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5.4.3 Compact Fluorescent Lighting

Compact fluorescent lamps are energy-efficient, long-lasting substitutes for incandescent lamps. Introduced in the early 1980s, these lamps use only one-quarter to one-third as much energy to produce the same light output as incandescents. Because they last up to 13 times longer than incandescent lamps, CFLs also provide an attractive return on investment.

Opportunities

Compact fluorescent lamps can be substituted for incandescent lamps in nearly all applications where incandescents are commonly used—except where directional accent lighting is required (for example, where artwork needs to be illuminated). Incandescent lamps used the most hours per day are the highest-priority candidates for replacement with CFLs; replacement can easily be justified because of the energy savings possible with any lamp used more than an hour a day. It is best to replace incandescent fixtures with those optically designed and hard-wired for CFLs. Alternatively, screw-in CFLs with integral ballasts can often be swapped for incandescent lamps, though this is not generally recommended for recessed downlights. CFLs are particularly appropriate for wall sconces, low ceiling downlights (ceilings up to 9 ft or 2.7 m), wall-washers, and decorative pendants.

Retrofit lamps that contain the lamp, ballast, and screw base all in one unit are widely available. As a rule, however, these units should be avoided for several reasons:

- They are often replaced by incandescent lamps when they fail, negating savings.
- The geometry of the bulky retrofit often makes it difficult to position the lamp in the fixture where it can achieve the best lighting output.
- The ballasts can outlast the lamps by a factor of five or more, and disposing of the ballast with the lamp is thus wasteful.
- Though this varies according to the manufacturer and the configuration, heat from an integral ballast does not dissipate well, and thus both lamp life and ballast life are reduced.
- It is easier for these relatively expensive retrofits to be stolen than for a whole new fixture to be removed.

Technical Information

Compact fluorescent lamps have excellent color rendition and are available in a wide variety of sizes, shapes, and wattages. They are suitable both in new buildings and in renovations and are most appropriate for general (as opposed to directional) lighting. For dimming applications, four-pin CFLs are required. As a rule of thumb, 1 watt of compact fluorescent can replace 3 to 4 watts of incandescent lighting—e.g., a 60-watt incandescent lamp can be replaced by a 15- to 20-watt compact fluorescent lamp. The light output of fluorescent lamps is sensitive to both temperature and burning position, while that of an incandescent bulb is not—so in some fixtures CFLs will perform differently than in others. Very-low-wattage CFLs (below 13 watts) have lower efficacy than higher-wattage CFLs, poor power factor, and lower-quality phosphors; they are generally available only with magnetic ballasts.

Fixtures for compact fluorescent lamps come in a variety of styles to meet many lighting situations. Fixtures hard-wired for CFLs contain ballasts required to operate the lamps and special sockets to hold the lamps in the proper position. With this modular configuration, when the lamps fail, they can be replaced without having to replace the longer-life ballasts as well. CFLs are also available with integral ballasts and screw-base sockets for use in fixtures designed for standard incandescent lamps. See the cautionary note on this page regarding retrofit lamps.

A lighting survey is the first step in planning to replace incandescent lamps with CFLs. Although not every incandescent lamp has a compact fluorescent equivalent, facility managers can establish a plan to gradually change over to these more cost-effective alternatives. Software such as the *Lighting Technology Screening Matrix* (LTSM) and the *Lighting System Screening Tool* (LSST) can help with planning and a financial assessment. See *Section 5.4* for a description of these tools and how to obtain them.

Rated lamp life of CFLs is typically 10,000 hours, or 5 to 13 times longer than that for incandescent lamps. Long life helps provide a favorable life-cycle cost and labor savings for lamp replacement. However, lamp life varies considerably by manufacturer (see NLPIP Specifier Report: Screwbase CFLs) and is sensitive to how often the lamp is switched on and off. Burning life is longer if lamps burn continuously or for many hours at a time; lamp life can be much shorter if the lamp is switched on and off frequently, so be careful about using CFLs in fixtures on motion sensors that are activated frequently.

Source: Pacific Northwest National Laboratory

The new twisted-tube compact fluorescent lamps are nearly as small as standard lightbulbs.

Overlighting is common, so one-for-one replacement of incandescent lamps with their CFL equivalents may result in overlit conditions. As part of a lighting survey, it is important to determine the lowest wattage lamp that can be used for the application.

$ Replacing incandescent fixtures with compact fluorescent fixtures typically achieves a 35% annual return on investment.

References

Electric Utility Guide to Marketing Efficient Lighting (ref. contract DE-AC65-86WA00467), Western Area Power Administration, Golden, CO, 1990.

Contacts

Defense Logistics Agency, Defense Supply Center, Richmond, VA; (800) DLA-BULB; www.dgsc.dla.mil.

EPA Green Lights and ENERGY STAR® Programs Hotline: (888) STAR-YES.

The National Lighting Product Information Program (NLPIP) of the Lighting Research Center at Rensselaer Polytechnic Institute offers independently evaluated product information, including manufacturer-specific test results on thousands of lamps, fixtures, ballasts, and controls; www.lrc.rpi.edu.

WHERE CFLS ARE NOT AS APPROPRIATE

Where CFLs Should Be Avoided	More Appropriate Solution
Applications where tight beam control is required	Provide low-wattage reflector-type tungsten halogen lighting.
Outdoor lighting in very cold areas	Many CFL ballasts will not operate below about 32°F (0°C). Even when low-temperature ballasts are used, lamps will not reach full brightness for several minutes in cold weather.
High-bay lighting—ceiling higher than 20 ft (6 m)	Specify linear fluorescent lighting, including high-bay luminaires using tightly packed T-5 lamps.
Medium-bay lighting—ceiling 12 to 20 ft (3.7 to 6 m)	Use a combination of direct and indirect lighting with linear fluorescents.
Exposed-lamp applications with high-wattage CFLs	High-wattage CFLs are very bright if exposed; provide some type of shielding.
Where frequent switching is required, such as with motion sensors	Frequent on-off switching will reduce lamp life of CFLs; incandescents (including halogen lamps) may be a better option.
Exit sign illumination	Replace incandescent or fluorescent lamps with LED retrofits, or replace exit signs with LED models.

☑ **Look for applications with long burn hours.** Interior and exterior hallways and walkways provide excellent opportunities for cost-effective replacements with CFLs because these locations typically have long burn hours. Sconces containing CFLs make excellent retrofit fixtures for these applications. Make sure the lamp does not extend below the bottom of the luminaire.

☑ The National Electric Code forbids the use of incandescent fixtures in small clothes closets and other locations where the heat from incandescent lamps can be a fire hazard. CFLs can be used in many of these applications due to their low heat generation.

☑ When replacing incandescent lamps in recessed cans with screw-in CFLs, it is often best to use a CFL with a built-in reflector or a retrofit CFL reflector fixture.

Some lamps take a second to turn on and flicker initially; others do not. Consult your supplier about this issue.