	PRE-QUALIFICATION CRITERIA (PQC)	
A	**General**	COMPLIED
	1. The bidder shall be an Original Equipment Manufacturer (OEM) or authorized by the OEM (to be supported with valid authorization from OEM for supplies to Indian region)	Yes / No
	2. The OEM shall be a fiber optic cable assembly manufacturer for industrial application.	Yes / No
	3. Offer shall be for new fiber optic cable assembly only and not for any used or refurbished material	Yes / No
	4. Vendors who are already developed and evaluated for regular supply of these **Fiber optic cable assembly 200/230µm ST-ST** to BHEL for usage in Traction IGBT power modules shall quote for the same item as per their approved part numbers.	Yes / No / NA
	5a. Vendors whose samples are under trial and pending approval from BHEL shall not be eligible for this tender.	Yes / No / NA
	5b. New vendor (with no prior supply history of this material to BHEL-EDN) shall not be eligible for this tender. They will be considered for development order as per the details below.	Yes / No / NA
B	**Criteria for placing Development Order on new Vendors** New vendors shall be considered for separate development orders for technical evaluation and subsequent field trials which is independent of this tender, provided the material is offered at a competitive price. They shall supply fiber optic cable assembly as per BHEL purchase specification PS4062348 rev 01.	Yes / No / NA

APPROVED BY: SUDHA IYENGAR		
PREPARED BY GIRISH T J	ISSUED BY SAE/406	DATE 16.03.2023

EDN BANGALORE	PURCHASE SPECIFICATION FOR FIBER OPTIC CABLE ASSEMBLY 200/230µm ST-ST	PS4062348 REV NO 01 PAGE 00 OF 07

SPECIFICATON FOR **FIBER OPTIC CABLE ASSEMBLY 200/230µm ST-ST**

REVISION HISTORY SHEET

Rev No	Date	Nature of Change	Reasons	Prepared By	Approved By
00	19.01.2023	FIRST ISSUE	--	Hari Kalluru	Girish T J
01	15.03.2023	Updation	Type test details added	Hari Kalluru	Girish T J

	Approved: T J Girish		
	Prepared: Hari Kalluru	Issued: SAE/406	Date: 19/01/2023

Brief description:

Fiber optic cable assembly to be prepared by using simplex multimode step index (200/230µm) fiber optic cable of required length terminated with ST connectors on both sides as per standard procedure required to be used in Traction applications.

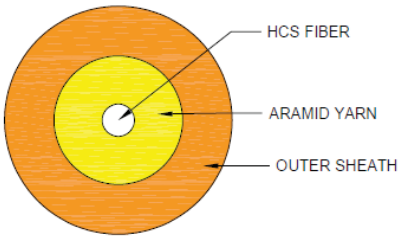
Scope of Supply:

Fiber Optic cable assembly of required length (as per table-1) having ST bayonet type connectors at both ends having protective cap meeting the technical specifications given in the document.

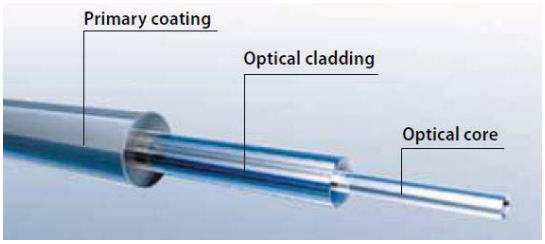
1. **Detailed specification:**

   A. **Fiber optic cable:** Simplex Multimode step index Glass fiber cable (200/230µm)
   Fiber cable with 200/230µm core/cladding, 500 µm buffer layer surrounded with aramid yarn, protected with a jacket material.

1. Diameter of the core glass	: 200 ±5 µm
2. Diameter of the cladding	: 230 µm (Nominal)
3. Coating diameter	: 500 µm (Nominal)
4. Cladding Eccentricity error	: < 5 µm
5. Bandwidth (λ = 850nm)	: >20 MHz / Km
6. Numerical aperture	: 0.37 (Nominal)
7. Fiber Temperature range	: -65^0C to $+125^0$C
8. Attenuation (λ = 850nm) at 20^0C	: ≤ 8 dB/km (typ.)
-40^0C to $+85^0$C	: ≤ 1db/50m
9. Material	: Hard Clad Silica
10. Strain relief	: Aramide yarn
11. Outer Jacket material	: PUR, flame retardant / LSFH / LSZH polymers
12. Cable diameter	: 2.6 mm +0.4 / -0.2 mm
13. Outer Jacket colour	: Orange
14. Min. Bending Radius	: 25mm



Fiber optic cable



HCS FIBER

B. Connectors:

1. Connectors	: ST connector with Bayonet fastener suitable for railway application
2. Insertion loss	: < 1.5 db/way (max) for 200/230um HCS fiber
3. Mechanical life	: > 500 mating cycles
4. Bayonet	: Metal (Brass nickel plated)
5. Ferrule	: Ceramic/Zirconia / Metal
6. Boot Colour	: Black

C. Service conditions:

1. Operating Temperature	: -40^0C to $+85^0$C
2. Humidity	: 100% during rainy season
3. Rain fall	: Very heavy in certain areas.
4. Atmosphere during hot weather	: Extremely dusty and desert terrain in certain areas.

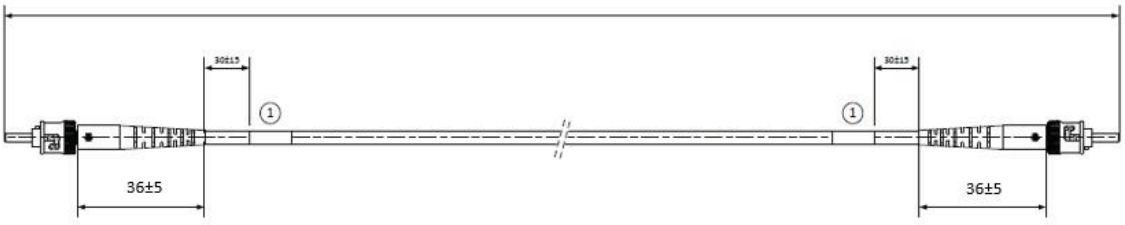
2. Standards for reference:

IEC 60794-1 Optical fiber cables - Generic specification - General
IEC 60794-2 Optical fiber cables - Indoor cables
IEC 60794-3 Optical fiber cables - Outdoor cables
IEC-60874-1 Fiber optic interconnecting devices and passive components
IEC 60793-2-30 Sectional specification for category A3 multimode fibres

Reference: CLW specification No. CLW/ES/3/0141

3. Cable assembly Dimensional details:

Length (L) +20 /-0 mm



Pos	Part Description
1	Marking label with make and part number details (one side / both sides)
2	Strain relief boot
3	Dust cap

Fig-1: Fiber optic cable with connectors

Item. No	Description	Length (L)
1	Fiber optic cable assembly 200µM ST-ST 210MM	210mm
2	Fiber optic cable assembly 200µM ST-ST 450MM	450mm
3	Fiber optic cable assembly 200µM ST-ST 540MM	540mm
4	Fiber optic cable assembly 200µM ST-ST 560MM	560mm
5	Fiber optic cable assembly 200µM ST-ST 700MM	700mm
6	Fiber optic cable assembly 200µM ST-ST 800MM	800mm

Table-1: Cable assembly length details

Marking on cable:

The following information shall be printed on cable

- Name of the Manufacturer/ Monogram / Identification number

4. Routine Tests:

- Cable assembly Attenuation: Insertion loss **≤ 1.5 dB** for cable assembly listed in Table-1 as per IEC 60874-1 (Insertion method).

5. Type Tests (During development):

Following type tests are to be conducted by the vendor for cable assembly of suitable length as per relevant IEC standard in the presence of BHEL representative / government approved labs / NABL accredited labs and test results shall be submitted to BHEL.

Visual inspection and cable attenuation test (Insertion loss ≤ 1.8 dB at 10m length) to be performed after each type test.

Details of the fiber, jacket material and connectors used in the assembly shall be indicated in the Type test report.

Note: Vendor is required to repeat type tests in case of any change in BOM of cable assembly (fiber, connectors, jacket material)

5.1 Vibration Test

5.2 Cyclic flexing test

5.3 Bending conduct

5.4 Crush Test

5.5 Long term stability test

5.6 Socket Impact test FST

5.7 Halogen content of combustion gases

5.8 Level of fumes and toxicity

5.9 Inflammability

5.10 Temperature Strain

5.11 Cable diameter

5.12 Rotation motion

5.13 Humidity

Type test procedure in brief given below, refer relevant standards for detailed procedure.

5.1 Vibration Test:
Test standard: IEC 60571 and IEC 88-2-8
Free oscillating Length2 50mm from connector with rear boot horizontally clamped.
Directions : 2
Frequency range : 1 to 100 Hz
Displacement : ≤ 15mm
Acceleration : ≤ 5 g(gravity)

5.2 Cyclic Flexing Test:
Test standard : IEC 60794-1-E8
Temperature : Room temperature
Flexing Speed : 30 flexing cycles per minute
Load : 10N clamped to the cable covering
Number of cycles : ≥10000
Bending radius : 25mm
Bending arm length : 150mm

5.3 Bending Conduct:
Test standard : IEC 60794-1-E6
Temperature : Room temperature
Flexing Speed : 10 flexing cycles per minute
Load resistance : 40N clamped to the cable covering
Number of cycles : ≥10000
Bending radius : 30mm

5.4 Crush Tester:
Test standard : IEC 60794-1-E3
Temperature : Room temperature
Load duration : >2 minutes prior to measurements
Surface Weight : 1800N/cm

5.5 Long term stability Test:
Test standard : IEC 60874-1, Method 8
Temperature : (-40 to +85°C)
Number of cycles : ≥500
Bending radius : 25mm
Duration : 15 minutes
Tension at the plug : 20 N

5.6 Socket impact test:
Experimental setup: 2 connectors are plugged into a ST-Coupler. The connectors are pulled back to their end stops and released so that their end faces hit one another with maximum force. After every impact the damping is measured

Cycles : 100

Analysis: Every 10 impacts, mean values are taken. The difference between the last mean value and the first one is decisive.

5.7 Halogen content of combustion gases:

Qualitative detection of halogens in accordance with the Beilstein Test / relevant IEC standard.

Test standard : SEV TP 20B/3A figure 344.1- No green colouring of the flamel.

If a positive reaction occurs, the qualitative analysis, according to DIN 53474, method 7,1, is carried out. The maximum permitted halogen content must not exceed 0.1%.

5.8 Level of fumes and toxicity:

Test standard : NF F 16-101, class F 3, UITP E-4 / relevant IEC standard

5.9 Inflammability:

Test standard : NF F 16-101, class D / relevant IEC standard

5.10 Temperature strain:

Temperature : -40 to +90°C
Number of cycles : >500
Duration : 10 Minutes

5.11 Cable diameter:

Outer Diameter: 2.6mm +0.4/- 0.2mm

5.12 Rotation motion:

Test standard : IEC 60874-1, Method 6
Temperature : Room temperature
Number of cycles : 500
Turning angle : 90 °C
Rotating speed : 10 turning motions per minute

5.13 Humidity Test:

Test standard : IEC 60874-1, Method 29.4
Temperature : 70°C
Duration : 10 days
Humidity : 90%

6. Packing:

The fiber optic cable assembly are packed in coils. It is permissible to pack the coils in single packing units or in meaningful combinations. A packing list shows the content of each packing unit.

The protective caps must be placed on the tips on the ST connectors.

Material shall be packed in a manner suitable for delivery and storage. Transport packaging shall provide adequate protection against accidental damage during handling.

7. Tender documents:

7.1 Approved vendor shall quote for the part number already approved.

7.2 Development order vendors:

7.2.1 Shall agree to conduct type tests as per Cl. 5 and submit test reports during development order (for evaluation and field trial).

7.2.2 If new vendor already conducted above type tests, they will be eligible for development order and can make supplies for evaluation and field trial.

8. Acceptance criteria:

8.1 Approved vendors shall submit routine test report for confirming dimension and cable assembly Attenuation.

8.2 Development vendors shall submit below documents for evaluation:

8.2.1 Data sheet which includes details as in cl.1 for fiber optic cable and assembly.
8.2.2 Dimension report for the fiber geometry and type test reports.

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