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NMCS Feeder Cable for Inductive Loop Detectors

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**NMCS FEEDER CABLE FOR INDUCTIVE LOOP
DETECTORS**

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EQUIVALENCE STATEMENT

Any requirements of this specification for goods or materials must be made in accordance with the Manual of Contract Documents for Highway Works, Volume 1 - Specification for Highway Works, Series 100 – Preliminaries, Clause 104.

1 SCOPE

This Technical Regulation details the materials to be used, the construction and the performance requirements of feeder cables (both armoured and non armoured) for NMCS inductive loop detectors used by the Highways Agency an Executive Agency of the Department of Environment, Transport and Regions on the National Motorway Communications System (NMCS). It is to be read in conjunction with MCH 1936 "NMCS Cables – General Technical Requirements" which details the general requirements for all NMCS cables.

2 NORMATIVE REFERENCES

The following standards contain provisions which, through reference in this text, constitute provisions of this Technical Regulation. All standards are subject to revision and parties using this Technical Regulation shall apply the most recent editions of the standards indicated below. Members of the IEC and ISO maintain registers of currently valid international standards.

ISO 472	Plastics Vocabulary
IEC 60050	International Electrotechnical Vocabulary
IEC 60189	Low Frequency Cables and Wires with PVC Insulation and PVC Sheath
IEC 60228	Conductors of Insulated Cables
IEC 60708	Low Frequency Cables with Polyolefin Insulation and Moisture Barrier Polyolefin Sheath
IEC 60811	Common Test Methods for Insulating and Sheathing Materials of Electric Cables
BS EN 10257-1	Zinc or Zinc Alloy coated non-alloy steel wire for armouring either power cables or telecommunications cables – Land Cables
BS 5099	Specification for Spark Testing of Electric Cables (no international equivalent)
BS 6500	Electric Cables – Flexible cords rated up to 300V/500V for use with appliances and equipment (no international equivalent)
MCH 1936	NMCS Cables – General Technical Requirements

3 DEFINITIONS

For the definition of terms within this Technical Regulation refer to:-

ISO 472	Plastics Vocabulary
IEC 60050	International Electrotechnical Vocabulary

The “Authority” or “Overseeing Organisation” is the Highways Agency, Scottish Development Department, National Assembly for Wales or the Department of the Environment for Northern Ireland, depending on which is responsible for the Contract.

4 CABLE CONFIGURATION

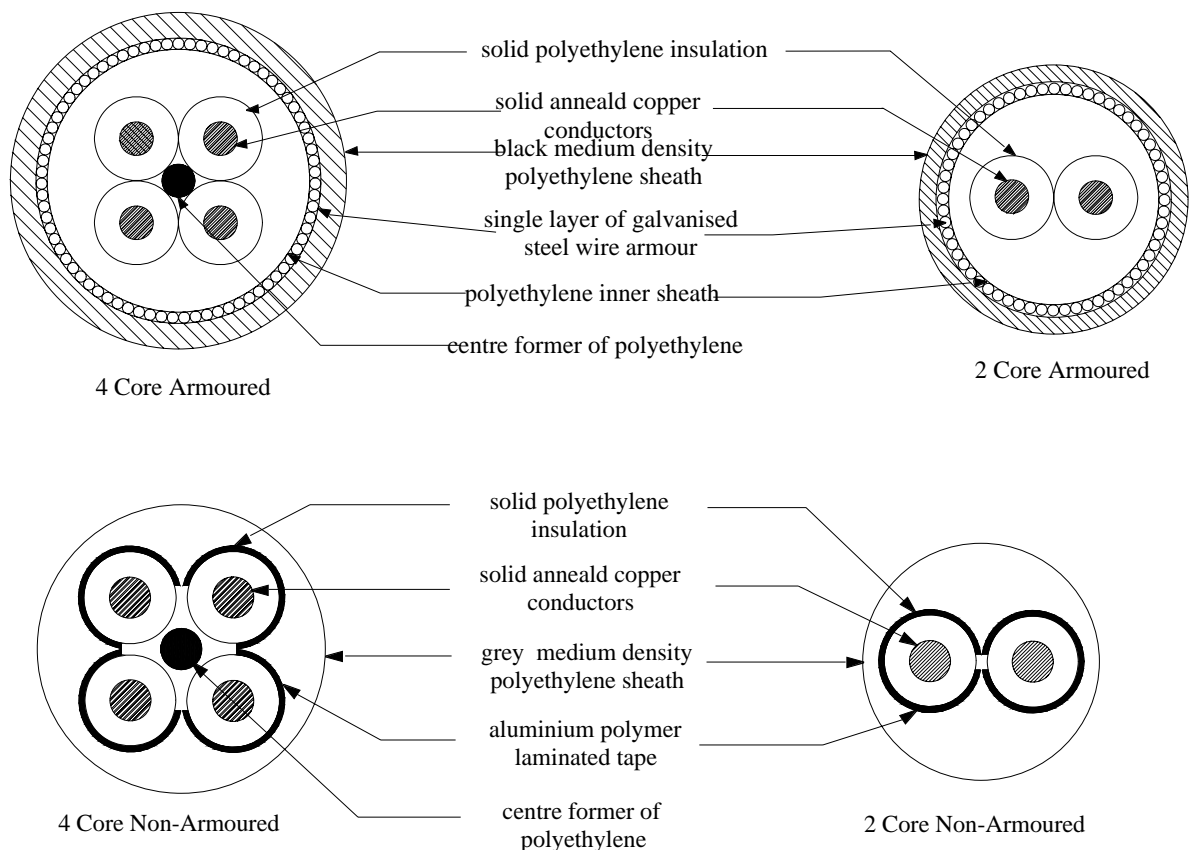
The cable configuration shall be stated in the contract which shall specify:-

- (a) Number of conductors:
 - 2 core,
 - 4 core;
- (b) Armoured or Non-Armoured;
- (c) Lengths;
- (d) Any special requirements.

5 GENERAL CONSTRUCTION

5.1 Description

The non armoured cable is a copper communications cable sheathed with medium density polyethylene designed for installation in a ducted network. This cable is constructed from solid plain copper conductors insulated with solid polyethylene. The armoured cable is a copper communications cable sheathed with medium density polyethylene with a single layer of galvanised steel wire armour designed for direct burial in the ground.



These drawings are for illustrative purposes only

5.2 Conductors

5.2.1 Material

Each conductor in the cable shall consist of a solid wire of plain annealed copper. This shall be smoothly drawn, circular in section, uniform in quality, free from defects and shall comply with IEC 60228 for Class 1 solid conductors. The cross sectional area of the conductor shall be 1.5mm^2 .

5.3 Insulation

5.3.1 Material

Each conductor shall be covered with solid polyethylene in accordance with IEC 60708.

5.3.2 Insulation Thickness

The insulation radial thickness shall be a nominal 0.7mm. The minimum thickness shall not fall below this value by an amount more than 0.135mm (i.e 5% + 0.1mm) when measured in accordance with IEC 60811 and BS 6500.

5.4 Colours

The core colours shall be readily identifiable and distinguishable from each other. The colours shall be as follows:

- a) 2 core - red and black
- b) 4 core - red - opposite to blue
- yellow - opposite to black

5.5 Core Lay-up

The cable core shall be laid into a compact and circular cable laid up with a right hand lay of 5 turns per metre (2 core) and 7 turns per metre (4 core). The 4 core cable shall be laid up around a central core of polyethylene.

5.6 Screen (Non Armoured Cable Only)

The non armoured cable shall be provided with an aluminium polymer laminate tape in accordance with IEC 60708. The screen shall be bonded to the cable sheath on the polymer laminate side.

5.7 Inner Sheath (Armoured Cable Only)

5.7.1 The cable shall be sheathed with medium density polyethylene (MDPE) in accordance with IEC 60708. The sheath shall be nominally circular in accordance with IEC 60189 and free from pin holes, joints, mended places and other defects.

5.7.2 The polyethylene shall have a carbon black content of $2.5\% \pm 0.5\%$. The carbon black content of polyethylene shall be in accordance with IEC 60811-4-1 (Part 4).

5.7.3 The sheath radial thickness shall be 0.8mm. The minimum thickness shall not fall below this value by an amount more than 0.22mm (i.e. $15\% + 0.1\text{mm}$) when measured in accordance with IEC 60811.

5.8 Armouring (Armoured Cable Only)

The armouring shall consist of an even, single layer of galvanised steel wire 0.9mm in diameter. The armour shall be applied directly over the inner sheath laid up in a left hand lay and complying with the requirements of BS EN 10257-1.

5.9 Armour Wire Joints (Armoured Cable Only)

5.9.1 When joints in armour are necessary, they shall be brazed or welded and any surface irregularity shall be removed. A joint in any wire shall be not less than 1m from the nearest joint in any other armour wire in the jointed cable.

5.9.2 The tensile strength of a 250mm length of wire containing a joint shall be not less than 80% of that of an adjacent sample of wire not containing a joint.

5.9.3 The elongation of a 250mm length of wire containing a joint shall be not less than 60% of that of the adjacent sample of wire not containing a joint.

5.10 Outer Sheath

5.10.1 The cable shall have an outer sheath of medium density polyethylene (MDPE), grey in colour, in accordance with IEC 60708. The outer sheath shall be nominally circular in accordance with IEC 60189 and free from pin holes, joints, mended places and other defects.

5.10.2 The sheath radial thickness shall be 1.4mm and shall not fall below this value by an amount more than 0.488mm (i.e. $20\% + 0.2\text{mm}$) when measured in accordance with IEC 60811-1-1.

5.10.3 The outer sheath shall be closely bonded to the steel wire armouring and shall not separate.

5.11 External Diameter

The external diameter of the cable when measured in accordance with the method specified in IEC 60811 shall comply with Table 1:

Number of Cores	Nominal External Diameter (mm)	
	Non Armoured Cable	Armoured Cable
2	9.0	11.8
4	10.2	13.2

Table 1 - External Diameter

6 MECHANICAL REQUIREMENTS

6.1 Insulation

Insulation shall be carefully removed from the conductor in the cable and tested in accordance with IEC 60811. The elongation at break shall not be less than 300% of the sample's normal length. Ultimate tensile stress of the piece tested in accordance with insulation elongation shall not be less than 10mN/m².

6.2 Environmental Stress Cracking

The cable shall be tested for resistance to environmental stress cracking in accordance with IEC 60811-4-1 (Procedure B).

6.3 Water Penetration

The cable shall be tested for resistance to water penetration in accordance with IEC 60708.

7 ELECTRICAL REQUIREMENTS

7.1 Conductor Resistance

The d.c. resistance of each conductor shall be measured in accordance with IEC 60189, and when corrected to 20°C by the appropriate factor specified in IEC 60228 shall not exceed 12.1 ohms per kilometre of cable.

7.2 Insulation Resistance

The insulation resistance of each conductor when measured with all the other conductors connected together shall, after one minute of steady electrification with not less than 500 Vdc, in accordance with the method specified in IEC 60189, be not less than 1500/LMΩ where L is the length in km.

7.3 Mutual Capacitance

7.3.1 Mutual capacitance measurements shall be made at a frequency of 1KHz in accordance with IEC 60189. During the measurements all conductors other than those under test shall be connected to earth.

7.3.2 The mutual capacitance of the pairs or adjacent cores shall not exceed 90pF per metre.

7.4 Inductance

The loop self inductance for adjacent cores shall not exceed 1.0 mH per kilometre when measured at a frequency of 1kHz ± 10%.

7.5 Voltage Test

7.5.1 This test shall be carried out before the measurement of insulation resistance described in 7.2.

7.5.2 The applied voltage shall be of sine-wave form having a frequency in the range of 40Hz to 62Hz. The completed cable shall be subjected to a voltage test comprising the application of 3000 V between conductors. The voltage shall be increased gradually to the specified voltage and maintained for 5 minutes. The insulation shall not break down.

7.6 Spark Test

The sheath of the cable shall be spark tested following the method described in BS 5099 using an alternating current from a supply at a minimum of 6kV/mm or by an alternative method of equal sensitivity.

7.7 Manufacturer's Test

7.7.1 The manufacturer shall define a quality plan for testing which shall include details of all tests required by this Specification. The quality plan shall be submitted to the Authority for acceptance.

7.7.2 Type Tests shall be carried out in accordance with IEC 60189.

7.7.3 The following Acceptance Tests shall be carried out on all drummed lengths of cable:-

- Conductor and Insulation Resistance in accordance with 7.1 and 7.2.
- Mutual Capacitance in accordance with Clause 7.3.
- Inductance in accordance with Clause 7.4.
- A voltage test in accordance with Clause 7.5.
- Spark Test in accordance with Clause 7.6.

ISSUE HISTORY

Issue	Amendments Since Previous Issue	Approved By	Date
B	Includes requirements for both Armoured and Non Armoured Cable. Reformatted.	Barry Johns	28/7/1994
C	External Diameter of Non-Armoured cable corrected (calculations used insulation thickness not sheath thickness), 6.3 added, clauses 5.3.2, 5.7.3 & 5.10.3 given absolute values and 7.7.3 added to.	Brian Oliver	16/12/1998
D	Detail changes.	Brian Oliver	28/03/2002
E	Changes as sidelined marked	Brian Oliver	25/02/2008