

# Electricity Specification 400C25

Issue 3      October 2021

## Overhead Line Conductors Carrying Optical Fibres



## Amendment Summary

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## 1 Introduction

This Specification comprises general requirements for approvals and testing of optical phase conductors (OPPC) and optical ground wire conductors (OPGW) employed on the overhead line network owned and operated by Electricity North West Limited (Electricity North West). Schedules of data to be provided by the supplier are included in [Appendix A](#).

OPPCs and OPGWs are to be used on overhead lines, where optical communications are required. Note that in this context the term “ground” is used in place of “earth” to allow the use of the common acronym “OPGW”.

OPPCs and OPGWs shall be capable of replacing equivalent, existing conductors, on the overhead line network. Both OPPCs and OPGWs are referred to as conductors throughout this specification, except where there is a need to differentiate.

## 2 Scope

This specification covers the requirements for optical fibres to be incorporated into a phase conductor or an earthwire (ground wire) conductor. OPPCs and OPGWs are intended to be direct replacements for the conventional equivalent conductors used on wood pole lines or steel tower overhead lines of PL1, PL4, PL9, PL10, PL16, L2, L3, L4, L7, L9 or L132 construction operating at 33kV or 132 kV. A list of OPPCs and OPGWs is included in Appendix B.

## 3 Definitions

<b>Approval</b>	Sanction by the Electricity North West Overhead Line Circuits Manager that specified criteria have been satisfied
<b>Contract</b>	The agreement between Electricity North West and the Contractor for the execution of the Works including therein all documents to which reference may properly be made in order to ascertain the rights and obligations of the parties under the said agreement.
<b>Contractor</b>	The person or person's firm or company, including personal representatives, successors and permitted assigns, who's Tender has been accepted by Electricity North West.
<b>ENA TS</b>	Energy Networks Association Technical Specification.
<b>OPPC</b>	Optical Phase Conductor.
<b>OPGW</b>	Optical Ground Wire.
<b>Specification</b>	The Specifications and schedules (if any) agreed by the parties for the purpose of the Contract.

<b>Sub-Contractor</b>	Any person (other than the Contractor) named in the Contract for any part of the Works or any person to whom any part of the Contract has been sub-let with the consent in writing of the Electricity North West Overhead Line Circuits Manager, and the legal representatives, successors and assigns of such person.
<b>Supplier</b>	Any person or person's firm or company who supplies goods to Electricity North West or to its Contractor.
<b>Tender</b>	An offer in writing to execute work or supply goods at a fixed price.
<b>Tenderer</b>	The person or person's firm or company, including personal representatives, successors and permitted assigns, invited by Electricity North West to submit a Tender.

## 4 General Requirements for Approvals and Testing

### 4.1 Product not to be Changed

No change in the product, packaging or labelling shall be made after Approval has been granted without prior notice to the Electricity North West Overhead Line Circuits Manager, and receipt of a written agreement to the proposed change from the Electricity North West Overhead Line Circuits Manager.

### 4.2 Electricity North West Technical Approval

The Tenderer shall submit, with this Tender, proposals for testing which will demonstrate, to the satisfaction of the Electricity North West Overhead Line Circuits Manager, compliance with this Specification. Such tests shall be carried out without expense to Electricity North West.

Alternatively, technical reports and other data may be submitted that the Tenderer considers will demonstrate, to the satisfaction of the Electricity North West Overhead Line Circuits Manager, compliance with this Specification. Acceptance of this evidence shall be at the discretion of the Electricity North West Overhead Line Circuits Manager but will not be unreasonably withheld.

Approval shall be 'factory specific' and is not transferable to another factory without the written Approval of the Electricity North West Overhead Line Circuits Manager.

The Supplier and product shall comply with all the relevant requirements of Electricity North West documents EPD311 and CP311.

### 4.3 Quality Assurance

The Tenderer shall confirm whether or not Approval is held in accordance with a quality assurance scheme accredited under ISO 9000. If not, the Tenderer shall submit a statement of the quality assurance procedures employed to control the quality of the product, including the performance of Suppliers and Sub-Contractors.

The right is reserved for the repeat of such tests, from time to time, that the Electricity North West Overhead Line Circuits Manager may deem to be reasonably necessary to demonstrate continued compliance with the Specification.

The Tenderer shall submit, with the Tender, a list of tests and inspections which are carried out on the product prior to despatch which shall demonstrate, to the satisfaction of the Electricity North West Overhead Line Circuits Manager, fitness for installation and service.

The Tenderer shall provide free of charge to Electricity North West such samples as may, in the opinion of the Electricity North West Overhead Line Circuits Manager, be reasonably required for inspection and/or retention as quality control samples. The Electricity North West Overhead Line Circuits Manager will confirm the requirement for samples at the time of Tendering.

The right is reserved for inspections to be made of Tenderer's facilities, from time to time, as deemed reasonably necessary by the Electricity North West Overhead Line Circuits Manager to ensure compliance with this Specification and any Contract of which it forms a part.

The Tenderer shall submit, with the Tender, such details of product packaging disposal, as will enable Electricity North West to comply with the requirements of BS EN ISO 14001 - Environmental Management Systems.

#### **4.4 Formulation**

The Tenderer shall submit, with the Tender, such details of the formulation and use of the product and associated substances as will enable Electricity North West to comply with the obligations of the Health and Safety at Work Act 1974 and the Control of Substances Hazardous to Health Regulations 2002, in the use, storage and disposal of the product. The Tenderer may stipulate, prior to submission of such information, that it is to remain confidential, and the Electricity North West Overhead Line Circuits Manager will, if requested, confirm agreement to this prior to receipt of the information.

#### **4.5 Identification Markings**

The Tenderer shall submit, with the Tender, details of markings which it is proposed to apply to the product or packaging to identify manufacturing batches or items. The forms and content of such markings shall be subject to the Approval of the Electricity North West Overhead Line Circuits Manager and shall in all cases include the Electricity North West approved description and commodity code number.

The Tenderer shall submit, with the Tender, such details of marking gross weight on components, assemblies and packages, as will enable Electricity North West to comply with the Health and Safety Manual Handling Operation Regulations 1992, for components, assemblies and packages supplied with a gross weight over 1kg. The forms and content of such markings shall be subject to the Approval of the Electricity North West Overhead Line Circuits Manager.

#### **4.6 Minimum Life Expectancy**

The minimum life expectancy of all products covered by this Specification is 40 years.

#### **4.7 Product Conformity**

Preference will be given to those Suppliers who can provide suitable product conformity certification to a recognised or specified standard, or an equivalent certification.

## 4.8 Confirmation of Conformance

The Tenderer shall complete the conformance declaration sheets in [Appendix C](#). Failure to complete these declaration sheets may result in an unacceptable bid.

## 5 Requirements for Type and Routine Testing

The Electricity North West Overhead Line Circuits Manager shall set out the requirement of the following tests to be carried out by the Supplier at the Supplier's cost.

### 5.1 Requirement for Type Tests at Suppliers Premises

These are a series of one-off type tests, which are carried out to ensure the satisfactory performance of the product design, under extremes of operating stresses, and of endurance, as may be appropriate, to be determined by the Electricity North West Overhead Line Circuits Manager.

These may or may not be destructive tests.

### 5.2 Requirement for Routine Tests at the Supplier's Premises

These tests may be required to be carried out on every individual unit or component, as specified, or at some regular frequency to be determined by the Electricity North West Overhead Line Circuits Manager.

The results of these tests may be required to be supplied to Electricity North West with each unit purchased or retained for inspection, at a period to be determined by the Electricity North West Overhead Line Circuits Manager.

## 6 General Technical Requirements

### 6.1 Overall Conductor Performance

The OPPC or OPGW supplied shall be suitable for installation on Electricity North West's overhead line network and shall, at Electricity North West's request, be supplied with all the necessary fittings and optical splice enclosures, including insulators to separate the fibre optic cable from the conductor and intermediate splice canisters. (The conductor will normally be erected by full tension stringing or by cradle-block stringing techniques.) Overhead line types on which these conductors are to be erected are denoted in the Scope.

A schedule of all OPPCs and OPGWs is included in [Appendix B](#).

The conductor shall meet or exceed the performance characteristics in [Table 1](#) and ES400C3 or ES400C4.

The conductor shall be at least a double layer construction with opposite lay consisting of aluminium alloy or steel strands with a minimum of two optical sub-units containing optical fibres. The conductor shall perform all the duties of an equivalent Electricity North West Approved conductor.

The conductor shall be produced in continuous lengths up to 2.5km; the individual supply contract will give specific details of the routes and the length to be supplied.



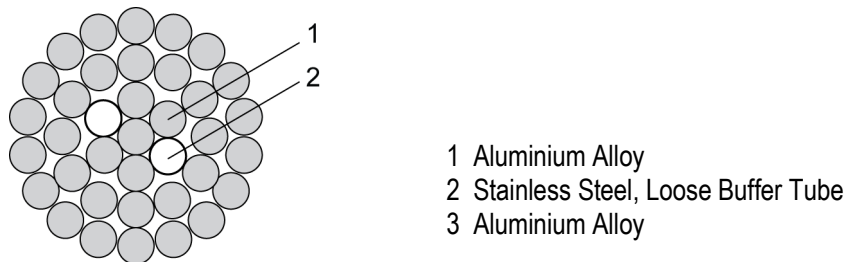
## 6.2 Optical Sub-Unit

### 6.2.1 General

The optical cable shall contain forty-eight optical fibres. The fibres shall meet the requirements of [Section 9](#) of this specification. Only Electricity North West Approved Fibres may be installed in the optical sub-unit.

Optical fibres shall be contained within a minimum of two buffer tubes and be loosely buffered. The tubes shall be of stainless steel. An example cross-section is illustrated in [Fig. 1](#) below.

**Figure 1 – Example Conductor Cross-Section Incorporating Optical Sub-unit**



### 6.2.2 Buffer Tube Identification

A permanent method of identification of the buffer tubes housing the optical fibres shall be specified on the manufacturer's data sheet.

The buffer tube identification shall be indelible to the cleaning chemicals and procedures commonly used for preparation of the tubes for fibre splicing.

Buffer tubes shall be filled with a gel compound to provide resistance to water penetration, vibration damping and for shock absorption. The filling compound shall pass the bleed test specified in [Table 1](#).

The conductor shall be designed such that strain is not directly imparted to the optical fibres in service.

No buffer tubes shall be in the outer layer of the conductor.

The conductor shall be designed so that the optical sub-unit has a strain margin such that strain of less than 0.1% is directly imparted to the optical fibres in service under maximum wind and or/ice load conditions. The load limit conditions shall be determined according to BS EN 50341. The manufacturer shall state the optical fibre strain margin of the conductor design.

**Table 1: Performance Characteristics Optical Sub-Unit**

CHARACTERISTIC	LIMITS	TEST METHOD IEC 60794-1-2
Tensile Performance <sup>(i) (ii)</sup>	90% Minimum NBL	IEC 60794-4-1 para 8.2
Temperature cycling; 4 cycles <sup>(ii)</sup>	-30 to +60°C	F1
Water penetration	-	F5
Bleeding of water blocking gel 24 h 60°C	none	E15
Notes:		
(i) The performance requirements relate to the conductor optical sub-unit. The conductor tension is to be applied with dead end fittings to be supplied with the conductor for installation.		
(ii) The attenuation of the fibres shall not increase by more than 0.05dB during the test. There shall be no permanent change in attenuation of the fibres after completion of the test.		

The optical sub-unit shall withstand the temperature rise associated with fault current flowing in the conductor without damage. The specific performance parameters are detailed in [Section 7.1.2](#).

The manufacturer shall supply tooling for cutting the stainless steel buffer tubes in preparation for splicing. The tools shall cut the tubes without leaving an internal burr on the tube.

Before shipment, the conductor shall be capped to prevent the ingress of water into the optical sub-unit.

### 6.2.3 Fibre Identification

Each conductor shall contain 48 fibres grouped into bundles of eight. Each fibre in each bundle shall be identified as follows:

- 1 Blue
- 2 Orange
- 3 Green
- 4 Red
- 5 Grey (slate)
- 6 Yellow
- 7 Brown
- 8 Violet

The manufacturer's data sheet shall specify how fibres of the same colour, but in different bundles, shall be identified.

## 6.3 Test Results and Fibre Data

Hard copy of test results and fibre data from this specification are to be attached to the cable drum (protected from weather) and a soft copy of the test results shall be sent to the Electricity North West Overhead Circuits Manager in charge of contract.

## 7 Test Requirements

### 7.1 Type Tests

Type tests are required to verify the characteristics of the conductor, which depend mainly on its design and the manufacturing process. The manufacturer shall produce documentary evidence to show that the following type tests have been satisfactorily completed.

#### 7.1.1 Fatigue Life

The manufacturer shall produce test data or offer other evidence to show that the fatigue life of the conductor including that of the optical sub-unit is in excess of  $10^8$  cycles at a peak to peak amplitude corresponding to  $300\mu$  strain on the outer strands at the last point of contact with a metal clamp with a radius similar to a suspension clamp.

#### 7.1.2 Fault Current $I^2t$ Measurement

A sample of conductor shall be raised to an initial temperature of  $30^\circ\text{C}$  and the rated  $I^2t$  pulse in ES300C3 or ES400C4 shall be applied in less than 1s following the method described in IEC 60794-4-1 E.

During the test, the temperature of the optical sub-unit shall be measured. The maximum temperature attained shall be less than the maximum temperature specified by the manufacturer and shall not lead to deterioration of the optical performance of the conductor within its 40-year design life.

This test shall be completed twice; the second test shall be completed within 30 minutes of the first test. Finally, the conductor shall be dismantled, and the optical sub-unit examined along its length for any signs of deterioration. The examination shall be carried out with normal or corrected vision, without any magnification.

#### 7.1.3 Lightning Simulation

The mid-point of a sample of conductor shall be subjected to a simulated lightning strike as described in IEC 60794-4-1 F, having the four consecutively applied components defined in [Table 2](#).

Following the complete test, the strength of all strands shall be measured. The total residual length, including that of any other metal parts, shall be greater than 75% of the Nominal Breaking Load (NBL) stipulated in ES400C3 or ES400C4. There shall be no visible damage or deterioration to any part of the optical sub-unit including any sheath. The examination shall be carried out with normal or corrected vision, without any magnification.

**Table 2: Simulated Lightning Strike**

COMPONENT	PARAMETER	VALUE	TOLERANCE
Initial Stroke	Peak Current	200kA	±10%
	Action Integral	2(kA) <sup>2</sup> S	
	Pulse Length	<500uS	
	Rise Time	<25uS	
Intermediate Current	Mean Amplitude	2kA	±10%
	Pulse Length	<5ms	±10%
	Charge Transfer	10C	
Continuing Current	Amplitude	200 – 800A	±10%
	Duration	250 – 1000ms	
	Charge Transfer	200C	
Re-strike	Peak Amplitude	100kA	±10%
	Action Integral	0.25 (kA) <sup>2</sup> S	
	Pulse Length	<500uS	

### 7.1.4 Running Blocks

A sheave test shall be carried out to demonstrate that the running blocks specified for conductor erection by tension stringing or cradle block shall not damage the conductor mechanically or optically. For tension stringing, running out block tests shall be conducted at the maximum stringing tension.

Where the optical sub-unit is contained in stainless steel buffer tubes after the running out block tests the earthwire shall be dismantled for examination. There shall be no indentation in the buffer tubes.

### 7.1.5 Temperature Cycling

The test shall be conducted in accordance with IEC 60794 with TA = -30°C, TB = +60°C and the duration t1= 4 hours.

## 7.2 Sample Testing

Sample tests shall be performed on 10% of the drums in a lot in accordance with ES400C3 or ES400C4 except as modified below.

The mechanical tests on aluminium and aluminium alloy wires shall be taken on straightened samples of individual wires taken after conductor stranding. In the event of the sample from any length not passing the mechanical or resistivity tests, a second and third sample shall be taken from the same length, and if one of these also fails under test, the length of conductor from which it has been taken shall be rejected.

The measurement of wire diameter, conductor lay ratio and the tolerances shall be as defined in ES400C3 or ES400C4.

The torsion test for steel wires shall be performed.

A 1000mm length of conductor shall be cut from the end of the drum and dismantled to inspect the internal surfaces to ensure they are free of nicks and cuts imperfections. The mass of grease shall also be measured to ensure that the mass is between the minimum and maximum as specified in ES400C3 or ES400C4.

The manufacturer shall provide evidence that the minimum breaking load and the maximum DC resistance for the complete conductor do not exceed the values stipulated in ES400C3 or ES400C4.

### **7.3 Routine Testing**

All Conductor and fittings shall be subjected to routine inspection according to a schedule proposed by the manufacturer to prove that the design performance requirements are being achieved. An optical performance test will be required at the factory on every cable drum, performed at the single mode wavelengths 1310nm & 1550nm using an Optical Time Domain Reflectometer (OTDR).

### **7.4 Site Tests (where applicable)**

Optical testing shall be performed at the single mode wavelengths 1310nm and 1550nm using an OTDR. Results shall be presented to the Electricity North West Overhead Circuits Manager in both PDF and the current bellcore OTDR file format on CD.

If the supply forms part of an installation contract, optical testing shall be completed after delivery and after installation of each section length prior to termination to ensure that no degradation has occurred between the production of the conductor and the installation. The conductor shall be tested with an OTDR on each fibre core from each end, to characterise the attenuation of the installation and to ensure that no physical damage has occurred to the optical fibre during installation. There shall be no point discontinuities.

End to end attenuation shall be measured in accordance with the manufacturer's technical data sheet values for each specified wavelength. These values shall meet or exceed the requirements of ITU-T G652 Appendix 1.1.

## **8 Conductor Requirements**

OPPCs and OPGWs are intended to be direct replacements for the equivalent conventional conductors (refer to [Appendix B](#)). As such they shall meet the requirements of the equivalent conductors in ES400C3 or ES400C4.

Steel strands for AACSR shall be manufactured from regular grade steel and coated with zinc by the hot dip process according classification S1A (refer to ES400C3 or ES400C4).

## **9 Optical Fibre Requirements**

### **9.1 All Fibre Types**

All Fibre Types shall comply with IEC 60794.

## 9.2 Single Mode Optical Fibres

Optical fibres shall conform to IEC 60793-2 and ITU-T G652D and lie within the test parameters detailed in [Table 3](#) for single mode fibres.

**Table 3: Performance Characteristics Single Mode Optical Fibre**

PARAMETER	LIMIT	SPECIFICATION		TEST METHOD	
		IEC 60793-2	ITU-T G652	IEC 60793-1	ITU-T G650
Coating diameter	245 ±10µm	5.1.4	-	A3	-
Cladding diameter	125 ±2µm	5.1.4	5.2	A2	2.2.1
Cladding non-circularity	≤2%	5.1.4	5.4.2	A2	2.2.1
Mode field diameter	9 ± 0.5µm	5.4.3	5.1	C9A	2.1.1
Mode field concentricity	≤1µm	5.1.4	5.3	A2	2.2.1
Proof Strain	≥1%	5.3	5.7.3	B1	2.6
Stripping force	≤3.2N	-	-	-	-
Attenuation 1310nm	≤0.4dB/km	5.4.1	6.1	C1A	2.4.1
Attenuation 1550nm	≤0.25dB/km	5.4.1	6.1	C1A	2.4.1
Chromatic dispersion 1285 – 1330nm	≤3.5ps/(km.nm)	5.4.2	6.2	C5C	2.5.1
Chromatic dispersion 1550nm	≤20ps/(km.nm)	5.4.2	6.2	C5C	2.5.1
Zero dispersion wavelength	1310nm	5.4.2	6.2	C5B	-
Cut-off wavelength λ <sub>c</sub>	≤1270nm	5.4.4	5.5	C7B	2.3.1
Polarisation mode distortion individual fibre length	≤0.5ps/√km	-	6.3	IEC TS61941	2.7
Polarisation mode distortion link of concatenated fibres	≤0.1ps/√km	-	6.3	IEC TS61941	2.7

## 10 Documents Referenced

All references to documents listed below are to the latest versions, unless stated otherwise.

DOCUMENTS REFERENCED	
<b>Health and Safety at Work Act 1974</b>	
<b>Control of Substances Hazardous to Health Regulations 2002</b>	
<b>Manual Handling Operations Regulations 1992</b>	
<b>BS EN ISO 9000:</b>	Quality management systems.
<b>BS EN ISO 14001:</b>	Environmental management systems. Requirements with guidance for use.
<b>BS EN 50341:</b>	Overhead electrical lines exceeding AC 45kV.
<b>IEC 60793-1:</b>	Optical fibres Part 1 - Generic specification.
<b>IEC 60793-2:</b>	Optical fibres Part 2 - Product specification.
<b>IEC 60794-1:</b>	Optical fibre cables Part 1 - Generic specification.
<b>IEC 60794-4:</b>	Optical fibre cables Part 4 - Sectional specification.
<b>ITU-T G650:</b>	Test Methods for Single Mode Optical Fibres.
<b>ITU-T G652:</b>	Characteristics for Single Mode Optical Fibres.
<b>CP311:</b>	Equipment Approval Policy and Process
<b>ES400C3:</b>	Wood Pole Overhead Line Conductors (up to and including 132kV)

**ES400C4:**

Steel Tower Overhead Line Conductors (33kV and 132kV)

## 11 Keywords

Conductor; Fibre



## Appendix A – Schedule of Required Data

### A1 Schedule of General and Technical Data

REF NO	DATA TO BE SUPPLIED
General details	
1.	Manufacturer name:
2.	Type designation:
3.	Manufacturing period:
4.	Month/year production commenced:
5.	Drawings (number/revision):
Technical details – conductor	
6.	Code name:
7.	Nominal aluminium equivalent area (mm <sup>2</sup> ):
8.	Actual cross-sectional area of aluminium (mm <sup>2</sup> ):
9.	Aluminium alloy (mm <sup>2</sup> ):
10.	Steel (mm <sup>2</sup> ):
11.	Optical sub-unit (mm <sup>2</sup> ):
12.	Total (mm <sup>2</sup> ):
13.	Number of wires in each layer: (Layer 1 = ) (Layer 2 = ) (Layer 3 = )
14.	Diameter and tolerance of wire (mm):
15.	Lay ratio:
16.	Overall diameter (mm):
17.	Rated tensile strength or nominal breaking load (kN):

18.	Mass per unit length, bare (kg/km):
19.	Mass per unit length, greased (kg/km):
20.	Maximum DC resistance at 20°C:
21.	Coefficient of linear expansion (per 10 <sup>6</sup> °C):
22.	Stress-strain relationship to ES400C3/C4:
23.	Final modulus of elasticity:
24.	Short circuit current rating I <sup>2</sup> t [(kA) <sup>2</sup> s]:
25.	Minimum bend radii (mm):
Technical details – grease	
26.	Grease type (designation):
27.	Grease manufacturer:
28.	Mass per unit length (kg/km):
29.	Dropping point (°C):
30.	Oil separation at specified temperature and duration (%):
Technical details – individual wires – aluminium/aluminium alloy (Measurement methods as ES400C3/C4; measurements to be made after stranding)	
31.	Resistivity of aluminium at 20°C (nΩ.m):
32.	Resistivity of aluminium alloy at 20°C (nΩ.m):
33.	Minimum tensile strength, aluminium wire (N/mm <sup>2</sup> )
34.	Minimum tensile strength, aluminium alloy wire (N/mm <sup>2</sup> )
35.	Minimum elongation at failure, aluminium alloy wire (%)
Technical details – individual wires – steel or Al clad steel (Measurement methods as ES400C3/C4; measurements to be made after stranding)	

36.	Number of wires:
37.	Diameter and tolerance (mm):
38.	Minimum load at 1% extension for steel wire (N):
39.	Minimum tensile strength of steel wire (N/mm <sup>2</sup> ):
40.	% elongation at failure (%):
41.	Torsional ductility (number of turns to failure):
42.	Minimum mass of zinc on galvanized steel wire (g/mm <sup>2</sup> ):
43.	Minimum aluminium thickness of ACS wire (mm):

## A2 Schedule of Type Test Data

### GENERAL DETAILS

Product description:

Product type:

### Test data

Test Item	Test Ref	Test Report No	Test Date	Compliance (yes, no, n/a)		
				Item	Procedure	Witness
<b>Conductor</b>						
Surface condition	ES400C3/C4					
Diameter	ES400C3/C4					
Inertness	ES400C3/C4					
Lay ratio and direction of lay	ES400C3/C4					
Number and type of wires	ES400C3/C4					
Mass per unit length	ES400C3/C4					
Stress-strain curve	ES400C3/C4					
Tensile breaking strength	ES400C3/C4					
Stringing test (if applicable)	ES400C3/C4					
Grease mass per unit length	ES400C3/C4					
Stability of grease in conductor	ES400C3/C4					
Fatigue life	ES400C25 & IEC 60794					
Fault current I <sup>2</sup> t measurement	ES400C25 & IEC 60794					

Lightning simulation	ES400C25 & IEC 60794					
Running blocks	ES400C25					
Temperature cycle	ES400C25 & IEC 60794					
<b>Aluminium wires or Aluminium Alloy wires to ES400C3/C4</b>						
Visual	ES400C3/C4					
Diameter	ES400C3/C4					
Tensile strength	ES400C3/C4					
Elongation	ES400C3/C4					
Resistivity	ES400C3/C4					
Wrapping	ES400C3/C4					
Welding	ES400C3/C4					
<b>Zinc coated steel wires to ES400C3/C4</b>						
Visual	ES400C3/C4					
Diameter	ES400C3/C4					
Tensile strength	ES400C3/C4					
Stress at 1% extension	ES400C3/C4					
Torsion test	ES400C3/C4					
Wrapping test	ES400C3/C4					
Mass of zinc coating	ES400C3/C4					
Zinc dip test	ES400C3/C4					
Adhesion of zinc coating	ES400C3/C4					

**Aluminium clad steel wires to ES400C3/C4**

Visual	ES400C3/C4					
Finish	ES400C3/C4					
Diameter	ES400C3/C4					
Tensile stress	ES400C3/C4					
Elongation	ES400C3/C4					
Torsion	ES400C3/C4					
Resistivity	ES400C3/C4					
Minimum aluminium thickness	ES400C3/C4					
Stress at 1% extension	ES400C3/C4					

**Grease**

High temperature stability test	ES400C3/C4					
Penetrability test	ES400C3/C4					
Adhesion test	ES400C3/C4					
Ageing test	ES400C3/C4					
Corrosion test	ES400C3/C4					
Stability in complete conductor	ES400C3/C4					

**Fibres**

Tensile performance	IEC 60794					
Temperature cycling	IEC 60794					
Water penetration	IEC 60794					
Bleeding of tube compound	IEC 60794					

## Appendix B – Schedule of OPPCs and OPGWs

APPROVED DESCRIPTION (FOR PURCHASING AND PRODUCT LABELLING)	CC NUMBER	ESTIMATED USAGE (METRES)	PRICE PER 1000 METRES
<b>OPPCs</b>			
Conductor, OPPC, AAAC, 200mm <sup>2</sup> (Poplar)	013930		
Conductor, OPPC, AAAC, 300mm <sup>2</sup> (Upas)	013932		
Conductor, OPPC, ACSR, 175mm <sup>2</sup> (Lynx)	013933		
Conductor, OPPC, ACSR, 226mm <sup>2</sup> (Keziah)	013931		
<b>OPGWs</b>			
Conductor, OPGW, ACSR, 70mm <sup>2</sup> (Horse)	013935		
Conductor, OPGW, ACSR, 175mm <sup>2</sup> (Lynx)	013934		

## Appendix C – Conformance Declaration

### SECTION-BY-SECTION CONFORMANCE WITH SPECIFICATION

The Tenderer shall declare conformance or otherwise for each product/service or range of products/services, section-by-section, using the following Conformance Declaration Codes.

**Conformance Declaration Codes:**

<b>N/A =</b>	Clause is not applicable/appropriate to the product/service.
<b>C1 =</b>	The product/service conforms fully with the requirements of this clause.
<b>C2 =</b>	The product/service conforms partially with the requirements of this clause.
<b>C3 =</b>	The product/service does not conform to the requirements of this clause.
<b>C4 =</b>	The product/service does not currently conform to the requirements of this clause, but the manufacturer proposes to modify and test the product in order to conform.

**Manufacturer:**

**Product/Service Description:**

**Product/Service Reference:**

**Name:**

**Company:**

**Signature:**



**SECTION-BY-SECTION CONFORMANCE**

Section	Section Topic	Conformance Declaration Code	Remarks * (must be completed if code is not C1)
4.1	Product not to be Changed		
4.2	Electricity North West Technical Approval		
4.3	Quality Assurance		
4.4	Formulation		
4.5	Identification Markings		
4.6	Minimum Life Expectancy		
4.7	Product Conformity		
4.8	Confirmation of Conformance		
5.1	Requirements for Type Tests at the Supplier's Premises		
5.2	Requirement for Routine Tests at the Supplier's Premises		
6.1	Overall Conductor Performance		
6.2.1	General		
6.2.2	Buffer Tube Identification		
6.2.3	Fibre Identification		

6.3	Test Results and Fibre Data		
7.1	Type Tests		
7.1.1	Fatigue Life		
7.1.2	Fault Current I <sup>2</sup> t Measurement		
7.1.3	Lightning Simulation		
7.1.4	Running Blocks		
7.1.5	Temperature Cycling		
7.2	Sample Testing		
7.3	Routine Testing		
7.4	Site Tests (where applicable)		
8.	Conductor Requirements		
9.1	All Fibre Types		
9.2	Single Mode Optical Fibres		

\* Applicable specifications shall be stated in the Remarks column where alternatives are quoted within a section. The Remarks column shall also be used to indicate cases where the products or services exceed the quoted specifications.

**Additional Notes:**