



Ergon Energy Corporation Limited

Technical Specification for Optic Fibre Cable

ETS03-01-07

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1. Purpose and Scope

This specification sets out the requirements for the manufacture, testing and delivery of optical fibre cables for use on the electricity distribution network in a totally exposed environment.

Items covered by this technical specification, are listed as follows:

ITEM No.	ITEM DESCRIPTION	STOCK CODE
Fibre Optic Underground Cable with Termite Protection:		
1	Single Mode 12 Fibres	0104766
2	Single Mode 36 Fibres	0104441
3	Single Mode 48 Fibres	0104440
All Dielectric Self Supporting (ADSS) Overhead Optical Fibre Cable:		
4	Single Mode 12 Fibres – Short Span (0 – 150m)	0104765
5	Single Mode 36 Fibres – Short Span (0 - 150m)	0104444
6	Single Mode 36 Fibres – Long Span (150m – 500m)	0104443
7	Single Mode 48 Fibres – Short Span (0 - 150m)	0104442
8	Single Mode 48 Fibres – Long Span (150m – 500m)	0104439

2. References

2.1 Applicable Standards

The optical fibre cables shall be designed, manufactured and tested in accordance with the relevant parts of the following Standards and all amendments issued from time to time except where varied by this specification.

STANDARD	TITLE
AS/ACIF S008:2006	Requirements for Customer Cabling Products.
ITU Recommendation G.652	Characteristics of a Single-Mode Optical Fibre Cable (Zero Water Peak)
ANSI TIA-598C	Optical Fibre Colour Coding
AS 1049	Telecommunications Cable – Insulation, Sheath & Jacket.
AS 2857 - 1986	Timber drums for insulated electric cables and bare conductors
AS 3983	Metal drums for insulated electric cables and bare conductors
ISO 9002	Quality systems - Model for quality assurance in production, installation and servicing

3. Drawings

There are no drawings attached to this specification.

4. Environment

4.1 Aerial optical fibre cables will be exposed to the following environmental conditions:

DESCRIPTION	CONDITION
Temperatures	Not exceeding 45°C as determined by a shaded thermometer (Summer day time) Minimum -5°C (Winter night time)
Solar Radiation Level	1100 watts per square metre with high ultraviolet content
Precipitation	Tropical summer storms with gust wind speeds above 160km/h and an annual rainfall in excess of 1500mm
Atmospheric classifications	Areas of coastal salt spray and / or industrial pollution with equivalent salt deposit densities in the range of 2.0 – 3.0 g/m ²

4.2 Underground optical fibre cables will be exposed to the following environmental conditions:

DESCRIPTION	CONDITION
Installation	Installed directly buried in fine grain bedding material, or, in PVC conduits at a nominal depth of up to 1000 mm, with cable ends rising up concrete or timber poles and exposed to direct sunlight.
Ambient Air Temperatures	Not exceeding 45°C as determined by a shaded thermometer (Summer day time) Minimum -5°C (Winter night time)
Ambient Ground Temperatures	Not exceeding 30°C
Altitude	Not exceeding 500 metres above sea level
Humidity	90% high humidity combined with a high temperature (35°C) followed by a sudden drop in temperature of up to 10°C

Exposed sections of underground optical fibre cables will be subject to the service conditions described in Clause 4.1 above.

5. Design and Construction

5.1 General

5.1.1 Metal Free

The offered cables shall be completely metal free and shall comply with the product approval requirements of AS/ACIF S008:2006.

5.1.2 Standard product range

It is preferred that the cables be part of or become part of the standard product range produced by the manufacturer.

5.1.3 ITU-T Recommendation

The optical fibre cable as specified shall have single mode optical fibres in accordance with ITU-T Recommendation G.652.

5.1.4 Outside diameter – Short span

The outside diameter of the ADSS Short Span cable shall be between 14mm and 14.99mm.

5.1.5 Outside diameter – Long Span

The outside diameter of the ADSS Long Span cable shall be between 18mm and 18.99mm.

5.2 Optical Fibre Requirements

5.2.1 Fibre Type

The optical fibres will be **single mode** fibres with the following characteristics.

5.2.2 Fibre Characteristics

Single Mode:

The characteristics of each single mode optical fibre in the optical fibre cable will adhere to the ITU-T's recommendation G.652 and as follows:

Transmission wavelength	1310 nm and suitable for 1550 nm
Mode field diameter	9.2 ± 0.4µm at a transmission wavelength of 1310 nm.
Attenuation	Not greater than 0.40 dB/km at an optical wavelength of 1310 nm and 0.30 dB/km at 1550 nm
Point Discontinuity	Not greater than 0.1 db at 1310 and 1550 nm.
Cable Cut-off Wavelength	< 1260 nm
Zero dispersion	1312 +/- 10nm
Dispersion Slope at Zero dispersion Wavelength	≤0.093ps/(nm ² -km)
Optical cladding diameter	125 µm ± 1.0µm
Life span	Greater than 35 years

5.2.3 Fibre Coatings

The secondary coating is required to be a tight UV Acrylate coating and shall be easily removed by mechanical means for jointing purposes. Preference is likely to be given to fibres, which have a primary buffer coating of 250 ±15 micron low modulus UV, cured

Acrylate material. Thus Tenderers are encouraged to offer prices for totally UV cured Acrylate coated fibres where possible. Tenderers may offer more than one primary, buffer coating material. In such cases Tenderers should provide as much information as possible regarding the physical, mechanical, and transmission performance of such fibres, with particular regard to the relative susceptibility to hydrogen degradation compared with UV Acrylate coated fibre.

5.2.4 Identification of Individual Fibres

The colours of individual fibres and tubes as well as other cable components shall allow for the unique identification of individual fibres within the cable and shall be in accordance with AS/ACIF S008:2006.

5.2.5 Factory Joints

The fibres shall not be jointed within any un-installed cable length without prior approval by the Purchaser. Where such approval is given, there shall be a maximum of one (1) joint allowed in any continuous length. This joint shall have a two way average splice loss of less than 0.2 dB at 1310 nm and 1550 nm.

5.2.6 Point Loss in Un-Installed Cable

For the un-installed optical fibre cable there shall be no point loss (of any cause) in any single fibre, whose average two way attenuation exceeds 0.01 dB at 1310 nm and 1550 nm.

5.3 Cable Requirements

5.3.1 Moisture Exclusion

As the cable may be subjected to total water immersion, the cable shall comply with the requirements for water penetration specified in Clause 25, Method –F5B of IEC60794-1-2 to prevent the ingress of moisture and other impurities to the optical fibres.

Dry core water blocking techniques shall be used for all cables.

5.3.2 Cable Configuration

The configuration of the cable shall be such that it is arranged in tubes of twelve (12) fibres. Filler tubes will be used as required.

5.3.3 Cable Sheathing

- The cable sheath shall consist of material compatible with the hauling of cable through ducts and shall be resistant to insect and termite attack.
- The cable sheath shall be resilient to ageing and embrittlement from heat and ultraviolet radiation such that the life expectancy of the cable is a minimum of 35 years.
- The entire cable shall consist of electrically insulating material.
- Distance markings shall be provided on the cable (in metres) in order to assist possible fault location in the future.
- A cable number and “**Ergon Energy**” name shall be provided on the cable.
- Long Span ADSS cable shall be marked with the words “LONG SPAN”.
- The markings are to be legible and indelible and shall not reduce the effectiveness of the cable in resisting insect and termite attack.

5.3.4 Cable Design

- The cable is to be of non-metallic construction.

- The cable will incorporate a strength member of glass reinforced plastic or equivalent.
- The optical fibres shall not be constrained firmly against other fibres, strength members, moisture barrier compound or any other cable components in order that the fibre strain is de-coupled from the strain in other components when the cable is under tension.
- The preferred construction type is "Loose Tube".

5.3.5 Cable Mechanical Requirements

The cable must be able to withstand a directly applied long term crush loads of 1 kN per 100 mm without increase in optical attenuation for any fibre or any decrease in the integrity of the optical fibre cable over its designated lifetime. Test method as per IEC 60794-1.

5.4 Drawings

Tenderers shall provide detailed drawings of the cross-section of the items offered.

6. Performance and Testing

6.1 Tests

6.1.1 Standards

Cables shall be tested in accordance with the requirements of the relevant Australian Standards.

6.2 Routine Test

6.2.1 Attenuation

The attenuation of the fibre shall be tested using a 1310 nm & 1550 nm light source at one end of the fibre and an optical level metre at the other end.

6.2.2 Continuity

Continuity shall be tested at 1310 nm & 1550 nm by measuring backscattered light using an Optical Time Domain Reflectometer (OTDR), which is adjusted to see the whole length of the fibre. This measurement shall be done from both ends of each fibre.

6.2.3 Recording

The overall attenuation and the OTDR traces shall be recorded and shall form part of the test certificates.

6.3 All Dielectric Self Supporting (ADSS) Optical Fibre Cable

6.3.1 Type Tests

6.3.1.1 Graph

Tenderers shall provide a graph of cable strain versus fibre strain.

6.3.1.2 Results of Type Testing

Results of type testing previously carried out on the same ADSS type offered shall be provided at time of tendering.

6.3.1.3 Breaking Load Test

Following completion of the stress/strain test, the tension shall be increased until breakage load and the load at which the ADSS or fitting began to yield under tension shall be recorded.

6.3.1.4 Crushing Force Test

A sample of the optical fibre core shall be subjected to a lateral crushing force, which shall be slowly increased from zero. The transmission characteristics of the optical fibres shall be continuously monitored. A graphical plot of transmission loss versus lateral force shall be prepared. The lateral force shall be increased until the change in transmission loss of the optical fibres exceeds 0.1dB, test method as per IEC60794-1.

6.3.2 Routine Tests

The optical fibre attenuation and continuity for each fibre of each cable drum length shall be measured and recorded prior to shipment from the manufacturing plant. The test results shall include date of test, drum number, drum length and names of test personnel.

6.4 Underground Optical Fibre Cable

6.4.1 Type Tests

6.4.1.1 Results of Type Testing

Results of type testing previously carried out on the same underground type cable offered shall be provided at time of tendering.

6.4.1.2 Breaking Load Test

Following completion of the stress/strain test, the tension shall be increased until breakage load and the load at which the underground cable began to yield under tension shall be recorded.

6.4.1.3 Crushing Force Test

A sample of the optical fibre core shall be subjected to a lateral crushing force, which shall be slowly increased from zero. The transmission characteristics of the optical fibres shall be continuously monitored. A graphical plot of transmission loss versus lateral force shall be prepared. The lateral force shall be increased until the change in transmission loss of the optical fibres exceeds 0.1dB, test method as per IEC60794-1.

6.4.2 Routine Tests

The optical fibre attenuation and continuity for each fibre of each cable drum length shall be measured and recorded prior to shipment from the manufacturing plant. The test results shall include date of test, drum number, drum length and names of test personnel.

6.5 Tests after Delivery

The cables may be subject to tests after delivery at Ergon Energy's expense. Ergon Energy reserves the right to reject all cables not in conformance with this Specification or the successful Tenderer's guaranteed parameters. All rejected cables shall be replaced by the successful Tenderer at the successful Tenderer's expense.

6.6 Test Certificates

6.6.1 Supply of Test Certificates

Test certificates shall be supplied by the successful Tenderer for all tests required by this Specification.

Payment under the Contract shall not become due and payable unless and until test certificates are received by Ergon Energy in accordance with the following:

6.6.1.1 Type Test Certificates

All type tests shall be completed and certificates submitted as part of the tender response.

6.6.1.2 Routine Test Certificates

Routine test certificates shall be submitted prior to the dispatch of the cable from the manufacturing plant.

7. Risk Assessment

There is no requirement for manufacturer provided safety risk assessments for the items covered by this specification.

8. Quality Assurance

8.1 Purchasers Policy

It is the Purchaser's policy to procure goods, equipment and services from sources that demonstrate the ability to supply quality products.

8.2 Documentary Evidence

Documentary evidence shall be provided concerning the level of quality system certification associated with the Tenderer and/or Manufacturer. This documentation shall include the Capability Statement associated with the Quality System Certification.

9. Samples

9.1 Production Samples

When requested, production samples of each item offered shall be submitted to assist in the evaluation of the offer.

Each sample shall be delivered freight free, suitably packaged and labelled with the following information:

Name of Supplier and this Contract No.
Contract Item Numbers
Any supporting data on features or characteristics

10. Packaging and Marking

10.1 General

10.1.1 Damage Free

It is the appointed supplier's responsibility to ensure that the fibre optic cable is delivered on site damage free. Storage, packaging, delivery to site and all other aspects of cable protection are the responsibility of the Tenderer.

10.1.2 Drum standards

Optical fibre cables may be supplied on either timber drums or steel drums complying with the requirements of AS 3983.

10.1.3 Standard for Timber Drums

Operational difficulties are anticipated with the use of cable drums manufactured in accordance with AS 2857-1996. Hence this specification is based on cable supplied on timber drums manufactured in accordance with the requirements of superseded standard AS 2857-1986.

10.1.4 Drum sizes

Optical fibre cables shall be supplied on drum sizes and in the lengths as detailed in Appendix A.1 to this specification.

10.1.5 Length

The cable shall be in one (1) length on each drum.

10.1.6 Winding

The cable shall be wound in such a way as to preclude the possibility of chafing or damage to the cable during winding and transport. The winding tension shall be as low as possible, being only as high as that required to minimise movement of cable between adjacent layers.

10.2 Lagging

The cable shall be protected by external lagging to ensure that it is delivered undamaged giving due consideration to the methods and distance of transportation and handling.

Sheet form wrapping alone is **NOT** acceptable.

10.3 Drum Durability

All drums must be of suitable quality and robustness to withstand a minimum of months twenty-four (24) exposure to all types of weather conditions during outdoor storage without deterioration.

10.4 Drum Surface Treatment

Drum surface treatment to protect against weather, the environment, galvanic action, and corrosion is required.

Suppliers shall state the type of surface treatment applicable to drums for each item.

10.5 Marking of Drums

10.5.1 Standard

The marking of information on the cable drum shall be in accordance with Clause 16.3 of AS / NZS 5000.1. In addition, the following information shall be provided indelibly and legibly marked directly on the flanges:

- a) The name Ergon Energy and the relevant stores stock code.
- b) Contract number.
- c) Order release authority or purchasing order number.
- d) Manufacturer's traceability number – derived from Manufacturer's first letter, hyphen, batch number, hyphen, drum number for this batch.

10.5.2 Size and location

Marking at least 25 mm high shall be located on both outside flange surfaces near the spindle.

10.5.3 Direction of rolling

Drums shall be marked with the preferred direction of rolling.

10.5.4 Additional Information to be provided

The following information shall also be provided:

ERGON ENERGY
All Dielectric Optical Fibre Cable
Contract No.
Purchase Order Number

10.6 Fixing of Cable End

The inner end of the cable shall be secured to the drum to ensure that the end will not flick off the drum barrel when the cable is being run out.

10.7 Quarantine Requirements

Should the items offered be supplied from overseas manufacturers, then it is mandatory that all conditions and inspections required by the Australian Quarantine Act be met and that all these costs be included in the tendered price. In particular, timber crates must be fumigated with methyl bromide with a concentration of 48 grams per cubic metre for 24 hours at 21 C. The supplier shall ensure that the procedure does not produce any deleterious effects to the cable or the drums.

11. Service Performance

Suppliers shall state:

- (a) the period of service achieved by the items offered within Australian service conditions;
- (b) Australian electricity supply authorities who have a service history of the items offered; AND
- (c) Contact names and phone numbers of relevant employees of those supply authorities who can verify the service performance claimed.

12. Reliability

12.1 Service Life

Suppliers are required to comment on the reliability of the cables and the performance of the materials offered for a service life of 35 years under the specified system and environmental conditions.

12.2 Evidence in Support of Reliability

Such comments shall include evidence in support of the reliability and performance claimed including information on Failure Mode and Effect Analysis.

13. Training

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

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

- Handling
- Storage
- Application (particularly in areas of heavy coastal pollution)
- Installation
- Maintenance
- Environmental performance
- Electrical performance
- Mechanical performance
- Disposal

14. Environmental Considerations

Suppliers are required to comment on the environmental soundness of the design and the materials used in the manufacture of the items offered. In particular, comments should address such issues as recyclability and disposability at the end of service life.

15. Information To Be Provided

15.1 Specific Technical Requirements

The specific technical requirements for the items offered shall be as stated in **Attachment 1** of this specification. The supplier shall provide all details requested by **Attachment 1** and shall guarantee such data.

15.2 Checklist of Supporting Documentation

Attachment 2 details a checklist of supporting technical documentation which is required to be submitted with the offer.

15.3 Fibre Information

15.3.1 Fibre Characteristics

The Tenderer is required to supply the following:

- (a) A graph of attenuation versus wavelength over the range of 700 nm to 1700 nm for single mode fibres.
- (b) A typical graph of fibre attenuation for the 1310 nm & 1550 nm wavelength for single mode fibres for the temperature range of 5°C to 75°C.
- (c) Details for the strength of the fibres.
- (d) A graph of attenuation versus cable strain for each cable offered.
- (e) Information on the chromatic dispersion co-efficient in ps/km/nm with respect to zero dispersion wavelength in the region of 1310 nm and 1550 nm for single mode fibre.

- (f) Information on the Dispersion Slope at Zero Dispersion Wavelength in $\text{ps}/(\text{nm}^2\text{-m})$

15.3.2 Fibre Performance

Tenderers shall provide information regarding the physical, mechanical, and transmission performance of fibres, with regard to the relative susceptibility to hydrogen degradation.

15.3.3 Field Jointing

Tenderers shall provide details of their fibres performance to different jointing techniques (including arc fusion and mechanical splicing), preferably in the form of histograms showing minimum obtainable splice losses.

15.4 Information on Cable

15.4.1 Moisture Exclusion

Full details of the water blocking compound shall be supplied by the Tenderer, including the method of removing the compound prior to cleaving and splicing.

15.4.2 Cable Sheathing

The Tenderer must include in the tender documents information detailing the design and performance of the sheath and jacket of the cables offered to demonstrate that the cable is adequate for a 35 year service life time. The information should include

- The material used as the outer sheath.
- Effectiveness of resisting pest attack as described in Clauses 4.1 and 4.2.
- The thickness of the outer sheath.
- Resistance to environmental stress cracking and thermal and ultraviolet radiation ageing.

15.4.3 Cable Design

The Tenderer is to provide details of the design of the cable. The documentation provided will include a cross section of the cable, nominating the materials used on the drawing and any other relevant information.

15.4.4 Material Properties

The Tenderer shall supply a full listing of the material components used in the cable with details on toxicity and safe handling of the materials.

15.4.5 Fibre Colours

Tenderers are required to supply details of the colour of fibres.

15.4.6 Fibre Tube Colours

Tenderers are required to supply details of the colour of fibres tubes

15.4.7 Vibration Testing

The Tenderer will supply results of vibration resistance tests.

15.4.8 Service Lifetime

The Tenderer will supply information to support a cable life time of 35 years for the environmental conditions listed in Clause 4.1. Details as to potential damage to fibres caused by cable materials with particular reference to hydrogen producing agents will be included.

15.4.9 Sag-Strain Characteristics for Aerial Cables

The fibre optic cable must have sag-strain characteristics to enable its installation onto existing power poles while maintaining clearances to low and high voltage mains and statutory clearances. The Tenderer shall supply stringing chart(s) or tables showing optical fibre strain and sag-tension information for the following conditions:

Range of spans	0-250 m in steps of 20 m.
Range of cable tensions	0-100% of the maximum recommended cable tension.
Range of temperatures	5°C to +75°C in steps of 5°C.

Tenderer to indicate the constant horizontal tension (@ 15°C no wind).

The Tenderer shall supply details of all assumptions used in calculating stringing chart(s) or tables.

15.5 Cable Installation Information

The Tenderer will nominate any special requirements that Ergon Energy will need to adhere to during the installation of the fibre to ensure that the cable is installed damage free and the lifetime of the installation is not unnecessarily reduced.

16. Appendix A.1 – Drum and Packaging Details

UNDERGROUND CABLE

Drum	Designation	Cable Code	Nominal Length (m/drum)
Timber	Metal		
1600/1100/1100	1600/800/1000	SM 36	4000
		SM 48	4000
		SM 12	4000

OVERHEAD CABLE

Drum	Designation	Cable Code	Nominal Length (m/drum)
Timber	Metal		
1600/1100/1100	1600/800/1000	SM 36	4000
		SM 48	4000
		SM 12	4000

17. Attachment 1 – Cable Performance - All Cables

NOTE: A separate schedule is to be provided for each item offered except for details common to all items which only needs to be provided once.

PARTICULARS	UNITS	ITEM No.
Manufacturer's Name and Address		
Place of Manufacture		
Cable Details:		
Nominal Overall Diameter	mm	
Calculated Breaking Load	kN	
Maximum permissible cable tension	kN	
Effective Cross Sectional Area	mm ²	
Effective Modulus of Elasticity	GPa	
Coefficient of Linear Expansion	per °C	
Nominal Mass	kg/km	
Maximum permissible cable strain	% strain	
Guaranteed strain free window	% strain	
Minimum permissible cable bending radius		
<ul style="list-style-type: none"> • No tension • Maximum permissible tension 	mm mm	
Minimum permissible radius of stringing sheaves	mm	

SIGNATURE OF TENDERER: _____

18. Attachment 1 – Cable Performance - All Cables (cont'd)

PARTICULARS	UNITS	ITEM No.
Packaging Details:		
Type of Drum		
AS 2857-1986 Drum Designation		
AS 3983-1991 Drum Designation		
Spindle Hole Diameter	mm	
Method of Lagging		
Length of Conductor per Drum	m	
Gross Mass of Drum, Conductor and Protective External Lagging	kg	
Mass of Drum and Conductor	kg	
Drum Surface Treatment: Barrel:		
Drum Surface Treatment: Internal Surface of Flanges		
Metal Drum: Protection Against Weather or Environment		

SIGNATURE OF TENDERER: _____

19. Attachment 2 – Technical Details – Fibre Performance

NOTE: A separate schedule is to be provided for each item offered except for details common to all items which only needs to be provided once.

PARTICULARS	UNITS	ITEM No.
SINGLE MODE:		
Mode field diameter at 1310 nm	µm	
and Tolerance	%	
Attenuation (at zero fibre tension)		
• At 1310 nm	dB/km	
• At 1550 nm	dB/km	
Maximum permissible fibre strain	% strain	
Fibre Proof test strain	% strain	
Attenuation (at Maximum permissible fibre strain)		
• At 1310 nm	dB/km	
• At 1550 nm	dB/km	
Optical cladding diameter	µm	
and Tolerance	%	
Dispersion		
• 1270 to 1340 nm	ps/km.nm	
• 1550 nm	ps/km.nm	
Dispersion Slope at Zero Dispersion Wavelength	ps/(nm ² -km)	
Maximum continuous operating temperature	°C	
Minimum bending radius for coated optical fibre		
• Under no tension	mm	
• Under maximum tension	mm	

SIGNATURE OF TENDERER: _____

20. Attachment 3 – Technical Documentation Checklist

CLAUSE Ref.	PARTICULARS	UNITS
Have full and comprehensive details been submitted WITH the tender documents associated with each of the following items?		
5.4	Drawings of conductor cross-section	Yes/No
8.2	Quality systems of BOTH the SUPPLIER and the MANUFACTURER	Yes/No
11	Service Performance	Yes/No
12	Reliability	Yes/No
13	Training materials	Yes/No
14	Environmental considerations	Yes/No
15	Completed Attachment 1 and Attachment 2	Yes/No

NAME OF TENDERER:

ADDRESS OF TENDERER: _____

SIGNATURE: _____ FOR AND ON BEHALF OF TENDERER

DATE: _____