Specification – HV Composite Insulators

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Asset Managers	*Project Directors*
Manager Asset Services	
Manager Engineering & Project Services	

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1 SCOPE

This Specification sets out the technical (electrical and mechanical) requirements for the performance, testing and supply of high voltage insulators for the overhead transmission system only.

This specification applies to station post, line post and long rod insulators, which will be installed on 3 phase 66, 132, 220, and 330 kV transmission systems throughout the Horizon Power Network.

Approval in terms of this specification must be obtained by one or a combination of the following:

Successful completion of the appropriate tests (required by this specification) by an independent and accredited test authority.

Provision of test certificates (from an independent and accredited test authority) based upon an alternative specification, with test requirements at least equivalent to this specification.

NOTE: Verification of accreditation of the test authority must be provided by NATA (National Association of Testing Authorities) accredited test house or by a test house possessing accreditation from a NATA MRA (Mutual Recognition Agreement) partner.

2 NORMATIVE REFERENCES

2.1 Standards

2.1.1 Horizon Power Standards

[1]. *Horizon Power Environmental Conditions*, standard number HPC-9EJ-01-0001-2013, available at http://horizonpower.com.au/contractors-suppliers/contractors/manuals-and-standards/ under the 'Standards' heading.

2.1.2 Australian Standards

The following standards are available at http://www.saiglobal.com.

[2]. *AS 1154.1, Insulator and conductor fittings for overhead power lines*, Standards Australia, 2009 (R2019) Amdt 1-2020

[3]. *AS 2067, Substations and high voltage installations exceeding 1 kV a.c.*, Standards Australia, 2016

[4]. *AS 4398.1, Insulators - Ceramic or glass - Station post for indoor and outdoor use - Voltages greater than 1000 V a.c. – Characteristics,* Standards Australia, 1996 (R2016)

[5]. *AS/NZS 4680, Hot-dip galvanized (zinc) coatings on fabricated ferrous articles*, Standards Australia, 2006

[6]. *AS/NZS 7000, Overhead line design*, Standards Australia, 2016

[7]. *AS IEC 60038, Standard voltages*, Standards Australia, 2022

[8]. *AS IEC 60437, Radio interference test on high-voltage insulators*, Standards Australia, 2005 (R2016)

[9]. *AS IEC 60720, Characteristics of line post insulators* (Ceramic), Standards Australia, 2007 (R2018)

[10]. *AS 61109, Insulators for overhead lines - Composite suspension and tension insulators for a.c. systems with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria,* Standards Australia, 2020

[11]. *AS 61466.1, Composite string insulator units for overhead lines with a nominal voltage greater than 1 000 V - Standard strength and end fittings,* Standards Australia, 2020

[12]. *AS 61952, Insulators for overhead lines - Composite line post insulators for a.c. systems with a nominal voltage greater than 1 000 V - Definitions, test methods and acceptance criteria,* Standards Australia, 2020

[13]. *AS IEC 62217, Polymeric HV insulators for indoor and outdoor use with a nominal voltage > 1000 V - General definitions, test methods and acceptance criteria*, Standards Australia, 2021

[14]. *AS 62231, Composite station post insulators for substations with a.c. voltages > 1000 V up to 245 kV - Definitions, test methods and acceptance criteria*, Standards Australia, 2007 (R2018)

[15]. *SA TS 60815.1, Selection and dimensioning of high voltage insulators intended for use in polluted conditions – Part 1: Definitions, information and general principles,* Standards Australia, 2020

[16]. *SA TS 60815.3, Selection and dimensioning of high voltage insulators intended for use in polluted conditions – Part 3: Polymer insulators for a.c. systems,* Standards Australia, 2020

[17]. *SA TS 62073, Guidance on the measurement of hydrophobicity of insulator surfaces,* Standards Australia, 2020

2.1.3 International Standards

The following standards are available at http://www.saiglobal.com.

[18]. *IEC 60812, Analysis techniques for system reliability—Procedure for failure mode and effects analysis (FMEA)*, International Electrotechnical Committee, 2006

2.1.4 Compliance with Standards

Various Standards are referenced in this Specification. The Standards have reference to the year they were published. If over the life of the Tender the Standards change, the Vendor is required to conform to the new edition of the Standard.

Unless otherwise specified herein, the equipment shall be designed, manufactured and type and routine tested in accordance with the referenced Australian Standards, including all amendments. Where there is no Australian Standard equivalent, International Standards or Codes as defined in this Specification shall be used. The specified documents contain provisions that, through reference in the text, constitute requirements of this Specification. At the time of publication of this Specification, the editions indicated were valid. Information on currently valid national and international standards may be obtained from the Australian Standards website. http://saiglobal.com

2.2 Definitions and Abbreviations

For the purposes of this specification, definitions shall apply as in the relevant Australian Standards with the addition of a few general definitions listed below in alphabetical order.

BIL: Basic insulation level.

Cantilever Load: A load applied at the conductor position on the insulator, perpendicular to the conductor, and perpendicular to the longitudinal axis of the insulator. Commonly referred to as "bending load".

Composite Insulator: An insulator made of at least two insulating parts, namely a core and a housing equipped with metal fittings

Creepage Factor (C.F.): The ratio between the total creepage distance (*It*) of the insulator and the arcing distance (*St*) of the insulator. *It/St*.

De-lamination: The loss of bonding of fibres to the matrix.

E-Glass: Electrical glass, standard glass composition used for most glass fibres, made from the oxides of silicon, aluminium, calcium, magnesium and boron.

End fitting: Integral component or formed part of an insulator intended to connect it to a supporting structure, or to a conductor, or to an item of equipment.

Note: Where the end fitting is metallic, the term "metal fitting" is normally used.

Erosion: Irreversible and non-conducting degradation of the surface of the insulator that occurs by loss of material which can be uniform, localised or tree-shaped as defined in AS 62231 [14].

Flashover: A disruptive discharge external to the insulator, and over its surface, connecting those parts that normally have the operating voltage between them.

Note: The term "flashover" used in this part includes a flashover across the insulator surface as well as disruptive discharges by spark-over through air adjacent to the insulator.

HTV Silicon: High Temperature Vulcanised silicon rubber

Highest voltage for equipment: These shall be as defined in AS 60038 [7].

Hydrophobic: A property of a surface material that causes water to bead, rather than forming a film.

Maximum Design Cantilever Load (MDCL): The polymeric/composite line post insulator cantilever load rating, assigned by the manufacturer. It is the maximum load that can be applied to the line post insulator for 96 hours without damaging the core rod. Some manufacturers list this rating as the Rated/Reference Cantilever Load (RCL) or Working Cantilever Load (WCL). It forms the basis of the selection of post insulators according to AS 62231 [14] and AS 61952 [12].

Maximum Design Compression Load (MDCoL): Compression load level above which damage to the insulator begins to occur and that should not be exceeded in service according to AS 62231 [14].

Maximum Design Tension Load (MDTL): Tension load level above which damage to the insulator begins to occur and that should not be exceeded in service according to AS 62231 [14].

Maximum Design Torsion Load (MDToL): Torsion load level above which damage to the insulator begins to occur and that should not be exceeded in service according to AS 62231 [14].

Polymeric Insulator: Insulator whose insulating body consists of at least one organic based material. Polymeric insulators are also known as non-ceramic insulators. It includes both composites and cyclo-aliphatic epoxy resin insulator types. Coupling devices may be or not attached to the ends of the insulating body.

Note: In this document, when definition polymeric is used, it defines both composite and epoxy resin insulators, as those form the subgroup of polymeric insulators. If used separately, composite or epoxy resin terms are used to describe specific property that belongs only to that subgroup.

Power-frequency withstand voltage: A rated insulation level. The voltage is sinusoidal, with a frequency at 50 Hz, and a duration of 60 s. Unless stated otherwise this is the 'wet' withstand (as opposed to 'dry' withstand).

Puncture Distance: The shortest distance through the insulating material between those parts which normally have the operating voltage between them.

Radio Interference Voltage (RIV): Any effect on the reception of a radio signal due to an unwanted disturbance within the Radio frequency spectrum. Radio interference is primarily of concern for amplitude modulated systems (AM radio and television video signals) since other forms of modulation (such as frequency modulation (FM) used for VHF radio broadcasting and television audio signals) are generally much less affected by disturbances that emanate from overhead lines.

Routine Test Load (RTL): The RTL is the load applied to all assembled composite suspension/strain insulators during a routine mechanical test. The load applied to composite insulators that is equal to or greater than 50 percent of the insulator Specified Mechanical Load (SML) rating for at least 10 s see AS 61109 [10]. It is also considered to be the maximum continuous working load of the insulator.

Silicone Rubber: Elastomer polymer using silicone, typically polydimethylsiloxane.

Specified Cantilever Load (SCL): The composite post insulator cantilever load rating which can be withstood by the insulator when tested under prescribed conditions according to AS 62231 [14] and AS 61952 [12], specified by the manufacturer.

Specified Compression Load (SCoL): Compression loads which can be withstood by the insulator when tested under prescribed conditions according to AS 62231 [14].

Specified Failing Loads: Loads specified by manufacturer that represent the ultimate strength of a composite insulator under load according to AS 62231 [14], AS 61952 [12] and AS 61109 [10]. The strength should be verified during Mechanical Load Tests.

Specified Mechanical Load (SML): A load specified by the manufacturer that represents the ultimate strength of a composite station post or suspension/strain insulator under tension. The strength should be verified during Mechanical Load Tests, and the historical failure loads should justify the manufacturer's choice of SML. It is not the maximum working load of the insulator. See RTL. The ultimate failing load shall be higher than the SML. It forms the basis of the selection of insulators according to AS 61109 [10].

Note: The SML of an insulator may be reduced by the class of hardware used for the end fittings.

Specified Tensile Load (STL): The load specified by the manufacturer that represents the ultimate strength of a composite line post insulator under tension. The strength is verified by the same testing procedures used to determine the Specified Mechanical Load (SML) for composite suspension/strain insulators. It forms the basis of the selection of a line post insulator according to AS 61952 [12].

Specified Tension Load (STL): Tension load level which can be withstood by the insulator when tested under prescribed conditions according to AS 62231 [14].

Specified Torsion Load (SToL): Torsion load level which can be withstood by the insulator when tested under prescribed conditions according to AS 62231 [14].

Standard lighting impulse withstand voltage: A rated insulation level. The voltage is an impulse, with a front time of 1.2 µs and a time-to-half value of 50 µs.

Television Interference Voltage (TIV) (sometimes referred to as TVI): Special case of radio interference for disturbances affecting the frequency ranges used for television broadcasting (video signal).

Torsion Loads: A load applied to post insulators producing rotation about the insulators longitudinal axis creating a twisting motion.

Tracking: Irreversible degradation consisting of the formation of conductive paths starting and developing on the surface of an insulating material. These paths are conductive even under dry conditions.

ULS: Ultimate limit state.

3 REQUIREMENTS

3.1 Compliance with the Specification

Equipment offered that is found on inspection not to conform to this Specification shall be replaced by the Vendor at no cost to Horizon Power.

3.2 Environmental Conditions

The performance of equipment must meet the requirements set out in Section 4 of the *Horizon Power Environmental Conditions* [1].

3.3 General

Horizon Power standardises its HV insulators to post, strain and suspension type insulators as follows:

1) Substation Post Insulators: Insulators mounted vertically with flanged base and top ends.

2) Line Post Insulators: These are insulators which may be mounted vertically, inclined at 15˚ from the horizontal or horizontally. Line Post insulators may have either a curve, flanged or flat base and may have either a clamp-top or drop tongue end. Bases curved and flat are further categorised into bendable and ridged while clamp tops are further categorised into vertical and horizontal fittings (refer to section 3.5.2.1 for requirements). Line Post insulators differ from station post insulators in that strength is rated for both cantilever (bending) and tension.

3) Suspension Insulators (Long Rod): These are used to suspend either a conductor or line post insulator at a pole/tower crossarm or allow a conductor a significant deviation. Horizon Power uses a long rod insulator with insulator sheds with a Clevis and Eye arrangement.

4) Tension Insulators (Long Rod): These are used to terminate a conductor at tension. Horizon Power uses a long rod insulator with insulator sheds and a Ball and Socket arrangement.

3.4 Material Requirements

3.4.1 Cores of Composite/Polymeric Insulators

Cores shall be solid and made of epoxy resin, reinforced with load-bearing fibres and of even cross-section.

The core, which provides the strength, shall be made of an acid resistant glass fibre reinforced rod (FRP) of high strength. Glass fibres shall be Boron free or Boron free E-Glass and shall exhibit both high electrical integrity and high resistance to acid corrosion. The matrix of the FRP rod shall be hydrolysis resistant. The FRP rod shall be manufactured through pultrusion process and shall be void free.

End fittings shall be crimped onto the fibreglass core.

3.4.2 Sheds of Composite/Polymeric Insulators

For all composite/polymeric insulators, results of the 5000 hour ageing test or accelerated ageing test (as per Annex B of AS IEC 62217 [13]) will be required.

Shed material shall be protected from weathering and depolymerisation by hydrolysis. Polymer composites shall have a hydrophobic surface in accordance with Annex A of SA TS IEC 62073 [17], note cycloaliphatic polymers are not acceptable.

Shed material shall be of a hardness sufficient to resist bird strike. Evidence of long-term in-service use should show geographic location to demonstrate resistance to fauna.

Shed material shall be stabilised against ultraviolet radiation and stabilised against oxidation.

Shed material shall be bonded to the core by either high-temperature vulcanisation or by injection mould and shall use a method to minimise voids. Shed material shall be formed such that it overlaps the end fittings and prevents moisture ingress.

3.4.3 Adhesive Compounds

The adhesive compound used for bonding the outer sheath to the FRP rod core and to the galvanised end fittings shall not allow the ingress of moisture for the duration of the operational design life of the insulator.

Evidence confirming the adhesive and nonporous properties for the operational design life of the insulator of the compound used shall be provided by the vendor as part of their submission.

3.4.4 Insulator Ends

Metal end fittings shall meet the requirements of AS 1154.1 [2], be suitable for the specified mechanical loads and made of either; cast iron, malleable cast iron, forged steel or aluminium alloy. Ferrous fittings shall be hot dip galvanized to AS/NZS 4680 [5].

3.4.5 Corona Rings

Corona rings shall be applied to the line end of all insulators above 220 kV and on both end for insulators above 500 kV. This will prolong the life of the insulator surfaces by suppressing the effects of corona discharges.

Corona rings shall be suitable for the selected insulator type and its end fittings, and be made from aluminium alloy.

3.5 High Voltage Composite/Polymeric Insulators

The insulators shall be designed, manufactured and tested in accordance with AS IEC 62217 [13].

Composite/Polymeric insulators shall consist of a core, housing including weather sheds and sheath and metal end fittings.

The housing and sheds are the external insulating part of the insulator and shall be designed to provide the necessary creepage distance defined in Section 3.9.

The insulation material covering the core and forming the sheds shall be a minimum of 3 mm thick.

The insulator design shall ensure that the core is totally sealed and no part of the core shall be exposed during normal handling and use. System of attachment of the end fittings to the rod shall provide superior sealing performance between housing, i.e. seamless sheath and metal connection. The sealing must be moisture proof preventing ingress of water to the core.

End fittings transmit the mechanical load to the core. They shall be connected to the rod by means of a controlled compression technique. As the main duty of the end fittings is the transfer of mechanical loads to the core, the fittings should be properly attached to the core by a coaxial or hexagonal compression process which should not damage the individual fibres or crack the core. Wedge type will not be considered.

Natural ageing and natural pollution performance tests will be preferable for all insulators in comparison to the artificial aging and pollution tests of housing (tracking and erosion) described in AS IEC 62217 [13].

Required electrical performance is given in Table 1 and section 3.8.1.

3.5.1 Station Post Insulators

The station post insulator is characterized by the impulse withstand voltage levels (BIL) and specific creepage distance (SCD) in electrical terms, and with specified mechanical (bending) loads (SML) and specified tensile failing load (STL) in mechanical terms.

Station post insulators will consist of two base mount ends in accordance with Table IVA of AS 4398.1 [4].

3.5.2 Line Post Insulators

The line post insulator is characterized by the impulse withstand voltage levels (BIL) and specific creepage distance (SCD) in electrical terms, and with maximum design cantilever load (MDCL), specified cantilever (bending) failing load (SCL) in mechanical terms.

Line post insulators may consist of the following end types:

1) Base

   - a curved base type; or
   - a flanged base type; or
   - a flat base type.

2) End

   - a drop tongue-top type; or
   - a vertical clamp-top type head as outlined in Figures 4 (Type R-EC) and 6 of AS IEC 60720 [9]; or
   - a horizontal mounting clamp-top type head as outlined in Figure 5 (Type R-EH) and 6 of AS IEC 60720 [9].

3.5.2.1 Clamp Top

Clamp top dimensions shall be in accordance with Figure 6 of AS IEC 60720 [9]. Saddles shall be available in both ferrous and aluminium options whilst seat shall be ferrous. Ferrous parts shall be galvanised to AS/NZS 4680 [5].

The female threads of inserts and caps shall be coated with an anti-corrosion compound and sealed with a removable cap or plug so that the threads cannot become corroded or the grease contaminated by sand or other foreign matter.

The external surface of inserts shall be galvanized steel to AS/NZS 4680 [5] or any non-corrosive material proven not to react with galvanised steel.

3.5.3 Suspension/Tension (Long Rod) Insulators

The long rod insulator is characterized by the impulse withstand voltage levels (BIL) and specific creepage distance (SCD) in electrical terms, and with routine test load (RTL) and specified mechanical load (SML) in mechanical terms.

Long rod insulators will consist of the following end types:

- a ball and socket with dimensions in accordance with Annex A of AS 61466.1 [11]
- a clevis and eye with dimensions in accordance with Annex B of AS 61466.1 [11]

3.5.4 Braced Line Post Assembly

The braced post assembly consists of line post insulator and long rod insulator attached together in a “V” shape, with the long rod acting as a stay to the line post providing a far higher vertical load capacity. The assembly of insulators is characterized by the impulse withstand voltage levels (BIL) and specific creepage distance (SCD) in electrical terms, and with vertical load, tension load, compression load and longitudinal load in mechanical terms.

Braced line post assemblies will consist of the following:

- a line post insulator having a base and drop tongue ends, the base being either curved or flat type
- a long rod insulator having two eye ends with dimensions in accordance with Annex B of AS 61466.1 [11]

3.6 Acceptable Profiles

Insulators shall have sheds with an open aerodynamic profile and good self-cleaning properties, as well as the following properties:

- Insulator shed profile, spacing, projection and selection in respect of polluted conditions shall be in accordance with the recommendation of SA TS 60815.1 [15] and SA TS 60815.3 [16];
- Sheds shall be resistant to bird strike (biting the sheds);
- Sheds shall be strong enough to withstand the expected handling stresses. The sheds shall maintain their shape during handling, storage and in-service operation; and
- Handling, storage and precautionary installation equipment and information shall be made available for insulator products offered.

3.7 Insulator Designations and Markings

3.7.1 Station Post Insulators

There is no IEC standard way of designating composite station post insulators, therefore the method of designation for ceramic station post insulators shall be used. Composite station post insulators shall be labelled according to AS 4398.1 [4] with the following:

1) ‘C’ indicating outdoor post insulator with external metal fittings;
2) The minimum falling cantilever load in kN; and
3) The lightning withstand voltage in kVp.

An example would be C10-1050.

3.7.2 Line Post Insulators

There is no IEC standard way of designating composite line post insulators, therefore the method of designation for ceramic line post insulators shall be used. These shall be labelled with five markings according to AS IEC 60720 [9] with the following:

1) ‘R’ indicating line post insulator;
2) The minimum bending failing load in kN;
3) ‘E’ or ‘J’ indicating external or internal fixing of the metal parts;

4) ‘T’, ‘C’ or ‘H’ indicating tie-top, vertical clamp top or horizontal clamp top;
5) The lightning withstand voltage in kVp; and
6) ‘N’ or ‘L’ indicating normal or longer creepage distance.

An example would be R 12.5 ET 170 N.

3.7.3 Suspension/Tension Insulators

Composite long rod insulators shall be labelled according to AS 61466.1 [11] with the following:

1) The letters ‘CS’;
2) The specified mechanical load (tension) in kN;
3) The type and size of coupling for the upper end of the insulator:
   a) ‘B’, ‘S’, ‘T’, ‘C’, ‘Y’, or ‘E’ for ball, socket, tongue, clevis, y-clevis or eye coupling, followed by the size in mm; and
4) The type and size of coupling for the lower end of the insulator (in the same format as the upper end designation).

An example designation is CS 70 S16 B16 for a 70 kN ball-and-socket composite long rod insulator.

3.7.4 Braced Line Post Assembly

Components of the assembly shall be as per sections 3.7.2 for the line post insulator and 3.7.3 for the long rod insulator.

3.8 Electrical Requirements

3.8.1 Rated Voltages

The *Equipment* shall be suitable for use on the 66 kV, 132 kV, 220 kV and 330 kV 3-phase 50 Hz effectively earthed transmission systems.

The *Equipment* shall adhere to the following equipment basic impulse insulation levels (BIL) and power frequency withstand voltages as stipulated in Table 3.1 of AS 2067 [3] for substations and Table 3.4 of AS/NZS 7000 [6] for lines, see Table 1.

Table 1: Withstand Voltages

Nominal system voltage		**66 kV**	**132 kV**	**220 kV**	**330 kV**
Highest voltage for equipment	kV	72.5	145	245	362
Power Frequency (wet)	kV	140	275[1]	460[1]	510[1]
Station Lightning Impulse	kVp	325	650[1]	1050[1]	1175[1]

[1] Values based on existing installed *Equipment* in Horizon Power networks.

Nominal system voltage		66 kV	132 kV	220 kV	330 kV
Line Lightning Impulse	kVp	350	650	950	1175
Station Switching Impulse	kVp	N/A	N/A	N/A	950[1]
Line Switching Impulse	kVp	350	650	950	1175
RIV level @ 1.1 $U_m/\sqrt{3}$	µV	N/A	≤2500	≤2500	≤2500

3.8.2 Pollution Categories

Minimum creepage lengths for high voltage insulators shall be in accordance with Pollution Level IV (Very Heavy) in accordance with SA TS 60815.1 [15] see Table 2 below.

3.9 Mechanical Requirements

The design and manufacturing process must confirm, that the performance characteristics of the *Equipment* is not affected by changes in the ambient conditions, such as temperature or humidity, and meet forces presented during fault and environmental conditions (see Section 3.2 Environmental Conditions paying particular attention to the wind region category).

The *Equipmen*t shall be suitable for continuous connection to a power system and in line with requirements of Table 2 and sections below.

Table 1: Mechanical Requirements

Nominal system voltage		66 kV	132 kV	220 kV	330 kV
Creepage (≥31 mm/kV)	mm	≥2232	≥4495	≥7595	≥11222
Equivalent Length	mm	>770	>1500	>2300	>2650
Corona rings		N/A	N/A	Yes	Yes

Shed design shall be in accordance with sections 3.4.2, 3.6 and 3.8.

3.9.1 Substation Post Insulators

Substation post insulators are subject to bending (cantilever) loads, compression (tension) loads and torsion loads. Station post insulators are standardised by the means of specified failing load (Bending) as per Table IV of AS 4398.1 [4].

Failing Loads (bending) shall be as a minimum be equal or greater than **10 kN** for standard substation bay widths and **16 kN** for bays with increased bay widths.

Fixing ends, dimensions and type, shall be in accordance with Table IVA of AS 4398.1 [4], see section 3.5.1.

3.9.2 Line Post Insulators

Line post insulators are subject to bending (cantilever) load and/or compression (tension) load (combined loading). Torsion loads are not dealt with in this specification as they are usually negligible in the configuration in which line post insulators are generally used. Line post insulators are standardised by the means of specified failing load (Bending) as per AS IEC 60720 [9].

"Combined Load Chart" or "Working Load Diagram" which defines the insulator's mechanical strength shall be provided for horizontal mounting applications.

Maximum Design Cantilever Loads shall be determined by "Line Design Engineer", though existing networks have been designed to **14.5 kN**.

Fixing ends shall be determined by "Line Design Engineer", see section 3.5.2.

3.9.3 Suspension/Tension Insulators

Composite long rod insulators are subject to tensile load. Composite insulators are standardised by the specified mechanical load (SML) and standard couplings, as per AS 61466.1 [11] and AS 1154.1 [2].

The insulator shall be suitable for both the suspension and tension type of load and metal end fittings shall be of tongue & clevis type. End fittings shall be the galvanized steel crimped type.

Specified Mechanical Loads shall be determined by the "Line Design Engineer", though existing networks the **suspension insulators** have been designed to **160 kN**, whilst the **tension insulators** to **210 kN**.

Fixing ends, dimensions and type, shall be in accordance with AS 61466.1 [11], see section 3.5.3.

3.9.4 Braced Line Post Assembly

The braced line post assemblies are subject to vertical, tensile, compressive and longitudinal loads. Noting that the assembly is composed of line post insulators, long rod insulators and standard couplings, the assembly is thus categorised by the combine load chart provided by the manufacturer.

The maximum specified vertical, tensile, compressive and longitudinal loads shall be determined by the "Line Design Engineer", though values above 30 kN for vertical, compressive and tension loads are expected.

Standards shall align with sections 3.9.2 and 3.9.3.

3.10 Service Requirements

3.10.1 Cleaning Requirements

Vendors shall provide information of how the insulator should be cleaned, including:

1) Recommended cleaning interval for each pollution category to SA TS 60815.1 [15];
2) Allowable water pressure; and
3) Cleaning method.

3.10.2 Coating Maintenance

Where insulators will benefit by the periodic application of a silicone compound, Vendors shall provide information on:

1) The recommended silicone compound;
2) The frequency of application for each pollution category to SA TS 60815.1 [15]; and
3) The method of application.

4 PACKAGING REQUIREMENTS

The *Equipment* shall be suitably packaged, such that it is "fit for use" at any location in Horizon Power's operational area. Packaging shall be capable of preventing damage whilst in storage and during transit to remote locations. The Vendor is required to nominate standard pack quantities and standard packs shall be clearly marked with the following information:

1) Manufacturer's name;
2) Manufacturer's part reference number;
3) Batch Number;
4) Horizon Power Order Number;
5) Horizon Power Stock Number;
6) Insulator description; and
7) Package weight.

Very strong consideration shall be given to appropriate packaging provided with any *Equipment* offered under this specification, with respects to satisfying the "fit for use" criteria mentioned above.

The combined height of the pallet and equipment of a standard pack shall not exceed 1,050 mm.

Each shipment shall be provided with box labels stating the part, stock and contract number as well as the routine test reports.

Each package is to have an identifying bar code and number which identifies as a minimum the:

- Manufacturers part number;
- Manufacturer;
- Factory of manufacture; and
- Month and year of manufacture.

The bar code should be code 128 and can be applied either by spray or on a plastic tag. The bar code and number does not have to be indelible beyond installation.

Note: The vendor is required to identify the cost of providing bar coding as specified in this section separately from the other cost requirements of this specification.

5 STORAGE

The *Equipment* shall be capable of being stored without deterioration within the temperature range of -10°C to +45°C for no less than 24 months.

6 RELIABILITY

Vendors shall provide information on the reliability of the *Equipment* and the performance of the materials offered over an operational life of 50 years under the specified field of application and conditions of service.

Information provided shall evidence the claimed reliability and performance for the *Equipment* offered, including information on Failure Mode and Effect Analysis, carried out in accordance with IEC 60812 [18]. Failure modes should be described: taking cantilever mechanical failure as an example, the failure may be excessive deflection, or brittle fracture. Electrical failure may be material damage such as puncture, polymer degradation, carbonisation, loss of hydrophobicity, etc.

Vendors may offer their standard *Equipment* but any variation to the foregoing standards must be clearly stated in writing at the time of the proposal. The products offered in the standing offer should be equal to or better in quality and performance than the existing items as listed under this Specification.

7 SAFETY

Material Safety Data Sheets (MSDS) applicable for each different *Equipment* or chemical ingredient in the Equipment which is considered harmful to personnel or environment in any manner, shall be supplied with the Proposal.

8 ENVIRONMENTAL CONSIDERATIONS

Vendors are required to provide information on the environmental soundness of the design and the materials used in the manufacture of the items offered. Vendors shall provide a detailed outline of the steps that have been put in place to fulfil any obligations that may be required pursuant to the *Waste Avoidance and Resource Recovery Act 2001* and any amendments. In particular:

a) Management of waste reduction;

b) The use of re-usable packing; and

c) Extended producer responsibility for the safe disposal of materials at the end of their life.

9 TESTS

9.1 Test Requirements

The Vendor shall prior to first delivery, complete the design, type, routine, sample and special tests and inspections as required by the relevant Australian or IEC standard. For sample tests, samples shall be selected using the method described in the referenced standard.

The passing of such tests does not prejudice the right of Horizon Power to reject the insulator or fitting if it does not comply with this Specification when installed.

9.2 Test Certificates

At the time of submitting the offer on the tender, single copies of test certificates, in English, shall be provided and shall be clearly marked and contain a reference number. If all the required type test reports/certificates are not submitted the tender will be rated incomplete and may not be considered.

Electronic copies of type test certificates shall be arranged in the order set out in this Specification and shall be marked clearly with the identifier and description in the contents section. Any extra test certificates shall be marked with “extra tests” and kept separate from the required test certificates.

All test certificates shall be submitted in electronic format and shall be in Adobe Acrobat (.pdf) format.

9.3 Required Tests

Tests that shall be performed on the insulators with follow-up documentation are as follows:

- Design tests;
- Type tests;
- Routine tests; and
- Sampling tests.

All tests required by the relevant Australian or International standards shall be carried out. The requirements for these are outlined in Appendix F Test Certificates

Additionally the following optional tests shall be undertaken:

a) Radio interference voltage test (AS IEC 60437 [8]); and

b) Impulse overvoltage puncture test.

9.4 Design Tests

Composite insulators shall be design tested in accordance with AS IEC 62217 [13] and the relevant standards below in line with the environmental conditions as per section 3.2:

- Station Post insulators shall also be design tested as defined in AS 62231 [14].
- Line Post insulators shall also be design tested as defined in AS 61952 [12].
- Suspension and Tension insulators shall also be design tested as defined in AS 61109 [10].

The design tests are intended to verify the suitability of the design, materials and method of manufacture (technology). When a composite/polymeric insulator is subjected to the design tests, the results shall be considered valid for the whole class of insulators which are represented by the one tested and having the following characteristics:

a) same materials for the core, and housing and same manufacturing method;

b) same material for the end fittings, same design, and same method of attachment;

c) same or greater minimum layer thickness of the housing material over the core (including a sheath where used)*;

d) same or smaller ratio of all mechanical loads to the smallest core diameter between fittings*;

e) same or smaller ratio of the highest system voltage to insulation length*; and

f) same or greater diameter of the core.

The tested composite/polymeric insulators shall be identified by a drawing giving all the dimensions with the manufacturing tolerances. Subsequently, if there are small variations in the design data of not more than 15% for characteristics marked with *, the design tests do not need to be repeated.

Certified design test results shall be submitted with the Proposal. The Vendor shall, in their evaluation submission, state which tests the insulator/s have passed.

9.5 Type Tests

Type tests verify the main characteristics of the insulator, which depend mainly on its shape and size. Certified type test results shall be submitted with the Proposal.

- Station Post insulators shall be type tested as defined in AS 62231 [14].
- Line Post insulators shall be type tested as defined in AS 61952 [12].
- Suspension and Tension insulators shall be type tested as defined in AS 61109 [10].

In addition to this, composite insulators that use fibre rods shall be subjected to the following tests:

- Brittle fracture resistance test (as set out in clause 9.8 of this Specification);
- Electrical routine testing (as set out in clause 9.9 of this Specification); and
- Interface integrity test (as set out in clause 9.10 of this Specification).

9.5.1 Brittle Fracture Resistance Test

A brittle fracture test shall be applied to composite insulators with fibre reinforced glass core rod.

9.5.1.1 Procedure

Brittle fracture test shall be carried out on a naked rod along with end fitting by applying “1N HNO_3 acid” (63 g concentrated HNO_3 added to 937 g of water) to the rod. The rod should be held at 80% of SML for the duration of the test. Test arrangement should ensure continuous wetting of the rod with Nitric acid.

The temperature shall be held at 20°C ± 5°C for the duration of testing.

9.5.1.2 Acceptance Criteria

The rod should not fail within the 96-hour test duration, and the de-lamination of the rod should not occur.

9.5.2 Electrical Routine Testing

Electrical testing is required to confirm the integrity of the insulation across the insulator.

9.5.2.1 Procedure

Apply the nominal AC voltage between the two ends of the insulator. With the voltage applied measure the leakage current or impedance across the insulator. The test is to be conducted until an acceptable constant reading is acquired.

9.5.2.2 Acceptance Criteria

Impedance above 1000 MΩ is required or as agreed to with the manufacturer.

9.5.3 Interface Integrity

The test applies to insulator designs with an interface between the insulator housing and an insulators mechanical element. A test procedure relevant to the technology must be set up by the manufacturer as part of the manufacturing process to prove interface integrity. Testing for composite insulators is to include life cycle and fire exposure tests to ensure no debonding or permeability of the outer sheath from the FRP core or galvanised end fitting occurs. This test procedure must be submitted for technical evaluation.

9.6 Sample Tests

Insulators shall be sample tested to the relevant Australian Standard. Two percent or two insulators, whichever is the greater, shall be selected as samples for lot sizes of less than 300 insulators. For lot sizes greater than 300, the sample sizes specified in the relevant Australian Standard shall be applicable.

- Station Post insulators shall be sample tested as defined in AS 62231 [14].
- Line Post insulators shall be sample tested as defined in AS 61952 [12].
- Suspension and Tension insulators shall be sample tested as defined in AS 61109 [10].

In addition, all composite/polymeric insulators shall be subjected to an interface integrity test (refer section 9.10) and the following additional test shall be performed on composite post insulators:

9.6.1 Cantilever test

The *Equipment* shall be mounted on a fixed frame. The mechanical load shall be applied on the neck perpendicular to the axis of the insulator. The *Equipment* shall withstand 90 % of the specified failing load determined in the insulator's type test. The insulator shall be tested in 4 perpendicular directions.

9.7 Routine Tests

Routine tests are intended to eliminate defective units and shall be carried out during the manufacturing process. Routine tests shall be carried out on every insulator and should not consist of visual examination only.

- Station Post insulators shall be sample tested as defined in AS 62231 [14].
- Line Post insulators shall be sample tested as defined in AS 61952 [12].
- Suspension and Tension insulators shall be sample tested as defined in AS 61109 [10].

The Vendor shall supply duly certified copies of the routine tests performed on the insulators to Horizon Power, either prior to or upon Delivery.

10 DOCUMENTATION AND SAMPLES

10.1 Documentation to be provided with Proposals

Submitted proposals shall provide all documentation and information as requested in this specification, including any further relevant information on the *Equipment* offered. The proposal must be complete in all respects. Failure to comply may cause the proposal to be considered incomplete and hence informal.

The vendor shall provide an electronic version of all documents in Adobe Acrobat (.pdf) format containing the information detailed below with their offer:

- Any non-compliance of the Specification shall be detailed in the Technical Deviation schedule;
- All information provided in Technical Requirements shall be in English and measurement units shall be in metric units;
- Material Safety Data Sheets;
- CAD drawings (Micro station preferred DGN format) of all *Equipment* showing all critical dimensions;
- *Equipment* data sheets showing the weight, material type, protective coatings, mechanical & electrical properties (Combined Load Charts shall be included);
- Installation instructions included in the packaging; and
- A copy of the Vendor's current Quality Assurance accreditation and category.

Should the preferred vendor submit drawings for approval by Horizon Power, this will in no way exonerate it from being responsible for the correct and proper function of the *Equipment*.

10.2 Service history

Vendors shall state:

- Other Australian electricity supply authorities who have a service history of the items offered; and
- Contact details of those supply authorities who can verify the service performance claimed.

10.3 Training Materials

Training material in the form of drawings, instructions and/or audio visuals must be provided for the items accepted under the offer.

Vendors shall state the availability of training materials which could include but is not limited to the following topics:

- Handling and storage;
- Application (particularly in areas of heavy coastal pollution);
- Installation;
- Maintenance;
- Environmental performance;
- Electrical performance;
- Mechanical performance;
- Disposal at the end of service life; and
- Production process and testing.

10.4 Samples

Samples of all proposed *Equipment* types are to be provided upon request of Horizon Power as part of the submitted proposals.

APPENDIX A REVISION INFORMATION

(Informative) Horizon Power has endeavoured to provide standards of the highest quality and would appreciate notification of errors or queries.

Each Standard makes use of its own comment sheet which is maintained throughout the life of the standard, which lists all comments made by stakeholders regarding the standard.

A comment sheet found in **DM# 42507407** can be used to record any errors or queries found in or pertaining to this standard. This comment sheet will be referred to each time the standard is updated.

Date	Rev No.	Notes
8/01/2024	0	Initial Document Creation

APPENDIX B QUALITY ASSURANCE (TO BE COMPLETED BY STORES)

DOCUMENT NUMBER	HPC-8DJ-25-0004-2023		**QUALITY ASSURANCE**	**DM NUMBER**	
DEVICE DESCRIPTION	**LABEL MATERIAL NO.**		**HV COMPOSITE INSULATOR PURCHASE**	**ASSET OWNER**	
	ASSET ID/ STOCK NO				
MANUFACTURER		**DIMENSION**			

ITEM	OPERATION/EQUIPMENT/FACILITY	DOCUMENT REF.	WHO CHECKS	INITIAL	DATE/ TIME	QUALITY ASSURANCE CRITERIA	PASS Y/N	COMMENTS
1	LABELLING							
1.1	Name of Manufacturer					*******		
1.2	Manufacturer's part reference number					*******		
1.3	Batch Number					*******		
1.4	Horizon Power Order Number					*******		
1.5	Horizon Power Stock Number					*******		
1.6	Insulator description					*******		
1.7	Package Weight					< 20 kg		
2	CONTENTS							
2.1	Installation Instructions					Clear, Legible and in English		
2.2	Bill of Materials					Clear, Legible and in English		
2.3	Material Safety Data Sheets (if required)					Clear, Legible and in English of all materials		

ITEM	OPERATION/EQUIPMENT/FACILITY	DOCUMENT REF.	WHO CHECKS	INITIAL	DATE/ TIME	QUALITY ASSURANCE CRITERIA	PASS Y/N	COMMENTS
2.4	Accessories (if required)					As per Bill of Materials		
2.5	Test and Inspection Reports					As per Standards referenced in the specification.		
3	PACKAGING							
3.1	Suitably stacked and secured on pallet					Packages suitably packed and prevented from coming loose		
3.2	Physical damage					Packages do not show puncture marks or other signs of damage		
3.3	Insulator/s in suitable packaging					Strong enough to prevent mechanical damage		
3.4	Packaging clearly labelled					Each package easily identifiable as per Section 4		
3.5	Items Individually Marked					Items clearly designated and marked as per Section 3.8		

SYMBOLS AND ABBREVIATIONS								
H = HOLD POINT	S = SUPERVISOR							
W = WITNESS POINT	T = TECHNICIAN, EL = ELECTRICIAN	REVISION						
V = VERIFICATION POINT	E = ENGINEER	DATE						
S/C = SUBCONTRACTOR	PM = PROJECT MANAGER	APPROVED BY						

APPENDIX C SCHEDULES A & B: ENQUIRY DOCUMENT

C1 Technical Schedules

Completion of the listed schedules in Appendix C2 by the vendor shall indicate the product offered is fully compliant with the nominated Clauses in this specification. All information provided shall be in English and measurement units shall be in metric units.

Any deviation from the specification shall be listed on the "Technical Deviation Schedule", provided in Section C3 with motivation to Horizon Power for consideration and written approval.

C2 Technical Requirements

Schedule A: Purchaser's specific requirements.

Schedule B: Particulars of equipment to be supplied.

C2.1 Technical schedules A and B for Composite Station Post insulators

HORIZON POWER	**SPECIFICATION ENQUIRY**	**HPC-8DJ-25-0004-2023**
	VENDOR'S NAME	
	DATE	

TECHNICAL SCHEDULES A & B

ITEM 1.1: 66 kV Composite Station Post Insulators

Item	Sub-clause	Description		Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator		xxxxxx	
2.		Manufacturer's/ vendor's catalogue number		xxxxxx	
3.		Manufacturer's/ vendor's drawing number		xxxxxx	
4.	3.8.1	Highest voltage	kV	72.5	
5.	3.8.1	Wet power frequency withstand voltage	kV	140	
6.	3.8.1	Lightning impulse withstand voltage	kVp	325	
7.	3.8.1	Switching impulse withstand voltage	kVp	N/A	
8.	3.8.1	Maximum RIV level	µV	N/A	
9.	3.9	Minimum creepage length @ Umax	mm/kV	2,232	
10.	3.9	Minimum equivalent length	mm	770	
11.	3.9	Corona rings		N/A	
12.	3.9.1	Minimum failing load (Cantilever)			
		Standard bay width Yes ☐ No ☐	kN	10	
		Elongated bay width Yes ☐ No ☐	kN	16	

Item	Sub-clause	Description			Schedule A	Schedule B
13.	3.9.1	Minimum failing load (Tension)				
		Standard bay width	Yes ☐ No ☐	kN	4	
		Elongated bay width	Yes ☐ No ☐	kN	5	
14.		Minimum failing load (Tension)		kN	xxxxxx	
15.		Minimum failing load (Compression)		kN	xxxxxx	
16.	3.4.1	Core Material			xxxxxx	
17.	3.4.2	Shed Material			xxxxxx	
18.	3.5.1	Bolt holes compliant with AS 4398.1 [4]			YES	
19.	3.6	Shed design according to SA ST 60815.3 [16]			YES	
20.		Mass of insulator		kg	xxxxxx	

TECHNICAL SCHEDULES A & B

ITEM 1.2: 132 kV Composite Station Post Insulators

Item	Sub-clause	Description			Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator			xxxxxx	
2.		Manufacturer's/ vendor's catalogue number			xxxxxx	
3.		Manufacturer's/ vendor's drawing number			xxxxxx	
4.	3.8.1	Highest voltage		kV	145	
5.	3.8.1	Wet power frequency withstand voltage		kV	275	
6.	3.8.1	Lightning impulse withstand voltage		kVp	650	
7.	3.8.1	Switching impulse withstand voltage		kVp	N/A	
8.	3.8.1	Maximum RIV level		µV	2,500	
9.	3.9	Minimum creepage length @ Umax		mm/kV	4,495	
10.	3.9	Minimum equivalent length		mm	1,500	
11.	3.9	Corona rings			N/A	
12.	3.9.1	Minimum failing load				
		Standard bay width	Yes ☐ No ☐	kN	10	
		Elongated bay width	Yes ☐ No ☐	kN	16	

Item	Sub-clause	Description			Schedule A	Schedule B
13.	3.9.1	Minimum failing load (Tension)				
		Standard bay width	Yes ☐ No ☐	kN	4	
		Elongated bay width	Yes ☐ No ☐	kN	6	
14.		Minimum failing load (Tension)		kN	xxxxxx	
15.		Minimum failing load (Compression)		kN	xxxxxx	
16.	3.4.1	Core Material			xxxxxx	
17.	3.4.2	Shed Material			xxxxxx	
18.	3.5.1	Bolt holes compliant with AS 4398.1 [4]			YES	
19.	3.6	Shed design according to SA ST 60815.3 [16]			YES	
20.		Mass of insulator		kg	xxxxxx	

TECHNICAL SCHEDULES A & B

ITEM 1.3: 220 kV Composite Station Post Insulators

Item	Sub-clause	Description			Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator			xxxxxx	
2.		Manufacturer's/ vendor's catalogue number			xxxxxx	
3.		Manufacturer's/ vendor's drawing number			xxxxxx	
4.	3.8.1	Highest voltage		kV	245	
5.	3.8.1	Wet power frequency withstand voltage		kV	460	
6.	3.8.1	Lightning impulse withstand voltage		kVp	1,050	
7.	3.8.1	Switching impulse withstand voltage		kVp	N/A	
8.	3.8.1	Maximum RIV level		µV	2,500	
9.	3.9	Minimum creepage length @ Umax		mm/kV	7,595	
10.	3.9	Minimum equivalent length		mm	2,300	
11.	3.9	Corona rings			Yes	
12.	3.9.1	Minimum failing load				
		Standard bay width	Yes ☐ No ☐	kN	10	
		Elongated bay width	Yes ☐ No ☐	kN	16	

Item	Sub-clause	Description			Schedule A	Schedule B
13.	3.9.1	Minimum failing load (Tension)				
		Standard bay width	Yes ☐ No ☐	kN	4	
		Elongated bay width	Yes ☐ No ☐	kN	6	
14.		Minimum failing load (Tension)		kN	xxxxxx	
15.		Minimum failing load (Compression)		kN	xxxxxx	
16.	3.4.1	Core Material			xxxxxx	
17.	3.4.2	Shed Material			xxxxxx	
18.	3.5.1	Bolt holes compliant with AS 4398.1 [4]			YES	
19.	3.6	Shed design according to SA ST 60815.3 [16]			YES	
20.		Mass of insulator		kg	xxxxxx	

TECHNICAL SCHEDULES A & B

ITEM 1.4: 330 kV Composite Station Post Insulators

Item	Sub-clause	Description			Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator			xxxxxx	
2.		Manufacturer's/ vendor's catalogue number			xxxxxx	
3.		Manufacturer's/ vendor's drawing number			xxxxxx	
4.	3.8.1	Highest voltage		kV	362	
5.	3.8.1	Wet power frequency withstand voltage		kV	510	
6.	3.8.1	Lightning impulse withstand voltage		kVp	1,175	
7.	3.8.1	Switching impulse withstand voltage		kVp	N/A	
8.	3.8.1	Maximum RIV level		µV	2,500	
9.	3.9	Minimum creepage length @ Umax		mm/kV	11,222	
10.	3.9	Minimum equivalent length		mm	2,650	
11.	3.9	Corona rings			Yes	
12.	3.9.1	Minimum failing load				
		Standard bay width	Yes ☐ No ☐	kN	10	
		Elongated bay width	Yes ☐ No ☐	kN	16	

Item	Sub-clause	Description	Schedule A	Schedule B
13.	3.9.1	Minimum failing load (Tension)		
		Standard bay width Yes ☐ No ☐ kN	4	
		Elongated bay width Yes ☐ No ☐ kN	6	
14.		Minimum failing load (Tension) kN	xxxxxx	
15.		Minimum failing load (Compression) kN	xxxxxx	
16.	3.4.1	Core Material	xxxxxx	
17.	3.4.2	Shed Material	xxxxxx	
18.	3.5.1	Bolt holes compliant with AS 4398.1 [4]	YES	
19.	3.6	Shed design according to SA ST 60815.3 [16]	YES	
20.		Mass of insulator kg	xxxxxx	

C2.2 Technical schedules A and B for Composite Line Post insulators

HORIZON POWER	**SPECIFICATION ENQUIRY**	**HPC-8DJ-25-0004-2023**
	VENDOR'S NAME	
	DATE	

TECHNICAL SCHEDULES A & B
ITEM 2.1: 66 kV Composite Line Post Insulators

Item	Sub-clause	Description		Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator		xxxxxx	
2.		Manufacturer's/ vendor's catalogue number		xxxxxx	
3.		Manufacturer's/ vendor's drawing number		xxxxxx	
4.	3.8.1	Highest voltage	kV	72.5	
5.	3.8.1	Wet power frequency withstand voltage	kV	140	
6.	3.8.1	Lightning impulse withstand voltage	kVp	325	
7.	3.8.1	Switching impulse withstand voltage	kVp	N/A	
8.	3.8.1	Maximum RIV level	µV	N/A	
9.	3.9	Minimum creepage length @ Umax	mm/kV	2,232	
10.	3.9	Minimum equivalent length	mm	770	
11.	3.9	Corona rings		N/A	
12.	3.9.2	Maximum design cantilever load	kN	14.5	
13.	3.9.2	Routine tension load	…..kN	xxxxxx	
14.	3.4.1	Core Material		xxxxxx	
15.	3.4.2	Shed Material		xxxxxx	
16.	3.5.2	Base			
		Flanged	Yes ☐ No ☐		
		Curved - Bendable	Yes ☐ No ☐		
		Curved - Rigid	Yes ☐ No ☐		
		Flat - Bendable	Yes ☐ No ☐		
		Flat - Rigid	Yes ☐ No ☐		

Item	Sub-clause	Description	Schedule A	Schedule B
17.	3.5.2	End		
		Drop Tongue Yes ☐ No ☐		
		Clamp - Horizontal Yes ☐ No ☐		
		Clamp - Vertical Yes ☐ No ☐		
18.	3.6	Shed design according to SA ST 60815.3 [16]	YES	
19.		Mass of insulator kg	xxxxxx	

TECHNICAL SCHEDULES A & B

ITEM 2.2: 132 kV Composite Line Post Insulators

Item	Sub-clause	Description	Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator	xxxxxx	
2.		Manufacturer's/ vendor's catalogue number	xxxxxx	
3.		Manufacturer's/ vendor's drawing number	xxxxxx	
4.	3.8.1	Highest voltage kV	145	
5.	3.8.1	Wet power frequency withstand voltage kV	275	
6.	3.8.1	Lightning impulse withstand voltage kVp	650	
7.	3.8.1	Switching impulse withstand voltage kVp	N/A	
8.	3.8.1	Maximum RIV level µV	2,500	
9.	3.9	Minimum creepage length @ Umax mm/kV	4,495	
10.	3.9	Minimum equivalent length mm	1,500	
11.	3.9	Corona rings	N/A	
12.	3.9.2	Maximum design cantilever load kN	14.5	
13.	3.9.2	Routine tension load …..kN	xxxxxx	
14.	3.4.1	Core Material	xxxxxx	
15.	3.4.2	Shed Material	xxxxxx	
16.	3.5.2	Base		
		Flanged Yes ☐ No ☐		
		Curved - Bendable Yes ☐ No ☐		

Item	Sub-clause	Description	Schedule A	Schedule B
		Curved - Rigid Yes ☐ No ☐		
		Flat - Bendable Yes ☐ No ☐		
		Flat - Rigid Yes ☐ No ☐		
17.	3.5.2	End		
		Drop Tongue Yes ☐ No ☐		
		Clamp - Horizontal Yes ☐ No ☐		
		Clamp - Vertical Yes ☐ No ☐		
18.	3.6	Shed design according to SA ST 60815.3 [16]	YES	
19.		Mass of insulator kg	xxxxxx	

TECHNICAL SCHEDULES A & B
ITEM 2.3: 220 kV Composite Line Post Insulators

Item	Sub-clause	Description	Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator	xxxxxx	
2.		Manufacturer's/ vendor's catalogue number	xxxxxx	
3.		Manufacturer's/ vendor's drawing number	xxxxxx	
4.	3.8.1	Highest voltage kV	245	
5.	3.8.1	Wet power frequency withstand voltage kV	460	
6.	3.8.1	Lightning impulse withstand voltage kVp	1,050	
7.	3.8.1	Switching impulse withstand voltage kVp	N/A	
8.	3.8.1	Maximum RIV level µV	2,500	
9.	3.9	Minimum creepage length @ Umax mm/kV	7,595	
10.	3.9	Minimum equivalent length mm	2,300	
11.	3.9	Corona rings	Yes	
12.	3.9.2	Maximum design cantilever load kN	14.5	
13.	3.9.2	Routine tension load …..kN	xxxxxx	

Item	Sub-clause	Description	Schedule A	Schedule B
14.	3.4.1	Core Material	xxxxxx	
15.	3.4.2	Shed Material	xxxxxx	
16.	3.5.2	Base		
		Flanged Yes ☐ No ☐		
		Curved - Bendable Yes ☐ No ☐		
		Curved - Rigid Yes ☐ No ☐		
		Flat - Bendable Yes ☐ No ☐		
		Flat - Rigid Yes ☐ No ☐		
17.	3.5.2	End		
		Drop Tongue Yes ☐ No ☐		
		Clamp - Horizontal Yes ☐ No ☐		
		Clamp - Vertical Yes ☐ No ☐		
18.	3.6	Shed design according to SA ST 60815.3 [16]	YES	
19.		Mass of insulator kg	xxxxxx	

TECHNICAL SCHEDULES A & B
ITEM 2.4: 330 kV Composite Line Post Insulators

Item	Sub-clause	Description	Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator	xxxxxx	
2.		Manufacturer's/ vendor's catalogue number	xxxxxx	
3.		Manufacturer's/ vendor's drawing number	xxxxxx	
4.	3.8.1	Highest voltage kV	362	
5.	3.8.1	Wet power frequency withstand voltage kV	510	
6.	3.8.1	Lightning impulse withstand voltage kVp	1,175	
7.	3.8.1	Switching impulse withstand voltage kVp	N/A	
8.	3.8.1	Maximum RIV level µV	2,500	

Item	Sub-clause	Description	Schedule A	Schedule B
9.	3.9	Minimum creepage length @ Umax mm/kV	11,222	
10.	3.9	Minimum equivalent length mm	2,650	
11.	3.9	Corona rings	Yes	
12.	3.9.2	Maximum design cantilever load kN	14.5	
13.	3.9.2	Routine tension load .....kN	xxxxxx	
14.	3.4.1	Core Material	xxxxxx	
15.	3.4.2	Shed Material	xxxxxx	
16.	3.5.2	Base		
		Flanged Yes ☐ No ☐		
		Curved - Bendable Yes ☐ No ☐		
		Curved - Rigid Yes ☐ No ☐		
		Flat - Bendable Yes ☐ No ☐		
		Flat - Rigid Yes ☐ No ☐		
17.	3.5.2	End		
		Drop Tongue Yes ☐ No ☐		
		Clamp - Horizontal Yes ☐ No ☐		
		Clamp - Vertical Yes ☐ No ☐		
18.	3.6	Shed design according to SA ST 60815.3 [16]	YES	
19.		Mass of insulator kg	xxxxxx	

C2.3 Technical schedules A and B for Composite Suspension/Tension (Long Rod) insulators

HORIZON POWER	**SPECIFICATION ENQUIRY**	**HPC-8DJ-25-0004-2023**
	VENDOR'S NAME	
	DATE	

TECHNICAL SCHEDULES A & B

ITEM 3.1: 66 kV Composite Long Rod Insulators

Item	Sub-clause	Description			Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator			xxxxxx	
2.		Manufacturer's/ vendor's catalogue number			xxxxxx	
3.		Manufacturer's/ vendor's drawing number			xxxxxx	
4.	3.8.1	Highest voltage		kV	72.5	
5.	3.8.1	Wet power frequency withstand voltage		kV	140	
6.	3.8.1	Lightning impulse withstand voltage		kVp	325	
7.	3.8.1	Switching impulse withstand voltage		kVp	N/A	
8.	3.8.1	Maximum RIV level		µV	N/A	
9.	3.9	Minimum creepage length @ Umax		mm/kV	2,232	
10.	3.9	Minimum equivalent length		mm	770	
11.	3.9	Corona rings			N/A	
12.	3.9.3	Specified mechanical load				
		Suspension	Yes ☐ No ☐	kN	160	
		Tension	Yes ☐ No ☐	kN	210	
13.	3.4.1	Core Material			xxxxxx	
14.	3.4.2	Shed Material			xxxxxx	
15.	3.5.3	Ball & Socket	Yes ☐ No ☐			
		Clevis & Eye	Yes ☐ No ☐			
16.	3.6	Shed design according to SA ST 60815.3 [16]			YES	
17.		Mass of insulator		kg	xxxxxx	

TECHNICAL SCHEDULES A & B
ITEM 3.2: 132 kV Composite Long Rod Insulators

Item	Sub-clause	Description		Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator		xxxxxx	
2.		Manufacturer's/ vendor's catalogue number		xxxxxx	
3.		Manufacturer's/ vendor's drawing number		xxxxxx	
4.	3.8.1	Highest voltage	kV	145	
5.	3.8.1	Wet power frequency withstand voltage	kV	275	
6.	3.8.1	Lightning impulse withstand voltage	kVp	650	
7.	3.8.1	Switching impulse withstand voltage	kVp	N/A	
8.	3.8.1	Maximum RIV level	µV	2,500	
9.	3.9	Minimum creepage length @ Umax	mm/kV	4,495	
10.	3.9	Minimum equivalent length	mm	1,500	
11.	3.9	Corona rings		N/A	
12.	3.9.3	Specified mechanical load			
		Suspension Yes ☐ No ☐	kN	160	
		Tension Yes ☐ No ☐	kN	210	
13.	3.4.1	Core Material		xxxxxx	
14.	3.4.2	Shed Material		xxxxxx	
15.	3.5.3	Ball & Socket Yes ☐ No ☐			
		Clevis & Eye Yes ☐ No ☐			
16.	3.6	Shed design according to SA ST 60815.3 [16]		YES	
17.		Mass of insulator	kg	xxxxxx	

TECHNICAL SCHEDULES A & B
ITEM 3.3: 220 kV Composite Long Rod Insulators

Item	Sub-clause	Description	Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator	xxxxxx	
2.		Manufacturer's/ vendor's catalogue number	xxxxxx	

Item	Sub-clause	Description		Schedule A	Schedule B
3.		Manufacturer's/ vendor's drawing number		xxxxxx	
4.	3.8.1	Highest voltage	kV	245	
5.	3.8.1	Wet power frequency withstand voltage	kV	460	
6.	3.8.1	Lightning impulse withstand voltage	kVp	1,050	
7.	3.8.1	Switching impulse withstand voltage	kVp	N/A	
8.	3.8.1	Maximum RIV level	µV	2,500	
9.	3.9	Minimum creepage length @ Umax	mm/kV	7,595	
10.	3.9	Minimum equivalent length	mm	2,300	
11.	3.9	Corona rings		Yes	
12.	3.9.3	Specified mechanical load			
		Suspension Yes ☐ No ☐	kN	160	
		Tension Yes ☐ No ☐	kN	210	
13.	3.4.1	Core Material		xxxxxx	
14.	3.4.2	Shed Material		xxxxxx	
15.	3.5.3	Ball & Socket Yes ☐ No ☐			
		Clevis & Eye Yes ☐ No ☐			
16.	3.6	Shed design according to SA ST 60815.3 [16]		YES	
17.		Mass of insulator	kg	xxxxxx	

TECHNICAL SCHEDULES A & B
ITEM 3.4: 330 kV Composite Long Rod Insulators

Item	Sub-clause	Description		Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator		xxxxxx	
2.		Manufacturer's/ vendor's catalogue number		xxxxxx	
3.		Manufacturer's/ vendor's drawing number		xxxxxx	
4.	3.8.1	Highest voltage	kV	362	
5.	3.8.1	Wet power frequency withstand voltage	kV	510	

Item	Sub-clause	Description			Schedule A	Schedule B
6.	3.8.1	Lightning impulse withstand voltage		kVp	1,175	
7.	3.8.1	Switching impulse withstand voltage		kVp	N/A	
8.	3.8.1	Maximum RIV level		µV	2,500	
9.	3.9	Minimum creepage length @ Umax		mm/kV	11,222	
10.	3.9	Minimum equivalent length		mm	2,650	
11.	3.9	Corona rings			Yes	
12.	3.9.3	Specified mechanical load				
		Suspension	Yes ☐ No ☐	kN	160	
		Tension	Yes ☐ No ☐	kN	210	
13.	3.4.1	Core Material			xxxxxx	
14.	3.4.2	Shed Material			xxxxxx	
15.	3.5.3	Ball & Socket	Yes ☐ No ☐			
		Clevis & Eye	Yes ☐ No ☐			
16.	3.6	Shed design according to SA ST 60815.3 [16]			YES	
17.		Mass of insulator		kg	xxxxxx	

C2.4 Technical schedules A and B for Composite Braced Line Post Assembly

HORIZON POWER	**SPECIFICATION ENQUIRY**	**HPC-8DJ-25-0004-2023**
	VENDOR'S NAME	
	DATE	

TECHNICAL SCHEDULES A & B

ITEM 4.1: 66 kV Composite Braced Line Post Assembly

Item	Sub-clause	Description	Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator	xxxxxx	
2.		Manufacturer's/ vendor's catalogue number	xxxxxx	
3.		Manufacturer's/ vendor's drawing number	xxxxxx	
4.	3.8.1	Highest voltage kV	72.5	
5.	3.8.1	Wet power frequency withstand voltage kV	140	
6.	3.8.1	Lightning impulse withstand voltage kVp	325	
7.	3.8.1	Switching impulse withstand voltage kVp	N/A	
8.	3.8.1	Maximum RIV level µV	N/A	
9.	3.9	Minimum creepage length @ Umax mm/kV	2,232	
10.	3.9	Minimum equivalent length mm	770	
11.	3.9	Corona rings	N/A	
12.	3.9.4	Maximum vertical, tension & compression load kN	30	
13.	3.9.4	Longitudinal load .....kN	xxxxxx	
14.	3.4.1	Core Material	xxxxxx	
15.	3.4.2	Shed Material	xxxxxx	
16.	3.5.4	Line Post Base		
		Curved - Bendable Yes ☐ No ☐		
		Curved - Rigid Yes ☐ No ☐		
		Flat - Bendable Yes ☐ No ☐		
		Flat - Rigid Yes ☐ No ☐		
17.	3.5.4	Line Post End	Drop Tongue	

Item	Sub-clause	Description	Schedule A	Schedule B
18.	3.5.4	Lond Rod Ends	Eye-Eye	
19.	3.6	Shed design according to SA ST 60815.3 [16]	YES	
20.		Mass of insulator kg	xxxxxx	

TECHNICAL SCHEDULES A & B
ITEM 4.2: 132 kV Composite Braced Line Post Assembly

Item	Sub-clause	Description	Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator	xxxxxx	
2.		Manufacturer's/ vendor's catalogue number	xxxxxx	
3.		Manufacturer's/ vendor's drawing number	xxxxxx	
4.	3.8.1	Highest voltage kV	145	
5.	3.8.1	Wet power frequency withstand voltage kV	275	
6.	3.8.1	Lightning impulse withstand voltage kVp	650	
7.	3.8.1	Switching impulse withstand voltage kVp	N/A	
8.	3.8.1	Maximum RIV level µV	2,500	
9.	3.9	Minimum creepage length @ Umax mm/kV	4,495	
10.	3.9	Minimum equivalent length mm	1,500	
11.	3.9	Corona rings	N/A	
12.	3.9.4	Maximum vertical, tension & compression load kN	30	
13.	3.9.4	Longitudinal load …..kN	xxxxxx	
14.	3.4.1	Core Material	xxxxxx	
15.	3.4.2	Shed Material	xxxxxx	
16.	3.5.2	Line Post Base		
		Curved - Bendable Yes ☐ No ☐		
		Curved - Rigid Yes ☐ No ☐		
		Flat - Bendable Yes ☐ No ☐		
		Flat - Rigid Yes ☐ No ☐		

Item	Sub-clause	Description	Schedule A	Schedule B
17.	3.5.4	Line Post End	Drop Tongue	
18.	3.5.4	Lond Rod Ends	Eye-Eye	
19.	3.6	Shed design according to SA ST 60815.3 [16]	YES	
20.		Mass of insulator kg	xxxxxx	

TECHNICAL SCHEDULES A & B

ITEM 4.3: 220 kV Composite Braced Line Post Assembly

Item	Sub-clause	Description	Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator	xxxxxx	
2.		Manufacturer's/ vendor's catalogue number	xxxxxx	
3.		Manufacturer's/ vendor's drawing number	xxxxxx	
4.	3.8.1	Highest voltage kV	245	
5.	3.8.1	Wet power frequency withstand voltage kV	460	
6.	3.8.1	Lightning impulse withstand voltage kVp	1,050	
7.	3.8.1	Switching impulse withstand voltage kVp	N/A	
8.	3.8.1	Maximum RIV level µV	2,500	
9.	3.9	Minimum creepage length @ Umax mm/kV	7,595	
10.	3.9	Minimum equivalent length mm	2,300	
11.	3.9	Corona rings	Yes	
12.	3.9.4	Maximum vertical, tension & compression load kN	30	
13.	3.9.4	Longitudinal load …..kN	xxxxxx	
14.	3.4.1	Core Material	xxxxxx	
15.	3.4.2	Shed Material	xxxxxx	
16.	3.5.2	Line Post Base		
		Curved - Bendable Yes ☐ No ☐		
		Curved - Rigid Yes ☐ No ☐		
		Flat - Bendable Yes ☐ No ☐		
		Flat - Rigid Yes ☐ No ☐		

Item	Sub-clause	Description	Schedule A	Schedule B
17.	3.5.4	Line Post End	Drop Tongue	
18.	3.5.4	Lond Rod Ends	Eye-Eye	
19.	3.6	Shed design according to SA ST 60815.3 [16]	YES	
20.		Mass of insulator kg	xxxxxx	

TECHNICAL SCHEDULES A & B

ITEM 4.4: 330 kV Composite Braced Line Post Assembly

Item	Sub-clause	Description	Schedule A	Schedule B
1.		Manufacturer/ vendor of insulator	xxxxxx	
2.		Manufacturer's/ vendor's catalogue number	xxxxxx	
3.		Manufacturer's/ vendor's drawing number	xxxxxx	
4.	3.8.1	Highest voltage kV	362	
5.	3.8.1	Wet power frequency withstand voltage kV	510	
6.	3.8.1	Lightning impulse withstand voltage kVp	1,175	
7.	3.8.1	Switching impulse withstand voltage kVp	N/A	
8.	3.8.1	Maximum RIV level µV	2,500	
9.	3.9	Minimum creepage length @ Umax mm/kV	11,222	
10.	3.9	Minimum equivalent length mm	2,650	
11.	3.9	Corona rings	Yes	
12.	3.9.4	Maximum vertical, tension & compression load kN	30	
13.	3.9.4	Longitudinal load …..kN	xxxxxx	
14.	3.4.1	Core Material	xxxxxx	
15.	3.4.2	Shed Material	xxxxxx	
16.	3.5.2	Line Post Base		
		Curved - Bendable Yes ☐ No ☐		
		Curved - Rigid Yes ☐ No ☐		
		Flat - Bendable Yes ☐ No ☐		
		Flat - Rigid Yes ☐ No ☐		

Item	Sub-clause	Description	Schedule A	Schedule B
17.	3.5.4	Line Post End	Drop Tongue	
18.	3.5.4	Lond Rod Ends	Eye-Eye	
19.	3.6	Shed design according to SA ST 60815.3 [16]	YES	
20.		Mass of insulator kg	xxxxxx	

C3 Technical Deviation Schedule

Table 2: Technical Deviation Schedule

Any deviations from this specification shall be listed below with reasons for deviation. In addition, evidence shall be provided that the proposed deviations will at least be more cost-effective than that specified by Horizon Power.		
Item	**Clause**	**Proposed Deviation**

APPENDIX D TECHNICAL SCHEDULE C: COMPLIANCE DOCUMENT

The Vendor shall indicate below whether this offer is fully compliant with the nominated clause in this Specification. A YES shall ONLY be indicated if the offer is 100% compliant with the relevant Clause. If NO is indicated and supporting documents are submitted, then mark the ATT box with the attachment number. Details of departure shall be provided in Appendix E.

CLAUSE NUMBER		YES	NO	ATT.
3	Requirements			
3.1	Compliance with the Specification	☐	☐	
3.2	Environmental Conditions	☐	☐	
3.3	General			
3.4	Material Requirements			
3.4.1	Cores of Composite/Polymeric Insulators	☐	☐	
3.4.2	Sheds of Composite/Polymeric Insulators	☐	☐	
3.4.3	Adhesive Compounds	☐	☐	
3.4.4	Insulator Ends	☐	☐	
3.4.5	Corona Rings	☐	☐	
3.5	High Voltage Composite/Polymeric Insulators			
3.5.1	Station Post Insulators	☐	☐	
3.5.2	Line Post Insulators	☐	☐	
3.5.2.1	Clamp Top	☐	☐	
3.5.3	Suspension/Tension (Long Rod) Insulators	☐	☐	
3.5.4	Braced Line Post Assembly	☐	☐	
3.6	Acceptable Profiles	☐	☐	
3.7	Insulator Designations and Markings			
3.7.1	Station Post Insulators	☐	☐	
3.7.2	Line Post Insulators	☐	☐	
3.7.3	Suspension/Tension Insulators	☐	☐	
3.7.4	Braced Line Post Assembly	☐	☐	
3.8	Electrical Requirements			
3.8.1	Rated Voltages	☐	☐	
3.8.2	Pollution Categories	☐	☐	
3.9	Mechanical Requirements	☐	☐	
3.9.1	Station Post Insulators	☐	☐	
3.9.2	Line Post Insulators	☐	☐	
3.9.3	Suspension/Tension Insulators	☐	☐	
3.9.4	Braced Line Post Assembly	☐	☐	

CLAUSE NUMBER		YES	NO	ATT.
3.10	Service Requirements			
3.10.1	Cleaning Requirements	☐	☐	
3.10.2	Coating Maintenance	☐	☐	
4	Packaging Requirements	☐	☐	
5	Storage	☐	☐	
6	Reliability	☐	☐	
7	Safety	☐	☐	
8	Environmental Considerations	☐	☐	
9	Tests			
9.1	Test Requirements	☐	☐	
9.2	Test Certificates	☐	☐	
9.3	Required Tests	☐	☐	
9.4	Design Tests	☐	☐	
9.5	Type Tests	☐	☐	
9.5.1	Brittle Fracture Resistance Test	☐	☐	
9.5.1.1	Procedure	☐	☐	
9.5.1.2	Acceptance Criteria	☐	☐	
9.5.2	Electrical Routine Testing	☐	☐	
9.5.2.1	Procedure	☐	☐	
9.5.2.2	Acceptance Criteria	☐	☐	
9.5.3	Interface Integrity	☐	☐	
9.6	Sample Tests	☐	☐	
9.6.1	Cantilever test	☐	☐	
9.7	Routine Tests	☐	☐	
10	Documentation and Samples			
10.1	Documentation to be provided with Proposals	☐	☐	
10.2	Service history	☐	☐	
10.3	Training Materials	☐	☐	
10.4	Samples	☐	☐	

APPENDIX E SCHEDULE D: DEPARTURES FROM TECHNICAL SPECIFICATION

The Vendor shall nominate the Clause and describe the departure:

CLAUSE NO.	DEPARTURE

APPENDIX F TEST CERTIFICATES

F1 Tests for High Voltage Station Post Insulators

Certificates and test results shall be provided showing successful tests carried out as shown in Table 9:

Table 3: Required Tests for Composite HV Station Post Insulators

Test Type	Design	Type	Sample	Routine
Electrical tests				
Thermal-mechanical pre-stressing	R2			
Water immersion pre-stressing	R1			
Dry lightning impulse voltage test		R2		
Steep-front impulse puncture test	R1			
Dry power-frequency voltage test	R1			
Wet power-frequency voltage test		R2		
Mechanical tests				
Maximum design cantilever load test	R2	R2	R2	
Maximum design torsion load test	R2		R2	
Specific tension load test	R2		R2	R2
Compression and buckling withstand load test		R2^		
Material property tests				
Hardness test	R1			
Dye penetration test	R1			
Water diffusion test	R1			
Accelerated weathering test	R1			
Tracking and erosion test (1000 hour salt fog)	R1			
Flammability test	R1			
Galvanising test			R2	
Other Tests				
Interface Integrity test	R1		R4	
Verification of dimensions	R1	R2	R2	
Visual examination				R2

R1 = Required to AS IEC 62217 [13]
R2 = Required to AS 62231 [14]
R3 = Required to both AS IEC 62217 [13] & AS 62231 [14]
R4 = Required by Horizon Power in accordance with Section 9.10
^Only required if compression is to be a major component of overall service mechanical loads.

F2 Tests for High Voltage Line Post Insulators

Certificates and test results shall be provided showing successful tests carried out as shown in Table 10:

Table 10: Required Tests for Composite HV Line Post Insulators

Test Type	Design	Type	Sample	Routine
Electrical tests				
Thermal-mechanical pre-stressing	R2			
Water immersion pre-stressing	R1			
Dry lightning impulse voltage test		R2		
Steep-front impulse puncture test	R1			
Dry power-frequency voltage test	R1			
Wet power-frequency voltage test		R2		
Wet switching impulse withstand		R2		
Mechanical tests				
Maximum design cantilever load test	R2	R2	R2	
Specific tension load test	R2			R2
Material property tests				
Hardness test	R1			
Dye penetration test	R1			
Water diffusion test	R1			
Accelerated weathering test	R1			
Tracking and erosion test (1000 hour salt fog)	R1			
Flammability test	R1			
Galvanising test			R2	
Other Tests				
Interface Integrity test	R3		R4	
Verification of dimensions	R1	R2	R2	
Mounting arrangements		R2		
Visual examination	R3			R2

R1 = Required to AS IEC 62217 [13]
R2 = Required to AS 61952 [12]
R3 = Required to both AS IEC 62217 [13] & AS 61952 [12]
R4 = Required by Horizon Power in accordance with Section 9.10

F3 Tests for High Voltage Suspension/Tension Insulators

Certificates and test results shall be provided showing successful tests carried out as shown in Table 11:

Table 11: Required Tests for Composite HV Suspension/Tension Insulators

Test Type	Design	Type	Sample	Routine
Electrical tests				
Sudden-release pre-stressing	R1			
Thermal-mechanical pre-stressing	R1			
Water immersion pre-stressing	R1			
Dry lightning impulse voltage test		R2		
Steep-front impulse puncture test	R1			
Dry power-frequency voltage test	R1			
Wet power-frequency voltage test		R2		
Wet switching impulse voltage test		R2		
Mechanical tests				
Assembled core load-time test	R2			
Damage limit proof and interface tightness test		R2	R2	
Routine tensile test				R2
Verification of locking system			R2	
Material property tests				
Hardness test	R1			
Dye penetration test	R1			
Water diffusion test	R1			
Accelerated weathering test	R1			
Tracking and erosion test (1000 hour salt fog)	R1			
Flammability test	R1			
Galvanising test			R2	
Other Tests				
Interface Integrity test	R3		R4	
Verification of dimensions	R1		R2	
Verification of end fittings			R2	
Visual examination	R3			R2

R1 = Required to AS IEC 62217 [13]
R2 = Required to AS 61109 [10]
R3 = Required to both AS IEC 62217 [13] & AS 61109 [10]
R4 = Required by Horizon Power in accordance with Section 9.10