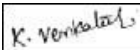
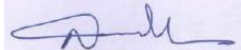
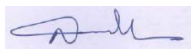


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COPYRIGHT AND CONFIDENTIAL The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED, It must not be used directly or indirectly in any way detrimental to the interest of the company.		<u>TECHNICAL SPECIFICATION FOR LOW TENSION POWER CABLES</u> 1.0 INTENT OF SPECIFICATION: 1.1 This specification governs the requirements of design, manufacture, testing packing at manufacturer's work and delivery at site and complete in all respects of this specification. 2.0 APPLICABLE STANDARDS: The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest versions of below standards. <table border="0"> <tr> <td>IS 1554-I</td> <td>:</td> <td>PVC insulated (heavy duty) electric cables.</td> </tr> <tr> <td>IS 209</td> <td>:</td> <td>Specification for Zinc.</td> </tr> <tr> <td>IS 5831</td> <td>:</td> <td>PVC insulation and sheath of electric cables.</td> </tr> <tr> <td>IS-8130</td> <td>:</td> <td>Conductors for insulated electric cables and flexible cords.</td> </tr> <tr> <td>IS 3975</td> <td>:</td> <td>Standard for Mild steel wires, strips & tapes for Armoring.</td> </tr> <tr> <td>IS 3961</td> <td>:</td> <td>Recommended current ratings for cables: Part-2 PVC insulated and PVC sheathed heavy duty cables.</td> </tr> <tr> <td>IS 10810(Pt-41):</td> <td></td> <td>Method of test for cables: Mass of zinc coating on steel armour.</td> </tr> <tr> <td>IS 10462(Pt-1) :</td> <td></td> <td>Fictitious calculation method for determination of Dimensions of protective coverings of cables: Part-1 Electrometric and thermoplastic insulated cables.</td> </tr> <tr> <td>IS 10418</td> <td>:</td> <td>Drums for electric cables.</td> </tr> <tr> <td>IS 10810(Pt-58):</td> <td></td> <td>Oxygen Index test.</td> </tr> <tr> <td>IS 10810(Pt-61):</td> <td></td> <td>Flame Retardant test.</td> </tr> <tr> <td>IS 10810(Pt-62):</td> <td></td> <td>Fire resistance test for bunched cables.</td> </tr> <tr> <td>IEC 60332-3</td> <td>:</td> <td>Tests on electric cables under fire conditions.</td> </tr> <tr> <td>ASTM-D2863</td> <td>:</td> <td>Standard for critical oxygen index and temperature index test.</td> </tr> <tr> <td>NEMA – WC 70:</td> <td></td> <td>Standard for Non-shielded power cables rated 2000Volts or less for the distribution of electrical energy.</td> </tr> <tr> <td>NEMA – WC 53:</td> <td></td> <td>Standard test methods for extruded dielectric power, control, instrumentation and portable cables for test.</td> </tr> <tr> <td>DIN 53387:</td> <td></td> <td>Artificial weathering and ageing of plastics and elastomers by exposure to Filtered Xenon arc radiation</td> </tr> <tr> <td>ASTM-G-154:</td> <td></td> <td>Standard practice for operating fluorescent light apparatus for UV exposure of non-metallic materials.</td> </tr> <tr> <td>BS: 7846:</td> <td></td> <td>Electric cables -600/1000V armoured fire resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire.</td> </tr> </table> The cables shall also conform to the provisions of Indian electricity rules and other statutory regulations as applicable. 3.0 CABLE REQUIREMENTS: a) Voltage grade : 650/1100 V b) The conductors (heavy duty type, Aluminum (Al.)) shall be solid for conductor of nominal area up to and including 6 sqmm and stranded beyond 6 sqmm. Conductors of nominal area less than 16sq.mm shall be circular only. Conductor of nominal area 16 sqmm and above may be circular or shaped as per IS 8130. Cables with reduced neutral conductor shall have sizes as per table 1 of IS 1554(part-I).				IS 1554-I	:	PVC insulated (heavy duty) electric cables.	IS 209	:	Specification for Zinc.	IS 5831	:	PVC insulation and sheath of electric cables.	IS-8130	:	Conductors for insulated electric cables and flexible cords.	IS 3975	:	Standard for Mild steel wires, strips & tapes for Armoring.	IS 3961	:	Recommended current ratings for cables: Part-2 PVC insulated and PVC sheathed heavy duty cables.	IS 10810(Pt-41):		Method of test for cables: Mass of zinc coating on steel armour.	IS 10462(Pt-1) :		Fictitious calculation method for determination of Dimensions of protective coverings of cables: Part-1 Electrometric and thermoplastic insulated cables.	IS 10418	:	Drums for electric cables.	IS 10810(Pt-58):		Oxygen Index test.	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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.	c) Insulation: The core insulation shall be with HR PVC compound applied over the conductor by extrusion and shall confirm to the requirements of type ‘C’ compound as per IS: 5831. The thickness of insulation and the tolerance on the thickness of insulation shall be as per Table 2 of IS: 1554 (part-1). Colour coding for cables upto 5 cores shall be as per Indian standard. d)The inner sheath shall be applied over the laid-up cores by extrusion and shall be of PVC conforming to the requirements of Type ST-2 PVC compound as per IS:5831. The minimum thickness of inner sheath shall be as per IS: 1554 (part-1). Single core cables shall have no inner sheath. d) Armouring For single core cables, the armoring shall be of non-magnetic material. For multi core cables armoring shall be by single round galvanized steel wires where the calculated diameter below armoring doesn’t exceed 13mm and by galvanized steel strips where this dimension is greater than 13mm. Requirement and methods of tests for armour material and uniformity of galvanization shall be as per IS -3975, IS -10810(Part-41). The dimensions of armour shall be as per method (b) of IS-1554 (Part-1). For single core cables, the armouring shall be with H4 grade hard drawn aluminium round wire of 2.5mm diameter. e) The outer sheath for the cables shall be applied by extrusion and shall be of PVC FRLS compound conforming to the requirements of type ST-2 compound as per IS:5831. The minimum and average thickness of outer sheath for unarmoured cables and minimum thickness of outer sheath for armoured cables shall be as per IS: 1554 (part-1). f) Outer sheath of all cables shall be black in color and the minimum value of oxygen index shall be 29 at $27 \pm 2^\circ \text{C}$. In addition suitable chemicals shall be added into the PVC compound of outer sheath to protect the cable against rodent and terminate attack. g) All cables covered in this specification shall be flame retardant low smoke (FRLS). The outer sheath of PVC cables shall posses flame propagation properties meeting requirements as per IS-10810 (Part-62) category AF. FRLS cable shall be identified by appropriate legend i.e., “FRLS category-C2” throughout the cable length. FRLS properties shall be as per IS-10810 Part 61 and Part62, IEC 60332 Part1 and Part3, IEEE-383, IEC-61034, IEC-60754 Part1, ASTM-D-2863. i) The overall diameter of the cables shall be strictly as per the values declared by the manufacturer in the technical information subject to a maximum tolerance of $\pm 2\text{mm}$ up to overall diameter of 60mm and $\pm 3\text{mm}$ for beyond 60mm. k) On the outer sheath of cable, necessary information such as vendor’s name, type, size, voltage grade of the cable, cable code, FRLS category-C2, BHEL Material code shall be embossed. Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing shall be legible and indelible. l) The joints in armor wire/strips shall be made by brazing or welding and any surface irregularities shall be removed. A joint in any wire/strip shall be at least 300m from the nearest joint in any wire/strip in the complete cable. 4.0 TESTS: 4.1 The Cables shall be subjected to Type, Routine, Acceptance tests and Special tests as detailed below. BHEL/End User reserves the right to witness all tests with sufficient advance notice from vendor.		
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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.		4.2 Cables offered shall have valid Type test certificates of recognized testing house such as CPRI, CMRI, PTB, BASEEFA, UL or equivalent. 4.3 The cables shall be tested and inspected at the vendor's works. All the materials employed in manufacture of the cable shall be subjected, both before and after manufacture, to examination, testing and approval by BHEL/End User. 4.4 Vendor shall furnish all necessary information concerning the supply to BHEL. 4.5 The inspector shall have free access to the vendor'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. 4.6 The vendor shall give at least 2 weeks advance notice to the purchaser, regarding the date of testing to enable him or his representative to witness the tests. 4.7 Type Tests and Special tests to be conducted/Valid Certificates to be submitted shall be governed by below clauses. If Type tests certificates and Special Tests Certificates (applicable for UV test, Accelerated water absorption test, Dielectric retention test) are not available for any size of cable, same shall be conducted by vendor at his own cost in any recognized laboratory. If in-house test facilities are to be used then the testing equipments shall be calibrated (valid calibration certificates shall be produced during inspection) and traced back to National Calibration standards. The reports shall be submitted for BHEL's approval before dispatch of the cables. There shall not be any delivery and commercial implications on account of this. 4.8 Routine Tests: All Routine tests on each size of cable as per IS 1554-I & approved data sheet shall be conducted. The Test reports shall be submitted for review to BHEL/BHEL's representative and annexed to the Inspection Report. QAP: In addition to above clauses, Quality requirements shall also be as per enclosed QAP(Annexure-1) of specification. 4.9 Acceptance Tests: All Acceptance tests on each size of cable as per IS 1554-I & approved data sheet shall be conducted in the presence of BHEL's representative. The Test reports shall be annexed to the Inspection Report. QAP: In addition to above clauses, Quality requirements shall also be as per enclosed QAP(Annexure-1) of specification. 4.10 Type Tests: Type test certificates for the type tests as per IS 1544-I & IS 5831 of not older than 5years (as on date of enquiry) issued by any recognized laboratory for the Size of cable shall be furnished for BHEL's review alongwith Technical data sheets. If Type test certificates are not available refer above clause no. 4.7. QAP: In addition to above clauses, Quality requirements shall also be as per enclosed QAP(Annexure-1) of specification.	
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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.	4.11 SPECIAL TESTS: 4.11.1 Ultra Violet radiation Test: Test for Resistance to Ultra Violet Radiation should be carried as per DIN 53387(latest) or ASTM-G-154(latest) on outer sheath. The retention values of tensile strength and ultimate elongation after the test shall be minimum 60% of tensile strength and ultimate elongation before the test. Test certificates to this test <u>(not older than one year) from</u> recognized testing laboratory to be furnished <u>for review by BHEL</u> alongwith Technical Data sheets. In case the Test certificates are not available, refer above clause no. 4.7. Sampling for this test is to be done randomly once for each order, provided outer sheath remains same. 4.11.2 Accelerated water absorption test: Accelerated water absorption test for insulation as per NEMAWC-70(latest):Test certificates with respect to this test <u>(not older than one year)</u> from recognized testing laboratory to be furnished for review by BHEL alongwith Technical Data sheets. In case test certificates are not available, refer above clause no. 4.7. Sampling for this is to be done randomly once for each order, provided type of insulation remains same. 4.11.3 Oxygen Index Test: The test shall be carried out as per IS-10810(Part-58). Sampling to be done for every offered lot/size as per sampling plan. 4.11.4 Flammability test: The test shall be carried out on finished cable as per IS: 10810 (part61& 62). Sampling for these tests to be done randomly once for each order. The acceptance criteria for tests conducted shall be as under: Part-61-The cable meets the requirement if there is no visible damage on the test specimen within 300mm from its upper end. Part-62-The maximum extent of the charred portion measured on the test sample should not have reached a height exceeding 2.5m above the bottom edge of the burner at the front of the ladder. 4.11.5 Rodent and Termite repulsion test: Test for rodent and termite repulsion property shall be carried out. The vendors shall furnish the test details to analyze the property by chemical method for BHEL's review/information. Sampling to be done for every offered lot/size as per sampling plan. 4.11.6 Dielectric retention test: Dielectric Retention test: The dielectric strength of the cable insulation tested in accordance with NEMA WC-70 at 75±1deg.C shall not be less than 50% of the original dielectric strength. Test certificates with respect to this test (not older than one year) from recognized testing laboratory to be furnished for review by BHEL before dispatch clearance of cable. In case test certificates are not available, refer above clause no. 4.7. Sampling for this test is to be done randomly and once for each size per order QAP: In addition to above clauses, Quality requirements shall also be as per enclosed QAP(Annexure-1) of specification.		
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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.		4.12 FRLS Tests: Following FRLS tests on each size (minimum one sample per size) of cable shall be conducted in the presence of BHEL's representative & reports shall be annexed to Inspection report. a) Oxygen index test as per ASTM D-2863 and minimum oxygen index shall be 29 at 27+/-2degC. b) Temperature index test as per ASTM D-2863 and minimum temp index shall be 250degC. c) Acid gas generation test as per IEC-60754(1) and Maximum acid gas generation shall be 20% by weight. d) Smoke generation test as per ASTM D-2843 and Maximum smoke density rating shall be 60%. e) Flammability Test: For Cables with OD >35: as per IEEE-383. For Cables with OD <=35: as per Clause F3 of SS: 4241475/88.									
		5.0 PACKING AND DESPATCH: 5.1 Cables shall be dispatched in non-returnable Steel drums of suitable barrel diameter, securely battened, with the take-off end fully protected against mechanical damage. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage. 5.2 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 water during transportation and storage. 5.3 On the flange of the drum, necessary information such as project title, vendor's name, type, size, voltage grade of the cable, length of the cable in meters, drum no., cable code, BIS certification mark, gross weight etc. shall be printed. An arrow shall be printed on the drum with suitable instructions to show the direction of the rotation of the drum. 5.4 Cables shall be supplied as per following drum lengths: <table border="0" style="width: 100%;"> <tr> <td>Multicore Power cables up to including 10 mm²</td> <td style="text-align: right;">: 2000 m</td> </tr> <tr> <td>Multicore Power cables from 10 mm² up to 50 mm²</td> <td style="text-align: right;">: 1000 m</td> </tr> <tr> <td>Multicore Power Cables 70 mm²</td> <td style="text-align: right;">: 750 m</td> </tr> <tr> <td>Multicore Power Cables from 95 mm² up to 300 mm²</td> <td style="text-align: right;">: 600 m</td> </tr> <tr> <td>Single core Power cables up to 630 mm²</td> <td style="text-align: right;">: 500 m</td> </tr> </table> A tolerance of +3 % (No Negative tolerance) shall be permissible for each drum and overall quantity.		Multicore Power cables up to including 10 mm ²	: 2000 m	Multicore Power cables from 10 mm ² up to 50 mm ²	: 1000 m	Multicore Power Cables 70 mm ²	: 750 m	Multicore Power Cables from 95 mm ² up to 300 mm ²	: 600 m
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Single core Power cables up to 630 mm ²	: 500 m										
6.0 DOCUMENTATION: 6.1 DRAWINGS, DATA AND MANUAL: 6.1.1 To be submitted along with bid a. Technical data sheets. Datasheets as per relevant formats given shall be furnished. Separately typed vendor datasheets are NOT acceptable. b. Type Test Certificates c. Certificates of Special Tests Type d. Bidder shall furnish NO Deviations e. Check list for Bid Submission.											
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6.1.2 To be submitted in 6 sets after award of contract <table border="1"> <thead> <tr> <th>Sl.No.</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>1.</td> <td>Completely filled in technical data sheets Datasheets as per relevant formats given shall be furnished. Separately typed vendor datasheets are NOT acceptable.</td> </tr> <tr> <td>2.</td> <td>Transport/Shipping dimension drawing</td> </tr> <tr> <td>3.</td> <td>Type Test Certificates</td> </tr> <tr> <td>4.</td> <td>Erection manual</td> </tr> <tr> <td>5.</td> <td>Catalogues</td> </tr> </tbody> </table> <u>No. of copies to be submitted for each submission shall be as follows</u> ➤ For Approval & Review documents shall be in 6 copies.					Sl.No.	Description	1.	Completely filled in technical data sheets Datasheets as per relevant formats given shall be furnished. Separately typed vendor datasheets are NOT acceptable.	2.	Transport/Shipping dimension drawing	3.	Type Test Certificates	4.	Erection manual	5.	Catalogues
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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.						8.0 GENERAL:					
						8.1 CHECKLIST FOR BID SUBMISSION					
						(TO BE FILLED BY BIDDER AND SUBMITTED ALONG WITH OFFER)					
						Sl. No.	Description	Bidder Confirmation	Comments/Remarks		
						1	Technical offer is conforming to technical specification PY55035 & its associated Annexures (if any), pre-bid clarifications (if any) etc., Bidder to confirm (Yes / No).				
						2	Bidder confirms that they have read the provisions of the Deviation Schedule and have included the deviation Schedule in the Offer after agreeing to the said Provisions (Yes/No).				
3	Bidder confirms that Prices for all items have been Quoted. Unpriced & Priced Schedules are included in the Techno-commercial Offer and Priced Offer respectively.(Yes/NO)										
4	As per specification, bidder confirms that complete set of test certificates have been included along with the Offer. In case bidder has not submitted test certificates, bidder confirms to conduct the tests as per cl.no 4.7 and submit the report to BHEL/customer for approval. (YES/NO)										
Notes: Offer received without affirmative confirmation against any of the above points may not be considered for evaluation.											
(Signature and stamp of bidder with date)											
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8.2 Quantities mentioned are tentative requirement. Based on the actual requirement, quantity can be increased or decreased by about 15% on overall qty. Final BOQ will be informed before price bid opening. Unit rates shall be applicable for the revised BOQ also.

8.3 GUIDELINES TO VENDORS FOR PREPARATION OF QUALITY ASSURANCE PLAN: REFER ANNEXURE-I

8.4 “Vendors should not be part of EIL holiday List. Package vendors will not source the items from sub-vendors who are part of EIL' holiday list”

TABLE-1
MATERIAL CODIFICATION

Sl.No	No. of cores & Sizes (Sq.mm.)	Armouring	Cond, Insulation & Outer sheath matl.	BHEL Material Code
01	3.5CX35	Armoured	3.5CX35SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035052
02	3.5CX50	Armoured	3.5CX50 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035060
03	3CX70	Armoured	3CX70 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035079
04	3CX185	Armoured	3CX185 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035087
05	3.5CX300	Armoured	3.5CX300 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035095
06	3CX35	Armoured	3CX35 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035109
07	1CX185	Armoured	1CX185 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035117
08	1CX95	Armoured	1CX95 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035125
09	3.5CX95	Armoured	3.5CX95 SQ MM AL, AR HRPVC, PVC/FRLS. PY9755035133	PY9755035133
10	4CX35	Armoured	4CX35 SQ MM AL, AR HRPVC, PVC/FRLS	PY9755035141
11	3CX25	Armoured	3CX25 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035222
12	3CX120	Armoured	3CX120 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035230
13	3CX240	Armoured	3CX240 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035249
14	3CX300	Armoured	3CX300 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035257
15	3.5CX120	Armoured	3.5CX120 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035265
16	3.5CX150	Armoured	3.5CX150 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035150
17	3.5CX185	Armoured	3.5CX185 SQ MM AL, AR HRPVC, PVC/FRLS.	PY9755035168

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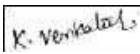
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Copyright and Confidential The information on this document is the property of BHARAT HEAVY ELECTRICALS LIMITED . It must not be used directly or indirectly in any way detrimental to the interest of the company.		c. Minimum Thickness: d. Extruded: Yes 21. Nominal outer diameter of cable : 22. Calculated outer diameter of cable: 23. Tolerance on outer diameter : 24. Electrical parameters: a. AC resistance at 90 deg.C: b. Cable reactance: c. Cable impedance: 25. Short circuit rating of conductor for the Duration of 1 sec(kA) 26. Maximum drum length of cable: 27. Continuous current rating for standard IS conditions laid direct (amps) a. In ground (ground temp of 30 deg.C) b. In duct (ground temp of 30 deg.C) c. In air (ambient temp of 40 deg.C) 28. Embossing on outer sheath: 29. Total I²R losses(watts/meter/phase), When cable laid in ground. 30. No. of end caps: 31. Tests to be conducted: 32. Current carrying capacity(in air at 40°C) : (in ground at 30°C) 33. Derating factor for cable current carrying : carrying for different method of laying	
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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.		TECHNICAL SPECIFICATION FOR LOW TENSION POWER CABLES 1.0 INTENT OF SPECIFICATION: 1.1 This specification governs the requirements of design, manufacture, testing packing at manufacturer's work and delivery at site and complete in all respects of this specification. 2.0 APPLICABLE STANDARDS: The equipment to be furnished under this specification shall be in accordance with the applicable section of the latest versions of below standards. <table border="0"> <tr> <td>IS 1554-I</td> <td>:</td> <td>PVC insulated (heavy duty) electric cables.</td> </tr> <tr> <td>IS 209</td> <td>:</td> <td>Specification for Zinc.</td> </tr> <tr> <td>IS 5831</td> <td>:</td> <td>PVC insulation and sheath of electric cables.</td> </tr> <tr> <td>IS-8130</td> <td>:</td> <td>Conductors for insulated electric cables and flexible cords.</td> </tr> <tr> <td>IS 3975</td> <td>:</td> <td>Standard for Mild steel wires, strips & tapes for Armoring.</td> </tr> <tr> <td>IS 3961</td> <td>:</td> <td>Recommended current ratings for cables: Part-2 PVC insulated and PVC sheathed heavy duty cables.</td> </tr> <tr> <td>IS 10810(Pt-41):</td> <td></td> <td>Method of test for cables: Mass of zinc coating on steel armour.</td> </tr> <tr> <td>IS 10462(Pt-1) :</td> <td></td> <td>Fictitious calculation method for determination of Dimensions of protective coverings of cables: Part-1 Electrometric and thermoplastic insulated cables.</td> </tr> <tr> <td>IS 10418</td> <td>:</td> <td>Drums for electric cables.</td> </tr> <tr> <td>IS 10810(Pt-58):</td> <td></td> <td>Oxygen Index test.</td> </tr> <tr> <td>IS 10810(Pt-61):</td> <td></td> <td>Flame Retardant test.</td> </tr> <tr> <td>IS 10810(Pt-62):</td> <td></td> <td>Fire resistance test for bunched cables.</td> </tr> <tr> <td>IEC 60332-3</td> <td>:</td> <td>Tests on electric cables under fire conditions.</td> </tr> <tr> <td>ASTM-D2863</td> <td>:</td> <td>Standard for critical oxygen index and temperature index test.</td> </tr> <tr> <td>NEMA – WC 70:</td> <td></td> <td>Standard for Non-shielded power cables rated 2000Volts or less for the distribution of electrical energy.</td> </tr> <tr> <td>NEMA – WC 53:</td> <td></td> <td>Standard test methods for extruded dielectric power, control, instrumentation and portable cables for test.</td> </tr> <tr> <td>DIN 53387:</td> <td></td> <td>Artificial weathering and ageing of plastics and elastomers by exposure to Filtered Xenon arc radiation</td> </tr> <tr> <td>ASTM-G-154:</td> <td></td> <td>Standard practice for operating fluorescent light apparatus for UV exposure of non-metallic materials.</td> </tr> <tr> <td>BS: 7846:</td> <td></td> <td>Electric cables -600/1000V armoured fire resistant cables having thermosetting insulation and low emission of smoke and corrosive gases when affected by fire.</td> </tr> </table> The cables shall also conform to the provisions of Indian electricity rules and other statutory regulations as applicable. 3.0 CABLE REQUIREMENTS: a) Voltage grade : 650/1100 V b) The conductors (heavy duty type, Copper (Cu.)) shall be solid for conductor of nominal area up to and including 6 sqmm and stranded beyond 6 sqmm. Conductors of nominal area less than 16sq.mm shall be circular only. Conductor of nominal area 16 sqmm and above may be circular or shaped as per IS 8130. Cables with reduced neutral conductor shall have sizes as per table 1 of IS 1554(part-I).				IS 1554-I	:	PVC insulated (heavy duty) electric cables.	IS 209	:	Specification for Zinc.	IS 5831	:	PVC insulation and sheath of electric cables.	IS-8130	:	Conductors for insulated electric cables and flexible cords.	IS 3975	:	Standard for Mild steel wires, strips & tapes for Armoring.	IS 3961	:	Recommended current ratings for cables: Part-2 PVC insulated and PVC sheathed heavy duty cables.	IS 10810(Pt-41):		Method of test for cables: Mass of zinc coating on steel armour.	IS 10462(Pt-1) :		Fictitious calculation method for determination of Dimensions of protective coverings of cables: Part-1 Electrometric and thermoplastic insulated cables.	IS 10418	:	Drums for electric cables.	IS 10810(Pt-58):		Oxygen Index test.	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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.		c) Insulation: The core insulation shall be with HR PVC compound applied over the conductor by extrusion and shall confirm to the requirements of type ‘C’ compound as per IS: 5831. The thickness of insulation and the tolerance on the thickness of insulation shall be as per Table 2 of IS: 1554 (part-1). Colour coding for cables upto 5 cores shall be as per Indian standard. d)The inner sheath shall be applied over the laid-up cores by extrusion and shall be of PVC conforming to the requirements of Type ST-2 PVC compound as per IS:5831. The minimum thickness of inner sheath shall be as per IS: 1554 (part-1). Single core cables shall have no inner sheath. d) Armoring For single core cables, the armoring shall be of non-magnetic material. For multi core cables armoring shall be by single round galvanized steel wires where the calculated diameter below armoring doesn’t exceed 13mm and by galvanized steel strips where this dimension is greater than 13mm. Requirement and methods of tests for armour material and uniformity of galvanization shall be as per IS -3975, IS -10810(Part-41). The dimensions of armour shall be as per method (b) of IS-1554 (Part-1). e) The outer sheath for the cables shall be applied by extrusion and shall be of PVC FRLS compound conforming to the requirements of type ST-2 compound as per IS:5831. The minimum and average thickness of outer sheath for unarmoured cables and minimum thickness of outer sheath for armoured cables shall be as per IS: 1554 (part-1). f) Outer sheath of all cables shall be black in color and the minimum value of oxygen index shall be 29 at 27 ± 2° C. In addition suitable chemicals shall be added into the PVC compound of outer sheath to protect the cable against rodent and terminate attack. g) All cables covered in this specification shall be flame retardant low smoke (FRLS). The outer sheath of PVC cables shall posses flame propagation properties meeting requirements as per IS-10810 (Part-62) category AF. FRLS cable shall be identified by appropriate legend i.e., “FRLS category-C2” throughout the cable length. FRLS properties shall be as per IS-10810 Part 61 and Part62, IEC 60332 Part1 and Part3, IEEE-383, IEC-61034, IEC-60754 Part1, ASTM-D-2863. i) The overall diameter of the cables shall be strictly as per the values declared by the manufacturer in the technical information subject to a maximum tolerance of ±2mm up to overall diameter of 60mm and ±3mm for beyond 60mm. k) On the outer sheath of cable, necessary information such as vendor’s name, type, size, voltage grade of the cable, cable code, FRLS category-C2, BHEL Material code shall be embossed. Sequential marking of the length of the cable in meters shall be provided on the outer sheath at every one meter. The embossing shall be legible and indelible. l) The joints in armor wire/strips shall be made by brazing or welding and any surface irregularities shall be removed. A joint in any wire/strip shall be at least 300m from the nearest joint in any wire/strip in the complete cable. 4.0 TESTS: 4.1 The Cables shall be subjected to Type, Routine, Acceptance tests and Special tests as detailed below. BHEL/End User reserves the right to witness all tests with sufficient advance notice from vendor.		
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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.	4.12 FRLS Tests: Following FRLS tests on each size (minimum one sample per size) of cable shall be conducted in the presence of BHEL's representative & reports shall be annexed to Inspection report. - Oxygen index test as per ASTM D-2863 and minimum oxygen index shall be 29 at 27+/-2degC. - Temperature index test as per ASTM D-2863 and minimum temp index shall be 250degC. - Acid gas generation test as per IEC-60754(1) and Maximum acid gas generation shall be 20% by weight. - Smoke generation test as per ASTM D-2843 and Maximum smoke density rating shall be 60%. - Flammability Test: For Cables with OD >35: as per IEEE-383. For Cables with OD <=35: as per Clause F3 of SS: 4241475/88. 5.0 <u>PACKING AND DESPATCH:</u> 5.1 Cables shall be dispatched in non-returnable Steel drums of suitable barrel diameter, securely battened, with the take-off end fully protected against mechanical damage. Ferrous parts used shall be treated with a suitable rust preventive finish or coating to avoid rusting during transit or storage. 5.2 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 water during transportation and storage. 5.3 On the flange of the drum, necessary information such as project title, vendor's name, type, size, voltage grade of the cable, length of the cable in meters, drum no., cable code, BIS certification mark, gross weight etc. shall be printed. An arrow shall be printed on the drum with suitable instructions to show the direction of the rotation of the drum. 5.4 Cables shall be supplied as per following drum lengths: <table border="0"> <tr> <td>Multicore Power cables up to including 10 mm²</td> <td>:</td> <td>2000 m</td> </tr> <tr> <td>Multicore Power cables from 10 mm² up to 50 mm²</td> <td>:</td> <td>1000 m</td> </tr> <tr> <td>Multicore Power Cables 70 mm²</td> <td>:</td> <td>750 m</td> </tr> <tr> <td>Multicore Power Cables from 95 mm² up to 300 mm²</td> <td>:</td> <td>600 m</td> </tr> <tr> <td>Single core Power cables up to 630 mm²</td> <td>:</td> <td>500 m</td> </tr> </table> A tolerance of +3 % (No Negative tolerance) shall be permissible for each drum and overall quantity. 6.0 <u>DOCUMENTATION:</u> 6.1 DRAWINGS, DATA AND MANUAL: 6.1.1 To be submitted along with bid - Technical data sheets. Datasheets as per relevant formats given shall be furnished. Separately typed vendor datasheets are NOT acceptable. - Type Test Certificates - Certificates of Special Tests Type - Bidder shall furnish NO Deviations - Check list for Bid Submission.			Multicore Power cables up to including 10 mm ²	:	2000 m	Multicore Power cables from 10 mm ² up to 50 mm ²	:	1000 m	Multicore Power Cables 70 mm ²	:	750 m	Multicore Power Cables from 95 mm ² up to 300 mm ²	:	600 m	Single core Power cables up to 630 mm ²	:	500 m
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Ref. Doc			

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मध्यम एवं उच्च वोल्टेज केबल तथा सहायक सामग्री के लिए निरीक्षण व परीक्षण योजना

INSPECTION AND TEST PLAN FOR MEDIUM AND HIGH VOLTAGE CABLES & ACCESSORIES

3	30.01.2014	Revised and Reissued	MJ	RS	SCG	SC
2	15.07.2011	Revised and Re-issued	AB	RJD	AKC	DM
1	28.09.07	Revised and Re-issued	AKG	PPM	MVKK	VC
0	30.04.02	Issued for implementation	RG	AKC	AKB	GRR
Rev. No.	Date	Purpose	Prepared by	Checked by	Standards Committee Convenor	Standards Bureau Chairman
Approved by						

INSPECTION AND TEST PLAN FOR MEDIUM AND HIGH VOLTAGE CABLES & ACCESSORIES

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 Standards	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	PO	:	Purchase Order
DT	:	Destructive Testing	PESO	:	Petroleum Explosive Safety Organization
DPT	:	Dye Penetrate Testing	PQR	:	Procedure Qualification Record
ERTL	:	Electronics Regional Test Laboratory	PR	:	Purchase Requisition
FCRI	:	Fluid Control Research Institute	PMI	:	Positive Material Identification
FM	:	Factory Mutual	PVC	:	Poly Vinyl Chloride
FLP	:	Flame Proof	QC	:	Quality Control
HIC	:	Hydrogen Induced Cracking	RT	:	Radiography Testing
ITP	:	Inspection and Test Plan	TC	:	Test Certificate
IP	:	Ingress Protection	TPI or TPIA	:	Third Party Inspection Agency
IC	:	Inspection Certification	UT	:	Ultrasonic Testing
IGC	:	Inter Granular Corrosion	UL	:	Under writer Laboratories
IEC	:	International Electro technical Commission	VDR	:	Vendor Data Requirement
JEC	:	Japanese Electro technical Committee	WPS	:	Welding Procedure Specification
LPT	:	Liquid Penetrate Testing	WPQ	:	Welders Performance Qualification
			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		

INSPECTION AND TEST PLAN FOR MEDIUM AND HIGH VOLTAGE CABLES & ACCESSORIES

STANDARD SPECIFICATION NO.

6-81-1051 Rev. 3

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1.0 SCOPE:

This Inspection and Test Plan covers the minimum testing requirements of PVC, XLPE insulated cables and cable jointing/terminating accessories for high and medium voltage systems.

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, Aluminum, PVC, XLPE, Galvanized Armour.	Purity, Dimensions, Physical and Chemical Properties.	100%	Material Test Certificates/ Test Records/Third Party Lab certificates	H	H	R
3.0	Inprocess Inspection						
3.1	Inspection during insulation, sheathing	Spark test, thickness of insulation, Conductor Resistance	100%	Test Records	--	H	R
4.0	Final Inspection						
4.1	Finished Cable	Visual, Drum details, Size, Ends Capping, Marking on outer sheath (such as Incremental Length, Voltage grade, manufacturer's name), Colour coding, etc.	100% for Drum details and Sample drums for balance details	Test Records	-	H	H/R**

INSPECTION AND TEST PLAN
FOR MEDIUM AND HIGH
VOLTAGE CABLES & ACCESSORIES

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.2	Finished Cable(Routine Tests)	- Conductor Resistance. - High Voltage - Partial Discharge (for XLPE only)	100%	Supplier's Test Records	-	H	H/R**
4.3	Finished Cable (Acceptance tests)	- Check calibration status of all testing equipment. - Dimension checks – overall dia, over/under armour, thickness of insulation, sheath, copper screen dimension, etc. - Conductor Resistance - Insulation resistance /Volume resistivity - High Voltage tests - Partial Discharge(for XLPE) - Hot Set (for XLPE insulation) - Tests on Conductor as applicable - Tests on PVC/XLPE Insulation & Sheath * - Armour Galvanization - dip test - Volume resistivity, Insulation resistance - Tensile and elongation (without ageing)	As per sampling plan	Inspection Test Records	-	H	H/R**
4.4	Finished Cable (Special tests)	- Flammability test as per applicable specification. - Accelerated water absorption test as per NEMA(Electrical method) # - Test for resistance to Ultra Violet Radiation # - Oxygen Index test as per IS /IEC - Rodent & Termite repulsion check - Drum length /surface finish check by re-winding - Test for circuit integrity for fire survival cables as per IEC(If applicable)	1 sample/size/ lot 1 sample /order 1 sample/order 1 sample/ order 1 sample/size/ lot 1 sample/ lot 1 or 2 drums/ lot 1 sample/ lot	Inspection test records		H	H/R**

INSPECTION AND TEST PLAN
FOR MEDIUM AND HIGH
VOLTAGE CABLES & ACCESSORIES

SL NO.	STAGE/ ACTIVITY	CHARACTERISTICS	QUANTUM OF CHECK	RECORD	SCOPE OF INSPECTION		
					SUB SUPPLIER	SUPPLIER	EIL/TPIA
4.5	Finished Cable (Type tests **)	- Dielectric Retention. - Type tests on PVC insulation and Sheath - High Voltage test (Water Immersion) - Dielectric power factor tests as function of voltage, temperature. (XLPE cables) - Heating cycle test (XLPE Cables) - Impulse withstand test (XLPE cables)	Sample	Test Records		H	R
4.6	Cable accessories	- Visual - Dimensions - Type tests** as per IS/IEC	Sample	Test Records		H	R
5.0	Painting	--	--	--	--	--	--
6.0	Documentation and IC						
6.1	Documentation and IC	- Review of Routine, Acceptance, Type test reports. - IC issuance	100%	Supplier TC & IC	-	-	H
6.2	Final Document submission	Compilation of Inspection reports ,drawings, etc as per VDR / PR	100%	Final data folder /Completeness certificate	-	H	H

In case TC (not older than one year) from independent test lab is available & type of compound used is same then the same may be accepted.

* Hot deformation, Heat shock and Shrinkage tests on insulation & sheath (One sample/Lot) shall be witnessed by EIL/TPIA, all other tests as per IS/IEC shall be carried out by supplier and test reports shall be reviewed by EIL/TPIA.

** EIL witness for HT cables only

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).

**INSPECTION AND TEST PLAN
FOR MEDIUM AND HIGH
VOLTAGE CABLES & ACCESSORIES**

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