SECTION 647 – FIBER OPTIC CABLE

647.01 Description. This section applies to the installation of fiber optic cable in accordance with the contract documents.

Due to the intricate nature of HDOT's CCTV and fiber optic cable system, the Bidder's fiber optic cable installer shall have previous experience working with the City and County of Honolulu or HDOT's existing CCTV system for at least three (3) previous projects. Written documentation confirming previous experience working on either CCTV systems or fiber systems shall be submitted to the Project Manager before January 25, 2024, at 3:30 PM (within five (5) working days after bid opening).

The Contractor and Installer shall be responsible for testing all fiber optic cables to provide a documented optical budget loss analysis for each link to and from a hub station. Only the Installer shall perform this work.

The Contractor and Installer shall be responsible for all hookup, assignments, dedication, testing, matching, and splicing of the fiber optic cables, unless otherwise indicated. Only the Installer shall perform this work.

All fiber optic splice points shall be spliced color-for-color whenever matching pairs are available. The Contractor and Installer shall be fully responsible for all splices, budget loss, attenuators, appropriate fiber hardware, accessories, and pigtail connections for a fully operational system. Only the Installer shall perform this work.

647.02 Material. The fiber optic cables will consist of single-mode fibers. Cables will be installed in existing conduits and overhead in the gain area reserved for the traffic signal systems under joint pole agreements. The Installer shall furnish and install fiber optic cable suitable, and meeting standards, for underground and aerial lashing installations. The fiber optic cables shall meet the requirements of the United States Department of Agriculture (USDA) Rural Utilities Service (RUS) 7 CFR 1755.900 and shall be included in the most current 'USDA List Of Acceptable Materials For Use On Telecommunications Systems Of RUS Borrowers'.

(A) Single-mode Fiber. The single-mode fiber utilized in the cable specified herein shall be dispersion unshifted and conform to the following specifications:

Cladding Diameter	125 µm ± 1.0 µm
Core-to-Cladding Offset	Less than 0.6 µm
Cladding Non-Circularity	Less than 1.0%
Coating Diameter	245 µm ± 10 µm
Colored Fiber Diameter	Nominal 250 µm
Attenuation Uniformity	Attenuation Uniformity No point discontinuity greater than 0.10 dB at either 1310 nm or 1550 nm
Attenuation at the Water Peak	The attenuation at 1383 ± 3 nm shall not exceed 2.1 dB/kM
Cutoff Wavelength	The cabled fiber cutoff wavelength shall be less than 1260 nm
Mode-Field Diameter 9.30 ± 0.50 µm at 1310 nm	9.30 ± 0.50 µm at 1310 nm 10.50 ± 1.00 µm at 1550 nm
Zero Dispersion Wavelength	Less than 1301.5 nm
Zero Dispersion Slope	Less than 0.092 ps/(nm2 kM)
Fiber Polarization Mode Dispersion	Less than 0.5ps/kM

The coating shall be a dual layered, UV cured acrylate applied by the fiber manufacturer. The coating shall be mechanically strippable.

(B) Fiber Specification Parameters.

Required Fiber Grade	Maximum individual fiber attenuation
Single Mode	The maximum dispersion shall be less than or equal to 3.2 ps/nmkM from 1285 to 1330 nm and shall be less than 18 ps/nm-kM at 1550 nm

The fiber manufacturer shall proof test all optical fibers to a minimum load of 0.7 GN/m2 (100 kpsi).

(C) Specifications for Outdoor Cable Construction. Optical fibers shall be inside a loose buffer tube in groups of 12. Optical fibers shall be mechanically strippable. Do not use gel filled. The fiber shall be colored with ultraviolet (UV) curable links. Each fiber shall be distinguishable by means of color coding in accordance with TIA/EIA-598- A, “Optical Fiber Cable Color Coding.”

Loose buffer tubes shall also be colored with distinct and recognizable colors in accordance with TIA/EIA-598-A, “Optical Fiber Cable Color Coding” and shall be marked Single mode. Fillers may be included in the cable core to lend symmetry to the cable cross section where needed. Cable construction shall utilize dielectric strength members.

Cable jacket shall be a PVC material that is fungus, water and UV resistant. The jacket shall be marked with the manufacturer's name, sequential meter or foot marking, month and year of manufacture,.

The maximum pulling tension shall be 2700 N (608 lbft) during installation (short term) and 890 N (200 lbft) long term installed.

The shipping, storage, and operating temperature range of the cable shall be -40C to +70C.

(D) Quality Assurance Provision. All cabled optical fibers > 1000 meters in length shall be 100% attenuation tested. Attenuation of each fiber shall be provided with each cable reel.

The cable manufacturer shall be ISO 9001 registered.

(E) Packaging. Top and bottom ends of the cable shall be available for testing.

Both ends of the cable shall be sealed to prevent the ingress of moisture. Each reel shall have a weather resistant reel tag attached identifying the reel and cable.

The reel tag shall include the following information:

Cable number	Gross Weight
Shipped length in meters	Job order number
Product Number	Date cable tested

A cable data sheet shall accompany each cable. Cable data shall include manufacturer number, billable length, bandwidth specs and measured attenuation of each fiber.

647.03 Construction Requirements.

(A) Drawings. The Contractor shall submit a fiber optic cable-pulling drawings for review and acceptance by the Engineer prior to beginning fiber optic cable installation. Do not install fiber optic cable without the Engineer's acceptance of the pulling drawings. The fiber optic cable pulling drawings shall include:

(1) Location of start and end of pulls,

(2) Location of cable reel trailers during installation,

(3) Location of any "figure-eight" of fiber optic cable, and

(4) Location of staged equipment.

Upon completion of the work, submit an 'As Built' in accordance with Subsection 108.13(B) – Pre-Final Inspection and Section 648 – Field Posted Drawings including in detail the following:

(1) Location and attenuation of every event along the installed fiber optic cable,

(2) Index of refraction of installed fiber,

(3) Fiber optic cable index of refraction, and

(4) Sequential fiber optic cable markings at each pullbox, cabinet, and splice closure.

(B) Excavation and Backfill. Excavation and backfill shall conform to Section 206A - Excavation and Backfill for Miscellaneous Facilities.

The Contractor and Installer shall be responsible for the repair of any damage to pavements, sidewalks and other improvements. Place the material from the excavation to prevent damage and obstruction to vehicular and pedestrian traffic and interference with surface drainage.

(C) Fiber Optic Cable. The Installer shall install the new fiber optic cable overhead on existing power poles and underground in conduits as shown in the contract documents. The Contractor and Installer will be responsible for all work and equipment required to install the messenger cable (when there is not already existing messenger cable) on existing joint poles for the overhead portion of the fiber installation. For the underground portion, the Installer will be responsible for furnishing and pulling the new fiber in ductlines using a breakaway swivel to prevent exceeding the tensile load during installation.

All fiber optic splices shall be fusion splices. Do not use mechanical splices. Fiber optic splice locations are permitted only at splice points where splice cabinets are shown on the plans. Fiber optic fibers shall be spliced in every splice cabinet location, and it is the responsibility of the Contractor and Installer to maintain a continuous run throughout the system. The Installer shall leave a minimum of 20-feet of cable service loops at every cabinet or splice location, or utilize aerial cable snowshoes for overhead storage.

Provide documented historical cable pulling data indicating tensile forces exerted on the cable during the installation. Any tension measurements, which exceed the manufacturer's recommendation, will be considered means for the cable rejection. The Contractor and Installer shall be fully responsible for the quality and integrity of the installed cable and the operability of the final fiber optic cable product.

All fibers shall be spliced at camera cabinets, hubs, and splice cabinets and shall have no more than 0.07 dB loss per splice based on the appropriate system operating wavelength.

The Installer shall complete all required fiber optic splices prior to final testing and acceptance. As part of the final testing and acceptance, submit optical time domain reflectometer (OTDR) readings in both hardcopy and electronic formats (such that it can be examined using the manufacturer's OTDR software) to the Engineer for review. Testing shall be conducted on all single mode fibers at 1310nm and 1550nm. Power meter attenuation testing should be performed at dual wavelength, bi-directionally.

All necessary equipment and plug-in, fiber optic pigtails, fittings, enclosures, and work to complete an operational system shall be furnished and installed by the Installer, unless otherwise indicated, at no increase in contract price or contract time.

(D) Services Provided By The County. The City and County of Honolulu, Department of Transportation Services (DTS) will be responsible for all splices and connections in DTS pullboxes and DTS cabinet locations where indicated in the contract documents.

The Contractor and Installer shall be responsible for the following:

(1) Arrange for phases of work with DTS or as specified by the Engineer.

(2) Give at least seven calendar days of advance notice to DTS when phases of the work require its services.

(E) Restoring Pavements and Other Improvements. Restore the existing pavements and other improvements such as driveways, sidewalks, curbs and gutters disturbed by excavation to their original condition in accordance with the contract documents. Materials used for restoration work shall be equal to or better in quality than the materials the Contractor will replace, and matching in thickness, texture, and color whenever applicable. The grades of the restored surfaces shall conform to the existing grades.

(F) Warranty. Materials and equipment installed for permanent construction shall be new. The contract contemplates the use of first-class material and equipment throughout the performance of the contract.

Secure from the manufacturer(s), a warranty or warranties guaranteeing equipment from defects in materials, design and workmanship for not less than 12 months from the date of acceptance.

When requiring adjustments or repairs during the warranty period, adjust or repair the existing unit within 24 hours from the time of notification.

When requiring repairs during the warranty period that cannot be repaired within the initial 24 hours, replace the existing unit with an accepted temporary operational replacement unit within 24 hours from the time of notification. The accepted temporary operational replacement shall remain in operation satisfactorily until the Installer can correct the problem in a manner acceptable to the Engineer or install a new unit. However, installation of the new, identical non-defective unit shall be completed within 30 days from the time of notification.

647.04 Method of Measurement. Fiber optic cables will be paid on a lump sum basis. Measurement for payment will not apply.

647.05 Basis of Payment. The Engineer will pay for the accepted fiber optic cables on a contract lump sum basis. Payment will be full compensation for the work prescribed in this section and the contract documents.

The Engineer will pay for the following pay item when included in the proposal schedule:

Pay Item	Pay Unit
Fiber Optic Cable	Lump Sum

END OF SECTION 647