BALL LENSES

- Fiber Coupling Spheres
- Collimating Lenses

Ball lenses are glass spheres commonly used in fiber optic applications. Ideal for focusing light into fibers, (Figure 1) as well as fiber coupling (Figure 2). The ratio of the collimated light input beam diameter to the ball lens diameter is defined as d/D (Figure 1). As the ratio increases, the back focal length increases.

Ball lenses are great tools for improving signal coupling between fibers, emitters and detectors.

The effective focal length of a ball lens is very simple to calculate (Figure 1) since there are only two variables: the ball lens diameter, D, and the index of refraction, n. The effective focal length is measured from the center of the lens. Therefore, the back focal length can also be easily calculated.

$$BFL = F - [D/2] \qquad EFL = nD/[4(n-1)]$$

The Numerical Aperture, NA, of a ball lens is dependent on the focal length of the ball and on the input diameter, d. Since spherical aberration is inherent in ball lenses the following equation begins to fall off as d/D increases.

$$NA = [2d(n-1)]/nD$$

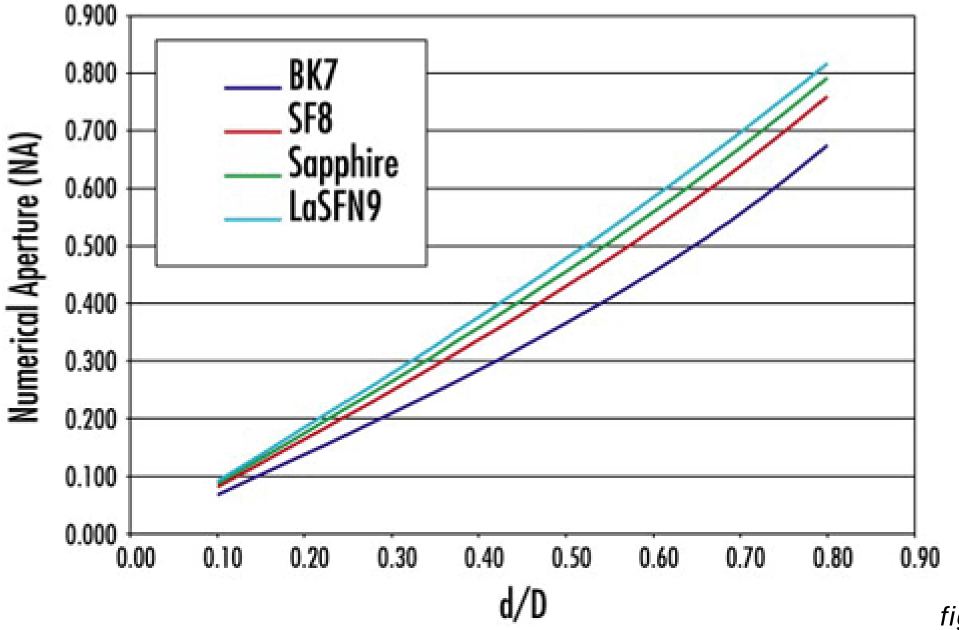


figure 2

Figure 2: Numerical Aperture vs. Input Beam Diameter for Common Ball Lens Glass Types.

OPTICS

When coupling light from a laser into a fiber, the choice of the ball is dependent on the NA of the fiber and the diameter of the laser beam. The diameter of the laser beam is used to determine the NA of the ball lens. The NA of the ball lens must be less than or equal to the NA of the fiber in order to couple all of the light into the fiber. The ball lens is placed directly onto the fiber as shown in Figure 3.

To couple light from one fiber to another fiber of similar NA, two identical ball lenses are used. Place the two lenses in contact with the fibers as shown in Figure 4.

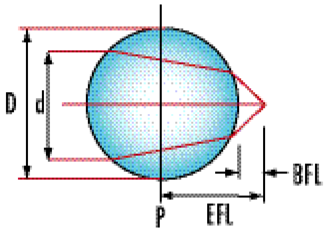


figure 1

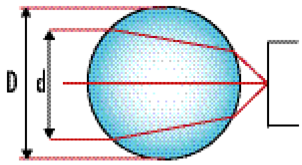
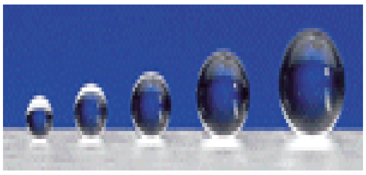


figure 3



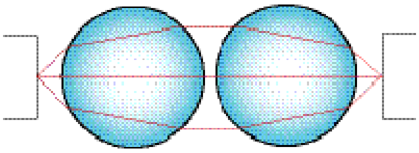


figure 4

Index of Refraction	
BK7	n = 1.517
SF8	n = 1.689
Surface Quality	40-20