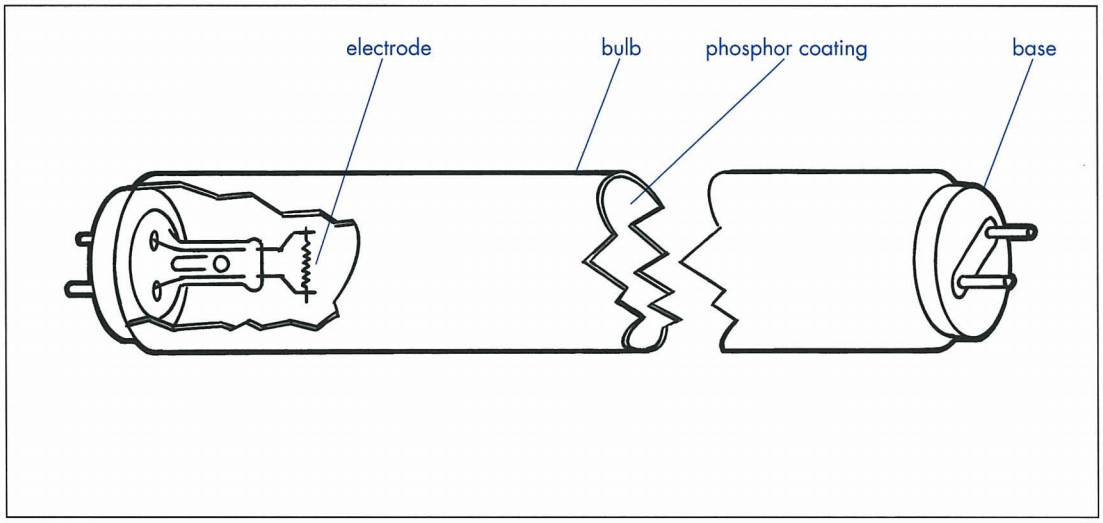
Fluorescent



Fluorescent lamps are cylindrical glass tubes that are coated on the inside with phosphors. They contain a small amount of mercury and are filled with a small quantity of argon, a combination of argon and neon, or krypton gases. During operation, an electrical current passes through the lamp and the mercury is vaporized, producing ultraviolet light. The phosphor coating absorbs the ultraviolet light and re-radiates it as visible light.

Fluorescent lamps require ballasts to provide the starting voltage and limit the electrical current during lamp operation. There are two types of ballasts commonly available for residential lighting: the energy-efficient magnetic ballast and the electronic ballast. The majority of ballasts sold today are energy-efficient magnetic types. Electronic ballasts are attractive because they are more energy-efficient than magnetic ballasts. They offer the advantages of lighter weight, quieter operation, and reduction of flicker, but they cost more than magnetic ballasts. For more information about ballasts, consult the Appendix.

Although fluorescent lamps all have tubular-shaped glass bulbs, the tubes can be bent into several shapes. The names for various shapes, and for shapes combined with ballasts and accessories, often are manufacturer-specific. This name variation can be confusing to consumers and specifiers. This book classifies compact fluorescent lamp shapes according to the 1992 National Electrical Manufacturers Association's system. Other names are adopted from the Illuminating Engineering Society of North America and the National Lighting Product Information Program.

A T12 or T8 tube bent in half is designated "U-shaped" and a tube bent to form a circle is designated "circline." Long twin-tube lamps, which consist of two parallel small-diameter tubes, are designated as "FT" for "fluorescent twin." The FT lamps are longer than most compact fluorescent lamps. "CFT" for "compact fluorescent twin" designates a shorter lamp composed of two parallel tubes. "CFQ" for "compact fluorescent quad" designates a lamp composed of four tubes in a quad formation. "CFM" designates other compact fluorescent shapes including the recently introduced triple loops or triple U's.

Compact and circline fluorescent lamps with an attached ballast that has a medium screwbase are designated "screwbase." Screwbase compact fluorescent lamp products can have one or two pieces; one-piece units

are called "self-ballasted" and two-piece units are called "modular." Circline fluorescent lamp products are modular. When a self-ballasted screwbase lamp burns out, the ballast is discarded with the lamp; modular lamps allow replacement of just the lamp if the separate ballast is still operational. Some screwbase compact fluorescent lamps are made with glass or plastic globes, lenses, and reflectors that protect the lamp, may reduce glare, and may optimize the light distribution. These lamps are designated "screwbase compact fluorescent lamps with integral accessories."

All fluorescent lamps are nondirectional light sources, with the exception of compact fluorescent lamps with reflector accessories. These compact fluorescent reflector lamps are directional sources.

Qualities

Color: The color characteristics of the light, and to a large extent the efficacy, are determined by the chemical elements used to create the phosphor coating. By varying the proportions of different phosphors, it is possible to produce lamps with different color rendering properties and correlated color temperatures (CCT). Fluorescent lamp colors such as "cool white" and "warm white" are produced with a single coating of phosphors known as halophosphors. Other colors are produced by a coating of rare-earth phosphors, also called triphosphors, that may be added over a layer of halophosphors or used alone. The resulting rare-earth lamps are both more efficacious than halophosphor lamps and have better color properties. Rare-earth lamps are also more expensive than halophosphor lamps.

In 1992 the National Electrical Manufacturers Association adopted a new color rendering index (CRI) and CCT designation system for lamps containing rare-earth phosphors. This system is used throughout this book and is summarized below.

Generic Name	CRI Range	New Name
thin-coat rare-earth phosphor	70-79	RE70
thick-coat rare-earth phosphor	80-89	RE80

To specify CCT, the zero of the designation above is replaced by the first two digits of the CCT, given in Kelvin. For example, an RE70 lamp of 3000 K temperature is noted as RE730. This is the most commonly recommended fluorescent lamp in the Designs chapter. For living rooms, where color rendering may be especially important for aesthetic reasons, an RE830 lamp is recommended.

Light Output: Fluorescent lamps are available in a large range of light outputs, from 250 to 3800 lumens. See the tables for specific light output ranges.

CONTINUED

Energy and Cost

Wattage: A fluorescent lighting system usually uses more watts than the rated lamp wattage because the ballast also consumes power.

Efficacy: Fluorescent lamps are significantly more efficacious than incandescent lamps. Linear and U-shaped fluorescent lamps are more efficacious than compact fluorescent lamps.

Life: Fluorescent lamps have significantly longer lamp life than incandescent lamps. Average rated lamp life is based on 3 hours per start. Lamp life will be reduced when lamps are operated for fewer than 3 hours per start, but the lamps may last longer (have a longer service life) because they may be on for fewer hours per day than lamps that are operated for 3 hours per start or longer. Lamp life will be increased when lamps are operated for more than 3 hours per start, but the service life may be reduced because the lamps may be on for more hours per day than lamps that are operated for 3 hours per start or less.

Cost: Except for linear fluorescent lamps with poor color characteristics, some of which will soon be removed from the market in the United States, fluorescent lamps are more expensive than most incandescent lamps.

Where to Buy: Different types of fluorescent lamps have different availabilities. Refer to the sections on specific fluorescent lamp types for availability and purchasing information.

Use

Installation: With the large selection of fluorescent lamp sizes and types, many applications are possible in homes.

Luminaires: Except for those that use screwbase compact and circline fluorescent lamps, a luminaire using a fluorescent lamp must contain a ballast.

Controls: Most can be dimmed but at a higher cost than dimming incandescent lamps. Special dimming ballasts and dimming controls are required.

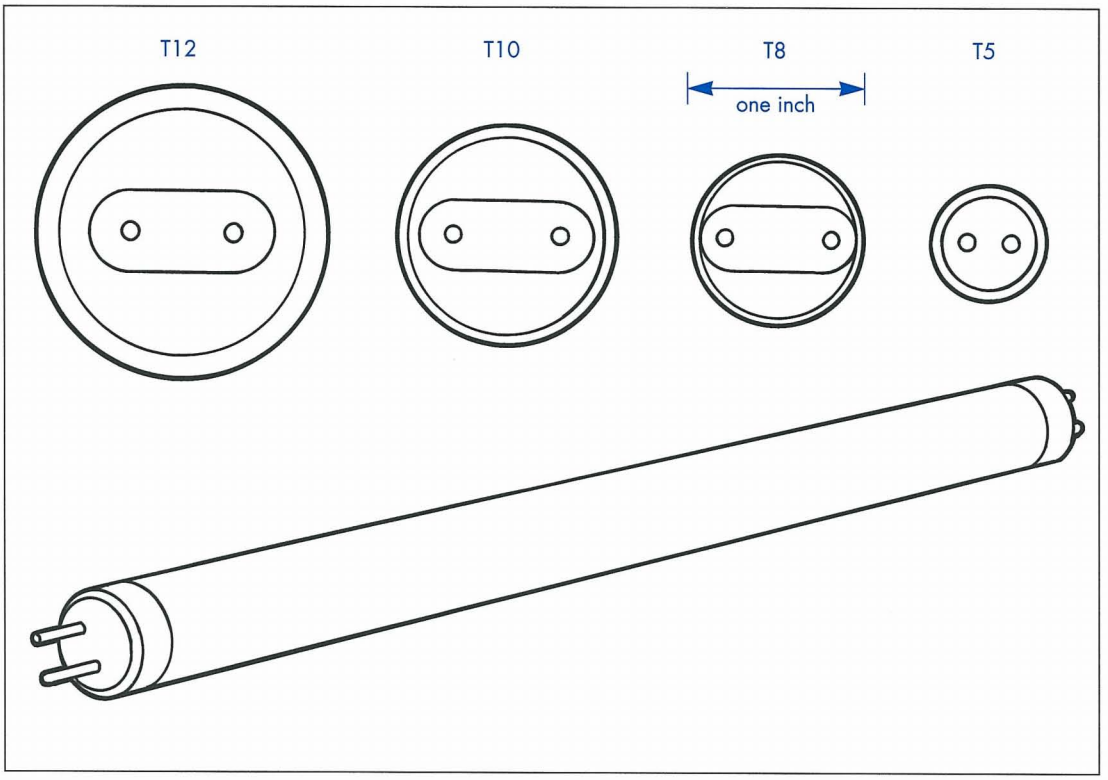
Cautions: Fluorescent lamps contain a small amount of mercury. Wear gloves if picking up broken fluorescent lamp fragments. Most fluorescent lamps operate poorly in extremely cold temperatures. Avoid exterior use in cold climates, unless an enclosed luminaire is used. Lamp ends may blacken and lamps may flicker as they reach the end of their useful life. Magnetic ballasts may produce an audible hum. Ballasts that have poor power quality characteristics may interfere with other household appliances. See the Appendix for more information.

For more information refer to

Designs: Fluorescent lamps commonly are used throughout a home.

Other Lamps: Incandescent, High-Intensity Discharge

Fluorescent: Linear



Linear fluorescent lamps are nondirectional light sources. The most common linear fluorescent lamps are 1½ inches in diameter and are designated as T12 for 12 eighths of an inch. Reduced-diameter fluorescent lamps, such as T10 (10 eighths or 1¼-inch diameter) lamps and T8 (8 eighths or 1-inch diameter) lamps with rare-earth phosphors, can provide improved system efficacy compared to conventional T12 lamps. Reduced-diameter lamps have created new opportunities for efficient luminaire designs that are better suited for focusing the light output from a fluorescent lamp. T5 (⅝-inch diameter) lamps are available in lower wattages for small spaces such as coves, furniture-integrated luminaires, and under-cabinet luminaires.

Rare-earth lamps of any size provide better color rendition and improved efficacy. Lamp efficacies associated with rare-earth phosphors are 5 to 15 percent better than those of conventional phosphors. Unfortunately, rare-earth phosphors are more expensive than conventional phosphors. However, because T10, T8, and T5 lamps have less surface area than T12 lamps, the cost of using rare-earth phosphors to coat these lamps is less than the cost to coat T12 lamps.

T10 lamps are used primarily to directly replace T12 lamps. They offer higher efficacies, increased light output, and longer life compared to common linear fluorescent lamps. Because of the higher light output of T10 lamps, fewer T10 lamps may be required in a design than T12 lamps. T10 lamps operate on the same ballasts as T12 lamps.

T8 lamps can fit in the same sockets as T12 lamps; however, they require a special ballast because they operate at a lower current. These lamps, like all four-pin fluorescent lamps, can be dimmed using dimming ballasts. T8 rare-earth lamps can have efficacies higher than T12 lamps. An excellent energy-saving system with good color rendering includes 4-foot T8 rare-earth phosphor lamps operating on electronic ballasts.

CONTINUED

Qualities

Color: Available in a variety of color characteristics. Good color is available that is compatible with incandescent lamps that are used in residences. To be compatible with incandescent lamps, select CCTs close to 3000 K. Higher CRI values indicate better color rendering for any given color temperature. For example, in areas where a warm color of light and colors are very important, such as a living room, an RE830 (rare-earth lamp with a color temperature of 3000 K and a CRI of 80+) is recommended. T8 lamps could be used for new installations.

		Input Power per Lamp (Lamp + Ballast)*								
		Magnetic		Electronic						
Lamp Type	Rated Lamp Watts	1 Lamp/ Ballast	2+ Lamps/ Ballast	1 Lamp/ Ballast	2+ Lamps/ Ballast	Average Rated Lamp Life (hours)	Light Output (lumens)	CCT (K)	CRI	Typical Price per Lamp ($)
Linear Fluorescent										
12″ T5 Cool White	8	10				7,500	390–400	4,200	62	5.00
12″ T5 Warm White	8	10				7,500	400	3,000	52	7.00
21″ T5 Cool White	13	18				7,500	820–860	4,200	62	6.00
21″ T5 Warm White	13	18				7,500	870–880	3,000	52	8.00
24″ T12 Cool White	20	32	27			9,000	1,200–1,240	4,200	62	4.00
24″ T12 RE730	20	32	27			9,000	1,275–1,300	3,000	70+	6.00
24″ T12 RE830	20	32	27			9,000	1,300–1,350	3,000	80+	10.00
24″ T8 RE730	17	24	22	22	17	20,000	1,325	3,000	70+	6.00
24″ T8 RE830	17	24	22	22	17	20,000	1,400	3,000	80+	7.00
36″ T12 Cool White	30	46	42	31	30	18,000	2,200–2,250	4,200	62	5.00
36″ T12 Cool White, RW	25	41	37	26	25	18,000	1,925–2,000	4,200	62	6.00
36″ T12 RE730, RW	25	41	37	26	25	18,000	2,025–2,350	3,000	70+	9.00
36″ T8 RE730	25	33	33	30	24	20,000	2,125	3,000	70+	6.00
36″ T8 RE830	25	33	33	30	24	20,000	2,250	3,000	80+	7.00
48″ T12 Cool White	40	52	48	46	36	20,000	3,050	4,200	62	2.00
48″ T12 Cool White, RW	34	46	42	38	30	20,000	2,650	4,200	62	3.00
48″ T12 RE730, RW	34	46	42	38	30	20,000	2,800	3,000	70+	6.00
48″ T12 RE830, RW	34	46	42	38	30	20,000	2,900	3,000	80+	10.00
48″ T10 RE730	40	52	48	40	36	24,000	3,700	3,000	70+	7.00
48″ T8 RE730	32	37	36	34	31	20,000	2,850	3,000	70+	5.50
48″ T8 RE830	32	37	36	34	31	20,000	3,050	3,000	80+	7.00
60″ T8 RE830	40	50	46	44	37	20,000	3,800	3,000	80+	8.50

CCT = Correlated Color Temperature CRI = Color Rendering Index RW = Reduced-wattage

* For two or more lamps, the number is the wattage consumed by one lamp plus its portion of the total ballast wattage. The total system wattage is the total number of lamps in the system multiplied by this number.

Energy and Cost

Wattage: Require a ballast for operation, which consumes some power during lamp operation.

Efficacy: High (up to 90 lumens per watt, including the power consumed by the ballast). Ballasts are available that operate from one to four fluorescent lamps. Operating several lamps on a single ballast improves efficacy and reduces the initial cost because fewer ballasts are needed. Ask about ballast options when purchasing a luminaire.

Life: Long (up to 20,000 hours; 24,000 hours for T10 lamps), although inexpensive "shop light" lamps may have a much shorter lamp life.

Cost: Higher than common incandescent lamps, particularly for rare-earth lamps, but less expensive than many specialty incandescent lamps. Linear fluorescent lamps are less expensive than U-shaped lamps that are formed from straight tubes of the same length.

Where to Buy: Discount department stores and hardware stores carry various lengths of T12 lamps. Lighting stores, building and electrical supply stores, and utility promotions offer many color and size options for lamps and many ballast types.

Use

Installation: Linear fluorescent lamps usually are installed in workshops, kitchens, and family rooms, but they can provide light in all areas of the home. The use of linear fluorescent lamps is most successful when the CCT, CRI, and ballast are carefully selected for the intended purpose.

Luminaires: Many types are available, in many styles. Luminaires can be incorporated into architectural features such as cabinets, valances, soffits, or coves. In these applications, inexpensive strip luminaires can be used.

Controls: Dimmable with the proper dimming control and ballast.

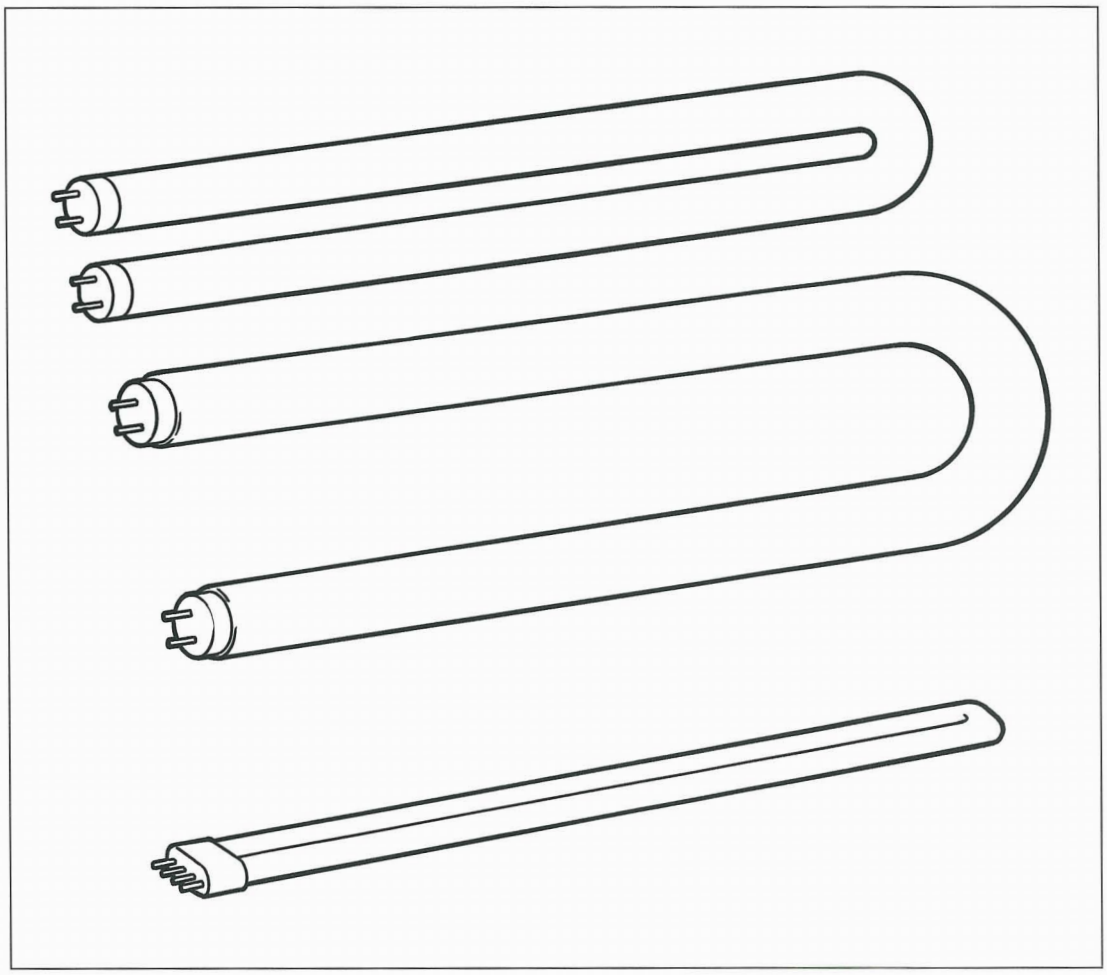
Cautions: Magnetic ballasts may produce an audible hum. Lamp ends blacken and lamps may flicker as they reach the end of their useful life. Most fluorescent lamps operate poorly in extremely cold temperatures. Avoid exterior use in cold climates, unless an enclosed luminaire is used.

For more information refer to

Designs: Small Kitchen, Medium Kitchens 2 and 3, Large Kitchen, Small Dinette, Medium Dinette, Medium Living Rooms, Large Living Rooms 1 and 3, Half Bath, Small Bath, Large Bath, Small Bedroom, Children's Bedroom, Large Bedroom, Home Office, Foyer with Open Stair, Multi-Family Fire Stair 1

Other Lamps: U-Shaped and Long Twin-Tube Fluorescent, Compact and Circline Fluorescent, Screwbase Compact and Circline Fluorescent, High-Intensity Discharge

Fluorescent: U-Shaped and Long Twin-Tube



Fluorescent lamps are available not only in a linear shape but also in U shapes and long twin-tube shapes (FT designates fluorescent twin). U-shaped lamps offer the benefits of a linear lamp but can be contained in a smaller luminaire. FT lamps are available in 10.5-, 16.5-, and 22.5-inch lengths. The reduced overall width of an FT compared to a U-shaped lamp facilitates better optical control of the light within certain luminaires. Like linear fluorescent lamps, U-shaped and long twin-tube lamps are available with improved color rendering and are nondirectional light sources.

Qualities

Color: Available in a variety of color characteristics. Rare-earth lamps provide good color that is compatible with other lamps that are used in homes. To be compatible with incandescent lamps, select CCTs close to 3000 K. Select rare-earth lamps where good color rendering is important, such as in living rooms. In areas where CCT and CRI are less important, such as in garages or utility spaces, cool white or warm white lamps are acceptable and usually are less expensive.

Light Output: High compared to most incandescent lamps.

Lamp Type	Rated Lamp Watts	Input Power per Lamp (Lamp + Ballast)* Magnetic 1 Lamp/ Ballast	Magnetic 2+ Lamps/ Ballast	Electronic 1 Lamp/ Ballast	Electronic 2+ Lamps/ Ballast	Average Rated Lamp Life (hours)	Light Output (lumens)	CCT (K)	CRI	Typical Price per Lamp ($)
U-Shaped and Long Twin-Tube										
T12/U6 Cool White	40	52	48	46	36	12,000	2,600	4,200	62	10.00
T12/U6 Rare-Earth	34	52	48	46	36	12,000	2,400	3,000	70+	14.00
T8 U-Shaped Rare-Earth	31	36	35	37	30	20,000	2,800	3,100	80+	12.00
10.5″ FT18W Rare-Earth	18	22	20	21	18	20,000	1,250	3,000	80+	13.00
16.5″ FT36W Rare-Earth	36, 39	48	43	37	34	12,000	2,900	3,000	80+	15.00
22.5″ FT40W Rare-Earth	40	44	41	43	38	20,000	3,150	3,000	80+	15.00

CCT = Correlated Color Temperature CRI = Color Rendering Index

* For two or more lamps, the number is the wattage consumed by one lamp plus its portion of the total ballast wattage. The total system wattage is the total number of lamps in the system multiplied by this number.

Energy and Cost

Wattage: Require a ballast, which draws a small amount of power during lamp operation.

Efficacy: High and similar to linear fluorescent lamps.

Life: Long (up to 20,000 hours).

Cost: Higher lamp cost than common incandescent and linear fluorescent lamps, particularly for rare-earth lamps.

Where to Buy: Lighting stores and building and electrical suppliers offer many color and size options for lamps and many ballast types.

Use

Installation: Smaller overall length than a linear fluorescent lamp of similar light output. The U-shaped fluorescent lamp can be used in many applications where reduced luminaire size is desired.

Luminaires: U-shaped lamps often are used in 2-foot by 2-foot luminaires. Fluorescent long twin-tube lamps are used in a variety of luminaires including wall wash luminaires and vanity lights.

Controls: Dimmable, with the proper dimming control and ballast.

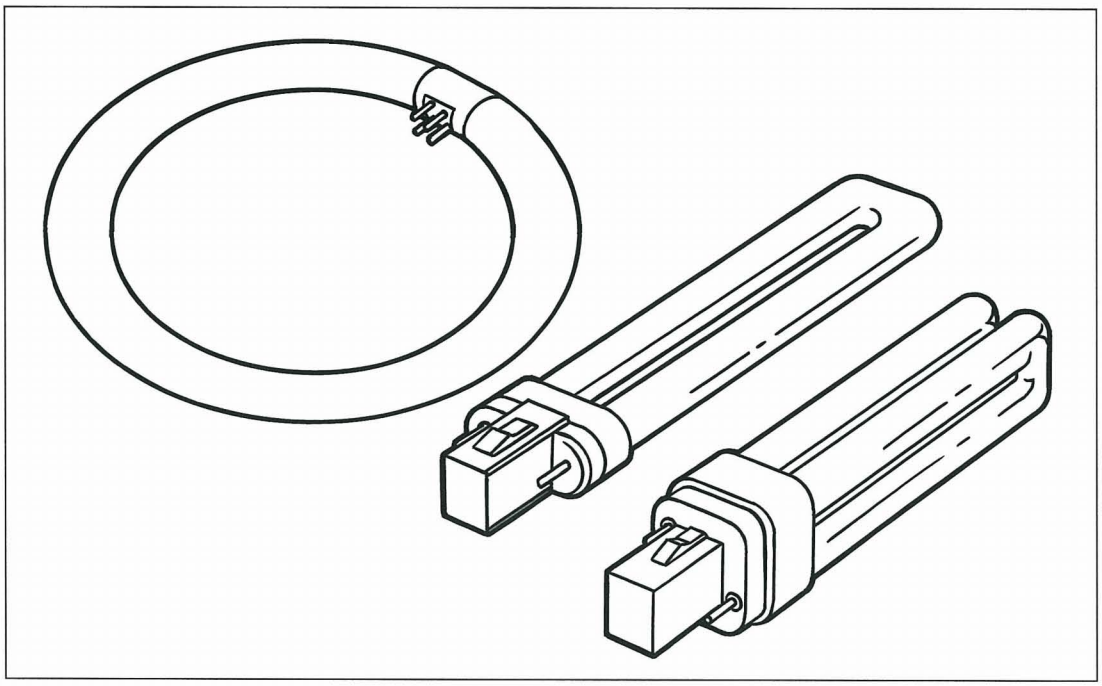
Cautions: Magnetic ballasts may produce an audible hum. Lamp ends blacken and lamps may flicker as they reach the end of their useful life. These lamps operate poorly in extremely cold temperatures. Avoid exterior use in cold climates unless an enclosed luminaire is used.

For more information refer to

Designs: Large Kitchen, Small Bath, Large Bath, Home Office

Other Lamps: Linear Fluorescent, Compact and Circline Fluorescent

Fluorescent: Compact and Circline



There are several types of compact fluorescent lamps. CFT or T4 twin-tube preheat lamps have starters in the base of the lamp and are available in 5, 7, 9, and 13 watts. CFQ or T4 or T5 quad-tube preheat lamps also have starters in the base and are most common in the 18- and 26-watt versions.

Circline fluorescent lamps are 6.5 to 16 inches in overall diameter and are available in wattages ranging from 20 to 40 watts. Compact fluorescent and circline lamps fit in even smaller spaces than U-shaped and FT lamps. Both energy-efficient magnetic ballasts and electronic ballasts are available for these lamps. Lamps with four-pin bases can be used with electronic ballasts or with dimming systems.

Although incandescent lamps cost less and can be more easily controlled optically, compact fluorescent lamps offer significantly greater efficacy and longer life than incandescent lamps. As a result, they are a relatively economical alternative to incandescent lamps. Both compact and circline fluorescent lamps are nondirectional light sources.

Compact lamp conversion kits for recessed luminaires containing incandescent lamps are available to modify the luminaire's optics and socket and to make room for compact fluorescent lamps.

Compact and circline fluorescent lamps can snap into screwbase ballasts and can directly replace many screwbase incandescent lamps. See Screwbase Compact and Circline Fluorescent Lamps for more information.

Qualities

Color: Compact fluorescent lamps use rare-earth phosphors and range from 2700 to 5000 K in correlated color temperature. Color appearance varies among manufacturers, but all render color well (CRI 80+). Select color temperatures of 2700 to 3000 K to approximate the color of incandescent lamps. Circline fluorescent lamps commonly are offered in warm white or cool white correlated color temperatures, with relatively poor color rendering. Rare-earth 3000 K circline fluorescent lamps are now available with good color rendering.

Lamp Type	Rated Lamp Watts	Input Power per Lamp (Lamp + Ballast)* Magnetic 1 Lamp/ Ballast	Magnetic 2+ Lamps/ Ballast	Electronic 1 Lamp/ Ballast	Electronic 2+ Lamps/ Ballast	Average Rated Lamp Life (hours)	Light Output (lumens)	CCT (K)	CRI	Typical Price per Lamp ($)
Compact Fluorescent and Circline										
CFT5W	5	7	6			10,000	250	2,700	82	6.00
CFT7W	7	9	8			10,000	400	2,700	82	6.00
CFT9W	9	11	10			10,000	600	2,700	82	6.00
CFT13W	13	15	14			10,000	825–900	2,700	82	7.00
CFQ9W	9	11	10			10,000	575	2,700	82	11.00
CFQ13W	13	15				10,000	860–900	2,700	82	11.00
CFQ18W	18	22				10,000	1,200	2,700	82	13.00
CFQ26W	26	30				10,000	1,800	2,700	82	14.00
6.5″ Circline Cool White	20	25				12,000	800	4,200	62	8.00
6.5″ Circline Warm White	20	25				12,000	825	3,000	52	8.50
8″ Circline Cool White	22	27				12,000	1,025	4,200	62	7.00
8″ Circline Warm White	22	27				12,000	1,000	3,000	52	9.00
8″ Circline RE730	22	27		22		12,000	1,150	3,000	70+	11.00
12″ Circline Cool White	32	42				12,000	1,800	4,200	62	8.00
12″ Circline Warm White	32	42				12,000	1,500–2,100	3,000	52	10.00
12″ Circline RE730	32	42		30		12,000	2,100	3,000	70+	11.00

CCT = Correlated Color Temperature CRI = Color Rendering Index

* For two or more lamps, the number is the wattage consumed by one lamp plus its portion of the total ballast wattage. The total system wattage is the total number of lamps in the system multiplied by this number.

Energy and Cost

Efficacy: High (up to 84 lumens per watt for higher-wattage lamps with electronic ballasts). Require a ballast, which consumes a small amount of power during lamp operation.

Life: Long (up to 10,000 hours for T4 types and 20,000 hours for rapid-start T5 types).

Cost: Higher than common incandescent and most linear fluorescent lamps.

Where to Buy: Lighting stores, electrical suppliers, electric utility promotions, and lighting catalogs offer a wide variety of these lamps. Many luminaires that are designed for compact or circline fluorescent lamps come packaged with the appropriate lamps.

Use

Installation: Compact and circline fluorescent lamps frequently are used in "dedicated" luminaires that can accommodate only these lamps. Unlike screwbase compact or circline fluorescent lamps, lamps in dedicated luminaires cannot be replaced with incandescent lamps when the lamps burn out. Compact and circline fluorescent lamps also can be used with modular screwbase ballasts.

CONTINUED

Luminaires: Some recessed luminaires, sconces, and table and desk lamps are designed for compact fluorescent and circline fluorescent lamps. In temperate climates, compact fluorescent lamps can be used for exterior lighting.

Controls: Most are not dimmable; however, dimming systems are available for compact fluorescent lamps that have four-pin bases.

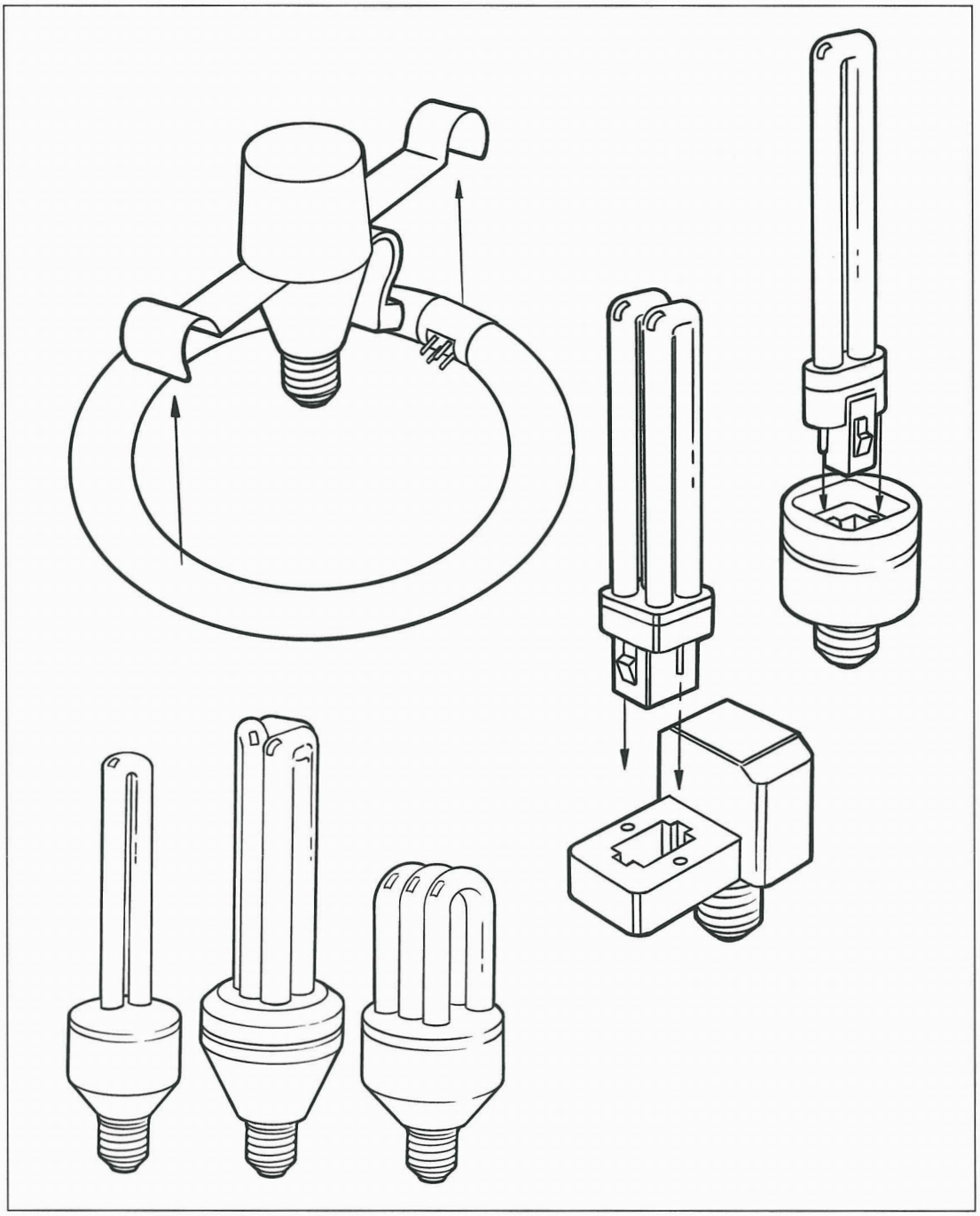
Cautions: Magnetic ballasts may produce an audible hum. Magnetically ballasted compact fluorescent lamps may blink briefly when turned on. Avoid exterior use in cold climates.

For more information refer to

Designs: Medium Kitchen 1, Large Kitchen, Small Dinette, Medium Dinette, Dining Room, Small Living Room 2, Medium Living Rooms, Large Living Room 1, Medium Baths, Large Bath, Children's Bedroom, Large Bedroom, Home Office, Foyer with Open Stair, Closed Stair, Hallway, Multi-Family Lobby, Multi-Family Fire Stair 1

Other Lamps: Linear Fluorescent, U-Shaped and Long Twin-Tube Fluorescent, Screwbase Compact and Circline Fluorescent

Fluorescent: Screwbase Compact and Circline



For direct replacement of incandescent lamps, some compact fluorescent lamp/ballast combinations are manufactured with medium screwbases. These may be two-piece (modular) units, shown above at the top and right, or one-piece (self-ballasted) units, lower left. The self-ballasted unit usually is smaller, and ensures that the lamp and ballast are compatible with each other. However, the entire unit must be replaced each time a new lamp is needed. Since ballasts can last three times longer than lamps, modular units with a lamp that separates from the ballast can be more economical. Compact and circline fluorescent lamps that were described in the previous section can also be used as screwbase units if they are snapped into a screwbase ballast.

CONTINUED

A 15-watt screwbase compact fluorescent lamp is rated at about the same light output as a 60-watt incandescent lamp. However, actual compact fluorescent light output is affected by lamp temperature, lamp position, and the luminaire's optical characteristics. Ongoing research will develop more-precise guidelines, but in the meantime, a reasonable rule of thumb is to divide the incandescent wattage by three to find the replacement compact fluorescent wattage. For example, replace a 75-watt incandescent lamp with one 26-watt or two 13-watt compact fluorescent lamps.

Like the common incandescent lamps they are designed to replace, screwbase compact and circline fluorescent lamps are nondirectional light sources. A screwbase compact or circline fluorescent lamp may easily be replaced by an incandescent lamp, which would negate the potential energy savings.

Qualities

Color: Choose a color temperature of 2700 to 3000 K to approximate the color of incandescent lamps. Circline fluorescent lamps commonly are offered in warm white or cool white color temperatures, with relatively poor color rendering, although some circline lamps use rare-earth phosphors and thus have good color rendering. Self-ballasted compact fluorescent lamps primarily are available in 2700 and 2800 K with good color rendering. Modular lamps are available in a variety of correlated color temperatures, from 2700 to 5000 K, all with good color rendering.

Lamp Type	Input Power (Lamp + Ballast Watts)*	Average Rated Lamp Life (hours)	Light Output (lumens)	CCT (K)	CRI	Typical Price per Lamp ($)
Self-Ballasted Compact Fluorescent**						
Ballast Type						
Electronic	15	10,000	900	2,700	82	17.00
Magnetic	18	10,000	700	2,800	82	20.00
Electronic	18	10,000	1,100	2,700	81	20.00
Electronic	20	10,000	1,200	2,700	82	20.00
Electronic	22	10,000	1,400	2,700	81	21.00
Electronic	23	10,000	1,550	2,700	82	20.00
Electronic	26, 27	10,000	1,550	2,800	84	22.00

CCT = Correlated Color Temperature CRI = Color Rendering Index

* The wattage on the package for self-ballasted compact fluorescent lamps includes both the lamp wattage and the ballast wattage.

** For information on modular lamps, refer to the table in the previous section, Compact and Circline Fluorescent.

Energy and Cost

Wattage: Ballast draws a small amount of power during lamp operation. Self-ballasted units include ballast power in the wattage rating. Modular units do not.

Efficacy: High compared with incandescent lamps.

Life: Long (up to 10,000 hours).

Cost: Higher than common incandescent and linear fluorescent lamps. Electric utility company incentives may offer substantial savings.

Where to Buy: Discount department stores and hardware stores may carry compact fluorescent lamps. Lighting stores, building and electrical supply stores, and utility promotions offer many color and size options for lamps and ballasts. Many mail-order catalogs offer screwbase compact fluorescent lamps.

Use

Installation: Screwbase compact and circline fluorescent lamps screw directly into medium-base lamp sockets that are used by incandescent lamps. A barrier to more widespread replacement of incandescent lamps with screwbase compact fluorescent lamps is luminaire compatibility. Screwbase compact fluorescent lamps are larger and heavier than the incandescent lamps that they replace. Check the available room in a luminaire before choosing a screwbase compact or circline fluorescent lamp and check to see if plug-in floor, table, or desk lamps would become unstable with the weight of the screwbase compact fluorescent lamp. It may be necessary to install a socket extender in luminaires with deeply recessed sockets or a harp extender to raise a table lamp shade to make more room for the compact fluorescent lamp. These adapters are available where the lamps are sold. Screwbase compact fluorescent lamps can be installed in a three-way incandescent lamp socket, but will only operate in two of the three settings and only at full light output.

Luminaires: In new construction, consider using luminaires that are designed for compact or circline fluorescent lamps instead of luminaires with sockets for screwbase lamps to prevent replacement with less-efficient incandescent lamps.

Controls: Most are not dimmable. Do not install screwbase compact or circline fluorescent lamps on dimmer circuits that are designed for incandescent lamps.

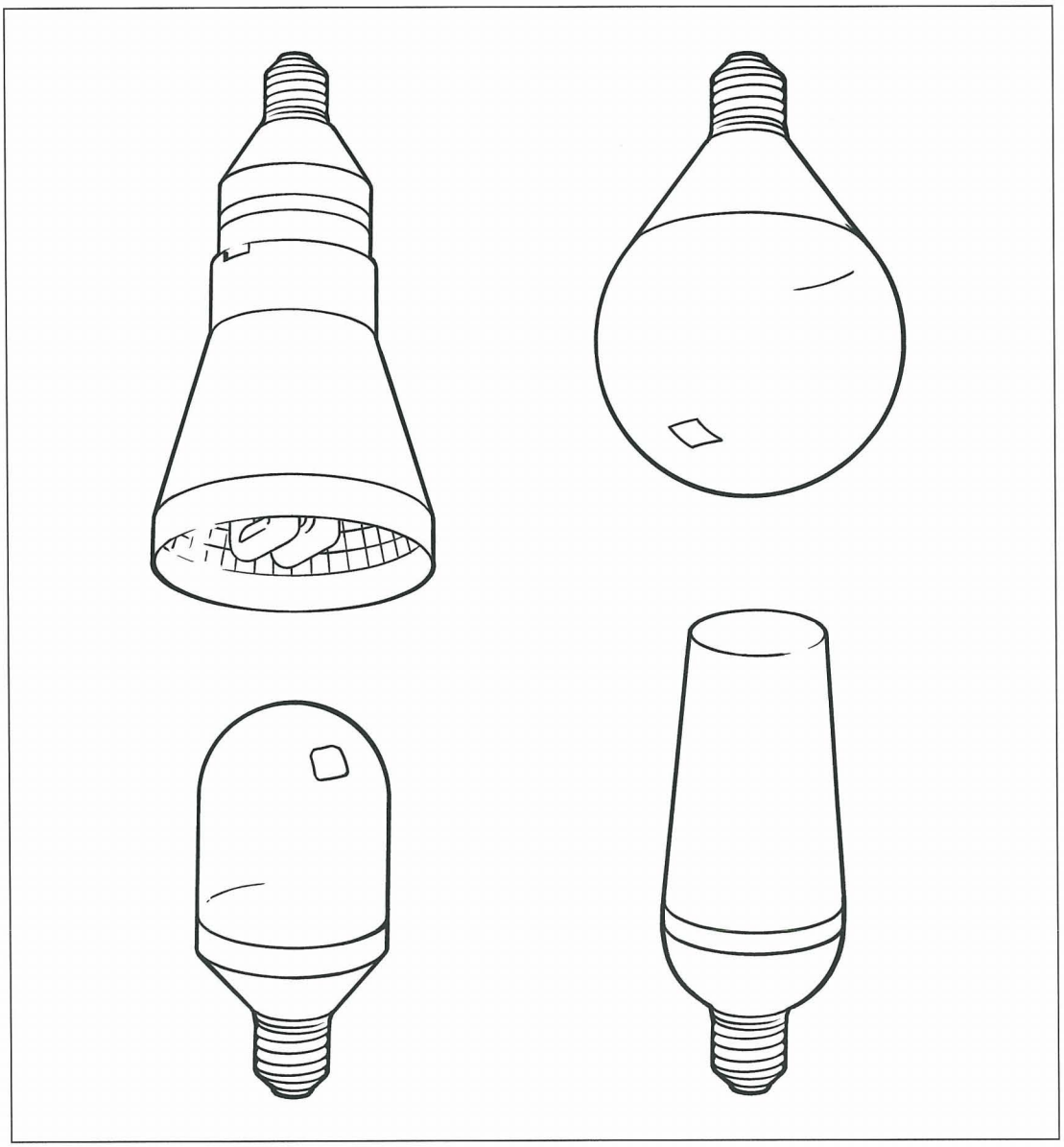
Cautions: Installation of compact or circline fluorescent lamps on an incandescent dimmer can cause overheating and possible loss of lamp life. Check lamp manufacturer's recommendations for maximum ambient temperature for rated life before installing a compact fluorescent lamp in an enclosed luminaire where ambient temperatures can be very high. Magnetically ballasted compact fluorescent lamps may blink briefly when turned on. Magnetic ballasts may produce an audible hum. Screwbase compact fluorescent lamps operate poorly in extreme temperatures. Electronic ballasts start lamps at 0°F and magnetic ballasts start lamps at 32°F. If the lamps are used outdoors in cold climates, however, they should only be used in enclosed luminaires. Most lamps provide less light output when operated in the base-down position. Ballasts that have poor power quality characteristics may interfere with television controls, timers, and other household appliances. See the Appendix for more information.

For more information refer to

Designs: Small Kitchen, Small Living Room 1, Large Living Rooms 1 and 3, Medium Bath 2, Small Bedroom, Large Bedroom, Home Office, Entry 1, Pole-Mounted Light

Other Lamps: Linear Fluorescent, U-Shaped and Long Twin-Tube Fluorescent, Compact and Circline Fluorescent, Screwbase Compact Fluorescent with Integral Accessories

Fluorescent: Screwbase Compact with Integral Accessories



Screwbase compact fluorescent lamps are available with diffusers (top) and reflectors (bottom). A screwbase compact fluorescent lamp with a diffuser has its fluorescent lamp tubes covered by a cylindrical or spherical diffusing enclosure called a globe or capsule. The enclosure may be glass or breakage-resistant plastic. Screwbase compact fluorescent lamps with diffusers are nondirectional light sources.

Compact fluorescent reflector lamps are designed to aim light in a particular direction. There are two types. One contains a lensed, aluminized glass reflector, a screwbase ballast, and a compact fluorescent lamp; this can be a one-piece assembly or can be ordered in three pieces. The advantage of the three-piece units is that adapters are available in "short, normal, or narrow" sizes that allow the combination to fit a variety of sockets. For example, a "short" adapter is selected when the overall height of the combined assembly is a major concern. These units are offered to replace incandescent reflector lamps. The other type of compact fluorescent reflector lamp is a one-piece unit consisting of a screwbase ballast, a compact fluorescent lamp, and an attached reflector.

Both types of compact fluorescent reflector lamps are directional light sources; the reflector increases the efficiency of the luminaire in which the lamp is used by increasing the amount of light that reaches the task.

Screwbase compact fluorescent capsule, globe, and reflector lamps are designed so that they may be used alone in a simple socket. In some cases, such as some globe luminaires, a screwbase compact fluorescent globe lamp may replace an incandescent lamp and the existing diffuser.

Qualities

Color: Primarily available in 2700 and 2800 K with good color rendering.

Lamp Type		Input Power (Lamp + Ballast Watts)*	Average Rated Lamp Life (hours)	Light Output (lumens)	CCT (K)	CRI	Typical Price per Lamp ($)
Screwbase Compact Fluorescent with Integral Accessories							
Ballast Type	Accessory						
Electronic	Globe	11	10,000	450	2,700	82	23.00
Electronic	Globe	15	10,000	700	2,700	82	24.00
Electronic	Globe	18	10,000	1,100	2,700	82	24.00
Magnetic	Capsule	15	9,000	700	2,700	82	18.00
Magnetic	Capsule	18	9,000	750	2,700	82	20.00
Electronic	Capsule	18	10,000	1,100	2,700	82	20.00
Electronic	Reflector	15	10,000	900	2,700	82	23.00
Electronic	Reflector	18	10,000	800	2,700	82	23.00

CCT = Correlated Color Temperature CRI = Color Rendering Index

* The wattage on the package for self-ballasted compact fluorescent lamps includes both the lamp wattage and the ballast wattage.

Energy and Cost

Wattage: Require a ballast, which consumes some power during lamp operation. The ballast wattage is included with the lamp wattage for self-ballasted units.

Efficacy: Higher than incandescent lamps, but not as high as linear or U-shaped fluorescent lamps. They emit less heat than incandescent lamps that provide equivalent light output.

Life: Long (up to 10,000 hours).

Cost: Higher than common incandescent R-, PAR-, and ER-lamps and other compact fluorescent lamps. Electric utility company incentives may offer substantial savings.

Where to Buy: Lighting stores, building and electrical supply stores, and utility promotions offer many options of lamps and ballasts. Many mail-order catalogs offer self-ballasted and modular compact fluorescent lamps with integral accessories.

CONTINUED

Use

Installation: Simple replacement for incandescent lamps. Globes and capsules are used primarily when the lamp will be seen. Compact fluorescent reflector lamps can replace R, PAR, or ER incandescent reflector lamps.

Luminaires: Screwbase compact fluorescent lamps with integral accessories are larger and heavier than the incandescent lamps they may replace. Some luminaires may not be able to accommodate the additional weight. Measure the dimensions of the luminaire before purchasing a compact fluorescent lamp to see if the lamp will fit. In new construction, consider using luminaires that are designed for compact fluorescent lamps, instead of those with screw sockets, to prevent replacement with less-efficient incandescent lamps.

Controls: Most are not dimmable. Do not install screwbase compact fluorescent lamps on dimmer circuits that are designed for incandescent lamps.

Cautions: Magnetically ballasted compact fluorescent lamps may blink briefly when turned on. Magnetic ballasts may produce an audible hum. Most screwbase compact fluorescent lamps operate poorly in extreme temperatures. Electronic ballasts start at 0°F, but if they are used outdoors in cold climates, lamps should be in enclosed luminaires. Lamps may provide less light output when in the base-down position. Ballasts that have poor power quality characteristics may interfere with television controls, timers, and other household appliances.

For more information refer to

Designs: Large Kitchen, Medium Dinette, Large Living Room 3, Small Bath, Hallway, Multi-Family Lobby, Multi-Family Corridor

Other Lamps: Halogen Incandescent, Reflector, Low-Voltage Halogen, Compact and Circline Fluorescent, Screwbase Compact and Circline Fluorescent