

**1X800 MW COAL BASED SUPERCRITICAL
NORTH CHENNAI TPS, STAGE-III**

VOLUME-II

TECHNICAL SPECIFICATION

FOR

SCREENED CONTROL CABLE

SPECIFICATION NO: *PE-TS-423-507-E004*

REVISION: 00



**BHARAT HEAVY ELECTRICALS LIMITED
POWER SECTOR
PROJECT ENGINEERING MANAGEMENT
NOIDA, UP (INDIA) – 201301**



1X800MW COAL BASED
SUPERCRITICAL NORTH CHENNAI TPS,
STAGE III
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES

SPECIFICATION NO. PE-TS-423-507-E004

VOLUME II

SECTION

REVISION 0

DATE: 06.11.2017

SHEET 1 OF 1

CONTENTS

<u>S. NO.</u>	<u>DESCRIPTION</u>	<u>NO. OF SHEETS</u>
1.	SECTION – I	
	COMPLIANCE CERTIFICATE	01
	SPECIFIC TECHNICAL REQUIREMENTS	03
	DATA SHEET-A	06
	ANNEXURE BI	02
	DATA SHEET-C	04
2.	SECTION – II	
	STANDARD TECHNICAL SPECIFICATION	03
	QUALITY PLAN (ALONGWITH ANNEXURE I TO QP)	09
	TOTAL NO. OF SHEETS=	30
	(INCLUDING COVER/ SEPARATOR SHEETS)	



1X800MW COAL BASED
SUPERCRITICAL NORTH CHENNAI TPS,
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SPECIFICATION NO. PE-TS- 423-507-E004

VOLUME II

SECTION I

REVISION 0

DATE: 06.11.2017

SHEET 1 of 1

COMPLIANCE CERTIFICATE

The bidder shall confirm compliance to the following by signing/ stamping this compliance certificate and furnishing same with the offer.

1. The scope of supply, technical details, construction features, design parameters etc. shall be as per technical specification & there are no exclusion/ deviation with regard to same.
2. There are no deviation with respect to specification other than those furnished in the 'schedule of deviations'.
3. Only those technical submittals which are specifically asked for in NIT to be submitted at tender stage shall be considered as part of offer. Any other submission, even if made, shall not be considered as part of offer.
4. Any comments/ clarifications on technical/ inspection requirements furnished as part of bidder's covering letter shall not be considered by BHEL, and bidder's offer shall be construed to be in conformance with the specification.
5. Any changes made by the bidder in the price schedule with respect to the description/ quantities from those given in "BOQ-Cum-Price schedule" of the specification shall not be considered (i.e., technical description & quantities as per specification shall prevail).

BIDDER'S STAMP & SIGNATURE



1X800MW COAL BASED
SUPERCRITICAL NORTH CHENNAI TPS,
STAGE III
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES

SPECIFICATION NO. PE-TS-423-507-E004

VOLUME II

SECTION I

REVISION 0

DATE: 06.11.2017

SECTION – I

SPECIFIC TECHNICAL REQUIREMENTS



1X800MW COAL BASED
SUPERCRITICAL NORTH CHENNAI TPS,
STAGE III
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES

SPECIFICATION NO. PE-TS-423-507-E004

VOLUME II

SECTION I

REVISION 0

DATE: 06.11.2017

SHEET 1 OF 2

1.0 SCOPE OF ENQUIRY

- 1.1 Design, Manufacture, Inspection and Testing at Manufacturer's works, proper packing and delivery to site of **Screened Control Cable** conforming to this specification.
- 1.2 General technical requirements of the Screened Control cables are indicated in Section-II. Project specific technical/ quality requirements / changes are listed in Data Sheet-A & Section-I.
- 1.3 The stipulations of Section-I, followed by those of Data Sheet-A shall prevail in case of any conflict between the stipulations of Section-I, Data Sheet - A & Section-II.

2.0 BILL OF QUANTITIES

- 2.1 Quantity requirements shall be as per BOQ-cum-price schedule enclosed in NIT.

3.0 SPECIFIC TECHNICAL REQUIREMENTS

- 3.1 Technical:

Sl. No.	Reference Clause No. of Section- II (if any)	Specific Requirement/ Change

- 3.2 Quality Inspection:

Sl. No.	Reference Clause No. of Section- II (if any)	Specific Requirement/ Change

4.0 DRAWINGS & DOCUMENTS TO BE SUBMITTED

- 4.1 Following documents shall be submitted for specific project requirement after placement of order for BHEL & customer's approval: -

Sl. No.	Drawing / Document Description	Drawing / Document no
1	Technical Data sheet – Screened Control cables	PE-V0-423-507-E141
2	Cross-sectional Drgs.- Screened Control Cables	PE-V0-423-507-E143
3	Manufacturing Quality Plan - Screened Control Cables	PE-V0-423-507-E916 (*)

NOTE: (*)

Standard Quality Plan as enclosed in the technical specification is to be appended with cover sheet bearing document number & description as stated above. The signed & stamped copy for the same shall be submitted to BHEL without making any changes in the contents of the document

- 4.2 Drawings/documents shall be submitted through Document Management System (DMS).



**1X800MW COAL BASED
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STAGE III
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES**

SPECIFICATION NO. PE-TS-423-507-E004

VOLUME II

SECTION I

REVISION 0

DATE: 06.11.2017

SHEET 2 OF 2

5.0 DRAWING/ DOCUMENT DISTRIBUTION SCHEDULE.

S. NO.	DESCRIPTION	No. hard /soft copies	No. of CD-ROMs	REMARKS
1	Drawings "FOR APPROVAL"	10	Soft copy	
2	Drawings "FOR INFORMATION"	10	Soft copy	
3	Drawings "FINAL APPROVED DRAWING"	8	Soft copy	
4	Drawings "AS BUILT "	8	3 CD-ROMs	
5	Operation & Maintenance manual	10	3 CD-ROMS	
6	Erection manual for approval	8	3 CD-ROMS	
7	Performance and Functional Guarantees test report	6	3 CD-ROMS	

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLES	SPECIFICATION NO. PE-TS-423-507-E004	
		VOLUME II-B	
		SECTION - Data sheet- A	
		REVISION 0	DATE: 06.11.2017
		SHEET 1 OF 6	

DATA SHEET-A
SPECIFIC TECHNICAL REQUIREMENTS

1.0 Type of cable : FRLS SCREENED CONTROL CABLES

2.0 Standards Applicable :

S. No.	STANDARD	APPLICATION
1	IS-1554-I	General Construction & tests for cables.
2	IS-694	For insulation thickness.
3	SEN-SS-424-1475, IEC-60332 Part 1, IEEE 383	Flammability Tests
4	ASTMD-2843, ASTMD-2863, IEC-754 Part-1, VDE 0815	FRLS Tests

3.0 Voltage grade : 1.1 kV

4.0 CONDUCTOR

a) Material : High conductivity multi stranded
annealed tinned electrolytic Copper

b) Minimum number of strands (dia.),
cross sectional area: 7 (0.307 mm.-strand dia, 0.8 mm-
conductor dia), 0.5 sq. mm.

5.0 INSULATION

a) Material : HR PVC Type C (as per IS-5831)

b) Application : Extruded

c) Insulation thickness : 0.6 mm (nominal) as per IS-694

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLES	SPECIFICATION NO. PE-TS-423-507-E004	
		VOLUME II-B	
		SECTION - Data sheet- A	
		REVISION 0	DATE: 06.11.2017
		SHEET 2 OF 6	

- c) Volume resistivity (Min.) : i. 3.5×10^{14} Ohm-cm at 27°C/ room temp. (Min.)
ii. 3.5×10^{11} Ohm-cm at 85°C (Min.)

6.0 LAYING OF CORES

- a) Min. number of twist per : 25
Metre for paired cables.
- b) Maximum lay of individual : 40 mm
twisted pair

- 7.0 IDENTIFICATION OF : As per attached Annexure-B-I
CORES

8.0 INDIVIDUALLY SCREENED

- a) Material : Aluminium-Mylar tape
- b) Coverage : 100%
- c) Overlap : Minimum 25%
- d) Min. thickness (Micron): **60 micron**

9.0 OVERALL SCREENED

- a) Material : Aluminium-Mylar tape
- b) Coverage : 100%
- c) Over lap : Minimum 25%
- d) Min. thickness (Micron) : **75 micron**

10.0 DRAIN WIRE

To be provided separately for individual pair shield (wherever applicable) and overall shield.

- a) Material : Annealed tinned copper conductor

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLES	SPECIFICATION NO. PE-TS-423-507-E004	
		VOLUME II-B	
		SECTION - Data sheet- A	
		REVISION 0	DATE: 06.11.2017
		SHEET 3 OF 6	

b) Minimum number of strands: 7 (0.307 mm.), 0.5 sq. mm.
(dia.), cross sectional area

c) Drain wire (7 stranded) laid under the contact with aluminium side of the tape.

11.0 BEDDING

a) Material : Mylar tape.

12.0 INNER SHEATH

a) Material : Extruded HR PVC Type ST2 as per IS-5831 & IS-1554 Part-I

b) Whether FRLS : YES

c) Fillers : Acceptable

d) Material of fillers : Same as inner sheath

e) Method of application

i) With fillers : Pressure / Vacuum Extrusion

ii) Without fillers : Pressure Extrusion

f) Inner sheath Thickness: As per IS-1554 Part-1

g) Colour : Black

13.0 RIP CORD : Non-metallic cord under inner sheath

14.0 FILLERS

a) Fillers : Acceptable, only if Flame Retardant & Moisture Resistant.

15.0 ARMOURING

a) Material : Galvanized steel round wire/ strip as per IS-3975 & IS-1554 Part-I

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLES	SPECIFICATION NO. PE-TS-423-507-E004	
		VOLUME II-B	
		SECTION - Data sheet- A	
		REVISION 0	DATE: 06.11.2017
		SHEET 4 OF 6	

- b) Minimum coverage : 90%
- c) Breaking load of joints : 95% of normal armour
- d) Method of jointing : Welding

16.0 OUTER SHEATH

- a) Material : Extruded HR PVC Type ST2 as per IS-5831 & IS-1554 Part-I
- b) Thickness : As per IS-1554 Part-1
- c) Application : Extruded
- d) Colour : Black.
- e) Whether FRLS : YES

17.0 FRLS/ FLAMMABILITY TESTS

- a) Oxygen Index : 29% Minimum as per ASTM D 2863
- b) Temperature Index : 250 °C Minimum as per ASTM D 2863
- c) Acid gas generation : less than 20% by weight (As per IEC-754-1)
- d) Average area under curve (Smoke density rating) : Not more than 60% (As per ASTM D 2843)
- e) Water immersion Test: As per VDE 0815
- f) Flammability Test : As per IEC-60332-1, IEEE-383 & Swedish Chimney SS-424-1475, class F3

- 18.0 Rodent & Termite Test : Few chippings of PVC compound are slowly ignited in a porcelain dish in a muffle furnace at about 600 deg. C. The resulting ignited ash is boiled with a little ammonium acetate solution (10%). A drop of aqueous sodium sulphide solution is placed on a thick filter paper and it is allowed to soak. The spot is touched with a drop of above extract. A black spot

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLES	SPECIFICATION NO. PE-TS-423-507-E004	
		VOLUME II-B	
		SECTION - Data sheet- A	
		REVISION 0	DATE: 06.11.2017
		SHEET 5 OF 6	

indicates the presence of anti-termite & rodent compound (lead).

19.0 TOLERANCE ON OVERALL DIAMETER : $\pm 2\text{mm}$ max. over the declared value in Technical Data Sheet

20.0 VARIATION IN DIA & OVALITY AT ANY CROSS-SECTION : Not more than 1 mm.

21.0 (i) DRUM MATERIAL : Non-returnable wooden drums

(ii) DRUM LENGTH

a) Standard drum length : 1000 metres upto & including 12 Pairs;
500 metres above 12 Pairs

b) Tolerance on drum length : + 5%

22.0 MARKING

a) Progressive sequential Length marking to be provided on outer sheath : Yes @ 1 m by printing/ embossing

b) Progressive marking @ 1 m : Manufacturer's name or trade mark, Type of cable, voltage grade, Year of manufacture, Type of insulation, Type of outer sheath e.g. "FRLS" etc., Nominal cross sectional area of conductor and number of pairs @ 1 metre by printing/ embossing.

	DOCUMENT TITLE TECHNICAL SPECIFICATION FOR SCREENED CONTROL CABLES	SPECIFICATION NO. PE-TS-423-507-E004	
		VOLUME II-B	
		SECTION - Data sheet- A	
		REVISION 0	DATE: 06.11.2017
		SHEET 6 OF 6	

23.0 TECHNICAL PARAMETERS (C & I) As per Table below

STANDARD CABLE PARAMETERS FOR INSTRUMENTATION CABLE

Parameter	0.5 mm ² (IS & OS) type-F	0.5 mm ² (OS) type-G
Mutual Capacitance (max.) at 0.8 kHz, nF/Km	120	100
Conductor Loop Resistance (max.), Ohm/Km	78.4	78.4
Insulation Resistance (min), M Ohm/ Km	100	100
Cross Talk attenuation (min) at 0.8kHz, dB/Km	60	60
Characteristic impedance (max.) at 1 kHz	320	340
Attenuation (max.) at 0.8 KHz, db/100m	0.11	0.11
Attenuation (max.) at 10 KHz, db/100m	0.29	0.29
Coupling capacitance (min) at 0.8kHz, pF/m	200	200

Note:

1. Cable parameters indicated above are at 20 degC (+/- 3 degC)

24.0 Test voltage & duration

(a) High Voltage Tests

- | | | |
|---------------------|---|------------------|
| (i) Core to core | : | 2KV for 1 minute |
| (ii) Core to shield | : | 2KV for 1 minute |

- 25.0 All cables shall be provided with anti termite, anti Rodent, anti-fungal & moisture resistant properties.



TITLE : 1X800MW COAL BASED SUPERCRITICAL
NORTH CHENNAI TPS, STAGE III

TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES

SPECIFICATION NO.
PE-TS-423-507-E004

VOLUME NO. II

SECTION: I

REV NO. : 0 DATE 06.11.2017

SHEET: 1 OF 2

ANNEXURE: B-I

CORE IDENTIFICATION / PAIR IDENTIFICATION



TITLE : 1X800MW COAL BASED SUPERCRITICAL
NORTH CHENNAI TPS, STAGE III

TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES

SPECIFICATION NO.
PE-TS-423-507-E004

VOLUME NO. II

SECTION: I

REV NO. : 0 DATE 06.11.2017

SHEET: 2 OF 2

ANNEXURE: B-I

The wires of pairs shall be coded by base colours on insulation which are repeated in every unit. Base colours of the pairs in a unit shall be as follows:

PAIR	CORE	COLOUR
1 st	1 st	Blue
1 st	2 nd	Red
2 nd	1 st	Grey
2 nd	2 nd	Yellow
3 rd	1 st	Green
3 rd	2 nd	Brown
4 th	1 st	White
4 th	2 nd	Black

Each four pair is laid to form one unit and wound with Mylar tape. The cores of each unit shall then be identified by colour bands for cables of more than 4-pair. e.g. All eight cores of the first unit shall have a single band of pink colour.

Unit	Ring Colour	Ring Group
1	PINK	I
2	PINK	II
3	PINK	III
4	PINK	IIII
5	ORANGE	IIIII
6	ORANGE	IIIIII
7	ORANGE	IIIIIII
8	ORANGE	IIIIIIII

The vertical lines under column (Ring Group) in the above table indicate number of rings at intervals of approx. 60 mm length of the wires of the units. For cables above 4 pair, each 4 pair units shall be open helically lapped with numbered binder taped for the purpose of binding & unit identification.



**1X800MW COAL BASED
SUPERCRITICAL NORTH CHENNAI
TPS, STAGE III
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES**

SPECIFICATION NO. PE-TS-423-507-E004

VOLUME II

SECTION - I

REVISION 0

DATE: 06.11.2017

Page 1

DATA SHEET-C

S.No.	Particulars	Unit	Description
1	Manufacturer's name	-	
2	Reference design standards	-	
3	Conductor size	sq. mm	
4	Rated Voltage	V	
5	Number of pairs	No.	
6	Cable suitable for both earthed & unearthed system	-	
7	Conductor		
	a) Material	-	
	b) Reference Standard	-	
	c) Grade	-	
	d) No. of strands	No.	
	e) Diameter of strands (nom.)	mm	
	f) Approx. dia of conductor	mm	
	g) Cross Section area	sq. mm	
8	Insulation		
	a) Reference Standard	-	
	b) Material composition	-	
	c) Application	-	
	d) Minimum thickness	mm	
	e) Nom.Thickness	mm	
	f) Max. thickness	mm	
	g) Minimum volume resistivity as per IS 5831	Ohm cm	
	h) Dielectric constant	-	
	i) Maximum conductor temperature withstand capacity	°C	
	j) Core diameter including insulation	mm	
9	Core laying		
	a) Whether cores/pairs are twisted.	-	
	b) Minimum no. of twists per meter.		
	c) Maximum lay of twist	mm	
10	d) Identification of cores/pairs	-	
	Individual Shield		



**1X800MW COAL BASED
SUPERCRITICAL NORTH CHENNAI
TPS, STAGE III
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES**

SPECIFICATION NO. PE-TS-423-507-E004

VOLUME II

SECTION - I

REVISION 0

DATE: 06.11.2017

Page 2

	a) Material	-	
	b) Thickness of tape	micron	
	c) Coverage/ Overlap	%	
	d) Noise interference better than	dB	
11	Drain wire for individual shield		
	a) Reference standard	-	
	b) Size (No. of strands x dia. of each strand)	sq. mm (no. x mm)	
	c) Material	-	
	d) Resistance of drain wire per km at 20 deg.C	ohm	
12	Overall shield		
	a) Material	-	
	b) Thickness of tape	mm	
	c) Coverage/Overlap	%	
	d) Noise interference better than	dB	
13	Drain wire for overall shield		
	a) Reference standard	-	
	b) Size (No. of strands x dia. of each strand)	sq. mm (no. x mm)	
	c) Material	-	
	d) Resistance per Km (with shield) at 20°C	Ohm/ km	
14	a) Fillers: Material (if applicable)		
	b) Bedding Material		
15	Inner sheath		
	a) Material, type and standard	-	
	b) Whether FRLS	-	
	c) Colour	-	
	d) Method of application	-	
	e) Thickness (min)	mm	
16	Armour		
	a) Material,	-	
	b) Formed wire / round wire		
	c) Minimum Coverage	%	
	d) Method of jointing	-	
	e) Breaking load of joint	-	
	f) Size (approx.) of strip	mm	
	g) Dia of armour	mm	
	h) No. of wires/ strip.	No.	
17	Outer sheath		
	a) Reference standard	-	
	b) Material	-	
	c) Minimum thickness of sheath	mm	



**1X800MW COAL BASED
SUPERCRITICAL NORTH CHENNAI
TPS, STAGE III
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES**

SPECIFICATION NO. PE-TS-423-507-E004

VOLUME II

SECTION - I

REVISION 0

DATE: 06.11.2017

Page 3

	d) Calculated dia under outersheath	mm	
	e) Oxygen index (as per ASTM D 2863)	-	
	f) Temperature index (in deg. C as per ASTM D 2863)	deg. C	
	g) Maximum acid gas generation as per IEC754-1	%	
	h) Maximum smoke density rating as per ASTM D 2843	%	
	i) Colour of outer sheath	-	
18	Dia over laid-up core	mm	
19	Dia under armour	mm	
20	Dia above armour	mm	
21	Overall diameter of cable	mm	
22	Tolerance on overall diameter	mm	
23	Weight of		
	Copper (conductor & drain wire)	Kg/ km	
	PVC (insulation, sheath & fillers)	Kg/ km	
	Armour	Kg/ km	
	Cable (approx.)	Kg/ km	
24	Cable parameters at 20°C(+/-3 deg. C)		
	a) Conductor resistance (max)	Ohm/ km	
	b) Insulation resistance (min)	M-Ohm/ km	
	c) Mutual capacitance at 0.8KHz (max)	nF/ km	
	d) Cross talk at 0.8KHz (min)	dB	
	e) Attenuation at 1 KHz (max)	dB/ km	
	f) Characteristic impedance at 1 KHz (max)	Ohm	
25	Continuous operating temp. (deg.C)	deg. C	
26	(a) Relevant IS standard including Part & category for Flame retardance of complete cable	-	
	(b) Relevant IEC standard including Part & category for Flammability of complete cable		
27	Whether complete cable passes Swedish Chimney test as per SEN 4241475 (F3)	-	
28	Identification		
	a) Length of cable marked at every mtr.	-	
	b) FRLS marked at every 5 mtrs	-	
	c) Each core of the pair numbered	-	
	d) Conductor identification details for pairs	-	
	e) Details of cable markings	-	
29	Test voltage		
	a) High voltage test/ Dielectric Strength		
	i) Voltage (KV), Core - Core	kV	
	ii) Duration	min	
	b) High Voltage test		



**1X800MW COAL BASED
SUPERCRITICAL NORTH CHENNAI
TPS, STAGE III
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES**

SPECIFICATION NO. PE-TS-423-507-E004

VOLUME II

SECTION - I

REVISION 0

DATE: 06.11.2017

Page 4

	i) Voltage (KV), Core - Screen	V	
	ii) Duration	min	
	c) Resistance to direct current test (applicable for 225 V cable as per VDE)	-	
	Voltage	V	
	Duration	hrs/days	
30	Min bending radius	No. x OD	
31	Ovality at any cross section	mm	
32	Variation of dia through out cable length	mm	
33	Cable cross-sectional drawings for each type of cable furnished		
34	i) Length of single coil in a drum	M	
	ii) Marking on drum	-	
	iii) Seasoned wood drum provided	-	
	iv) Both ends of cable to be sealed with PVC/ Rubber caps to prevent water/ moisture ingress	-	
	v) Gross weight (approx.)	kg.	
	vi) Net weight (approx.)	kg	
35	Type test procedures as per BHEL Technical Spec. and other relevant standards enclosed.	-	
36	Anti termite & rodent test	-	



1X800MW COAL BASED
SUPERCRITICAL NORTH CHENNAI TPS,
STAGE III
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES

SPECIFICATION NO. PE-TS-423-507-E004

VOLUME II

SECTION II

REVISION 0

DATE: 06.11.2017

SECTION-II

STANDARD TECHNICAL REQUIREMENTS



1X800MW COAL BASED
SUPERCRITICAL NORTH CHENNAI TPS,
STAGE III
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES

SPECIFICATION NO. PE-TS-423-507-E004

VOLUME II

SECTION II

REVISION 0

DATE: 06.11.2017

Sheet 1 of 2

1.0 CODES AND STANDARDS

- 1.1 The material shall comply with all currently applicable safety codes and statutory regulations of India as well as of the locality where the material is to be installed.
- 1.2 The design, material, construction, manufacture, inspection and testing of Screened Control Cable shall conform to the latest revision of relevant standards as per Data Sheet-A.
- 1.3 In case of conflict between the applicable reference standard and this specification, this specification shall govern.

2.0 TECHNICAL REQUIREMENTS

- 2.1 Screened Control Cable shall be supplied as per technical particulars specified in Data Sheet – A.

3.0 QUALITY ASSURANCE, TESTING & INSPECTION

- 3.1 Bidder shall confirm compliance with the BHEL Standard Quality Plan (PE-QP-999-507-E004, Rev-1) as attached with the specification without any deviations. At contract stage, the successful bidder shall submit the same QP for BHEL/ ultimate customer's approval. In case bidder has reference QP agreed with ultimate customer, same can be submitted for specific project after award of contract for BHEL/ultimate customer's approval. There shall be no commercial implication to BHEL on account of minor changes in QP during contract stage.
- 3.2 All materials shall be procured, manufactured, inspected and tested by vendor/ sub-vendor as per approved Quality Plan.
- 3.3 Type testing, routine / acceptance testing and special testing requirements shall be as per Annexure to QP. Charges for all these tests for all the equipment & components shall be deemed to be included in the bid price (except UV Radiation & Hydraulic Stability test).
- 3.4 The charges of UV Radiation test & Hydrolytic Stability test (if applicable) shall be reimbursed extra at actual against original money receipt of Govt. Lab. (CPRI/ ERDA etc).
- 3.5 Cost of cables consumed for testing shall be to bidder's account.

4.0 PACKING

- 4.1 Cables shall be supplied in non-returnable drums. Material of cable drums shall be wooden.
- 4.2 For wooden drums, all wooden parts shall be manufactured from seasoned wood treated with copper naphthenates / zinc naphthenates (refer IS: 401) and anti-termite. The surface of the drum and the outer most cable layer shall be covered with water proof cover. Both the ends of the cables shall be properly sealed with heat shrinkable PVC/ rubber caps secured by 'U' nails so as to eliminate ingress of water during transportation, storage and erection. Dimensions of wooden drums shall be as per IS 10418. All ferrous parts shall be treated with suitable rust protective



1X800MW COAL BASED
SUPERCRITICAL NORTH CHENNAI TPS,
STAGE III
TECHNICAL SPECIFICATION FOR
SCREENED CONTROL CABLES

SPECIFICATION NO. PE-TS-423-507-E004

VOLUME II

SECTION II

REVISION 0

DATE: 06.11.2017

Sheet 2 of 2

finish or coating to avoid rusting during transit and storage. BIS certification mark shall be stamped on each cable drum.

- 4.3 Each drum shall carry manufacturer's name or trade make, purchaser's name, address and contract no., Type of cable & voltage grade, Year of manufacture, Type of insulation e.g. HRPVC item no., No. of pairs and size of cables & Type, Cable code e.g. FRLS, No. of length on drum, if more than one, length of cable and net gross weight stencilled on both sides of drum. A tag containing same information shall be attached to the leading end of the cable. An arrow & suitable accompanying wording shall be marked on one end of the reel indicating the direction in which it should be rolled.

		QUALITY PLAN		CUSTOMER : TANGEDCO		PROJECT : 1X800MW NORTH CHENNAI TPS		SPECIFICATION : PE-TS-423-507-E004			
				BIDDER/ : VENDOR		QUALITY PLAN NUMBER: PE-QP-999-507-E004, REV 01.		SPECIFICATION TITLE			
		SHEET 1 OF 5		SYSTEM		ITEM :INSTRUMENTATION CABLES		SECTION		VOLUME II	
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY		REMARKS
									P	W	V
1	2	3	4	5	6	7	8	9	10		11
Instructions: 1. Cable manufacturer to maintain records to show co-relation of raw materials to finished cables i.e. raw material batch/ lot no. should be traceable to the final cable drum number or batch no. 2. Cable manufacturer to maintain all quality records identified as per all QP stages enumerated below whether it is identified for BHEL verification or witness or not.											
1.0	RAW MATERIAL										
1.1	Copper Rods/ Wires (For Conductor & drain wire)	GENERAL : 1. Physical properties 2. Elec.Properties SPECIFIC CHECKS : a) Make b) Grade c) Resistivity	MA	Physical Tests	Sample	Relevant Standard/ Approved datasheet	Relevant Standard/ Approved datasheet	Inspection Report/ Test Cert.	2/3	-	1/2
			MA	Electrical Tests	Sample	-do-	-do-	-do-	2/3	-	1/2
			MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	Log book/ Test Cert.	3/2	-	1
			MA	-do-	-do-	IS 613/ Approved datasheet	IS 613/ Approved datasheet	-do-	3/2	-	1
			MA	Electrical Tests	Manufacturer	IS 613	IS 613	-do-	3/2	-	1
1.2	PVC Compound (for insulation)	GENERAL : 1. Physical properties 2. Elec.Properties SPECIFIC CHECKS : a) Make b) Type/ Grade c) Shelf life/ Storage condition	MA	Physical Tests	Sample	Relevant Standard/ Approved datasheet	Relevant Standard/ Approved datasheet	Inspection Report/ Test Cert.	2/3	-	1/2
			MA	Electrical Tests	Sample	-do-	-do-	-do-	2/3	-	1/2
			MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	COC/ Test Cert.	3/2	-	1
			MA	-do-	-do-	Approved datasheet	Approved datasheet	-do-	3/2	-	1
			MA	-do-	-do-	Compound Manufacturer std.	Compound Manufacturer std.	-do-	3/2	-	1
1.3	Screen / Tapes/ Binders	1. Make 2. Dimension 3. T.S. & Elongation 4. Chem. & Phys. Properties	MA	Verify	100%	Manufacturer approved source	Manufacturer approved source	TC & IR	3/2	-	1/2
			MA	Measurement	Manufacturer std.	Manufacturer datasheet/ Approved datasheet	Manufacturer datasheet/ Approved datasheet	TC & IR	3/2	-	1/2
			MA	Physical Tests	-do-	Manufacturer datasheet	Manufacturer datasheet	-do-	3/2		1/2
			MA	Chemical & Physical Tests	-do-	Manufacturer std.	Manufacturer std.	-do-	3/2		1/2
BHEL			PARTICULARS		BIDDER/VENDOR						
			NAME								
			SIGNATURE								
			DATE				BIDDER'S/VENDORS COMPANY SEAL				

		QUALITY PLAN		CUSTOMER : TANGEDCO		PROJECT : 1X800MW NORTH CHENNAI TPS			SPECIFICATION : PE-TS-423-507-E004				
				BIDDER/ : VENDOR		TITLE QUALITY PLAN NUMBER: PE-QP-999-507-E004. REV 01.			NUMBER : SPECIFICATION TITLE				
SHEET 2 OF 5		SYSTEM		ITEM :INSTRUMENTATION CABLES			SECTION			VOLUME III			
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	11	12	13	
1.4	Fillers (as applicable)	1. Type 2. Flame retardant & moisture resistant (as applicable)	MA CR	Verify Chemical/ Environ.	-do- -do-	Approved datasheet -do-	Approved datasheet -do-	-do- -do-	3/2 3/2	- -	1 2	* Sample from each size/ Batch/Lot.	
1.5	Galvanised steel wire/strip for Armour (if applicable)	GENERAL : 1. Make 2. Dimension 3. Phy.and Elec. Properties 3.Galvanization Quality	MA MA MA MA	Verify Measurement Physical & Electrical Tests Galv.Tests	Manufacturer std. -do- Sample* -do-	Manufacturer approved source -do- Relevant Standard/ Appd. Data Sheet/ -do-	Manufacturer approved source -do- Relevant Standard/ Appd. Data Sheet/ -do-	Inpection Report/ Test Cert. -do- -do- -do-	2/3 2/3 2/3 2/3	- - - -	1 2 2 2		
1.6	PVC compound for Sheath	GENERAL : 1. Physical properties 2. Elec.Properties 3. FRLS Properties (as applicable) SPECIFIC CHECKS : a) Make b) Type/ Grade c) Shelf life/ Storage condition	MA MA CR MA MA MA	Physical Tests Electrical Tests Chemical/ Environ. Verify -do- -do-	Sample Sample Sample 100% -do- -do-	Relevant Standard/ Approved datasheet -do- -do- Manufacturer approved source Approved datasheet Compound Manufacturer std.	Relevant Standard/ Approved datasheet -do- -do- Manufacturer approved source Approved datasheet Compound Manufacturer std.	Log book/ Test Cert. -do- -do- Log book/ Test Cert. -do- -do- -do-	3/2 3/2 3/2 3/2 3/2 3/2	- - - - - -	1/2 1/2 1/2 1 1 1		
1.7	Wooden drums	1. Phy. & Constructional checks 2. Anti termite treatment	MA MA	Visual Chem.	Mfr's Plant Std. -do-	IS 10418 Mfr's Plant Std.	IS 10418 Mfr's Plant Std.	Log book/ Test Cert. COC	3/2 3/2	- -	1 1		
1.8	Steel drums	1. Dimension 2. Surface finish	MA MA	Meas. Meas.	Mfr's Plant Std. -do-	Mfr's Plant Std. -do-	Mfr's Plant Std. -do-	Log book/ Test Cert. -do-	3/2 3/2	- -	1 1		
2.0 IN PROCESS													
2.1	Wire Drawing & Annealing.	1. Size 2. Surface finish 3. % of Elongation	MA MA MA	Dimensional Visual Mechanical	Mfr's Plant Std. -do- -do-	Approved datasheet Surface shall be smooth IS 8130	Approved datasheet Surface shall be smooth IS 8130	Inpection Report	2	-	1		(Applicable only for tin-coated copper conductor and drain wire)
2.2	Tinning (Conductor or drain wire)	1. Size 2. % of Elongation	MA MA	Dimensional Mechanical	Plant Mfg. Std. -do-	Approved datasheet IS 8130	Approved datasheet IS 8130	Log Book	2	-	1		
2.3	Stranding of wires	1. No. of wires	MA	Counting	Mfr's Plant Std.	IS 8130/ Appd. Data Sheet	IS 8130/ Appd. Data Sheet	-do-	2	-	-		
			PARTICULARS		BIDDER/VENDOR								
			NAME										
			SIGNATURE										
			DATE					BIDDER'S/VENDORS COMPANY SEAL					

	QUALITY PLAN SHEET 3 OF 5			CUSTOMER : TANGEDCO			PROJECT : 1X800MW NORTH CHENNAI TPS			SPECIFICATION : PE-TS-423-507-E004				
				BIDDER/ : VENDOR			TITLE			NUMBER :				
				SYSTEM			QUALITY PLAN NUMBER: PE-QP-999-507-E004, REV 01.			SPECIFICATION TITLE				
				ITEM :INSTRUMENTATION CABLES			SECTION			VOLUME III				
SL. NO.	COMPONENT/OPERATION			CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
											P	W	V	
1	2			3	4	5	6	7	8	9	10			11
2.4	Core Insulation (No repair permitted)			2. Resistance	CR	Electrical	-do-	-do-	-do-	-do-	2	-	-	# To be checked at starting & finish end of Extruded Length
				3. Sequence, lay length & Direction	MA	Visual, Meas	Sample	BHEL'S/ Vendor's Spec./ Approved datasheet	BHEL'S/ Vendor's Spec./ Approved datasheet	-do-	2	-	-	
				4. Surface Finish	MA	Visual	Sample	-do-	-do-	-do-	2	-	-	
				5.Dimension	MA	Measurement	Sample	Appd. Data Sheet	Appd. Data Sheet	-do-	2	-	-	
				1. Surface finish	MA	Visual	100%	-	Free from bulging burnt particles lumps, cuts & Scratches.	Inpection Report	2	-	-	
				2 Insulation thickness (Min./ Max.)	CR	Measurement	Sample	Appd.data sheet/ Relevant Std.	Appd.data sheet/ Relevant Std.	-do-	2	-	-	
				3. Concentricity #	CR	Measurement	Sample	Mfr's Std./Appd. data sheet	Mfr's Std./Appd. data sheet	Inpection Report	2	-	-	
				4 Dia over insulation	MA	Measurement	Sample	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	-do-	2	-	-	
				5. Core identification	MA	Visual	100%	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	-do-	2	-	-	
				6. TS & % Elongation	MA	Mechanical	100%	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	-do-	2	-	-	
2.5	Core pairing, screening (provision of drain wire & laying)			1. Pair identification	MA	Visual	100%	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	Log Book	2	-	-	
				2.Wire size & tape size	MA	Measurement	100%	-do-	-do-	-do-	2	-	-	
				3.Test for capacitance	CR	Elect. Test	100%	-do-	-do-	-do-	2	-	-	
				4. Sequence of lay and lay length	MA	Visual meas	Sample	Appd. Data Sheet & MFRs. Std.	Appd. Data Sheet & MFRs. Std.	-do-	2	-	-	
				5. Screen overlap & coverage	MA	Measurement	Sample	-do-	-do-	-do-	2	-	-	
				6. Dia over laid up core	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
				7. Continuity of drain & drain wire with Screen	MA	Elect. Test	100%	<-----No Discontinuity ----->		-do-	2	-	-	
					PARTICULARS			BIDDER/VENDOR						
BHEL					NAME									
					SIGNATURE									
					DATE						BIDDER'S/VENDORS COMPANY SEAL			

	QUALITY PLAN		CUSTOMER : TANGEDCO			PROJECT : 1X800MW NORTH CHENNAI TPS			SPECIFICATION : PE-TS-423-507-E004			
			BIDDER/ : VENDOR			TITLE QUALITY PLAN NUMBER: PE-QP-999-507-E004, REV 01.			NUMBER : SPECIFICATION TITLE			
	SHEET 4 OF 5			SYSTEM			ITEM :INSTRUMENTATION CABLES			SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS
1	2	3	4	5	6	7	8	9	10	11	12	
2.6	Inner Sheath Extrusion (if applicable)	1. Surface finish	MA	Visual	100%	--	Free from bulging, burnt particles,lumps cuts & scratches.	-do-	2	-	-	
		2. Sheath thickness	MA	Measurement	Sample			-do-	2	-	-	
		3.Dia over inner sheath	MA	Measurement	Sample	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	-do-	2	-	-	
		4. Colour	MA	Visual	100%	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	-do-	2	-	-	
2.7	Armouring (If Applicable)	1. No.of wires/Strips	MA	Counting	At the start of the process	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	-do-	2	-	-	
		2. Size of wire/ Strip	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
		3. Lay Direction	MA	Visual	-do-	-do-	-do-	-do-	2	-	-	
		4. Lay Length	MA	Visual, Meas.	At the start of the process	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	Log Book	2	-	-	
		5. Coverage	MA	Measurement	-do-	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	-do-	2	-	-	
		6. Dia over armouring	MA	Measurement	-do-	-do-	-do-	-do-	2	-	-	
2.8	Outer Sheath Extrusion	1. Surface Finish	MA	Visual	100%	-	Free from Bulging Burnt particles, lumps, cuts & scratches	Log Book	2	-	-	
		2.Sheath thickness	MA	Measurement	Sample	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	Log Book	2	-	-	
		3. Dia over outer sheath	MA	Measurement	Sample	-do-	-do-	-do-	2	-	-	
BHEL			PARTICULARS			BIDDER/VENDOR						
			NAME									
			SIGNATURE									
			DATE						BIDDER'S/VENDORS COMPANY SEAL			

		QUALITY PLAN		CUSTOMER : TANGEDCO			PROJECT : 1X800MW NORTH CHENNAI TPS			SPECIFICATION : PE-TS-423-507-E004			
				BIDDER/ : VENDOR			TITLE QUALITY PLAN NUMBER: PE-QP-999-507-E004, REV 01.			NUMBER : SPECIFICATION TITLE			
		SHEET 5 OF 5			SYSTEM			ITEM :INSTRUMENTATION CABLES			SECTION VOLUME III		
SL. NO.	COMPONENT/OPERATION	CHARACTERISTICS CHECK	CAT.	TYPE/ METHOD OF CHECK	EXTENT OF CHECK	REFERENCE DOCUMENT	ACCEPTANCE NORM	FORMAT OF RECORD	AGENCY			REMARKS	
1	2	3	4	5	6	7	8	9	10	P	W	V	11
3.0	Final Inspection	4. Marking/ Colour/ Embossing	MA	Visual	100%	Appd. Data Sheet	Appd. Data Sheet	Test Report	2	-	-	-	Sequential marking shall be done by printing
		5. TS & % Elongation	MA	Mechanical	100%	Relevant Standard/ Appd. Data Sheet	Relevant Standard/ Appd. Data Sheet	-do-	2	-	-	-	
		1. Finish & Length	MA	Visual	(See remark)	Relevant Standard/ Appd. Data Sheet	Free from Bulging Burnt particles, lumps, cuts & scratches	Inpection Report	2	1	-	-	One drum in a Lot
		2. Dimensions	MA	Measurement	Sample Lengths	Appd. Data sheet	Appd. Data sheet	Inpection Report	2	1	-	-	
		3. Armouring - Coverage No.of Wires/Strips	MA	Visual & Meas.	Sample	-do-	-do-	-do-	2	1	-	-	
		4. Marking/Colour/ pair identification	MA	Visual	-do-	-do-	-do-	-do-	2	1	-	-	
		5. Test for screening	CR	Elect. Test	-do-	-do-	-do-	-do-	2	1	-	-	
		6. Acceptance Tests	CR	Phy & Elect. Tests	sample	-do-	-do-	-do-	2	1	-	-	
7. Type & FRLS Tests	CR	Measurement	Sample	Appd. Data sheet	Appd. Data sheet	-do-	2	1	-	-	Refer Annexure to QP for sampling plan.		
NOTES:- (A) JOINTS IN WIRE SHALL BE AS PERMITTED BY REL STD / BHEL SPECIFICATION. VENDOR TO CERTIFY THE SAME. (B) NO REPAIR OF CORE INSULATION PERMITTED (C) CABLE ENDS SHALL BE SEALED AS PER REL. STD./ BHEL SPECIFICATION (D) RECORD OF RAW MATERIAL, PROCESS & ALL STAGES SHALL BE CERTIFIED BY VENDORS QC. AND ARE LIABLE TO AUDIT CHECK BY PURCHASER. (E) FILLERS/DUMMY CORES ETC. SHALL BE AS PER BHEL SPECIFICATION (F) WHEREVER EXTENT OF CHECK FOR STAGE IS MENTIONED AS SAMPLES AND NOT DEFINED IN QP, THE SAME SHALL BE AS PER VENDORS SAMPLING PLAN AGREED BY PURCHASER. (G) VENDOR SHALL FURNISH COMPLIANCE CERTIFICATE TO THE INSPECTION AGENCY CONFIRMING THE PACKING AS PER REL. STD./ BHEL SPECIFICATION. (H) FOR LIST OF TYPE TESTS, ROUTINE TESTS & ACCEPTANCE TESTS; REFER ANNEXURE TO QAP. LEGEND : P : PERFORMER W: WITNESSER V: VERIFIER 1- BHEL/CUSTOMER 2-VENDOR 3 SUB VENDOR CHP: CUSTOMER HOLD POINT TC : Test Certificates, Spec. : Specification Mfg. : Manufacturer.													
			PARTICULARS		BIDDER/VENDOR								
BHEL			NAME										
			SIGNATURE										
			DATE										
BIDDER'S/VENDORS COMPANY SEAL													

	ANNEXURE TO QP	CUSTOMER: TANGEDCO	PROJECT TITLE: 1X800MW COAL BASED SUPERCRITICAL NORTH CHENNAI TPS	SPECIFICATION NUMBER: PE-TS-423-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0	SPECIFICATION TITLE:
	SHEET	SYSTEM	ITEM: SCREENED CONTROL CABLES (AS PER IS)	DOC. NO.

I. Type Test:

The type tests shall be carried out on one drum out of every 10 drums or less for each size of cable in each lot, in presence of Owner's representative as per applicable standards in Govt. approved Laboratory if adequate testing facility is not available at works of the supplier.

Sr. No.	Name of Test	Governing standard	Special requirements as per owner's specification.
For Conductor			
1	Annealing test (for copper)	IS : 8130/84	As per IS: 8130/84
2	Conductor resistance test & Diameter test	IS : 10810	As per approved G.T.P.
3	Per sulphate test (for tinned copper wire)	IS : 8130/84	As per IS: 8130/84
For Armour Wire/ Strip			
4	Test for measurement of dimensions	IS : 3975	As per approved G.T.P.
5	Tensile test and elongation at break of armouring material.	IS : 3975	As per IS:3975 & IS: 1554 (I)
6	Torsion test on galvanised steel round wire for armouring	IS : 3975	As per IS:3975 & IS: 1554 (I)
7	Test for measurement of DC resistance & resistivity of armour	As per IS:3975 & IS: 1554 (I)	As per IS:3975 & IS: 1554 (I)
8	Uniformity of zinc coating on steel armour	IS : 3975	As per IS:3975 & IS: 1554 (I)
9	Mass of zinc coating on steel armour	IS : 3975	As per IS:3975 & IS: 1554 (I)
10	Adhesion test on galvanised steel round/ formed wire	IS : 3975	As per IS:3975 & IS: 1554 (I)
11	Wrapping test	IS : 3975	As per IS:3975 & IS: 1554 (I)
For PVC Insulation & Sheath			
12	Test for measurement of thickness of insulation & sheath & other dimensions.	IS : 1554 (I)	As per approved G.T.P.
13	Measurement of volume resistivity of HRPVC insulation	IS : 5831-1984	i. 3.5×10^{14} Ohm-cm at 27°C / room temp. (Min). ii. 3.5×10^{11} Ohm-cm at 85°C (Min.)
14	Tensile strength and elongation test for insulation & sheath.	IS:5831/1984	As per IS:5831/84
15	Ageing test for insulation & sheath. Loss of mass test for PVC insulation & sheath.	IS:5831/1984	As per IS:5831/84
16	Shrinkage test for PVC insulation & sheath.	IS:5831/1984	As per IS:5831/84
17	Hot deformation test for PVC insulation & sheath	IS:5831/1984	As per IS:5831/84
18	Cold bend test for PVC insulation.	IS:5831/1984	As per IS:5831/84
19	Cold impact test for PVC sheath.	IS:5831/1984	As per IS:5831/84

	ANNEXURE TO QP	CUSTOMER: TANGEDCO	PROJECT TITLE: 1X800MW COAL BASED SUPERCRITICAL NORTH CHENNAI TPS	SPECIFICATION NUMBER: PE-TS-423-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0	SPECIFICATION TITLE:
	SHEET	SYSTEM	ITEM: SCREENED CONTROL CABLES (AS PER IS)	DOC. NO.

20	Heat shock test for PVC insulation & sheath.	IS:5831/IEC-502	IS:5831/IEC-502
21	Thermal stability test for PVC insulation and sheath.	IS:5831/ IEC-60811 _405	IS:5831/ IEC-60811 _405
22	Test for bleeding and blooming of pigments for PVC insulation and sheath.	IS:5831/1984	As per IS:5831/84
23	Colour fastness to water.	IS:5831/1984	As per IS:5831/84
24	Colour fastness to day light.	IS:5831/1984 /equivalent international standard	As per IS:5831/84 /equivalent international standard
25	High voltage test (water immersion test)	IS:1554(I)	IS:1554(I)
26	Test for rodent & termite repulsion property of sheath.	-	Presence of lead shall be detected.
27	Oxygen index test on inner & outer sheath material.	ASTM:D-2863/77	Min.29
28	Temp. index test on inner & outer sheath material	ASTM:D-2863/77	Min. 250° C
29	Acid gas emission test on inner & outer sheath material.	IEC-754-1	Acid gas generation shall be less than 20% by weight.
30	Smoke Density test on inner & outer sheath material	ASTM-D-2843/77	Min. 40% light transmission during test.
31	Flammability test on finished cable samples as per following methods: i) Swedish chimney test ii) Vertical tray flame propagation test. iii) Single vertical cable fire resistance test.	i) SS-424-14-75 Cl. F-3 ii) IEEE-383 iii) IEC-332-1	i) SS-424-14-75 Cl. F-3 ii) IEEE-383 iii) IEC-332-1
32	Tests for all electrical properties at 20°C & maximum operating temp. as per GTP.	As per GTP	As per approved G.T.P.
33	Oxygen index test & Acid Gas generation test for Fillers	ASTMD – 2863, IEC 60754-1	As per approved GTP
34	Continuity test, Shield thickness, Overlap test of Al Mylar shield	As per GTP	As per approved GTP
35	Noise interference test, Cross talk test, Mutual capacitance, Drain wire continuity test.	IEEE Transaction, VDE 0472	As per approved GTP

	ANNEXURE TO QP	CUSTOMER: TANGEDCO	PROJECT TITLE: 1X800MW COAL BASED SUPERCRITICAL NORTH CHENNAI TPS	SPECIFICATION NUMBER: PE-TS-423-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0	SPECIFICATION TITLE:
	SHEET	SYSTEM	ITEM: SCREENED CONTROL CABLES (AS PER IS)	DOC. NO.

II Routine Test:

Routine test shall be carried in presence of owner's representative for all types of cables.

Sr. No.	Name of Test	Governing standard	Special requirements as per owner's specification.
1	High voltage test	IS:1554 (I)	2 KV (RMS) for one minute (as per GTP)
2	Conductor Resistance	IS:8130/84	As per GTP

III Acceptance Tests:

Following tests shall be carried out on 1 drum out of every 10 drums or less for each size of cables in each lot, in presence of owner's representative.

Sr. No.	Name of Test	Governing standard	Special requirements as per owner's specification.
1	High voltage test	IS:1554 (I)	2 KV (RMS) for one minute (as per GTP)
2	Conductor Resistance	IS:8130/84	As per GTP
3	Measurement of volume resistivity of HRPVC insulation	IS : 5831-1984	i. 3.5×10^{14} Ohm-cm at 27°C / room temp. (Min). ii. 3.5×10^{11} Ohm-cm at 85°C (Min.)
4	Measurement of Mutual capacitance at 0.8 KHZ	As per approved GTP	(i) 100 nF/Km (max) for G type. (ii) 120 nF/Km (max) for F type
5	Calculation & Verification of Characteristic impedance on the basis of value obtain for mutual capacitance at 0.8 KHZ with the help of following formula $Z = R/2fC$ where Z = characteristic impedance in ohm R = Loop resistance of cable per km in ohms at 20°C. f = Frequency of test in Hz (800) C c = mutual capacitance per km.	As per approved GTP	(i) 340 Ohms (max) for G type. (ii) 320 Ohms (max) for F type.
6	Measurement of thickness of insulation and sheath & other dimensions	IS:1554 (I)	As per approved GTP
7	Tensile test and elongation at break of insulation & sheath	IS:5831/1984	As per IS:5831/84

	ANNEXURE TO QP	CUSTOMER: TANGEDCO	PROJECT TITLE: 1X800MW COAL BASED SUPERCRITICAL NORTH CHENNAI TPS	SPECIFICATION NUMBER: PE-TS-423-507-E004
		BIDDER/VENDOR:	QUALITY PLAN NUMBER : PE-QP-999-507-E004, R0	SPECIFICATION TITLE:
	SHEET	SYSTEM	ITEM: SCREENED CONTROL CABLES (AS PER IS)	DOC. NO.

8	Oxygen index test on inner & outer sheath material.	ASTM:D-2863/77	Min.29
9*	Temp. index test on inner & outer sheath material	ASTM:D-2863/77	Min.250°C
10*	Acid gas emission test on inner & outer sheath material.	IEC-754-1	Acid gas generation shall be less than 20% by weight.
11	Smoke Density test on inner & outer sheath material	ASTM-D-2843/77	Not more than 60% area under coverage. (Min. 40% light transmission during test)
12	Flammability test on finished cable samples as per following methods: i) Swedish chimney test ii) Vertical tray flame propagation test. iii) Single vertical cable fire resistance test.	i) SS-424-14-75 Cl. F-3 ii) IEEE-383 iii) IEC-332-1	i) SS-424-14-75 Cl. F-3 ii) IEEE-383 iii) IEC-332-1

* (If no. of drums selected for acceptance test for a particular cable size are more than one, the tests marked with * i.e. Sr. no. 9 & 10 under acceptance tests shall be carried out on one drum only).