Technical Specification

for

Insulators

Part 1

Insulators for High and Extra-High Voltage Overhead Lines

1.1 Porcelain 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 are valid for the manufacturing, the delivery and the testing of porcelain long-rod insulators according to EN 60433, DIN 48006-1 and DIN 48006-2 for high voltage and extra-high voltage overhead lines of the associated companies mentioned in the title.

This technical specification only regard insulators of class A according to EN 60383-1 (long-rod insulators), preferably 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 and requirements

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

3.1.1 Design of the insulating body

The ceramic surface of the insulating body must be brown-glazed according to DIN 40686. The colour must be RAL 8016 (brown). The shield shape is determined according to DIN 48115.

The cone of the insulating body, in the insulator cap, must show an even ascent up to its front surface and may not show sharp edges. The edges of the cone faces must be rounded and glazed as well. For this, the

outer radius must be at least as big as the inner radius of the cap. The cone surfaces must be smooth and without any elevations; scores, chatter marks, breakouts and protruding section hubs are inadmissible.

3.1.2 Design of the insulator caps and their cementing

The insulator caps must be designed in compliance with the requirements of the client according to DIN 48062-1 as socket caps or according to DIN 48062-2 as clevis caps. The design of the caps must be form B. The connecting dimensions have to correspond with the IEC 60120 for socket caps and with the IEC 60471 for clevis caps. The caps must be hot-dip galvanised according to EN ISO 1461; they must be identified with the mark of the cap manufacturer.

For clevis caps, the centres of the cap bores in an insulator may be twisted by a maximum of 4° to each other, in case of socket caps the socket opening may be twisted by a maximum of 15° to each other.

An additional element of the socket caps is the locking device according to EN 60372. The locking device must be included in every socket cap.

The insulator manufacturer must deliver proof on cap quality by means of incoming inspection protocols. These must be forwarded to client on request with the insulator inspection protocols. Only caps of the same manufacturer may be installed to one individual insulator.

A lead-antimony alloy must be used for fixing the cap. If any other material than lead-antimony is to be used, this must be approved beforehand in written form by the client. The cone surfaces of the insulator must be surrounded completely by cementing material; the front surfaces of the insulator must be surrounded by cementing material to 70% as a minimum. In order to protect the insulator cone, a soft lead disk with a thickness of approximately 3 mm must be inserted between cap bottom and cone front surface before casting. The cementing must be free from cavities in the area of the insulator cone. Lead-antimony tips protruding over the cap edge after the casting must be removed in order to obtain an even surface of the casting.

3.1.3 Length sorting

The measuring of the lengths must be performed with a measuring device with fixed length, to be appropriate with respect to the accuracy to be obtained. The insulators will be classified into three tolerance groups with respect to their length. The tolerances refer to the nominal value of the constructive length. The identification is performed by means of a coloured spot at the lower cap; the durability of this identification must be at least 5 years.

Tolerance group [%]			Colour
-3	to	-1	Red
-1	to	+1	Yellow
+1	to	+3	Blue

3.1.4 Identification

As a restriction to EN 60433, the insulator may carry identification on the upper shield. The identification of all insulators, which must have a font size of approximately 8 mm and a line thickness of approximately 1 mm, as well as a durability of more than 20 years, must include the following indications:

-Manufacturer/Company logo

-Core diameter
-Manufacturing date (week and year)
-Amount of shields
-determined mechanical failing load.

3.1.5 Determined mechanic failing load and routine test force

The following mechanic routine test forces and determined mechanic failing loads must be complied with for all long-rod insulators:

Insulator designation acc. to EN 60433	Insulator designation acc. to DIN 48006	Determined mechanic failing load [kN]	Insulator routine test force [kN] (RTL)
L 100 C19L 550/2120	LG 60/22/1200	100	80
L 100 B16 550/2120	LP 60/22/1170	100	80
L 120 B16 550/2460	LP 75/22/1230	120	96
L 160 C19L 550/2460	LG 75/22/1270	160	128
L 160 C19L 550/2950	LG 75/22s/1270	160	128
L 210 C22L 550/2460	LG 85/22/1310	210	168

3.2 Materials

3.2.1 Porcelain

The insulating body must be made of high alumina porcelain according to EN 60672-1 and 3. The material characteristics must correspond to the value interval of the subgroups of C 120 to C130.
The lower limit of the elasticity module is 85 GPa. The minimum bending strain is 1000 µm/m.

3.2.2 Caps and locking device

The caps must be manufactured referring to DIN 48062-1 and DIN 48062-2 of malleable cast iron according to EN 1562 in the specification EN-GJMB-550-4 or EN-GJMW-550-4. The hot-dip galvanising of the caps must be conform to EN ISO 1461.

The locking device for the socket caps must conform to EN 60372. The locking device has to be manufactured of a proper copper alloy or stainless steal material.

3.2.3 Cap cementing

A lead-antimony alloy PbSb-10 must be used for the cap cementing.

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 manufacturer.

4.2 Testing

Routine tests and sample tests must be performed in order to ensure continuous quality monitoring. As far as not required differently in the following, these testing must be performed according to EN 60383-1.

4.2.1 Type test

For an initial order at a new contractor, the client requires a type test according to section 6.1 and table 3 of EN 60383-1, 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.

For type tests, the client may require a 4-point bending test according to EN 60672-2. Divergently to this standard, the tests must be performed at 10 insulators of the same type from one manufacturing charge. The minimum bending strength and the static E-Module must be proven.

4.2.2 Routine test

Routine tests must be performed according to section 6.3 and table 3 of EN 60383-1 for all long-rod insulators of the contractor's delivery lot.

4.2.2.1 Visual characteristics

In addition to the standard mentioned above, glazing defects are generally inadmissible on the core and on the shed base. The overall surface of glazing defects in the shed area must not exceed the following values:

$$0{,}7 \cdot \left(100 + \frac{D \cdot F}{2.000}\right) \text{ in mm}^2$$

D - biggest diameter
F - creeping path

4.2.2.2 Mechanic routine test

I. First, an ultrasonic longitudinal and transversal test in un-reinforced state must be performed for each insulator in addition to EN 60383-1 (porosity test). The frequency range for the ultrasonic test must be between 1 and 5 MHz (guide value: sound velocity 6000 m/s). A decreased sound velocity or increased sound absorption indicate porosity, taking into account results from the ongoing fabrication.

II. During the subsequent mechanic tension test, the insulator must be loaded with the full mechanic routine test force (80% of the determined mechanic failing load over a load duration of 1 minute), and to be vibrated by means of strokes with a gum hammer onto the caps, in vertical direction to the insulator axis. This test must be repeated with a stroke direction shifted by 90°.

III. After the mechanic test, an inclined intromission of sound must be performed into both metal parts (disk rupture test); (frequency and guide value for sound velocity see I.)

4.2.3 Sample tests

Sample tests must be performed according to the requirements given in section 6.2 and table 3 of EN 60383-1, as well as according to Appendix B of this technical specification. For this, a random sample must be taken from the delivery lot. The amount of samples E1 and E2 depends on section 8.2 of EN 60383-1.

Sample tests must be performed by the contractor 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 an inspection performed by the client in the factory of the contractor, two copies of the complete inspection protocols about the factory inspections 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 inspections 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.

4.2.3.1 Testing of the specified mechanic failing load

The testing of the insulators with respect to the achievement of the specified mechanic failing load, as well as the evaluation of the tests, must be performed according to section 19 of EN 60383-1, for which all insulators to be tested must comply with the required minimum failure load.

4.2.3.2 Porosity test

Generally, the porosity test must be performed with a methine dye mixture according to the procedure described in section 5.6 of EN 60168. After previous agreement, this test can also be performed by means of ultrasound.

4.2.3.3 4-point bending test

The client may require the 4-point bending test described in 4.2.1 also in the scope of sample test; in this case, the inspection must be performed only once per year and insulator type, on a sample to be determined by the client. The 4-point bending test must be performed at 10 finished insulators of a production lot.

Furthermore, the client may require a physical-chemical material analysis of the porcelain mass, to be performed by an independent laboratory.

4.2.4 Acceptance/rejection

If only one insulator fails as a complete component during the sample test, a repeated test according to item 8.3 of EN 60383-1, 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.

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 4.2.3 of these technical specification)
- all records, documents and descriptions as well as indication, type and warning signs must 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 packaging of the individual long-rod insulators must fix the insulator in a way that slipping is impossible, and integrate the caps (long bar belts). On the pallets, the packed insulators must be grouped layer-wise with appropriate belts. The individual pallets must only be loaded with insulators of the same length tolerance class. The insulators must be arranged on the pallets in a way that the upper caps all point to the same direction. Packing must be performed separately according to individual projects of the client.

Per pallet, not more than a certain amount of insulators are to be packed.

Quantity per pallet	Insulator type
42	L100 C19L 550/2120 (LG 60/22/1200) L100 B16 550/2120 (LP 60/22/1170) L120 B16 550/2460 (LP 75/22/1230) L160 C19L 550/2460 (LG 75/22/1270)
36	L160 C19L 550/2950 (LG 75/22s/1270)
30	L210 C19L 550/2460 (LG 85/22/1310)

For other insulator types, the amount of delivered insulators per pallet must be agreed with the client.
The packaging must allow at least two more transport processes after delivery (e. g. on the construction site or in the storage site).

All pallets 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, e. g.: L 160 C19L 550/2460 in the specification LG 75/22/1270
- quantity of insulators on the corresponding pallet
- manufacturer

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.

Appendix A –List of Applicable Standards

EN ISO 1461	Hot dip galvanized coatings on fabricated iron and steel articles – Specification and test methods
EN 1562	Malleable cast irons
ISO 9001	Quality assurance systems; model for the proof of quality assurance in design/development, production, installation and service
DIN 40686	Surfaces of dense ceramic components
DIN 48006-1	Insulators for overhead lines – Part 1: Long-rod insulators LP with socket caps
DIN 48006-2	Insulators for overhead lines – Part 2: Long-rod insulators LG with clevis caps
DIN 48062-1	Socket caps for insulators
DIN 48062-2	Clevis caps for insulators
DIN 48115	Outdoor insulator sheds
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
EN 50341-3-19	Overhead lines of more than 45 kV AC –National Normative Appendix
IEC 60120	Dimensions of ball and socket couplings of string insulator units
EN 60372	Locking devices for ball and socket couplings of string insulator units – Dimensions and tests
EN 60383-1	Insulators: Testing and acceptance

EN 60433	Insulators for overhead lines with a nominal voltage above 1kV - Ceramic insulators for AC systems / characteristics
IEC 60471	Dimensions of clevis and tongue couplings of string insulator units
EN 60672	Ceramic and glass insulating materials
IEC 60815-1-2	Selection and dimensioning of high-voltage insulators for polluted conditions

Appendix B – Specification of porcelain long-rod insulators

B-1 L 100 C19L 550/2120 in the specification LG 60/22/1200

B-2 L 100 B16 550/2120 in the specification LP 60/22/1170

B-3 L 120 B16 550/2460 in the specification LP 75/22/1230

B-4 L 160 C19L 550/2460 in the specification LG 75/22/1270

B-5 L 160 C19L 550/2950 in the specification LG 75/22s/1270

B-6 L 210 C22L 550/2460 in the specification LG 85/22/1310

B-1 Type: L 100 C19L 550/2120 in the specification LG 60/22/1200 acc. to DIN 48006-2

Sample tests as per DIN EN 60383-1, string insulator, insulator class A

Date:	_____	Manufacturer:	_____
Order:	_____	Project:	_____
Quantity ordered:	_____	Quantity inspected:	E1=___ E2=___

1. Mechanic key data (samples E1+E2)

Construction length:	1,200 mm ± 36.0 mm		
Colour marking:	red	1,164.0 to 1,187.9	(-3% to - 1%)
	yellow	1,188.0 to 1,212.0	(-1% to +1%)
	blue	1,212.1 to 1,236.0	(+1% to +3%)
Number of sheds / diameter:	22 / 120 ± 6.3 mm		
Specified mechanical load:	100 kN		
Core diameter:	60 mm ± 3.9 mm	(56.1 mm to 63.9 mm)	
Nominal creepage distance:	2,120 mm		
Minimum creepage distance:	2,061 mm		
Clevis cap:	GL 60 B		DIN 48062-2
Clevis opening:	20 mm (+2 mm to –0 mm)		IEC 60471
Clevis hole:	20 mm (+1.4 mm to –0.2 mm)		IEC 60471
Bar width:	8 mm (+1 mm to –0 mm)		DIN 48062-2
Cap cementing:	Lead-antimony alloy PbSb-10		
Surface/glazing:	brown (RAL 8016)		DIN 40686

2. Inspection of variations (test samples E1+E2)

Inspection as per Section 21; one-sided axle variation 0.6%*1,115mm=6.7 mm; cap rotation max. 4°

3. Temperature cycle test (samples E1+E2)

Testing as per Section 23; cyclical immersion of the insulators in 2 different water baths with a 70 k temperature difference; duration of immersion cyclically alternating between 3 x 30 min hot and 3 x 30 min cold; bath change every 30 sec; after 3 cycles tensile test with 80% of the specified mechanical breaking load for 1 minute

4. Proof of routine test load and specified mechanical load (samples E1)

Testing as per section 19; 1 min. 80% of the specified mechanical load: 0.8 x 100 kN = 80 kN (routine test load); subsequently increase of load until failure: Acceptance criteria according to 4.2.4 of the technical specification

5. Porosity test (samples E1) by means of methine dye mixture or ultrasound

Testing as per Section 25; The porosity test must generally be performed with a methine dye mixture according to EN 60168. If agreed, an ultrasound test can also be performed, using a frequency between 1 and 5 MHz. In this case, porosity is determined by decreased sound velocity and increased sound absorption; Guide value: 6,000 m/s

6. Galvanising test (samples E1+E2)

Testing as per Section 26; Test of the evenness of the zinc layer by layer thickness measurement (10 measurements); Average value ≥ 85 µm, minimum value = 70 µm

B-2 Type: L 100 B16 550/2120 in the specification LP 60/22/1170 acc. to DIN 48006-1

Sample tests as per DIN EN 60383-1, string insulator, insulator class A

Date:	_____	Manufacturer:	_____
Order:	_____	Project:	_____
Quantity ordered:	_____	Quantity inspected:	E1=___ E2=___

1. Mechanic key data (samples E1+E2)

Construction length:	1,170 mm ± 35,3 mm	
Colour marking:	red 1,134.9 to 1,158.3 (-3% to - 1%) yellow 1,158.4 to 1,181.7 (-1% to +1%) blue 1,181.8 to 1,205.1 (+1% to +3%)	
Number of sheds / diameter:	22 / 120 ± 6.3 mm	
Specified mechanical load:	100 kN	
Core diameter:	60 mm ± 3.9 mm (56.1 mm to 63.9 mm)	
Nominal creepage distance:	2,120 mm	
Minimum creepage distance:	2,061 mm	
Socket cap:	PL 60 B	DIN 48062-1
Ball / socket conection:	16	IEC 60120
Socket opening:	19.2 mm (+1.6 mm / –0 mm)	IEC 60120
Cap cementing:	Lead-antimony alloy PbSb-10	
Surface/glazing:	brown (RAL 8016)	DIN 40686

2. Inspection of variations (test samples E1+E2)

Inspection as per Section 21; one-sided axle variation 0.6%*1,115mm=6.7 mm; cap rotation max. 15 °

3. Inspection of the safety system (test samples E2)

Inspection as per Section 22; conformity of the safety device with requirements as per EN 60372; safety inspection on the basis of a fitted pin-socket connection; performing the functional inspection for W-clips with F_{min} = 25 N / F_{max} = 250 N and Split pins with F_{min} = 50 N / F_{max} = 500 N

4. Temperature cycle test (samples E1+E2)

Testing as per Section 23; cyclical immersion of the insulators in 2 different water baths with a 70 k temperature difference; duration of immersion cyclically alternating between 3 x 30 min hot and 3 x 30 min cold; bath change every 30 sec; after 3 cycles tensile test with 80% of the specified mechanical breaking load for 1 minute

5. Proof of routine test load and specified mechanical load (samples E1)

Testing as per section 19; 1 min. 80% of the specified mechanical load: 0.8 x 100 kN = 80 kN (routine test load); subsequently increase of load until failure: Acceptance criteria according to 4.2.4 of the technical specification

6. Porosity test (samples E1) by means of methine dye mixture or ultrasound

Testing as per Section 25; the porosity test must generally be performed with a methine dye mixture according to EN 60168. If agreed, an ultrasound test can also be performed, using a frequency between 1 and 5 MHz. In this case, porosity is determined by decreased sound velocity and increased sound absorption; Guide value: 6,000 m/s

7. Galvanising test (samples E1+E2)

Testing as per Section 26; test of the evenness of the zinc layer by layer thickness measurement (10 measurements); Average value ≥ 85 µm, minimum value = 70 µm

B-3 Type: L 120 B16 550/2460 in the specification LP 75/22/1230 acc. to DIN 48006-1

Sample tests as per DIN EN 60383-1, string insulator, insulator class A

Date: _____ Manufacturer: _____
Order: _____ Project: _____
Quantity ordered: _____ Quantity inspected: E1=___ E2=___

1. Mechanic key data (samples E1+E2)

Construction length:	1,230 mm ± 36.8 mm		
Colour marking:	red	1,193.1 to 1,217.7	(-3% to - 1%)
	yellow	1,217.8 to 1,242.3	(-1% to +1%)
	blue	1,242.4 to 1,266.9	(+1% to +3%)
Number of sheds / diameter:	22 / 150 ± 7.5 mm		
Specified mechanical load:	120 kN		
Core diameter:	75 mm ± 4.5 mm	(70.5 to 79.5 mm)	
Nominal creepage distance:	2,460 mm		
Minimum creepage distance:	2,392.5 mm		
Socket:	PL 75 16 B		DIN 48062-1
Ball / socket conection:	16		IEC 60120
Socket opening:	19.2 mm (+1.6 mm / –0 mm)		IEC 60120
Cap cementing:	Lead-antimony alloy PbSb-10		
Surface/glazing:	brown (RAL 8016)		DIN 40686

2. Inspection of variations (test samples E1+E2)

Inspection as per Section 21; one-sided axle variation 0.6%*1,185mm=7.1 mm; cap rotation max. 15 °

3. Inspection of the safety system (test samples E2)

Inspection as per Section 22; conformity of the safety device with requirements as per EN 60372; safety inspection on the basis of a fitted pin-socket connection; performing the functional inspection for W-clips with F_{min} = 25 N / F_{max} = 250 N and Split pins with F_{min} = 50 N / F_{max} = 500 N

4. Temperature cycle test (samples E1+E2)

Testing as per Section 23; cyclical immersion of the insulators in 2 different water baths with a 70 k temperature difference; duration of immersion cyclically alternating between 3 x 30 min hot and 3 x 30 min cold; bath change every 30 sec; after 3 cycles tensile test with 80% of the specified mechanical breaking load for 1 minute

5. Proof of routine test load and specified mechanical load (samples E1)

Testing as per section 19; 1 min. 80% of the specified mechanical load: 0.8 x 120 kN = 96 kN (routine test load); subsequently increase of load until failure: Acceptance criteria according to 4.2.4 of the technical specification

6. Porosity test (samples E1) by means of methine dye mixture or ultrasound

Testing as per Section 25; the porosity test must generally be performed with a methine dye mixture according to EN 60168. If agreed, an ultrasound test can also be performed, using a frequency between 1 and 5 MHz. In this case, porosity is determined by decreased sound velocity and increased sound absorption; Guide value: 6,000 m/s

7. Galvanising test (samples E1+E2)

Testing as per Section 26; test of the evenness of the zinc layer by layer thickness measurement (10 measurements); Average value ≥ 85 µm, minimum value = 70 µm

B-4 Type: L 160 C19L 550/2460 in the specification LG 75/22/1270 acc. to DIN 48006-2

Sample tests as per DIN EN 60383-1, string insulator, insulator class A

Date: _____ Manufacturer: _____
Order: _____ Project: _____
Quantity ordered: _____ Quantity inspected: E1=___ E2=___

1. Mechanic key data (samples E1+E2)

Construction length:	1,270 mm ± 37.8 mm		
Colour marking:	red	1,232.2 to 1,257.2	(-3% to - 1%)
	yellow	1,257.3 to 1,282.6	(-1% to +1%)
	blue	1,282.7 to 1,307.8	(+1% to +3%)
Number of sheds / diameter:	22 / 150 ± 7.5 mm		
Specified mechanical load:	160 kN		
Core diameter:	75 mm ± 4.5 mm	(70.5 to 79.5 mm)	
Nominal creepage distance:	2,460 mm		
Minimum creepage distance:	2,392.5 mm		
Clevis cap:	GL 75 B		DIN 48062-2
Clevis opening:	20 mm (+2 mm to –0 mm)		IEC 60471
Cleves hole:	20 mm (+1.4 mm to –0.2 mm)		IEC 60471
Bar width:	11 mm (+1 mm to –0 mm)		DIN 48062-2
Cap cementing:	Lead-antimony alloy PbSb10		
Surface/glazing:	brown (RAL 8016)		DIN 40686

2. Inspection of variations (test samples E1+E2)

Inspection as per Section 21; one-sided axle variation 0.6%*1,185mm=7.1 mm; cap rotation max. 4°

3. Temperature cycle test (samples E1+E2)

Testing as per Section 23; cyclical immersion of the insulators in 2 different water baths with a 70 k temperature difference; duration of immersion cyclically alternating between 3 x 30 min hot and 3 x 30 min cold; bath change every 30 sec; after 3 cycles tensile test with 80% of the specified mechanical breaking load for 1 minute

4. Proof of routine test load and specified mechanical load (samples E1)

Testing as per section 19; 1 min. 80% of the specified mechanical load: 0.8 x 160 kN = 128 kN (routine test load); subsequently increase of load until failure: Acceptance criteria according to 4.2.4 of the technical specification

5. Porosity test (samples E1) by means of methine dye mixture or ultrasound

Testing as per Section 25; The porosity test must generally be performed with a methine dye mixture according to EN 60168. If agreed, an ultrasound test can also be performed, using a frequency between 1 and 5 MHz. In this case, porosity is determined by decreased sound velocity and increased sound absorption; Guide value: 6,000 m/s

6. Galvanising test (samples E1+E2)

Testing as per Section 26; Test of the evenness of the zinc layer by layer thickness measurement (10 measurements); Average value ≥ 85 µm, minimum value = 70 µm

B-5 Type: L 160 C19L 550/2950 in the specification LG 75/22s/1270 acc. to DIN 48006-2

Sample tests as per DIN EN 60383-1, string insulator, insulator class A

Date: _____ Manufacturer: _____
Order: _____ Project: _____
Quantity ordered: _____ Quantity inspected: E1=___ E2=___

1. Mechanic key data (samples E1+E2)

Construction length:	1,270 mm ± 37.8 mm		
Colour marking:	red	1,232.2 to 1,257.2	(-3% to - 1%)
	yellow	1,257.3 to 1,282.6	(-1% to +1%)
	blue	1,282.7 to 1,307.8	(+1% to +3%)
Number of sheds / diameter:	22 / 175 ± 8.5 mm		
Specified mechanical load:	160 kN		
Core diameter:	75 mm ± 4.5 mm	(70.5 to 79.5 mm)	
Nominal creepage distance:	2,950 mm		
Minimum creepage distance:	2,870 mm		
Clevis cap:	GL 75 B		DIN 48062-2
Clevis opening:	20 mm (+2 mm to –0 mm)		IEC 60471
Clevis hole:	20 mm (+1.4 mm to –0.2 mm)		IEC 60471
Bar width:	11 mm (+1 mm to –0 mm)		DIN 48062-2
Cap cementing:	Lead-antimony alloy PbSb-10		
Surface/glazing:	brown (RAL 8016)		DIN 40686

2. Inspection of variations (test samples E1+E2)

Inspection as per Section 21; one-sided axle variation 0.6%*1,185mm=7.1 mm; cap rotation max. 4°

3. Temperature cycle test (samples E1+E2)

Testing as per Section 23; cyclical immersion of the insulators in 2 different water baths with a 70 k temperature difference; duration of immersion cyclically alternating between 3 x 30 min hot and 3 x 30 min cold; bath change every 30 sec; after 3 cycles tensile test with 80% of the specified mechanical breaking load for 1 minute

4. Proof of routine test load and specified mechanical load (samples E1)

Testing as per section 19; 1 min. 80% of the specified mechanical load: 0.8 x 160 kN = 128 kN (routine test load); subsequently increase of load until failure: Acceptance criteria according to 4.2.4 of the technical specification

5. Porosity test (samples E1) by means of methine dye mixture or ultrasound

Testing as per Section 25; the porosity test must generally be performed with a methine dye mixture according to EN 60168. If agreed, an ultrasound test can also be performed, using a frequency between 1 and 5 MHz. In this case, porosity is determined by decreased sound velocity and increased sound absorption; Guide value: 6,000 m/s

6. Galvanising test (samples E1+E2)

Testing as per Section 26; Test of the evenness of the zinc layer by layer thickness measurement (10 measurements); Average value ≥ 85 µm, minimum value = 70 µm

B-6 Type: L 210 C22L 550/2460 in the specification LG 85/22/1310 acc. to DIN 48006-2

Sample tests as per DIN EN 60383-1, string insulator, insulator class A

Date:	_____	Manufacturer:	_____
Order:	_____	Project:	_____
Quantity ordered:	_____	Quantity inspected:	E1=___ E2=___

1. Mechanic key data (samples E1+E2)

Construction length:	1,310 mm ± 38.8 mm		
Colour marking:	red	1,270.7 to 1,296.9	(-3% to - 1%)
	yellow	1,297.0 to 1,323.1	(-1% to +1%)
	blue	1,323.2 to 1,349.3	(+1% to +3%)
Number of sheds / diameter:	22 / 160 ± 7.9 mm		
Specified mechanical load:	210 kN		
Core diameter:	85 mm ± 4.9 mm	(80.1 to 89.9 mm)	
Nominal creepage distande:	2,460 mm		
Minimum creepage distande:	2,393 mm		
Clevis cap:	GL 85 B		DIN 48062-2
Clevis opening:	20 mm (+2 mm to –0 mm)		IEC 60471
Clevis hole:	24 mm (+0.6 mm to –1.0 mm)		IEC 60471
Bar width:	15 mm (+1.5 mm to –0 mm)		DIN 48062-2
Cap cementing:	Lead-antimony alloy PbSb-10		
Surface/glazing:	brown (RAL 8016)		DIN 40686

2. Inspection of variations (test samples E1+E2)

Inspection as per Section 21; one-sided axle variation 0.6%*1,205mm=7.2 mm; cap rotation max. 4°

3. Temperature cycle test (samples E1+E2)

Testing as per Section 23; cyclical immersion of the insulators in 2 different water baths with a 70 k temperature difference; duration of immersion cyclically alternating between 3 x 30 min hot and 3 x 30 min cold; bath change every 30 sec; after 3 cycles tensile test with 80% of the specified mechanical breaking load for 1 minute

4. Proof of routine test load and specified mechanical load (samples E1)

Testing as per section 19; 1 min. 80% of the specified mechanical load: 0.8 x 210 kN = 168 kN (routine test load); subsequently increase of load until failure: Acceptance criteria according to 4.2.4 of the technical specification

5. Porosity test (samples E1) by means of methine dye mixture or ultrasound

Testing as per Section 25; the porosity test must generally be performed with a methine dye mixture according to EN 60168. If agreed, an ultrasound test can also be performed, using a frequency between 1 and 5 MHz. In this case, porosity is determined by decreased sound velocity and increased sound absorption; Guide value: 6,000 m/s

6. Galvanising test (samples E1+E2)

Testing as per Section 26; Test of the evenness of the zinc layer by layer thickness measurement (10 measurements); Average value ≥ 85 µm, minimum value = 70 µm

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.

Malleable cast iron
Malleable cast iron is a heat-treated iron-carbon alloy, which solidifies in the as-cast condition with a graphite-free structure, i.e. the total carbon content is present in the cementite form (Fe3C). Two groups of malleable cast iron are specified, differentiated by chemical composition, temperature and time cycles of the annealing process, the annealing atmosphere and the properties and microstructure resulting there from. These are:
- Whiteheart malleable cast iron and
- Blackheart malleable cast iron.

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.