

cessor of the present-day mercury and fluorescent lamps. In general, today's mercury lamps are about twice as efficient generators of light as the filament lamps. However, there are advantages and disadvantages to both that affect the choice of lamp type for any specific application.

High-pressure mercury lamps have the objectionable characteristic of delayed starting and restarting. Several minutes are required for the lamp to reach full brightness, and in case of a momentary power interruption, the lamp will not restart until the arc tube has cooled sufficiently for the mercury vapor to condense—a matter of about 5 minutes. These disadvantages are partly overcome by installing filament lighting along with the mercury, to provide illumination during the brief periods that the mercury lamps are inoperative. One of the most recent improvements in mercury lamps is the addition of a phosphor coating, which converts part of the mercury radiation to light in the red region of the spectrum. When combined with the bluish green light from the mercury arc, color rendition of objects viewed under this source is improved markedly.

C. FLUORESCENT LAMPS

Fluorescent lamps, first introduced commercially in 1938, have become increasingly popular in recent years. Today, more illumination for general lighting purposes is provided by fluorescent lamps than by all other sources combined. The rapid growth of this type of lighting is due in part to the trend toward higher levels of illumination. Fluorescent lamps are about three times as efficient as filament lamps.

Basically, a fluorescent lamp consists of a low-pressure mercury-arc tube through which current flows, causing the mercury vapor to radiate invisible energy.⁴⁴ This radiation in turn activates the phosphor coating on the inside of the glass tube, converting this energy to visible light. The lime-glass tube filters out all radiation that would be harmful to the eyes or skin.

Until recently fluorescent lamps were started by means of a starter for each lamp, which heated the electron-emitting cathode in each end of the lamp. More recent developments have made it possible to eliminate this starter switch. Modern fluorescent lamps are started either by ballasts having sufficient voltage to start the lamp instantly or by ballasts having auxiliary windings that heat the cathodes very rapidly to emitting temperature. This latter type of operation is called Rapid-Start.

Fluorescent lamp life,⁴⁵ unlike filament lamp life, is not limited by lamp efficiency. Consequently, fluorescent lamps are designed to give much longer service (7500 hours). However, lamp life is affected by the number of times the lamp is started. The 7500-hour life rating is based on 3 hours of lamp operation per start. More frequent starting will reduce the life span, whereas lamps will last longer if started less frequently.

D. GERMICIDAL LAMPS

Germicidal lamps are basically the same as fluorescent except that no phosphor

⁴⁴ C. L. Amick, *Fluorescent Lighting Manual*. McGraw-Hill, New York, 1942.

⁴⁵ R. N. Thayer, Determinants of fluorescent lamp life, *Illum. Eng.*, 49, 527 (1954).

phor is used on the tube. Disinfection of air, water, pharmaceuticals and so forth, with germicidal lamps, is accomplished by making the lamp of a special glass that allows the short-wave ultraviolet energy to irradiate the product. Care should be exercised to avoid exposure of the skin and particularly the eyes to this energy.

E. INFRARED LAMPS

Infrared lamps⁴⁶ are filament lamps designed to heat areas of the body or to heat products, such as painted surfaces, textiles, and metal parts. Any filament lamp is an efficient source of infrared energy. Infrared lamps are usually designed to have a long life (5000 hours); they are not designed to produce light efficiently.

VIII. Lighting Benefits

The trend in lighting application is continually toward better seeing conditions.⁴⁷ With the understanding of the importance of balanced brightness⁴⁸ and minimized glare in industrial areas, and the development of better techniques of controlling light, higher lighting levels have become practical and highly desirable. Figure 12 shows the increase in illumination levels recommended for indus-

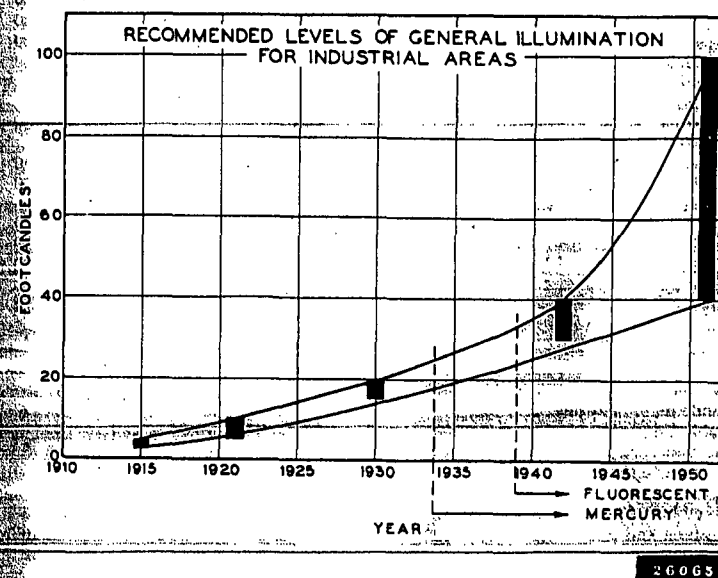


Figure 12. The steady increase in levels of illumination recommended for industrial areas over the past 40 years. Recommendations ranged between the lower and upper solid lines. Broken lines show dates of introduction of new types of lamps.

⁴⁶ C. E. Egeler, Infrared lamps at work, *Magazine of Light*, 20, 8 (February, 1951).

⁴⁷ E. A. Linsley, The industrial lighting look, *Magazine of Light*, 23, 9 (May-June, 1954).

⁴⁸ E. A. Linsley, Revolution in lighting, *Natl. Safety News*, January, 1954.