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Ensuring Reliability By Proper Fiber Optic Installation

Reliability Vs. Installation Cost

The goals of a fiber optic installation should not be solely based on achieving the lowest initial cost. Should lowest cost result in reduced reliability, lowest initial cost may result in significantly increased lifecycle cost. Such a choice is undesirable.

Instead, the project manager should make the choice based on achieving the maximum possible reliability. To make this choice, the project manager needs to understand the conditions that indicate installed reliability.

In this series of articles, I my present my experience of installed reliability as three sets of understandings. In this article, I present the first set: the conditions that represent high reliability. In a second article, I present the second set: test results that indicate high reliability. In a third article, I present a format for requirements for acceptance of an installed network. As installation includes installation of cables, connectors, and splices. I present separate conditions for each of these products.

Cable Reliability Results from Stress-Free Installation

Stress on the fiber results in two reductions in reliability. The first is the potential for breaking, often many years after installation. From a project manager's point of view, this is problematic: the project manager cannot go to the installation organization and claim that the installation was improper.

The installer’s response might be: the fiber did not break upon initial installation and therefore, something else caused the break. Obviously, this is a situation in which the project manager has no argument or data to convince the installer to repair the cable without charge.

Stress on the cable can result from 2 conditions: violation of the minimum recommended bend diameter and installation that induces longitudinal stress on the fiber. Proper installation avoids both causes. Demonstration of proper installation involves testing and proper interpretation of test results. I present testing and interpretation in second article of this series.

The second reduction in reliability results from increased power loss in the cable caused by stress. Increased power loss reduces power delivered to the receiver. This reduction results in a reduced ‘operating margin in the fiber optic link. This margin is the difference between the maximum loss that the transmitter-receiver pair can tolerate and the as-installed link loss. This margin is the maximum increase in loss that can occur during the life of the link. In summary, stress on the cable reduces reliability in two ways, through reduced cable life and reduced link life.

Connector Reliability Results from Feature-Free Core and Contamination-Free Ferrule.

Proper connector installation results from 1) proper fiber ferrule endface finish and 2) ferrule surfaces without contamination. Features on the core can block or divert the light from its normal path, resulting in increased power loss. Contamination of the cladding or ferrule may result in in incomplete contact of the connectors, which in turn, can result in increased separation of the two ferrules and increased power loss and reflectance.

Splice Reliability Results from Proper Routing

Proper splice installation results in low power loss and minimal reflectance. Proper splice installation results from six factors: correct fusion splicer setup, low angle cleaves, clean fibers, uniform splice diameter, bubble free splice, and proper routing (aka dressing) of the fiber in both the splice tray and the closure. The fusion splicer machine operates with acceptance limits on the first five factors, resulting in rejection of conditions in violation of these limits. Installation personnel control the routing of fibers in closures.

Improper routing can result in increased power loss due to bend diameter violation of the fibers (as in cables) within the tray and enclosure. This increased power loss reduces link lifetime through reduction of the operating margin. Improper routing can also result in fibers extending out of the tray that can get pinched or broken when trays are closed or stacked.

In Conclusion

With the understanding from this article, the manager can evaluate candidate installation suppliers through their answers to the question: how do you ensure and verify reliable installation of cables, connectors, and splices? In future articles, I will the present the subjects of test results that indicate high reliability and requirements of acceptance.

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For 45 years, Pearson Technologies Inc. has provided fiber training and consulting in North America, the Far East, and Europe. Mr. Pearson was a founding Director of the Fiber Optic Association and a Master Instructor for the FOA.

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