WESTERN POWER DISTRIBUTION

Serving the Midlands, South West and Wales
Gwasanaethu Canolbarth a De Orllewin Lloegr a Chymru

Company Directive

ENGINEERING SPECIFICATION

EE SPEC : 93/3

Specification for Single Core 66kV Cables

Author: **Richard Summers**

Implementation Date: **April 2020**

Approved by

Carl Ketley-Lowe
Engineering Policy Manager

Date: **14th April 2020**

Target Staff Group	**Network Services Staff**
Impact of Change	**Green – No major impact**
Planned Assurance checks	**Checks to be carried out by Team Managers as part of normal compliance checks**

IMPLEMENTATION PLAN

Introduction

This Engineering Equipment Specification (EE Spec) details the requirements for 66kV Cables used on the WPD distribution network.

Main Changes

Updated to reflect WPDs requirement for XLPE insulated 66kV cables.

Impact of Changes

No major impact.

Implementation Actions

N/A.

Implementation Timetable

This Document replaces 93/2.

REVISION HISTORY

Document Revision & Review Table		
Date	**Comments**	**Author**
April 2020	• Updated to reflect WPDs requirement for XLPE insulated 66kV cables	Richard Summers

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1.0 FOREWORD

This Specification deals with Western Power Distribution (WPD's) requirements for a high voltage, dry design of polymeric insulated cable suitable for use on an 38/66) kV, three phase, earthed, 50 Hz underground transmission system.

The finished cable shall meet the requirements of Electricity Association Technical Specification (EATS) 09-16, (or equivalent standard), and IEC 60840 or where modified by this Specification.

2.0 SCOPE

This specification covers the construction elements required for designs of single core cable having U_o = 38kV and U_m = 72.5kV with copper conductors complete with longitudinal water blocking, cross linked polyethylene (XLPE) extruded insulation covered with radial water blocking, extruded lead alloy or aluminium sheath, medium density polyethylene (MDPE) oversheath and their accessories.

The test requirements and test methods employed by the cable manufacturer shall demonstrate the capability of the cable to operate at a sustained maximum conductor temperature of 90^{o}C. The cable is to be designed to be suitable for a maximum short circuit temperature of 250^{o}C. Cables conforming to this specification are intended to be suitable for laying direct in ground, ducts or air.

3.0 66kV CABLE SPECIFICATION

66kV cables supplied against this specification shall comply with the latest versions of the relevant standards. These include:-

- IEC 60840 Power Cables With Extruded Insulation and Their Accessories
- BS EN BS EN 60885-2 Electrical Test Methods For Electric Cables Pt 2
- BS 7912 Power Cables and Accessories For Rated Voltage 66kV to 132kV
- BS EN 60228 Conductors in Insulated Cables
- EA TS 09-16 Tests on Power Cables With XLPE Insulation and Metallic Sheaths and Their Accessories

4.0 CONSTRUCTION OF CONDUCTORS

The conductors shall be circular compacted stranded plain annealed copper conductor complying with BS EN 60228. The conductors shall be clean and free from metallic and foreign particles, which may contaminate the insulation and cause high stress points.

Stranded circular copper phase conductor of 185, 300, 400, 630 & 1000mm²

Conductors shall prevent the longitudinal penetration of water along the conductor using water blocking tapes.

5.0 CONDUCTOR SCREEN

The conductor screen, insulation and insulation screen shall be applied in a continuous single pass extrusion free of factory repairs. The conductor screen shall consist of an extruded layer of semi conducting compound. The screen shall fill the gaps between individual strand wires forming the outer layer of the conductor and provide a smooth, regular finish over which the insulation layer shall be applied. It shall be fully bonded (non strippable) and shall not separate from the insulation due to the effects of bending, load cycling and short circuit.

A semi-conducting tape is permitted between the conductor and conductor screen.

The screen material shall not adhere to or penetrate the conductor and shall have an average thickness of 1mm with a minimum thickness at any one point of not less than 0.6mm.

6.0 INSULATION

The insulation and the semi-conducting screens shall be applied as a continuous single pass triple extrusion, free of factory repairs. The cross linking process shall be “Dry Cured” with no water used during the process.

The cooling process shall be designed to eliminate, as far as possible, micro voids in the dielectric.

The materials used in the manufacture of insulation compound shall be of the highest purity, mixed together and processed under such conditions of cleanliness as to ensure a stable product with the required physical and electrical characteristics suitable for prolonged use without deterioration in service under the environmental and operational conditions prevailing on site.

Factory made repairs to the insulation and screens shall not be prohibited.

Minimum insulation thickness shall be 12.4mm with a maximum shrinkage of 2%

The contaminant / particulate content shall comply with the requirements of ENA TS09-16 3.10.1

7.0 INSULATION SCREEN

The insulation screen shall be an extruded layer of semi conductor or compound having a smooth even surface and shall be in intimate contact with the core insulation. This screen shall be extruded in the same operation as the insulation and conductor screen. It shall be fully bonded (non strippable) and shall be continuous and cover the whole area of the insulation and shall have no tendency in service to separate from the insulation due to the effects of bending, load cycling and short circuit.

The materials used in the manufacture of compound for the semi conducting conductor screen insulation shall be of the highest purity, mixed together and processed under such conditions of cleanliness as to ensure a stable product with the required physical and electrical characteristics suitable for prolonged use without deterioration in service under the environmental and operational conditions prevailing on site.

Details of the above process shall be provided in Appendix 1

The insulation screen shall have an average thickness of 1mm with a minimum thickness at any one point of not less than 0.6mm.

8.0 REMOVAL OF BI-PRODUCTS

Once the two semi-conducting layers and the insulation have been extruded, in a single pass, the completed cable shall be stored in such a manner as to remove the bi-products produced during the cable manufacture down to a level of 1%.

Details of the de-gassing process shall be provided Appendix 1

9.0 WATER BLOCKING TAPE

Semi conducting water-blocking tapes shall be applied over the screened core to form a compact and circular layer under the extruded metal sheath.

10.0 EXTRUDED METAL SHEATH

A lead alloy or seamless aluminium sheath shall be extruded over the water blocking tapes. The sheath shall be capable of carrying an earth fault current of 7kA for 3 seconds adiabatically. A layer of bitumen shall be applied over the lead sheath. For aluminium sheaths this layer will be thick and completely cover the aluminium.

NOTE: - If the cable manufacturer uses an aluminium sheath, then the corrugations in the sheath shall be of the type where the ribs are of a discrete type, i.e. transverse to the cable axis.

The nominal and minimum thickness of the metallic sheath and method of bitumen application shall be declared in Appendix 1.

11.0 OVERSHEATH

The sheath shall be medium density polyethylene (MDPE) coloured black. The thickness of the sheath shall be in accordance with IEC 60840, or equivalent standard. This sheath shall be subjected to a retraction test, as defined in BS EN 60811 and shrinkage shall not exceed 2%.

The density of the compound, corrected in accordance with clause 2.4.3.7 of BS 6469, shall be within the range 0.925g/cm2 to 0.94g/cm2. The test method for checking the density shall be determined by BS 6469 clause 2.4. The sheath shall be indelibly printed with numerical distance markers at one-(1) meter intervals.

A graphite coating shall not be provided on the 66kV cables.

12.0 EMBOSSING/MARKING

Embossing/marking shall be in accordance with BS 7870 Part 4.10 clause 4.5, or equivalent standard, in addition to the embossing/marking given in clause 4.5.1 the year of manufacture shall be included on the external surface of the cable as detailed in clause 4.5.2. In addition the manufacturer shall add a unique number, which shall identify that particular cable to a batch that produced the said cable.

The embossing shall be clear and distinct.

Other forms of identification will be considered upon application to the Cable Policy Engineer of WPD.

13.0 SEALING AND DRUMMING

Before despatch, the manufacturer shall seal both ends of all cables by means of metal caps fitted over the ends and plumbed to the extruded metal sheath so as to prevent the ingress of water during storage and transportation. The manufacturer and WPD shall agree any other means of sealing. The cable end projecting from the drum shall be protected from damage. Each drum shall bear a distinguishing number on the outside of the flange and particulars of the cable, i.e. voltage, length, conductor size, cable type and gross weight shall also be clearly visible. An arrow shall indicate the direction of rolling.

14.0 TESTING

Cables shall be tested in accordance with BS 7912 and meet the additional requirements of ENA TS 09-16.

Cables and accessories must be suitable for on-site tests. These tests will be either an AC Series Resonance test between 30 to 300Hz of a very low frequency test (VLF). These tests will apply 66kV phase-earth for 1 hour.

APPENDIX 1

Self Certification of Conformance / Technical Particulars

	Units / relevant standard	Remarks / Comments
Conductor		
Construction		
Moisture blocking material		
Milliken Insulation (tape, oxidized, enamel etc.)		
Conductor screen		
Material		
Nominal thickness		
Minimal thickness		
Nominal resistivity at 90°C		
Insulation		
Material		
Nominal thickness		
Minimum thickness		
Insulation screen thickness		
Continuous single pass triple extruded	Yes / No	
Free from factory repairs	Yes / No	
Please provide details of your cross linking and cooling processes		
Type of extrusion line (catenary or vertical)		
Maximum level of particle content		
Please provide details of your methods of preventing contamination to insulating compounds		

Please provide details of your methods of de-gassing		
Insulation screen		
Material		
Nominal thickness		
Minimal thickness		
Nominal resistivity at 90oC		
Design stress		
Max design stress at conductor screen		
Max design stress at insulation screen		
Sheath type for 7KA/3s		
Material		
Nominal thickness		
Minimum thickness		
Area of Cu wires		
Water blocking		
Method / details of water blocking		
Bitumen coating		
Method of application		
Outer Sheath		
Material		
Nominal thickness		
Minimum thickness		

APPENDIX A

SUPERSEDED DOCUMENTATION

This document supersedes EE SPEC: 93/2 dated November 2014 which has now been withdrawn.

APPENDIX B

RECORD OF COMMENT DURING CONSULTATION

EE SPEC: 93/3 - Comments

APPENDIX C

KEY WORDS

None.