Template for submitting comments/inputs on Draft New Test Guide titled "Solid Polythene Insulated Fully Jelly Filled, Polythene Sheathed Underground Telecom Cables (TEC 68091:2026)":

Name of Manufacturer/Stakeholder:

Organization:

Contact details:

Clause No.	Clause Description	Comments, if any	Remarks, if any

Note: The comments/inputs on the draft Test Guide (Draft Test Guide No. TEC 68091:2026) may be furnished in the above format through email to adgfa-tec-dot@gov.in with copy to dirfa.tec@gov.in and ddgfla.tec@gov.in at the earliest and within prescribed time period.

परीक्षण निर्दे शका

टीईसी ६८०९१:२०२६

TEST GUIDE

TEC 68091:2026

For

सॉ लड पॉ लथीन इंसुलेटेड फुल्ली जेली फल्ड, पॉ लथीन शीथेड अंडरग्राउंड टेलीकॉम केबल्स

(मानक संख्या.: टीईसी ६८०९०:२०२६)

Solid Polythene Insulated Fully Jelly Filled, Polythene Sheathed Underground Telecom Cables

(STANDARD No.: TEC 68090:2026)

ISO 9001:2015

दूरसंचार अ भयांत्रिकी केंद्र

खुर्शीदलाल भवन, जनपथ, नई दिल्ली-110001, भारत

TELECOMMUNICATION ENGINEERING CENTRE

KHURSHIDLAL BHAWAN, JANPATH, NEW DELHI–110001, INDIA

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Release 1: XXXX, 2026

FOREWORD

Telecommunication Engineering Centre (TEC) is the technical arm of Department of Telecommunications (DOT), Government of India. Its activities include:

- Framing of TEC Standards for Generic Requirements for a Product/Equipment, Standards for Interface Requirements for a Product/Equipment, Standards for Service Requirements & Standard document of TEC for Telecom Products and Services
- Formulation of Essential Requirements (ERs) under Mandatory Testing and Certification of Telecom Equipment (MTCTE)
- Field evaluation of Telecom Products and Systems
- Designation of Conformity Assessment Bodies (CABs)/Testing facilities
- Testing & Certification of Telecom products
- Adoption of Standards
- Support to DoT on technical/technology issues

For the purpose of testing, four Regional Telecom Engineering Centers (RTECs) have been established which are located at New Delhi, Bangalore, Mumbai, and Kolkata.

ABSTRACT

This document enumerates detailed test schedule and procedure for evaluating conformance / functionality / requirements / performance of Solid Polythene Insulated Fully Jelly Filled, Polythene Sheathed Underground Telecom Cables as per GR No. TEC 68090:2026.

CONTENTS

A. HISTORY SHEET

S. No.	*Standard/ Document No*	*Title*	*Remarks*
1.	TEC 68090:2026	Solid Polythene Insulated Fully Jelly Filled, Polythene Sheathed Underground Telecom Cables	First issue

B. INTRODUCTION

This document enumerates detailed test schedule and procedure for evaluating conformance / functionality / requirements / performance of Solid Polythene Insulated Fully Jelly Filled, Polythene Sheathed Underground Telecom Cables as per GR No. TEC 68090:2026.

C. General information

Sl. No.	General Information	Details *(to be filled by testing team)*	
1.	Name and Address of Applicant		
2.	Date Of registration:		
3.	Name and No. of GR/IR/Applicant's Spec. against which type approval sought	Solid Polythene Insulated Fully Jelly Filled, Polythene Sheathed Underground Telecom Cables	TEC 68090:2026.
4.	Details of Equipment		
	Type of Equipment	Model No.	Serial No.
(i)			
(ii)			
5.	Any other relevant Information:-		

:

D. Testing team: (*to be filled by testing team*)

S. No.	Name	Designation	Organization	Signature
1.				
2.				
3.				

E. List of the test instruments:

S. No.	Name of test Instrument	Quantity	Make / Model *(to be filled by testing team)*	Validity of calibration (to be filled by testing team) dd/mm/yyyy	Remark
1.					
2.					
3.					
4.					

F.Equipment Configuration Offered: *(to be filled by testing team)*

(a) <Equipment/product name> Configuration:

Sl. No.	Item	Details	Remarks

Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product

(b) <Other equipment name> Configuration:

Sl. No.	Item	Details	Remarks

Relevant information like No. of cards, ports, slots, interfaces, size etc. may be filled as applicable for the product

G. Equipment System Manuals: (*to be filled by testing team)*

Availability of Maintenance manuals, Installation manual, Repair manual & User Manual etc. (Y/N)

H. Clause-wise Test Type and Test No.:

Clause. No.	*Clause*	*Type of Test / Test No. etc.*
1.0	INTRODUCTION	
1.1	This GR governs the constructional requirements and technical properties of twisted pair underground telecom cables with solid polythene insulated copper conductors, core fully filled with filling compound, and with poly-al laminate moisture barrier bonded to the polythene sheath. The cable will be either unarmoured or armoured and jacketed as required.	Information
1.2	Cables for use in ducts will omit the Clauses 11 and 12 on armouring and jacketing. The length of the duct cables will be indicated in the purchase order or by the actual user subsequent to the order. The tolerance on length (Clause 17.3) will not be applicable duct cables.	Information
2.0	GENERAL REQUIREMENTS:	
2.1	This document deals with the technical requirements and does not include all the terms and provisions of a contract.	Information
2.2	Number of Pair: The cable shall be in sizes from 5 pairs to 2400 pairs and the preferred Sizes are indicated in Table-I. The nominal conductor diameter shall be 0.40. 0.50, 0.63 and 0.90 mm.	Information
3.0	CONDUCTOR:	
3.1	Each conductor shall consist of a solid, round wire of annealed, high conductivity Copper, smoothly drawn, nominally circular in section, uniform in quality and resistance, and free from defects. The quality of copper shall conform to IEC: 28 or IS:12444.	Certificate from accredited labs to be submitted
3.2	The resistance of conductor and the resistance unbalance of pairs shall meet the requirements in Clause 18.1.	Test Case-1
3.3	The joints in the conductor shall be kept to a minimum and shall fulfil the following conditions:-	Information
3.3.1	The resistance of a 100 cm length of conductor containing a joint shall not be more than 101.25% of that of an adjacent shall be of conductor not containing a joint.	Test Case-2

3.3.2	The tensile strength of a 25 cm length of conductor containing a joint shall not be less than 90% of that of an adjacent sample of conductor not containing a joint.	Test case-2
4.0	**INSULATION:**	Information
4.1	Each conductor shall be insulated with solid polythene of type specified below: -	Information
4.1.1	The conductor insulation shall be made of insulating-grade polyethylene, using 100% virgin material, in accordance with ASTM D883.	Certificate from accredited labs to be submitted
4.2	The insulation shall be of materials adequately stabilized with an antioxidant copper inhibitor system sufficient to pass the oxidation induction time and other relevant test stipulated in this GR.	Test Case-3
4.3	The polythene shall conform to ASTM D1248 Type II or III, Class A, Category 4 or 5 and shall meet the parameters detailed below:- i) Density - Type II (0.926 to 0.940 gm/cc) - Type III (0.941 to 0.959 gm/cc) ii) Flow rate (melt Flow Index) - Maximum 1.0 gm/l0 minutes (190°C, 2160 gm load) iii) Dissipation factor (power factor) - Maximum 0.0005 iv) Dielectric constant (Permittivity) - Maximum 2.35 v) Volume resistivity - Minimum 1 x 10^{15} Ohm-cm vi) Oxidation Induction Time (OIT) - Minimum 60 minutes, when tested in an aluminium pan at 200°C.	Test case-3
4.4	The insulation shall be uniform and smooth, and shall be coloured as in Table 2. The colour shall be identifiable under normal lighting conditions and shall generally conform to IS: 9938.	Certificate from accredited labs to be submitted
4.5	The grade of pigment used for colouring the polythene shall be such that the coloured insulation meets the specified requirements.	Information
4.6	The thickness of insulation shall be adequate to meet the electrical and mechanical Requirements of this GR.	Information

4.7	Joints, if any, in the insulated conductor shall be covered with nonhygroscopic dielectric material to leave no portion of the conductor exposed. Such joints shall be of a quality, adequate to meet all the specified electrical and mechanical requirements.	Information
4.8	Integrity of Insulation: The insulated conductor shall be subjected to spark test at 4.5 kV DC or 3 kV AC RMS for all conductor sizes. There shall not be more than one spark over per 5 km of the insulated conductor, when assessed on bobbin basis on the insulating line. The test will be at the extrusion stage.	Test case-4
5.0	PAIRING:	Information
5.1	Two insulated conductors shall be twisted together with uniform lay to form a pair. The length of the lay of any pair shall be different from that of adjacent pairs. The lay of various pairs shall be so chosen as to satisfy the capacitance unbalance requirements as per Clause 18.4 and cross-talk requirements as per Clause 18.5 of this GR. To the extent possible, the lay of any pair may be limited to 150 mm. The manufacturer may use at his discretion a system of non-uniform lay for pairs etc., if the requirements of the GR are guaranteed.	Test case-5
6.0	CABLE CORE:	Information
6.1	50 and 100 pairs Super Units: 10 or 20 pairs shall be stranded to form a group called a Unit. This assembly shall be as per Table-2. Each unit shall have an open helical lapping of polyester/poly-propylene/ polythene tape of thickness 0.02 mm minimum. The lay of the tape shall not exceed 100 mm. The tape shall be coloured as in Table-3 for the identification of the units; colour of the tape shall be distinguishable under normal lighting conditions.	Test case-5
6.1.1	5 Nos. of 10 pair units shall be assembled to form a 50 pair super unit.	Information
6.1.2	A 100 pair super unit will comprise of 5 Nos. of 20 pair units and a spare pair. This spare pair shall he added in an interstice or in the centre, but shall not be within any unit. The numbering of the units shall be clockwise from the running end. Each super unit shall have an open helical lapping of polyester/polypropylene/polythene tape of thickness 0.02 mm minimum and coloured as in Table-4 for identification the colour of the tape shall be distinguishable under normal lighting conditions	Test case-5

6.2	**Cables – Laying up:**	Information
6.2.1	5 pair cable: 5 pairs shall be stranded in accordance with Table-2 to form the cable core.	Information
6.2.2	10, 20, 50 and 100 pair cables shall be laid up as for unit/super units described in clause 6.1 above. The 100 pair cable shall not have any spare pair.	Information
6.2.3	For other sizes, the requisite number of super units shall be assembled as indicated Table-5 to form the core. The numbering of super units in a layer shall be as in Table-4.	Undertaking from OEM
6.3	**Defective Pairs:**	Information
6.3.1	Cables not having any spare pair: Cable with any defective pair will not be acceptable.	Information
6.3.2	Cable having any spare pair: Cables with defective pairs will be accepted subjected to the following conditions: - i) The total number of defective pairs in a cable shall be equal to or less than 50% of the spare pairs in the cable. ii) The number of defective pairs in any super unit shall not be more than one. iii) The acceptance of such cable will be decided by the purchasing authority. iv) The cables offered for prototype evaluation shall not contain any defective pair in any of the cables.	Information
6.3.3	Any pair, if it does not conform to any of the specified requirements is considered as a defective pair; however, in the case of any pair showing earth fault by contact to the poly-al tape, the cable will be outright rejected.	Information
7.0	**FILLING COMPOUND:**	Information
7.1	The cable core shall be filled with filling compound of type petroleum jelly or Absorbent Thyrotrophic Gel. The compound shall be compatible with the insulation; binder sand tapes used in the cable. The compound shall be of homogeneous and uniformly mixed material containing an anti-oxidant. It shall not contain dirt, metallic particles or other foreign matter. It shall meet the requirements of Clause 20 of this GR.	Test case-3
7.2	The compatibility between the insulation and filling compound shall be	Test case-

	as per Clause 22 of this GR.	9
8.0	CORE WRAPPING:	Information
8.1	After application of the filling compound, at least one closed helical or longitudinal application of a non-hygroscopic and non-wicking polyester tape or tape of any other Suitable material shall be provided over the cable core. Application of a flooding compound below and above the core wrapping tape is recommended.	Undertaking from OEM
9.0	SCREEN:	Information
9.1	An aluminium tape coated with polythene/copolymer on both sides shall be applied over the cable core with a minimum overlap of 3 mm for the cables, whose specified maximum diameter over sheath is less than 30 mm, and a minimum overlap of 6 mm for the cables whose specified maximum diameter over sheath is equal to or above 30 mm. The thickness of the aluminium tape shall be 0.2 mm ± 10% and that of polythene/copolymer coating on each side 0.05 mm nominal. The thickness of the composite tape shall be 0.3 mm ± 15%.	Test case-6
9.2	The aluminium tape shall he sealed at the overlap and bonded to the inner surface of the polythene sheath extruded over it. The tape shall be electrically continuous throughout the length of the cable. The screen may be corrugated, if desired by the manufacturer for better performance.	Test case-6
9.3	The peel strength of the polythene/copolymer coating from aluminium shall not be less than 25 gm/mm width.	Test case-6
10.0	SHEATH:	Information
10.1	The cable shall be sheathed with polythene conforming to type 03C or H03C of BS 6234, and shall contain a suitable antioxidant system. The material shall be virgin, as per ASTM D-883 and shall meet the requirements specified below: - i) Melt Flow Index - Shall not be more than 1.0 gm/10 minutes (190°C, 2160 gm load). ii) Density - For 03C, shall be 0.910 to 0.940 gm/cc For H03C, shall be greater than 0.940 gm/cc. iii) Oxidation Induction Time - Minimum 30 minutes, when tested in aluminium pan at 200°C.	Test case-3, Certificate from accredited lab to be submitted

<table>
<tr><td></td><td>Note: - The sheathing/jacketing compound is required to be source approved. The source approval certificate shall clearly indicate the density and the type of polyethylene approved. The density range for various types of raw material are given below: -
LDPE: 0.910 to 0.925 gms/cc;
MDPE: 0.926 to 0.940 gms/cc;
HDPE: above 0.940 gms/cc.
The above densities are after giving necessary correction for carbon black content.</td><td></td></tr>
<tr><td>10.2</td><td>The sheath shall be reasonably circular, and free from pin-holes and other detects the variation· between the maximum and the minimum diameter at any cross section conform to the following: -
<table>
<tr><th>Specified maximum diameter Over sheath (in mm)</th><th>Maximum variation (in mm)</th></tr>
<tr><td>Up to 40</td><td>3.0</td></tr>
<tr><td>Above 40 and up to 68</td><td>4.0</td></tr>
<tr><td>Above 68</td><td>5.0</td></tr>
</table></td><td>Test case-7</td></tr>
<tr><td>10.3</td><td>The thickness of sheath shall conform to Table-6. The minimum thickness shall not be less than 75% of the specified nominal. The average of six measurements at each end, equally placed around the circumference, shall not be less than 85% of the specified nominal value.</td><td>Test case-7</td></tr>
<tr><td>10.4</td><td>Integrity of Sheath: The sheath shall be spark tested at the voltage given in Table-6. There shall be no spark-over. This is an online test.</td><td>Test case-7</td></tr>
<tr><td>10.5</td><td>The maximum diameter of cable for different sizes/gauges over the sheath shall be as per Table- 7.</td><td>Test case-7</td></tr>
<tr><td>11.0</td><td>ARMOURING:</td><td>Information</td></tr>
<tr><td>11.1</td><td>When armouring is required, bedding and armour shall be provided over the sheath to be followed by the jacket specified in Clause 12.0.</td><td>Information</td></tr>
<tr><td>11.2</td><td>Bedding: Two close helical lappings of polythene or poly-propylene tape shall be applied over the sheath to provide sufficient mechanical protection during armouring. Each tape shall be applied with a minimum 5% overlap. The second tape shall cover the overlap of the</td><td>Information</td></tr>
</table>

	first tape about evenly. The thickness of the tape shall be such that it shall meet the requirement of the Clause 23.5.1 of the GR. The width of the tape is left to the discretion of the manufacturer.	
11.3	Armour:	Information
11.3.1	This shall be of two applications of galvanized steel tape conforming to IS: 3975, both applied helically in the same direction with a gap in the first tape of 15% to 35% of the nominal width of the tape, the second tape evenly covering the gap of the first tape. In any case, the overlap of the second over the first tape shall not be less than 15% of the nominal width of the tape on either side. The raw material GS tape when tested as per IS: 3975 shall meet the following requirements: - i) Tensile strength - 300 to 450 MPa ii) Elongation - Min. 10% iii) Dip Test – Shall withstand a minimum of 2, one minute dips when tested in a copper sulphate solution prepared as per IS: 2633.	Certificate from accredited labs to be submitted
11.3.2	The thickness of GS tape shall conform to Table 8. The width is left to the discretion of the manufacturer. However, the width of both the tapes in the cable shall be same.	Undertaking from OEM
11.3.3	The steel tape of the required width shall be galvanized; it should not be slit to a smaller width after galvanization, as in that case, there will not be zinc coating on the cut edge/edges.	Undertaking from OEM
11.3.4	The joints in the armouring tape shall be kept to the minimum. Wherever joints are made, adequate corrosion protection shall be provided on both the sides and edges.	Undertaking from OEM
12.0	JACKET:	Information
12.1	The armoured cable shall be tightly jacketed with polythene conforming to the requirements as specified for sheath in Clause 10.1. The nominal thickness of the jacket shall be as per Table-9. The minimum and average thickness shall be regulated as in Clause 10.3.	Information
12.2	The jacket shall be reasonably circular, and free from pin-holes and other defects.	Physical check
12.3	The jacket shall be spark tested as per Table-9. There shall be no sparkover. This is an on-line test.	Information
12.4	The maximum diameter of cable for different sizes/gauges over jacket shall be as per Table-7.	Physical Check

13.0	IDENTIFICATION AND LENGTH MARKINGS:	Information
13.1	To enable proper identification of the cable, the following markings shall be embossed or engraved on the polythene jacket in case of armoured cable, and on the sheath for un-armoured cables. All the markings shall be in white or yellow colour. a) Telephone handset emblem b) Name of manufacturer c) Month and Year of manufacture in the form of MMYY, where MM is month and YY is year. d) No. of pairs/conductor size (Ex: 100 pairs/0.63 mm) e) Length marking f) User Organization g) Specific cable serial number uniquely to identify each cable length.	Physical Check
13.2	The markings shall be clear, distinct and visible to the naked eye from a distance of about 1 metre; the size of markings shall be minimum 3 mm.	Physical Check
13.3	The markings shall be at intervals of one metre and shall be throughout the length. The running length marking is critical.	Physical Check
14.0	PRE-CONNECTORISATION:	Information
14.1	The cable shall be preconnectorised when so desired by the user. The Materials and techniques used for preconnectorisation shall be got approved from the purchaser before supply.	Undertaking from OEM
15.0	SEALING OF ENDS:	Information
15.1	Immediately after completion of the electrical tests, the ends of the cable shall be sealed by thermo shrinkable end caps of adequate wall thickness. Alternatively, ends may be sealed by enclosing them in rubber or PVC caps of wall thickness not less than 1.8 mm. The cap shall be of robust construction, and tight fit. The cap shall be coloured black and shall be secured to the sheath/ jacket with appropriate hose clips or ties or black adhesive tape or heat shrinkable sleeves.	Undertaking from OEM
16.0	INSPECTION:	Information
16.1	The cable shall be tested and examined at the manufacturer's works. The manufacturer shall provide the necessary stable voltage and testing apparatus and shall afford all facilities and assistance required for the purpose. Where considered necessary, the purchaser may test	Information

	the cables in his premises with his testing equipment.	
16.2	The raw materials used for the manufacture shall be tested by lab accredited by TEC/ NABL including CACT & any other Govt Laboratory.	Certificates from accredited labs to be submitted
16.2.1	The inspector shall have the power to reject any wire/other materials, which appear to him to be of unsuitable description or of unsatisfactory quality.	Information
16.3	Notice shall be given to the Inspector when the cables are ready for inspection and tests.	Information
16.4	The manufacturer shall supply certified copies of results of all the tests carried out on each drum length.	Information
16.5	Prototype evaluation will be carried out in accordance with the latest Type Approval Procedure of TEC. The Test Plan and the Schedule of Tests for different contexts are at Appendix-1 and Appendix-2 respectively.	Information
17.0	PACKING and MARKING: The provision of cable length in a drum shall be based on the requirement of purchaser.	Information
17.1	The end with the clockwise direction of rotation of the colour scheme of the units in the cable shall be indicated by bands of red colour. Suitable selfadhesive tapes may be used for the purpose.	Information
17.2	Various components of the wooden drums may be assembled using nails, provided that any nail which comes through into the cable space shall be properly and effectively clinched.	Undertaking from OEM
17.3	The nominal length of cable (except duct cable) for different sizes shall be as per Table-I. A tolerance of +10% to -25% on nominal length is permissible. Normally one nominal length shall be wound on a drum.	Test case-8
17.3.1	If any short lengths are acceptable to the purchasing authority, the details of such cables, price and quantity shall be indicated by him. In such cases, a maximum of two short lengths of the same size /gauge of cable for the same consignee can be wound on one drum provided both the ends of both the cables are distinctly marked. Adequately supported and accessible for tests.	Information

17.4	After the cable wound on a drum as above, has been tested and approved by the inspector, it shall be prepared for dispatch to destination in such a manner as to comply with the following: -	Information
17.4.1	The drums shall be effectively lagged with stout and closely fitting battens so as in prevent damage to the cable during storage or transit.	Information
17.4.2	Both ends of the cable(s) on the drum shall be kept inside the drum secured and protected. The ends of the cable(s) shall be easily accessible for testing.	Undertaking from OEM
17.4.3	The cable ends shall be so fastened and secured to the drum that during the process of transit, rolling, etc., the cable is not loosened or displaced.	Udertaking from OEM
17.4.4	The batten or battens on the drum which should be removed to obtain access to the ends of the cable must be indicated clearly by painting them with red paint.	Physical Check
17.5	The following details shall be clearly indicated on each drum/package in good oil paint, preferably, by black colour. a) Manufacturer's name b) The consignee's full address c) Description of the content including size/gauge/length and type of cable. The type of cable of this GR shall be indicated as PIJF. The length markings shall include initial final and actual length of cable(s). d) Gross weight e) Rolling mark f) "Not to be slung except by bar through Centre". g) The details provided on polythene sheath/jacket as per Clause 13.1 (g) and any other markings (these markings are also to be shown in the column provided for the purpose in the invoices in which the quantity and description of contents of each package shall be clearly and separately stated).	Physical Check
17.5.1	In case, the cables are transported by ship, the following marking shall also be clearly stenciled on the drum in good oil paint:- "STOW AWAY FROM BOILERS"	Undertaking from OEM
18.0	**ELECTRICAL TESTS:** The following tests shall be conducted on the completed cable. The cable shall be tested on an automatic test set for resistance,	Information

	resistance unbalance,capacitance, capacitance unbalance, cross-talk and attenuation. The average/RMS value specified is the average/RMS of the individual values of the pairs in the cable/super unit tested. In case of 200/400 pairs cable, two SUs of 50 pairs shall be tested as one group of 100 pairs.	
18.1	**Conductor Integrity Test:**	Information
18.1.1	All the conductors in the completed cable shall be tested for continuity and absence of crossed pairs and contacts. No conductor shall have contact with poly-al tape.	Test case-1
18.1.2	Conductor Resistance: The resistance of conductors and the tolerance of individual values as per IS:10810 (part-5) shall meet the requirements of Table-11. The temperature correction factor is indicated in Table-11. The temperature correction for resistance shall be made using the following equation: $\text{Resistance at } 20°C = \frac{\text{Resistance at t }^{\circ}C}{[1 + 0.00393\ (t-20)]}$	Test case-1
18.1.3	Conductor Resistance Unbalance: The conductor resistance unbalance (RU) shall not exceed the values listed in Table-12.	Test case-1
18.1.3.1	The percentage RU of any individual pair tested shall be calculated as follows: - % Resistance Unbalance = (R1- R2)/ (R1+ R2) x 100 Where, R1 and R2 are the resistances of individual conductors of the pair under test and R1 is higher than R2.	Test case-1
18.2	Poly-al Tape: The poly-al tape shall be tested for continuity, and its resistance value noted	Physical Check
18.3	Mutual Capacitance: The average mutual capacitance of the pairs measured at any frequency between n 800 to 1000 Hz shall be 52 ± 3 nF/km. However, the mutual capacitance of individual pairs shall be within the limits of 52 ± 4.5 nF/km.	Test case-10
18.4	**Capacitance Unbalance:**	Information
18.4.1	The pair to ground capacitance unbalance at any frequency between 800 to 1000 Hz shall not exceed the following values: Average 750	Test case-10

	pF/km Individual 3000 pF/km	
18.4.2	The pair-to-pair capacitance unbalance measured at only frequency between 800 to 1000 Hz for all combinations of pairs in each unit of a super unit or cable shall not exceed the following limit. Average…… 50 pF/km Individual combination…… 200 pF/km	Test case-10
18.4.3	The measured value shall be corrected as follows: - i. Capacitance unbalance pair to ground – The measured value shall be divided by L/1000, Where L is the length of the cable tested in metres. Ii. Capacitance unbalance pair to pair – The measured value shall be divided by:- 1/2 (L/1000+√L/1000) Where L is the length of cable tested in metres	Test case-10
18.4.4	For these tests, the cable lengths less than 100 metres shall be considered as 100 metres.	Information
18.5	**Cross – talk:** Equal Level Far End Cross-Talk (ELFEXT) and Near End Cross-Talk (NEXT) at 150 kHz of the cable shall meet the requirements indicated in 18.5.1 and 18.5.2 respectively. The measurement will be made on pair combinations as indicated in clause 18.4.2.	Test case-10
18.5.1	**ELFEXT:** The individual and RMS values shall be equal to or better than 55 dB/km and 67.8 dB/km respectively. The RMS dB is given by RMS (dB) = 10 log10 * ∑ 10-m (I,j)/10/n] where m(I,j) = Cross-talk values between the I and j pairs n = number of pair combinations	Test case-10
18.5.1.1	For length other than one km, the measured value shall be corrected by 10log10L/1000L, being the cable length tested in metres.	Information
18.5.2	**NEXT:** The individual value between pairs shall be equal to or better than 55 dB, when corrected to a unit length of 1 km.	Test case-10
18.5.2.1	**NEXT Correction:** No correction is necessary if cable lengths of 300 metres or more are tested. For other lengths. The NEXT value shall be corrected with the following formula: Nx = No – 10 log 10[1-e-4∞.1x/1-e-4∞lo]	Test case-10

	where, ∞ = Average attenuation in Nepers per km Nx = Next in dB corrected to a unit length of 1 km No = Measured value for length (10) in dB lx = 1 km lo = length of cable tested in km \e =2.71828	
18.5.2.2	Lengths less than 150 meters shall not be tested for this parameter.	Information
18.6	**Attenuation:** The average attenuation of the pairs at 20°C at 150 kHz shall not exceed the values given below: Conductor dia / Attenuation 0.40 mm / 12.00 dB/km 0.50mm / 8.25 dB/km 0.63 mm / 6.30dB/km 0.90mm / 4.40dB/km	Test case-10
18.6.1	Temperature correction for attenuation shall be made using the following equation: Attenuation at 20˚C = Attenuation at t˚ C/ [1 + 0.0018 (t. 20)]	Test case-10
18.7	**Insulation Resistance:** The insulation resistance measurement shall be made with a DC voltage of magnitude not less than 500 V after steady electrification for one minute. The insulation resistance values between each conductor in the cable and all the other conductors connected together and to the screen and earthed shall not be less than 5000 Mega ohm-km. (cable length in km x observed insulation in (Mega ohms) at room temperature.	Test case-10
18.8	**Dielectric Strength:**	Information
18.8.1	The insulation between conductors shall withstand for 3 seconds a DC potential indicated below: 2.4 kV for 0.40 & 0.50 mm conductors 3.5 kV for 0.63 & 0.90 mm conductors	Test case-10
18.8.2	The insulation between the conductors and shield shall withstand for 3 seconds a DC potential of 5 kV for 0.40 & 0.50 mm and 10 kV for 0.63 & 0.90 mm co	Test case-10
19.0	**MECHANICAL TEST ON CONDUCTOR:**	Information
19.1	**Annealing Test:** When a sample of conductor from the completed	Test case-

	cable, 250 mm long, is slowly and steadily stretched, the elongation at break shall not be less than the appropriate value given in Table-10.	12
20.0	TESTS ON FILLING COMPOUND:	Information
20.1	**Stability:** When held at a temperature of 65 ± 1°C for 5 days, the compound shall not show any separation of the constituents of the filling compound.	Physical Check
20.2	**Colour:** The compound shall not obscure the identification of the colour of the insulation of the conductors.	Undertaking from OEM
20.3	**Handling:** The compound shall be readily removable from the insulated conductors by wiping. It shall be free from unpleasant odour and shall have no toxic or dermatic hazards.	Undertaking from OEM
20.4	**Volume Resistivity:** The Volume resistivity, measured at 100°C by the method described in ASTM D 1169 or any other approved method shall not be less than 1 x 10^{10} Ohm-cm.	Undertaking from OEM
20.5	**Permittivity:** The permittivity at 1 MHz when tested as in ASTM D 924 shall not be greater than 2.3 at 20°C.	Undertaking from OEM
20.6	**Flash Point:** The flash point of filling compound when tested as per - ASTM D 92, shall not be less than 200 °C.	Undertaking from OEM
21.0	TESTS ON INSULATED CONDUCTORS:	Information
21.1	**Retraction of Insulation:** When cut at a point not less than one metre from one end of the insulated conductor on the bobbin, the retraction of the insulation on the conductor at room temperature shall not exceed 2.5 mm after one minute.	Test case-12
21.2	**Resistance to Compression**: Two lengths of insulated conductor shall be uniformly twisted under light tension so that there are 10x 360˚ twist in a length of 100 mm. Not more than 50 mm in the middle of the twisted pair shall be placed between two flat rigid metal plates coated with polythene on the inside surface. A compressive force of 200 N (minimum) shall be applied between the plates. One minute after the application of the force, there shall be no electrical contact between the insulated conductors. The test shall be made at 12 V DC with a suitable indicator.	Test case-12

21.3	**Shrink Back of Insulation:** 200 mm specimen shall be cut from the centre of 1500 mm length and then reduced to 150 mm by trimming each end of the specimen. The 150 mm specimen shall be placed in a convection type air circulating oven for 24 hours at a temperature of 100 ± 1°C. A minimum of six samples shall be tested at a time. The total shrinkage from both ends shall be measured at ambient temperature. The average shrinkage of six samples shall not exceed 6.35 mm.	Test case-12
21.4	**Thermal Stress Cracking:** 10 lengths of insulated conductor of 15 cm shall be wrapped on their own diameter with a minimum of 10 contiguous turns of the insulated samples closely wound. It shall be suspended in an air oven maintained at 70 ± 1°C for 14 days. After this period, they shall be removed from the oven and observed at ambient temperature for cracks with naked eye. There shall be no cracks.	Test case-12
21.5	**Cold Bend:** 10 samples of the Conductor with insulation shall be tested in accordance with ASTM D 2633 (Cold bend test), after conditioning at a temperature of -40°C for one how with mandrel diameter equal to the diameter of the insulated conduct. There shall not be more than one failure out of ten samples.	Test case-12
22.0	**COMPATIBILITY OF INSULATION AND FILLING COMPOUND:**	Information
22.1	**Absorption of filling Compound:** For this test, 15 cm centre length of insulation carefully removed from conductors, shall be weighed (about 2 gm) corrected to 1 mg. The lengths (suitably coiled and bent. if necessary) shall be placed in a test tube or beaker full of filling compound with its end one centimetre above the level of filling compound and maintained at 70 +1˚C for 14 days. At the end of this period, the insulation samples shall be removed, the surface shall be wiped clean and again weighed at ambient temperature & accurately. Increase in weight shall not be more than 10%.	Test case-9
22.2	**Elongation and Tensile Strength:** 10 long lengths of insulation shall be carefully removed from the conductor and made into two sets of 10 halflengths. The first set shall be tested as per ASTM D 1248. The percentage elongation at break and tensile strength shall be noted and averages worked out. These values shall not be· less than 300% and	Test case-9

	100 kg/cm2 respectively. The second set shall be aged in a test tube or beaker full of filling compound at 70 ± 1°C for 14 days. After ageing, the insulation shall be removed from the compound and gently wiped free of compound, and then tested for tensile properties as per the' other set. The average percentage elongation at break and tensile strength after ageing shall not change by more than 30% and 15% respectively of the values before ageing.	
22.3	**Environmental Stress Cracking:** 10 lengths of insulated conductor of 150 mm each shall be immersed in filling compound for 24 hours at 70 ± 1°C. The Insulated conductors shall then be removed from the compound and wiped clean at ambient temperature. Each conductor shall then be wrapped around its own diameter for a minimum of 10 contiguous turns closely wound. They shall then be suspended in an oven maintained at 70 ± 1°C for 14 days. At the end of this period, they shall be removed from the oven and observed at ambient temperature for cracks with naked eye. There shall be no cracks.	Test case-9
23.0	**TESTS ON COMPLETED CABLES:**	Information
23.1	**Drip Test:** When tested, there shall be no dripping of the filling compound.	Test case-11
23.2	**Oxidation Induction Time:** The induction time in oxygen with an aluminium pan when tested shall not be less than 30 minutes for each colour of insulation removed from the conductor of the completed cable.	Test case-12
23.3	**Bond Strength of composite sheath:** The bond strength of the poly-al laminate to the polythene sheath and at the overlap be 40 gm/mm width (minimum) and 60 gm/mm width (average) of 5 samples.	Test case-6
23.4	**Tests on Sheath:** For the tests in this section, the polythene sheath shall be stripped off the laminate.	Information
23.4.1	**Tensile Strength and Elongation:** The samples of polythene removed from the cable sheath shall meet the following requirements when tested in accordance with BS 6234: Tensile strength -- Min. 70 kg/cm² Elongation -- Min. 300%	Test case-9
23.4.2	**Environmental Stress Cracking:** The specimen cut from the polythene sheath shall meet the environmental stress cracking test as described	Test case-9

	in ASTM D 1693, when tested with 10% Igepal solution at 50 ± 1˚C for 48 hours. There shall be no failure.	
23.4.3	**Shrinkage Test:** A specimen shall be cut from the cable sheath 50 mm long measured along the axis and 12 mm wide and placed in a convection type air circulating oven at a temperature of 100 ± 1°C for a period of 24 hours. At the end of this period, the shrinkage as measured at ambient temperature in the lengthwise direction shall not exceed 5 %.	Test case-13
23.4.4	**Carbon Black Content:** The carbon black content of sheath shall be determined as in BS 6234, and shall be 2% to 3% by weight.	Undretaking from OEM
23.4.5	**Carbon Black Dispersion:** The carbon black dispersion in sheath shall conform to BS 6234.	Undertaking from OEM
23.4.6	**Oxidation induction Time:** The induction time in oxygen when tested with an aluminium pan shall not be less than 25 minutes.	Test case-13
23.5	**PROPERTIES OF ARMOURING:**	
23.5.1	The thickness of bedding tape removed from the completed cable shall not be less than 0.05 mm.	Physical Check
23.5.2	The galvanized steel tape removed from the completed cable shall meet the following requirements:- a) The thickness of the tape shall be as per Table-8. b) The tensile strength shall be 250 to 450 MPa. c) The elongation shall not be less than 8%. d) The tape shall withstand two dips of one minute when tested a copper sulphate solution prepared as per IS 2633. e) The tape should be free from rust/bare patches.	Physical Check, Undertaking from OEM
23.6	**PROPERTIES OF JACKET:**	
23.6.1	The jacket shall meet the test requirements as per Clause no. 23.4.	Information
23.7	**WATER PENETRATION:**	Test case-11
23.7.1	This test shall normally be conducted at the sheathing stage on the sheathed cable. In case, the cable has already been armoured or jacketed, the bedding tape, the steel tape and jacket, as applicable, have to be removed at the point of application of water.	Test case-11

23.7.2	One metre of the cable shall be supported horizontally and one metre head of water applied at ambient temperature. The test duration shall be as indicated below: - Type tests -- 14 days Acceptance tests for bulk supplies – 4 days	Test case-11
23.7.3	During the above period no water shall have seeped from the cable sample.	Test case-11
23.8	CABLE BEND TEST:	Test case-11
23.8.1	The test shall be taken on the completed cable. In the case of armoured cable the jacket, Armour and bedding shall be removed.	Test case-11
23.8.2	The cable sample shall be coiled around a mandrel having a diameter of 12D for at least one complete turn, 'D' being the diameter of the cable under test. The sample shall then be straightened and observed. The sheath shall not ripple and there shall be no damage in sheath.	Test case-11

H. TEST SETUP & PROCEDURES:

Note:

(a) The test set-up given in this document are tentative and may be changed by testing officer, considering, network/testers/ analyzer/simulator availability. In case of any discrepancy between this Test Guide and GR, GR clause shall prevail.

(b) Since this is provisional Test Guide. Based on inputs received setup was prepared. Whenever the first testing was offered this provisional Test Guide would be revised.

(c) Actual setup and tester/simulator may vary at the time of testing.

(d) Testing of Solid Polythene Insulated Fully Jelly Filled, Polythene Sheathed Underground Telecom Cables will be done on the basis on testing facility available for testing Solid Polythene Insulated Fully Jelly Filled, Polythene Sheathed Underground Telecom Cables. If no testing facility is available for testing Solid Polythene Insulated Fully Jelly Filled, Polythene Sheathed Underground Telecom Cables, then undertaking from OEM may be taken.

Test No.	**Test Case-1 (Conductor Integrity, Conductor Resistance & Resistance Unbalance Test)**
Test Details	Clause no. 3.2, 18.1.1, 18.1.2, 18.1.3, 18.1.3.1
Test Setup	1. Completed cable drum length selected for testing. 2. Calibrated Automatic Cable Test Set / Digital Low-Resistance Ohmmeter 3. Digital Contact Thermometer / Temperature probe 4. Cable connection fixture/harness for pair breakout and poly-al tape shield access. 5. Temperature chamber calibrated to 35°C ambient temperature.
Test Procedure	1. **Conductor Continuity & Integrity Sequence** a) Strip both ends of the cable drum to expose the conductors and the poly-al screen, then clean off the jelly then connect all core conductors of the completed cable drum to the automatic test set / continuity tester to check and verify continuity across every conductor from end to end. b) Perform a test across all conductors to ensure complete absence of short circuits (contacts between conductors) and crossed pairs. c) Connect the test probe to the poly-al moisture barrier tape/screen and verify that no conductor has contact (earth fault) with the poly-al tape. **2. Conductor Resistance Measurement & Temperature Correction Sequence** a) Measure the ambient temperature (t deg Celsius) of the testing environment / cable drum and log the value. b) Measure the DC loop/conductor resistance of each individual conductor in the cable using the test set as per IS:10810 (Part-5). c) Convert the measured resistance at t deg celsius to resistance at 20 deg celsuius using the temperature correction formula:- Resistance at 20°C = Resistance at t ˚C

	/([1 +0.00393 (t-20)]) d) Normalize the converted value per kilometer (Omega/km) using the tested cable length. **3. Conductor Resistance Unbalance (RU) Verification Sequence** a) For each individual twisted pair, record the individual resistances R1 and R2 of the two conductors (where R1 > R2) b) Calculate the percentage Resistance Unbalance (RU) for each pair using the formula: % Resistance Unbalance = (R1- R2)/ (R1+ R2) x 100 c) Calculate the average percentage Resistance Unbalance across all pairs in the cable / super unit.
Test limits	1. All the conductors in the completed cable shall be tested for continuity and absence of crossed pairs and contacts. No conductor shall have contact with poly-al tape. 2. Conductor Resistance at 20 deg. C shall comply with Table-10 of GR. And correction factor for conductor resistance shall comply with Table-11 of GR. 3. Conductor Resistance Unbalance shall comply with Table-12 of GR.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-2 (Conductor Joints Resistance & Tensile Strength Test)**
Test Details	Clause no. 3.3.1,3.3.2
Test Setup	1. Five prepared conductor joint samples per operator. 2. Five adjacent continuous (unjointed) reference conductor samples taken from the same spool/wire. 3. Calibrated Micro-ohmmeter / Digital Low Resistance Ohmmeter 4. Calibrated Tensile Testing Machine (UTM) 5. Calibrated steel ruler / measuring scale
Test Procedure	**1. Joint Resistance Verification Sequence** a) Cut a 100 cm conductor specimen containing the joint, and an adjacent 100 cm specimen of continuous conductor without any joint. b) Mount the jointed 100 cm conductor across the resistance measurement terminals and measure the DC resistance value (R_joint). c) Mount the adjacent unjointed 100 cm reference conductor across the terminals and measure its DC resistance (R_reference). d) Compute the relative resistance ratio: %resistance= (R_joint/ R_reference) *100 e) Repeat across all 5 operator sample pairs. **2. Joint Tensile Strength Verification Sequence** a) Cut a 25 cm conductor specimen containing the joint, along with an adjacent 25 cm reference unjointed specimen. b) Clamp the 25 cm jointed specimen into the tensile tester jaws and apply steady tensile load at standard pull rate until tensile rupture/break occurs; record breaking load(T_joint). c) Clamp the adjacent 25 cm unjointed reference specimen and stretch until break; record breaking load(T_reference).

	d) Calculate tensile retention: % Tensile Strength= (T_joint/ T_reference) *100 e) Repeat across all 5 operator sample pairs.
Test limits	1. Conductor joint resistance shall not be more than 101.25% of that of the adjacent conductor without a joint. 2. Tensile breaking strength of conductor containing a joint shall not be less than 90% of the adjacent conductor without a joint.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-3 (Conductor Insulation Material Properties & Oxidation Induction Time Test)**
Test Details	Clause no. 4.2,4.3,7.1,10.1
Test Setup	1. Raw polythene granules (Type II / Type III, Class A, Category 4 or 5) sampled from two (2) different bags. 2. Melt Flow Index (MFI) Apparatus calibrated at 190 deg celsius with 2.16 kg load 3. Precision Analytical Balance & Density Gradient Column

	4. High-precision LCR Bridge / Dissipation Factor & Permittivity Test Cell 5. High-resistance Megohmmeter / Electrometer Cell 6. Differential Scanning Calorimeter (DSC) with pure Oxygen and Nitrogen gas supplies
Test Procedure	**1. Density & Melt Flow Index Sequence:** a) Determine the raw resin density using the density gradient column at standard reference temperature. b) Load the extrusion plastometer with resin pellets, stabilize at 190 deg celsius, apply a 2160 g standard weight, and determine extruded mass flow over 10 minutes. **2. Electrical Properties Sequence:** a) Prepare molded plaque specimens and measure dissipation factor (power factor) and dielectric constant (permittivity) using the calibrated dielectric test cell. b) Measure volume resistivity with test voltage applied across the electrode test fixture. **3. Oxidation Induction Time (OIT) Sequence:** a) Place a calibrated specimen in an open aluminium pan inside the DSC cell under nitrogen atmosphere. b) Heat specimen to isothermal test temperature of 200 deg Celsius. c) Switch atmosphere from nitrogen to pure oxygen gas and record the time duration until the onset of exothermic thermal oxidation.
Test limits	1. Oxidation Induction Time (OIT): Minimum 60 minutes in aluminium pan at 200 deg Celsius. 2. The polythene shall conform to ASTM D1248 Type II or III, Class A, Category 4 or 5 and shall meet the parameters values menetioned in clause 4.3 of GR.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-4 (Conductor Insulation Spark Integrity Test at Extrusion Stage)**
Test Details	Clause no. 4.8
Test Setup	1. Extrusion Line Spark Tester 2. Calibrated High-Voltage Spark Test Unit 3. Automatic fault counter and audio/visual spark indicator. 4. Extruder length logger/bobbin tracking logging system
Test Procedure	1. Calibrate spark test electrode potential to 4.5 kV DC or 3 kV AC RMS. 2. Pass the insulated copper wire through the bead electrode continuously during line extrusion, ensuring complete circumferential contact with the electrode at line speed. 3. Monitor the spark tester fault counter continuously during the running bobbin production. 4. Record total spark-over faults per bobbin against cumulative run length (km) and verify production records.
Test limits	There shall not be more than one spark over per 5 km of insulated conductor when assessed on a bobbin basis on the insulating line. . The test will be at the extrusion stage.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-5 (Pairing Lay Length & Core Unit Binder Lapping Test)**
Test Details	Clause no. 5.1,6.1,6.1.2
Test Setup	1. Sample length stripped from completed cable drum. 2. Calibrated precision steel rule / vernier caliper 3. Calibrated digital micrometer 4. Standard inspection lighting and magnification viewer.
Test Procedure	**1. Pairing Lay Length Verification:** a) Unravel adjacent twisted pairs from the cable core sample. b) Measure the axial length of one full 360 deg twist (lay length) for each pair using the steel rule and compare the lay lengths of adjacent pairs to ensure all adjacent pairs have different lay lengths and do not exceed 150 mm. **2. Unit & Super Unit Binder Tape Verification:** a) Inspect open helical lapping of binder tape around 10/20 pair units and 50/100 pair super units. b) Measure axial distance of one complete spiral wrap of binder tape (tape lay). c) Remove a sample of binder tape and measure its thickness across 5 points using a micrometer. Inspect binder tape colors against Table-3 (COLOUR SCHEME FOR BINDER FOR UNIT IDENTIFICATION) and Table-4 (COLOUR SCHEME FOR BINDER FOR SUPER UNIT IDENTIFICATION) of GR.
Test limits	1. Pair lay length shall not exceed 150 mm, and adjacent pairs shall have distinctly different lay lengths. 2. Unit binder tape thickness shall be greather than equal to 0.02 mm minimum. 3. Unit binder tape lay length shall not exceed 100 mm. 4. Color identification of unit binders (Blue, Orange, Green, Brown, Grey) and super unit binders (Red marker, White intermediate, Black reference) shall comply Table-3 and Table-4 of GR.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-6 (Poly-Al Moisture Barrier Screen Dimensions & Peel Strength Test)**
Test Details	Clause no. 9.1,9.2,9.3,23.3
Test Setup	1. Samples of poly-al tape (5 coils raw material) and composite sheath from completed cable. 2. Precision digital micrometer / dial thickness gauge (0.001 mm) 3. Calibrated Tensile/Peel Testing Machine with 180 deg peel fixture 4. Calibrated steel ruler / Vernier caliper
Test Procedure	**1. Dimensional & Overlap Verification Sequence:** a) Measure total thickness of composite poly-al tape across sample strips. b) Strip the coating to measure base aluminium thickness and copolymer coating thickness on both sides. Measure the circumferential overlap of the poly-al screen over the cable core. **2. Copolymer Peel Strength Test Sequence:** a) Prepare five 10 mm wide test strips from raw poly-al tape coils. b) Initiate separation of copolymer coating from the base aluminium substrate at one end. Clamp separated ends into tensile test jaws and pull at constant rate; record average peel force per mm width. **3. Composite Sheath Bond Strength Sequence:** a) Cut five 10 mm wide circumferential test strips of bonded poly-al/PE sheath from completed cable. b) Perform peel separation between poly-al laminate and polyethylene sheath, and at the tape overlap seam. Record minimum and average bond strength.
Test limits	1. An aluminium tape coated with polythene/copolymer on both sides shall be applied over the cable core with a minimum overlap of 3 mm for the cables, whose specified maximum diameter over sheath is less than 30 mm, and a minimum

	overlap of 6 mm for the cables whose specified maximum diameter over sheath is equal to or above 30 mm. 2. The thickness of the aluminium tape shall be 0.2 mm ± 10% and that of polythene/copolymer coating on each side 0.05 mm nominal. 3. The thickness of the composite tape shall be 0.3 mm ± 15%. 4. The peel strength of the polythene/copolymer coating from aluminium shall not be less than 25 gm/mm width.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-7 (Sheath Thickness, Circularity & Spark Integrity Test)**
Test Details	Clause no. 10.2,10.3, 10.4, 10.5
Test Setup	1. Finished cable drum sample stripped at both ends (outer jacket/armour removed) 2. Optical Profile Projector / Dial Vernier Caliper / Micrometer. 3. Online high-voltage Sheath Spark Tester.
Test Procedure	**1. Sheath Thickness Verification Sequence:** a) Take ring specimens of polyethylene sheath stripped from poly-al laminate at both ends of the cable. b) Take six thickness measurements equally spaced around the circumference at each end. Determine the absolute minimum single-point thickness and calculate the average of the 6 measurements. **2. Sheath Circularity & Diameter Variation Sequence:** a) Measure maximum and minimum diameters over sheath at any cross-section using a vernier caliper. b) Compute ovality variation and verify overall sheath diameter against Table-7 of GR. **3. Sheath Spark Test Verification Sequence:** a) Verify in-line spark tester potential during sheath extrusion as specified in Table-6 of GR. b) Check line logs to ensure no dielectric breakdown or spark puncture occurred.
Test limits	1. The thickness of sheath shall conform to Table-6. The minimum thickness shall not be less than 75% of the specified nominal. The average of six measurements at each end, equally placed around the circumference, shall not be less than 85% of the specified nominal value. 2. Integrity of Sheath: The sheath shall be spark tested at the voltage given in Table-6 of GR. There shall be no spark-over. 3. The maximum diameter of cable for different sizes/gauges over the sheath shall be as per Table- 7 of GR.
Expected Results	. Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-8(Nominal Cable Drum Length Verification Test)**
Test Details	Clause no. 17.3
Test Setup	1. Completed cable drum 2. Calibrated length marking inspection setup / Time Domain Reflectometer (TDR) / Cable length measuring wheel.
Test Procedure	1. Read and record initial length marking at outer end and final length marking at inner end of the cable drum. 2. Calculate total actual cable length: L =End Mark- Start Mark. 3. Cross-verify against the nominal drum length specified in Table-1 of GR for the corresponding pair count and conductor gauge. Compute percentage length deviation.
Test limits	Cable length per drum shall meet nominal values in Table-1 of GRwith an allowable tolerance of +10% to -25% (excluding custom duct cables).
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-9(Compatibility of Conductor Insulation and Cable Filling Compound Test)**
Test Details	Clause no. 7.2,22.0,22.1,22.2,22.3, 23.4.1, 23.4.2
Test Setup	1. Insulated conductor samples for each insulation color from production bobbins/cores. 2. Filling compound sample. 3. Precision Analytical Balance accurate to 1 mg. 4. Forced air circulating thermal conditioning oven calibrated and maintained at 70 deg celsuis. 5. Calibrated Tensile Testing Machine (UTM) 6. Test tubes / borosilicate beakers for oil/gel immersion. 7. Non-abrasive lint-free wiping cloths and solvent/cleaning materials.
Test Procedure	**1. Absorption of Filling Compound Sequence:** a) Carefully strip a 15 cm center length of insulation from the conductors (about 2 g total mass) and weigh accurately on an analytical balance to 1 mg (W1). b) Place the coiled insulation samples in a test tube or beaker filled with the filling compound, keeping the upper ends 1 cm above the liquid level. c) Maintain the immersed samples in the oven at 70 deg Celsius continuously for 14 days. d) Remove samples, wipe the surface completely clean at ambient room temperature, and re-weigh accurately (W2). Compute percentage weight increase. **2. Tensile Strength and Elongation Retention Sequence:** a) Carefully remove 10 long lengths of insulation from conductors for each color and divide each into two sets of 10 half-lengths (Set A and Set B). b) Test Set A immediately as per ASTM D1248; record initial tensile strength (T1) and elongation at break (E1), and calculate average values. c) Immerse Set B completely into a test tube/beaker filled with filling compound and place in an oven maintained at 70 deg celsius for 14 days.

	d) Remove Set B samples after aging, gently wipe them clean of filling compound, and test for tensile strength (T2) and elongation at break (E2). Calculate the percentage change in average tensile strength and elongation before and after thermal aging. **3. Environmental Stress Cracking Sequence:** a) Take 10 specimens of insulated conductor (150 mm long) for each color and immerse them fully in the filling compound at 70 deg Celsius for 24 hours. b) Remove insulated conductors from the compound, allow them to cool, and wipe them clean at ambient temperature. c) Wrap each insulated conductor around its own diameter for a minimum of 10 contiguous, closely wound turns. d) Suspend the tightly wrapped coils inside an air oven continuously for 14 days. Remove specimens, cool to ambient room temperature, and visually inspect the coils under normal light with the naked eye for any stress cracks, splitting, or defects.
Test limits	1. Increase in weight of the insulation after 14 days immersion shall not be more than 10%. 2. The average percentage elongation at break and tensile strength after ageing shall not change by more than 30% and 15% respectively of the values before ageing. 3. There shall be no cracks or surface ruptures visible to the naked eye after 14 days aging.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-10(Electrical & Transmission Parameters Test)**
Test Details	Clause no. 18.3, 18.4.1, 18.4.2, 18.4.3, 18.5, 18.5.1, 18.5.2.1, 18.6, 18.6.1, 18.7, 18.8, 18.8.1, 18.8.2
Test Setup	1. Completed cable drum 2. LCR Meter / Capacitance Bridge 3. Network Analyzer / Crosstalk Measurement Set, 4. Megohmmeter (500V DC minimum) 5. High Voltage Tester (AC/DC).
Test Procedure	1. Measure the average and individual mutual capacitance of the pairs at a frequency between 800 to 1000 Hz. 2. Measure pair-to-ground and pair-to-pair capacitance unbalance at 800 to 1000 Hz, applying length correction formulas. 3. Measure Equal Level Far End Cross-Talk (ELFEXT) and Near End Cross-Talk (NEXT) at 150 kHz across pair combinations. 4. Measure the average attenuation of pairs at 150 kHz and correct the measured value to 20°C using the formula: Attenuation at 20°C= Attenuation at t°C / [1 + 0.0018(t - 20)] 5. Apply a 500V DC potential for one minute between each conductor and all other conductors connected to the grounded screen to measure insulation resistance. 6. Apply specified DC voltage (Dielectric Strength) for 3 seconds between conductors, and between conductors and the shield.
Test limits	1. Mutual Capacitance: Average 52 ± 3 nF/km, Individual 52 ± 4.5 nF/km. 2. Capacitance Unbalance: Pair-to-ground maximum 750 pF/km (average) / 3000 pF/km (individual). Pair-to-pair maximum 50 pF/km (average) / 200 pF/km (individual). 3. Cross-talk (150 kHz): ELFEXT minimum 55 dB/km (individual) and 67.8 dB/km (RMS). NEXT minimum 55 dB (individual). 4. Attenuation (150 kHz): Maximum 12.00 dB/km (0.40mm), 8.25 dB/km (0.50mm), 6.30 dB/km (0.63mm), and 4.40

	dB/km (0.90mm). 5. Insulation Resistance: Minimum 5000 Mega ohm-km. 6. Dielectric Strength: Shall withstand applied voltage for 3 seconds without breakdown. Between conductors: 2.4 kV (0.4/0.5mm), 3.5 kV (0.63/0.9mm). Conductors to shield: 5 kV (0.4/0.5mm), 10 kV (0.63/0.9mm).
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-11(Drip Test, Water Penetrartion and cable bend Test)**
Test Details	Clause no. 23.1, 23.7, 23.7.1, 23.7.2, 23.7.3, 23.8, 23.8.1,23.8.2
Test Setup	1. Completed cable samples 2. 1-meter water head apparatus 3. Testing mandrel of diameter 12D (where D is cable diameter).
Test Procedure	1. **Drip Test:** Take test specimens from each end of the selected cables. Suspend the cable specimens inside the test chamber and observe the bottom exposed end of the cable sample for any dripping, leakage, or drainage of the jelly filling compound. 2. **Water Penetration:** Cut a 1-metre length of cable; in case of armoured/jacketed cable, strip and remove the outer jacket, steel tape armour, and bedding tape at the point of water application. Support the 1-metre cable sample horizontally and fit one end to the vertical water column. Apply a continuous 1-metre head of water at ambient room temperature to the core. Maintain this ambient temperature for 14 days (Type Approval) or 4 days (Acceptance test). Continuously inspect the exposed opposite end and edges of the sample for any signs of water seepage or moisture exit. 3. **Cable Bend Test:** Take a sample of completed cable; if the cable is armoured, strip and remove the outer jacket, steel tape armour, and bedding tape to expose the polythene sheath. Measure the diameter (D) of the cable under test and select a test mandrel having an outside diameter equal to 12D. Coil the cable sample closely around the 12D mandrel for at least one complete turn (360 deg) at a uniform bending speed. Unwind and straighten the cable sample back to its original linear profile. Visually inspect the sheath surface under bright light for rippling, cracking, splitting, or any physical damage.
Test limits	1. There shall be no dripping of the filling compound. 2. No water shall seep from the cable sample during the entire duration of the water penetration test.

	3. The polythene sheath shall not ripple and there shall be zero damage / cracks in the sheath after bending around the 12D mandrel and straightening.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-12(Insulated Conductor Mechanical & Thermal Tests)**
Test Details	Clause no. 19.0, 19.1, 21.0, 21.1, 21.2, 21.3, 21.4, 21.5,23.2
Test Setup	1. Insulated conductor samples representing each insulation color 2. Calibrated Tensile Testing Machine (UTM) 3. Precision steel ruler / Vernier caliper 4. stopwatch / digital timer 5. Convection-type air circulating oven (calibrated up to 100°C). 6. Differential Scanning Calorimeter (DSC) with aluminum pans and oxygen supply. 7. Compressive force test rig with polythene-coated flat rigid metal plates and 12V DC continuity indicator. 8. Cold chamber
Test Procedure	1. **Conductor Annealing Sequence :** Remove a 250 mm long conductor sample from the completed cable. Slowly and steadily stretch the sample in the UTM until it breaks. Record the percentage elongation at break. 2. **Insulation Retraction Sequence:** Cut the insulated conductor at a point not less than one meter from the end of the bobbin. Wait exactly one minute at room temperature, then measure the length of exposed conductor caused by insulation retraction.

	3. **Resistance to Compression Sequence:** Lightly tension and twist two insulated conductors together (10 full 360° twists per 100 mm). Place a maximum of 50 mm of the twisted middle section between two flat, polythene-coated rigid metal plates. Apply a minimum compressive force of 200 N. After one minute under load, test for electrical contact between the conductors using a 12V DC source. 4. **Shrink Back Sequence:** Cut a 200 mm specimen from the center of a 1500 mm length, then trim both ends to reduce it to exactly 150 mm. Place 6 such samples in the air oven at 100 ± 1°C for 24 hours. Measure the total combined shrinkage from both ends at ambient temperature and calculate the average. 5. **Thermal Stress Cracking Sequence:** Wrap 10 insulated conductor lengths (15 cm each) around their own diameter for a minimum of 10 contiguous, closely wound turns. Suspend them in an air oven at 70 ± 1°C for 14 days. Remove, cool to ambient, and visually inspect for cracks with the naked eye. 6. **Cold Bend Sequence:** Take 10 insulated conductor specimens per color and condition them in the sub-zero chamber at -40 deg Celsius for one hour as per ASTM D2633. Wind the conditioned samples around a mandrel having a diameter equal to the diameter of the insulated conductor. Inspect all specimens for surface fractures or insulation cracks. 7. **Completed Cable OIT Sequence:** Carefully strip insulation samples of each color from the conductors of the completed cable. Place a weighed specimen into an open aluminium pan inside the DSC cell under nitrogen atmosphere. Heat and isothermally stabilize the specimen at 200 deg Celsius. Switch gas flow to pure oxygen and measure the time duration until the onset of exothermic thermal oxidation.

Test limits	1. **Annealing:** Elongation at break shall not be less than 15% (for 0.40/0.50 mm) or 18% (for 0.63/0.90 mm). 2. **Retraction:** Shall not exceed 2.5 mm after one minute at room temperature. 3. **Compression:** There shall be no electrical contact between the insulated conductors. 4. **Shrink Back:** The average shrinkage of six samples shall not exceed 6.35 mm. 5. **Thermal Stress Cracking:** There shall be no cracks. 6. **Cold Bend:** There shall not be more than one failure out of ten samples. 7. **Completed Cable OIT**: Shall not be less than 30 minutes for each color of insulation.
Expected Results	Check measurement accuracy and limit as specified in GR.

Test No.	**Test Case-13(Sheath Shrinkage & Sheath Oxidation Induction Time Test)**
Test Details	Clause no. 23.4.3,23.4.6
Test Setup	1. Completed cable samples (sheath stripped off the laminate from 5 cables for shrinkage, 2 cables at random for OIT). 2. Convection-type air-circulating thermal oven calibrated to 100 deg celsius. 3. Differential Scanning Calorimeter (DSC) with high-purity Nitrogen and Oxygen gas supplies. 4. Open aluminium sample pans. 5. Calibrated precision Vernier Caliper. 6. Micro-analytical balance.

Test Procedure	**1. Sheath Shrinkage Test Sequence:** a) Strip the polythene sheath off the poly-al laminate from the completed cable sample. b) Cut test specimens measuring exactly 50 mm in length along the cable axis and 12 mm in width. c) Measure and record the exact initial longitudinal length at ambient room temperature. d) Place the specimens in the convection air-circulating oven maintained at 100 deg Celsius continuously for 24 hours. e) Remove specimens from the oven, allow them to cool to ambient temperature, and measure the final lengthwise dimension and calculate the percentage longitudinal shrinkage. **2. Sheath Oxidation Induction Time (OIT) Sequence:** a) Take a sample of polythene sheath stripped cleanly from the laminate of the completed cable. b) Place a prepared test specimen in an open aluminium pan inside the DSC cell under a continuous nitrogen purge. c) Ramp the cell temperature up and stabilize isothermally at 200 deg celsius under the nitrogen atmosphere. d) Switch the purge gas from nitrogen to pure oxygen t = 0 and record the time duration until the onset of exothermic thermal-oxidative degradation.
Test limits	1. The lengthwise shrinkage measured at ambient temperature after 24 hours at 100 deg celsius shall not exceed 5%. 2. The induction time in oxygen tested in an aluminium pan at 200deg Celsius shall not be less than 25 minutes.
Expected Results	Check measurement accuracy and limit as specified in GR.

I. SUMMARY OF TEST RESULTS

TEC Standard No._____

TEC Guide No._____

Equipment name & Model No._____

Clause No.	*Compliance* *(Complied /Not Complied / Submitted/Not Submitted / Not Applicable)*	*Remarks / Test Report Annexure No.*

[Add as per requirement]

Date:

Place:

Signature & Name of TEC testing Officer /

* Signature of Applicant / Authorized Signatory

* *Section J as given above is also to be submitted by the Applicant/ Authorised signatory as part of in-house test results along with Form-A. The Authorised signatory shall be the same as the one for Form 'A'.*