

## **MATERIAL SPECIFICATIONS FOR FIBER OPTIC CABLE**

### A. General

1. Ensure that the fiber optic cable used for outdoor applications is single mode single jacket single armor gel-free with loose buffer tubes and it meets or exceeds all applicable Standards.
2. When the fiber optic cable is not used for outdoor applications:
  - a. Ensure that general use cable is resistant to the spread of fire and labeled OFN.
  - b. Ensure that fiber optic cable installed in plenums, ducts or other space used for environmental air has fire-resistant and low smoke producing characteristics and is labeled OFNP.
  - c. Ensure that fiber optic cable installed in risers, spaces used for vertical runs in a shaft or from floor to floor has fire-resistant characteristics capable of preventing the spreading of fire from floor to floor and is labeled OFNR.
3. Standards
  - a. Electronic Industry Standards (EIA/TIA), EIA/TIA-455, EIA/TIA-472, EIA/TIA-598
  - b. Fiber Optic Testing Parameters (FOTP)
  - c. International Telecommunications Union (ITU), ITU G.652.D
  - d. ASTM standards, ASTM D3349, ASTM D1248
  - e. National Fire Protection Code (NFPA), NFPA 70, National Electrical Code (NEC)
4. Environmental
  - a. Operating temperature range: -40 °F to +158 °F
  - b. Installation temperature range: -22 °F to +158 °F
  - c. Storage Temperature: -40 °F to +158 °F

### B. Cable Characteristics

1. Ensure that the optical fibers are contained within loose, gel-free buffer tubes that are stranded around an all-dielectric central strength member.
2. Ensure that the cable core is a tensile strength member and is surrounded by a water swellable yarn.
3. Ensure that a high or medium density polyethylene outer jacket is provided for overall protection.
4. Ensure that the fiber optic cable includes the following components:
  - a. Color coded single mode optical fibers.
  - b. Gel-free color coded buffer tubes.
  - c. Central strength member - glass reinforced plastic dielectric rod.
  - d. Filler rod - medium or high density polyethylene.
  - e. Stranding – buffer tubes stranded around central member and held in place with binders.
  - f. Water-swellable yarn and tape that is non-nutritive to fungus, electrically non-conductive, non-toxic, dermatological safe and compatible with all other cable components.
  - g. Core separator or binders - non-hygroscopic, non-wicking and dielectric with low shrinkage.
  - h. Tensile outer strength member - high tensile strength aramid yarns and fiberglass helically stranded evenly around the cable core.
  - i. Ripcord – minimum two ripcords, equally spaced (180° for 2).
  - j. Outer jacket - HDPE or MDPE, co-extruded colored stripe, coded and labeled.
  - k. Each optical fiber is to be distinguishable from others in the same buffer tube by means of color coding according to EIA/TIA-598-B color coding for fiber optic cable.
  - l. In cables containing multiple buffer tubes each buffer tube is to be distinguishable from others in the same cable by means of color coding according to EIA/TIA-598 color coding for fiber optic cable.
5. Mechanical Characteristics
  - a. Maximum tensile loading during installation: 600 lbf (also called loaded)
  - b. Maximum tensile loading for the unloaded application: 130 lbf (also called installed)

- c. Minimum bending radius of during installation: 15 times the cable diameter
- d. Minimum bending radius for unloaded application: 10 times the cable diameter
- 6. Fiber Characteristics
  - a. Single Mode Fiber
  - b. Type: Step Index
  - c. Core diameter: 8.3  $\mu\text{m}$  (nominal)
  - d. Cladding diameter: 125  $\mu\text{m} \pm 0.7 \mu\text{m}$
  - e. Core to Cladding Concentricity:  $\leq 0.5 \mu\text{m}$
  - f. Cladding Non-circularity:  $\leq 1.0 \%$
  - g. Coating Diameter: 245  $\mu\text{m} \pm 5 \mu\text{m}$
  - h. Proof/ Tensile Test: 100 kpsi, minimum
  - i. Attenuation:
    - (A) @ 1310 nm  $\leq 0.64 \text{ dB/mile}$  (or  $\leq 0.4 \text{ dB/km}$ )
    - (B) @ 1550 nm  $\leq 0.48 \text{ dB/mile}$  (or  $\leq 0.3 \text{ dB/km}$ )
  - j. Attenuation at the Water Peak:  $\leq 2.1 \text{ dB/km}$  @ 1383  $\pm 3 \text{ nm}$
  - k. Chromatic Dispersion:
    - (A) Zero Dispersion Wavelength 1302 to 1322 nm
    - (B) Zero Dispersion Slope 0.092 ps/ (nm<sup>2</sup>•km)
  - l. Maximum Dispersion:
    - $\leq 3.5 \text{ ps/ (nm}\cdot\text{km)}$  for 1285-1330 nm
    - $< 18 \text{ ps/ (nm}\cdot\text{km)}$  for 1550 nm
  - m. Cut-Off Wavelength:  $< 1260 \text{ nm}$
  - n. Mode Field Diameter: 9.2  $\pm 0.4 \mu\text{m}$  at 1310  $\mu\text{m}$ ,  
10.4  $\pm 0.8 \mu\text{m}$  at 1550  $\mu\text{m}$
  - o. Macro bending Loss  
Measured on loose fiber of  
100 turns of 75 mm diameter (tested  
in accordance with EIA-455-62):  $\leq 0.05 \text{ dB}$  @ 1310 nm  
 $\leq 0.10 \text{ dB}$  @ 1550 nm
- 7. Buffer Tubes
  - a. Minimum buffer tube diameter: 0.078 inch
  - b. Maximum buffer tube diameter: 0.12 inch
  - c. Fibers per tube: 2 – 12
  - d. Tubes per cable: 1 – 24
  - e. Water blocking protection: Water-Swellable yarn
- 8. Outer Jacket
  - a. Materials
    - (A) For fiber optic cable designated for outdoor use application: high density or medium density polyethylene as defined by ASTM D1248, Type II, Class C, Category 4, Grade J4, E7 and E8.
    - (B) For fiber optic cable designated for other applications: Provide material meeting specifications under section A.
  - b. Minimum jacket thickness - 0.055 inch.
  - c. Labeling:
    - (A) Additional parameters required on the label:
      - “NJDOT FIBER OPTIC CABLE”
      - # FIBERS “FIBER”
      - “SINGLE MODE”
      - Manufacturer’s name, Date of manufacture.
  - d. Sequential Cable labeling is to be printed on the cable outer jacket every two feet or as designated in the contract documents. Use capital letters for labeling with a text height of 0.1 inch.
  - e. Use contrasting color to the cable jacket for marking.
  - f. Co-extruded stripe color-coded with 0.04 inch stripe width.
  - g. Provide ultra-violet light protection.
- 9. Cable Armor

- a. Cable Armor to provide rodent and corrosion resistance while minimizing the susceptibility to lightning damage. Use of stranded wires in conjunction with tape armor is not permitted.
  - b. Design and Test Criteria: ANSI/ICEA S-87-640
  - c. Material: Electrolytically chrome coated, low carbon steel tape, coated with Polymer material on both sides
  - d. Application: Corrugated Single armor applied longitudinally around outside of water-swellaable tape with overlapping seam
10. Cable Types
- a. Number of fibers, number of buffer tubes, number of fibers per buffer tube, outer jacket stripe color and outer diameter are to be as shown below:

FIBER OPTIC CABLE TYPE	NUMBER OF FIBERS	NUMBER OF BUFFER TUBES	NUMBER OF FIBERS PER BUFFER TUBE	OUTER JACKET STRIPE COLOR	Nominal Outer Diameter (inch)
Type A	48	8	6	Green	0.63
Type B	36	6	6	Blue	0.55
Type C	24	4	6	Orange	0.52
Type D	18	3	6	White	0.52
Type E	12	2	6	Red	0.52
Type F	6	1	6	Red	0.52
Type G	96	8	12	Green	0.54