

Electricity Specification 400C9

Issue 8 February 2023

11kV Distribution Cables



Amendment Summary

| ISSUE NO. DATE | DESCRIPTION |
|---|---|
| Issue 7 September 2021 | <p>Restructure and reformatting to the new Model Electricity Specification template. Update of technical information to latest versions of British Standards. Addition of the following cable types:</p> <ul style="list-style-type: none"> • 95/185/300mm² aluminium triplex cables with LSOH sheath • 400mm² aluminium conductor, triplex cable with MDPE sheath • 400mm² copper conductor, single core cable with LSOH sheath • 400mm² aluminium conductor, single core cable with LSOH sheath <p>Prepared by: P. Howell</p> <p>Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, Engineering and Technical Director</p> |
| Issue 8 February 2023 | <p>400mm² copper conductor triplex cable with MDPE sheath added to Appendix A.</p> <p>Prepared by: D M Talbot</p> <p>Approved by: Policy Approval Panel and signed on its behalf by Steve Cox, Engineering Director</p> |

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1 Scope

This Specification covers the technical requirements for 11kV cables for use on the Electricity North West Limited (hereinafter referred to as Electricity North West) Distribution System.

2 Definitions

| | |
|-----------------------|--|
| Approval | Sanction by the Electricity North West Underground Circuits Manager that specified criteria have been satisfied |
| Contract | 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. |
| Contractor | 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. |
| Specification | The Specifications and schedules (if any) agreed by the parties for the purpose of the Contract. |
| Sub-Contractor | 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 Underground Circuits Manager, and the legal representatives, successors and assigns of such person. |
| Supplier | Any person or person's firm or company who supplies goods to Electricity North West or to its Contractor. |
| Tender | An offer in writing to execute work or supply goods at a fixed price. |
| Tenderer | The person or person's firm or company, including personal representatives, successors and permitted assigns, invited by Electricity North West to submit a Tender. |

3 General Requirements for Approvals and Testing

3.1 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 Underground Circuits Manager, and receipt of a written agreement to the proposed change from the Electricity North West Underground Circuits Manager.

3.2 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 Underground 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 Underground Circuits Manager, compliance with this Specification. Acceptance of this evidence shall be at the discretion of the Electricity North West Underground 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 Underground Circuits Manager.

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

3.3 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 Underground 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 Underground 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 Underground Circuits Manager, be reasonably required for inspection and/or retention as quality control samples. The Electricity North West Underground 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 Underground 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.

3.4 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 Underground Circuits Manager will, if requested, confirm agreement to this prior to receipt of the information.

3.5 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 Underground 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 Underground Circuits Manager.

3.6 Minimum Life Expectancy

The minimum life expectancy of all products covered by this Specification is 60 years.

3.7 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.

3.8 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.

4 Conditions of Installation

Cables specified in this Specification will be pulled or laid into open trenches, pulled into ducts or installed in air. Cables may also be installed directly by trenchless installation techniques.

During storage and after installation cables can be expected to be subjected to the full range of climatic conditions encountered in the UK.

Cables may be surrounded by ground water for most of their operating life. Where cables are installed in ducts, flooding of ducts can occur resulting in permanently wet sections along the cable route.

Cables installed above ground will be supported by means of cleats either vertically or horizontally and these cables may be exposed to direct sunlight for significant periods.

Cables may be installed on wood poles in contact with the pole and, therefore, in contact with a pole preservation medium such as creosote.

Accessories may be cold applied or require application of heat.

5 Conditions of Operation for Power Cables

The following are the general conditions under which power cables purchased in accordance with this Specification are required to operate:

- Nominal system voltage 11 000/6 360 volts.
- The working voltage of any part of the system does not normally exceed the normal system voltage by more than 6%.
- Basic Impulse Level (lighting withstand) of 95kV.
- Nominal system frequency: 50Hz.
- The system operates with the neutral point earthed either directly or through a resistance or reactance at one or more points.

6 Cable Longevity

Cables offered shall be designed and manufactured to operate satisfactorily under the installation and operating conditions detailed in [Sections 4](#) and [5](#).

Cables offered must have successfully passed the long-term aging test detailed in BS7870;4.10 clause 8.3.

Preference will be for manufacturers that carry out the test on a continual 1-year cycle.

7 Manufacturing

At the time of Tender, the Tenderer shall provide details of manufacturing location(s) for each cable offered. For cables with extruded insulation, the Tenderer shall also provide details of extrusion and curing technology for each cable offered. The cross linking process will be completely “Dry Cured” and no water will be used during this process.

Any Approval granted will be site specific and will not be transferable to any other site without the prior written agreement of the Electricity North West Underground Circuits Manager.

8 Technical Support

During the Contract period questions will arise regarding unusual or non-standard applications where advice will be required on matters such as cable ratings etc. The successful Tenderer(s) will be expected to support Electricity North West with technical advice on these matters.

9 Requirements for Type and Routine Testing

9.1 Type Test Approval

All cables offered shall be fully Type Tested and Qualified according to the requirements of the Technical Specification and Standards detailed for each cable type. The Tenderer shall provide Type Test certificates and Type Test reports, including details of independent witnesses, at the time of Tender.

Where a Tenderer wishes to offer a cable which has been Type Tested to an alternative Standard(s), full details of the alternative Standard(s) and how it differs from the Specified Standard(s) shall be provided at the time of Tender along with Type Test certificates.

If, during the period of the Contract, the Contractor wishes to make any changes to the Approved product, packaging or labelling, proposals for such changes shall be notified in writing to the Electricity North West Underground Circuits Manager. No such changes shall be implemented without the prior written Approval of the Electricity North West Underground Circuits Manager. If the Electricity North West Underground Circuits Manager deems that the changes require Type Approval testing to be repeated, in full or in part, the cost of such testing shall be borne by the Contractor.

9.2 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 Underground 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 Underground Circuits Manager.

9.3 Routine and Sample Testing

The Contractor shall carry out all routine and sample tests specified for each cable. Tenderers shall state at the time of Tender their proposals for sample test frequencies where such frequencies are not detailed specifically by this Specification or the relevant referenced Standards or Specifications. The Electricity North West Underground Circuits Manager reserves the right to be present and witness routine and sample tests. Where the Electricity North West Underground Circuits Manager wishes to witness any such tests, the date and time of testing shall be mutually agreed.

9.4 Samples

During the Tender period the Tenderer shall submit samples for Approval as required by the Electricity North West Underground Circuits Manager. The samples will be of reasonable lengths to allow for any testing on suitability for the ENWL cable jointing system to be made.

Such samples shall remain the property of Electricity North West.

10 Technical Particulars

10.1 Cable Design

This Specification covers the supply of the following types of 11kV distribution cables:

- (a) Single core: 400mm² polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded copper phase conductors, with a MDPE oversheath.
- (b) Single core: 400mm² polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded copper phase conductors, with a LSOH oversheath.
- (c) Single core: 400mm² polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded aluminium phase conductors, with a MDPE oversheath.
- (d) Single core laid up in triplex formation: 400mm² polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded aluminium phase conductors, with a MDPE oversheath.
- (e) Single core laid up in triplex formation: 400mm² polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded copper phase conductors, with a MDPE oversheath.
- (f) Single core: 400mm² polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded aluminium phase conductors, with a LSOH oversheath.
- (g) Single core laid up in triplex formation: 95, 185, 300mm² polymeric insulated 'quasi-dry design' with copper screen wires and swellable water blocking tapes under and over the screen wires and solid round aluminium phase conductors with MDPE oversheath.
- (h) Single core laid up in triplex formation: 95, 185, 300mm² polymeric insulated 'quasi-dry design' with copper screen wires and swellable water blocking tapes under and over the screen wires and solid aluminium phase conductors, with a LSOH oversheath.

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10.2 Technical Requirements

Where a requirement of this Specification differs from that of another quoted Specification or Standard, the requirements of this Specification shall apply.

If a Tenderer is unsure regarding any requirement of this Specification, clarification shall be sought in writing from Electricity North West.

11kV cables referenced at [10.1](#) shall comply with BS 7870 Part 4 Section 4.10.

10.3 Cable Data

The following additional cable data shall be provided with all cables supplied:

10.3.1 Impedance Data

- Maximum dc resistance of phase conductor at 20°C in ohm/km.

- Maximum ac resistance of phase conductor at maximum conductor temperature in ohm/km.
- Equivalent star reactance at 50 Hz in ohm/km.
- Equivalent star capacitance in pF/km.
- Charge current per phase at normal voltage and frequency in mA/m.
- Zero sequence impedance $R_0 + jX_0$ in ohms/km.

10.3.2 Current Rating Data

The maximum continuous current carrying capacity per phase conductor for the following conditions:

- Laid Direct with $g = 1.2 \text{ }^\circ\text{C/W}$ and $T_g = 15 \text{ }^\circ\text{C}$.
- Laid Direct with $g = 0.9 \text{ }^\circ\text{C/W}$ and $T_g = 15 \text{ }^\circ\text{C}$.
- Drawn into a 150mm ID smooth wall plastic duct (one cable or triplex cable per duct) where $g = 1.2 \text{ }^\circ\text{C/W}$ and $T_g = 15 \text{ }^\circ\text{C}$.
- Drawn into a 150mm ID smooth wall plastic duct (one cable or triplex cable per duct) where $g = 0.9 \text{ }^\circ\text{C/W}$ and $T_g = 15 \text{ }^\circ\text{C}$.
- In Air where $T_g = 25 \text{ }^\circ\text{C}$.

The following assumptions shall be made when quoting ratings:

- Single core cables are laid in touching trefoil.
- Cover to top of 11kV cables is 600mm.
- Ground thermal resistivity = 1.2 Km/W .
- Ground temperature = $15 \text{ }^\circ\text{C}$.
- Air temperature = $25 \text{ }^\circ\text{C}$.

Tenderers shall also provide data to show the variation in rating with Ground TR and depth of cover.

10.3.3 Installation Parameters

For each power cable offered the Tenderer shall provide the following parameters:

- Minimum dynamic bending radius in mm.
- Minimum static bending radius in mm.
- Recommended pulling method and maximum pulling tension in kgF.

10.4 Shrinkage

Insulation shrinkage shall be performed at 130°C for 6 hours and limited to 2%. In addition, a further test at 65°C for 24 hours shall be performed and the results noted.

10.5 Cable Identification

Each delivery length of cable shall be allocated a unique reference number. This unique reference number shall be embossed on the cable near to the metre mark. This unique reference number will be used to identify all materials used within the manufacturing process. This number shall appear on the factory test sheet covering the cable length and shall be clearly marked on the drum on which the length is delivered and shall be referred to on all invoices and advice notes.

An option to have “Electricity North West” or “ENW” printed on to the sheath or conductor to enable positive identification of ownership in event of theft may be requested in the tendering process. Manufacturers shall provide details and any additional costs for this option if requested to do so.

10.5.1 Oversheath Marking

Oversheath embossing/indenting and printing shall be in accordance with BS 7870:4.10 clause 4.5.

Each cable shall be metre marked by printing or embossing/indenting.

Cables that are supplied laid up in triplex formation shall have L1, L2 and L3 marked externally by embossing or indenting.

All external markings shall be clearly visible.

10.6 Logistical Requirements

Each cable supplied shall meet the requirements of [Appendix B](#).

11 Schedule One – Single Core: 400mm² ‘QUASI-DRY Design’ Polymeric Insulated cables.

11.1 Specification

Specific cables designs are listed in [Appendix A](#), (items a to f). They shall conform to the following specifications;

Depending on specific cable, the conductors shall either be;

- a) circular compacted stranded copper conductors complying with BS EN 60228 (class 2);
- b) circular compacted stranded aluminium conductors complying with BS EN 60228 (class 2)

The conductor screen, insulation and insulation screen shall be applied as a continuous single pass triple extrusion free of factory repairs. It shall use cross linked polyethylene (XLPE) type DIX 3 or EPR type DIE 5 to BS 7870-1, Annex B

Insulation thickness shall comply with BS 7870:4.10 and any additional requirements of ENATS 09-17.

Concentricity and circularity of the extruded insulation shall comply with the requirements of BS7870 part 4 section 4.10.

The metallic screen shall be copper wires of 35mm² applied in a spiral or “SZ” configuration with maximum gap of 4mm at any point between wires. The wires should be lapped with a copper equalising tape applied in a counter helix. Swellable water blocking tapes shall be applied under and over the screen wires. The swellable water blocking tapes under the wires shall be semi-conducting. Moisture content of water blocking tape will be less than 50,000 ppm.

Depending on the specific cable, the oversheath shall be either;

- a) an extruded layer of red MDPE type DMP 5 to BS 7870-1, Annex B. Maximum permissible shrinkage shall be 2% when subjected to a retraction test as defined in BS EN 60811. The compound shall have a density within the range quoted in ENA TS 09-17.
- b) an extruded layer of orange Low Smoke, zero halogen (LSOH) compound to type DMZ 4 to BS 7870-1, Annex B.

Written evidence shall be provided to show that the cable has undergone long term aging testing detailed in clause 8.3, BS 7870:4.10.

The cable may be supplied as single core, or as three single cores laid up in triplex formation (aluminium conductor versions only) depending on the types listed in Appendix A.

NOTE: This cable is primarily intended for use in substation environments.

12 Schedule Two – Single Core laid up in triplex formation: 95, 185, 300mm² ‘QUASI-DRY Design’ Polymeric Insulated cables.

12.1 Specification

Specific cables designs are listed in [Appendix A](#), items g to h of this document. They shall conform to the following specifications;

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The cable shall have circular solid aluminium conductors complying with BS EN 60228 (class 1)

The conductor screen, insulation and insulation screen shall be applied as a continuous single pass triple extrusion free of factory repairs. It shall use cross linked polyethylene (XLPE) type DIX 3 or EPR type DIE 5 to BS 7870-1, Annex B

Insulation thickness shall comply with BS 7870:4.10 and any additional requirements of ENATS 09-17.

Concentricity and circularity of the extruded insulation shall comply with the requirements of BS7870 part 4 section 4.10.

The metallic screen shall be copper wires of 35mm² applied in a spiral or “SZ” configuration with maximum gap of 4mm at any point between wires. The wires should be lapped with a copper equalising tape applied in

a counter helix. Swellable water blocking tapes shall be applied under and over the screen wires. The swellable water blocking tapes under the wires shall be semi-conducting. Moisture content of water blocking tape will be less than 50,000 ppm.

Depending on the specific cable, the oversheath shall be either;

- a) an extruded layer of red MDPE type DMP 5 to BS 7870-1, Annex B. Maximum permissible shrinkage shall be 2% when subjected to a retraction test as defined in BS EN 60811. The compound shall have a density within the range quoted in ENA TS 09-17.
- b) an extruded layer of orange Low Smoke, zero halogen (LSOH) compound to type DMZ 4 to BS 7870-1, Annex B.

Written evidence shall be provided to show that the cable has undergone long term aging testing detailed in clause 8.3, BS 7870:4.10.

Three single core cables shall be laid up in triplex formation.

13 Documents Referenced

| DOCUMENTS REFERENCED | |
|---|---|
| Health and Safety at Work Act 1974 | |
| Control of Substances Hazardous to Health Regulations 2002 | |
| Manual Handling Operations Regulations 1992 | |
| BS EN ISO 9000 | Quality management systems |
| BS EN ISO 14001: 2004 | Environmental management systems. Requirements with guidance for use |
| BS EN 60228: 2005 | Conductors of insulated cables |
| BS 6234 | Specification for polyethylene insulation and sheath of electric cables |
| BS 7655 | Insulation and sheathing materials for cables |
| BS 7870 Part 4 | Single Core 11 & 33kV Cables |
| ENA TS 09-17 | Single core cables for use in substations having extruded insulation and rated voltages of 6350/11 000 volts, and 19 000/33 000 volts |
| CENELEC HD 605 | Electrical Cables – Additional test Methods |
| EPD311 | Approval of Equipment |
| CP311 | Equipment Approval Process |
| ES400C7 | Returnable Cable Drums for Mains Cables Conforming to ECP 410 Chapter 1 |

14 Keywords

11kV; Cable; EPR; MDPE; XLPE;

Appendix A – Schedule of Cables

| ITEM NO. | ORDERING SPECIFICATION | SIZE (MM ²) | CC NO. |
|----------|--|-------------------------|----------------------------|
| A | Single Core: polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded copper phase conductors . MDPE oversheath | 400 | 004701 |
| B | Single Core: polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded copper phase conductors . LSOH oversheath | 400 | 004761 |
| C | Single Core polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded aluminium phase conductors . MDPE oversheath | 400 | 004685 |
| D | Single Core laid up in triplex formation: polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded aluminium phase conductors . MDPE oversheath | 400 | 005702 |
| E | Single Core laid up in triplex formation: polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded copper phase conductors . MDPE oversheath | 400 | TBA |
| F | Single Core: polymeric insulated 'quasi-dry' design with copper screen wires, swellable water blocking tapes under and over the screen wires and stranded aluminium phase conductors . LSOH oversheath | 400 | TBA |
| G | Single Core laid up in triplex formation: polymeric insulated 'quasi-dry design' with copper screen wires, swellable water blocking tapes under and over the screen wires and solid aluminium phase conductors . MDPE oversheath | 95 185 300 | 004679 004680 004681 |

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| H | Single Core laid up in triplex formation: polymeric insulated 'quasi-dry design' with copper screen wires, swellable water blocking tapes under and over the screen wires and solid aluminium phase conductors. LSOH oversheath | 95 185 300 | 995183 995184 995184 |
|---|--|------------------|----------------------------|

Appendix B – Logistical Requirements

B1 Cable Drums and Labelling

Drums used for 11 and 33kV cables shall have a maximum width of 1200mm and a maximum weight of 2500kg.

Cable drums shall meet the requirements of ES400C7.

All cable drums shall be marked in accordance with the relevant cable specification or standard. The drum label shall also contain:

- Electricity North West commodity code
- Name of manufacturer
- Supplied length
- Rated voltage
- Number of cores
- Size of conductor
- Type of conductor material ("Cu" or "Al")
- Abbreviated description of cable construction
- Gross and nett weights
- Direction of rolling drum
- The metre marking start and end values
- The unique reference number

B2 General Logistical Requirements

Cable drums may be stored for long periods outdoors. All drum labels shall remain legible and durable under these conditions.

All cable drums shall be returnable, and the Tenderer shall arrange to collect empty drums from the company's normal delivery locations. Tenderers shall state at the time of Tender their proposed cable drum sizes and weights for each cable type offered.

The ends of all cables shall be effectively sealed against the ingress of moisture by a method appropriate to the cable type. Tenderers shall detail at the time of Tender their proposed sealing arrangement for each cable type offered.

The cable end projecting from the drum shall be protected from damage during transit, storage and handling on site.

The cable on the drum shall not be susceptible to damage during transit, storage and handling on site.

Tenderers shall state at the time of Tender their proposed method of protection for each cable.

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:

| | |
|--------------|--|
| N/A = | Clause is not applicable/appropriate to the product/service. |
| C1 = | The product/service conforms fully with the requirements of this clause. |
| C2 = | The product/service conforms partially with the requirements of this clause. |
| C3 = | The product/service does not conform to the requirements of this clause. |
| C4 = | 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) |
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Additional Notes: