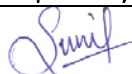
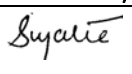
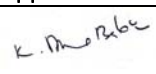


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Rev. No.	00												
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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company. <u>Specification for Fire Alarm, Communication & Control cables</u> 1. SCOPE This technical specification covers the Design, Manufacturing, testing at vendor works, inspection by purchaser, packing and transportation to site of Fire alarm, Communication and Control cables. 2. SCOPE of SUPPLY – As per enquiry 3. INSTRUCTIONS TO BIDDERS 3.1 Bidders are advised to contact BHEL for essential technical queries in writing within one week of issue of Enquiry. In the event of any conflict between these specifications, data sheets, related standards, codes etc. the vendor shall refer the matter to the purchaser for clarifications before bid submission and the decision of Purchaser shall be final & binding on Bidder, without any cost & delivery implications. In the event of conflict, most stringent requirements shall be followed in general. 3.2 Offers with incomplete information will not be considered for evaluation, and are likely to be rejected outright without any further interaction with the Bidder. 3.3 Any technical features [over & above BHEL enquiry specification requirements] proposed by Bidder will not be given preference for the purpose of evaluation. 3.4 Bidder shall submit the “Duly filled & Signed copy of Check list” compulsorily along with technical offer without which offer is liable for rejection without any further interaction with the Bidder 4. CODES and STANDARDS – Refer EIL specification 6-51-0052 Rev. 6 5. <i>The total length of the cable against each material code to be supplied by vendor as per BHEL enquiry. Further if any additional length required for conducting tests as per BHEL specification shall be considered by vendor over and above the length mentioned in the BHEL enquiry.</i>													
Revisions: Refer to record of revisions		Prepared By:  Sunil Gautam	Checked By :  Sujatha Sapavat	Approved :  K. Anand Babu	Date : 24.06.17								



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6. CHECK LIST (To be filled by BIDDER and submitted along with Technical offer)

Vendor shall submit the following documents mandatorily as part of COMPLTE technical offer.

Enquiry No. / Date :

Name of the Bidder :

Project Name :

Item Description :

S. No	Document	Supplier confirmation (Yes/No)	Remarks
1	Technical offer complies with the specifications and its associated annexures, pre-bid clarifications in Toto and there are no technical deviations. Signed and stamped copy of this specification along with annexures enclosed along with technical offer.		
2	In case of deviation, vendor to confirm that these are technically not feasible deviations and same are submitted in BHEL format . In case technically feasible deviations are proposed by the bidder and subsequently withdrawn, <u>no commercial implications can be claimed by the bidder</u>		
3	All items are manufactured confirming to latest version of material grade standard and manufacturing standard mentioned in this specifications		
4	Bidder to quote as per BHEL price format only. No other format is acceptable. Bidder to attach un-priced price bid format by indicating "QUOTED" against each item and submit with technical offer duly signed & stamped.		
7	For addition/reduction of quantity, unit rate quoted in the present offer shall be considered during ordering and shall be valid up to execution of the contract to the extent of + 10% and - 30% of order Value.		
8	Drum length for cables shall be as below: a) <u>Up to 50 Pairs</u> : 1000 meters b) <u>Above 50 Pairs & Up to 100 pairs</u> : 500 meters c) <u>Above 100 Pairs</u> : As per job requirement (Subject to max length of 500 meters) The actual produced drum length shall not vary by more than $\pm 5\%$. Tolerance over the total ordered length shall be as follows: $\pm 5\%$ for total length less than 5 km, $\pm 2\%$ for total length more than 5 km.		
9	<u>Valid type test Certificate not older than five years (as on date of enquiry for all types of cables) is furnished along with offer for cables similar to those being offered.</u> (OR) <u>If Type tests certificates are not available for any size of cable, same shall be conducted by vendor at his own cost. There shall not be any delivery and commercial implications on account of this.</u>		

 (Bidder's Signature and stamp with date)



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DEVIATION FORMAT

Enquiry No.:Item:Name of Bidder:Offer Ref. No.:

Sl. No.	Clause no. & Spec. no.	Description as per Specification	Deviation taken	Nature of Deviation	Remarks

NOTES:

1. Technical offer of the bidder will be evaluated only on the basis of Deviation Schedule. Deviation Schedule constitutes this sheet (with these Notes) duly signed and stamped.
2. Deviations, if any, shall be clearly brought out only in this format. Deviations mentioned / taken elsewhere or in any other format will be ignored.
3. Additional sheets in the same format can be attached by the vendor, if necessary.
4. Nature of Deviations shall only be of Design / Manufacturing constraints and non-availability of items / components / makes in market.
5. No price implications shall be entertained for deviations withdrawn during the technical scrutiny. If any deviations are accepted by BHEL during technical scrutiny then also there will be no price implication. Hence, in no case there will be consideration of Price implications.
6. Reasons for the deviations shall be specified in the Remarks column.
7. If there are no deviations from the specifications, bidder still has to submit the signed copy of this format by writing "NO Deviations" on this format.
8. If the "Deviation Schedule" is not submitted along with the offer, the bidder's offer is likely to be rejected without any further interaction with the bidder. Only the accepted deviations in conjunction with the original tender shall constitute the contract document for the award of job to the bidder

SIGNATURE OF THE BIDDER_____

NAME_____

DESIGNATION_____

DATE_____

COMPANY SEAL

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7. TECHNICAL REQUIREMENTS

- 7.1 **Control cables** shall be twisted pair overall shielded type and conform to EIL standard specification 6-51-0052. However, Cl. 5.0 of EIL specification 6-51-0052 is not applicable for control cables. Control cables for use on medium voltage systems shall be heavy-duty type, 650/1100V grade with Cu conductor, PVC insulated, inner-sheathed, armoured and overall FRLS PVC sheathed.
- 7.2 **Fire alarm cables** shall conform to EIL standard specification no. 6- 51-0052 and shall be annealed copper conductor, overall screened and amoured. Fire alarm cables shall be with RED colour outer sheath.
- 7.3 **Communication cable** shall conform to EIL standard specification no. 6- 51-0052 and shall be with copper conductor, armoured, overall screened. Colour of the outer sheath of the plant communication cables shall be GREY.
- 7.4 Refer EIL data sheets for Control, Fire and Communication cables for other technical requirements.

8. INSPECTION AND TESTING

(A)	Type Tests	:	Requirement	Remarks
8.1	Type tests shall be as per IS 1554 part-1;	:	Certificate Review during technical evaluation	<u>Vendor to confirm as per cl. 6.(9) of this specification;</u> Offers without confirmation to the above will be rejected without any intimation to bidder.
8.2	Flame retardant test a) For quantity ≥ 1000 meters: As per IEC 332-3 Part 3 Cat-A b) For quantity < 1000 meters: As per IEC 332-3 Part 3 Cat-C	:	Certificate Review during technical evaluation	
(B)	<u>Routine Tests</u> Vendor shall carry out these tests during various stages of manufacturing.			
8.3	Insulation and sheaths: All tests as per IS-5831 shall be conducted as part of routine tests, except for insulation resistance, voltage and spark test	:	Certificate Review	
8.4	Insulation resistance, voltage and spark test shall be as per BS-5308 part-2	:	Certificate Review	
8.5	Armour test as per IS –3975	:	Certificate Review	
8.6	Conductor resistance test as per IS 8130.		Certificate Review	
8.7	Electrical test including cable capacitance (core-core) and (core-screen).	:	Certificate Review	
8.8	Spark test as per BS 5308 Part 2.	:	Certificate Review	
(C)	<u>Acceptance Tests</u> : As per EIL specification 6-51-0052 Rev.6 & EIL ITP 6-81-1052 Rev.3	:	100% Witness	

9. DOCUMENTATION

- 9.1 **Information** to be included with offer
Vendor shall make the offer in detail, with respect to every item of the Purchaser's specifications. Any offer not conforming to this shall be summarily rejected.
- Signed and stamped copy of enquiry technical specification,
 - Unpriced price schedule (To be submitted compulsorily without fail)
 - Deviation list, if any (as per "No deviation format" given in this specification).
- Data sheets shall not be submitted during technical offer; even if it is submitted only signed technical specification will be considered for evaluation**
- 9.2 Documentation submission within 2 weeks of placement of LOI (for approval by BHEL and / or BHEL's customer in 4 sets)
- Data sheets of each and every Cable.
 - Comprehensive Quality Assurance plan (QAP).
- 9.3 Documents to be submitted after Inspection (Note: submission of these documents are commercially linked)
- Final Data sheets
 - All test certificates including material test certificates, inspection reports shall be furnished within 1 week of completion of Inspection by BHEL and / or BHEL's Third Party.
2 sets of CD-ROM – containing **Test certificates and Engineering documents** (1 set to be included with item dispatch and balance to BHEL purchase department).



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10. PACKING AND DISPATCH

11.1 Packing and dispatch shall be as per EIL specifications 6-51-0052 Rev 6.

11.2 However, for foreign shipments packing shall be Sea-worthy or Air-Transportation packing shall be done as per latest revision of AA0490004 and type of packing applicable for cables is "CP". This specification shall be obtained by vendor on request.

11.3 Mandatory Spare parts shall be packaged separately and clearly marked as 'Mandatory Spares '.

11.4 Commissioning spares, Tools & tackles to be packed separately & suitably tagged.

11.5 *If mandatory spare items are ordered, same shall be sent in pre-decided lots in containers /secure boxes distinctly marked in Red color with boldly written "S" mark on each face of the containers /secure boxes***11. MARKING**

Each cable drum shall be marked with the following information at a visible place

a) Manufacturer's name

b) Details of cable

c) Length of the cable

d) Gross weight

e) Purchase order number

f) BHEL Material code

g) Direction of rotation of drum by means of an arrow for unwinding

h) BHEL Part no. (Printed on Purchase Order copy).

12. VARIANT TABLE

Var No	Material code	Item description	Application	Outer Sheath Colour
03	PY9756224037	5P x 0.9 mm Dia, Cu, PVC/FRLS PVC, Overall Shield, Armoured	Communication Cable	Grey
08	PY9756224088	50P x 0.9 mm Dia, Cu, PVC/FRLS PVC, Overall Shield, Armoured	Communication Cable	Grey
11	PY9756224118	2P x 1.5 mm ² , Cu, PVC/FRLS PVC, Overall Shield, Armoured	Fire Alarm Cable	Red
12	PY9756224126	12P x 1.5 mm ² , Cu, PVC/FRLS PVC, Overall Shield, Armoured	Fire Alarm Cable	Red
40	PY9756224401	2P x 1.5 mm ² , Cu, PVC/FRLS PVC, Overall Shield, Armoured	Control Cable	Black
41	PY9756224410	4P x 1.5 mm ² , Cu, PVC/FRLS PVC, Overall Shield, Armoured	Control Cable	Black
42	PY9756224428	6P x 1.5 mm ² , Cu, PVC/FRLS PVC, Overall Shield, Armoured	Control Cable	Black
43	PY9756224436	8P x 1.5 mm ² , Cu, PVC/FRLS PVC, Overall Shield, Armoured	Control Cable	Black
44	PY9756224444	12P x 1.5 mm ² , Cu, PVC/FRLS PVC, Overall Shield, Armoured	Control Cable	Black



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RECORD OF REVISIONS

Rev. No.

Date _____

Revision Details

Revised By

Approved By

00

24.06.2017

Original issue

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K. Anand Babu

K. M. Rube

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संचार और अग्नि चेतावनी केबल के लिए विनिर्देश

SPECIFICATION FOR COMMUNICATION AND FIRE ALARM CABLES

6	01/04/16	REVISED AND ISSUED AS STANDARD SPECIFICATION	RG	MKS	BRB	RN
5	27/04/11	REVISED AND ISSUED AS STANDARD SPECIFICATION	PS	ANPS	UAP	DM
4	25/04/08	REVISED AND ISSUED AS STANDARD SPECIFICATION	ANPS	UAP	JMS	VC
3	21/03/03	REVISED AND ISSUED AS STANDARD SPECIFICATION	UAP	AAN	VPS	SKG
2	05/05/97	REVISED AND ISSUED AS STANDARD SPECIFICATION	NS	VPS	SG	AS
Rev.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

Abbreviations:

ASTM	:	American Society for Testing and Materials
BIS	:	Bureau of Indian Standards
BS	:	British Standard
CEA	:	Central Electricity Authority
DOT	:	Department of Telecommunications (Government of India)
FR	:	Flame Retardant
FRLS	:	Flame Retardant Low Smoke
FS	:	Fire Survival
HR PVC	:	Heat Resistant Polyvinyl Chloride
IEC	:	International Electro technical Commission
IEEE	:	Institute of Electrical and Electronics Engineers
IS	:	Indian Standards
LF	:	Low Frequency
NEMA	:	National Electrical Manufacturers Association
PE	:	Polyethelene
PO	:	Purchase Order
PVC	:	Polyvinyl Chloride
UV	:	Ultra Violet
VDE	:	Verband Deutscher Elektrotechniker

Electrical Standards Committee

Convener:	Mr. B.R. Bhogal
Members:	Ms. S. Anand
	Mr. Parag Gupta
	Mr. M. K. Sahu
	Ms. N. S. Bhattacharya
	Mr. Saeed Akhtar (Inspection)
	Ms. N.P. Guha (Projects)

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1.0 SCOPE

The intent of this specification is to define the requirements for design, manufacture and supply of Flame Retardant Low Smoke type and Fire Survival type PVC sheathed cables for use in plant communication and fire alarm systems and jelly filled telecommunication cables.

2.0 CODES AND STANDARDS

The equipment shall comply with the requirements of the latest revision of the following standards:

2.1 BIS and other Standards

ASTM D-883	:	Standard terminology relating to plastics.
ASTM-D-2863	:	Measurement of minimum oxygen concentration to support candle like combustion of plastics
ASTM-G-154	:	Standard practice for operating fluorescent light apparatus for UV exposure of non-metallic materials.
IEC: 60331-21	:	Tests for electric cables under fire conditions circuit integrity – Procedures and requirements – Cables of rated voltage up and including 0.6/1.0kV.
ASTM D-924	:	Standard test method for dissipation factor (or power factor) and relative permittivity (dielectric constant) of electric insulating liquids.
BS-6234	:	Specification for polythene insulation and sheath of electric cables.
IS-694	:	PVC insulated cables for working voltages upto and including 1100V.
IS-1554 (Part 1)	:	PVC insulated (heavy duty) electric cables (Part-1 for working voltages up to and including 1100V).
IS-5831	:	PVC insulation and sheath of electric cable.
IS-8130	:	Conductors for insulated cables and flexible cords.
IS-9938	:	Recommended colour for PVC insulation for LF wires and cables.
IS-10418	:	Drums for electric cables.
IS-10462 (Part 1)	:	Fictitious calculation method for determination of dimensions of protective coverings of cables (Part-1: Elastomeric and thermoplastic insulated cables).
IS-10810 (Part 58)	:	Methods of test for cables (Part 58: Oxygen index test).
IS-10810 (Part 61)	:	Methods of test for cables (Part 61: Flame retardant test)
IS-10810 (Part 62)	:	Methods of test for cables (Part 62: Fire resistance test for bunched cables).
IS-12444	:	Continuously cast and rolled electrolytic copper wire rods for electrical conductors.

2.2 DOT Standards

GR/WIR-06/03	:	Specification for cable - switchboard (Screened and Unscreened) - Generic requirements.
GR/CUG-01/03	:	Specification for solid polythene insulated fully filled, polythene sheathed underground telecom cables.

2.3 In case of imported cables, standards of the country of origin shall be applicable, if these standards are equivalent to or stringent than the applicable Indian standards.

2.4 The cables shall also conform to the provisions of the CEA Regulations and other statutory regulations currently in force in the country.

- 2.5 In case Indian standards are not available for any material, standards issued by IEC/ BS/ VDE/ IEEE/ NEMA or equivalent agency shall be applicable.
- 2.6 In case of any conflict between requirements specified in various applicable documents for the project, the most stringent one shall prevail. However, Owner's decision in this regard will be final and binding.

3.0 SITE CONDITIONS

Cables shall be suitable for installation in following conditions:

- Above ground in open-air locations (trays/ ducts) in tropical, humid and corrosive atmosphere prevalent in refineries/ petrochemical plants with severe weathering and exposure to solar radiation.
- Directly buried in underground trenches, conduits with uncontrolled back-fill and possibility of flooding by water and chemicals.
- Design ambient air temperature of 40°C/ ground temperature of 30°C.

4.0 TECHNICAL REQUIREMENTS FOR NON JELLY FILLED CABLES

- 4.1 Non jelly filled communication and fire alarm cables shall in general conform to the requirements of DOT specification GR/WIR-06/03.

4.2 Conductors

- 4.2.1 The size of conductor shall be as per job requirement.
- 4.2.2 The conductors shall consist of annealed, high conductivity solid copper wire, smoothly drawn, circular in cross-section, uniform in quality, free from defects and uniformly coated with pure tin and shall conform to Cl. 3.0 of DOT specification GR/WIR-06/03.

4.3 Insulation

- 4.3.1 The core insulation shall be with PVC compound applied over the conductor by extrusion.
- 4.3.2 PVC insulation shall meet the following requirements:

Conductor Diameter (Area)	Type of Insulation	Thickness of Insulation (Minimum)
Up to 0.5mm (0.2mm ²)	Type-A or B as per IS-5831	0.18 mm
Above 0.5mm (0.2mm ²) & up to 0.71mm (0.4mm ²)		0.26 mm
Above 0.71mm (0.4mm ²) & up to 0.9mm (0.63mm ²)		0.31 mm
Above 0.9mm (0.63mm ²) & up to 1.12mm (1mm ²)		0.39 mm
Above 1.12mm (1mm ²) & up to 1.38mm (1.5mm ²)		0.58 mm
1.78mm (2.5mm ²)		0.71 mm
2.26mm (4mm ²)		0.80 mm

- 4.3.3 The colours used for insulation shall conform as nearly as practicable to the standard colours as per IS-9938. The wire insulation shall have colours in accordance with Table-2 of DOT specification GR/WIR-06/03. The applied colour shall neither have deleterious effect on the electrical, mechanical or ageing properties of basic insulation nor shall get damaged by any friction etc.
- 4.3.4 For single pair cables, the colour shall be incorporated in the insulation.

- 4.3.5 For multi pair cables, cores shall have uniform pattern of continuous spiral (Pitch not exceeding 25mm) to facilitate easy identification. This may be done by the application of one or more coloured strips on a base colour or by direct extrusion.
- 4.3.6 Alternately, colouring may consist of concentric coloured rings or dots or dashes on the base colour. The coloured rings, dots or dashes shall have a width of not less than 1.0mm and shall be repeated along the length of the insulation at an interval not less than 15mm and not more than 25mm.
- 4.3.7 The dots or dashes shall be applied on diametrically opposite sides of the insulation, so that all colours are visible when the insulation is viewed from any side.

4.4 Twisting

The two insulated conductors of a pair shall be uniformly twisted with a suitable right hand lay, which shall not exceed 80mm.

4.5 Core Formation

The core formation shall conform to Cl. 6.0 of DOT specification no. GR/WIR-06/03.

4.6 Screen

- 4.6.1 The cables shall be provided with overall screen. The screen shall be of aluminium tape with minimum thickness of 0.04mm. The overlap shall be minimum 3mm for cables up to 50 pair & minimum 6mm for cables above 50 Pair. The screen shall be backed by an outer protective layer of 0.13mm PVC tape or other non-hygroscopic material lapped applied longitudinally or helically with overlap.
- 4.6.2 The cables shall be provided with a drain wire. Drain wire shall have a minimum cross-section of 0.5mm^2 , shall be composed of multistrand bare tinned annealed copper conductor. The drain wire shall be in continuous contact with the aluminium side of the overall screen. The drain wire resistance including screen shall not exceed 30 ohm/km.

4.7 Ripcord

A non-metallic ripcord of suitable quality shall be laid longitudinally under the inner sheath & screen. The ripcord when pulled shall cut through the sheath and strip the core.

4.8 Inner Sheath

- 4.8.1 An extruded inner sheath of type ST2 PVC, as per IS-5831, with minimum thickness as per Table-4 of IS-1554 (Part-1) shall be applied over the laid up core, by extrusion to fit closely on it.
- 4.8.2 The inner sheath shall be as circular as possible. It shall be possible to remove the inner sheath without damage to the insulation.
- 4.8.3 When one or more layers of non-hygroscopic tape is helically applied over the laid up cores, as a binder, the thickness of such tape(s) shall not be construed as a part of the inner sheath.

4.9 Armour

- 4.9.1 The cables shall be provided with armouring, made of hot dip galvanised steel wire /strip over the inner sheath.
- 4.9.2 The armour shall be by means of 1.4mm thick round wires for cables with under armour diameter upto 13mm. For cables with an under armour diameter above 13mm, the armour shall either be of steel strip or round wire with thickness as per IS-1554 (Part-1).

4.10 Outer Sheath

- 4.10.1 The cables shall be provided with an extruded PVC sheath for external protection. The PVC shall be type ST2 PVC, as per IS-5831.

- 4.10.2 All cables covered in this specification shall be flame retardant low smoke (FRLS). The other sheath shall be with oxygen index 29% at $27 \pm 2^\circ\text{C}$ and possess flame retardant low smoke properties meeting the requirements of IS 10810 Part-62 category - AF. In addition, suitable chemicals shall be added to the PVC compound of the outer sheath to protect the cable against rodent and termite attack.
- 4.10.3 The thickness of outer sheath shall be as per IS-1554 (Part 1).
- 4.10.4 The outer sheath shall fit tightly on the armour and shall be applied in such a manner that no undue residual strain is left in the material.
- 4.10.5 The outer sheath shall be red in colour for cables to be used for fire alarm system, grey in colour for cables to be used for telephone & communication system and black in colour for all other functions.
- 4.10.6 Sequential marking of the length of the cable, in meters, shall be provided on the outer sheath at every one meter. The marking shall be legible and indelible by suitable method.
- 4.10.7 The overall diameter of the cables shall be strictly as per the values declared in the data sheet, subject to a maximum tolerance of $\pm 2\text{mm}$.
- 4.11 The fire survival cables (if specified in data sheet) shall meet the following additional requirements:
- i) The insulation shall be of EPR or equivalent material with glass mica tape below or above insulation.
 - ii) The cables shall meet requirement of circuit integrity test for a minimum period of 3 hours at maximum temperature of 950°C .
 - iii) Vendor shall have the test certificate for circuit integrity test as per IEC: 60331-21.
- 4.12 **Cable Capacitance**
- 4.12.1 The core to core capacitance of the cables shall not exceed 100nF/km at 1kHz .
- 4.12.2 The core to screen capacitance for the screened cables shall not exceed 250nF/km at 1kHz .
- 5.0 **TECHNICAL REQUIREMENTS FOR JELLY FILLED CABLES**
- 5.1 Jelly filled telecom cables shall in general conform to the requirements of DOT specification GR/CUG-01/03.
- 5.2 **Conductors**
- 5.2.1 The conductors shall consist of annealed, high conductivity solid copper wire, smoothly drawn, circular in cross-section, uniform in quality, free from defects and uniformly coated with pure tin and shall conform to Cl. 3.0 of DOT specification GR/CUG-01/03.
- 5.3 **Insulation**
- 5.3.1 Each conductor shall be insulated with insulating grade PE conforming to Cl. 4.0 of DOT specification GR/CUG-01/03.
- 5.4 **Twisting**
- The two insulated conductors of a pair shall be uniformly twisted with a suitable right hand lay, which shall not exceed 150mm .
- 5.5 **Core Formation**
- The core formation shall conform to Cl. 6.0 of DOT specification GR/CUG-01/03.
- 5.6 **Filling Compound**
- 5.6.1 The cable core shall be filled with a suitable stable water resistant compound, which shall be compatible with the insulation, binders and tapes used in the cable.

- 5.6.2 It shall be homogeneous and uniformly mixed material containing an anti-oxidant.
- 5.6.3 The compound shall not obscure the identification of the colour of the insulation of the conductors.
- 5.6.4 It shall not contain dirt, metallic particles or other foreign matter.
- 5.6.5 The compound shall be readily removable from the insulated conductors by wiping.
- 5.6.6 It shall be free from any unpleasant odour and shall have no toxic or dermatic hazards.
- 5.6.7 The flash point of the compound shall not be less than 200°C.
- 5.6.8 The volume resistivity measured at 100°C shall not be less than 10^{10} ohm-cm.
- 5.6.9 The permittivity at 1 MHz tested as per ASTM D-924 shall not be greater than 2.3 at 20°C.

5.7 Core Wrapping

At least one closed helical or longitudinal application of a nonhygroscopic and nonwicking polyester tape or tape of any other suitable material shall be provided over the cable core.

5.8 Screen

- 5.8.1 The cables used for telephone system shall be provided with overall screen. The screen shall be of aluminium tape with minimum thickness of 0.2mm. The overlap shall be minimum 3mm for cables having maximum diameter over inner sheath < 30mm & minimum 6mm for cables having maximum diameter over inner sheath ≥ 30 mm. The screen shall be coated with 0.05 mm nominal thickness polythene/copolymer on both sides. The thickness of the composite tape shall be $0.3\text{mm} \pm 15\%$.
- 5.8.2 The aluminium tape shall be electrically continuous through out the length of the cable.

5.9 Inner Sheath

- 5.9.1 The inner sheath shall be as circular as possible and free from pinholes and other defects. It shall be possible to remove the inner sheath without damage to the insulation.
- 5.9.2 The inner sheath shall be of 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 meet the requirements of Cl. 10.1 of DOT specification no. GR/CUG-01/03.
- 5.9.3 The thickness of inner sheath shall conform to Table-6 of DOT specification no. GR/CUG-01/03.
- 5.9.4 The maximum diameter over inner sheath shall conform to Table-7 of DOT specification no. GR/CUG-01/03.

5.10 Armour

- 5.10.1 The cables shall be provided with bedding and armour over the inner sheath.
- 5.10.2 The bedding shall consist of two close helical lappings of polythene or polypropylene tape. Each tape shall be applied with a minimum of 5% overlap.
- 5.10.3 The armour shall be made of hot dip galvanised steel tape of thickness as per Table-8 of DOT specification GR/CUG-01/03.

5.11 Outer Sheath

- 5.11.1 The external protection shall consist of a polythene sheath conforming to the material specification defined in Clause 5.9 above.
- 5.11.2 The thickness of outer sheath shall conform to Table-9 of DOT specification GR/CUG-01/03.
- 5.11.3 The outer sheath shall be as circular as possible and free from pinholes and other defects.
- 5.11.4 Colour of outer sheath shall be grey.

5.11.5 The maximum diameter over outer sheath shall conform to Table-7 of DOT specification GR/CUG-01/03.

5.12 Cable Capacitance

The average mutual capacitance of the pairs measured at 800 to 1000Hz shall be 52 ± 3 nF/km. However, the mutual capacitance of individual pairs shall be within the limits of 52 ± 4.5 nF/km.

6.0 INSPECTION, TESTING AND ACCEPTANCE

6.1 The cables shall be tested and examined at the manufacturer's works. All the materials employed in the manufacture of the cable shall be subjected to examination, testing and approval by EIL/ Owner. Manufacturer shall furnish all necessary information concerning the supply to EIL/ Owner's inspectors. The inspector shall have free access to the manufacturer's works for the purpose of inspecting the process of manufacture in all its stages and will have the power to reject any material, which appears to be of unsuitable description or of unsatisfactory quality.

6.2 The following acceptance tests shall be conducted on the completed jelly filled cables as per the test procedures given in DOT specification GR/CUG-01/03 and this specification:

- i. Measurement of diameter of conductor, over inner sheath & over outer sheath.
- ii. Measurement of thickness of insulation, inner sheath, screen, armour & outer sheath.
- iii. Measurement of resistance of conductor.
- iv. Measurement of resistance unbalance.
- v. Continuity check & measurement of resistance of Poly-al tape.
- vi. Colour coding.
- vii. Conductor continuity test.
- viii. Mutual capacitance test.
- ix. Capacitance unbalance test.
- x. Cross talk test.
- xi. Attenuation test.
- xii. Insulation resistance test.
- xiii. Dielectric strength test.
- xiv. Drip test.
- xv. Armour galvanisation test.
- xvi. Conductor annealing test.
- xvii. Measurement of drum length.

6.3 Following tests shall be carried out to prove FRLS property of the cable.

- a. Critical oxygen index as per ASTM-D-2863 i.e. Determination of % of oxygen required for combustion at room temperature of FRLS sheath which shall remain as 29% (min.)
- b. Temperature index as per ASTM-D-2863 i.e. To determine at what temperature normal oxygen content of 29% in air will support combustion of FRLS sheath which shall remain as 250°C.
- c. Halogen acid gas emission as per IEC-60754 Part 1 i.e. To determine the % of release of hydrochloric acid gas from the FRLS sheath under fire which shall be 20% (max.)
- d. Smoke Density Test shall be as per ASTM D - 2843 and Smoke Density Rating of FRLS Sheath shall be 60% (max.).

6.4 The test for circuit integrity for fire survival cables shall be carried out as per IEC-60331 (Part-21).

6.5 The following tests shall be conducted on the completed non jelly filled cables as per the test procedures given in DOT specification GR/WIR-06/03 and this specification:

6.5.1 Acceptance tests

- i. Measurement of diameter of conductor, over inner sheath & over outer sheath.
- ii. Measurement of thickness of insulation, inner sheath, screen, armour & outer sheath.
- iii. Measurement of resistance of conductor.
- iv. Colour coding.
- v. Conductor continuity test.
- vi. Mutual capacitance test.
- vii. Capacitance unbalance test.
- viii. Insulation resistance test.
- ix. High voltage test.
- x. Armour galvanisation test.
- xi. Conductor annealing test.
- xii. Measurement of drum length.

6.5.2 Special Tests

The non jelly filled cables shall also be subjected to following special tests.

- i. Oxygen index test as per IS-10810 (Part 58).
- ii. Flammability test on finished cable as per IS-10810 (Part 61 & 62).

The special test shall be conducted on one sample from each lot. The sample will be selected by the inspector.

7.0 PACKING AND DESPATCH

7.1 Cables shall be dispatched in non-returnable steel drums of suitable barrel diameter, securely packed, with the take-off end fully protected against mechanical damage.

7.2 On the flange of the drum, necessary information such as project title, manufacturer's name, type, size, length of cable in meters, drum no., cable code, BIS certification mark, gross weight, 'Owner's particulars', 'P.O. numbers' etc., shall be printed. An arrow shall be printed on the drum with suitable instructions to show the direction of rotation of the drum.

7.3 The drum lengths for cables shall be as below:

- | | | |
|-----------------------------------|---|---|
| - Upto 50 pairs | : | 1000 meters |
| - Above 50 pairs & upto 100 pairs | : | 500 meters |
| - Above 100 pairs | : | As per job requirement (subject to max. length of 500 meters) |

7.4 A tolerance of $\pm 5\%$ shall be permissible for each drum. However overall tolerance on each size of cable shall be limited to $\pm 2\%$.

7.5 For non jelly filled cable, PVC/ rubber end caps shall be supplied free of cost for each drum with a minimum of eight per thousand meter length. In addition, ends of the cables shall be properly sealed, with caps, to avoid ingress of moisture/ water during transit and storage.

7.6 For jelly filled telephone cables, the ends of the cable shall be sealed by thermo shrinkable end caps of adequate wall thickness. Alternately ends may be sealed by enclosing them in rubber or PVC caps of wall thickness not less than 1.8mm. The caps shall be secured to the outer sheath with hose clips or ties or black adhesive tape or heat shrinkable sleeves.

7.7 The cables may be stored outdoors for long periods before installation. The packing shall be completely suitable for outdoor storage, in areas with heavy rains and high ambient temperature.

PURCHASER'S DATA									
Project		Revival of Ramagundam Fertilizer Complex			Location		Ramagundam, Telengana		
Client		M/s RFCL			Unit		Water Block		
A Site conditions									
1	Maximum ambient temperature:	47.50	°C	4	Relative humidity:	97.4% at 47.5deg, 87% at 36.6deg			
2	Minimum ambient temperature:	8.4	°C	5	Altitude	< 1000 m			
3	Ground temperature:		°C	6	Environment:	Tropical & Corrosive			
B Technical particulars									
1	Cable type/code	Non Jelly Filled							
2	Type of Screening	Overall Screened			3	Refer Spec	Refer Job Spec		
MANUFACTURER'S DATA									
A Twisted pair unshielded cables		Not Applicable			3	Performance Data			
1	Name of manufacturer				3.1	Rated voltage	660 V		
2	Material Specifications				3.2	Max. resistance at 20°C	Ohms		
2.1	Conductor dia.	mm dia.(*mm2)			3.3	Max. core-core capacitance	nF		
2.2	Insulation thickness	mm of PVC type A			3.4	Max. inductance	mH		
2.3	Inner sheath thickness	mm of PVC type ST2			3.5	Nominal impedance	Ohms		
2.4	Outer sheath thickness	mm of FR PVC type ST2							
4	Technical Particulars								
S.No	No. of pairs								
1	Approx. overall diameter (mm)								
2	Approx. dia. over armour (mm)								
3	Approx. dia. under armour (mm)								
4	Armour galvanised steel wire thickness								
5	Minimum outer sheath thickness (mm)								
B Twisted pair shielded cables									
1	Name of manufacturer				2.3	Inner sheath thickness	mm of PVC type ST2		
2	Material specifications				2.4	Outer sheath thickness	mm of FR PVC type ST2		
2.1	Conductor dia.	mm dia.(*mm2)			4	Shielding data			
2.2	Insulation thickness	mm of PVC type A			4.1	Material of shielding			
3	Performance data				4.2	Minimum thickness	mm		
3.1	Rated voltage	660 V			4.3	Coverage and overlap			
3.2	Max. resistance at 20°C	Ohms			5	Drain wire for overall sheath			
3.3	Max. core-core capacitance	nF			5.1	Drain wire material			
3.4	Max. core-screen capacitance	nF			5.2	Area of cross section	mm ²		
3.5	Maximum inductance	mH			5.3	No. of strands			
3.6	Nominal impedance	Ohms			5.4	Diameter	mm		
6	Technical particulars								
S.No	No. of pairs								
6.1	Conductor size (mm2)								
6.2	Approx. overall dia.(mm)								
6.3	Approx. dia. over armour (mm)								
6.4	Approx.dia. Under armour (mm)								
6.5	Armouring of galvanized steel wire								
6.6	Min. outer sheath thick(mm)								
C	02.08.16	Revised and Issued with Package			MB	MHR	RS		
B	24.02.16	Revised and Issued with Package			MB	MHR	RS		
A	23.11.15	Issued with Package			MB	MHR	RS		
Rev. No	Date	Purpose			Prepared by	Checked by	Approved by		

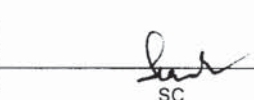
Altitude	Cable Type
< 1000 m	Fire alarm
> 1000 m	Communication
	Signal
Environment	
Humid & corrosive	

PURCHASER'S DATA									
Project		Revival of Ramagundam Fertilizer Complex			Location		Ramagundam, Telengana		
Client		M/s RFCL			Unit		Water Block		
A Site conditions									
1	Maximum ambient temperature:	47.50	°C	4	Relative humidity:	97.4%	at 47.5deg, 87% at 36.6deg		
2	Minimum ambient temperature:	8.4	°C	5	Altitude	< 1000 m			
3	Ground temperature:		°C	6	Environment:	Tropical & Corrosive			
B Technical particulars									
1	Cable type/code	Non Jelly Filled							
2	Type of Screening	Overall Screened			3	Refer Spec	Refer Job Spec		
MANUFACTURER'S DATA									
A Twisted pair unshielded cables		Not Applicable			3	Performance Data			
1	Name of manufacturer				3.1	Rated voltage	660 V		
2	Material Specifications				3.2	Max. resistance at 20°C	Ohms		
2.1	Conductor dia.	mm dia.(*mm2)			3.3	Max. core-core capacitance	nF		
2.2	Insulation thickness	mm of PVC type A			3.4	Max. inductance	mH		
2.3	Inner sheath thickness	mm of PVC type ST2			3.5	Nominal impedance	Ohms		
2.4	Outer sheath thickness	mm of FR PVC type ST2							
4	Technical Particulars								
S.No	No. of pairs								
1	Approx. overall diameter (mm)								
2	Approx. dia. over armour (mm)								
3	Approx. dia. under armour (mm)								
4	Armour galvanised steel wire thickness								
5	Minimum outer sheath thickness (mm)								
B Twisted pair shielded cables									
1	Name of manufacturer				2.3	Inner sheath thickness	mm of PVC type ST2		
2	Material specifications				2.4	Outer sheath thickness	mm of FR PVC type ST2		
2.1	Conductor dia.	mm dia.(*mm2)			4	Shielding data			
2.2	Insulation thickness	mm of PVC type A			4.1	Material of shielding			
3	Performance data				4.2	Minimum thickness	mm		
3.1	Rated voltage	660 V			4.3	Coverage and overlap			
3.2	Max. resistance at 20°C	Ohms			5	Drain wire for overall sheath			
3.3	Max. core-core capacitance	nF			5.1	Drain wire material			
3.4	Max. core-screen capacitance	nF			5.2	Area of cross section	mm ²		
3.5	Maximum inductance	mH			5.3	No. of strands			
3.6	Nominal impedance	Ohms			5.4	Diameter	mm		
6	Technical particulars								
S.No	No. of pairs								
6.1	Conductor size (mm2)								
6.2	Approx. overall dia.(mm)								
6.3	Approx. dia. over armour (mm)								
6.4	Approx.dia. Under armour (mm)								
6.5	Armouring of galvanized steel wire								
6.6	Min. outer sheath thick(mm)								
B	03.08.16	Revised & Re-Issued with Package				MB	MHR	RS	
A	24.02.16	Issued with Package				MB	MHR	RS	
Rev. No	Date	Purpose				Prepared by	Checked by	Approved by	

Altitude	Cable Type
< 1000 m	Fire alarm
> 1000 m	Communication
	Signal
Environment	
Humid & corrosive	

संचार और अग्नि चेतावनी केबल
के लिए
निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN
FOR
COMMUNICATION AND
FIRE ALARM CABLES

3	30.01.2014	Revised and Reissued	 MJ	 RS	 RKS	 SC
2	29.06.2012	Revised and Reissued	RKP	RJD	AKC	SC
1	28.09.2007	Revised and Re-issued	AKG	PPM	MVKK	VC
0	30.04.2002	Issued for implementation	RG	AKC	AKB	GRR
Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

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Abbreviations

AS	:	Alloy Steel	MPT/MT	:	Magnetic Particle Testing
BASEEFA	:	British Approval Service for Electrical Equipment in Flammable Atmospheres	MRT	:	Mechanical Run Test
BIS	:	Bureau of Indian Standard	MTC	:	Material Test Certificate
CCE or CCOE	:	Chief Controller of Explosives	MOC	:	Material of Construction
CEIL	:	Certification Engineers International Limited	NPSH	:	Net Positive Suction Head
CIMFR	:	Central Institute of Mining & Fuel Research	NDT	:	Non Destructive Testing
CE	:	Carbon Equivalent	NEMA	:	National Electrical Manufacturers Association
DFT	:	Dry Film Thickness	PD	:	Partial Discharge
DT	:	Destructive Testing	PO	:	Purchase Order
DPT	:	Dye Penetrate Testing	PESO	:	Petroleum Explosive Safety Organization
ERTL	:	Electronics Regional Test Laboratory	PQR	:	Procedure Qualification Record
FCRI	:	Fluid Control Research Institute	PR	:	Purchase Requisition
FM	:	Factory Mutual	PMI	:	Positive Material Identification
FLP	:	Flame Proof	PVC	:	Poly Vinyl Chloride
HT	:	Heat Treatment	QC	:	Quality Control
HIC	:	Hydrogen Induced Cracking	TC	:	Test Certificate
ITP	:	Inspection and Test Plan	TPI or TPIA	:	Third Party Inspection Agency
IP	:	Ingress Protection	UT	:	Ultrasonic Testing
IC	:	Inspection Certification	UL	:	Under writer Laboratories
IGC	:	Inter Granular Corrosion	VDR	:	Vendor Data Requirement
IEC	:	International Electro technical Commission	WPS	:	Welding Procedure Specification
JEC	:	Japanese Electro technical Committee	WPQ	:	Welders Performance Qualification
LPT	:	Liquid Penetrate Testing	XLPE	:	Cross Linked Poly Ethylene

Inspection Standards Committee

Convenor : Mr. S.C. Gupta

Members:

Mr. R.K. Singh	Mr. Rajeev Kumar	Mr. Himangshu Pal
Mr. Neeraj Mathur	Mr. T Kamalakannan	Mr. Deepak Gupta (Project)
Mr. Mayank Jain		

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1.0 SCOPE

This Inspection and Test Plan covers the minimum testing requirements of flame retardant type PVC sheathed cables for use in Plant communication, Fire Alarm systems and Jelly filled telecommunication cables.

2.0 REFERENCE DOCUMENTS

PO/PR/ Standards referred there in/Job specifications/Approved documents.

3.0 INSPECTION AND TEST REQUIREMENTS

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
1.0	Procedures	--	--	--	--	--	--
2.0	Material Inspection						
2.1	Incoming raw material like Copper Aluminium, PVC, PE, Jelly Compound, Armour material, etc.	Dimensional, Purity, Physical, Chemical Properties, Tests on jelly compound as per DOT spec.	Sample	Sub supplier TC/Supplier's Test Records/ Third party Lab	H	H	-
3.0	In process Inspection						
3.1	Manufacturing Stage	Dimensions at various stages, Spark test, Stage Inspection	100%	Supplier's Test Records	-	H	-
4.0	Final Inspection						

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.1	Final Inspection on completed cable	Visual, Drum details, Size, Ends Capping, Drums Condition, Marking on outer sheath (such as incremental length, voltage grade, manufacturer's name and for jelly filled cables marking as per DOT spec), Colour coding of cores, etc.	100%	Inspection Witness Record	-	H	RW
4.2	Final Inspection on completed Cable(Jelly Filled Cables) Acceptance Test	• Dimension checks. • Test for insulation and sheath. • Continuity of conductors, absence of crossed pairs and absence of contact with poly-al tape • Continuity in poly-al tape • Colour coding • Conductor Resistance, Resistance Unbalance in pair. • Mutual capacitance (pair/average), Capacitance Unbalance (pair to ground and pair to pair) • Cross talk • Attenuation • Drip test • Dielectric Strength • Insulation Resistance • Conductor Annealing • Armour Galvanization • Overall finish and Drum length by re-winding	100%	Inspection Witness Record	-	H	RW

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.3	Final Inspection on completed Cable(Jelly Filled Cables) Type Tests	- Type tests on insulated conductors, compatibility of Insulation and filling compound as per DOT spec. - Type tests on Composite sheath and Jacket as per DOT spec - Oxygen index test - Water Penetration test - Cable bend test.	One Sample	Supplier's Test Records	-	H	R
4.4	Final Inspection on completed Cable(Non Jelly Filled Cables) Acceptance Test	- Dimension checks - Continuity of conductors - Colour code - Overlap in poly-al tape and drain wire resistance (if shielding specified) - Conductor Resistance. - Mutual capacitance (pair/average), Capacitance Unbalance (pair to ground and pair to pair) for communication cables - Dielectric Strength - Insulation Resistance / Volume Resistivity. - Tensile and Elongation (without ageing) - Conductor Annealing - Armour Galvanization - Tests on Insulation and sheath as per IS/IEC	100 %	Inspection Witness Record	-	H	RW

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SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.5	Final Inspection on completed Cable(Non Jelly Filled Cables) Special Test	- Oxygen Index Test - Flammability test as per applicable specification - Test for Rodent & termite repulsion - Surface finish and drum length check by wiring	100 %	Inspection Witness Record	-	H	RW
4.6	Final Inspection on completed Cable(Non Jelly Filled Cables) Type Tests	- Type test on conductor as per spec - Type tests on insulation and Sheath as per spec	Sample	Supplier's Test Records	-	H	R
5.0	Painting						
6.0	Documentation and IC						
6.1	Documentation and IC	- Review of Internal Test Reports and MTCs. - IC issuance	-	Supplier's Test Records / Inspection Certificate (IC)	-	H	H
6.2	Final Document submission	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

* - Thermal Stability, Hot deformation, Heat shock and Shrinkage tests on insulation and sheath shall be witnessed by EIL (One Sample/Lot), all other tests as per IS-5831 shall be carried out by supplier and test reports shall be reviewed by EIL.

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Legends: H- Hold (Do not proceed without approval, R-Review, RW-Random witness (As specified or 10 % - Samples must include min 1 No of each type), W- Witness (Give due notice, work may proceed after scheduled date).

NOTES :-

1. This document describes the generic test requirements. Any additional test or inspection scope if specified in contract documents shall also be applicable. (Unless otherwise agreed upon).
2. Acceptance Norms for all the activities shall be as per PO/PR/ Standards referred there in/ Job specifications /Approved documents