

ESP-001- 2A Rev. 00 	PRODUCT STANDARD PROJECT ENGINEERING & SYSTEMS DIVISION HYDERABAD		Std. / Doc. Number																
			PY 56223																
			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.	Specification for <u>SIGNAL CABLES</u> [BS EN 50288-7]																		
	1. SCOPE This technical specification covers the Design, Manufacturing, testing at vendor works, inspection by purchaser, packing and transportation to site of SIGNAL 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 <u>within one week of issue of Enquiry</u> . 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 The cable shall conform to the latest editions of various standards mentioned in the specification. In case of conflict between any standard and these specifications the matter shall be referred to the Purchaser before proceeding with the manufacturing of the cables.																		
	<table border="0"> <tr> <td>IS-1554 (Part 1)</td> <td>PVC insulated (heavy duty) electric cables (Part-1 for working voltage up to and including 1100V).</td> </tr> <tr> <td>IS-2633</td> <td>Method for testing uniformity of coating on zinc coated articles.</td> </tr> <tr> <td>IS-3975</td> <td>Mild steel wires, formed wires and tapes for armouring of cables.</td> </tr> <tr> <td>IS-5831</td> <td>PVC insulation and sheath of electric cable.</td> </tr> <tr> <td>BS EN 50288 (Part 7)</td> <td><u>Instrumentation Cables</u></td> </tr> <tr> <td>ASTM D-2863</td> <td>Test method for measuring the minimum oxygen concentration to support cable like combustion of plastics (oxygen index)</td> </tr> <tr> <td>DIN-50049</td> <td>Document on material testing</td> </tr> <tr> <td>IEC-332-3 (Part 3)</td> <td>Tests on bunched wires and cables</td> </tr> </table>				IS-1554 (Part 1)	PVC insulated (heavy duty) electric cables (Part-1 for working voltage up to and including 1100V).	IS-2633	Method for testing uniformity of coating on zinc coated articles.	IS-3975	Mild steel wires, formed wires and tapes for armouring of cables.	IS-5831	PVC insulation and sheath of electric cable.	BS EN 50288 (Part 7)	<u>Instrumentation Cables</u>	ASTM D-2863	Test method for measuring the minimum oxygen concentration to support cable like combustion of plastics (oxygen index)	DIN-50049	Document on material testing	IEC-332-3 (Part 3)
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3.1 <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:  Vineet Kumar	Checked By :  Sujatha Sapavat	Approved :  K. Anand Babu	Date : 29.06.17														



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5. 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 ± 5%. Tolerance over the total ordered length shall be as follows: ± 5% for total length less than 5 km, ± 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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6. TECHNICAL REQUIREMENTS

(1)	Type of cable	:	Shielded, armored, single/multi pair signal/Triad cables.
(2)	Quantity of cable	:	As per enquiry
(3)	Voltage grade [Uo/U]	:	600 / 1100 V
(4)	No. of Pairs / Triads	:	As per enquiry
(5)	Applicable standards	:	BS EN 50288-7 , IS-1554 part-1, IS-5831, IS-3975, ASTM D-2863, DIN-50049 and IEC-332-3 (Part 3), HD-383 S2 , IEC-60189-2 , EN 60708
(6)	CONDUCTOR		
6.1	Material	:	Annealed tinned electrolytic grade stranded copper conductor as per BS EN 50288-7 , EN 50288-1 , HD383 class-2 , IS-8130
6.2	Nominal area of conductor	:	As per enquiry
6.3	No. of strands	:	7
6.4	Dia of each Strand (Before Stranding) as per IS-8130 & EN 50288-1 .	:	0.3 mm for 0.5 mm ² 0.43 mm for 1 mm ² 0.53 mm for 1.5 mm ²
(7)	INSULATION		
7.1	Material	:	Extruded HR-PVC, 85° C as per BE EN 50290-2-21 <i>for Non-IS cables</i> ; Polyethylene as per BS EN 50290-2-23 <i>for IS (Intrinsic Safe) cables</i>
7.2	Minimum Thickness	:	For 0.5 mm ² : As per EN-50288-7 & EN-50288-1 For 1 mm ² : As per EN-50288-7 & EN-50288-1 for 1.5 mm ² : As per EN-50288-7 & EN-50288-1 Negative tolerance on insulation thickness is not acceptable
(8)	No. of Twists for each pair / Triad <i>per meter</i>	:	Positive and negative conductors shall be twisted together to form a pair/triad with no. of twists per meter > 13
(9)	PAIR / TRIAD Screening	:	Applicable
9.1	Material	:	A foil applied with a minimum overlap of 20%
9.2	Overlapping / Coverage	:	20 % / 100 %
9.3	Nominal Thickness	:	0.06 mm
9.4	Drain wire Size & material	:	0.5 mm ² & Annealed tinned multi stranded copper
9.5	Drain wire [No. of strands x diameter]	:	7 x 0.3 mm
(10)	Cable Bundling	:	<i>Applicable for Multi Pair / Triad cables;</i> <i>Not applicable for Single Pair / Triad cables</i>
10.1	Binding material	:	Mylar / polyester tape
10.2	No. of twists/meter	:	4 to 6
10.3	Tape thickness	:	0.025 mm
10.4	Communication Cable		
10.5	Conductor material	:	Annealed tinned multi stranded copper wire
10.6	Size	:	0.5 mm ² ((7x0.3 mm)
10.7	Insulation material	:	Type-C, HR PVC
10.8	Insulation thickness	:	0.4 mm
10.9	Colors of cores of communication cable	:	Green & Red
(11)	Overall Screening	:	<i>Applicable for Multi Pair / Triad cables;</i> <i>Not applicable for Single Pair / Triad cables</i>
11.1	Material	:	A foil applied with a minimum overlap of 20%
11.2	Minimum Thickness	:	0.075
11.3	Drain wire Size & material	:	0.5 mm ² & Annealed tinned multi stranded copper
11.4	Drain wire [No. of strands x diameter]	:	7 x 0.3 mm
11.5	Overlapping / Coverage	:	20 % / 100 %
(12)	INNER SHEATH		
12.1	Material	:	As per material code in enquiry [Extruded PVC or Fire Retardant (FR) Extruded PVC, 90°C, type- ST2] & Properties as per EN-50288-7 , EN-50288-1 , IS-5831 .
12.2	Minimum/ Nominal Thickness	:	As per EN-50288-7 , IS-1554 Part-1
12.3	Approx. Dia of cable over Inner Sheath	:	Vendor to specify
12.4	non-metallic rip cord	:	Required
12.5	Colour	:	Black (subject to change during drawing approval)

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(13)	ARMOUR	
13.1	Material	: Galvanized steel
13.2	Type	: Round Wire or Flat strips as per EN-50288-7
13.3	Flat / Wire Nominal thickness/diameter	: As per EN-50288-7 , EN-50288-1
13.4	Approx. Dia of cable over Armour	: Vendor to specify
(14)	OUTER SHEATH	
14.1	Material	: As per material code in enquiry [Extruded FRLS PVC or Extruded FR PVC, 90° C, type- ST2, anti-rodent] & Properties as per EN-50288-7 , EN-50288-1 , IS-5831 .
14.2	Minimum/Nominal Thickness	: As per EN-50288-7 , EN-50288-1 , IS-1554 Part-1
14.3	Approx. Dia of cable over Outer Sheath	: Vendor to specify
14.4	Colour	: BLACK for Non-IS cables; subject to change during drawing approval. LIGHT BLUE for IS (Intrinsic Safe) cables; subject to change during drawing approval.
(15)	ELECTRICAL CHARACTERISTICS	
15.1	Conductor DC resistance at 20°C	: As per EN-50288-7 , EN-50288-1 and HD-383
15.2	Inductance	: ≤ 1.0 mH / Km between conductor of each pair and all other at 1000Hz.
15.3	Mutual Capacitance	: ≤ 0.25 μ F/Km between adjacent cores in a pair at 1000Hz.
15.4	L/R ratio for adjacent cores	: ≤ 25 μ H / Ω (For 0.5 mm ²), ≤ 40 μ H / Ω (For 1.0 mm ²), and ≤ 40 μ H / Ω (For 1.5 mm ²).
15.5	Drain wire + Shield Resistance	: ≤ 30 Ω/ Km
15.6	Capacitance between any core or between any screen	: ≤ 0.4 μF/Km at 1000Hz.
15.7	Electrostatic noise rejection ratio	: Over 76dB
15.8	Attenuation	: ≤ 1.2 dB / Km
15.9	Insulation resistance	: 100 MΩ/Km
15.10	CHARACTERISTICS OF FR / FRLS PVC	
15.11	Oxygen index	: Over 30% at room temperature
15.12	Temperature index	: Over 250°C
15.13	HCL gas emission	: 20% (max.)
15.14	Smoke density	: 60% (max.)

7. INSPECTION AND TESTING

(A)	<u>Type Tests</u>	:	Requirement	Remarks
7.1	Type tests shall be as per IS 1554 part-1;	:	Certificate during technical evaluation	<u>Vendor to confirm as per cl. 5.(9) of this specification;</u> Offers without confirmation to the above will be rejected without any intimation to bidder.
7.2	Flame retardant test As per IEC 332-3 Part 3 Cat-A	:	Certificate during technical evaluation	
7.3	Fire resistance test as per IEC 331 (As per variant table/material code)	:	Certificate during technical evaluation	
(B)	<u>Routine Tests</u>			
	Vendor shall carry out these tests during various stages of manufacturing.			
7.4	Armour test as per IS –3975, EN-50288-7 , EN-50288-1	:	Certificate Review	
7.5	Conductor resistance test as per EN-50289-1-2 , EN-50288-7 , HD-383 , IS-8130 .	:	Certificate Review	
7.6	High Voltage test as per EN-50288-7 .	:	Certificate Review	
7.7	Spark test as per EN-50288-7 .	:	Certificate Review	

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(C)	Acceptance Tests			
7.8	High Voltage test as per EN-50288-7.	:	100% Witness	The sampling plan is as per IS1554-I for each material code.
7.9	Conductor resistance test as per EN-50289-1-2, EN-50288-7, HD- 383, IS-8130.	:	100% Witness	
7.10	Inductance between 2 adjacent cores at 1 kHz frequency.	:	100% Witness	
7.11	Mutual capacitance between 2 adjacent cores and core - screen at 1 kHz frequency.	:	100% Witness	
7.12	L/ R ratio at 1 kHz frequency.	:	100% Witness	
7.13	Drain wire resistance as per EN-50288-7, IS 8130.	:	100% Witness	
7.14	Continuity test.	:	100% Witness	
7.15	Oxygen & temp. Index test as per ASTM – D 2863	:	100% Witness	
7.16	Acid gas generation test as per IEC – 754. (For FRLS)	:	100% Witness	
7.17	Smoke density test as per ASTM –D 2843. (For FRLS)	:	100% Witness	
7.18	Dimensional checks overall diameter, under armour and over armour diameter. Overall diameter shall be with in ± 2 mm over offered value.	:	100% Witness	
7.19	Checks for uniformity of galvanization of armour wire as per IS-2633.	:	100% Witness	
7.20	Checks for armour wire size as per EN-50288-7, S 1554, part-1.	:	100% Witness	
7.21	Armour test as per IS-3975.	:	100% Witness	
7.22	Electrostatic noise rejection test, type wise for each lot.	:	100% Witness	
7.23	Laying of cores	:	100% Witness	
7.24	Conductor annealing	:	100% Witness	
7.25	Pair Twisting, Shield overlap	:	100% Witness	
7.26	Insulation and sheaths: All tests as per EN-50289-3, IEC 60189-2, IS 5831 (Volume Resistivity, Insulation resistance, Tensile and Elongation (without ageing), Hot deformation, Heat shock and Shrinkage tests on insulation and sheath shall be witnessed and all other tests as per IS-5831 shall be carried out by vendor and test reports shall be reviewed)	:	100% Witness	
7.27	Overall finish and Drum length check	:	100% Witness	

8. DOCUMENTATION

8.1 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.

a) Signed and stamped copy of enquiry technical specification,

b) Unpriced price schedule (To be submitted compulsorily without fail)

c) 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

8.2 Documentation submission within 2 weeks of placement of LOI (for approval by BHEL and / or BHEL’s customer in 4 sets)

a) Data sheets of each and every Cable.

b) Comprehensive Quality Assurance plan (QAP).

8.3 Documents to be submitted after Inspection (Note: submission of these documents are commercially linked)

a) Final Data sheets

b) 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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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.		9. SHIPPING			
		9.1 Cables shall be dispatched in wooden drums, securely battened with takeoff end fully protected against damage. 9.2 The ends of the cable shall be sealed with suitable PVC/rubber caps to prevent ingress of moisture. 9.3 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. 9.4 Mandatory Spare parts shall be packaged separately and clearly marked as ‘Mandatory Spares ‘. 9.5 Commissioning spares, Tools & tackles to be packed separately & suitably tagged. 9.6 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			
		10. 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).			



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Variant Table**COPYRIGHT AND CONFIDENTIAL**

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Var No	Material Code	Cable Type	Var No	Material Code	Cable Type
00	PY9756223006	1P x 1.5 mm2 IS, PVC/FRLS PVC, BS EN 50288-7	50	PY9756223502	1P x 1.5 mm2 NIS, PVC/FRLS PVC, BS EN 50288-7
01			51		
02			52	PY9756223529	4P x 1.5 mm2 NIS, PVC/FRLS PVC, BS EN 50288-7
03			53		
04			54	PY9756223545	6P x 0.5 mm2 NIS, PVC/FRLS PVC, BS EN 50288-7
05			55		
06			56	PY9756223561	8P x 1.5 mm2 NIS, PVC/FRLS PVC, BS EN 50288-7
07	PY9756223073	12P x 0.5 mm2 IS, PVC/FRLS PVC, BS EN 50288-7	57	PY9756223570	12P x 0.5 mm2 NIS, PVC/FRLS PVC, BS EN 50288-7
08	PY9756223081	12P x 1.5 mm2 IS, PVC/FRLS PVC, BS EN 50288-7	58	PY9756223588	12P x 1.5 mm2 NIS, PVC/FRLS PVC, BS EN 50288-7
09			59		
10	PY9756223103	1T x 1.5 mm2 NIS, PVC/FRLS PVC, BS EN 50288-7+Fire resistant	60	PY9756223600	1T x 1.5 mm2 NIS, PVC/FRLS PVC, BS EN 50288-7
11	PY9756223111	8T x 1.5 mm2 NIS, PVC/FRLS PVC, BS EN 50288-7 + Fire Resistant	61	PY9756223618	8T x 1.5 mm2 NIS, PVC/FRLS PVC, BS EN 50288-7



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Revision Details

Revised By

Approved By

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Original issue

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K. Anand Babu

K. M. Rube

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