

- Tensile and elongation tests
- Flame retardency as per IEC 332
- Oxygen index test
- FRLS characteristics
- Flammability test as per IEC-332 Part -3 (Category-B) and IEEE-383
- Swedish Chimney test as per SEN-SS 4241475 class F3

9.02.05 Fiber Optic Cable

A	Fiber: The optical fiber core shall be of ultra pure fused silica glass coated with UV-cured acrylate suitable to withdraw temperature of about 80 Deg C (continuous). Fiber Optic cables shall be suitable for installation on cable tray, duct bank, cable trench, and direct burial as necessary.		
1	Type	Multiple single mode & Multi-Mode Fiber to avoid usage of any repeaters.	
2	Core Diameter	Multimode Fiber cable	Singlemode Fiber cable
		62.5 ± 2 microns or 50 ± 2 microns depending upon distance between source & destination.	9 ± 1 microns
3	Cladding Diameter	125 ± 2 microns	
4	Fiber Proof test	As per IEC/EIA & other international standard.	
5	Coating Diameter Test	As per IEC/EIA & other international standard.	
6	Number of Fibers/core	Four/Eight/Twelve (Colour Coded) with min. 100% spare core (Fibers)	
B1	Optical Characteritics – Bandwidth, Attenuation & Numerical Aperture	For multimode fiber cable with core diameter 62.5 ± 2 microns:	For multimode fiber cable with core diameter 50 ± 2 microns:
1	Bandwidth @ 850 nm Bandwidth @ 1300 nm	160 MHz-Km min 500 MHz-Km min	500 MHz-Km min 500 MHz-Km min
2	Attenuation @ 850 nm Attenuation@ 1300 nm	3.0 dB/Km max 0.8 dB/Km max	3.0 dB/Km max 0.8 dB/Km max
3	Numerical Aperture	0.275 ± 0.015	0.200 ± 0.015
B2	Optical Characteritics - Attenuation	for Singlemode fiber cable outside plant:	for Singlemode fiber cable inside plant:
1	Attenuation@ 1310 nm Attenuation@ 1550	0.35 dB/Km max 0.2 dB/Km max	1 dB/Km max 1 dB/Km max

	nm	
C	Cable Construction:	
	Fiber Optic cable shall be of loose tube design. Typically, fibres shall be housed in groups of 4/8/12 (as per requirements) within gel-filled buffer tubes to protect against ingress of moisture and vibration. The tubes shall be manufactured with industry standard material tools & practices. The buffer tubes shall be stranded around the central strength member utilizing reverse oscillating lay (ROL). Blank fillers shall be used as necessary to maintain circular cable structure. Fillers shall be flame retardant and moisture resistant. The cable shall be of dual jacket & armoured. Optic Fibre cable shall be polymer coated, Electrolytically chrome plated corrugated steel taped (ECCST) armoured, fully water blocked with central dielectric material for outdoor/indoor application so as to prevent any physical damage. Two highly visible ripcords are placed under the jacket to aid in sheath removal. A co-polymer coated steel tape is corrugated and wrapped around the inner jacket to provide additional cable compression strength and Termite & rodent protection. A ripcord is also placed underneath the armour for easy outer jacket removal.	
1	Outer Colour	Orange
2	Outer Jacket	Polyethylene minimum 1.5mm thick, Flame retardant & UV resistant.
3	Inner Jacket	Core-locked flame retardant polyethylene
4	Filler / Strength member	As per Manufacturer's standard
5	Central Strength member	FiberGlass reinforced plastic (FRP) and Buckle resistant material to provide both tensile and anti bucking strength to the cable.
6.	Details marked at every meter on outer sheath.	Manufacturer's Name, Month and Year of Manufacturer, Coded description of the cable based on telcordia's (bellcore) SR-2014 suggested optical cable code (SOCC), Sheath identification Number, Sequential Length marking in meter, A telephone Handset symbol to distinguish communication from power cable as per NESC section-35G.
7.	Life Expectancy	Fiber Optic cable shall provide a long life expectancy of minimum 25 years under continuous operation without degradation to optical or mechanical performance.
8.		Spliced/Repaired cables are not acceptable.
D	Stripping Ability	All layers easily removed with Commercially available tools
E	Installation:	
1	Minimum bending radius	20 X D (D=core Diameter) - During

		Installation , Short Term , loaded 15 X D (D=core Diameter) – Installed, Long Term , No load
2	Maximum Tensile Load/Strength	During Installation: 2200 N Installed: 1500N
3	Method of laying	Directly laid in cable trays / duct bank / clamped with available structure
4	Pulling	Ordinary cable grips
F	Storage Temperature	- 20 ° C to 70 ° C
G	Operating Temperature & Humidity	- 20 ° C to 70 ° C & 100%
	Maximum Cable weight	46Kg/1km
	Maximum cable length	1 km
H	Data Speed performance	10 Gbps minimum
I	Test Specification (EIA/TIA – STD455/ IEC standard):	
1	Impact Resistance	2000 Impacts minimum
2	Crush Resistance	4000 N/10cm minimum
3.	Compressive Strength	3000 N minimum
J	Moisture / Water Resistance as per IEC standard.	Water blocking layer, Cable shall withstand water penetration when tested with a one meter static head or equivalent continuous pressure applied at one end of a one meter length of filled cable for one hour. No water shall leak through the open cable end.
K.	Optical time Domain reflectometer	a. A recording optical time domain reflecto meter (OTDR) will be utilized to test for end-to-end continuity and attenuation of each optical fiber. The OTDR shall be equipped with data storage, printer, help feature, compare trace features and OTDR software. The data storage unit must include a built-in floppy disk drive capable of storing a minimum of 100 test traces. b. Data traces saved to disk shall include the following labels. i. Fiber Identification (ID) with a minimum of 10 characters. ii. Cable ID with a minimum of 10

		characters iii. OTDR location with a minimum of 20 characters iv. Far End location with a minimum of 20 characters. v. Test operator initials with a minimum of 3 characters. c. The printer shall preferable be internal. The printer shall be able to print data traces within 30 seconds or less. The machine setting used to repeat tests at a later time shall include index, range, wavelength, average time, pulse width and scale settings. The test results (on printout) shall provide information including: loss, distance, reflectance, data and time. d. The requirements for the compare trace feature include the ability to recall two historical traces from a diskette and display them simultaneously for analysis and printing. The compare trace must compute and display a single graph representing any differences between two traces. The compare trace must be able to recall historical traces from a discrete and perform the same tests on connected live fibers. The compare trace shall perform a two point loss measurement test for any two particular fibers in a comparison analysis. The losses between the two points on the each fiber shall be displayed, and the differences between the two readings clearly shown. e. The OTDR must be equipped with software to support all of the required functions. The software shall provide for printing of whole set of traces (batch print) with minimal commands eliminating the time spent for printing traces individually. f. Bidder shall provide all mounting
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		accessories, cables and connectors required to establish data communication.
L.	Fiber Optic splicer, terminator and tool kit box	Bidder shall provide new unused tools comprise of splicer and fusion jointer and tool kit comprise of cutter, stripper, polishing tool, handheld microscope, heat shrinkable sleeve, scissor, knife etc as required for maintenance and commission.
M.	Standards	Optical cable shall be conform to i) IEC 60794/IEC 60793 & EIA/TIA 455. ii) Low smoke (IEC 1034 -light transmittance of 80%). iii) Halogen free (IEC 754: 1&2- maximum acid gas generation shall be 2% by weight and PH >4.3). iv) Fire & flame retarded (IEC 331,IEEE 383). v) Rodent resistant. vi) Crush Resistant (EIA -455-41). vii) Impact Resistant (EIA -455-25). Bidder shall submit Type test report for review, conform to IEC 60794, IEC 60793, IEEE 383, and IEC 754: 1 & 2, IEC 331, IEEE 1034 and EIA/TIA standard. Colour codes shall be as per EIA/TIA 598-A.
N.	TESTS	Following minimum test as per any approved standard shall be carried out on the cables for witness of owner: a. Attenuation and Dispersion characteristics tests b. Proof Tests c. Macro-Bend resistance Test d. Mechanical Test e. Low and High Temperature cable Bend Test f. Impact resistance Test g. Compressive strength Test h. Tensile strength Test i. Cable Twist test j. Cable cyclic flexing test k. Environmental characteristics Test l. Temperature cycling test m. Colour permanence Test n. Cable Aging test o. Water penetration test

		p. Lightning Test q. Kink Test r. Crush Test
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9.02.06 Data Cable:

Data transmission cables are control & signal cables used in electronics of computer system, electronic control equipment etc. in power plant data processing system. The cable has an overall screening which suppresses external electrical influences and ensures precise pulse transmission. The screen braiding of tinned copper wires is wrapped around the core or inner sheath.

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|------------------------------------|---|---------------------------------|
| i) Min. bending radius for flexing | : | 15x cable diameter. |
| ii) Temp. Range | : | (-30 to +80) deg.
Centigrade |
| iii) Loop resistance | : | Max.78.4 ohm/km. |
| iv) Inductance | : | 0.65 mH / Km. |
| v) Coupling | : | 200 pF / Km. |

Co axial and fibre optic cables are also used as data cables.

9.02.07 All type of Instrumentation & extension cables near high temperature zone shall be high temperature heat resistant cables, which shall be terminated at a junction box in normal temperature zone. Thermocouple extension cables and Instrumentation copper conductor cables for high temperature applications shall be with insulation of individual conductor and outer sheath of extruded FEP (i.e. Teflon) as per VDE 0207 Part 6 and ASTM D 2116. The thickness of insulation shall be 0.5 mm nominal (i.e. 0.4 mm minimum). These cables shall be single / Multipair twisted & shielded. Other parameters/properties shall remain same as specified for Instrumentation and extension cables.

9.02.08 Fire survival instrumentation Cables shall be similar to the Fire survival control cables specified in electrical section (Vol. IV) except that conductor material shall be annealed tinned copper conductor. Size of conductor shall be same as defined at cl. No. 9.01.03.16. In addition the cables shall have high degree of immunity from electromagnetic interference.

Fire survival cables (Power, Control and Instrumentation) shall be provided for the following applications, as these cables can withstand 750°C temperature for three (3) hours:

- a) DC emergency lube oil pumps
- b) DC seal oil pump
- c) DC emergency lighting cables for main plant building.
- d) Batteries to battery chargers and DC distribution boards and as well as incoming DC cables to switchgears located in main plant building and firefighting switchgear.