Centration

The mechanical axis and optical axis exactly coincide in a perfectly centered lens.

OPTICAL AND MECHANICAL AXES

For a simple lens, the optical axis is defined as a straight line that joins the centers of lens curvature. For a plano-convex or plano-concave lens, the optical axis is the line through the center of curvature and perpendicular to the plano surface.

The mechanical axis is determined by the way in which the lens will be mounted during use. There are typically two types of mounting configurations: edge mounting and surface mounting. With edge mounting, the mechanical axis is the centerline of the lens mechanical edge. Surface mounting uses one surface of the lens as the primary stability reference for the lens tip and then encompasses the lens diameter for centering. The mechanical axis for this type of mounting is a line perpendicular to the mounting surface and centered on the entrapment diameter.

Ideally, the optical and mechanical axes coincide. The tolerance on centration is the allowable amount of radial separation of these two axes, measured at the focal point of the lens. The centration angle is equal to the inverse tangent of the allowable radial separation divided by the focal length.

MEASURING CENTRATION ERROR

Centration error is measured by rotating the lens on its mechanical axis and observing the orbit of the focal point, as shown in figure 3.1. To determine the centration error, the radius of this orbit is divided by the lens focal length and then converted to an angle.

DOUBLETS AND TRIPLETS

It is more difficult to achieve a given centration specification for a doublet than it is for a singlet because each element must be individually centered to a tighter specification, and the two optical axes must be carefully aligned during the cementing process. Centration is even more complex for triplets because three optical axes must be aligned. The centration error of doublets and triplets is measured in the same manner as that of simple lenses. One method used to obtain precise centration in compound lenses is to align the elements optically and edge the combination.

CYLINDRICAL OPTICS

Cylindrical optics can be evaluated for centering error in a manner similar to that for simple lenses. The major difference is that cylindrical optics have mechanical and optical planes rather than axes. The mechanical plane is established by the expected mounting, which can be edge only or the surface-edge combination described above. The radial separation between the focal line and the established mechanical plane is the centering error and can be converted into an angular deviation in the same manner as for simple lenses. The centering error is measured by first noting the focal line displacement in one orientation, then rotating the lens 180 degrees and noting the new displacement. The centering error angle is the inverse tangent of the total separation divided by twice the focal length.

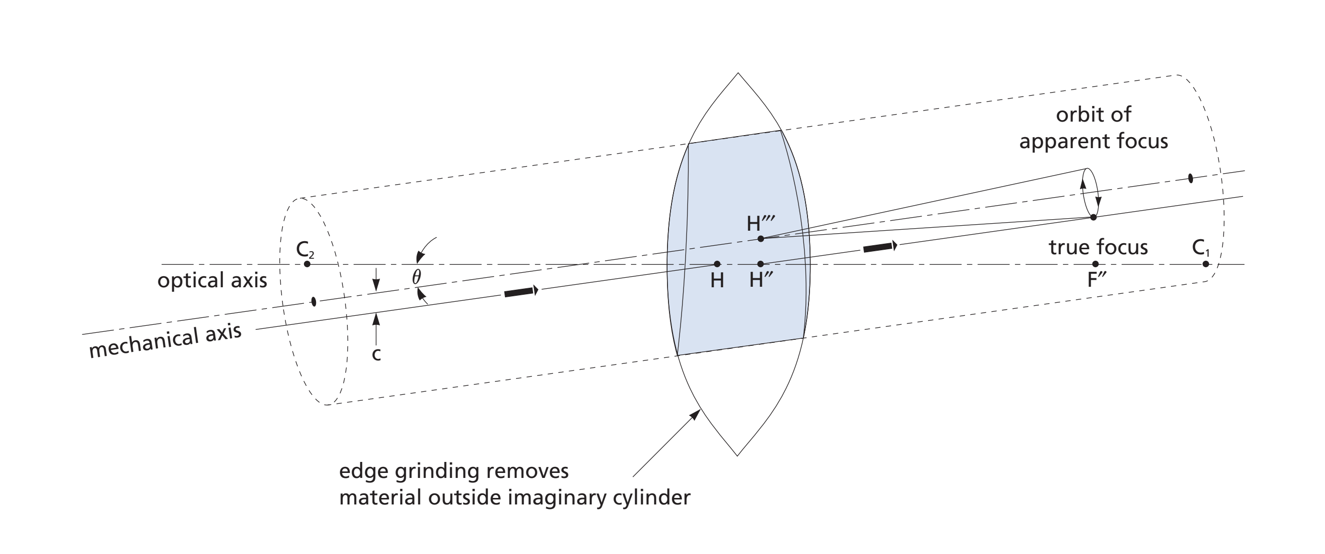

Figure 3.1 **Centration and orbit of apparent focus**