TELECOMMUNICATION EQUIPMENT SPECIFICATION

Single Sheath Non-metallic Optical Fiber Cable

General

The Single Sheath Non-metallic Optical Fiber Cable shall have high mechanical strength to protect the fibers from external forces, be easily installed without requiring any special care or equipment, and shall be suitable (depend on the application needs which are specified elsewhere) for installation in **conduits, ducts or cable trench**. All cable accessories including terminations, insulating materials, markers, support grips and cable ties shall be furnished and installed. The proposed Single Sheath Non-metallic Optical Fiber Cable shall be certified by TISI according to **TISI 2165-2548 or TISI 2166-2548** standards and the bidder shall required to submit the copy of certificate with proposal.

Technical Specification

1 Single Mode Fiber Characteristics

1.1	Nominal mode field diameter:	10 μm ±1 μm
1.2	Cladding diameter	: 125 μm ±3 μm
1.3	Mode field concentricity error:	1 μm maximum
1.4	Non-circularity	
	1.4.1 Mode field	: Refer to ITU-T Rec.G.652C or G.652D
	1.4.2 Cladding	: Less than 2%
1.5	Chromatic Dispersion coefficient	@1310 nm: ≤3.5 ps/(nm.km)
		@1550 nm: ≤20 ps/(nm.km)
1.6	Polarization mode dispersion coefficient	: ≤ 0.5 ps/$\sqrt{km}$ (for G.652C)
		: ≤ 0.2 ps/$\sqrt{km}$ (for G.652D)
1.7	Attenuation coefficient	
	@ 1310 nm	: **≤ 0.40** dB/km
	@ 1550 nm	: **≤ 0.35** dB/km
1.8	Fiber Identification	: each fiber shall be uniquely identifiable throughout the length of the cable
1.9	Operating Temperature	: **0°C to 70°C continuously**
1.10	Overall Diameter	: **≥ 11.0 mm**
1.11	Weight	: **≥ 85 kg/km**

2 Cable structure

The Single Sheath Non-metallic Optical Fiber Cable shall consist of:
- Multiple fiber cores, as required,
- Central strength member,
- Loose tube,
- Suitable hydrogen absorbing compound.
- **Aramid yarn or equivalent material**
- Polyethylene **or High-density polyethylene outer sheath**

The central strength member shall be fiber reinforced plastic or other material of equivalent strength. The fibers shall be protected in jelly filled loose tubes stranded around a central strength member to ensure optimum performance and long life. Each fiber shall be color coded for easy identification during splicing and termination.

The interstices of the cable core shall be completely filled with water repellant **(petroleum jelly compound or equivalent material)** to

prevent water impregnation. **The outer sheath shall be made of polyethylene or high-density polyethylene.** The outer sheath of finished cable shall be clearly colored to distinguish from power cable (i.e. orange or red or black with color strip) and provided identification printed with the information about the manufacturer's name, type of cable and year of manufacture.

Mechanical Properties

Allowable tension : Shall withstand at least **120 kg** force without breaking or damaging the fibers in the cable.

Bending Radius : The permissible bending radius shall be no greater than 20 times the external diameter of the cable.

3 Cable length : at least 3000 meters/reel (In case of cable route is longer than 3000 meters) or as specify in price schedule.

4 Factory Testing

All factory tests performed on the cables are subject to ASTM and/or IEC60794-1-2 and/or TIA/EIA specifications. Factory tests shall be performed on samples randomly selected from the reels of strand.

The factory tests required by EGAT and arranged for by the contractor shall include, but not be limited to, the following:

- optical fiber attenuation
- tensile strength

In addition, the Contractor shall provide standard test certificates for each of the type tests listed below. Separate certificates shall be provided for each type of cable proposed. Alternatively, the tests may be quoted as an option for EGAT consideration.

- bend response
- waterproof and anti-freeze performance
- hydrogen attack performance
- heat cycle test
- high temperature performance
- low temperature performance
- impact characteristics

5 Conduit

5.1 Rigid Steel Conduit (RSC)
The conduit shall be made of non-corrosive material, rust-proof and weather-proof to withstand outdoor climatic and environmental condition.

5.2 High Density Polyethylene Conduit (HDPE)
The HDPE shall be made of high-density polyethylene which is non-corrosive, flexible, and suitable for installation in cable trench, above ground or direct burial.

5.3 EFLEX Corrugated Hard Polyethylene Conduit (EFLEX)

The EFLEX shall be made of high-density polyethylene with spiral corrugated pipe shape which is highly corrosion, weather resistant, flexible, mechanically strong and suitable for installation in cable trench, above ground or direct burial.

The conduit shall have inside diameter of 30 mm and shall contain a minimum diameter of 4.8 mm poly propylene strand rope or acceptable equal for use in pulling the cable or other pulling line.

6 Packing and Shipping

The cable shall be furnished on reels of sufficiently sturdy construction to withstand normal shipping, hauling, and field erection. The size, length, weight, manufacturer's name or trade mark, date of manufacture, direction of rolling for each drum, and contract number shall be clearly marked on the outside of each drum. The cable shall be packed to protect it from moisture, salt, or any other impurities which may cause rust or other harmful effects.

7 Rack Cabinet

The rack cabinet shall be designed by taking into flexibility, softly and durability in its operation, and capability to meet all types of EGAT's demands. The rack shall made of steel sheet with the typical thickness of 1.5 mm molded to be durable and 100% rust-proof. The mounting support shall be designed to be durable and capable of adjustment as required. Panels shall be constructed in 1 mm steel sheet and all corners shall be welded and dressed prior to finishing.

The rack cabinet shall be 19" rack unit Telecom Standard format which complied with standard DIN 41494, EIA RS-310C1977, IEC 297-2 and the dimension of 2200 mm high, 600 mm wide and 600 mm deep. Flush doors at front and rear shall be mounted on lift-off type hinges. The doors shall have a full 180° swing and shall be fitted with central key lock or magnetic catches. The front door shall be made of plastic acrylic with transparency brown color having the thickness of 5 mm, dust-proof rubber edge and right-hand hinged.

Side panels shall be lift off for easy access. Jacking feet shall be fitted inside the rack base for leveling. The rack shall have mobile base with large castors. At the bottom of the rack, there shall be slide panel with sponge for running signal cable., electrical wire and preventing the intrusion of animals.

8 Fiberframe Termination Cabinet

The fiberframe termination cabinet at each station shall be rack mounted and suitable and large enough **(with approximate size: 3U)** to accommodate the connection all burried cables and fiber cords leading to optical line terminating equipment as shown in the drawing.

The fiberframe termination cabinet shall have at least two splicing trays with the amount of splice reinforcement tubes as same as the number of fiber core specified in the price schedule and shall be a unit for terminating and patching of up to the number of fibers as specified in price schedule in 19" rack frames. The fiberframe termination cabinet shall have a slide out termination compartment and front access patch panel which shall have the amount of single FC connector as same as the number of fiber core specified in the price schedule. The through adapter (D-Format) shall be supplied by the contractor for each fiberframe termination cabinet with the same amount as the FC connectors. The

through adapter shall combine a metal housing and either Phosphorus Bronze or Copper inner alignment sleeve. The termination compartment shall have rear and side cable entry points and facilities for fusion splicing or direct termination of outdoor and indoor style cable. The fiber frame termination cabinet shall have looming facilities maintaining correct bend radii to ensure orderly arrangement of excess fiber lengths.

The contractor shall provide optical fiber patch cords of at least 10 meters long and pigtails of 1.5 meters long or otherwise specified with FC connector for splicing to all fibers in each of optical fiber cable cores and terminating to through adapter (D-format) of the fiber distribution panel.

9 Fiber Terminal Box

The fiber terminal box at each station shall be suitable and large enough to accommodate the connection of all optical fiber cable and fiber cord leading to optical line terminating equipment. The fiber terminal box shall have at least four splicing trays and shall be a secure and versatile wall mounted unit for terminating and patching of optical fiber cable.

The contractor shall provide optical fiber patch cords of at least 10 meters long and pigtails of 1.5 meters long or otherwise specified with FC connector for splicing to all fibers in each of optical fiber cable cores and terminating to the fiber distribution panel.

10 Joint Boxes

The joint box shall be air-tight, water-proof, and weather-proof. The cover shall be securely fastened to the case by non-loosening fasteners. Both the case and the cover shall be made of non-metallic. The life time of joint box shall be not less than 20 years. The joint box shall be sufficiently rugged and sturdy to withstand outdoor climatic and environmental conditions. The joint box shall accommodate sheath protected arc-fusion splices and up to 1.5 m of additional fiber on each side of the splice; guides shall be provided to keep the extra fiber well above the allowable bending radius of the fiber. The spliced parts of the optical fiber within the joint box shall be reinforced and free from tension after completion of the splicing. The joint box shall be installed without drilling the tower structure, and shall not be removed manually. The fixing part and the joint box base shall be mounted by using shear nuts and shear bolts or equivalent mounting accessories.

The Contractor shall provide one set of terminating materials with every joint box for optical fiber connection

2-Way and 3-Way Joint Box

This type of joint box shall be used to straight joint cable(s) to cable(s). It shall be used at all locations requiring such a device except those specified otherwise in the text or drawings elsewhere in this specification.

11 Installation

The cable shall be installed from take-off structure at each substation to the fiber terminal box/rack cabinet in the corresponding substation communication room.

The cable shall be placed in RSC and buried at 0.5 m depth from take-off structure to the cable trench, and installed the EFLEX or HDPE conduit along the

trench side for the full length of the cable trench, and to the fiber terminal box/rack cabinet in the communication room.

Cable pulling

The wire grip, swivels, a steel winch line if required etc. shall be used to pull the cable. The maximum pulling tension of the cable shall be 50% of working load or recommended by the cable manufacturer. Extreme care shall be exercised during installation of all cable to prevent tension and bending conditions in excess of the manufacturer's recommendation. Damage to the sheath or finish of the cable shall be sufficient cause for rejection the cable. The cable damage in any way during installation shall be replace by and at the expense of the contractor.

12 Optical Fiber Connections

The jointing of optical fiber shall be performed using arc-fusion splicing. All cores shall be spliced at every location, fiber identification shall be matched and maintained for the entire length of the installation.

The optical fiber splicing loss shall not be more than 0.07 dB for any one joint. Splicing loss shall be measured immediately after the splice has been made, and if the splice does not meet minimum standards above, it shall be re-spliced or replaced.

All successful splices shall be protected using a heat shrink protection sleeve with integrated reinforcement, or some other material/process providing equivalent protection. An additional slack of 1 to 1.5 m shall be provided on each side of each splice, and stored securely in the joint box.

13 Field Testing

The optical fiber cable shall be tested in the field from end to end, at each applicable location. All test equipments to be used shall be kept calibrated and still within one year prior to their validity periods. EGAT reserve the right to use his own test equipments for verification of the result. The calibration report which shall conform to International Electro-technical Commission (IEC) standard shall be submitted to EGAT for approval. The bidder shall also submit the make, model and serial number of the test equipments that to be used in this field test. Test to be performed shall include, but not be limited to, the following:

13.1 Optical Fiber Loss Requirement

The Contractor shall measure the attenuation loss at each FOTS terminal station, from the joint box at each take-off structure to the terminal box located in the corresponding substation communications room. These values shall be within the "Maximum Transmission Loss per km" figure specified in section 1.

13.2 Optical Fiber Splice Loss

The Contractor shall measure the splicing loss per joint for each and every splicing point for wavelength 1310 nm and 1550 nm. This value shall be within **the Maximum splicing loss per joint, i.e. 0.07 dB per point.**

The results of these tests shall be tabulated by location.