Luminaires

A Pacific Energy Center Factsheet

Pacific Gas and Electric Company
Pacific Energy Center

Introduction

A luminaire is a complete lighting unit, comprised of a light source (lamp or lamps), together with the parts that distribute the light, position and protect the lamps, and connect the lamps to the power supply. The luminaire's function is to direct light to appropriate locations, without causing glare or discomfort. With thousands of different luminaires made by hundreds of manufacturers, there are more luminaires on the market than any other type of lighting equipment. Choosing luminaires that efficiently provide appropriate luminance patterns for the application is an important part of energy efficient lighting design.

Often, modern lamp technologies require special luminaire features. For example, T-8 lamps are 33% smaller in diameter than equivalent T-12 lamps, while producing nearly as many lumens. Because T-8 lamps are brighter per unit area, proper luminaire shielding is more critical than for T-12 lamps.

Luminaire Components

Luminaires generally consist of some or all of the following parts:

1. ***Lamps*** and lamp holders or sockets
2. ***Ballasts*** to start and operate the lamps
3. ***Reflectors*** to direct the light
4. ***Shielding/diffusion components*** (lens, diffuser, louver, or the like) to shield the lamps from the eyes at normal viewing angles, reduce discomfort and disability glare, and to distribute light evenly
5. ***Housings*** to contain the above elements as well as electrical components, such as wiring connections

An efficient luminaire optimizes the system performance of each of its components.

Lamp Sources

Efficient luminaires use the most efficient sources appropriate for that luminaire type. Luminaires should be selected specifically to take advantage of the source's unique features, particularly with respect to size and thermal performance.

Reflectors

Advances in materials science have resulted in several key new materials capable of precisely and efficiently redirecting incident light rays.While these types of reflector materials are advantageous for some luminaire designs, in other cases, optical performance requirements dictate the use of standard painted reflectors that produce diffuse, scattered, or wide-spread distribution of the incident light. Appropriate use of reflector materials (specular or diffuse) will maximize luminaire efficiency while maintaining the desired light distribution.

Luminaire Performance

In evaluating a luminaire, its efficiency (the ratio of lumens emitted by the luminaire to lumens emitted by that luminaire's lamps) and its distribution characteristics are of considerable importance. One should consider how the luminaire controls glare, as well as the proportion of lamp lumens that reach the workplane, as measured by the coefficient of utilization (CU). The CU accounts not only for light losses within the luminaire, but also for the effects of room configuration and surface reflectances. Most general lighting luminaire manufacturers provide CU data tables for their luminaires.

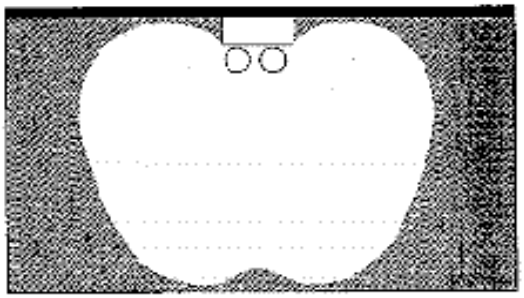
The luminaire system consists of the luminaire itself along with its reflectors, lenses and housings, as well as the lamps and ballasts. System performance depends on how well all these components work together, as well as many other factors including room finishes, daylight contribution, room geometry, and task components. See the fact sheet on the Anatomy of a Lighting System.

General Lighting Luminaire Types

Luminaires designed for general illumination of large areas constitute the majority of lighting installations and the majority of the energy consumed for lighting. These lighting systems consist of a luminaire layout pattern that provides uniform lighting throughout the space.

Open Direct Luminaires

Figure 1. Open Direct Luminaire



Open direct systems do not employ shielding at all. These systems include surface- and pendant-mounted strip fluorescent fixtures and suspended open industrial and commercial luminaires. Unless equipped with reflectors, these systems radiate light in all directions. Open direct lighting systems are often very efficient, with high CU values, but they may cause visual discomfort and disability glare.

Shielded Direct Lighting Systems

Figure 2. Shielded Direct Luminaire

Shielded systems use some form of lens, louver, or baffle to prevent direct viewing of the lamps at normal angles of view (see Figure 2). Surface and suspended luminaire types include industrial HID downlights, baffled industrial fluorescent luminaires, fluorescent wrap-around lens luminaires, and commercial fluorescent lens luminaires. Recessed systems include HID downlights and a wide range of fluorescent "troffers" using lenses, louvers, or baffles to control glare.

Parabolic Louvered Recessed Troffers

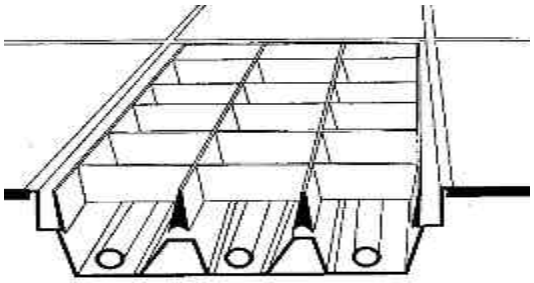


Figure 3. Typical Three-Lamp Parabolic Troffer

An increasingly popular commercial general lighting fixture is the recessed parabolic troffer, which uses specular parabolic louvers to control the luminaire's light distribution, providing sharp cut-off glare control. Depending on the spacing between the louvers, these luminaries can be classified as large-cell and small-cell parabolic luminaires. Large-cell luminaires are generally more efficient, with relatively high CU values, while smaller cells can offer better glare control. Many standard sizes are available, including 2'x 4', 2'x 2', 1'x 4' The extent of glare control depends on the specific louver design.

Standard Lensed Troffers

Standard lensed troffers typically have higher efficiency and CU values than parabolic louvered troffers, but provide less precise glare control. Many lens types can be used (i.e., patterned prismatic, batwing, linear batwing, and polarizing), though final photometric performance also depends on a number of other factors such as reflector type, number of lamps, lamp type, and ballast type.

Indirect Lighting Systems

Lighting systems that radiate light up to a reflecting ceiling are called indirect lighting systems. These systems generally employ luminaires suspended from the ceiling, though cove lights and lights mounted to walls and furniture can also be used. Indirect lighting systems using well-designed and properly spaced luminaires can provide excellent illumination, uniformity, and freedom from glare. Their success depends on maintaining a high ceiling reflectance in combination with nearly uniform brightness. In this way, a maximum amount of light is reflected down to the work plane, yet light patterns are less likely to create reflected glare in VDT screens.

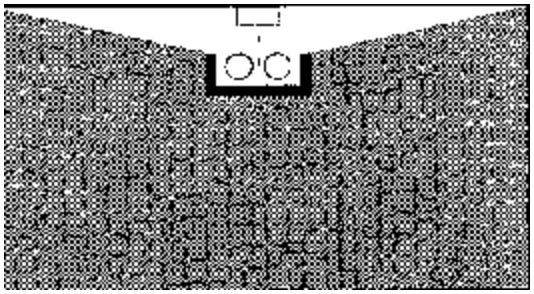


Figure 4. Indirect Lighting Luminaire

Recent designs in fluorescent indirect lighting systems use lenses or imaging reflectors to achieve high luminaire efficiency, by producing a broad batwing light distribution while allowing for close-to-ceiling mounting. These designs can increase an indirect system's CU to nearly that of traditional lensed troffer systems.

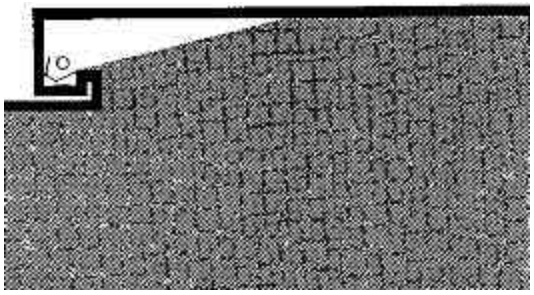


Figure 5. Cove Lighting System

Other new designs in indirect lighting luminaires, especially for cove and coffer installations, increase the effectiveness of traditional strip lights and eliminate socket shadows.

Direct/Indirect Lighting Systems

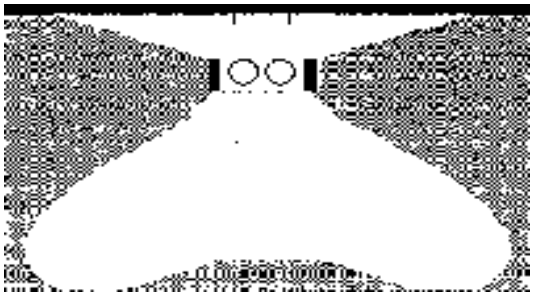


Figure 6. Direct/Indirect Luminaire

These systems combine the benefits of both traditional direct lighting and indirect lighting systems. Combing the high CU of direct illumination with the uniformity and glare control of indirect lighting can be an ideal solution for many spaces. The appropriate balance of direct and indirect light is dependent on the nature of individual applications.

Architectural Luminaires

Architectural lighting systems, which are generally used in building spaces such as lobbies and corridors include recessed downlights, wall washers, track lights, and wall sconces. Since these luminaires are employed mainly for highlighting high-quality spaces, aesthetics is a principal consideration in their design and selection. Nevertheless, there are many opportunities to utilize efficient lighting in these applications.

Recessed Low-Wattage HID Downlights

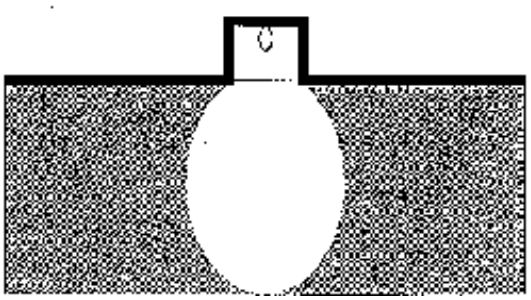


Figure 7. Recessed Architectural Downlight

New HID downlights, equipped with high-CRI compact metal halide and white high pressure sodium lamps, can replace traditional incandescent downlights in high-quality and/or low-ceiling spaces, thereby achieving significant energy savings and extended lamp life.

Recessed Compact Fluorescent Downlights

The popular compact fluorescent downlight is now available in a variety of configurations, and some units include dimmable lamps designed for use with electronic ballasts. In general, compact fluorescent lamps replace incandescent downlights on a 1 watt for 3 watts basis. A relatively recent development, the 1'x 1' parabolic downlight for compact fluorescent lamps is extremely efficient, allowing replacement of incandescent lamps on a 1 watt for 4 watts basis.

Track-Mounted Lighting

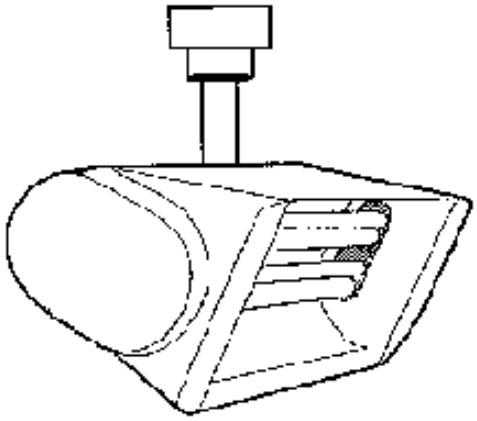


Figure 8. Compact Fluorescent Track Light

Several interesting recent designs in track luminaires using compact fluorescent and low-wattage HID lamps offer significant energy savings over standard incandescent track luminaires Track lighting systems provide flexibility in design and make it possible to accommodate changing displays.

Task Lights

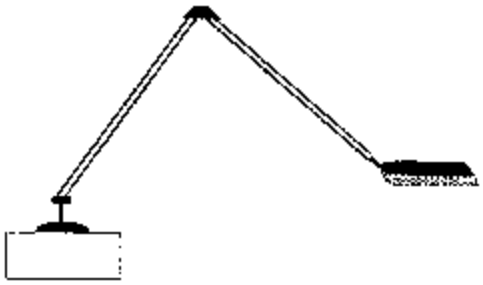


Figure 9. Typical Compact Fluorescent Task Light

Task lights work in conjunction with general lighting systems to meet diverse needs of individual occupants for specific visual tasks. Compact fluorescent lamp technology has special relevance for task lighting applications. In VDT applications where high levels of ambient light often interfere with visibility, task lighting may be especially important for non-VDT tasks, particularly when those visual tasks are difficult to perform because of low contrast, high speed, and/or worker age.

Decorative Luminaires

A renaissance in decorative lighting fixtures in the form of pendants, wall sconces, chandeliers, exterior lanterns, and landscaping lights occurred in the 1980s. In most instances, decorative lighting luminaires are used to provide general or ambient lighting in areas where a more customized appearance is desired. Although decorative lighting is still most often used in restaurants and hotels, an increasing number of applications exist in offices, retail stores, apartment buildings, and other commercial spaces. Many decorative luminaires employ efficient light sources, increasing opportunities for using less energy.

Low-Wattage HID and Compact Fluorescent Wall-Mounted Luminaires

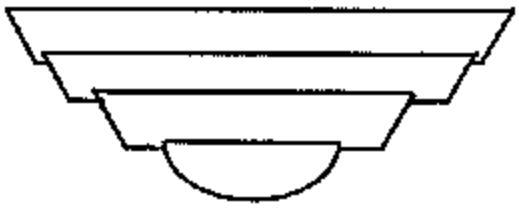


Figure 10. Compact Fluorescent Wall Sconce

Many traditional applications for incandescent wall-mounted sconces and brackets can be replaced with similar-appearing luminaires designed specifically for compact fluorescent or HID lamps. See Figure 10 for an example.

Compact Fluorescent Pendants and Chandeliers

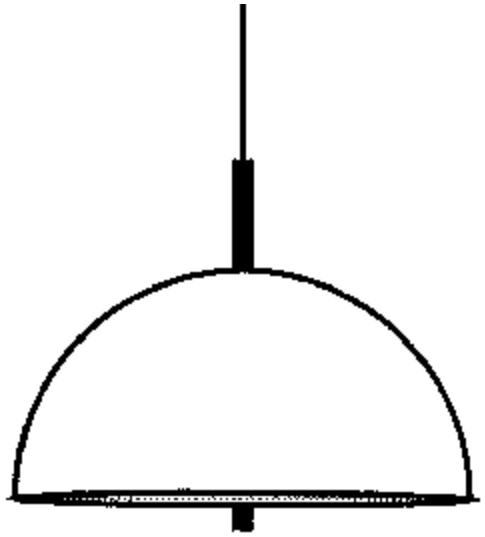


Figure 11. Decorative Pendant Luminaire

Luminaire designs continue to evolve for compact fluorescent decorative chandeliers and pendants used in applications once limited to traditional incandescent fixtures.

For More Information

Contact your PG&E representative or call 1-800-468-4743 for more information about PG&E's energy efficiency programs and other services.