Unit-2

Lecture -9

Fiber to Fiber joints, Coupler, Isolators

Fiber-to-Fiber Joint

- Fiber-to-Fiber coupling loss:

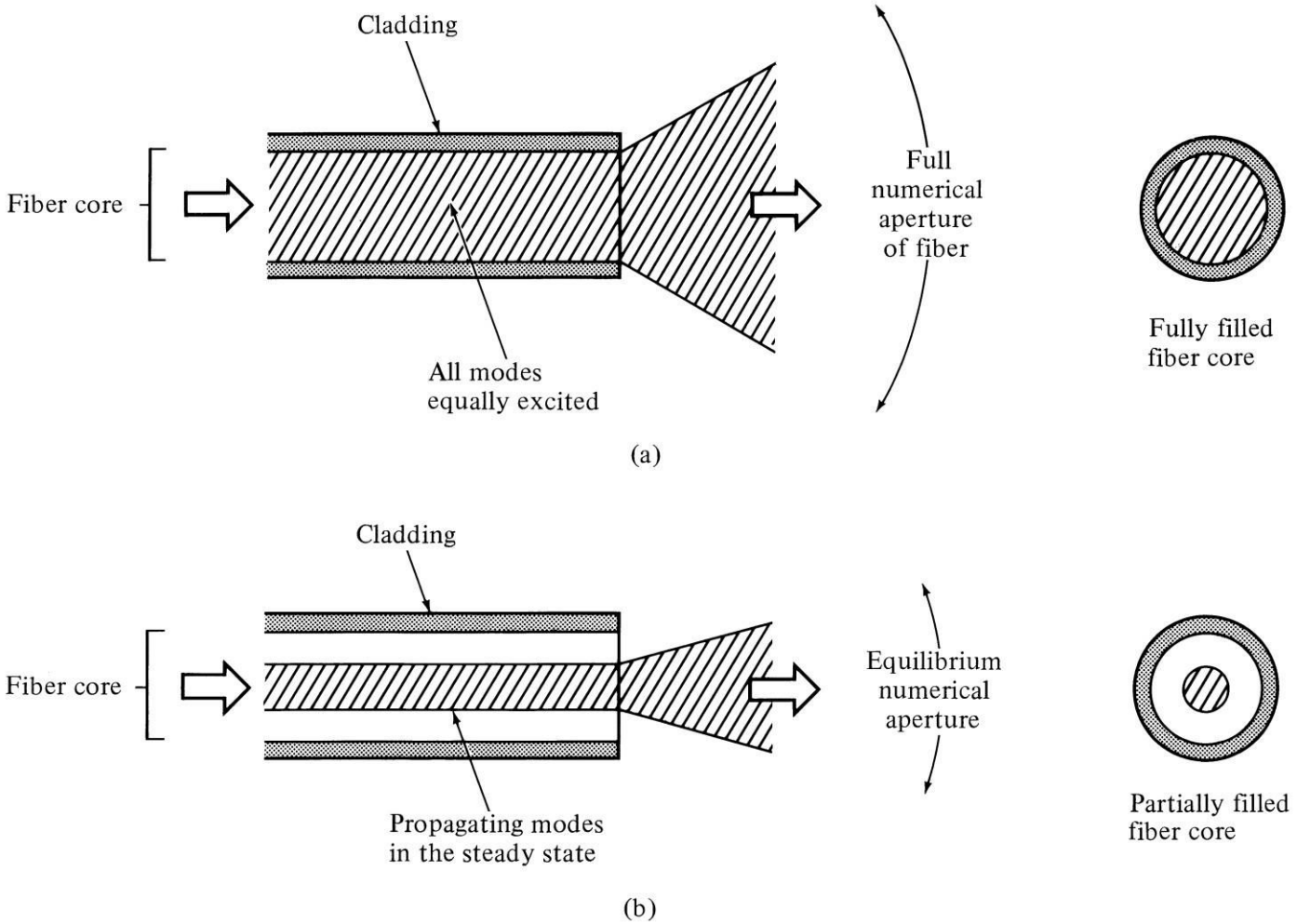
$$L_F\,[\mathrm{dB}] = -10\log\eta_F \qquad [5\text{-}8]$$

- Low loss fiber-fiber joints are either:

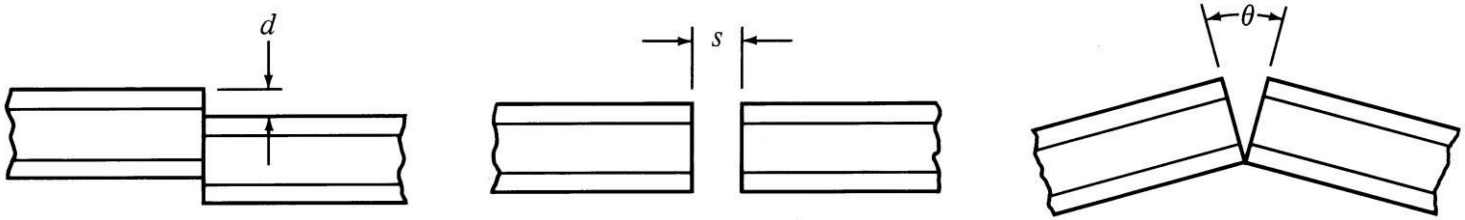
  1- **Splice** (permanent bond)

  2- **Connector** (demountable connection)

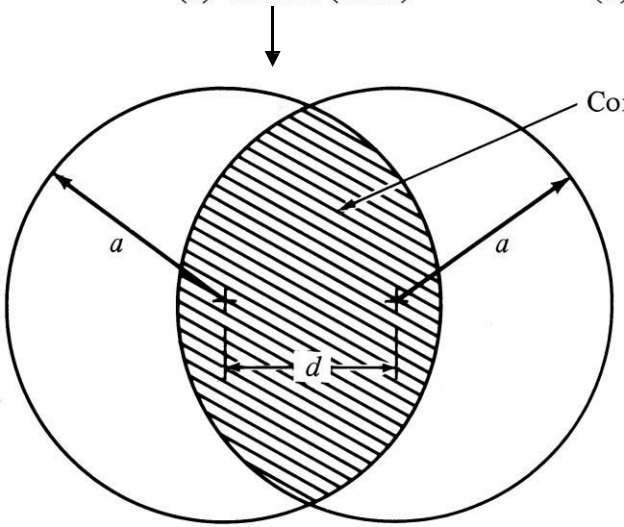
Different modal distribution of the optical beam emerging from a fiber lead to different degrees of coupling loss. a) when all modes are equally excited, the output beam fills the entire output NA. b) for a steady state modal distribution, only the equilibrium NA is filled by the output beam.



Mechanical misalignment losses



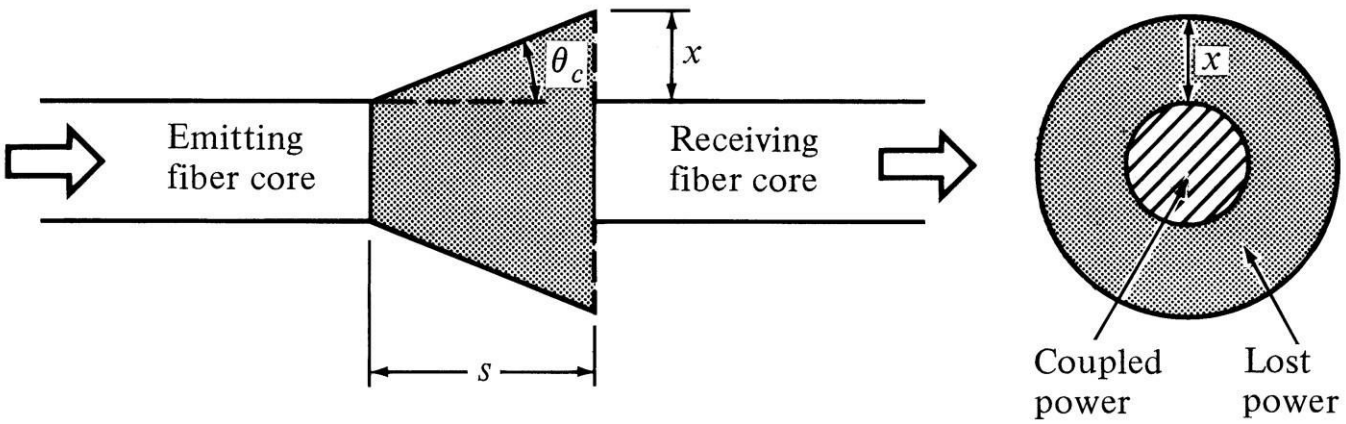
(a) Lateral (axial) (b) Longitudinal (end separation) (c) Angular



Lateral (axial) misalignment loss is a dominant Mechanical loss.

$$\eta_{F,\text{step}} = \frac{A_{comm}}{\pi a^2} = \frac{2}{\pi}\arccos\frac{d}{2a} - \frac{d}{\pi a}\left[1-\left(\frac{d}{2a}\right)^2\right]^{1/2} \qquad [5\text{-}9]$$

Longitudinal offset effect



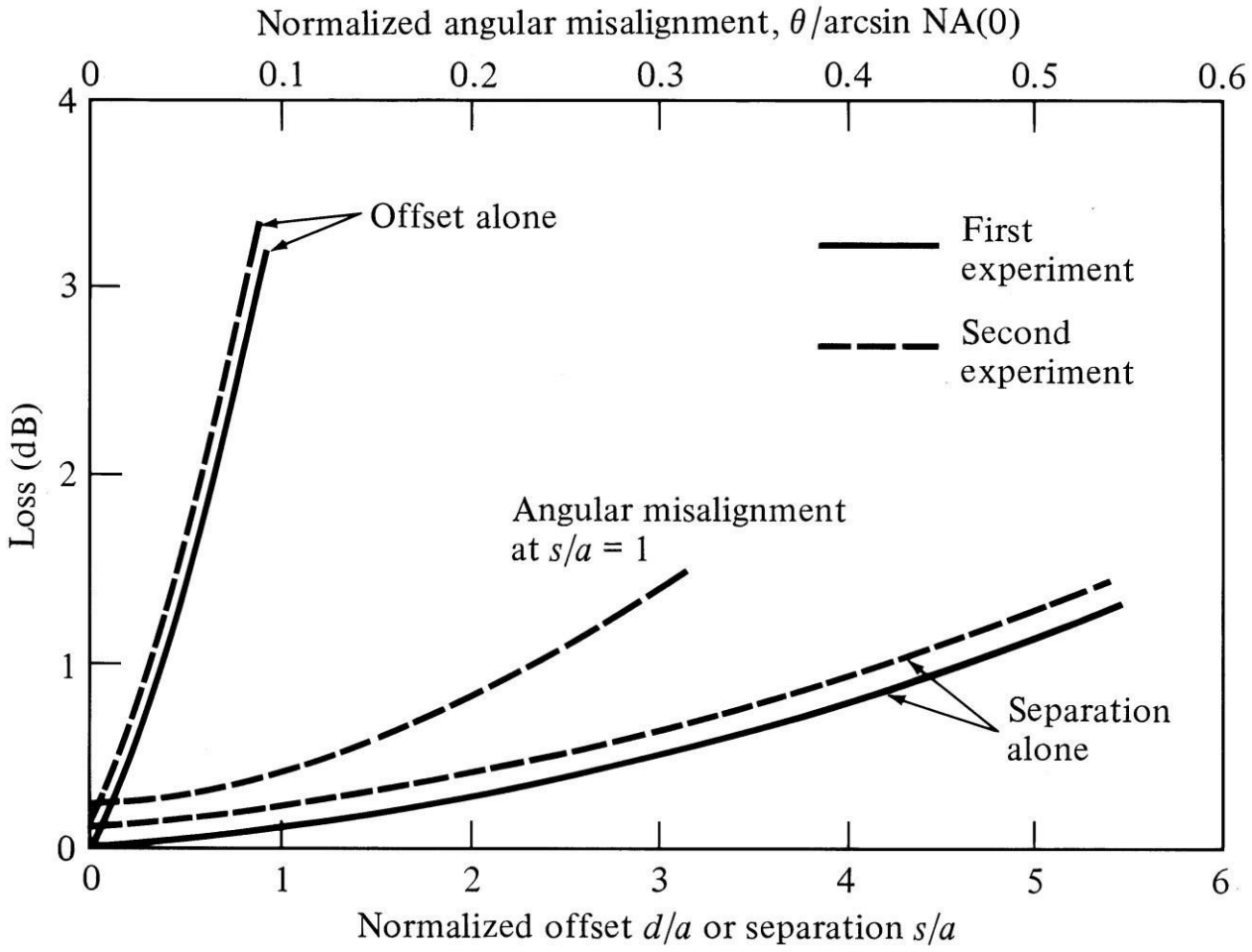
Losses due to differences in the geometry and waveguide characteristics of the fibers

$$L_F(a) = -10\log\left(\frac{a_R}{a_E}\right) \qquad \text{for } a_R \le a_E$$

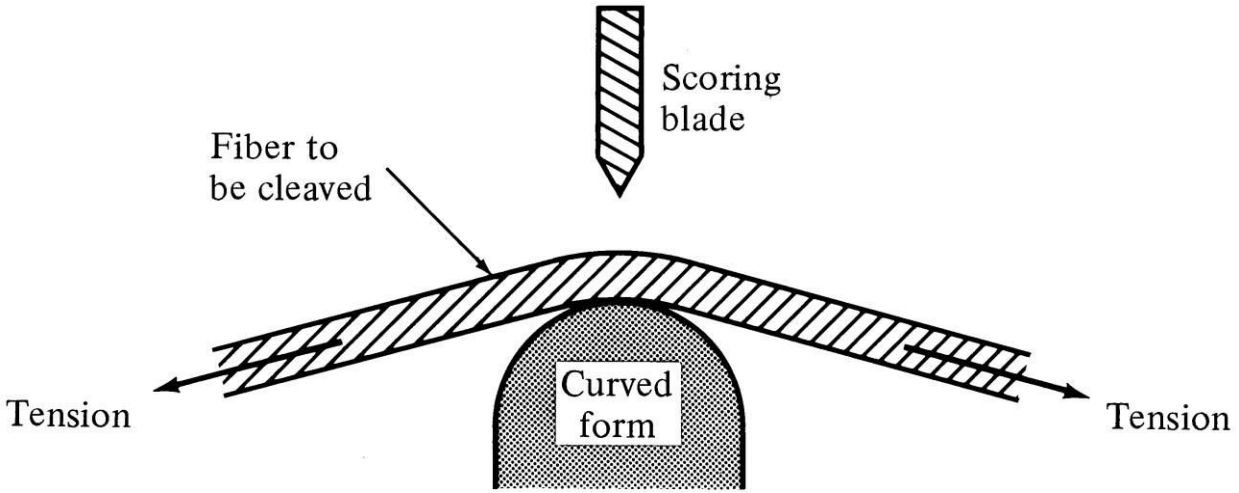
$$L_F(a) = -20\log\left(\frac{\mathrm{NA}_R}{\mathrm{NA}_E}\right) \qquad \text{for } \mathrm{NA}_R \le \mathrm{NA}_E \qquad [5\text{-}10]$$

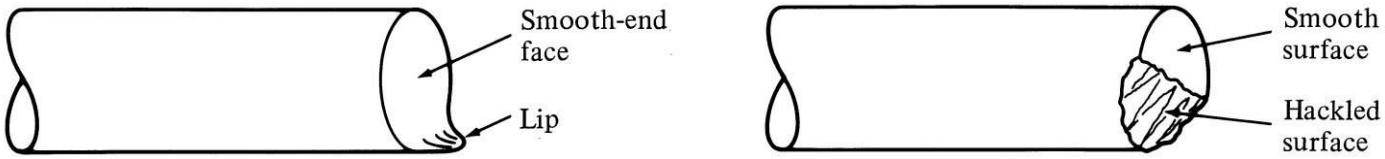
E & *R* subscripts refer to emitting and receiving fibers.

Experimental comparison of Loss as a function of mechanical misalignment



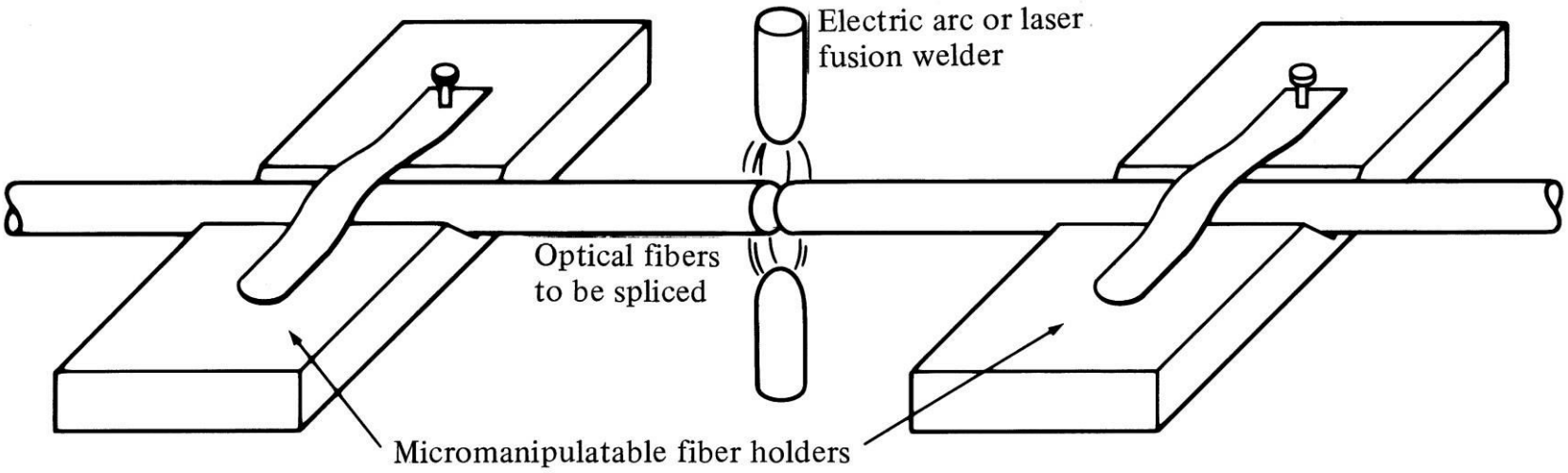
Fiber end face





Fiber end defects

Fiber splicing



Fusion Splicing

V-groove optical fiber splicing

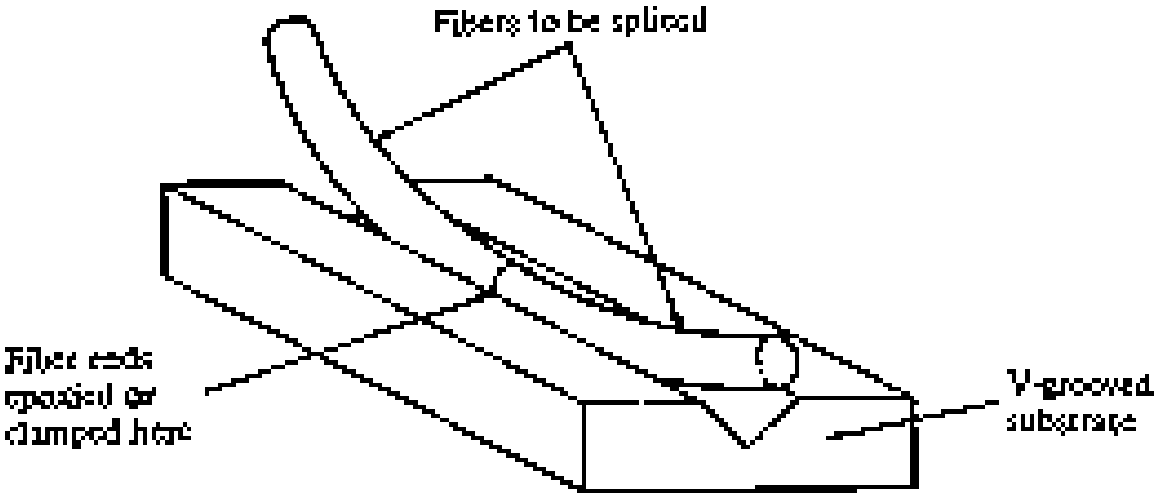


FIGURE 5-18

Optical Fiber Connectors

- Some of the principal requirements of a good connector design are as follows:

  1- low coupling losses

  2- Interchangeability

  3- Ease of assembly

  4Low environmental sensitivity

  5Low-cost and reliable construction

  6- Ease of connection

Connector Return Loss