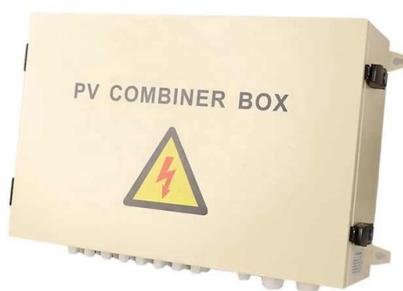


Enterprise Standards for Hollow-Core Optical Fiber



Overview

An RFS Guide to Hollow Core Fiber [Updated August 2026]Hollow Core Fiber (HCF) is an advanced optical fiber technology designed to meet the growing demand.

Key Takeaways

Hollow-core optical fiber (HCF) is emerging as a next-generation fiber technology with unique performance characteristics, requiring adapted testing, deployment, and certification standards for enterprise networks.Key Properties and Performance Metrics

HCF guides light through an air-filled core rather than solid glass, offering lower latency, reduced chromatic dispersion, and minimal nonlinear effects compared to standard single-mode fiber (SMF) (latency $\sim 3.33 \mu\text{s}/\text{km}$ vs. $\sim 4.9 \mu\text{s}/\text{km}$ in SMF) and chromatic dispersion below $5 \text{ ps}/\text{nm}/\text{km}$ (vs. $\sim 17 \text{ ps}/\text{nm}/\text{km}$ in SMF) . Attenuation can be reduced below $0.11 \text{ dB}/\text{km}$, and the fiber supports a wider low-loss spectral region, enabling ultra-wideband transmission . Nonlinear effects such as stimulated Raman scattering are negligible, simplifying power optimization in high-capacity networks .

Testing and Certification Considerations

HCF requires adapted testing protocols because conventional OTDR and SMF-based methods are insufficient. Key considerations include:

- Weak Rayleigh backscatter ($\sim 14\text{--}20 \text{ dB}$ lower than SMF), which reduces OTDR trace visibility and event detection .

- Non-uniform backscatter coefficients due to microstructural variations and gas infiltration, necessitating bidirectional OTDR analysis.
 - High-reflection transitions at splices or SMF-HCF interfaces, creating potential OTDR dead zones .
 - Spectral attenuation measurements across the intended transmission band, often starting in the S-band (~1450 nm), to detect bending and absorption anomalies .
 - Dispersion testing remains important despite low chromatic and polarization mode dispersion, ensuring signal integrity in latency-sensitive applications .
- Deployment and System-Level Standards

Enterprise deployment of HCF involves:

- Fiber types: Photonic Bandgap Fiber (PBGF) and Anti-Resonant Hollow-Core Fiber (AR-HCF) are commonly used, each with specific confinement mechanisms .
- Splicing and connectorization: Specialized splicing techniques are required for HCF-to-HCF and HCF-to-SMF transitions to minimize reflections and insertion loss .
- System validation: Round-trip delay measurements and comparison with equivalent SMF links are recommended to quantify latency reduction (~30%) .
- Amplification: Optical amplifiers must be compatible with HCF's low nonlinearity and wide spectral range .

Emerging Standardization Efforts

While formal enterprise standards are still evolving, best practices are being established through:

- Field trials and early operational deployments in data center interconnects, metro, and long-haul networks .
- Alignment with ITU-T and IEEE recommendations for optical fiber testing and deployment, adapted for HCF's unique properties .
- Development of an ecosystem including connectors, splicers, and amplifiers tailored to HCF, as demonstrated by Microsoft's DNANF deployments .

Summary

Hollow-core fiber offers transformative advantages for enterprise networks, including ultra-low latency, minimal nonlinear effects, and broad spectral bandwidth. Enterprise standards for HCF focus on adapted testing, certification, and deployment protocols, with attention to OTDR measurement adaptations, spectral and dispersion characterization, and specialized splicing. While formalized standards are still emerging, current best practices provide a robust framework for integrating HCF into next-generation optical transport networks .

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