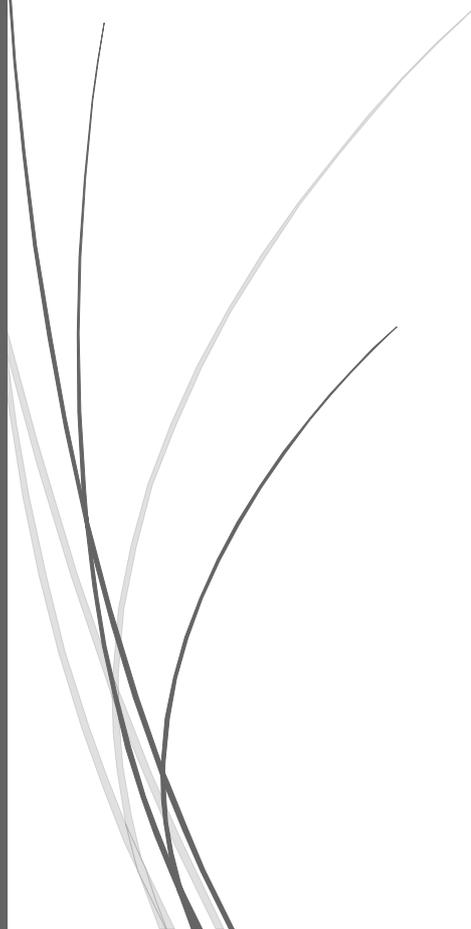




March 2021

# **Technical specification for post insulators for the Danish Railway network**



## Table of contents

1	Introduction .....	2
2	Purpose and scope .....	2
3	Technical specifications .....	2
3.1	Standards .....	2
3.2	Material and technical requirements .....	4
4	Tests .....	6
4.1	Design, Type, Sample and Routine tests.....	6
5	Documentation .....	7
5.1	Linguistic requirement for documentation .....	7
5.2	General requirement for format and formatting .....	7
5.3	Requirement for system documentation .....	8
5.4	Documentation of technical requirements .....	8
5.5	Drawings .....	9
6	Quality assurance and environmental management standards.....	10
7	Assessment of Chemicals .....	10
8	Warranty and lifetime .....	10
8.1	Warranty.....	10
8.2	Lifetime .....	10
9	Delivery .....	10
9.1	Health, Safety and Environmental requirements for delivery on-site....	11

# 1 Introduction

This document is the technical specifications of post insulators.

## 2 Purpose and scope

The technical specifications define requirements for the design, manufacturing, testing and delivery of an outdoor insulator for the Danish railway network.

## 3 Technical specifications

### 3.1 Standards

The insulators shall meet the requirements, where applicable, and be manufactured and tested according to the standards listed below:

- ❖ DS/EN 50119:2020 Railway applications – Fixed installations – Electric traction overhead contact lines
- ❖ DS/EN 50124:2017 Railway applications – Insulation coordination
  - Part 1: Basic requirements – Clearances and creepage distances for all electrical and electronic equipment
  - Part 2: Overvoltages and related protection
- ❖ DS/EN 60305:1997 Insulators for overhead lines with a nominal voltage above 1 kV – Ceramic or glass insulator units for a.c. systems – Characteristics of insulator units of the cap and pin type
- ❖ DS/EN 60433:2000 Insulators for overhead lines with a nominal voltage above 1 kV – Ceramic Insulators for a.c. systems – Characteristics of insulator units of the long rod type
- ❖ DS/EN 60672:2001 Ceramic and glass insulating materials
- ❖ DS/EN 62621:2016 Railway applications – Fixed installations – Electric traction – Specific requirements for composite insulators used for overhead contact line systems
- ❖ DS/EN ISO 1461:2009 Hot dip galvanized coatings on fabricated iron and steel articles – Specifications and test methods
- ❖ IEC 60273:1990 Characteristics of Indoor and Outdoor Post Insulators for Systems with Nominal Voltages Greater Than 1000 V
- ❖ IEC 60060-1:1989 High Voltage Test Techniques
  - Part 1: General definitions and test requirements
- ❖ DS/EN 60383:1997 Insulators for overhead lines with a nominal voltage

above 1000 V

- Part 1: Ceramic or glass insulator units for a.c. systems – Definitions, test methods and acceptance criteria
  - Part 2: Insulator strings and insulator sets for a.c. systems - Definitions, test methods and acceptance criteria
- ❖ IEC 60815:2008 Selection and dimensioning of high-voltage insulators intended for use in polluted conditions –
    - Part 1: Definitions, information and general principles
    - Part 2: Ceramic and glass insulators for a.c. systems
    - Part 3: Polymer insulators for a.c. systems
- ❖ IEC 61109:2008 Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1000 V - Definitions, test methods and acceptance criteria
- ❖ IEC 61466:
    - Part 1: 2016 Composite string insulator units for overhead lines with a nominal voltage greater than 1000 V - Standard strength classes and end fittings
    - Part 2:1998 Composite string insulator units for overhead lines with a nominal voltage greater than 1000 V - Dimensional and electrical characteristics
- ❖ IEC 61952:2008 Composite line post insulators for A.C. overhead lines with a nominal voltage greater than 1000 V - Definitions, test methods and acceptance criteria
- ❖ IEC 62217:2012 Polymeric HV insulators for indoor and outdoor use – General definitions, test methods and acceptance criteria
- ❖ IEC TS 62073: Guidance on the measurement of hydrophobicity of insulator surfaces
- ❖ IEC TR 62039: Selection guide for polymeric materials for outdoor use under HV stress

### 3.2 Material and technical requirements

The general requirements are described in the tables below.

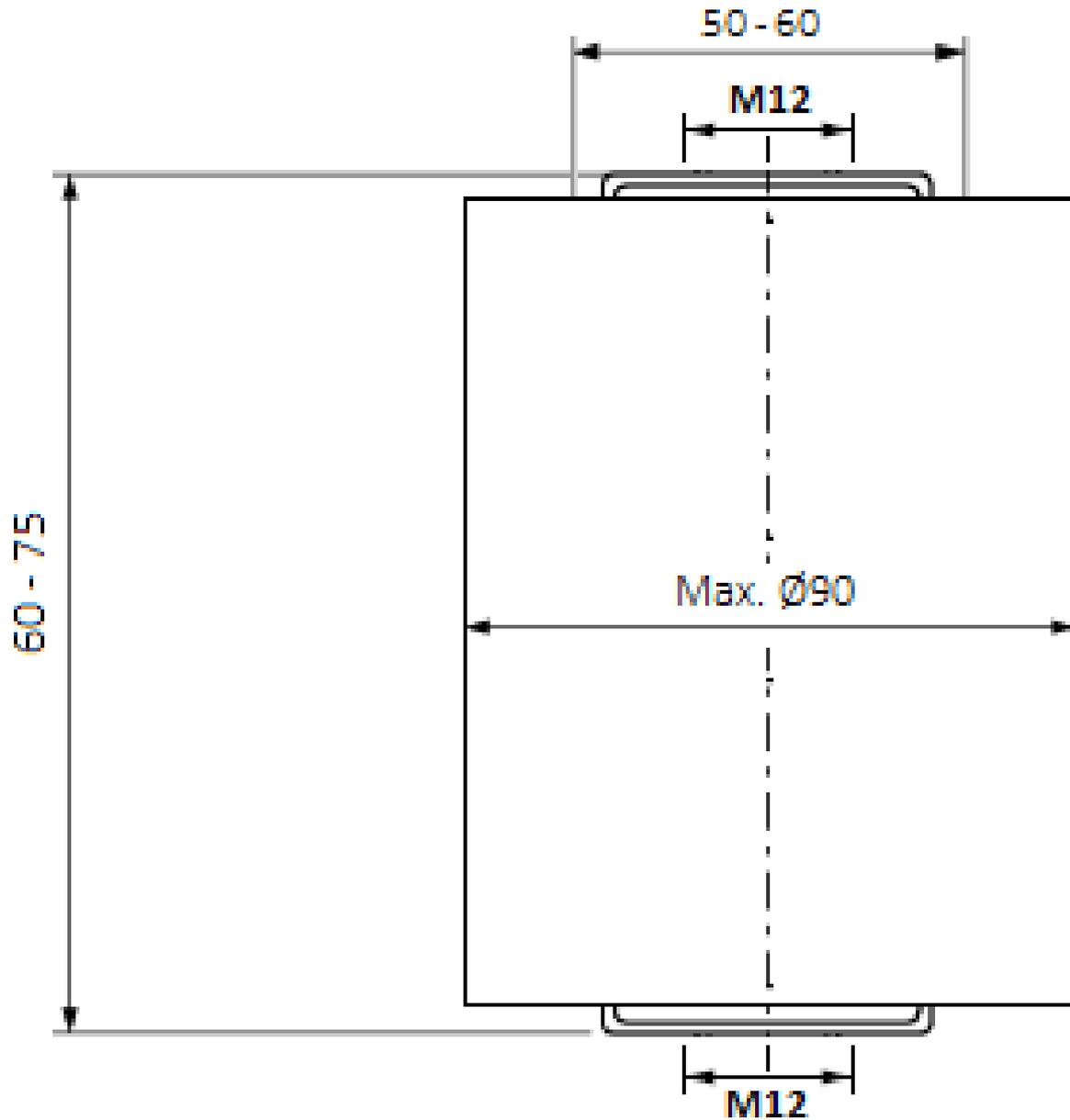
The manufacturer must document experience of having manufactured the stated insulator or equivalent types. The insulators in this document must be well known to the manufacturer. The manufacturer must prove that the solution they present, is an insulator that is already existing and is used on railway systems or similar. It must be documented with references; for how many years it has been used, where it is physically placed in the railway system or similar and in which country/ies it is used (geographical location).

The insulator is for outdoor use and are exposed to heavy pollution, ref. EN 50124, class PD4A. The insulator must be maintenance free under normal operating conditions (in free air).

Material	Requirement/Description
Material of insulator	Crosslinked Polyethylene / Composite
Color of the insulator	Grey or brown. The color must be in the manufactures standard delivery range. The manufacturer must state the equivalent RAL number.
Shed design	Should be specified in accordance with IEC 60815-3.
Corrosion protection	Corrosion protection must be provided by hot dip galvanizing. The zinc thickness must be measured by a proven method.
Identification	The insulator must be marked with a batch number, the month and year of manufacture and manufacturer name.

Technical	Requirement/Description
Nominal operating voltage	1,65-1,8 kV
Lightning impulse withstand voltage, dry	15 kV
Power frequency withstand voltage, wet	5 kV
Maximum working load	5 kN

Minimum creepage distance	105 mm
Dimensions	See drawing below
Technical standards	DS/EN 61109, 61952, 50119, 50124, 60433, 62217, 62621, 60273, 60185-3, 62073, 62039 and ISO 1461



**Figure 1** Støtteisolator – Post insulator

## 4 Tests

All tests and measurements shall be made available to the client by the manufacturer. The manufacturer is responsible for the financial costs.

Representatives from Equipotential Bonding System management of Banedanmark has the right to witness any factory (FAT<sup>1</sup>) or type test and must be informed min. 14 days prior to the event. The purpose of FAT is to ensure that the manufacturer produce insulators in accordance with the requirements set by Banedanmark.

The mechanical- and electrical tests are outlined in DS/EN 61109 and DS/EN 60383.

### 4.1 Design, Type, Sample and Routine tests

Following test shall be made:

**The design tests;** Intended to verify the suitability of the design, materials, and method of manufacture. If the manufacturer can provide a certified test report for a similar insulator, the test can be considered equivalent.

**The type tests;** Must be done to verify the main characteristics (i.e. electrical and mechanical) of the insulators. These are mainly defined by the insulators design, i.e. shape and size (dimensions).

If the manufacturer can provide a certified test report for a similar insulator with same fittings of the type in question, the test may be considered equivalent.

**The sample tests;** Must be carried out to verify the characteristics of the insulator which can vary with the manufacturing process and the quality of the component materials of the insulator. Sample tests are used as acceptance tests on a sample of insulators taken from a random lot which has met the requirements of the relevant routine tests/offered for acceptance.

**The routine tests;** Must be carried out on every insulator during the manufacturing process, with the aim to eliminate the defects units.

Each insulator must be evaluated and tested in accordance with DS/EN 61109, DS/EN 62217 and DS/EN 60383. The definitions, test methods and acceptance criteria are outlined in the above-stated standards.

These tests must be carried out on the whole insulator and the manufacturer has

---

<sup>1</sup> Factory Acceptance Test

to confirm pass of required tests with certificates and reports. It must be shown that the insulator has passed all the required tests.

## 5 Documentation

This section contains all the documentation requirements that the manufacturer must meet accordingly, in the delivery of the insulators as specified in this document.

### 5.1 Linguistic requirement for documentation

The manufacturer must always deliver the technical documentation to Banedanmark in either Danish or English.

Regarding the manufacture translating existing documentation from a language other than Danish or English, it is very important that the manufacturer ensures that the correct technical terminology used in Danish or English is used.

### 5.2 General requirement for format and formatting

This section contains Banedanmark's general requirements for technical documentation and drawings.

In the preparation of technical documentation and drawings, the manufacturer must comply with Banedanmark's general requirements for documentation. All current requirements that Banedanmark sets for the design, approval and submission can be found in the following documents and manuals. There are several templates (drawing heads, etc.) for electronic documents as well as tools and examples.

- Krav til teknisk dokumentation i Banedanmark og dertilhørende bilag. (*Requirements for technical documentation in Banedanmark and associated appendices*)  
<https://www.bane.dk/da/Leverandoer/Krav/Teknisk-Dokumentation>
  - Bilag 6 Kørestrøm 01.03.2019 (*Appendix 6 Traction current 01.03.2019*)
  - Tegningsnummerering i henhold til bilag, Kørestrøm Køreledning (*Drawing numbering according to appendix, Traction current Overhead Contact line*)
- Banedanmark's CAD Manual and associated appendices.  
[CAD | Banedanmark](#)

The manufacturer also has the option of obtaining a copy of technical drawings for a facility or track area for information. The copy drawings can be ordered by sending an email to [tekdok@bane.dk](mailto:tekdok@bane.dk) with information about professional discipline, type of facility and location.

### **5.3 Requirement for system documentation**

The system documentation contains a description of the solution that the manufacturer delivers to Banedanmark. The system description must explain how the manufacturer meets the present technical requirements and must document that the manufacturer is suitable for manufacturing insulators. Thus, it is not sufficient for the manufacturer to state that the requirements are met. The manufacturer must also argue for how they meet the requirements with appropriate evidence which can be attached as an appendix to the system description, if possible. There must be a description of the manufacturer and what experience the manufacturer has with manufacturing insulators. There must be full traceability in the system description and the technical requirements specified in this document.

The system description can be regarded as a document that binds and collects all the other documents that the manufacturer must deliver to Banedanmark, such as technical data sheets, drawings, calculations, certificates of tests and other technical documentation and descriptions. The document is prepared as a report.

### **5.4 Documentation of technical requirements**

The following documentation must be supplied for the insulator through datasheets, drawings and reports:

- Type of insulator
- Indoor or outdoor use
- Material, i.e. Glass or composite
- Insulation class acc. DS/EN 60383-1
- Corrosion class
- Pollution degree acc. To DS/EN 50124
- Min. creepage distance
- Min. clearance
- Min. failing load, tension
- Min. failing load, bending

- Max. working load
- Nominal frequency
- Highest operating voltage
- Electrical resistivity of the insulator
- Lightning impulse withstand voltage (1,2/50  $\mu$ s), dry
- Power frequency withstand voltage, 1 min.; dry, wet
- Breakdown voltage
- Arcing distance
- Max. Weight
- Insulator dimensions
- End-fitting dimensions/geometry and mechanical fastening details, i.e. holesize, hole distance, bolt size etc.
- Color
- Hydrophobicity measurement of insulator surfaces
- Lifetime
- Test reports of design, type, sample and routine tests as described in IEC 61109 and IEC 60383, for the insulator
- Technical Standards used in designing and testing the insulator
- Physical samples for visual inspection and examination of the design and quality
- Handling instructions and requirements of the installation, if any
- Labelling of all parts of the insulator in relation to the drawing material
- Time schedule for production and testing of the insulators and delivery time
- Quality Assurance system

## **5.5 Drawings**

The manufacturer must deliver detail drawings of the insulators. Dimensions and measurements must be illustrated, i.e. dimension of the insulator, end-fitting geometry, mechanical fastenings details, sizes and distances etc. Technical specifications must be listed on the drawings as well.

A drawing must be delivered as PDF-file and in a digital file format (CAD-format, i.e. DGN- or DWG format) as well.

Manufacturer must meet the format requirements as stated in section 5.2.

## **6 Quality assurance and environmental management standards**

The manufacturer must meet the following standards and be able to produce certificates recognizing this.

The environmental management standard ISO 14001.

The quality management system standard ISO 9001 or ISO 9002.

## **7 Assessment of Chemicals**

The Danish Environmental Protection Agency's ('the Danish EPA') List of Undesirable Substances (LOUS), indicates substances of concern whose use should be halted completely. LOUS is comprised of 40 chemical substances and groups of substances which have been documented as dangerous (see <https://www2.mst.dk/udgiv/publications/2011/05/978-87-92708-95-3.pdf>).

Banedanmark therefor forbids any use of above stated chemicals in the production of the insulators. When seeking substitute substances, one should, in addition to verification of technical applicability, ensure that the alternative is less harmful to health and the environment than the original substance even if the alternative does not appear in LOUS.

## **8 Warranty and lifetime**

### **8.1 Warranty**

The warranty period on the insulators shall be minimum 20 years from date of delivery.

### **8.2 Lifetime**

Lifetime expectancy of minimum 40-50 years in heavy polluted environments in Denmark.

## **9 Delivery**

Delivery will take place according to the General Terms and Conditions of the Banedanmark, i.e. directly to the construction site or the warehouse located in DK-8700 Horsens, Denmark, during normal working hours, agreed prior to shipping.

All cases /boxes must be clearly marked with content, item list, and relevant drawing numbers and as specified in the purchase orders from the Danish Railways.

See also contract and relevant attachments.

### **9.1 Health, Safety and Environmental requirements for delivery on-site**

On arrival and unloading at construction site, the driver must follow instructions and directions that will be given. These can be given in Danish or English, and the driver must be able to understand one of these two languages.

The delivery of goods is to be within the agreed timeframe, otherwise new time will have to be agreed. Any additional cost associated hereto will be for the account of the supplier.

There is a total ban on the consumption of alcohol and drugs both before arrival and during stay on site. Persons who fail to comply with this policy can be asked to do an alcohol test and will be expelled if found to be under the influence of alcohol or drugs.

Minimum Personal Protection Equipment (PPE) requirements on site are:  
High-visibility clothing of at least class 2 according to EN 471 or EN 20471,  
safety shoes and hard hat.