Comparison of Low Loss and Delay Performance of Fiber Optic Fusion Splice Boxes

Overview

These results demonstrate that mass fusion splicing with flexible ribbons is not only fast and reproducible but also achieves ultra-low loss, even with passive V-groove alignment.

Key Takeaways

Fusion splice boxes provide superior low-loss performance and long-term reliability compared to mechanical splice boxes, making them the preferred choice for permanent fiber optic networks.

Low Loss Performance

Fusion splicing achieves extremely low insertion loss, typically under 0. 05 dB per splice, due to the permanent glass-to-glass joint formed by melting fiber ends together. Laboratory tests on mass fusion splicing with flexible ribbon fibers have demonstrated average splice losses below 0.

02 dB, with 97% of fibers showing losses of 0. 04 dB or less, far exceeding ITU-T standards. The use of heat-shrink splice protectors does not increase insertion loss, ensuring both protection and optical performance.

In contrast, mechanical splicing generally produces higher losses, ranging from 0. 1 to 0. 5 dB per splice, because fibers are aligned and held with gel or adhesive rather than fused.

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This difference is critical in networks with tight loss budgets, such as FTTH deployments.

Lifespan and Reliability

Fusion splice boxes offer long-term stability because the fused joint forms a continuous glass path, making it highly resistant to environmental stress, vibration, and temperature fluctuations. Mechanical splices, while faster and easier to deploy in temporary or low-cost installations, are more sensitive to environmental conditions and may degrade over time, leading to increased insertion loss and potential network downtime. Fusion splice boxes also allow for consistent performance across multiple fibers, especially in mass fusion splicing of ribbon cables, reducing the likelihood of outliers that could affect network reliability.

Practical Considerations

Installation Speed: Mechanical splicing is faster for small-scale or temporary setups, but mass fusion splicing can efficiently handle multiple fibers simultaneously, reducing overall deployment time for large networks. Maintenance: Fusion splice boxes require minimal maintenance due to the permanent nature of the splice, whereas mechanical splices may need periodic inspection or rework. Cost: While fusion splicing equipment is more expensive upfront, the total cost of ownership is lower over time due to reduced rework, lower loss, and longer lifespan.

Conclusion

For permanent fiber optic networks, fusion splice boxes outperform mechanical splice boxes in both low-loss performance and lifespan. Mass fusion splicing with flexible ribbon fibers further enhances efficiency and consistency, achieving ultra-low insertion loss while maintaining long-term reliability. Mechanical splicing remains suitable for temporary or low-cost deployments but is generally not recommended for critical or long-term infrastructure.

Article Content

Ultra-Low Splice Loss: Mass Fusion Splicing

These results demonstrate that mass fusion splicing with flexible ribbons is not only fast and reproducible but also achieves ultra-low loss, even with passive V-groove alignment.

Fusion Splicing of Fibers – electric discharge, fusion splicers

Fusion splicing provides the lowest possible splice loss and weakest reflections compared to other methods. The resulting joints are extremely stable and robust because the fiber is permanently fused

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Is That Splice Really Good Enough? Improving Fiber Optic Splice

A review of currently available standards related to optical fiber splicing and splice loss measurements revealed that they do not adequately address the very low splice loss specifications

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This document is for preliminary research. Verify specifications against current standards, product documentation and project requirements.

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