FIBER OPTICS

ITEM 632 INTERCONNECT MISC.: SLACK INSTALLATION

WHERE DESIGNATED IN THE PLANS, THE CONTRACTOR SHALL PROVIDE AN AERIAL MOUNTED SLACK CABLE INSTALLATION CONFORMING TO THE ENCLOSED DETAILS. WHERE AN UNDERGROUND INSTALLATION IS REQUIRED, THE CONTRACTOR SHALL PROVIDE 150 FEET (45 M) OF SLACK CABLE INSIDE OF THE DESIGNATED PULL BOX. CABLE STORED IN PULL BOXES SHALL BE NEATLY LASHED AND ATTACHED TO THE SIDE OF THE PULL BOX BY TIE WRAP OR OTHER APPROVED MEANS. SLACK CABLE SHALL NOT BE STORED ON THE FLOOR OF THE PULLBOX.

ALL COSTS INCLUDING MATERIALS, EQUIPMENT AND LABOR TO PROVIDE A SLACK INSTALLATION SHALL BE AT THE BID ITEM PRICE FOR EACH ITEM 632 INTERCONNECT MISC.: SLACK INSTALLATION. NOTE THE COST FOR THE FIBER OPTIC CABLE USED IN THE SLACK INSTALLATION (BOTH AERIAL AND UNDERGROUND) SHALL BE INCLUDED IN THIS PAY ITEM. THE QUANTITY 150 FEET (45 M) OF SLACK CABLE IS INCLUDED IN THIS PAY ITEM AND IS NOT ITEMIZED IN THE LINEAR BID ITEM PRICE OF THE FIBER OPTIC CABLE BACK BONE CABLE. SEE SHEET 186 FOR LOCATION OF SLACK INSTALLATION.

ITEM 632 SIGNALIZATION, MISC.: FIBER OPTIC CABLE TESTING

OTDR'S SHALL BE CALIBRATED TO SHEATH (JACKET) LENGTH, NOT OPTICAL LENGTH BY ADJUSTING THE UNIT'S INDEX OF REFRACTION.

WORST CASE WAVELENGTHS SHALL BE USED FOR TESTING. IN THE CASE OF MULTI-MODE CABLE, 850 AND IN THE CASE OF SINGLE MODE FIBERS A WAVE LENGTH OF 1550 SHALL BE USED.

ALL OTDR TRACES SHALL MAXIMIZE BOTH THE VERTICAL AND HORIZONTAL SCALES TO THE GREATEST EXTENT POSSIBLE AND STILL FIT THE ENTIRE TRACE ON THE SCREEN.

LEAST SQUARE AVERAGING (LSA) METHOD SHALL BE USED TO MEASURE EVENTS WITH THE OTDR.

A SERIES OF TESTS SHALL PERFORMED BY THE CONTRACTOR AT VARIOUS STAGES OF CONSTRUCTION. FAILURE OF A LINK AT ANY PART OF THE TESTING SHALL RESULT IN THE CONTRACTOR TO REPAIR THE PROBLEM AND RETEST THE INSTALLATION. COST FOR ANY REQUIRED REPAIR AND RETESTING SHALL BE BOURNE SOLELY BY THE CONTRACTOR.

1. PRE-INSTALLATION TESTING (TESTED WITH OTDR IN ONE DIRECTION) PRIOR TO ANY WORK THE CONTRACTOR SHALL CERTIFY TO THE ENGINEER THAT ANY AND ALL FIBER OPTIC CABLE THAT SHALL BE USED ON THIS PROJECT HAS BEEN DELIVERED TO THE WORK SITE AND/OR THE CONTRACTOR'S STORAGE FACILITY WITHIN THIS SECTION'S SPECIFICATIONS. COMPLIANCE WITH THIS REQUIREMENT MAY BE ACCOMPLISHED IN ONE OF TWO WAYS.

   (A) THE CONTRACTOR SHALL TEST ALL FIBERS ON EACH REEL OF CABLE PRIOR TO INSTALLATION ACCORDING TO THE TESTING PROCEDURE OUTLINED BELOW UNDER "CONTINUITY TESTING."

   UPON COMPLETION OF THESE TEST PROCEDURES THE CONTRACTOR SHALL ISSUE TO THE ENGINEER ALL TEST DATA AS SPECIFIED AND A "LETTER OF QUALITY ASSURANCE" FROM THE CONTRACTOR STATING THAT THE FIBER CABLE HAS BEEN DELIVERED TO THE CONSTRUCTION SITE AND/OR THE CONTRACTOR'S STORAGE FACILITY IS IN CONFORMANCE WITH THE SPECIFICATIONS. UPON RECEIPT OF THE LETTER OF QUALITY ASSURANCE AND THE ENGINEER'S ACKNOWLEDGMENT OF SAID RECEIPT, THE CONTRACTOR MAY COMMENCE INSTALLATION OF SAID CABLE AT THE CONTRACTOR'S RISK. AT THIS POINT THE CABLE MANUFACTURER WILL BE HELD BLAMELESS FOR QUALITY OF THE FIBER OPTIC CABLE. THIS DOES NOT VOID MANUFACTURER WARRANTY. THE LETTER OF QUALITY ASSURANCE SHALL CERTIFY TO THE ENGINEER THAT THE CABLE DELIVERED TO THE PROJECT IS ACCEPTABLE FOR INSTALLATION AND ANY PROBLEMS THAT DEVELOP DURING OR AFTER INSTALLATION ARE CONSTRUCTION RELATED AND THEREFORE THE RESPONSIBILITY OF THE CONTRACTOR.

   (B) THE CONTRACTOR MAY CERTIFY TO THE ENGINEER WITHOUT TESTING THE FIBERS THAT THE FIBER CABLE DELIVERED TO THE SITE AND/OR HIS STORAGE FACILITY IS IN CONFORMANCE WITH THIS SPECIFICATION, IF THE CONTRACTOR SUPPLIES TO THE ENGINEER THE COMPLETE FACTORY TEST RESULTS, ACCOMPANIED BY A "LETTER OF QUALITY ASSURANCE" FROM THE CONTRACTOR. UPON RECEIPT OF THE LETTER OF QUALITY ASSURANCE, AND THE ENGINEER'S ACKNOWLEDGMENT OF SAID RECEIPT, THE CONTRACTOR MAY COMMENCE INSTALLATION OF SAID CABLE AT THE CONTRACTOR'S RISK. THIS DOES NOT VOID MANUFACTURER WARRANTY. THE LETTER OF QUALITY ASSURANCE SHALL CERTIFY TO THE ENGINEER THAT THE CABLE DELIVERED TO THE PROJECT IS ACCEPTABLE FOR INSTALLATION AND ANY PROBLEMS THAT DEVELOP DURING OR AFTER INSTALLATION ARE CONSTRUCTION RELATED AND THEREFORE THE RESPONSIBILITY OF THE CONTRACTOR.

2. TESTING AFTER TERMINATION AND/OR SPLICING
UPON COMPLETION OF THE PULLS, ALL SPLICES, AND AFTER THE COMPLETION OF TERMINATION OF CABLE ENDS; EACH AND ALL FIBERS WITHIN EACH SECTION OF THE CABLE PULL SHALL BE TESTED FOR CONTINUITY, EVENTS ABOVE 0.30 DB, AND TOTAL ATTENUATION OF THE CABLE. THE TEST SHALL BE CONDUCTED ACCORDING TO THE TESTING PROCEDURE AS OUTLINED BELOW.

   THIS TEST PROCEDURE WILL BE WITNESSED BY THE ENGINEER. NO EVENT SHALL EXCEED THE THRESHOLDS GIVEN IN THESE SPECIFICATIONS, IF ANY EVENT IS DETECTED ABOVE THE MAXIMUM LEVEL, THE CONTRACTOR SHALL REPLACE OR REPAIR THAT EVENT POINT TO THE SATISFACTION OF THE ENGINEER. THE TOTAL DB LOSS OF THIS TRACE, LESS EVENTS, SHALL NOT EXCEED THE MANUFACTURER'S PRODUCTION SPECIFICATIONS AS FOLLOWS:

FIBER	WAVELENGTH (NM)	MAXIMUM ATTENUATION(DB/KM)
MULTIMODE	850	3.5
SINGLE-MODE	1550	0.4

   IF THE TOTAL LOSS EXCEEDS THESE SPECIFICATIONS, THE CONTRACTOR SHALL REPLACE OR REPAIR THAT CABLE RUN AT THE CONTRACTOR'S EXPENSE, BOTH LABOR AND MATERIALS. ELEVATED ATTENUATION DUE TO EXCEEDING THE PULLING TENSION DURING INSTALLATION WILL REQUIRE THE REPLACEMENT OF THE CABLE RUN AT THE CONTRACTOR'S EXPENSE, BOTH LABOR AND MATERIALS.

   UPON COMPLETION THE CONTRACTOR SHALL ISSUE TO THE ENGINEER ALL TRACES AND LOSS/LENGTH PRINT OUTS AND COMPUTER FILES (ASCII FORMAT) FOR APPROVAL.

   NOTE: AT THE CONTRACTOR'S OPTION, THE ENGINEER WILL ALLOW THE "DIRECTIONAL/AVERAGING" PROCESS OF OTDR TESTING WHEN SPLICE LOSSES ARE BEING UNFAVORABLY IMPACTED BY "MODE FIELD DIAMETER MISALIGNMENT", "CORE OFFSET" OR "CORE MISALIGNMENT".

3. CONTINUITY TESTING
THIS TEST IS FOR CONTINUITY AND ATTENUATION PER KILOMETER, ALONG WITH A GRAPHIC REPRESENTATION OF THE OPTICAL FIBER, "TRACE". THE TEST SHALL BE CONDUCTED ON THE 850 NM MULTIMODE, 1300 NM MULTIMODE AND 1550 NM SINGLE-MODE WITH AN OPTICAL TIME DOMAIN REFLECTOMETER (OTDR) BY A QUALIFIED TECHNICIAN. ALL FIBERS INCLUDING NON-USED (SPARE) FIBERS SHALL BE TESTED FOR CONTINUITY.

   THE METHOD OF CONNECTIVITY BETWEEN THE OTDR AND THE CABLE SHALL BE A FACTORY PATCH CORD OF A LENGTH GREATER THAN OR EQUAL TO THE "DEAD ZONE" OF THE OTDR WITH THE SPLICE TO THE PREPARED END OF THE FACTORY FIBER VIA "LAB SPLICE" OR THE CONTRACTOR CAN USE A FACTORY "FIBER BOX" OF 328 FEET (100 M) MINIMUM WITH NO SPLICES WITHIN THE BOX. IF A PATCH CORD IS UTILIZED, THE LENGTH OF PATCH CORD SHALL BE STORED ON A FIBER STORAGE BOBBIN WITH A MINIMUM DIAMETER OF 4" (10 CM).

   THE FIBER "TRACES" CREATED BY THE OTDR SHALL DEMONSTRATE THAT THE CABLE HAS PERFORMANCE CAPABILITIES WITHIN -3% TO +3% OF THE FACTORY TEST DOCUMENTATION THAT CAME WITH THAT REEL OF FIBER OR 1% OF THE CABLE'S PUBLISHED PRODUCTION DB LOSS PER KM PLUS THE MAXIMUM OTDR ERROR LEVEL AS NOTED BY THE MANUFACTURER OF THE OTDR (TYPICALLY +2%).

   EACH TRACE SHALL INCLUDE THE FOLLOWING DATA:
   (1) THE TRACE ITSELF WITH A LAUNCH TRANSITION NOT TO EXCEED 6 DB.

   (2) MEASUREMENT RESULTS; CURSOR, MARKER, DISTANCE BETWEEN CURSOR AND MARKER, TOTAL LOSS BETWEEN LAUNCH POINT AND END OF FIBER, ATTENUATION CALCULATION IN DB/MILE (DB/KM)

CALCULATED ACB
CHECKED BJK

TRAFFIC SIGNAL GENERAL NOTES

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