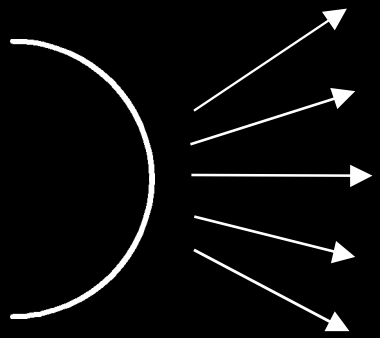
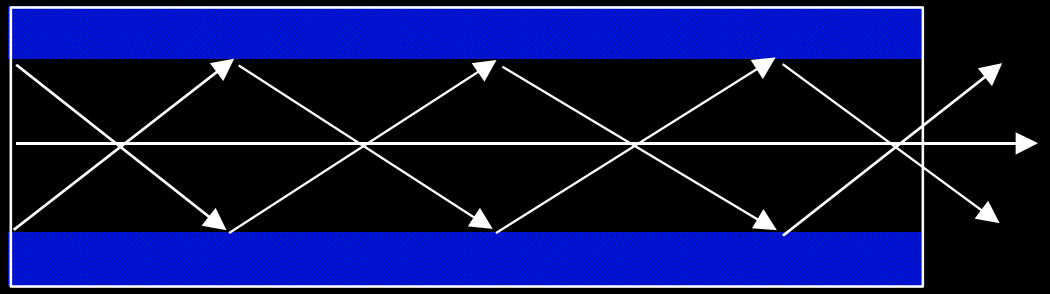
What is Fiber Optics?

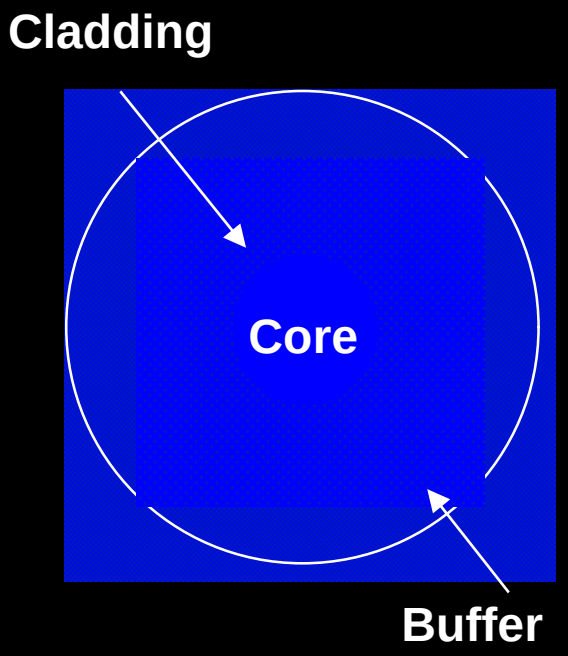
Use rays of light to send large quantities of information over hair thin fiber at very high speeds



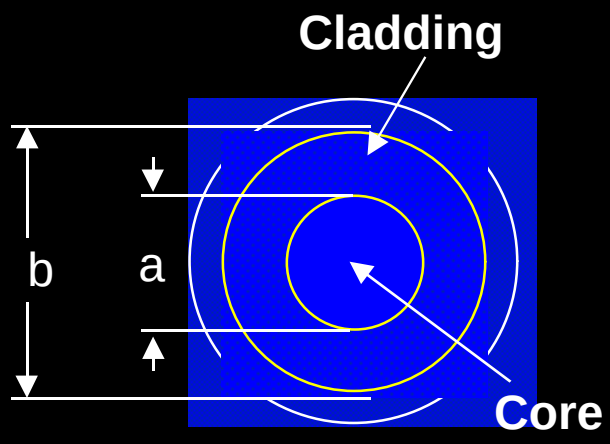


The Optical Fiber

- Core
  - usually glass
  - carries the light signal
- Cladding
  - keeps the light within the core
- Buffer
  - protective coating



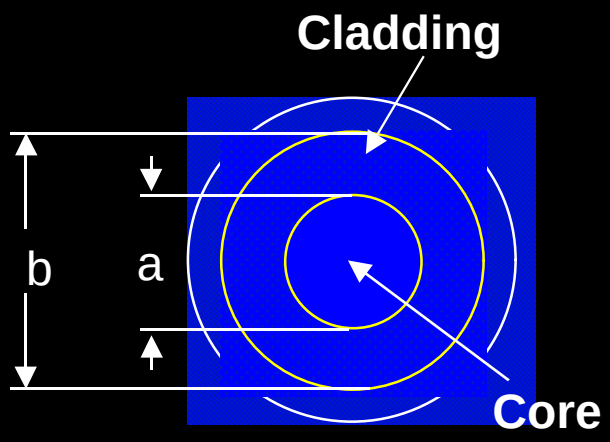
Fiber Size



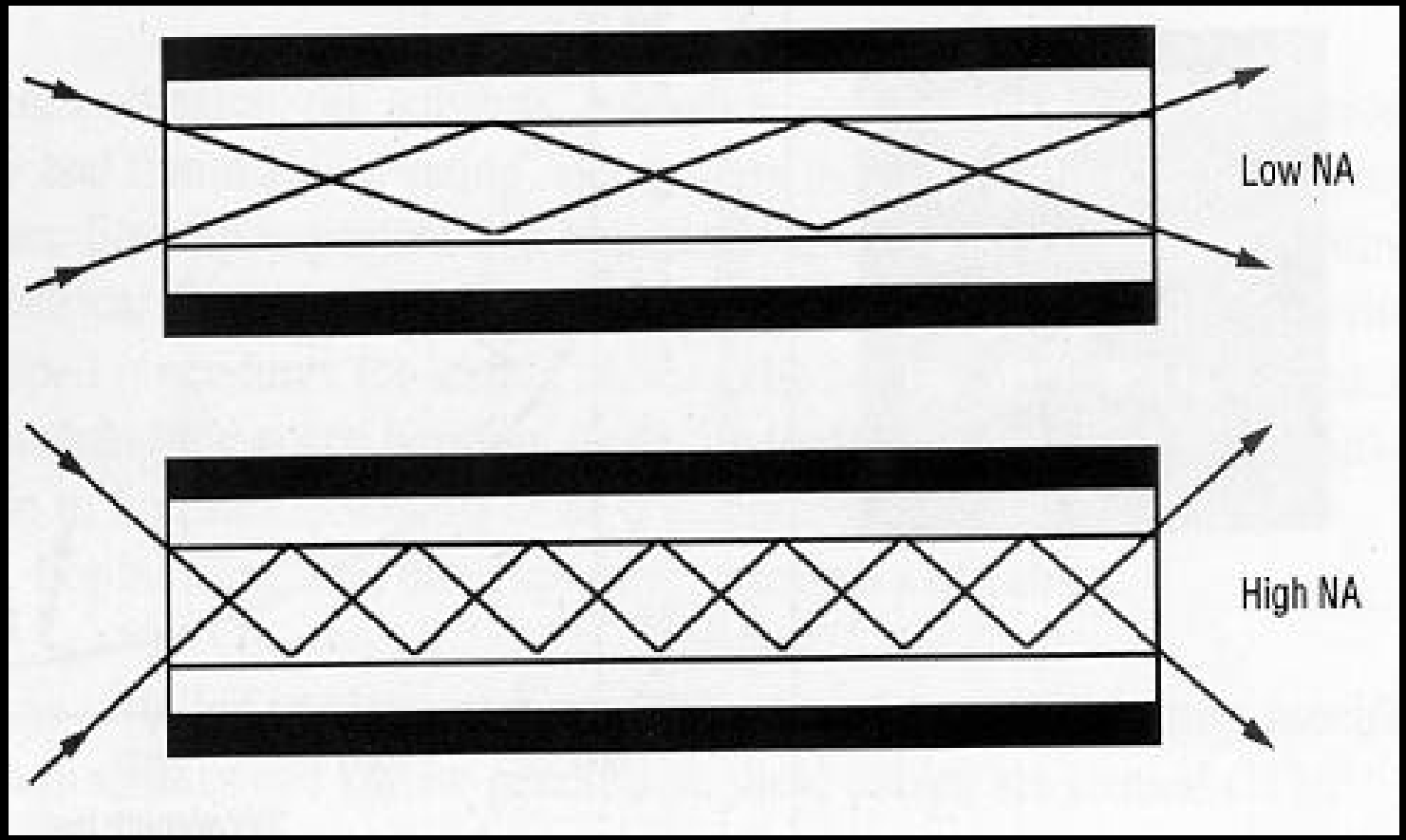
- Measured in microns (1 millionth of a meter)
- Human hair = 85 µm

Fiber Size

- Most common industrial sizes
  - 9/125 µm
  - 50/125 µm
  - 62.5/125 µm
  - 100/140 µm
  - 200/230 µm

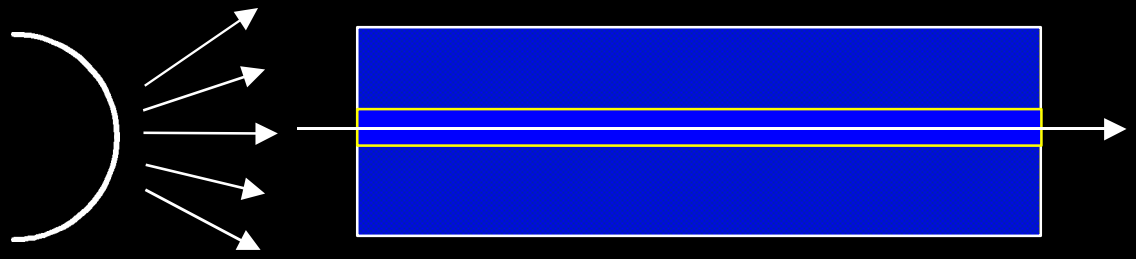


Numerical Aperture

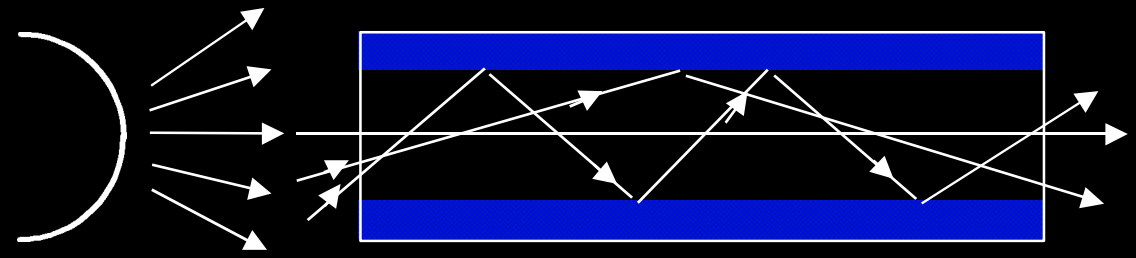


Structure

- The structure of the fiber determines how light travels through it - modes

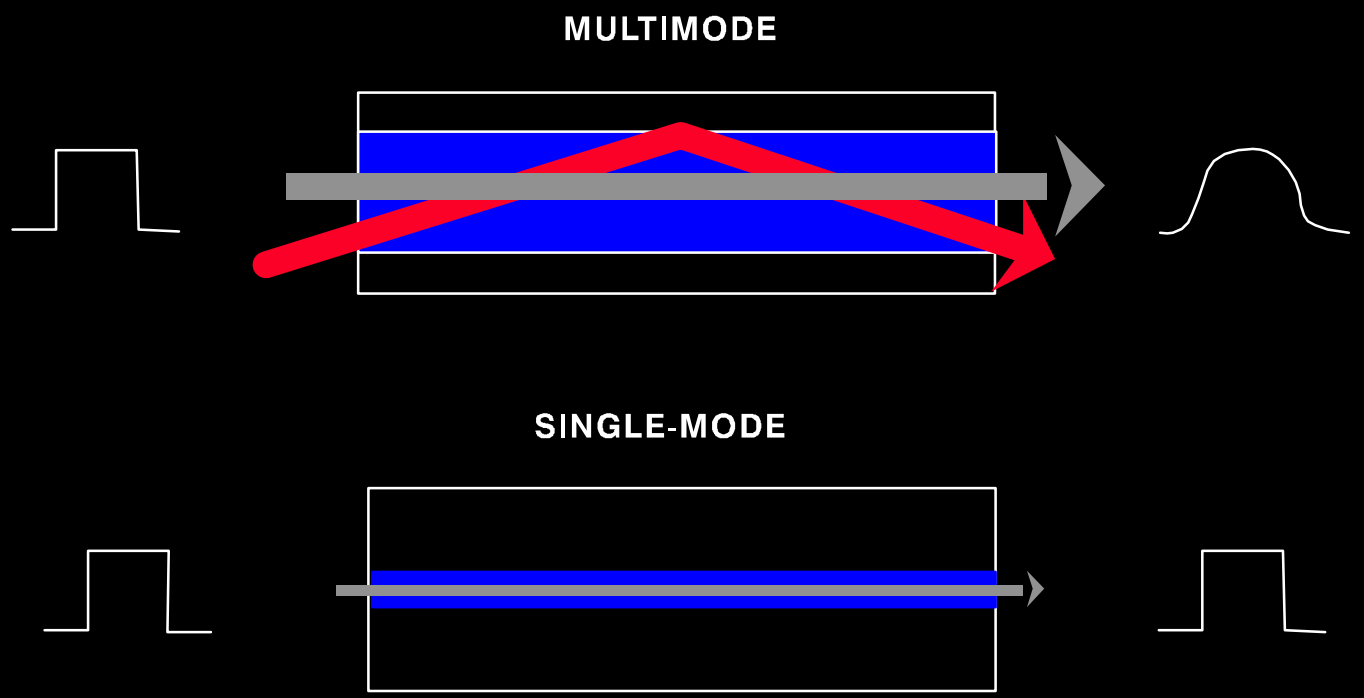


Single-mode Fiber:
A single path through the fiber.

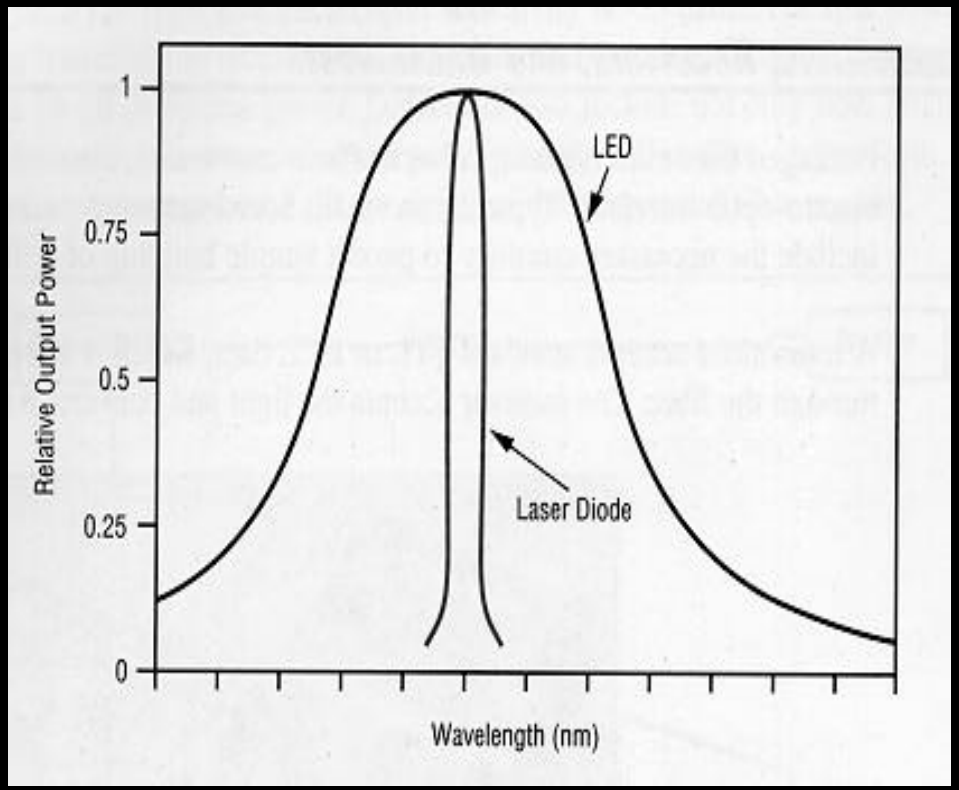


Multimode Fiber:
Multiple paths through the fiber.

Multi vs Single Mode



Equipment Factors (cont)



- Spectral width
  - all light sources emit a range of wavelengths around a center wavelength
  - for LED this is about 50 nm in the 1300 nm window (100 for 850 nm)
  - for a laser it is less than 5 nm

Dispersion

- Modal dispersion (mode = pathway)
  - Various modes follow different paths, resulting in pulse broadening
- Chromatic dispersion
- Material dispersion

Typical Attenuation Values

- Cable
  - singlemode - 9um
    - 0.5 dB/km @ 1300 nm
  - multimode - 62.5um
    - 3.5 dB/km @ 850 nm
    - 1.5 dB/km @ 1300 nm
  - large core - 200um
    - 6-8 dB/km @ 850 nm
- Connectors
  - adhesive/polish

    62.5um

    0.5 - 0.75 dB
  - crimp & cleave

    200um

    1.5 - 2dB

Bandwidth

- Bandwidth is the amount of information that a fiber can carry
- Specified in MHz / km
- Industrial fiber = 20 MHz / km
  Datacom fiber = 500 MHz / km
  Telecom fiber = >2 GHz

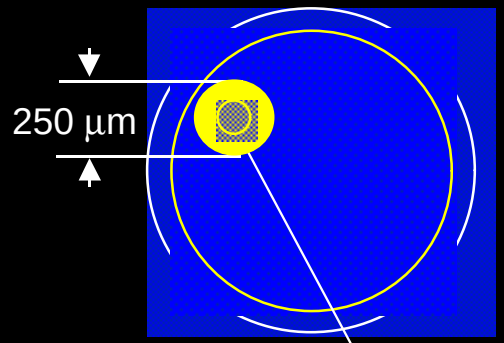
Fiber Comparison

	Size µm	Source	λ nm	Attenuation dB/km	Bandwidth Mhz/km
Singlemode	9/125	Laser	1300 - 1500	.3 - .6	>GhZ
Multimode	62.5/125	LED	850 - 1310	1.5 - 3.5	100 - 500
Large Core	200/230	LED	850	6 - 8	20
Plastic	980/1000	LED	660	220	5

Cable Construction

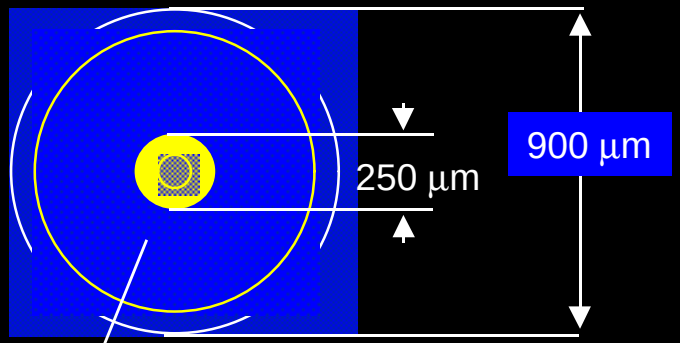
- Two Basic Types:
  - Loose Tube (Outdoors)
  - Tight Buffer (Indoors)

Loose Tube



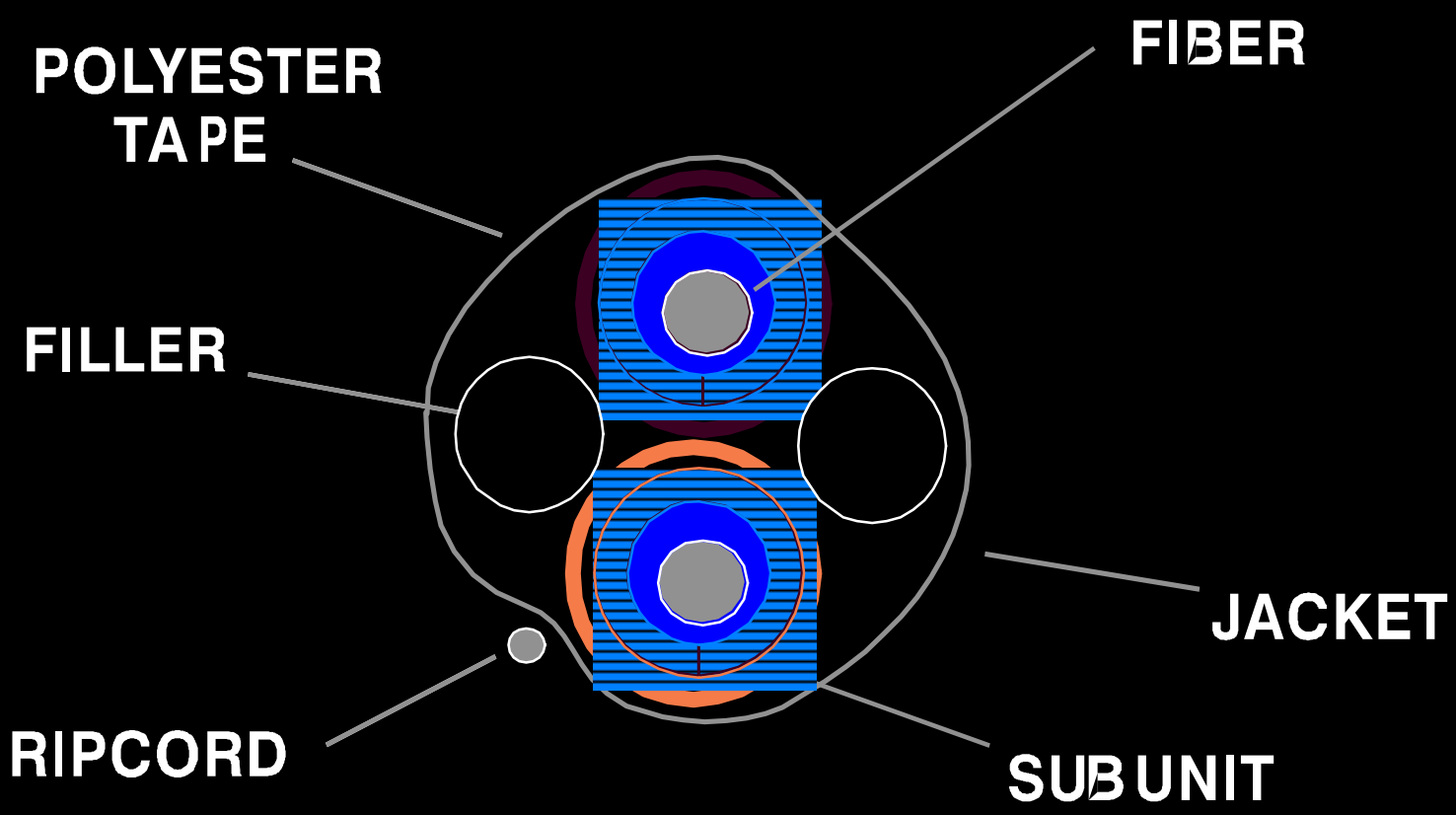
Optical Fiber with
250 µm Buffer

Tight Buffer

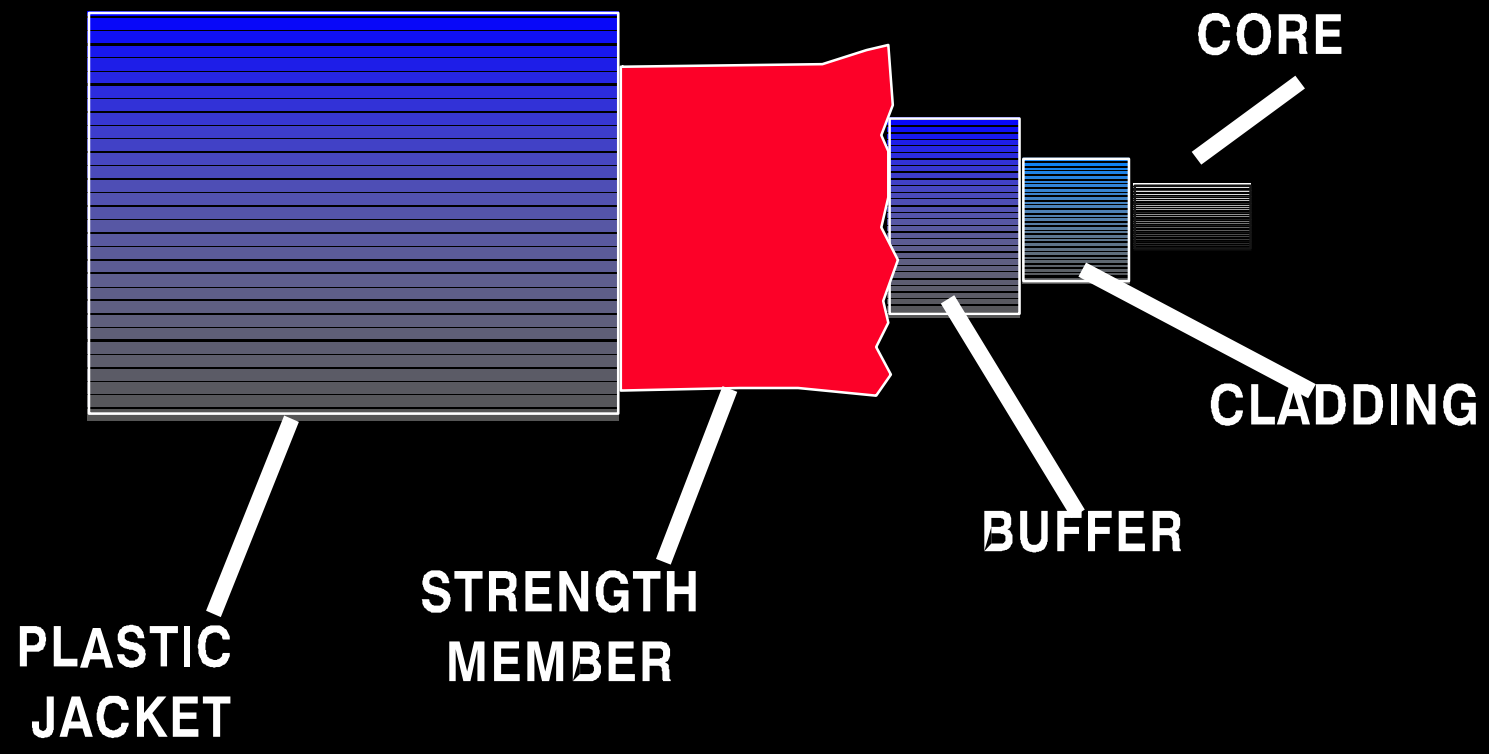


Optical Fiber with secondary
900 µm Buffer

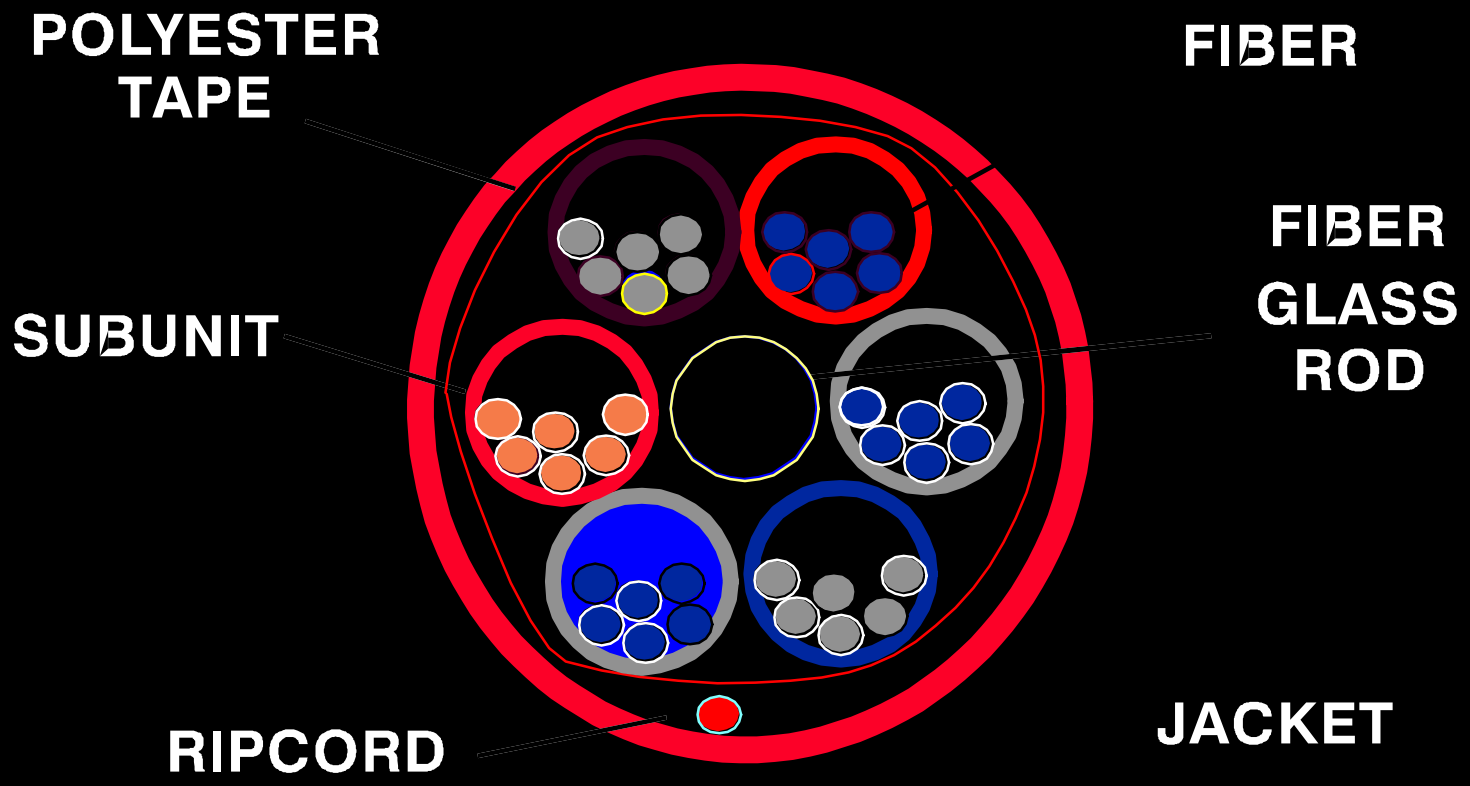
Tight Buffered



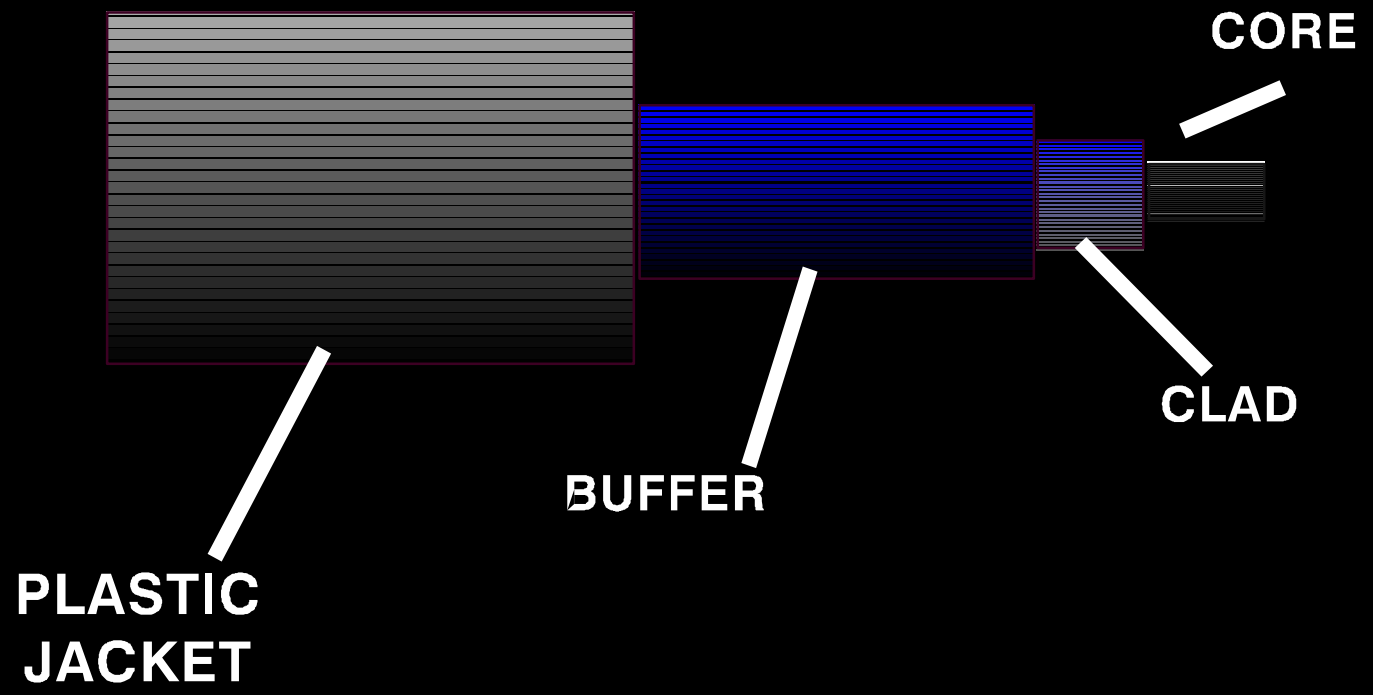
Tight Buffered



Loose Tube Cable



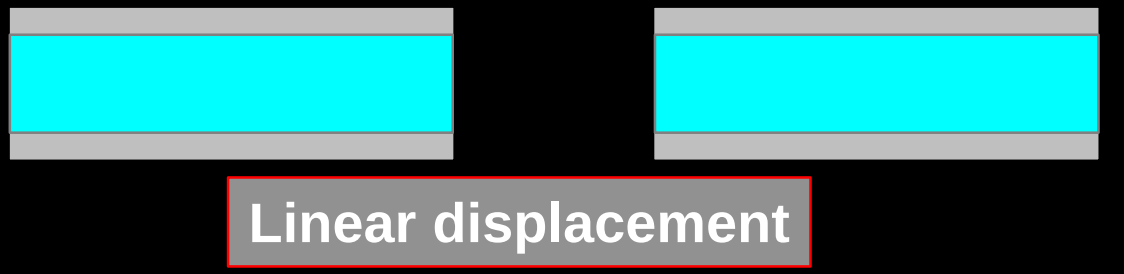
Loose Tube Cable



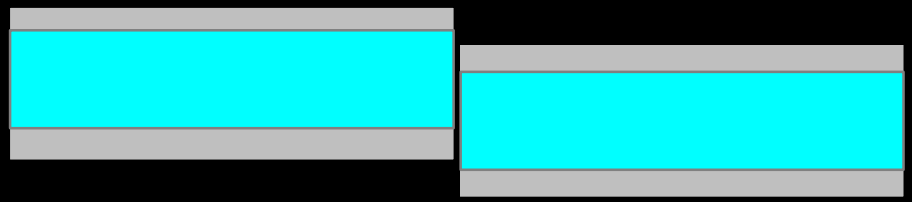
Connector - ST

Connector - SMA

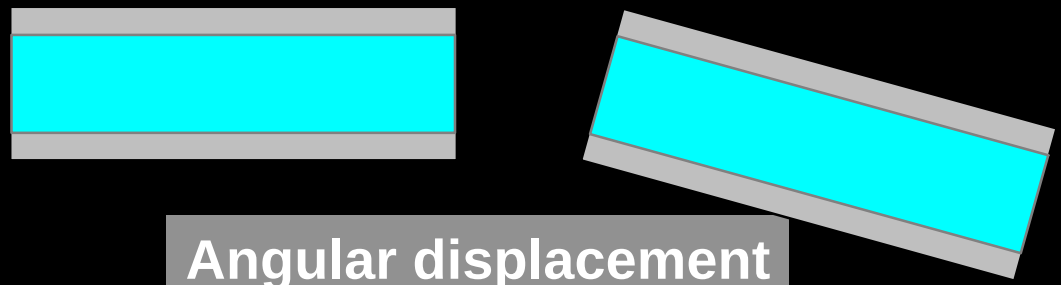
Misalignment



Linear displacement

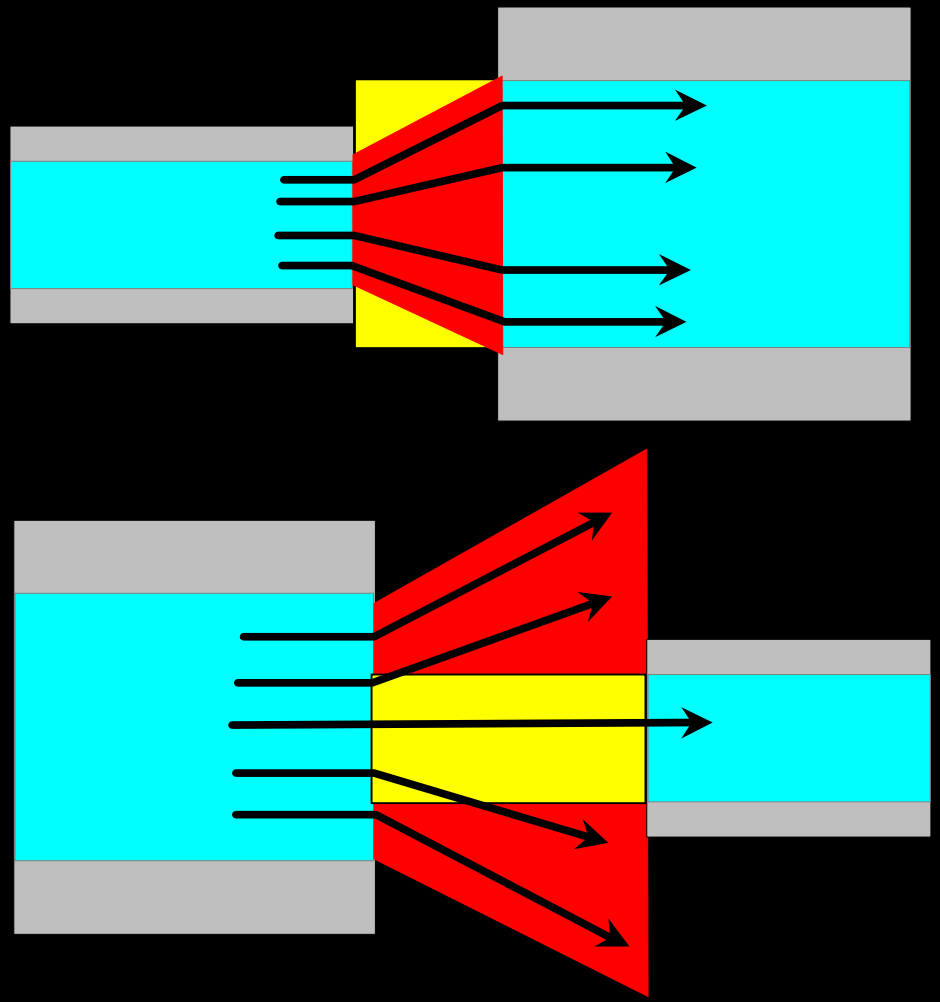


Lateral displacement

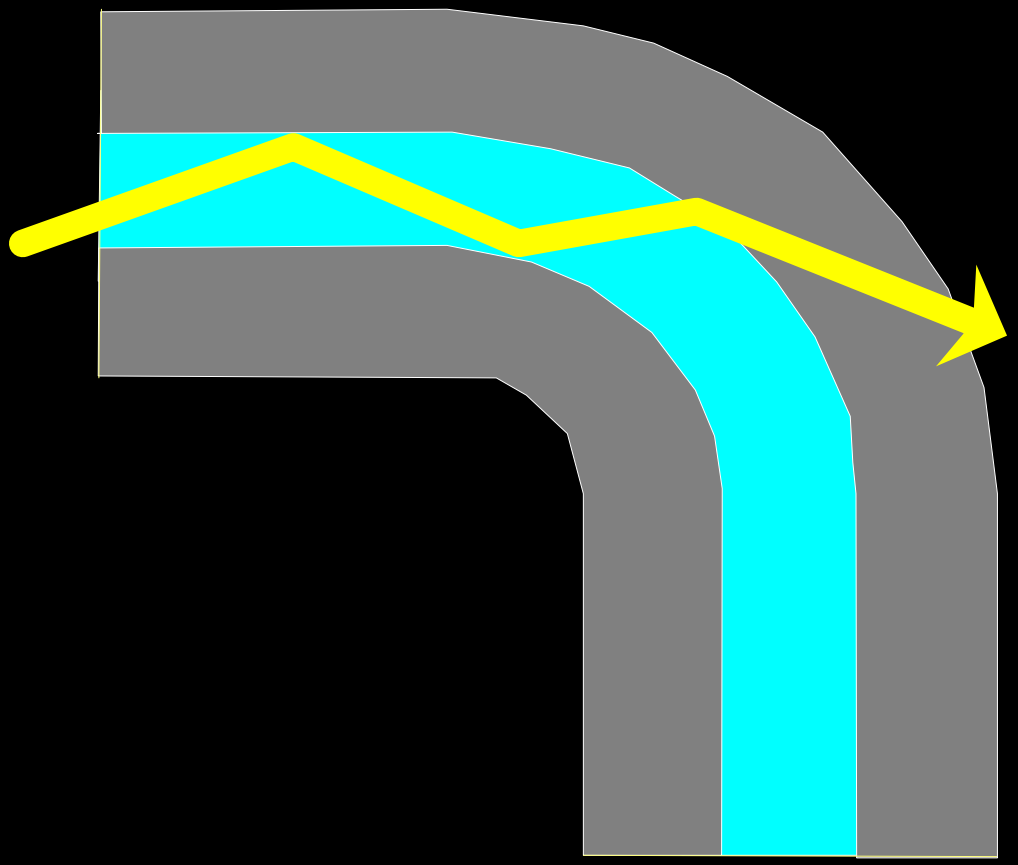


Angular displacement

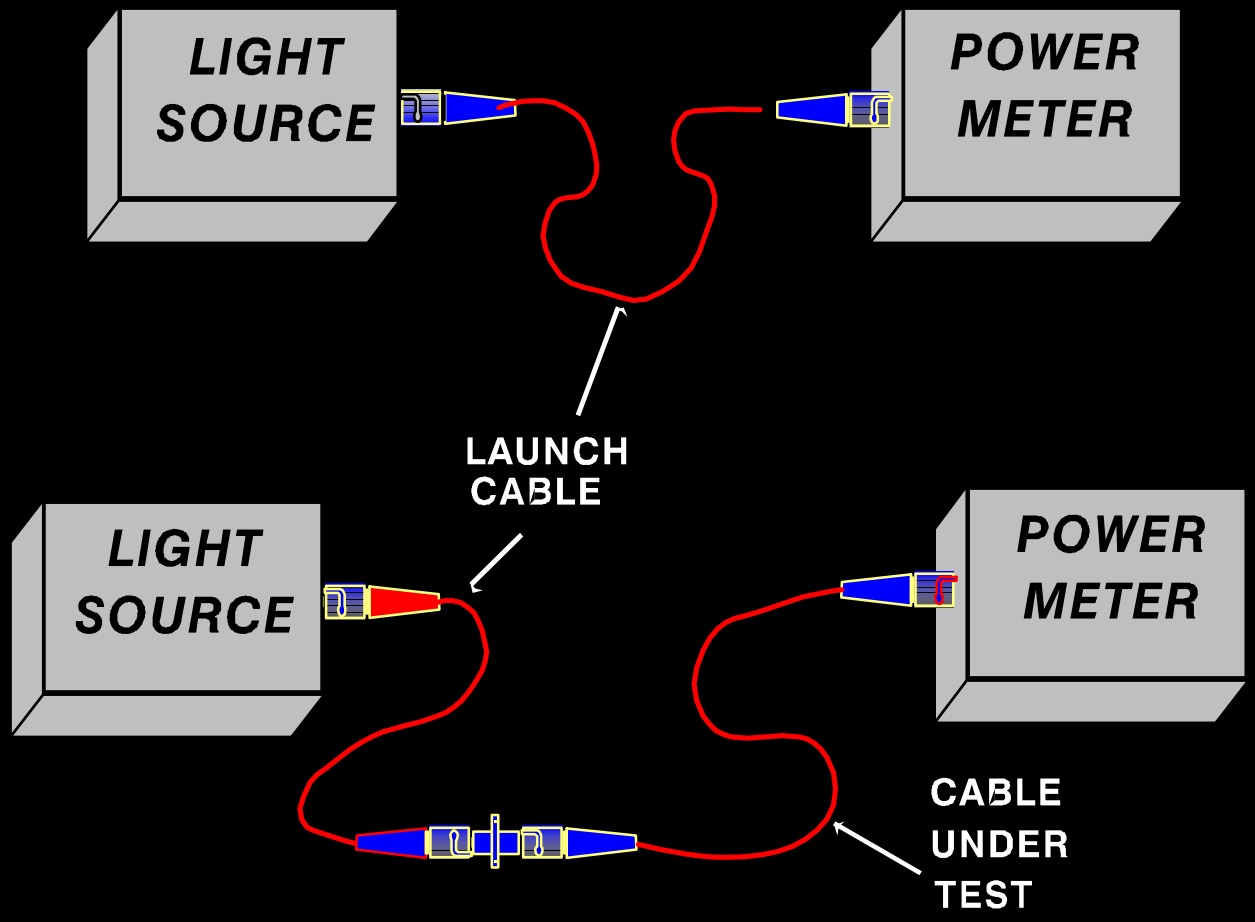
Fiber to Fiber



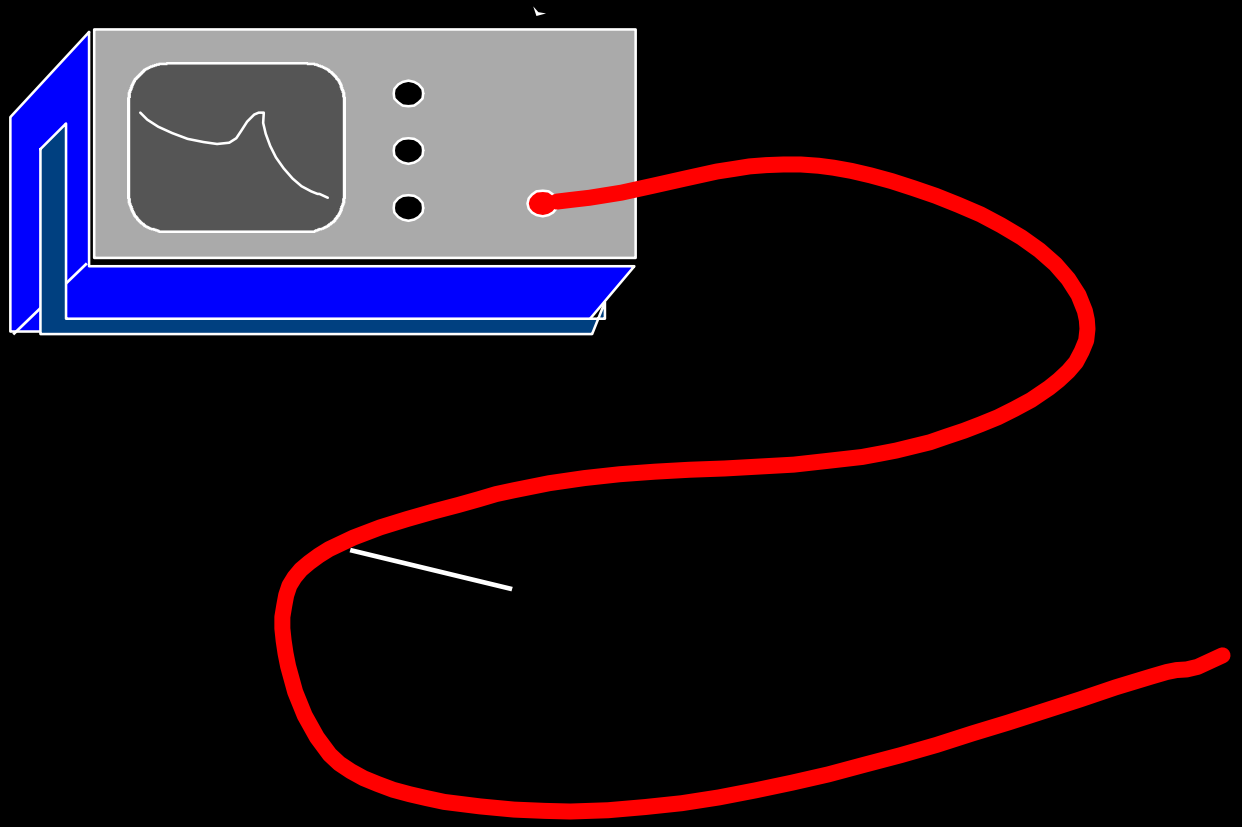
Bend Radius



Power Meter


LIGHT SOURCE
POWER METER
LAUNCH CABLE
LIGHT SOURCE
POWER METER
CABLE UNDER TEST

Optical Time Domain Reflectometer



Applications

- Factory communications
- Factory automation
- Control systems
- High lightning areas
- High EMI/RFI areas
- Secured communications
- Transportation systems/traffic control

Markets Served

- Petrochemical
- Power generation
- Water & wastewater
- Mining
- Pipeline
- Pulp & paper
- Pharmaceutical
- Food & Beverage
- Oil & gas
- Automotive
- Transportation
- Chemical
- Any industry that uses PLC’s

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