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ITEM 632 SIGNALIZATION, MISC.: FIBER OPTIC CABLE TESTING (CONT.)

- (3) CABLE INFORMATION; FIBER ID (IF NOT THE FILENAME), CABLE ID (REEL NUMBER & MANUFACTURER'S ID REEL NUMBER), OTDR LOCATION, END OF FIBER LOCATION, OPERATOR ID, DATE SHOT, TIME SHOT.
- (4) THE SET UP PARAMETERS; WAVELENGTH, PULSE WIDTH, REFRACTORY INDEX, RANGE, AND HORIZONTAL SCALE.

EACH TRACE SHALL BE PRINTED (HARD COPY) AND SAVED ON DISK FOR FUTURE REFERENCE.

COST FOR ALL OF THE ABOVE TEST REQUIREMENTS SHALL BE MADE AT THE BID ITEM PRICE FOR ITEM 632 SIGNALIZATION, MISC.: FIBER OPTIC CABLE TESTING. CABLE THAT MUST BE REPLACED DUE TO TEST FAILURE SHALL BE RETESTED AT NO COST TO THE PROJECT.

ITEM 633 CONTROLLER ITEM, MISC.: FIBER OPTIC TRANSCEIVER (MM)
COMMUNICATIONS ON THE FIBER OPTIC CABLE SHALL REQUIRE FIBER OPTIC
TRANSCEIVERS. THE CONTROLLERS ARE TO BE EQUIPPED WITH TRANSCEIVERS CAPABLE
OF COMMUNICATIONS WITH THE SUPPLIED TRAFFIC SIGNAL CONTROLLERS. IT IS THE
CONTRACTORS RESPONSIBILITY TO INSTALL AND ACTIVATE EACH OF THESE MODEMS IN
THE CONTROLLER HOUSING AND CONTACT THE MANUFACTURER FOR REPLACEMENT PANELS
IF NECESSARY. PRICE FOR THE CONTROLLERS IS ITEMIZED SEPARATELY.

PAYMENT SHALL BE MADE AT THE CONTRACT UNIT PRICE BID PER EACH OF ITEM 633, CONTROLLER ITEM, MISC.: FIBER OPTIC TRANSCEIVER (MM)

ITEM 632 SIGNALIZATION, MISC.: FIBER OPTIC TRAINING PLAN
THE CONTRACTOR SHALL SUBMIT A COMPREHENSIVE FIBER OPTIC TRAINING PLAN FOR APPROVAL WITHIN 15 DAYS OF NOTICE OF SIGNED CONTRACT. THE TRAINING COURSE SHALL TAKE PLACE PRIOR TO INSTALLATION. THIS TRAINING SHALL BE FOR TWENTY (20) PERSONNEL TO BE DETERMINED BY THE ENGINEER.

THE TRAINING SHALL BE CONDUCTED BY AN APPROVED INSTRUCTOR WHO CAN DEMONSTRATE A MINIMUM OF 2 YEARS EXPERIENCE IN FIBER OPTICS AND FIBER OPTIC TRAINING WITHIN THE TRANSPORTATION INDUSTRY. THE INSTRUCTOR(S) SHALL BE FAMILIAR WITH THE CABLE TYPES AND EQUIPMENT BEING INSTALLED ON THIS PROJECT. INCLUDED WITHIN THE TRAINING PLAN SHALL BE AN APPROVED FIBER OPTIC TECHNICIAN AS THE INSTRUCTOR'S ASSISTANT. THE PLAN SHALL BE FOR A MINIMUM FOUR (4) DAY FIBER OPTIC TRAINING COURSE, INCLUDING LECTURE, CLASSROOM "HANDS-ON", AND PROJECT FIELD TRAINING. ONE HALF OF THE TOTAL TRAINING COURSE SHALL BE DEDICATED TO VARIOUS CABLE SPLICING AND TESTING EQUIPMENT WORKSHOPS. NO MORE THAN 2 PEOPLE SHALL BE ASSIGNED TO ONE WORK STATION AT A TIME TO ENABLE EACH PERSON THE ABILITY TO WORK WITH FIBER OPTIC CABLE.

THE COURSE SHALL TEACH PROCESSES, FINE TUNE TECHNIQUES AND VERIFY A CRAFTSMAN'S ABILITIES TO INSTALL AND INSPECT CABLE, FAN-OUT, TERMINATE, SPLICE (BOTH MECHANICAL & FUSION), AND TEST (HAND HELD, MINI- OTDR AND FULL SIZE OTDR) FIBER OPTIC CABLE. SPECIFIC FOCUS WILL BE ON THE TRAFFIC INTERCONNECT SYSTEMS, WITH EMPHASIS ON "DROP AND INSERT" (CLOSED LOOP) AND "NETWORK" (DATA LOOP) INSTALLATIONS. AT THE END OF THE COURSE THE STUDENTS WILL BE GIVEN A TECHNICIAN CERTIFICATION TEST TO DETERMINE COMPETENCE.

THE FOLLOWING SUBJECTS SHALL BE COVERED AT MINIMUM. COURSE CONTENT IS NOT LIMITED TO THIS LIST.

FIBER OPTIC THEORY
CABLE TYPES & APPLICATIONS, CABLE MANUFACTURERS OVERVIEW
CABLE PLACEMENT
SHEATH REMOVAL
ARMOR GROUNDING METHODS
DUCT PULLING OPTIONS
AERIAL PULLING OPTIONS
TESTING PROCESSES OVERVIEW (HAND HELD PROCESS, MINI-OTDR, OTDR)
CABLE SPLICING (MECHANICAL & FUSION)
SPLICE ENCLOSURE INSTALLATION & SPLICING DISCUSSION AND WORKSHOP
CABLE FAN-OUT W/KITS
CABLE FAN-OUT W/KITS
CABLE PLACEMENT (DISTRIBUTION BOX)
TERMINATION (FIELD) DISCUSSION AND WORKSHOP
TESTING THE SYSTEM
CLOSURE & SLACK MANAGEMENT
TROUBLE SHOOTING
SYSTEM RESTORATION

TWO(2) SEPARATE SESSIONS OF FOUR (4) DAYS EACH MAY BE PRESENTED TO DIFFERENT GROUPS IN ORDER TO ACCOMMODATE THE 2 PERSON WORK STATION REQUIREMENT. THE TRAINING SITE SHALL BE WITHIN IO MILES OF THE MAINTAINING AGENCY OR AT MUTUALLY AGREED UPON LOCATION. ALL COSTS ASSOCIATED FOR PROVIDING THE ABOVE TRAINING SHALL BE INCLUDED AT THE BID LUMP SUM PRICE FOR ITEM 632 SIGNALIZATION, MISC.: FIBER OPTIC TRAINING PLAN

CABLE INSTALLATION

- BOTH ARIAL AND CONDUIT INSTALLATIONS SHALL COMPLY WITH NO LOAD AND APPLIED LOAD BEND RADII SPECIFIED BELOW. MINIMUM BEND RADIUS 10 X CABLE DIAMETER UNDER NO LOAD (0-180LBS) 20 X CABLE DIAMETER UNDER APPLIED LOAD (181 LBS 400 LBS) MINIMUM BEND DIAMETER IS 2 X MINIMUM BEND RADIUS
- 2. NO FIBER OPTIC CABLE SHALL BE INSTALLED PRIOR TO THE CONTRACTOR SUPPLIES A LETTER OF QUALITY ASSURANCE PER THE FIBER OPTIC CABLE TESTING REQUIREMENTS.
- FIBER OPTIC CABLE INSTALLED IN CONDUIT SHALL BE IN ACCORDANCE WITH THE FOLLOWING: A. NO MORE THAN TWO 90 DEGREE CHANGES IN DIRECTION PER CABLE PULL. B. CIRCUITOUS PULLS AND PULLS EXCEEDING 1000 FEET (300 METER) SHALL BE MADE BY BACK FEEDING OR CENTER FEEDING OF CABLE. C. AFTER INSTALLATION THERE SHALL BE NO TENSION EXCEPT DUE TO CABLE WEIGHT. D. TENSION OF CABLE SHALL BE MONITORED WITH A TENSIOMETER DURING INSTALLATION. E. THE APPLIED TENSION SHALL NOT EXCEED 400 POUNDS. F. THE CENTRAL STRENGTH MEVBER AND THE ARAMID YARN SHALL BE DIRECTLY ATTACHED TO THE PULLING EYE. "BASKET GRIP" OR "CHINESE FINGER" TYPE ATTACHMENTS TO THE OUTER JACKET OF THE CABLE WILL NOT BE PERMITTED. A BREAKAWAY SWIVEL SHALL BE USED ON ALL PULLS. G. FOR UNDERGROUND INSTALLATION IN EXISTING CONDUIT, THE CONTRACTOR SHALL INSTALL FIBER OPTIC CABLE WITHIN I' (25 MM) INNERDUCT. A DETECTABLE TAPE SYSTEM IS NOT REQUIRED WHEN INSTALLING FIBER OPTIC CABLE IN EXISTING CONDUIT, HOWEVER, A TONE WIRE MUST BE INSTALLED IN THE CONDUIT TO PROVIDE A METHOD OF LOCATING FIBER/CONDUIT BETWEEN PULL BOXES. THE TONE WIRE SHALL HAVE SUFFICIENT LENGTH STORED WITHIN PULL BOXES TO PROVIDE FOR THE ATTACHMENT OF ELECTRONIC EQUIPMENT. IF CONTRACTOR REMOVES COPPER CABLE IN CONDUIT AFTER FIBER TESTING, FIBER AND TONE WIRE MUST BE TESTED AGAIN FOR APPROVAL BY THE ENGINEER.
- 4. FIBER OPTIC CABLE INSTALLED AERIALLY SHALL BE PROVIDED WITH A SAG OF 3% - 5% UNLESS EXISTING CABLES WILL BE SHARING THE POLE IN WHICH CASE A SAG MATCHING THE EXISTING CABLES SHALL BE PROVIDED.

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