

Company Directive

ENGINEERING SPECIFICATION


EE SPEC : 77/4

**Specification for 66kV and 132kV Single Core Cables and
132kV Accessories
($U_m=145\text{kV}$).**

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Implementation Date: June 2022

Approved by



Carl Ketley-Lowe
Engineering Policy Manager

Date: 6th June 2022

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

All references to Western Power Distribution or WPD must be read as National Grid Electricity Distribution or NGED

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IMPLEMENTATION PLAN

Introduction

This Engineering Equipment Specification (EE Spec) details the requirements for 66kV and 132kV Cables and 132kV Accessories used on the WPD distribution network.

Main Changes

Updated to reflect NG specifications – inclusion of welded aluminium sheath cables.

Impact of Changes

No impact.

Implementation Actions

N/A.

Implementation Timetable

This document replaces EE77/3.

REVISION HISTORY

Document Revision & Review Table		
Date	Comments	Author
June 2022	<ul style="list-style-type: none">Update to include welded aluminium sheath cables.	Richard Summers
June 2020	<ul style="list-style-type: none">Update to British Standard references.	Richard Summers
February 2020	<ul style="list-style-type: none">Updated to reflect WPDs requirement for 132kV cables.	Richard Summers
February 2018	<ul style="list-style-type: none">Specification amended to include joints and accessories.	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 66kV and 132kV, three phase, earthed, 50 Hz underground transmission system.

The finished cable and accessories 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 cables with either aluminium or copper conductors complete with longitudinal water blocking, cross linked polyethylene (XLPE) extruded insulation covered with radial water blocking, metallic 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°C. The cable is to be designed to be suitable for a maximum short circuit temperature of 250°C. Cables conforming to this specification are intended to be suitable for laying direct in ground, ducts or air.

3.0 66kV AND 132kV CABLE AND 132kV ACCESSORY SPECIFICATION

132kV cables and accessories 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 or stranded aluminium 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.

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

Milliken conductors will be required for conductor sizes of 1000mm² and above. Oxidized or enameled Milliken will only be considered where the manufacture can provide evidence that conductor jointing can be carried out without additional abrading of the conductor or bespoke connectors.

Conductor sizes of 185, 300, 630, 1000, 1000S, 1600S & 2000Smm² will be required.

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 XLPE 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.

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.

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

6.0 INSULATION

The XLPE 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 compound for XLPE 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.

The maximum design stresses shall not exceed 8kV/mm at the conductor screen and 4kV/mm at the insulation screen.

Factory made repairs to the insulation and screens shall be prohibited.

The contaminant / particulate content shall comply with the requirements of BS 7912.

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 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.

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 metal sheath.

10.0 METAL SHEATH

A lead alloy, seamless aluminium or welded aluminium shall be applied over the water blocking tapes. A layer of bitumen shall be applied over the lead sheath. For extruded aluminum sheaths this layer will be thick and completely cover the aluminium and corrugations. For welded aluminium the aluminium shall be fully bonded to the outersheath.

NOTE: - If the cable manufacturer uses an extruded 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.

Where additional copper wires are required to meet the fault rating these shall be applied below the metal sheath and will be water blocked.

Typical fault ratings of the lead alloy sheath will be 21.5kA, 25kA or 31.5kA.

11.0 OVERSHEATH

The outer covering shall be of black extruded medium/high density polyethylene. The thickness of the outer covering shall not fall below the nominal thickness by more than 0.1mm 15% at any point. The extruded outer sheath shall have a conductive coating to facilitate DC serving tests.

The nominal and minimum thickness of the oversheath shall be declared in Appendix 1.

Embossing/marking shall be in accordance with BS 7870 Part 4.10 2011 clause 4. In addition to the embossing/marking given in clause 4.5.1 there shall be a unique number, which shall identify that particular cable to a batch

The embossing shall be clear and distinct.

12.0 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.

13.0 TESTING

Cables shall be tested in accordance with BS 7912.

Cables and accessories must be suitable for on-site tests. These tests will be either an AC voltage test, at the power frequency, a series resonance test where the frequency is at or about the power frequency, namely between 30 to 300Hz or a very low frequency test (VLF). These tests will apply 132kV phase-earth for 1 hour.

14.0 JOINTS

Joints are required to connect between new cables and existing XLPE cables these may have copper or aluminium conductors, bonded screens, lead, aluminium, corrugated copper or stranded copper earth screens and may contain water swellable tapes or powders.

Joints and accessories offered shall be supplied by the cable manufacturer for installation by either the cable manufacturer or contractors working on behalf of WPD. All accessories shall be fully compatible with the cables detailed in this specification.

Joints shall be premoulded and capable of accepting different sizes of cable.

15.0 TERMINATIONS

Outdoor terminations will be self-supporting. Indoor and outdoor terminations shall comply with need to comply with IEC 60840 and BS 7912. Self-supporting sealing ends will also need to meet the cantilever load test specified in BS EN 62155.

GIS shall meet the requirements of the relevant clauses of IEC 60840, BS 7912 and withstand a bending moment of 4,500Nm at the base for not less than 1 minute.

Creepage distances will be 25mm/kV for moderate environments and 31mm/kV for severe environments.

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 process		
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 21.5KA/s		
Material		
Nominal thickness		
Minimum thickness		
Area of Cu wires		
Sheath type for 25KA/s		
Material		
Nominal thickness		
Minimum thickness		
Area of Cu wires		
Sheath type for 31.5KA/s		
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: 77/3 dated June 2020 which has now been withdrawn.

It also supersedes EE SPEC: 93/4 dated June 2020 which has now been withdrawn.

APPENDIX B

RECORD OF COMMENT DURING CONSULTATION

All NSMs are happy with this update.

APPENDIX C

KEY WORDS

None.