



Standard

High Voltage Disc Insulator Standard

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Authorisations

Action	Name and title	Date
Prepared by	Andrew Ling, Senior Asset Strategy Engineer, Network Asset Strategy	26/04/2021
Reviewed by	David Eccles, Senior Asset Strategy Engineer, Network Asset Strategy	26/04/2021
Authorised by	Darryl Munro, Team Leader, Network Asset Strategy	03/05/2021
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Responsibilities

This document is the responsibility of the Network Asset Strategy Team, Tasmanian Networks Pty Ltd, ABN 24 167 357 299 (hereafter referred to as "TasNetworks").

Please contact the Primary Systems Asset Strategy Team Leader with any queries or suggestions.

- Implementation All TasNetworks staff and contractors.
- Compliance All group managers.

Minimum requirements

The requirements set out in TasNetworks' documents are minimum requirements that must be complied with by all TasNetworks team members, contractors, and other consultants.

The end user is expected to implement any practices which may not be stated but which can be reasonably regarded as good practices relevant to the objective of this document.

Record of revisions

Version	Section number	Details
1.0	All	Amended to reflect TasNetworks branding and document numbering
2.0	All	High Voltage Disc Insulator Schedule combined with Standard in Appendix 1 and 2
2.0	All	Standards updated to reflect changes since last version
2.0	3	Table 3 One minute power frequency revised for U160BS

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1 General

1.1 Purpose

To define the requirements for high voltage disc insulators, (hereafter referred to as 'disc insulators'), under the responsibility of Tasmanian Networks Pty Ltd (hereafter referred to as 'TasNetworks').

1.2 Scope

This standard defines requirements to be met by the manufacturer in the design, construction and testing of disc insulators, as well as requirements for packaging and delivery of disc insulators to TasNetworks.

1.3 Objective

Compliance with this standard in the procurement of disc insulators by TasNetworks will ensure:

- a) that relevant Australian legal requirements are met;
- b) that the requirements of the Tasmanian Electricity Code and National Electricity Rules are met;
- c) personnel and public safety;
- d) the safety of TasNetworks' assets;
- e) ease of operation and maintenance;
- f) reliability and continuity of power supplied by the power transmission network;
- g) minimum disruption to the power transmission network following a fault;
- h) alignment with TasNetworks' management strategies and TasNetworks' established maintenance practices;
- i) that the requirements of TasNetworks' Corporate plan are met; and
- j) that the risk exposure to TasNetworks and the public is minimised.

1.4 Precedence

Any apparent conflict between the requirements of this standard and the law, mandatory requirements, industry standards, project specifications, non-statutory standards or guidelines, and any other associated documents should be brought to the immediate attention of TasNetworks for resolution and no action must be taken that might result in a breach of law or mandatory standard. Where there may be a conflict between the requirements of this standard and any:

- (a) law, mandatory requirement or industry standard, then that law or statutory requirements will prevail over this standard;
- (b) non-mandatory standard, or guideline, then this standard will prevail over that standard or guideline; and
- (c) project specification, then the contract documentation will prevail over this standard.

1.5 Deviation

Special approval for a deviation to this standard may only be accorded if it does not reduce the quality of workmanship, does not deviate from the objective of this document or from the intent of the standard. A request for a deviation shall follow a designated procedure that involves approval from TasNetworks.

Deviations, if any, shall be specifically requested and requires approval in writing by TasNetworks prior to award of Contract.

1.6 References

This standard is to be read in conjunction with other standards and documents as applicable. In particular this includes the project specifications and the following:

AS 2947.1	Insulators – Porcelain and glass for overhead power lines – Voltages greater than 1000 V A.C. – Test Methods – Insulator units
AS 2947.4	Insulators – Porcelain and glass for overhead power lines – Voltages greater than 1000 V A.C. – Test methods – Insulator strings and insulator sets
SA TS 60815.1	Selection and dimensioning of high-voltage insulators intended for use in polluted conditions - Polymer insulators for A.C. systems
AS 60305	Insulators for overhead lines with a nominal voltage above 1000 V – Ceramic or glass insulator units for A.C. Systems – Characteristics of insulator units of the cap and pin type
IEC 60071-1	Insulation co-ordination – Part 1: Definitions, principles and rules
AS/NZS 4680	Hot-dip galvanised (zinc) coatings on fabricated ferrous articles
AS 62271.1	High-voltage switchgear and controlgear - Common specifications
AS 1566	Copper and copper alloys – Rolled flat products
AS 1444	Wrought alloy steels – Standard, hardenability (H) series and hardened and tempered to designated mechanical properties
AS 60120	Dimensions of ball and socket couplings of string insulator units
AS 60372	Locking devices for ball and socket couplings of string insulator units – Dimensions and tests
AS/NZS 7000	Overhead line design

2 Design requirements

All materials used in the manufacture of disc insulators shall be of the latest design and conform to the best modern practices adopted in the extra high voltage field. The supplier shall only offer insulators that are suitable for 110 kV and 220 kV transmission lines and have a proven service record of good performance.

- a) The following disc insulator design requirement must be met as a minimum:
- b) Disc insulators shall comply with this standard and requirements detailed in AS 60305, AS 2947.1, AS 2947.4, and other applicable Australian Standards.
- c) Disc insulators shall be cap and pin type with ball and socket coupling, suitable for use in suspension or tension strings.
- d) Disc insulators shall comply with the dimensions specified in AS 60120.
- e) The cap and pin shall be designed to uniformly transmit the mechanical stresses to the shell by compression and shall not rely on adhesive strength alone. The design of the disc shall be such that stresses due to expansion or contraction in any part of the insulator shall not lead to deterioration.
- f) The cap shall be circular with the inner and outer surfaces being concentric, of such a design that it will not yield or distort under loading.
- g) The pin ball shall move freely in the cap socket but without risk of accidental uncoupling during erection or while installed.
- h) The insulating material shall be glass or porcelain. Ferrous parts other than stainless steel shall be hot dip galvanised in accordance with AS/NZS 4680.
- i) Porcelain insulator glazing shall be uniform with a smooth surface and good lustre, shall be free from any blisters, burns or other defects, shall cover the entire part of the insulator and shall not crack or

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chip by ageing under the normal service condition. Porcelain disc insulator colour shall be as per the project specifications.

- j) Insulator pins shall have a sacrificial zinc collar fitted. The zinc sleeve shall have a purity of not less than 99.7 per cent zinc. The sleeves shall be fused to the pin shank for no less than 80 per cent of the area interface between the sleeve and the pin shank. The zinc sleeve shall be embedded in the cement for at least 50 per cent of its length. The dimensions and position of the sleeve shall be clearly shown on a full scale drawing of the insulator.

The following security clip design requirement must be met as a minimum:

- a) Security clips or locking devices shall be either austenitic stainless steel or phosphor bronze split pin 'W'-clip, in accordance with AS 60372, AS 1444 (for stainless steel) or AS 1566 (for phosphor bronze).
- b) The material used to construct the locking device shall not have a surface coating for corrosion protection nor shall it give rise to significant contact corrosion (chemical reaction) between the locking device and the ball and socket coupling.
- c) The locking device should be resilient, corrosion resistant and of suitable mechanical strength.
- d) Under no circumstances shall the locking device allow separation of insulator units or fittings under the specified service conditions.
- e) The hole for the security clip shall be countersunk and the clip shall be of such a design that the eye of the clip may be engaged by a hot line clip puller to provide for disengagement under energised condition and the force required to pull the security clip into unlocked position shall not be less than 50 N or more than 500 N.

3 Technical data

Environmental conditions and any specific design criteria for particular location or projects will be stated in the project specifications.

Tables 1, 2, 3 and 4 specify the operating environment within which disc insulators will be installed and the minimum technical design requirements to be met by individual disc insulators and by insulator strings.

Table 1 TasNetworks' transmission system information

Attribute	Unit	Value/Designation	
Nominal system voltage	kV	110	220
Maximum system voltage	kV	123	245
Basic Impulse Level (BIL)	kV _{peak}	550	1050
Power frequency withstand voltage	kV _{rms}	230	460
Rated system frequency	Hz	50	
No. of phases	-	3	

Table 2 TasNetworks' transmission system nominal operating conditions

Nominal operating conditions	
Maximum ambient temperature	40
Minimum ambient temperature	-10
Max Relative humidity %	95
Pollution [SA TS 60815.1] ¹	Light
Maximum altitude above sea level ²	≤ 1100m

1. Pollution level is to be assessed individually for each project. Refer to SA TS 60815.1 for pollution level descriptors.
2. For altitude >1100m refer to AS 62271.1

Table 3 Technical parameters for single disc insulator units of type U70BL or U160BS

Description		Units		Type	
				U70BL	U160BS
Standard coupling		mm		16	20
Disc diameter (max)		mm		255	280
Nominal spacing		mm		146	146
Total creepage distance (min)		mm		295	315
Electromechanical or mechanical failing load		kN		70	160
Security clips or locking devices		Type		'W'-clip 16B	'W'-clip
Flashover voltage	Power frequency	Dry	kV	75	75
		Wet	kV	45	45
	50 % Impulse	Positive	kV	125	130
		Negative	kV	130	135
Withstand voltage	One minute power frequency	Dry	kV	70	75
		Wet	kV	40	45
	Impulse	Wet	kV	100	110
Power frequency puncture voltage		kV		130	130

Note that insulators installed in accordance with previously approved standards may not meet the criteria in this standard.

Table 4 Technical parameters for insulator strings comprising disc insulator units of type U70BL or U160BS

Parameters	Units	Type	
		U70BL	U160BS
Power Frequency withstand voltage (wet)	kV _{rms}	230	460
Lightning impulse withstand voltage (wet)	kV _{peak}	550	1050
Nominal number of discs	units	7	13

4 Packaging and appearance

The supplier is responsible for ensuring that adequate packaging is provided to minimize the risk of damage to insulators during delivery. The packaging shall be suited to the particular methods of delivery, provide protection against damage from all foreseen hazards and be suitable for external storage for a period of up to 6 months without loss of integrity.

Details of packaging methods shall be submitted to TasNetworks for approval. All insulators shall be fully washed and all surplus grout shall be removed from the disks prior to delivery. Failure to ensure this is carried out will be grounds for rejection.

5 Testing

Disc insulators shall be duly tested in accordance with AS 2947.1. Where tests are optional in the standards, it will be considered that these tests are required by TasNetworks, unless otherwise requested by the Contractor and agreed to in writing by TasNetworks before the award of Contract.

All test reports shall be forwarded to TasNetworks for approval and acceptance. The tests will be considered as completed only after approval and acceptance in writing of test results by TasNetworks. The tests to be conducted on the disc insulators are given in Sections 5.1 to 5.4.

All testing is to be undertaken at the suppliers' cost.

5.1 Type tests

Type tests are intended to verify the main characteristics of the disc insulator and to prove their suitability for operation under the conditions detailed in the specifications. Type tests shall be carried out prior to delivery. A certified test report, detailing the results of such tests along with the procedures followed, shall be provided to TasNetworks. These tests shall have been applied to a disc insulator of identical design with that offered, or on a disc insulator of a design which does not differ from that offered in any way which might influence the properties to be confirmed by the type test.

Where such tests have already been performed, a copy of type test reports that qualifies for the exemption from conducting these tests shall be provided with the tender.

Type tests shall be performed to relevant Australian Standards, in particular AS 2947.1. Where the manufacturer's type tests differ from the requirements under the relevant Australian Standards, a list of non-conformances shall be submitted to TasNetworks for consideration.

Type tests to be performed on disc insulators include:

- a) verification of dimension;
- b) electromechanical failing load;
- c) mechanical failing load;
- d) thermal mechanical performance test;
- e) power frequency voltage withstand and flashover test under dry and wet conditions;
- f) impulse voltage withstand and flashover test (dry); and
- g) visible discharge test (dry).

5.2 Sample tests

Sample tests are intended to verify those characteristics of an insulator which can vary with the manufacturing process and quality of material. The tests are used as acceptance tests on a sample of disc insulators that have met the requirements of the relevant routine tests. The number of sample tests required will be as stipulated in AS 2947.1.

Sample tests as detailed in AS 2947.1 shall be performed.

TasNetworks shall be given a minimum of 14 days notification prior to sample tests being undertaken to enable TasNetworks to send representatives to witness the tests. TasNetworks will not accept sample test results if the minimum 14 days notification is not given. If TasNetworks chooses not to attend these tests then acceptance of the tests will be provided by TasNetworks in writing.

Sample test results shall be submitted to TasNetworks for approval prior to shipment.

Sample tests to be performed on disc insulator will include:

- a) visual examination;
- b) verification of dimension;
- c) electromechanical failing load;
- d) mechanical failing load;
- e) temperature cycle test;
- f) power frequency puncture withstand test;
- g) verification of axial, radial and angular displacement;
- h) verification of locking system; and
- i) thermal shock test.

5.3 Routine tests

Routine tests shall be conducted on every disc insulator supplied to prove quality of manufacture and conformance with the relevant performance requirements of the applicable standards. Routine testing shall be performed at the manufacturer's works prior to delivery.

Routine tests detailed in AS 2947.1 shall be performed.

Routine tests shall follow the procedures outlined in AS 2947.1 for electrical, mechanical and other tests. Supporting documentation to confirm routine test procedures shall be submitted to TasNetworks for approval and acceptance. Routine tests shall not be conducted unless the routine test procedures have been accepted and approved by TasNetworks.

Routine test results and certificates shall be submitted to TasNetworks for approval and acceptance. Routine tests will not be considered as completed until TasNetworks approves and accepts the test results.

Routine factory test results shall be approved and accepted by TasNetworks prior to dispatch of disc insulators to site.

Routine tests to be performed on disc insulators include:

- a) visual inspection;

- b) mechanical routine test; and
- c) electrical routine test.

5.4 Test on locking device

All tests on locking devices shall be performed in accordance with AS 60372. Tests for locking devices shall include:

- a) visual examination;
- b) checking of dimensions;
- c) verification of resistance of bending;
- d) hardness test; and
- e) corrosion resistance test (in some cases).

On request a certificate shall be supplied by the manufacturer confirming that tests are carried out on locking device in accordance with AS 60372.

All testing is to be undertaken at the suppliers' cost.

6 Other requirements

6.1 Disc insulator marking

Each disc insulator shall be supplied with permanent marking detailing requirements as per AS 2947.1 and shall be legibly and indelibly marked with the name of the manufacturer, and month and year of manufacture.

6.2 General documentation requirements

All documents and drawings shall be clear, legible and free from errors or omissions.

All documents and drawings shall be in the English language only.

Only SI system of units can be used. Units shall be stated for all values.

Scales, wherever used, shall be as per the applicable Australian Standards.

All scale drawings shall include a scale block.

Only information relevant to the particular type of insulator supplied shall be shown in the documentation and drawings.

6.3 Drawings and information

The supplier shall submit for approval all drawings and design information. These will consist of fully dimensioned drawings, and guaranteed electrical and mechanical characteristics, at time of submission of offer/price.

7 Hold points

Hold points in the supply of disc insulators include:

- a) 'Detailed Design Documentation' shall be submitted prior to manufacturing or procurement of equipment for TasNetworks' review, comment and approval;

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- b) an 'Inspection and Test Plan' shall be submitted prior to any testing of equipment, for TasNetworks' review, comment and approval;
- c) sample tests will not be commenced without a TasNetworks representative in attendance, unless TasNetworks has declined in writing;
- d) completed design documentation shall be submitted prior to sample tests;
- e) sample and routine test results shall be submitted to TasNetworks for approval, with any identified non-conformances rectified prior to shipment;
- f) all 'as-built documentation', test results and test certificates shall be submitted to TasNetworks and must be accepted by TasNetworks prior to final acceptance; and
- g) inspection of the equipment as received on site is required by TasNetworks prior to final acceptance.

Appendix A – Schedules to be completed by tenderer – U160BS

No.	Description	Specified Requirement	Guaranteed Value
1	General		
1.1	Manufacturer	-	
1.2	Type	U160BS	
1.3	Country of manufacture	-	
1.4	Insulation material		
1.5	Colour of disc insulator	-	
1.6	Sacrificial zinc collar zinc purity	-	
1.7	Galvanising compliant to AS/NZS 4680 Standard	-	
1.8	Security clips or locking devices	'W'-clip	
2	Disc Insulator Electrical Properties		
2.1	Power Frequency withstand voltage - Dry	75 kV	
2.2	Power Frequency withstand voltage - Wet	45 kV	
2.3	Power Frequency flashover voltage - Dry	75 kV	
2.4	Power Frequency flashover voltage - Wet	45 kV	
2.5	50% impulse flashover voltage - Positive	130 kV	
2.6	50% impulse flashover voltage - Negative	135 kV	
2.7	Impulse withstand voltage	110 kV	
2.8	Power Frequency Puncture Voltage	130 kV	
3	Disc Insulator Mechanical Characteristics		
3.1	Minimum failing load	160 kN	
4	Dimensions and Masses		
4.1	Creepage distance	315 mm (min)	
4.2	Coupling size	20 mm	
4.3	Mass of insulator	-	
4.4	Nominal spacing	146 mm	
4.5	Disc Diameter	280 mm (max)	

Appendix B – Schedules to be completed by tenderer – U70BL

No.	Description	Specified Requirement	Guaranteed Value
1	General		
1.1	Manufacturer	-	
1.2	Type	U75BL	
1.3	Country of manufacture	-	
1.4	Insulation material		
1.5	Colour of disc insulator	-	
1.6	Sacrificial zinc collar zinc purity	-	
1.7	Galvanising compliant to AS/NZS 4680 Standard	-	
1.8	Security clips or locking devices	'W'-clip	
2	Disc Insulator Electrical Properties		
2.1	Power Frequency withstand voltage - Dry	75 kV	
2.2	Power Frequency withstand voltage - Wet	45 kV	
2.3	Power Frequency flashover voltage - Dry	75 kV	
2.4	Power Frequency flashover voltage - Wet	45 kV	
2.5	50% impulse flashover voltage - Positive	125 kV	
2.6	50% impulse flashover voltage - Negative	130 kV	
2.7	Impulse withstand voltage	100 kV	
2.8	Power Frequency Puncture Voltage	130 kV	
3	Disc Insulator Mechanical Characteristics		
3.1	Minimum failing load	75 kN	
4	Dimensions and Masses		
4.1	Creepage distance	295 mm (min)	
4.2	Coupling size	16 mm	
4.3	Mass of insulator	-	
4.4	Nominal spacing	146 mm	
4.5	Disc Diameter	255 mm (max)	