not exceed +/- 10 mm of the nominal overall length. The measuring of the length must be performed with a measuring device with fixed length, to be appropriate with respect to the accuracy to be obtained. The nominal creepage distance must not fall short of more than 1 %.

3.1.6 Identification

The identification of the insulator must only be applied on the first shed, by means of laser engraving or casting-in. Subsequently, the engraving, or the cast-in label must be coloured. The identification of all insulators must have a font size of approximately 8 mm and a line thickness and engraving depth of approximately 0.5 mm, and it must include the following indications:

- Manufacturer/Company logo
- Rod diameter
- Manufacturing date (Day/Month/Year)
- Amount of sheds
- Specified mechanical failing load.

Identification by adhesive labels or printing is inadmissible. Furthermore, the end fittings must be permanently identified with the sign of the fitting manufacturer.

3.1.7 Specified mechanical failure load (SML) and routine test load (RTL)

The following mechanic routine test load and specified mechanical failing loads must be complied with for all long-rod insulators:

U _N [kV]	Insulator designation acc. to EN 61466-2	Insulator designation in the specification	Specified mechanical failing load (SML) [kN]	Routine test load (RTL) [kN]
110-132	CS 120 C19L-550/2460	CS 120 C19L-550/2460/1270	120	96
110-132	CS 120 C19L-550/3820	CS 120 C19L-550/3820/1270	120	96
110-132	CS 120 T22L-550/2460	CS 120 T22L-550/2460/1295	120	96
110-132	CS 120 T22L-550/2460	CS 120 T22L-550/2460/1295 (R) *	120	96
110-132	CS 120 T22L-550/3820	CS 120 T22L-550/3820/1300	120	96
110-132	CS 160 C19L-550/2460	CS 160 C19L-550/2460/1270	160	128
110-132	CS 160 T22L-550/2460	CS 160 T22L-550/2460/1300	160	128

* (R) – end fittings 90° rotated



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3.2 Materials

3.2.1 GRP rod

The GRP rod must be made of hot setting glass fibre reinforced epoxy resin. The glass must be electrically and chemically stable (ECR glass). The glass transition temperature (point of inflexion) according to chapter 2.11 of the CIGRE report WG D1.14 must be at least 15 K above the highest application temperature. Within this specification, a highest application temperature of 90°C can be assumed. This must be ensured by a respectively high glass transition temperature.

3.2.2 Rod housing and sheds

The rod housing must be silicone rubber (HTV or LSR). The siloxane content must be minimum 30 % according to DIN 53621. RTV and EPDM are inadmissible.

3.2.3 End fittings

The fittings must be of forged tempering steel. The hot-dip galvanising of the end fittings must conform EN ISO 1461. The steel quality must be as a minimum C 45 according to EN 10083-2.

4. Approval and testing

4.1 Quality control

The contractor has to provide proof of an integrated quality control system according to EN ISO 9001, which guarantees a continuous assurance of the unchanging product properties as requested by the client and agreed upon by the contractor.

4.2 Testing

Routine and sample tests must be performed in order to ensure continuous quality monitoring. As far as not required differently in the following, these tests must be performed according to IEC 61109.

4.2.1 Design test

The contractor must prove the design test according to item 5 of IEC 61109. Furthermore, the following criteria must be met.

4.2.1.1 Flammability test

The sample and the test procedure must correspond to EN 60695-11-10. Material thickness must be 3 mm. The flammability classes HB40 and V0 must be proven.

4.2.1.2 Hydrolysis resistance proof

The rod material must be resistant against hydrolysis; this must be proven with the test described in item 5.4.2 of IEC 61109.



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4.2.1.3 Ultraviolet resistance proof

The test described in item 9.3.2 of the standard EN 62217 must be performed in order to prove the ultraviolet strength of housing and sheds. Proof has to be given with the xenon arc method.

4.2.1.4 Proof of the high voltage tracking resistance, high voltage arc resistance, and high voltage diffusion puncturing strength

The tests according to DIN VDE 0441-1 must be performed in order to prove the high voltage arc resistance (HL 3), high voltage tracking resistance (HK 2) and high voltage diffusion puncturing strength (HD 2).

4.2.1.5 Proof of stability

The test described in item 9.3.1 of the standard EN 62217 must be performed in order to prove the stability of housing and sheds.

4.2.1.6 Proof of thermo mechanic strength

The thermo mechanic strength test must be performed according to item 5.1.3.2 of IEC 61109, with following supplements.

The test must be performed on 3 samples (complete insulators from running production). Each insulator must be submitted to a tensile strain of 5% of the SML at constant temperature, for 1 minute. During this time, the length values of the samples must be recorded with an accuracy of 0.5 mm. The recorded length values will serve as reference length values.

Now, the samples must be submitted to alternating temperature load with simultaneous tensile strain of at least 50% of the SML, for an overall duration of 96 hours. The lower temperature is -40°C; the upper temperature is +60°C (maximum deviation ± 5 K for both temperature values). During these 96 hours, a temperature change is initiated every 8 h. The transition time between both temperature values shall be about 4 hours, so that 4 cycles each are completed in both temperature ranges.

After this test, another length measurement must be performed for the samples, with the temperature and the load for which the reference measurement was performed. The length increase must not exceed 2 mm. The ends of all samples, including the triple point areas, must be immersed in a methine dye solution for 15 minutes. Afterwards the samples are dried, and the ends of the samples are cut off in an angle of 90° to the insulator axis and with a distance of 50 mm from the two metal caps. The cut-off ends are divided in two halves and the rod housing is removed.

The test is passed if dye has not entered anywhere.

4.2.2 Type test

For an initial order at a new contractor, the client requires a type test according to section 6 of IEC 61109 and Amendment 1, in order to test the main characteristics of the insulator. The extent to which this type test is performed must be agreed beforehand between contractor and client. If a new insulator type is used, the type test must be performed in any case. Furthermore, the following criteria must be complied with during the type tests.



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4.2.2.1 Brittle fracture strength proof and corrosion resistance proof of the rod

The test according to IEC 61109, Amendment 1, is extended by a 4th sample rod. With this rod, the resistance against brittle fracture (stress corrosion cracking) must be proven additionally by means of a 96 hours test. This proof is performed at ambient temperature by means of the subsequently described test.

An insulator from the running production or a test piece is used here. The test piece must have a length between the end fittings of at least ten times of the rod diameter. The end fittings must be identical to those used in production.

At least 150 mm of the insulator housing must be removed in the medium part of the insulator. The visible rod surface must be smoothed with a fine sand paper (grain size 180). Housing residues must be meticulously removed.

An acid container is arranged around the visible rod surface in a way that liquid can be poured easily into the container, and such that the liquid comes in contact with the rod. The size of the acid container must be adapted in a way that the GRP rod is surrounded by a liquid thickness of at least 1 cm and a liquid height of at least 4 cm. The container must be covered in order to prevent the liquid from evaporating by a value of more than 5 % of its volume during the test period.

The insulator is submitted to a permanent and static tensile strain between the metal parts. The load is increased quickly but evenly from 0 to 70 % of the SML, and then held at this value for 96 hours. Immediately after applying the load, nitric acid with a concentration of 1n (1n = 63 g HNO₃ plus 937 g water) into the acid container. The acid must not come in contact with the end fittings.

The test is passed if the rod does not fail during the 96 hours test.

4.2.2.2 Proof of the compliance of the maximum admissible field strength in the insulating parts area

It must be proven that the electric field strength of 0.45 kV/mm is not exceeded in the area of the silicone surfaces and in particular in the area of the triple point. Here, inhomogeneities must be accounted for, too. The determination of values must be performed with a calculation program basing on the finite-element method. For the calculation, the combination of the insulator with the protection fitting provided for practical use must always be considered.

4.2.3 Routine test

Routine tests must be performed according to item 8 of IEC 61109, at all composite insulators from the delivery batch of the contractor. Furthermore, the following criteria must be met.

4.2.3.1 Visual properties

Insulators not complying with the following criteria in addition to item 8.2 of IEC 61109, must be regarded as defective:

- Cracks at the dust housings and on the shed surface are inadmissible



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- Individual projections of up to 2 mm at the edge of the sheds are admissible, projections at the housing are not
- Seams from the casting process of the silicone housing in line with the insulator axis must not be present

4.2.3.2 Mechanical routine test

The mechanical routine test at composite insulators must be performed according to IEC 61109. Deviating from this, 80 % of the SML must be used as routine test load.

4.2.4 Sample test

Sample tests must be performed by the contractor according to item 7 of IEC 61109, independently from the presence of a representative of the client. Generally, for every order the client reserves the right to participate in the sample tests in factory. The sample test date must be agreed between the client and the contractor 3 weeks before delivery. Independent from a testing performed by the client in the factory of the contractor, two copies of the complete test protocols about the factory tests performed by the contractor, must always be handed to the client, generally together with the delivery of an order. These protocols must clearly state the results of the required tests as well as the comparison to the target values. During the acceptance of the fabricated insulators, all protocols on the incoming inspections of the used raw materials, as well as the production reports, must be provided on request. All batches of the used raw materials must be submitted to an incoming inspection prior to processing. Furthermore, the following criteria must be complied with during the sample tests.

4.2.4.1 Extent of sample tests

The amount of insulators E1 and E2 submitted to sample tests can be taken from IEC 61109. For calling order amounts of less than 300 units, E1=1 and E2=2 apply.

4.2.4.2 Dimension test (E1 and E2)

The specifications from item 3.1.5 and annex B of this technical specification as well as the dimension given in the data sheet must be met.

4.2.4.3 Adhesion test (E1)

The adhesion between rod and housing as well as between housing and shed can be tested by tearing off a shed from a sample rod (test quantity max. E1). Separation of the connection points housing/rod and housing/shed, respectively, may not occur.

4.2.4.4 Proof of the specified mechanical load (SML) (E1)

This test must be performed according to item 7.4 of IEC 61109. After applying SML, this load must be held for 1 minute. Subsequently, the traction power is increased until failure.

4.2.5 Acceptance/rejection

If only one insulator fails as a complete component during the sample test, a repeated test according to item 7.6 of IEC 61109, must be performed. If two or more insulators fail the sample test as complete components, the entire delivery lot must be withdrawn by the manufacturer.



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5. Documentation

The complete subject (order number, text, site) must be repeated in all written documents of the contractor. Generally, the correspondence of the contractor (order acceptance, delivery schedule, quantity changes) is directed to the corresponding orderer stated in the call for supply. Correspondence must generally be in the language of the client.

The correspondence between contractor and client with respect to acceptance tests/quality control must be carried out between the responsible technical departments.

On demand of the client, the following must be presented by the contractor:

- A valid QM certificate for the production place according to EN ISO 9001, for which the entity of certification must be accredited at the DAR or at another member entity of the EAC
- If necessary, proof of the validity of the QM certificate and the regular inspection by the certifying body
- All required product-specific documentation, proof certificates and test protocols, in two copies (see also section 4.2.4 of these technical specification)
- All records, documents and descriptions as well as indication, type and warning signs shall be executed in the language of the client. Translations have to be notarised and handed over together with original text.

6. Packaging, delivery and transport

6.1. Packaging

The long rods must be packed in stable wooden crates in order to ensure a protected transport without damages. For this, a deformation of the sheds must be avoided, too. Packing must be performed separately according to individual projects of the client. For each project, an installation instruction must be supplied with the delivery.

Furthermore, the packing of the individual long rods must be such that these cannot come in direct contact with cellulose-containing materials; biogenic alien layers with adverse effects on the hydrophobism behaviour may form under influence of humidity in the transport and storage process.

The packaging must be stable enough to allow at least two more transport processes after delivery (e. g. on the construction site or in the storage site).

All crates must be equipped with a data sheet, clearly visible from the outside, including following indications:

- Order number of the client for the call for supply
- Complete insulator designation according to item 3.1.7 of this technical specification (e. g.: CS 160 C19L-550/2460/1270)
- Quantity of insulators on the corresponding packaging unit
- Manufacturer



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6.2 Delivery and transport

The transport of the insulators must be performed in a way that damage is avoided. Shipping is performed according to orders of the client or of the calling contractor (installation company). The shipping address is included in the order or will be disclosed by the calling contractor (installation company). The addressees must be informed in time (at least 3 working days before delivery) about the scheduled delivery in order to enable exact timely matching.

Unloading of the insulators is performed by the contractor (installation company) in co-ordination with the client.

7. Disposal

With the delivery of the insulators, the manufacturer/supplier undertakes to indicate the possibilities for disposal/recycling based upon the corresponding laws, regulations and ordinances of the country of the client.



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Appendix A – List of Applicable Standards

DIN VDE 0441-1	Test of plastic insulators for operating alternate voltages above 1 kV - Material tests for outdoor insulators
EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles – Specification and test methods
ISO 9001	Quality assurance systems; model for the proof of quality assurance in design/development, production, installation and service
EN 10083-2	Steels for quenching and tempering – Part 2: Technical delivery for non alloy steels
EN 50341-1	Overhead lines of more than 45 kV AC
EN 50341-3-4	Overhead lines of more than 45 kV AC –National Normative Appendix
IEC 60815-1-2	Selection and dimensioning of high-voltage insulators for polluted conditions
IEC 60695-11-20	Fire hazard testing test flames – 500 W test flame methods
IEC 61109	Composite insulators with a nominal voltage of more than 1000 V - Concepts, test procedures and acceptance criteria
EN 61466-1	Composite string insulators for overhead lines with a nominal voltage of more than 1kV - Standardised strength classes and end fittings
EN 61466-2	Composite string insulators for overhead lines with a nominal voltage of more than 1kV - Dimensions and electrical characteristics
IEC 62217	Polymeric insulators for indoor and outdoor use with a nominal voltage greater than 1000 V – General definitions, test methods and acceptance criteria



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Appendix B – Specification of composite long-rod insulators

B-1	CS 120 C19L-550/2460/1270
B-2	CS 120 C19L-550/3820/1270
B-3	CS 120 T22L-550/2460/1295
B-4	CS 120 T22L-550/2460/1295 (R)
B-5	CS 120 T22L-550/3820/1300
B-6	CS 160 C19L-550/2460/1270
B-7	CS 160 T22L-550/2460/1300

B-1 CS 120 C19L-550/2460/1270

Sample tests as per IEC 61109

Date: _____
 Order: _____
 Quantity ordered: _____

Manufacturer: _____
 Project: _____
 Quantity inspected: E1=___ E2=___

1. Verification of dimensions (E1+E2)

Construction length:	1270 mm ± 10 mm
Amount of sheds / shape:	ca. 15 sheds / plain or under ribbed profile as per IEC 60815-1
Distance between upper shed/fitting (G):	> 45 mm
Distance between lower shed/fitting (H):	> 45 mm
Length of end fitting (E):	max. 125 mm
Shed diameter (F):	max. 135 mm
Rod diameter:	min. 22 mm
Nominal creepage distance:	2460 mm (pollution level II, 20 mm/kV acc. to EN 60071)
Flashover distance:	min. 1020 mm
Cap torsion:	max 4 °
Clevis opening:	20 mm + 2 / - 0 mm acc. to IEC 60471
Clevis hole:	20 mm – 0.2 / + 1.4 mm acc. to IEC 60471
Bar width:	10 mm + 1 / - 0 mm
Specified mechanical load (SML):	> 120 kN

2. Verification of the specified mechanical load (SML) (E1)

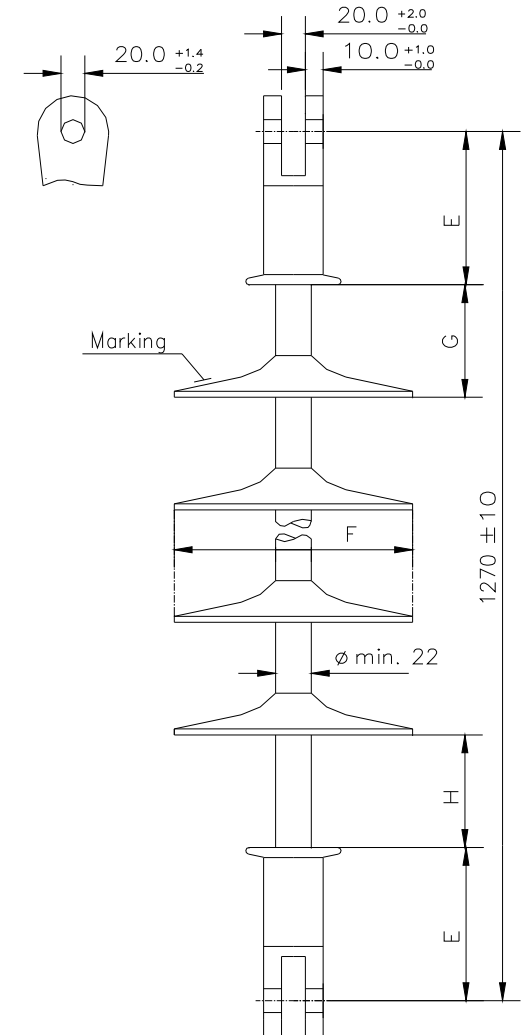
Rise until 100% SML (120 kN), hold for 1 minute, then proceed until failure (failure description/cause), acceptance criteria according to 4.2.5 of the Technical Specification

3. Zinc-plating test (samples E1+E2)

Test of the evenness of the zinc layer by layer thickness measurement (10 measurements):
 Medium value ≥ 85 µm, minimum value = 70 µm

4. Adhesion test (E1)

Tearing off a shed from a sample rod, no separation of the connection point housing/rod or housing/shed allowed.



B-2 CS 120 C19L-550/3820/1270

Sample tests as per IEC 61109

Date: _____
Order: _____
Quantity ordered: _____

Manufacturer: _____
Project: _____
Quantity inspected: E1=___ E2=___

1. Verification of dimensions (E1+E2)

Construction length:	1270 mm ± 10 mm
Amount of sheds / shape:	ca. 15 - 35 sheds / alternating or under ribbed profile as per IEC 60815-1
Distance between upper shed/fitting (G):	> 45 mm
Distance between lower shed/fitting (H):	> 45 mm
Length of end fitting (E):	max. 125 mm
Shed diameter (F):	max. 175 mm
Rod diameter:	min. 22 mm
Nominal creepage distance:	3820 mm (pollution level IV, 31 mm/kV acc. to EN 60071)
Flashover distance:	min. 1060 mm
Cap torsion:	max 4 °
Clevis opening:	20 mm + 2 / - 0 mm acc. to IEC 60471
Clevis hole:	20 mm - 0.2 / + 1.4 mm acc. to IEC 60471
Bar width:	10 mm + 1 / - 0 mm
Specified mechanical load (SML):	> 120 kN

2. Verification of the specified mechanical load (SML) (E1)

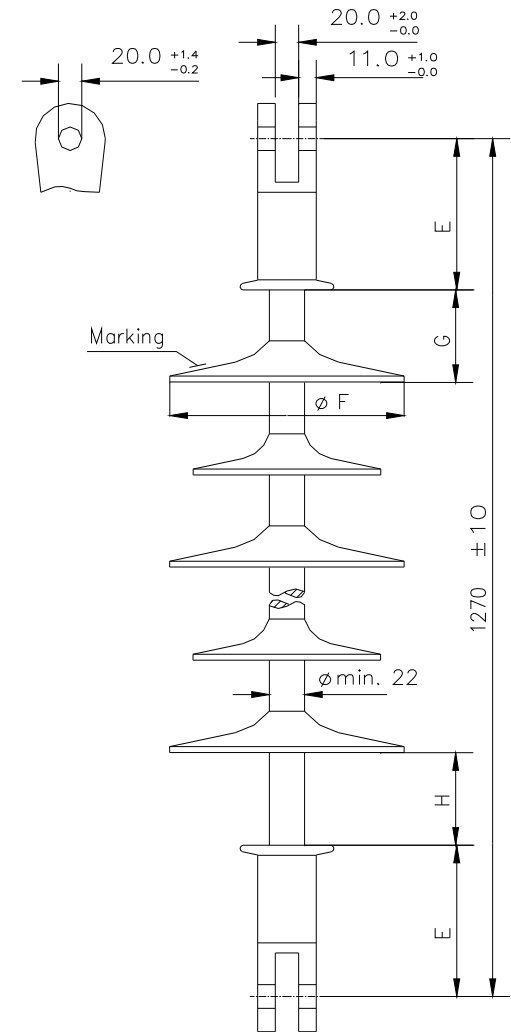
Rise until 100% SML (120 kN), hold for 1 minute, then proceed until failure (failure description/cause), acceptance criteria according to 4.2.5 of the Technical Specification

3. Zinc-plating test (samples E1+E2)

Test of the evenness of the zinc layer by layer thickness measurement (10 measurements):
Medium value ≥ 85 µm, minimum value = 70 µm

4. Adhesion test (E1)

Tearing off a shed from a sample rod, no separation of the connection point housing/rod or housing/shed allowed.



B-3 CS 120 T22L-550/2460/1295

Sample tests as per IEC 61109

Date: _____
Order: _____
Quantity ordered: _____

Manufacturer: _____
Project: _____
Quantity inspected: E1=___ E2=___

1. Verification of dimensions (E1+E2)

Construction length:	1.295 mm ± 10 mm
Length of end fitting (E):	max. 160 mm
Shed diameter (F):	max. 135 mm
Nominal creepage distance:	2460 mm
Flashover distance:	970 mm + 10 / - 0 mm (between arcing horns)
Cap torsion:	max 4 °
Tongue width:	19 mm - 1,5 / + 0,5 mm acc. to IEC 60471
Tongue hole diameter:	24 mm - 1,0 / + 0,6 mm acc. to IEC 60471
Specified mechanical load (SML):	> 120 kN

2. Verification of the specified mechanical load (SML) (E1)

Rise until 100% SML (120 kN), hold for 1 minute, then proceed until failure (failure description/cause), acceptance criteria according to 4.2.5 of the Technical Specification

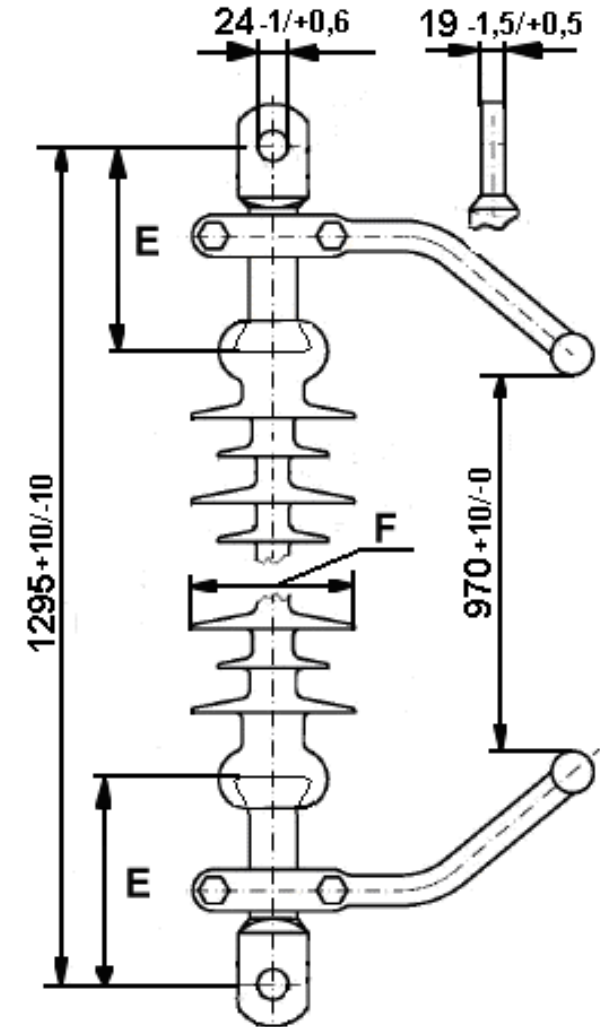
3. Zinc-plating test (samples E1+E2)

Test of the evenness of the zinc layer by layer thickness measurement (10 measurements):
Medium value ≥ 85 µm, minimum value = 70 µm

4. Adhesion test (E1)

Tearing off a shed from a sample rod, no separation of the connection point housing/rod or housing/shed allowed.

Note: The insulator always has to be delivered with arcing protection device.



B-4 CS 120 T22L-550/2460/1295 (R)
(R) – endfittings 90° rotated

Sample tests as per IEC 61109

Date: _____
Order: _____
Quantity ordered: _____

Manufacturer: _____
Project: _____
Quantity inspected: E1=___ E2=___

1. Verification of dimensions (E1+E2)

Construction length:	1.295 mm ± 10 mm
Length of end fitting (E):	max. 160 mm
Shed diameter (F):	max. 135 mm
Nominal creepage distance:	2460 mm
Flashover distance:	970 mm + 10 mm (between arcing horns)
Cap torsion:	max 4 °
Tongue width:	19 mm - 1,5 / + 0,5 mm acc. to IEC 60471
Tongue hole diameter:	24 mm - 1,0 / + 0,6 mm acc. to IEC 60471
Specified mechanical load (SML):	> 120 kN

2. Verification of the specified mechanical load (SML) (E1)

Rise until 100% SML (120 kN), hold for 1 minute, then proceed until failure (failure description/cause), acceptance criteria according to 4.2.5 of the Technical Specification

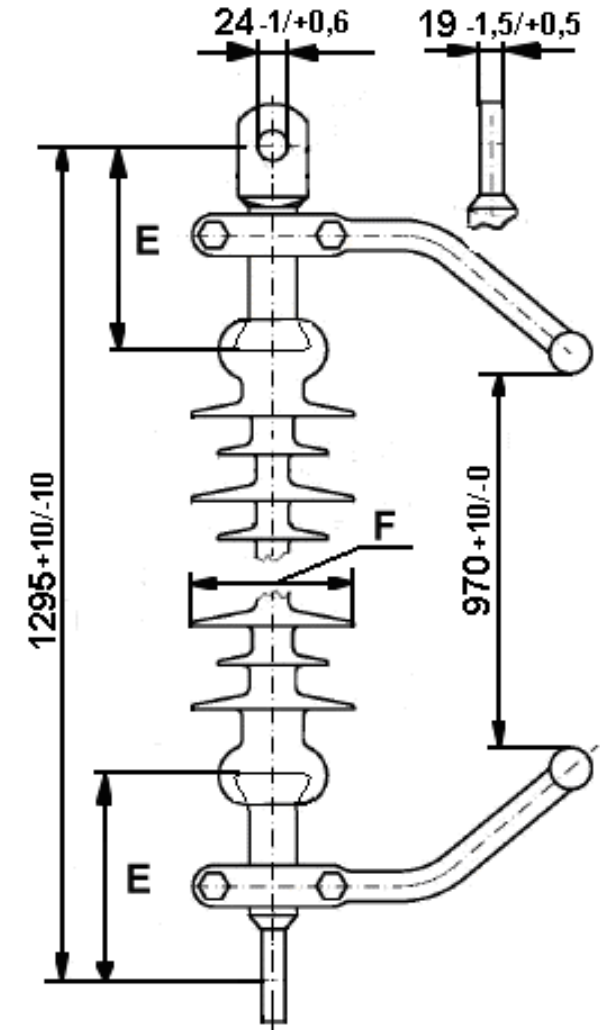
3. Zinc-plating test (samples E1+E2)

Test of the evenness of the zinc layer by layer thickness measurement (10 measurements):
Medium value ≥ 85 µm, minimum value = 70 µm

4. Adhesion test (E1)

Tearing off a shed from a sample rod, no separation of the connection point housing/rod or housing/shed allowed.

Note: The insulator always has to be delivered with arcing protection device.



B-5 CS 120 T22L-550/3820/1300

Sample tests as per IEC 61109

Date: _____
Order: _____
Quantity ordered: _____

Manufacturer: _____
Project: _____
Quantity inspected: E1=___ E2=___

1. Verification of dimensions (E1+E2)

Construction length:	1.300 mm ± 10 mm
Length of end fitting (E):	max. 160 mm
Shed diameter (F):	max. 150 mm
Nominal creepage distance:	3820 mm (pollution level IV, 31 mm/kV acc. to EN 60071)
Flashover distance:	970 mm + 10 mm (between arcing horns)
Cap torsion:	max 4 °
Tongue width:	19 mm - 1,5 / + 0,5 mm acc. to IEC 60471
Tongue hole diameter:	24 mm - 1,0 / + 0,6 mm acc. to IEC 60471
Specified mechanical load (SML):	> 120 kN

2. Verification of the specified mechanical load (SML) (E1)

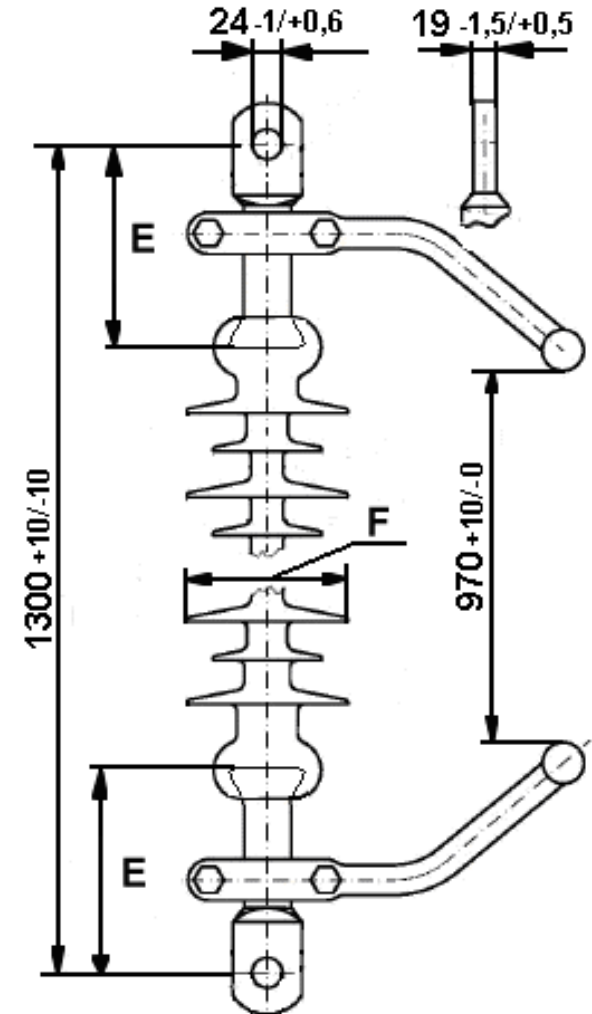
Rise until 100% SML (120 kN), hold for 1 minute, then proceed until failure (failure description/cause), acceptance criteria according to 4.2.5 of the Technical Specification

3. Zinc-plating test (samples E1+E2)

Test of the evenness of the zinc layer by layer thickness measurement (10 measurements):
Medium value ≥ 85 µm, minimum value = 70 µm

4. Adhesion test (E1)

Tearing off a shed from a sample rod, no separation of the connection point housing/rod or housing/shed allowed.



Note: The insulator always has to be delivered with arcing protection device.

B-6 CS 160 C19L-550/2460/1270

Sample tests as per IEC 61109

Date: _____
 Order: _____
 Quantity ordered: _____

Manufacturer: _____
 Project: _____
 Quantity inspected: E1=___ E2=___

1. Verification of dimensions (E1+E2)

Construction length:	1270 mm ± 10 mm
Amount of sheds / shape:	ca. 17 sheds / plain profile as per IEC 60815-1
Distance between upper shed/fitting:	> 45 mm
Distance between lower shed/fitting:	> 45 mm
Length of end fitting (E):	max. 125 mm
Shed diameter:	max. 140 mm
Rod diameter:	min. 30 mm
Nominal creepage distance:	2460 mm (pollution level II, 20 mm/kV acc. to EN 60071)
Flashover distance:	min. 1040 mm
Cap torsion:	max 4 °
Clevis opening:	20 mm + 2 / - 0 mm acc. to IEC 60471
Clevis hole:	20 mm – 0.2 / + 1.4 mm acc. to IEC 60471
Bar width:	11 mm + 1 / - 0 mm
Specified mechanical load (SML):	> 160 kN

2. Verification of the specified mechanical load (SML) (E1)

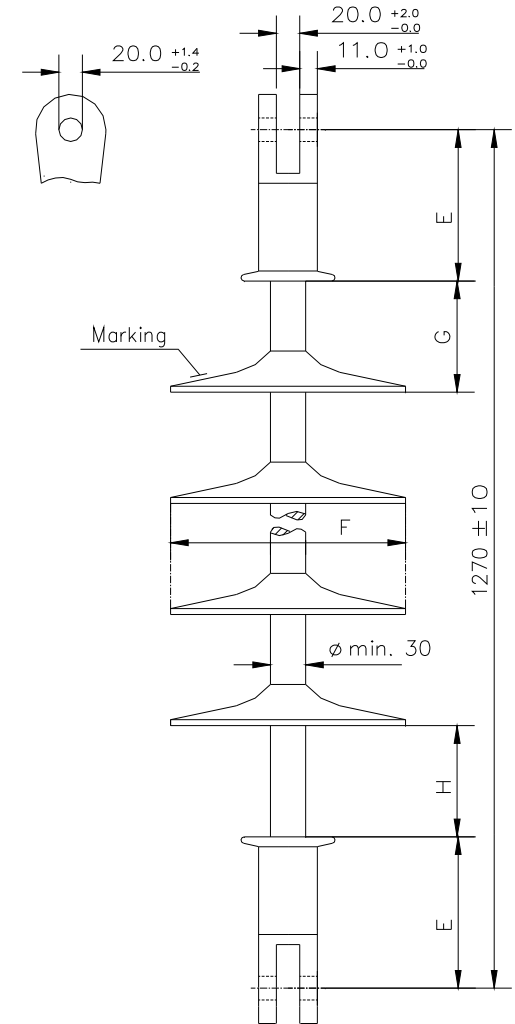
Rise until 100% SML (160 kN), hold for 1 minute, then proceed until failure (failure description/cause), acceptance criteria according to 4.2.5 of the Technical Specification

3. Zinc-plating test (samples E1+E2)

Test of the evenness of the zinc layer by layer thickness measurement (10 measurements):
 Medium value ≥ 85 µm, minimum value = 70 µm

4. Adhesion test (E1)

Tearing off a shed from a sample rod, no separation of the connection point housing/rod or housing/shed allowed.



B-7 CS 160 T22L-550/2460/1300

Sample tests as per IEC 61109

Date: _____
 Order: _____
 Quantity ordered: _____

Manufacturer: _____
 Project: _____
 Quantity inspected: E1=___ E2=___

1. Verification of dimensions (E1+E2)

Construction length:	1.300 mm ± 10 mm
Length of end fitting (E):	max. 160 mm
Shed diameter (F):	max. 140 mm
Nominal creepage distance:	2460 mm (pollution level II, 20 mm/kV acc. to EN 60071)
Flashover distance:	970 mm + 10 mm (between arcing horns)
Cap torsion:	max 4 °
Tongue width:	19 mm -1,5 / +0,5 mm
Tongue hole diameter:	24 mm -1,0 / +0,6 mm
Specified mechanical load (SML):	> 160 kN

2. Verification of the specified mechanical load (SML) (E1)

Rise until 100% SML (120 kN), hold for 1 minute, then proceed until failure (failure description/cause), acceptance criteria according to 4.2.5 of the Technical Specification

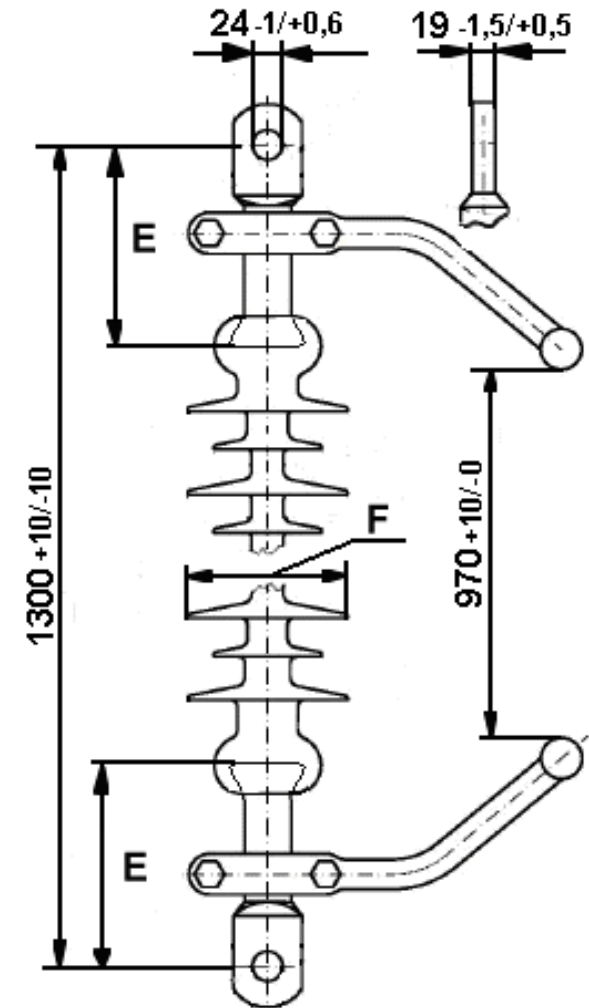
3. Zinc-plating test (samples E1+E2)

Test of the evenness of the zinc layer by layer thickness measurement (10 measurements):
 Medium value ≥ 85 µm, minimum value = 70 µm

4. Adhesion test (E1)

Tearing off a shed from a sample rod, no separation of the connection point housing/rod or housing/shed allowed.

Note: The insulator always has to be delivered with arcing protection device.





**Technical Specification
for Insulators – Part 1**

1.3: Composite Long-Rod Insulators for High and
Extra-High Voltage Overhead Lines

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Appendix C – Definitions

Business Unit

Single company within the E.ON group. It is member of a super ordinate market unit.

Charge

Quantity of products with the same characteristics which are either manufactured in a cohesive production process or purchased by a collective order.

Client

Affiliated company of the E.ON group that places orders to the contractor for the delivery of certain products.

Contractor

Company that contracts with the E.ON group for the delivery of distinctive products.

Market Unit

Super ordinate unit that is responsible for a special market within the E.ON group.

Prequalification system

System for the release of new suppliers. It consists of the following procedure steps:

1. Pre-inspection of the interested supplier using questionnaires and documents required in these.
2. Auditing of companies, products and procedures.
3. Assignment and verification of a test order.