Covered Conductor Thick (CCT)

ETS 0060

Amendment No 1
19 September 2019



Endeavour Energy

Revision History

This amendment replaces amendment no. 0 and the NNSW Covered Conductor Thick (CCT) Technical Specification. All changes are highlighted in this document with grey colouring.

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Contact Information

The latest version of this document and other standards, are located on Endeavour Energy's standards website located at:

http://www.endeavourenergy.com.au/aspPortal/webengine/au/com/ee/asp/Standards/Standards.

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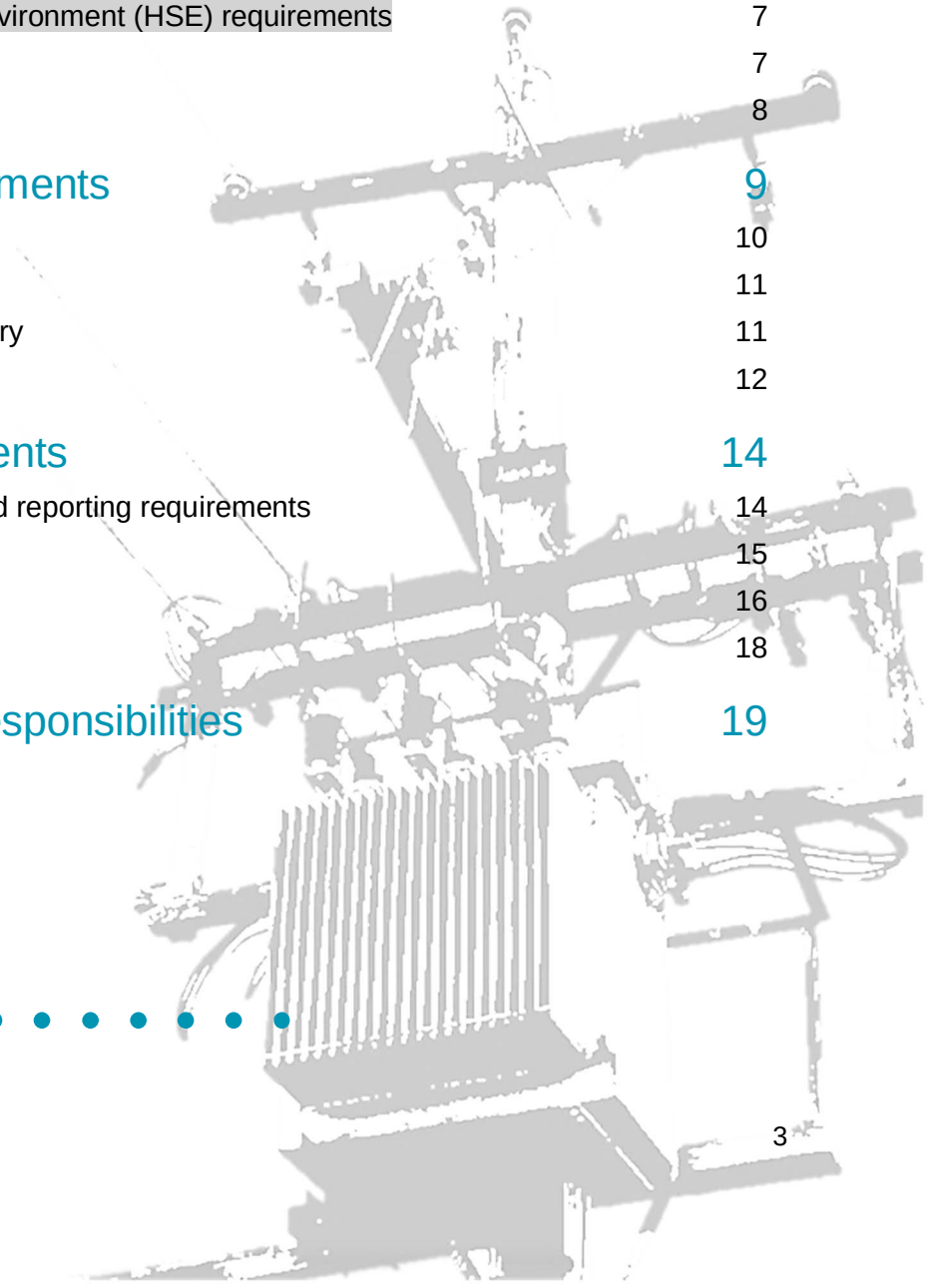
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1 Documentation Scope

This specification covers the design, engineering, manufacture, testing, supply and delivery of covered conductor thick (CCT) for use on Endeavour Energy's overhead distribution network.

2 References

External Regulations
Electricity Supply Act 1995 (NSW)
Electricity Supply (Safety and Network Management) Regulation 2014
National Electricity (NSW) Law 1997 National Electricity Rules

External Standards
AS 1531:1991 – Conductors – Bare overhead – aluminium and aluminium alloy
AS/NZS 1660 series – Test methods for electric cables, cords and conductors
AS 2700:2011 – Colour standards for general purposes
AS/NZS 2857:1996 – Timber drums for insulated electric cables and bare conductors
AS/NZS 3675:2002 – Conductors – Covered overhead – For working voltages 6.35/11(12)kV up to and including 19/33(36)kV
AS/NZS 3808:2000 – Insulating and sheathing materials for electric cables
AS/NZS ISO 9001:2016 – Quality management systems – Requirements
AS/NZS ISO 14001:2016 – Environmental management systems – Requirements with guidance for use
ENA National Electricity Network Safety Code (ENA Doc 001-2008)

Company Policies and Procedures
Company Policy 9.2.1 – Network Planning
Company Policy 9.2.5 – Network Asset Design
Company Policy 9.2.10 – Network Asset Ratings
Company Policy 9.7.1 – Network Asset Construction

3 Definitions and Abbreviations

Abbreviation	Meaning
AAAC	All aluminium alloy conductor
AC	Alternating Current
AS	Australian Standard
CCT	Covered Conductor Thick
DC	Direct Current
IEC	International Electrotechnical Commission
ISO	International Organisation for Standardisation
MSDS	Material Safety Data Sheet
NATA	National Association of Testing Authorities
NZS	New Zealand Standard
RMS	Root Mean Square

4 General Requirements

All covered conductor thick (CCT) must comply with the requirements of:

- this specification;
- AS/NZS 3675:2002 and other standards and codes referenced therein; and,
- all other relevant standards as listed in Clause 2 of this specification.

Where this specification conflicts with any Australian standard, this specification will prevail.

It is the supplier's responsibility to comply with any changes to the Australian Standards, referenced in this specification, that occur whilst the product(s) are being supplied and affect the design, engineering, manufacture and / or testing of the cables being supplied are approved by the Mains Assets Manager prior to the changes being implemented.

Endeavour Energy may consider CCT conductors manufactured to other recognised international standards provided the standards are at least equivalent to Australian/IEC standards. The supplier must submit a comparison between the tested standard and the equivalent Australian standard.

Endeavour Energy requires covered conductor samples to be provided by the supplier. A minimum length of 1.5 metres of each conductor type being offered must be provided. The covered conductor markings complying with Clause 5.4.1 of this specification must be clearly visible on each sample.

4.1 Requirements exceeding the Australian Standards

The requirements for CCT conductors that are above those contained in AS/NZS 3675:2002 are detailed in Table 1 below:

Table 1 – Requirements exceeding Australian Standards

Requirement	Description	Reference Section/Clause in this Specification
Concentricity	Concentricity of the covering on the conductor, calculated as the percentage deviation in the measured maximum and minimum covering thicknesses from the conductor, must not be greater than 15%.	5.2
Conductor markings	Height of the markings on the external surface of the CCT must be not less than 5mm	5.4.1
	Following additional markings are required on the external surface of the CCT: • Batch number; • Month and year of manufacture in format 'MM/YYYY'; and, • Nominal size of the conductor.	

Requirement	Description	Reference Section/Clause in this Specification
Drum Markings	Additional markings on the drum are: - • Australian Standard that the covered conductor complies to; • Manufacturer's drum serial number; • Endeavour Energy's purchase order number; • Endeavour Energy's stock code; • Finish number of the metre marking as on the outer end of the conductor; • Net mass of the conductor; • Month and year of manufacture of the conductor in format 'MM/YYYY'; and, • An arrow with the words "CONDUCTOR PULLING DIRECTION"	5.4.2
Discharging of conductors after testing	The covered conductors must be fully discharged from any residual test voltages/charges.	6
Sample test	Additional sample test for concentricity of the covering is required.	0

4.2 Health, safety and environment (HSE) requirements

The supplier must provide full details regarding the health and safety aspects of all the materials offered in their offer or supplied equipment regardless of content. The request items includes, but not limited to, the composition and toxicological information of the materials.

Recommended procedures must be provided for the safe handling, safe operation and maintenance of products supplied.

Material safety data sheets (MSDS) must be provided for each material used in the manufacturing of the covered conductor.

Suppliers are required to demonstrate if each component of the product can be recycled and/or disposed of at the end of products life (e.g. recycling of aluminium conductor). Any materials that cannot be recycled must be listed and recommended disposal / handling processes provided.

4.3 Quality assurance

The supplier must provide the following quality assurance documentation with their offer:

- Quality Management System certificate in accordance with AS/NZS ISO 9001:2016 or similar; and/or,
- Environmental Management System certificate in accordance with AS/NZS ISO 14001:2016 or similar.

4.4 Service history

The supplier must provide service history information for covered conductors to Endeavour Energy with the offer. As a minimum, the supplier must provide the following information:

- The period of service of the items being offered within the Australian environmental conditions;
- Australian customers or electricity supply authorities who have a service history of the items being offered; and,
- Contact names and telephone numbers of relevant employees of those customers/electricity supply authorities who can verify the service performance claimed.

5 Technical Requirements

All conductors must comply with the requirements specified in Table 2 below, which are based on the requirements from AS/NZS 3675:2002 and AS 1531:1991:

Table 2 – Technical requirements

Characteristic		Units	Acceptable values				
Operating voltage		*kV*	*6.35/11*				*12.7/22*
Conductor CSA		*mm²*	*40*	*80*	*120*	*180*	*120*
Maximum conductor operating temperature	**Normal operation**	°C	80				
	Emergency operation		100				
	Short-circuit operation (5s maximum)		210				
Short Circuit Rating for 1 second (80°C initial conductor temperature)		kA	3.7	6.8	11	16.2	11
Number of wires (strands)/nominal wire diameter in conductor		#/mm	7/2.75	7/3.75	7/4.75	19/3.50	7/4.75
Maximum diameter of a wire (strand)		mm	2.778	3.788	4.798	3.535	4.798
Minimum diameter of a wire (strand)		mm	2.723	3.713	4.703	3.465	4.703
Max. resistivity of wires (strands) at 20°C		μΩ.m	0.0293				
Calculated conductor DC resistance at 20°C.		Ω/km	0.713	0.383	0.239	0.163	0.239

Characteristic		Units	Acceptable values				
Operating voltage		*kV*	*6.35/11*				*12.7/22*
Conductor CSA		*mm²*	*40*	*80*	*120*	*180*	*120*
Interstrand conductivity	**Maximum DC resistance, when connected to all wires (strands) of outer layer, at 20°C**	Ω/km	0.727	0.391	0.244	0.166	0.244
	Maximum DC resistance, when connected to a single wire (strand) of outer layer, at 20°C		0.742	0.398	0.249	0.170	0.249
Covering thickness (for X-90UV compound)	**Minimum average thickness**	mm	3.40				5.50
	Minimum thickness (at any point)	mm	2.96				4.85
	Maximum thickness (at any point)	mm	4.00				6.40

5.1 Conductors

Conductors must be ungreased, all aluminium alloy (AAAC) 1120, in accordance with AS1531:1991.

A certificate of chemical composition from the ingot supplier that is used to manufacture the conductor must be submitted with the offer.

The conductor sizes must be as specified in Table 3 below. The conductor must be water blocked to prevent migration of water along the conductor. The water blocking compound must be a contrasting colour to that of the conductor.

Table 3 - Standard CCT conductor sizes

Item no.	Voltage rating (kV)	Conductor size (mm^2)	Stranding (number/diameter in mm)	Conductor material	Endeavour Energy stock code
1	6.35/11	40	7/2.75	AAAC/1120	1501204
2		80	7/3.75		1103910
3		120	7/4.75		1103928
4		180	19/3.50		1116540
5	12.7/22	120	7/4.75		1502020

5.2 Covering material

The conductors must be covered with a single layer of UV stabilised X-90 compound that complies with the requirements of AS/NZS 3808:2000. The UV stabilisation of conductor covering material must be achieved by means other than the addition of carbon black.

The colour of the UV stabilised X-90 covering material must be N53 - Blue Grey, in accordance with AS 2700:2011.

Covering of the completed covered conductor must also satisfy the concentricity requirement below:

$$\frac{t_{max} - t_{min}}{t_{min}} \times 100\% \leq 15\%$$

where:

t_{max} = thickness of covering measured at the thickest point; and,

t_{min} = thickness of covering measured at the thinnest point.

5.3 Preparation for delivery

The covered conductor must be supplied on timber drums manufactured in accordance with AS/NZS 2857:1996 and must be suitable for outdoor storage. The spindle holes must be fitted with steel spindle plates. Drums with spindle tubes will not be accepted.

Wooden drums must be treated or lined on both the barrel and the inner face of the flange with a robust and impervious material to prevent damage to the conductor due to leaching of wood acids. Details of the treatment used must be provided by the supplier and must include the MSDS for the treatment applied.

Where the supplier allows for the drum recycling option, the supplier will be responsible for transporting the empty cable drums, at their own cost, from Endeavour Energy's store to the manufacturing plant or holding facility for re-use.

The cable drums must meet the marking requirements detailed in Clause 5.4.2.

5.3.1 Winding of conductor on cable drums

Only one (1) continuous length of conductor shall be wound on each drum. The conductors must be wound in a manner such that there is no looseness between each layer.

The inner end of the conductor must be adequately secured to the drum (e.g. with the use of saddles) to prevent it becoming free during installation. The use of string to secure the inner end of a conductor to the drum is not permitted. The cable drum must be lagged to protect the cable from damage.

5.4 Markings

5.4.1 Covered conductor markings

The covered conductors must have markings embossed or printed on the external surface with a minimum character height of 5mm. The markings must be legible and durable.

All covered conductors must be marked on the external surface with the following information:

- A registered name or registered trade mark that enables the manufacturer of the covered conductor to be identified;
- Batch number;
- Month and year of manufacture in the form 'MM/YYYY';
- Metre marking in sequential numbers at one (1) metre intervals, with the lowest number at the inner end of the drum. The metre markings shall be limited to six (6) digits and any drum length may be started at any integral number;
- The applicable operating voltage as appropriate (e.g. 6.35/11kV or 12.7/22kV);
- The type of construction (e.g. CCT);
- Nominal size of the conductor; and,
- Conductor material, for example, AAAC/1120.

5.4.2 Cable drum markings

Each cable drum must be marked in accordance with the requirements of Clause 2.6, AS/NZS 3675:2002.

The following information must be on the drums:

- The complying Australian Standard for the covered conductor;
- A registered name or registered trade mark that enables the manufacturer of the covered conductor to be identified;
- Manufacturer's drum serial number;
- Endeavour Energy's purchase order number;
- Endeavour Energy's stock code (in accordance with Table 3);
- Type of construction (e.g. CCT);
- The applicable operating voltage (e.g. 6.35/11kV or 12.7/22kV);

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- The start number of the metre marking on the inner end of the conductor;
- The finish number of the metre marking on the outer end of the conductor;
- The conductor length on the drum;
- Nominal conductor size and material;
- Gross mass of the drum and the conductor;
- The net mass of the conductor on the drum;
- An arrow with the words “CONDUCTOR PULLING DIRECTION” marked on the outer face of both flanges; and,
- Month and year of manufacture of the conductor in format ‘MM/YYYY’.

6 Testing Requirements

All CCT conductors to be supplied must be type, sample and routine tested in accordance with this section of the specification, which is based on Table 3.1 of AS/NZS 3675:2002 and test reports must be submitted with the offer.

All CCT conductors must be fully discharged from any residual voltages / charge prior to being delivered to Endeavour Energy.

Type tests shall be repeated if any of the following events occur:

- Changes to the processes of manufacturing;
- Change to the design of the covered conductor;
- Changes to any materials used;
- Changes to the manufacturing technology;
- Changes in the source of raw materials; or
- Any other circumstances, at the discretion of Endeavour Energy.

6.1 Test accreditation and reporting requirements

All type tests must be carried out by a testing authority/laboratory holding accreditation:

- by NATA Australia; or
- by an accreditation authority recognised by NATA Australia.

Tests from other testing authorities may be accepted at the discretion of Endeavour Energy.

All type test reports must be accompanied by copies of the accreditation certificate(s) issued to the testing laboratory. The accreditation certificate(s) must be valid for the relevant test(s) and for the duration of the test(s).

Type tests must be less than five (5) years old. Type tests beyond this limit may be submitted provided sufficient information to demonstrate that the manufacturing process, raw materials, design and quality control processes have not significantly changed since the original test date is also submitted with the offer.

Separate type tests will be required for each manufacturing plant intended to be used for manufacturing covered conductors to this specification. For example, if a supplier sources covered conductors from more than one supplier, or a manufacturer operates more than one manufacturing facility, type tests will be required for each of the manufacturing facilities or sources of supply.

All routine tests may be conducted at the manufacturing facility's test laboratory on the condition that sufficient evidence is provided with the offer to demonstrate the testing facility's capability to perform the specified tests. As a minimum, the following information must be provided:

- Qualifications/experience of testing staff;
- Test procedures for all routine tests;
- Testing facility quality control procedures; and

- Test instrument calibration certificates/procedures.

All documentation submitted (including reports, tests, testing procedures/policies, calibration certificates and the like) must be in English. Where any documentation is in any language other than English, these will only be accepted if the reports are translated into English by an external translator.

All test reports must specify the size and voltage of the covered conductor tested, test assembly, procedure, test requirement and test results. Test reports only indicating that the items have passed without listing the test conditions above will be deemed non-compliant.

6.2 Type tests

Type test reports must include the results of all type, sample and routine tests, as specified in Table 4, Table 5 and Table 6 of this specification, for approval of the offered covered conductors to be used on Endeavour Energy's network.

6.2.1 Type test qualification ranges

A type test on a finished covered conductor of a stated conductor size and thickness of covering will qualify any other covered conductor with the same number of wires and thickness of covering. That is, a type test on a 80mm^2 conductor with 7 wires and a covering thickness of 3mm will qualify all other conductors with 7 wires and a covering thickness of 3mm.

A type test on a covering material from any conductor size and thickness of covering will qualify that material for any other covered conductor. Tests on covering material include Tests 2.1, 3 (h) and 3 (i) from AS/NZS 3675:2002 and are included in Table 4 below.

Where a cable is offered with a type test qualification range for validation, the supplier must provide a list of all conductors in the qualification range as an attachment to the qualifying conductor type test report.

6.2.2 Required type tests

The type tests required to be submitted with the offer are listed in Table 4 – Type test requirements.

Table 4 – Type test requirements

	Test required		Test reference in AS/NZS 3675:2002	Pass criteria
Tests on X-90UV covering material	**Mechanical tests (before ageing)**	**Tensile strength**	Table 3.1 Test 2.1	≥ 12.5MPa
		Elongation at rupture		≥ 200% (as a percentage of the unstretched length)
	Mechanical tests (after ageing)	**Tensile strength**		≥ 75% (percentage of the unaged specimens)
		Elongation at rupture		≥ 75% (percentage of the unaged specimens)
	Insulation resistance constant (k_i)			≥ 3000 GΩ.m at 20°C ≥ 3.0 GΩ.m at 90°C

	Test required	Test reference in AS/NZS 3675:2002	Pass criteria
Tests on completed covered conductor	**Dynamic water blocking test**	Table 3.1 Test 3 (d)	Water penetration < 2.0 mm.
	Adhesion test	Table 3.1 Test 3 (f)	No failures listed in Clause G6 (a), (b), (c) or (d) of Appendix G of AS/NZS 3675:2002 must occur.
	UV weathering test	Table 3.1 Test 3 (h)	Variation of the material properties (V) ≥ 0.8.
Tests on completed covered conductor	**Dripping test**	Table 3.1 Test 3 (i)	No dripping of blocking compound into tray.
	High voltage AC withstand test	Table 3.1 Test 3 (j)	No breakdown must occur after four (4) hours at: • 18kV rms for 6.35/11kV CCT; or, • 36kV rms for 12.7/22kV CCT.

6.3 Sample tests

To conduct the sample tests prescribed in Table 5 of this specification, samples must be selected such that one sample of finished covered conductor is taken from each production run or from each 10km of covered conductor, whichever is the lesser.
All samples must be tested for covering thickness.

The static water blocking test and stripping test, may be performed on a minimum of 20% of the randomly selected samples.

In case of any test failure, the selection of samples for retesting must be performed as described below:

- If any test specimen fails, then two further specimens must be taken from the same drum of covered conductor.
- If either of the two specimens from above fail, then that drum of covered conductor must be rejected, and each remaining drum of covered conductor in the production run must be tested.

6.3.1 Required sample tests

The sample tests required to be submitted with the offer are listed in Table 5 below.

Table 5 – Sample test requirements

	Test requirement		Test reference	Pass criteria	
Tests on X-90UV covering material	Hot set test	Elongation under load	AS/NZS 3675:2002 Table 3.1 Test 2.1	≤ 175%	
		Residual elongation after cooling		≤ 15%	
Tests on X-90UV covering material	Thickness of covering	Voltage	AS/NZS 3675:2002 Table 3.1 Test 3 (b)	6.35/11kV CCT	12.7/22kV CCT
		Min. average (mm)		3.40	5.50
		Min. at any point (mm)		2.96	4.85
		Max. at any point (mm)		4.00	6.40
Tests on completed covered conductor	Static water blocking test		AS/NZS 3675:2002 Table 3.1 Test 3 (c)	Water penetration < 2.0mm	
	Stripping test		AS/NZS 3675:2002 Table 3.1 Test 3 (e)	No water blocking compound left on the contact surface of the conductor	
	Concentricity		Clause 2.1 of AS/NZS 1660.2.1:1998.	Concentricity must comply with the following requirement : $\frac{t_{max} - t_{min}}{t_{min}} \times 100\% \leq 15\%$ where: t_{max} = thickness of covering measured at the thickest point; and, t_{min} = thickness of covering measured at the thinnest point.	

6.4 Routine tests

All routine tests as specified in Clause 6.4.1 below must be performed on all production lengths of completed covered conductors.

6.4.1 Required routine tests

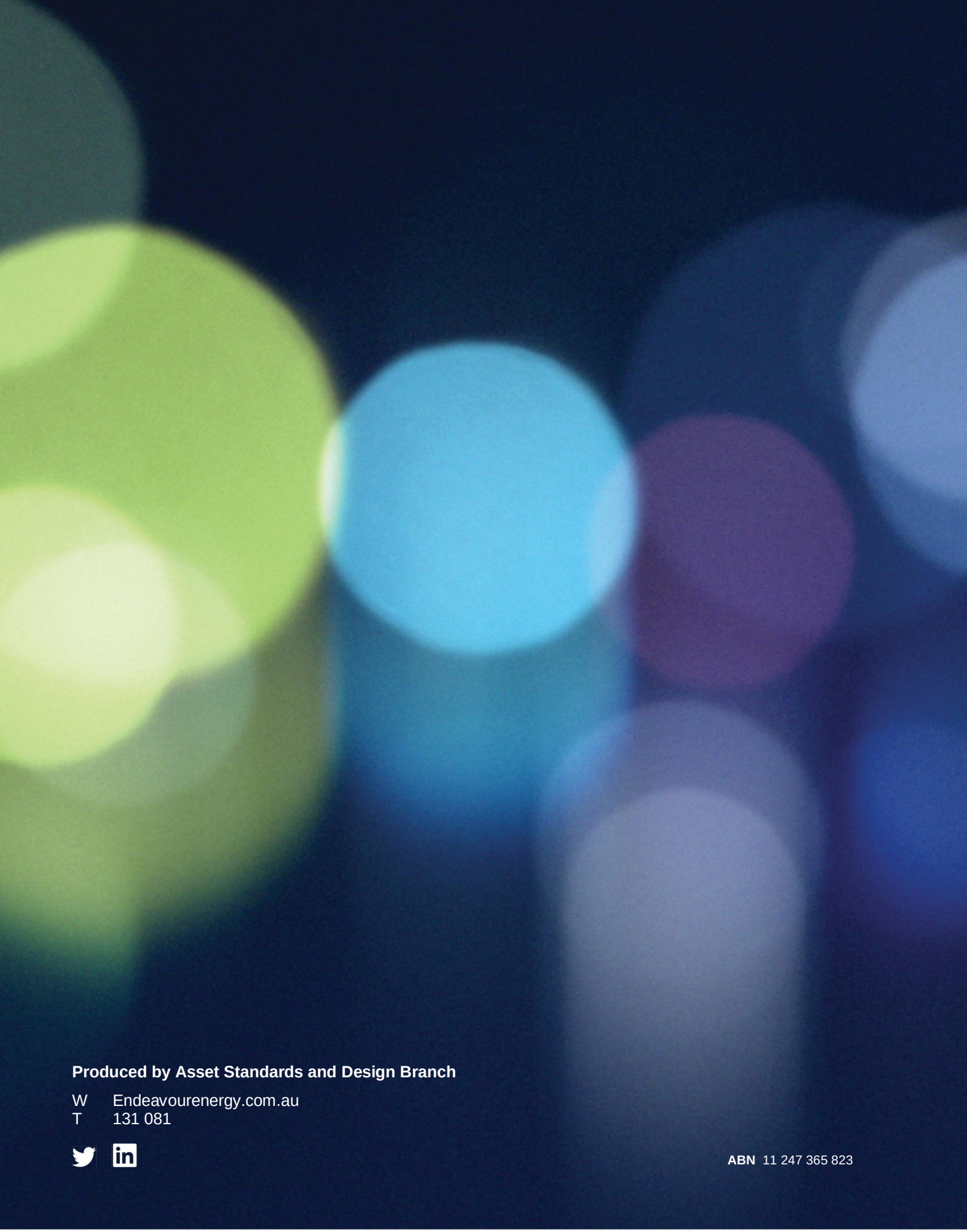
The routine tests required to be submitted with the offer are listed in Table 6 below.

Table 6 – Routine test requirements

	Test required		Test reference in AS/NZS 3675:2002	Pass criteria			
				40mm²	80mm²	120mm²	180mm²
Tests on wire before stranding	Wire diameter	No./size of strand	Table 3.1 Test 1 (a)	7/2.75	7/3.75	7/4.75	19/3.50
		Maximum diameter (mm)		2.778	3.788	4.798	3.535
		Minimum diameter (mm)		2.723	3.713	4.703	3.465
		Maximum ovality (%)		2	2	2	2
	Ultimate tensile strength (MPa)		Table 3.1 Test 1 (b)	250	240	230	240
	Wrapping test		Table 3.1 Test 1 (c)	No surface fracture			
	Resistivity test		Table 3.1 Test 1 (d)	≤ 0.0293 µΩ.m			
Tests on wire after stranding	Interstrand conductivity test	Max. resistance when connected to outer layer (Ω/km)	Table 3.1 Test 3 (a)	0.727	0.391	0.244	0.166
		Max. resistance when connected to a single wire (Ω/km)		0.742	0.398	0.249	0.170
	Spark test		Table 3.1 Test 3 (g)	No breakdown Test voltage must be either 25kV AC (rms) or 38kV DC.			

7 Authorities and Responsibilities

Role	Authority and Responsibilities
General Manager Asset Management	• Approving technical specifications including any variations. • Making all decisions concerning compliance in respect to this Specification. • Approving nominations of Endeavour Energy representatives. • Delegating any of these authorities and responsibilities to the Manager Asset Standards & Design.
Manager Asset Standards & Design	• Approving this instruction for minor changes and making recommendations to General Manager Asset Management for major changes in respect to this instruction. • Making recommendations concerning compliance in respect to this specification. • Making nominations of Endeavour Energy representatives.
Mains Assets Manager	• Keeping the contents of this instruction up to date. • Reviewing all test reports submitted and making recommendations to the Manager Asset Standards & Design.
Head of Procurement and Logistics	• Determining that all CCT conductors purchased by Endeavour Energy comply with the requirements of this specification.



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