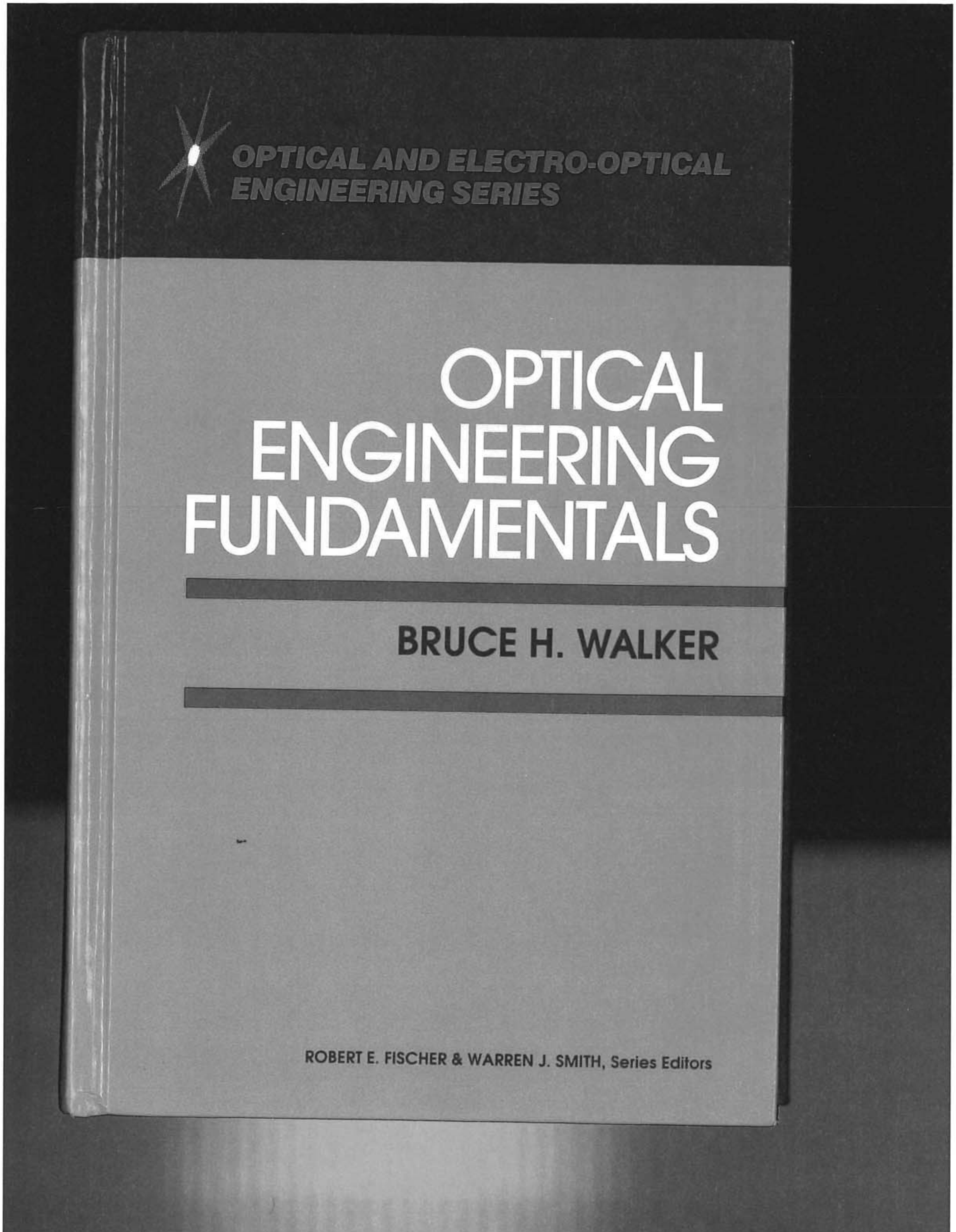
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4
Thin-Lens Theory

4.1 Definition of a Thin Lens

A *thin lens* is a lens whose thickness is assumed to be zero and therefore is negligible. The thin lens is a design tool, used to simulate a real lens during the preliminary stages of optical system design and analysis. This concept is particularly valuable because it enables the optical engineer to quickly establish many basic characteristics of a lens or optical system design. By assuming a lens form where the thickness is zero, the formulas used to calculate object and image relationships are greatly simplified. The drawback to the thin-lens approach is that it is not possible to determine image quality without including the actual lens thickness (and other lens data) in the calculations. As a result, while it is possible to establish many valuable facts about an optical system through the application of thin-lens theory and formulas, the ultimate quality of the image can, at best, only be estimated.

4.2 Properties of a Thin Lens

Figure 4-1 is an illustration of a positive thin lens. Any lens or system analysis must start with several known factors which will generally be provided by the end user, or the customer. From these given factors it will be possible, using thin-lens theory and formulas, to generate the missing information required to completely describe the final lens system. In the case shown in Fig. 4-1, for example, it is given that the system detector (image size) will be 25 mm in diameter and that the full

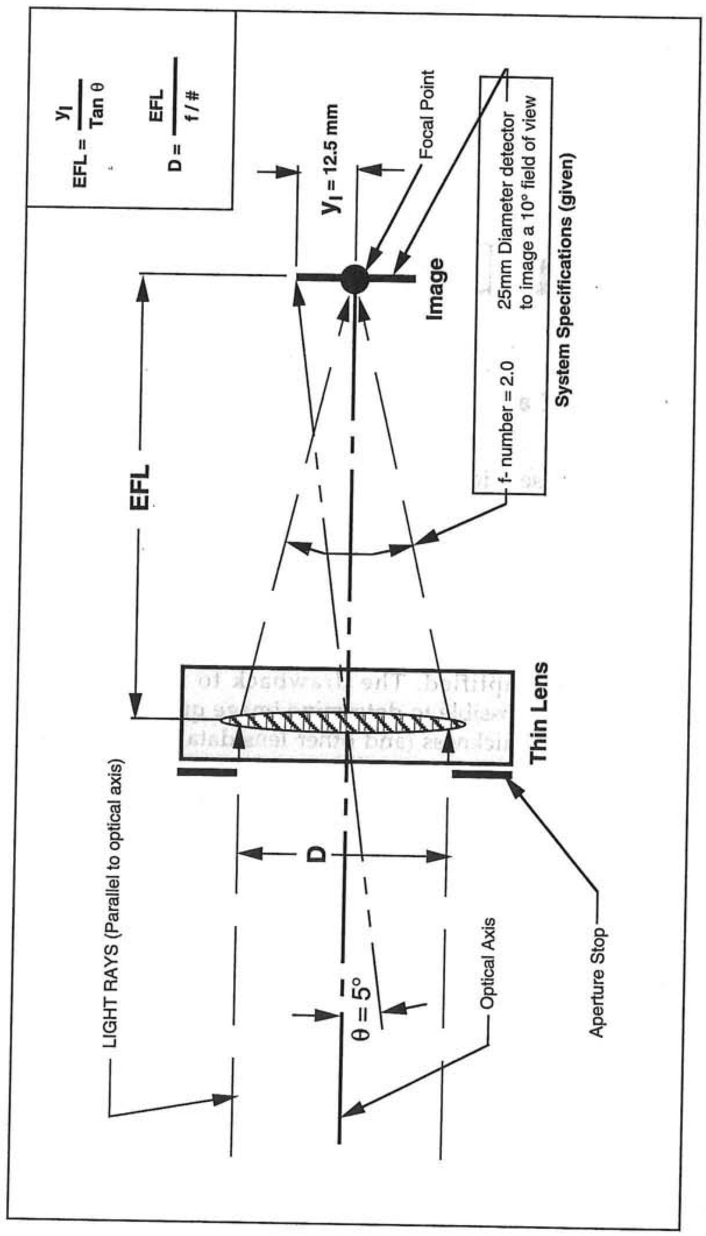

Figure 4-1. Shown are the basic parameters of the thin lens. In the example discussed in the text, the image size y_I, the field of view θ, and the lens speed (*f* number) are given. From these it is possible to determine the focal length (EFL) and diameter (*D*) of the lens.

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4.3 Aperture
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