Optical cables are classified by cable core

Overview

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Key Takeaways

Optical cables are primarily classified by their core into single-mode and multimode fibers, with further distinctions based on core size and refractive index profile.Core-Based Classification

1. Single-Mode Fiber (SMF) Single-mode fibers have a small core diameter, typically around 8–10 µm, allowing only one light mode to propagate. This design minimizes modal dispersion, enabling long-distance, high-speed transmission over tens or hundreds of kilometers. Single-mode fibers are commonly used in telecommunications, long-haul networks, and high-bandwidth applications where signal integrity over long distances is critical . 2. Multimode Fiber (MMF) Multimode fibers feature a larger core, usually 50 µm or 62.5 µm, which allows multiple light modes to travel simultaneously. This makes them suitable for short-distance communication, such as within local area networks (LANs). Multimode fibers are cost-effective and compatible with LEDs or VCSELs as light sources, but they experience higher modal dispersion, limiting their effective transmission distance .

Refractive Index-Based Classification

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1. Step-Index Fiber In step-index fibers, the core has a uniform refractive index, and the cladding has a slightly lower refractive index. Light travels in a zigzag pattern due to total internal reflection. Step-index fibers are simple and robust, suitable for both single-mode and multimode applications, particularly for short to medium distances .
2. Graded-Index Fiber Graded-index fibers have a core with a gradually decreasing refractive index from the center outward. This design reduces modal dispersion by allowing light rays traveling different paths to arrive at the receiver simultaneously, improving signal quality over longer distances in multimode fibers. Graded-index multimode fibers are widely used in enterprise networks and data centers .

Summary of Core CharacteristicsTypeCore DiameterLight ModesTypical UseAdvantagesSingle-Mode8–10 µm1Long-haul, telecomLow dispersion, high bandwidthMultimode (Step-Index)50–62.5 µmMultipleLAN, short-distanceSimple, cost-effectiveMultimode (Graded-Index)50–62.5 µmMultipleLAN, data centersReduced dispersion, better signal quality

The core material is usually ultra-pure glass (silica) or plastic, and it is surrounded by cladding to maintain total internal reflection. The choice of core type directly affects transmission distance, bandwidth, and compatibility with light sources, making it a critical factor in optical network design .

Article Content

Core (optical fiber)

The core of a conventional optical fiber is the part of the fiber that guides the light. It is a cylinder of glass or plastic that runs along

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