Armoured Fibre Optic Cable & FODP

2019

Engineering Department

WEST BENGAL STATE ELECTRICITY TRANSMISSION COMPANY LIMITED
পশ্চিমবঙ্গ রাজ্য বিদ্যুৎ সংবহন কোম্পানি লিমিটেড
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Technical Specifications for Armoured Fibre Optic Cable

1.0 Description

a) This is a reference technical specification for survey, planning, co-ordination with other suppliers' equipment, design, Engineering, supply at site including transportation, laying, installation, termination, testing & commissioning of Fibre Optic Cables along with associated hardware & accessories and Fibre Optic Distribution Panel (FODP) along with associated inside plant complete for speech communication in dialing mode and or through 4 wire express telephone, data communication etc. at each Sub-station where fibre optic links are to be established.

Bidder shall furnish with their bids, detailed functional description, Guaranteed Technical particulars etc. of the Fibre Optic Cables along with associated hardware & accessories and Fibre Optic Distribution Panel (FODP) along with associated inside plant. The information should meet the specification requirements and should include information of manufacturers and type of equipment

2.0 Scope of Work

Survey, planning, design, engineering, supply, transportation, laying, installation, termination, testing, commissioning and documentation of :

(i) One no 24F/48F Armoured Fibre Optic cable to be laid along the Power Cable using suitable hangers etc.

(ii) One no 24F/48F Underground armouredFibre Optic approach cable to be laid along the underground power and control cable in the existing cable trench form Gantry structure to FODP located at control room/PLCC room at each Sub-station where fibre optic links are to be established in co-ordination with other suppliers' equipment.

(iii) Termination and splicing of the Fiber Optic cable with Fibre Optic approach cable at the entry of each Sub-Station end up to Fibre Optic Distribution Panel (FODP).

(iv) Supply installation & commissioning of Fibre Optic Distribution Panel (FODP) at each Sub-station where fibre optic links are to be established

(v) Interconnection/termination of Fibre Optic cable cable with, Fibre Optic Distribution Panel (FODP) at each Sub-station where fibre optic links are to be established.

(vi) One no 24F/48F Underground armouredFibre Optic cable cable between RTU and Fibre Optic Distribution Panel (FODP) and subsequent Interconnection/termination of the same with FODP in co-ordination with other suppliers' equipment.

(vii) Development of installation guides and procedures for the stringing, mechanical installation and splicing of the Fiber Optic cable, including testing & documentation. This includes termination of approach cable from Fiber Optic cable at the from the entry of each Sub-Station end up to Fibre Optic Distribution Panel (FODP).

(viii) Splicing required for the optical fibres.

(ix) Testing the fibre system end to end over several tandem paths.

(x) Factory and field testing of fibre cable.
(xi) Providing documented evidence of satisfactory Type Test performance of similar type Armoured Fibre Optic cable cable to employer.
(xii) Transportation/Shipment of all equipment and documentation to employer designated location and/or staging areas.
(xiii) All documentation and drawings as specified.
(xiv) All required spare parts, maintenance aid and test equipment.
(xv) Training of employer personnel in installation of fibre cable, splicing of fibres and use of test equipment

3.0 Operating Instruction

For the purpose of submission of Tender, the following documents in Triplicate shall be submitted by the bidder along with the Tender:

Complete technical literature in English with detailed cable construction diagram of various sub-component including FODP with dimensions and test data of the cable shall be provided. All aspects of installation shall also be covered in the handbook.

4.0 General

Armouredfibre optic cable shall be suitable for installation in pipes as well as suitable for direct burial inside trenches installation. The armouredfibre optic cable shall be suitable for installation and laying along the Power Cable. The cable shall be rodent, termite proof, field proven and type tested. The cable should be of low weight, small volume and high flexibility. The mechanical design and construction of each unit shall be inherently robust and rigid under all condition of operation, adjustment, replacement, storage and transport.
All necessary hardware, software and other accessories delivered as part of communication network shall be field proven type tested and should be latest modified version.

4.1 Fibre Type(s) and Counts
The cable shall contain 48 nos. of Dual Window Single Mode (DWSM) fibres.

4.2 Optical Characteristics
Dual Window Single Mode (DWSM) fibre shall conform to the ITU-T Recommendations G.652D. However, the attenuation coefficient of the fibre to be supplied in the cable shall be as follows :
@ 1310nm ≤ 0.35 dB/km, @ 1550nm ≤ 0.20 dB/km.

The overall optical fibre path attenuation including all optical cable losses caused by bending, compression, splicing and terminations shall be less than 0.25dB/km @ 1500nm. Excessive splice or coupling losses demonstrated as resulting from fibre mismatch with dissimilar fibre, shall be documented and to be submitted.

4.3 Applicable Standards
The fibre/cable shall conform to the latest relevant IEC/IEEE/IS/EIA/ASTM etc.standards.

4.4. Allowable System Outage:
The system outage is defined as an actual measured value determined during the Guaranteed System Availability Test (GSAT). The actual availability achieved at the end of the GSAT

duration would be calculated jointly by the contractor's representative and WBSETCL's representative.

During the GSAT duration no failure in fibres/cables and associated hardware fittings & accessories, splice enclosures and FODPs etc. shall be acceptable.

5.0 General Construction for Armoured Fibre Optic Cable.

The optical cable shall consist of a central fibre optic unit protected by one or more layers of helically or reverse lay (SZ) wound anti-hygroscopic tape or yarn. The central fibre optic unit shall be designed to house and protect the fibres from damage due to forces such as crushing, bending, twisting, tensile stress and moisture, wide temperature variations, hydrogen evolution etc. The fibre shall be of loose tube construction. Gel filled loose buffer fibre is preferable. The inner polyethylene jacket, armouring tape, outer sheath jackets etc. shall be uniform, free from pinholes, joints, splits or any other defects.

The armoured Cable shall be a UV resistant fire retardant rodent proof, with steel tape, corrugated tube or galvanized wire type armour construction cable. The cable shall be suitable for direct burial, laying in trenches & PVC/Hume ducts, laying under false flooring and on indoor or outdoor cable raceways and shall have minimum 2.0 mm HDPE outer jacket thickness.

All fibre optic cable shall have a minimum service life span of 25 years.

5.1 The cable construction and mechanical parameters for the armoured OFC shall be as specified in the Table below :

Table

Cable Construction and Mechanical parameters :

Parameter	Units	
No. of fibers in the cable		48F
Type of fibers		Single Mode
No. of fibers per tube		6/12
No. of loose tubes		8/4
No. of dummy		1
Cable diameter		
	mm	16.1
Nominal tolerance	mm	± 0.5
Cable Weight	Kg/Km	250-280
Temperature dependence		Induced attenuation ≤0.05 dB/km (-60°C to 85°C)
Temperature - humidity cycling - 10°C ± 85°C (85-95% RH)		Induced attenuation ≤0.05 dB/km
Max Continuous length		4km ± 5%
Cable Design Life		More than 25 years.

Parameter	Units	
No. of fibers in the cable		24F
Type of fibers		Single Mode
No. of fibers per tube		6
No. of loose tubes		4
No. of dummy		1
Cable diameter		
nominal	mm	16.1
tolerance	mm	± 0.5
Cable Weight	Kg/Km	250-280
Temperature dependence		Induced attenuation ≤0.05 dB/km (-60°C to 85°C)
Temperature - humidity cycling - 10°C ± 85°C (85-95% RH)		Induced attenuation ≤0.05 dB/km
Max Continuous length		4km ± 5%
Cable Design Life		More than 25 years.

6.0 Cable drums, Marking, Packaging and Transport

All optical fibre cable shall be supplied in strong wooden drums provided with lagging with adequate strength, constructed to protect the cabling against all damage and displacement during transit, storage and subsequent handling during installation. The cable drum shall be suitable to carry fibre optic cable of length of 4 Km ± 5%. Both cable ends in the drum shall be sealed and shall be readily accessible. The drum shall be marked with arrows to indicate the direction of rotation. Both the ends of the cable shall be provided with pulling eye. The pulling eye and its coupling system shall withstand the same tensile load as applicable to the cable. The following marking shall be done on each side of the cable drums.

i) Manufacturer/Suppliers name and address
ii) Type of cable
iii) Number of fibres
iv) Type of fibres
v) Year of manufacturing, month & batch no.
vi) Total cable length

Packing list supplied with each drum shall have all the information provided on marking on the respective cable drum and following additional information: OTDR length measurement of each fibre and ratio of fibre and cable length.

7.0 Optical fibre cable marking

A suitable marking shall be applied in order to identify this cable from other cables.

8.0 Optical Fibre Termination and Splicing

Optical fibre terminations shall be installed in Fibre Optic Distribution Panels (FODP) designed to provide protection for fibre splicing of preconnectorized pigtails and to accommodate connectorized termination and coupling of the fibre cables. The Contractor shall provide appropriate sized as constrained by the available space, rack mounted Fiber Optic Distribution Panels (FODPs) and shall terminate the fibre optic cabling up to the FODPs. The Contractor shall

be responsible for connectivity between the FODP and the terminal equipment. The location of FODP rack shall be fixed in suitable place preferably adjacent to the Optical equipment.

9.0 Fibre Optic Distribution Panels

At each location requiring the termination of at least one fibre within a cable, all fibres within a cable, all fibres within that cable shall be connectorized and terminated in Fibre Optic Distribution Panels in a manner consistent with the following :

a) All fibre optic terminations shall be housed using FODPs provisioned with splice organizers and spile trays. All fibres within a cable shall be fusion spliced to preconnectorized pigtails and fitted to the "Back-side" of the provided fibre optic couplings.

b) FODPs shall be suitable for use with each of the cable types provided as part of this contract. FODPs shall accommodate pass-through splicing and fibre terminations.

c) All FODPs shall be of corrosion resistant, robust construction and shall allow both top of bottom entry for access to the splice trays. Specific selection of the entry points shall be made at the time of installation. Ground lugs shall be provided on all FODPs and the Contractor shall ensure that all FODPs are properly grounded. The FODP for indoor installation shall meet or exceed ingress protection class IP55 specifications.

Table
Technical details of FODP

Sl. No.	Description	Tchnical Particulars
1	Dimension (H*W*D) mm	1400*600*400
2	Construction Materials	Sheet Steel/ CRCA minimum 2mm thick
3	Installation clearance: Front Access (cm) Rear Access(cm): Top*Bottom*Sides(cm)	 60 60 60
4	Colour & Finish	Light Grey, RAL 7035
5	Coating thickness	75 µm
	FODP 96Fibres Sub-rack	
1	Construction Materials	Cold-Rolled Steel minimum 2mm thick
2	Cable Glanding & Fixing	Six Cable glanding & fixing
3	Locking Arrangement	Two slots for door snap-on/ Two slots with Nylatch
4	Total no. Of optical couplings	96 FC/PC connectors
5	Provision for pass through splicing	yes
6	No. of cables that can be accommodated	6 (each of 48Fibre)

7	Diameter of cable that can be accommodated	8-30mm
8	Cable entry	Suitable for all 24 & 48 Fibre approach cable
9	Method of mounting	19" rack mounting in cabinet
	Splice Trays	
1	Material	Acrylonitrile Butadiene Styrene(ABS)
2	Method of mounting	Sub-rack containing all splice trays or individual splice trays to be of sliding and detachable type.
3	No. of splice Trays	8
4	Maximum no. of splices per tray	12

10.0Optical Fibre Connectors

Optical fibres shall be connectorised with **FC-PC type** connectors. Fibre optic coupling supplied with FODPs shall appropriate for the fibre connectors to be supported. **There shall be no adapters allowed**.

11.0 IN-LINE FIBRE OPTIC SPLICE ENCLOSURES

All in-line splices shall be enchased in In-Line Fibre Optic Splice enclosures. Suitable splice enclosures shall be provided to encase the optical cable splices in a protective enclosure and dust free environment. The splice enclosures shall be designed for the storage and protection of a minimum of 144 optical fibre splices and shall provide access through lockable doors. They shall be fitted with suitable encapsulant that is easily removable, should re-entry be required into the enclosures.

In-line splice enclosures shall be suitable for outdoor use specifications and shall be suitable for tower mounting. with the OPGW cable provided under this contract.
The OPTIC SPLICE ENCLOSURES for outdoor installation shall meet or exceed ingress protection class IP66

Splice enclosures shall be appropriate for mounting on EHV Transmission towers above anti-climb guard levels at about 10 meters from ground level and shall accommodate pass-through splicing.

12.0 OPTICAL FIBRE SPLICES

Splicing of the optical fibre cabling shall be minimised through careful contractor planning. There shall be no mid-span splices allowed. All required splices shall be planned to occur within facilities or on tower structures. All optical fibre splicing shall comply with the following :

a) All fibre splices shall be accomplished through fusion splicing.
b) Each fibre splice shall be fitted with a splice protection sheath fitted over the final splice.

c) All splices and bare fibres shall be neatly installed in covered splice trays. No more than six (6) fibres shall be installed in each splice tray.
d) Attenuation of single mode fusion splices shall not average 0.05 dB and no single splice attenuation shall exceed 0.1 dB when measured at 1310 / 1550 nanometers.
e) For in-line splicing, fibre optic cable service loops of adequate length shall be provided so that all splices occurring at tower structures can be performed at ground level.

13.0 Methodology for installation and Termination

All optical fibre cable termination, installation, stringing and handling plans, guides and procedures, and engineering analysis (e.g. tension, sag, vibration etc.) shall be submitted to the Employer for review and approval in the engineering/design phase of the project, prior to establishing the final cable lengths for manufacture. Installation procedures including details of personnel and time required shall be documented in detail and submitted to Employer for approval. All installation practices shall be field proven and ISO accredited.

All cable segments shall include service loops. The maximum allowable stringing tension, maximum allowable torsional shear stress, crush strength and other physical parameters of the cable shall not be exceeded. The preventative measures to be taken shall be documented in detail and submitted to Employer in advance of installation.

Optical fibre attenuation shall be measured after installation and before splicing. Any increase in attenuation or step discontinuity in attenuation shall not be acceptable and shall constitute a cable segment failure. In the event of cable damage, the complete span shall be replaced as mid-span joints are not acceptable.

Any or all additional steel work of modifications required to lay the fibre cabling to the along the power cable shall also be carried out by the Contractor. The Contractor shall supply all tools and accessories required for installation. It shall be the Contractors responsibility to provide adequate communications among all crew members and support staff to ensure safe and successful installations.

14.0 Service Loops

For purpose of this specification, cable and fibre service loops are defined as slack (extra) cable and fibre provided for facilitating the installation, maintenance and repair of the optical fibre cable plant.

a) Outdoor Cable Service Loops :
FODPs and in-line splice enclosures installed outdoors and mounted on the utility towers, shall be installed with sufficient fibre optic cable service loops such that the recommended minimum bend radius is maintained while allowing for installation or maintenance of the cable to be performed in a controlled environment at ground level.

b) Indoor Cable Service Loops :
FODPs shall provide at least three (3) metres of cable service loop. Service loops shall be neatly secured and stored, coiled such that the minimum recommended bend radius are maintained.

c) Fibre Units Service Loops :

For all fibre optic cable splicing, the cable shall be stripped back a sufficient length such that the fan-out or fibre units shall provide for at least one (1) metre of fibre unit service loop between the stripped cable and the bare fibre fan-out.

d) Pigtail Service Loops :

Connectorized pigtails spliced to bare fibres shall provide a least 0.5 metre of service loop installed in the FODP fibre organizer and at least 1(one) metre of service loop to the couplings neatly stored behind the FODP coupling panels.

e) Fibre Service Loops :

At least 0.5 metre of bare fibre service loop shall be provided on each side of all fibre splices. The bare fibre service loops shall be neatly and safely installed inside covered splice trays.

The Contractor shall supply and install this fibre optic cable, including design, supply & installation of all required installation hardware fittings & accessories and including any custom designed hardware fittings & accessories as required. The Contractor shall supply and install the optical fibre cable and approach cable & other accessories as required based on the actual requirement. The specified items will be paid as per the unit rates quoted. Termination of fibres to FODPs through appropriate connectors shall be done by the Contractor at no extra cost. Cost of supply of connectors & other termination materials as along with termination work, shall be included in rate for "laying & termination" of fibre optic cables.

15.0 Installation of Cable :

A network of cable trenches and / of ducts may exist at some sites but shall require expansion and / or new construction at stations. It shall be a responsibility of the Contractor to co-operate fully with the Employer and all other on-going project Contractors in the planning and efficient use of existing and new-construction infrastructure supporting on-station communications cabling. The existing cable trenches / cable raceways proposed to be used shall be identified in the survey report. The contractor shall make its best effort to route the cable through the existing available cable trenches. Where suitable existing cable trenches are not available, suitable alternatives shall be proposed for Employer's approval. The contractor shall provide any additional outdoor cable raceways and / or cable trenches required for such approved alternative.

It may be noted that in order to utilise the existing trenches, the cable may be required to be co-located with HV and LV cables. Accordingly, the cable shall be installed in corrosion resistant flexible conduit. Suitable provisions shall be made by the Contractor to ensure adequate safety earthing and insulated protection for the approach cable.

Cables existing from the ground or passing through floors shall be protected against mechanical damage.

Cables will be laid within HDPE cable duct throughout from Gantry-joint box to FODP. In case FO cable is laid underground along with power cable, separate HDPE duct will be used for FO cable. Cables shall penetrate buildings through cable ducts. The cabling shall route within buildings in cable raceways or under raised floors. The Contractor may utilize existing ducts, building penetration, cable trays, racks, etc. where appropriate and approved by the

Employer. The cables shall be affixed to cable supports using approved ties, clips or cleats at regular intervals. On short cable runs for which cable supports are not required, the Contractor shall fix the cable to the structure of the building using approved fixing and cable cleats.

The Contractor shall be responsible for new building penetrations required for cabling. Caution shall be taken to ensure that existing equipment and site personnel are protected from dust and debris incident to the cable penetration work. Penetrations shall be neatly formed and sealed for protection from moisture, dust, wind and vermin intrusion.

All required fittings, supports accessories, ducts, inner ducts, conduits, risers and any item not specially mentioned but required for lay and installation of approach cables shall be supplied and installed by the Contractor.

16.0 Cable Raceways :

The Contractor is required to provide and install any additional indoor cable raceways which may be required for proper implementation of the fibre optic cabling system the cable raceways shall conform with the following:

a) All cable raceways shall be sized to support full loading requirements plus at least a 200% safety loading factor.
b) Indoor cable raceways shall be fabricated from construction grade aluminium, galvanized iron or anodized sheet metal or any other suitable material approved by the Employer. Suitable anti-corrosion measures shall be provided steel fabricated raceways shall be finished inside and out, treated to resist rust and to form a metal-to-paint bond.
c) Mechanical construction drawings of the cable raceways shall be submitted for Employer's information and review.

17.0 INSPECTION AND TESTS

17.1 TYPE TESTS:

Type Test for Indigenous or fully Imported Materials:

The offered equipment/material must have fully type tested as per relevant ISs and / or any other specified international standards, during the last five years period reckoned from the date of opening of the tender. Photocopy of such type test reports/certificates must be submitted along with the tender bid. The type test certificates of prototype manufactured and tested by foreign collaborators of the tenderers at their works shall not be acceptable for indigenously manufactured equipment. If type test reports of any type test/tests is/are not submitted by the proposed sub-vendor carried out within last 5 (five) years, the same shall be conducted in presence of WBSETCL representative at vendor's cost. This cost shall be inclusive of Fooding and lodging cost of WBSETCL representatives (min two persons).

17.2 Inspection

The material for final inspection shall be offered by the Contractor only under packed condition. The employer shall select samples at random from the packed lot for carrying our acceptance test.

Certificate of manufacturing tests shall be maintained by the Contractor and be produced for verification as and when desired by the Employer.

Materials shall not be transported/shipped from its point of manufacture before it has been satisfactorily inspected and tested.

The acceptance of any quality of materials shall in no way relieve the contractor of his responsibility for meeting all the requirements of the specification and shall not prevent subsequent rejection, if such materials are later found to be defective.

The Contractor shall give the Employer thirty (30) days written notice of any material being ready for testing.

17.3 General Condition for Tests

a) **The entire cost of testing for acceptance and routine test and test during manufacture specified herein shall be treated as included in the quoted unit price of materials**.

b) The Contractor shall submit for the Employer's approval a Test Procedure Specification at least three(3) months before each individual test will be performed. Fully approved test procedures shall be submitted to Employer at least 4 weeks prior to the commencement of testing. The test procedure specification shall specify the details test in accordance with the requirement of this specification.

c) The Employer reserves the right to require the Contractor to perform any other reasonable test(s) at the Contractors premises, on site or elsewhere in addition to the aforementioned Acceptance, Routine or manufacturing tests to assure Employer of specification compliance.

17.4 Test Plans

Test Plans and procedures for both factory and field tests shall be provided by the Contractor. Test plans and procedures shall ensure that each factory and field test is comprehensive and verify all the features of the equipment to be tested. Test plans and procedures shall be modular to allow individual test segments to be repeated upon request.

There shall be two factory and field tests shall be submitted for Employer's approval at least three months before the start of testing.

17.5 Factory Acceptance Tests

Factory tests shall be conducted on selected sample of equipment to be supplied. Equipment shall not be shipped until required Factory tests are completed satisfactorily, all variances are resolved, full test documentation has been delivered to the Employer and the Employer has approved for shipment/transportation. Successful completion of the Factory tests and the Employer's approval to ship/transport shall in no way constitute final acceptance of the system or any portion thereof.

Factory tests shall not proceed without the prior delivery to and approval of all test documentation by the Employer. In addition, upon the approval of the test documents by the Employer, the Contractor-supplied maintenance and operators manuals will be used during the tests as guide and as a check that each manual is correct and complete.

ACCEPTANCE CRITERIA FOR OFC

OFC CONSTRUCTION PARAMETERS

Parameters	Units	Acceptance Criteria	
		Armoured	Unarmoured
No. of fibers in the cable	No.	**48F**	**48F**
Type of fibers		Single Mode	Single Mode
No. of fibers per tube	No.	6/12 for 48F	6/12for 48F
No. of loose tubes	No.	8/4 for 48 F	8/F4 for 48 F
No. of dummy	No.	1 for 48F	1 for 48F
Cable diameter (Nominal/tolerance)	mm	16.1 ± 0.5 for 48F	13.4 ± 0.5 for 48F
Cable Weight	Kg/km	250-280 for 48F	145-161 for 48F
Max Continuous length of cable	Km	4km ± 5%	4km ± 5%
Rip Cord (s)		Should be available	Should be available
Physical dimension		Should meet the technical requirement	Should meet the technical requirement
Fiber Continuity with OTDR		Should be continious	Should be continious
Fiber Attenuation with OTDR at 1550 mm	dB/km	≤ 0.20 dB/km	≤ 0.20 dB/km
Fiber Attenuation with OTDR at 1310 mm	dB/km	≤ 0.35 dB/km	≤ 0.35 dB/km
Sheath/Inner Jacket			
i) Material		High Density Polyethyline-HDPE (Black)	High Density Polyethyline-HDPE (Black)
ii) Thickness		≥1.5mm	≥1.8mm
Outer Jacket/Termite Protection			
i) Material		HDPE (Red/Black)	
ii) Thickness		≥3mm	≥0.65mm
Armouring			
iii) Material		Stainless Steel Alloy	-
iv) Thickness		≥0.125mm	-

Parameters	Units	Acceptance Criteria	
		Armoured	Unarmoured
No. of fibers in the cable	No.	**24F**	**24F**
Type of fibers		Single Mode	Single Mode
No. of fibers per tube	No.	6 for 24F	6 for 24F
No. of loose tubes	No.	4 for 24F	4 for 24F
No. of dummy	No.	1 for 24F	1 for 24F
Cable diameter (Nominal/tolerance)	mm	16.1 ± 0.5 for 24F	13.4 ± 0.5 for 24F
Cable Weight	Kg/km	250-280 for 24F	145-161 for 24F
Max Continuous length of cable	Km	4km ± 5%	4km ± 5%
Rip Cord (s)		Should be available	Should be available
Physical dimension		Should meet the technical requirement	Should meet the technical requirement
Fiber Continuity with OTDR		Should be continious	Should be continious
Fiber Attenuation with OTDR at 1550 mm	dB/km	≤ 0.20 dB/km	≤ 0.20 dB/km
Fiber Attenuation with OTDR at 1310 mm	dB/km	≤ 0.35 dB/km	≤ 0.35 dB/km
Sheath/Inner Jacket			
iii) Material		High Density Polyethyline-HDPE (Black)	High Density Polyethyline-HDPE (Black)
iv) Thickness		≥1.5mm	≥1.8mm
Outer Jacket/Termite Protection			
v) Material		HDPE (Red/Black)	
vi) Thickness		≥3mm	≥0.65mm
Armouring			
vii) Material		Stainless Steel Alloy	-
viii) Thickness		≥0.125mm	-

9.0 FAT/OFC Acceptance Criteria :

Prior to acceptance, cable drums shall be tested for compliance to the acceptance criteria wherein the following measurements shall be carried out before acceptance of each cable drum:

i) Physical Check of the cable

ii) Optical fiber continuity

iii) fiber attenuation with OTDR (≤ 0.20DB/km @ 1550nm & ≤ 0.35dB @ 1310 nm.
iv) Max. Tensile Strength As per IEC60794-1-E1
v) Cable Bend Test As per IEC60794-1-E11
vi) Repeated Bending Test As per EIA-455-104
vii) Crush Strength As per IEC60794-1-E3
viii) Impact Test As per IEC60794-1-E4
ix) Torsion resistance As per IEC60794-1-E7
x) Kink Test As per IEC60794-1-E10
xi) Drip Test on cable As per TEC procedure
xii) Sheath/Inner Jacket i) Material, ii) Thickness
xiii) Outer Jacket i) Material, ii) Thickness
xiv) Armouringi) Material, ii) Thickness
xv) Rewinding Test
xvi) Strain margin Test

17.6 Site Acceptance Tests

During the course of installation the Employer shall have full access for inspection of the progress of the work and for checking workmanship and accuracy as may be required. On completion of the work prior to commissioning, all equipment shall be tested to the satisfaction of the Employer to demonstrate that it is entirely suitable for commercial operation.

The tests shall be carried out in the presence of and to the satisfaction of the Employer by the qualified technical representatives of the Contractor.

Prior to installation every spooled fibre optic cable segment shall be tested for compliance with the Pre-shipment data previously received from the manufacturer. This requirement will preclude the installation of out of specification cable segments that may have been damaged during shipment.

During the installation, spliced cable segments shall be tested and documented. Upon completion of a continuous cable path all fibres within the cable path shall be demonstrated for acceptance of the cable path. Fibre Optic cable field testing minimum requirements are provided in the following tables.

Fibre Optic Cable Pre-Installation Testing

Item	Description
1	Physical Inspection of the cable assembly for damage
2	Optical fibre continuity end-to-end
3	Per fibre OTDR

Fibre Optic Cable Splice Testing

Item	Description
1	Per Splice Attenuation

2	Per splice OTDR
3	Physical inspection of splice box/enclosure for proper fibre routing techniques.
4	Physical inspection of sealing techniques, weatherproofing, etc.

18.0 MISCELLANEOUS SUPPLIES

The Contractor shall provide all required consumable and non-consumable supplies necessary to support all installation and test activities through final operational acceptance.

19.0 MAINTENANCE SUPPORT FACILITIES IN INDIA

The Bidder shall describe his own maintenance support capabilities and facilities in India in his technical bid.

20.0 Other Services

The following services shall be included in the proposal.

a) An experienced, English speaking instructor shall hold training sessions on installation, commissioning, operation and maintenance of OPGW.
   - One week training for installation and commissioning shall be held prior to installation for about 6 to 12 persons at the owner's premises.
   - One week training for operation and maintenance shall be held after the installation for about 6 to 12 persons at the site.

b) Vendor shall bear all necessary charges for boarding and lodging at the place of training for the above engineers/working personnel of WBSETCL or authorised representatives for attending the above mentioned training programme at onwers' premises. The training programmes shall be of class room training as well as on job training as mentioned in Clause (a), above. Bidder also to submit training programme and schedule including context of training well in advance (minimum one month) for deputing engineer/working personnel).

c) Factory inspection/acceptance test : 3 days for 3 persons (MAX.) at Factory. The vendor shall bear all necessary charges for inspecting personnel including to and fro journey by air from purchasers headquarters to manufacturers works. This also includes boarding, lodging, medical insurance (in case of inspection to be carried out outside India)etc. at the manufacturers' place and transit, if any for the purpose of inspection and testing.

d) If inspection call raised by the bidder more than one time, they shall have to be borne necessary inspection charges in each inspection

The contractor shall submit the Guaranteed Technical Particulars (GTP), Manufacturer's Routine Test Reports as per applicable standards to meet the acceptance criteria mentioned above.